Geophysical Research Abstracts
Vol. 12, EGU2010-2423, 2010
EGU General Assembly 2010

Extensive survey of terrestrial organic carbon in surface sediments of the East Siberian Sea

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The East Siberian Sea (ESS) is the largest and shallowest continental shelf sea of the Arctic Ocean, yet it is the least explored. The perenially frozen tundra and taiga of the circum-Arctic coastal area holds approximately half of the global belowground carbon pool. Significant amounts of terrestrial organic carbon (terrOC) are exported with the Great Siberian Arctic rivers to the shelf seas. In addition, the carbon–rich, ice-bound Yedoma coasts in East Siberia release significant amounts of Pleistocene carbon through thermal degradation and coastal erosion. The fate of these large-scale releases of terrOC in the East Siberian Shelf Sea is still poorly understood. The urgency of this research is accentuated by the fact that the East-Siberian Arctic landmass is experiencing the strongest climate warming on Earth, with a great potential for various carbon-climate feedback links.
During the International Siberian Shelf Study 2008 (ISSS-08), a 50-day research expedition onboard the Russian vessel Yakob Smirnitskiy in late summer 2008, we obtained surface sediments from over 60 ESS locations. The data obtained after bulk analyses of these sediments are combined with results obtained from previous ESS campaigns in 2003 and 2004 to facilitate a comprehensive investigation of the ESS surface sediment composition. Sedimentary OC contents were between 0.13 and 3.7% (median 1.02%, interquartile range 0.563) with the highest values near the Indigirka and Kolyma river mouths and in the Long Strait. Stable carbon isotope values were in the range of -27.4 to -21.2 per mill (median -25.3 per mill, interquartile range 2.04), with more depleted values close to the coast. A clear transition was observed east of 170° E with more enriched values, signalling a regime shift with stronger influence of the Pacific Ocean. The terrOC fraction in the surface sediments was estimated from the 13C data to be on average 70% for ESS as a whole, with maximal values of 90-100% (along most of the coastline and in Sannikov and Dmitry Laptev Strait) and minimal values of 10-35% (outer shelf and Long Strait). An extensive set of bulk organic 14C data of the sedimentary OC in the ESS will also be interpreted with respect to relative contributions of coastal Yedoma erosion versus river input. Based on published and calculated (calculated from ISSS08 sediment cores) sedimentation velocities, we estimated terrOC burial sink on the East Siberian Shelf Sea.