Manganese, iron, and sulfate reduction rates in terrestrial carbon-dominated Siberian Arctic shelf and slope sediment

VOLKER BRÜCHERT[1,4], JOANNA E. SAWICKA[1,4], XIAOLE SUN[3,4], LISA BRÖDER[2,4], MAGNUS MÖRTH[1,4], CHRISTOPH HUMBORG[2,3,4], SAMANTHA JOYE[4], VLADIMIR SAMARKIN[4]

[1]Department of Geological Sciences, Stockholm University
[2]Department of Environmental Sciences and Analytical Chemistry, Stockholm University
[3]Baltic Sea Research Center, Stockholm University
[4]Bolin Centre for Climate Research, Stockholm University
[5]Department of Marine Sciences, University of Georgia

The Siberian Arctic Sea shelf and slope is a key region for the mineralization of terrestrial organic material transported from the organic carbon-rich permafrost regions of Siberia to the sea. We report on sediment carbon mineralization rates from 20 shelf and slope stations measured by whole core incubation studies, ^{35}S-sulfate tracer experiments, and porewater analyses of inorganic carbon (DIC), $\delta^{13}C_{DIC}$, iron, manganese, and inorganic nutrients. On average over 80% of the depth-integrated carbon mineralization was by aerobic respiration. The shelf sediments had high rates of iron and manganese reduction occurring concurrently with bacterial sulfate reduction, but only the marine organic matter-dominated sediment of the East Siberian Sea supported a high flux of manganese to shelf bottom waters, from where it can be transported to the central Arctic Ocean.

DIC/NH_4^+ ratios in porewaters and the stable carbon isotope composition of remineralized DIC indicated that the degraded organic matter was a mixture of marine and terrestrial organic carbon, with a higher contribution in the Laptev Sea than in the East Siberian Sea. Terrestrial organic matter was a source of degraded organc matter even in distal, deep-water continental slope sediment in the Laptev Sea pointing to signficant downslope transport of terrestrial POC. Isotope end member apportionment over the outer shelf of the Laptev and East Siberian Sea suggest that about 16 Tg C per year are respired in the outer shelf sea floor sediment, to which terrestrially-derived organic matter contributes between 0.3 to 0.5 Tg per year. These data provide rare data on the magnitude of aerobic and anaerobic carbon mineralization rates in Laptev Sea and East Siberian Sea sediment and help to constrain East Siberian land-ocean interactions and the Arctic marine carbon cycle.