Geophysical Research Abstracts
Vol. 12, EGU2010-11021, 2010
EGU General Assembly 2010
© Author(s) 2010

Molecular and isotopic investigation of eroding reliefs of the East Siberian Arctic Coastal-Ice complex

L. Sánchez-García (1), J. Vonk (1), V. Alling (1), S. Pugach (2), B. van Dongen (3), A. Charkin (2), D. Kosmach (2), O. Dudarev (2), I. Semiletov (2,4), and Ö. Gustafsson (1)

(1) Department of Applied Environmental Science and the Bert Bolin Climate Research Centre, Stockholm University, Sweden (* corresponding author: laura.sanchez@itm.su.se), (2) Pacific Oceanological Institute, Russian Academy of Sciences, Vladivostok, Russia, (3) School of Earth, Atmospheric and Environmental Sciences, The University of Manchester, United Kingdom, (4) International Arctic Research Center, University of Alaska, Fairbanks, USA

The Eurasian Arctic represents contains a vast stock of carbon in form of frozen loess deposits formed during the Last Glacial Maximum (∼40,000 years ago): the so-called Yedoma or Ice Complex. The current global warming with particular influence on this area [1] is causing the thawing of the so far freeze-locked carbon deposits, remobilizing and releasing large amounts of carbon mainly as particulate organic carbon (POC) [2]. A combination of thermal collapse, sea-level rise and enhanced wave fetch from loss of coastal sea-ice cover, is causing accelerated coastal erosion of the Pleistocene Ice Complex [3]. Utilization of this old carbon, remobilized during the Ice Complex erosion by the microbial community present, would mean reintroduction of fossil forms of carbon in the short-term carbon cycle and potentially cause the release of greenhouse forms which, in turn, would trigger further warming. Our knowledge on the magnitude of the climatically-forced coastal erosion and the fate of the terrestrial OC once it enters the Arctic Ocean is still very limited.

This study aims to approach these questions, studying a well known case of coastal erosion (retreat rate up to 20 m/y over last decade) in the Eurasian Arctic Shelf (EAS): The island of Muostakh (SE Laptev Sea). Soil samples (n=11) were collected from Muostakh in 2006 along 4 “erosion transects”, in order to characterize the eroded material in terms of organic carbon (OC) content, bulk ^{14}C-based age and lipid biomarkers composition (n-alkanes, n-alkanoic acids, n-alkanols, sterols). On-site CO_2 measurements were carried out on similar surface, to detect degradation signals. To elucidate what happens with the eroded OC once it enters the shelf, seawater samples (n=218) were collected at different depths from 94 sites on the EAS samples, as part of the ISSS-08 (International Siberian Shelf Study, 2008) sampling program. The distribution and composition of POC was studied in relation with other water column parameters (salinity, turbidity, aromatic moieties, DOC, humic substances).

The ratio of high-molecular weight (HMW) $n-$alkanoic acids over $n-$alkanes showed lower values for the older soil samples collected from the lower reliefs of Muostakh. This, together with larger CO_2 fluxes and higher abundance of short-chain $n-$alkanes ($<C_{20}$) with even-over-odd predominance, relative to odd long-chain $n-$alkanes ($>C_{27}$), illustrate the higher extent of degradation at the low part of the island. The higher exposure of the low reliefs to wave impact and coastal erosion facilitates the OC remobilization and makes it potentially available for biodegradation.

Once in the water column, larger contents of POC and aromatic moietieswere observed close to land, showing a rapid decrease with distance from the coast. The coupling between both parameters suggesting similar terrestrial sources related with coastal erosion. The higher POC values observed in erosion affected sites, in contrast to higher DOC values derived from river origin, make the POC/DOC ratio a useful tool to distinguish between river (ratios < 0.2) and coastal erosion sources (ratios ≥ 0.2). The highest POC/DOC ratios (up to 0.5) and largest content of aromatic moieties were measured nearby Muostakh, manifesting the intensity of erosion affecting the island.

References

[1] NOAA (National Oceanic and Atmospheric Administration), 2006. State of the Arctic Report.

[2] Guo, L. and MacDonald, R.W., 2006. Global Biogeochem. Cycles 20,

GB2011, doi:10.1029/2005GB002593.

[3] Stein, R. and MacDonald, R.W., 2004. The organic carbon cycle in the Arctic Ocean 363 pp, Springer, Berlin.