



The great Arctic Siberian rivers as methane sources: linking marine and terrestrial methane measurements.

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The Siberian shelves are an “estuary” for the Arctic Ocean with 70% of the riverine input into the Arctic derived from the discharge of the Lena, Ob, and Yenisey. The great Siberian Rivers are situated more or less in the permafrost area and receive water from the numerous wetlands, streams and lakes that cover a significant part of the land area. In general, the northern lakes are thermokarst or thaw by origin. Thaw lakes are underlain by zones of thawed permafrost called taliks. The depth of the taliks increases with the age of thaw lakes and can reach 10^2 m, providing a pathway for the organic reservoir immobilized in permafrost to become involved in modern biogeochemical cycling (Semiletov et al., 1996; Zimov et al., 1997). Throughout the numerous channels which form watersheds, dissolved methane is transported to the rivers and thence to the ocean. Thus the Siberian rivers accumulate a methane “signal” depending from geological history and abundance of biodegradable old organic carbon in their watersheds. According to our results obtained in September 2005 along the Northern Sea Route from Belomorsk/White sea to Tiksi/Laptev Sea, the concentration of dissolved methane increased from the west to the east. Lowest methane values were detected in estuary of the Ob River (mean value ~ 30 nM) increasing in the estuary of the Yenisey River (mean value ~ 75 nM). The highest methane values were found in the Lena River estuary (mean value ~ 240 nM). Thaw lakes surrounding the Lena delta (connected with the Lena channels via numerous drainage streams) keep higher methane concentration (up to 400-500 nM). Data from pyrolysis-GC/MS of the sedimentary organic carbon (SOC) indicated an increase in the freshness of the organic matter from west to east on the Siberian arctic coast, with increasing relative abundance of furfurals (polysaccharides) with respect to nitriles (Guo et al., 2004). This

condition suggested that the SOC in the eastern river basins was less decomposed and fresher. This finding was consistent with the observation that the watersheds in the east have a greater abundance of permafrost that tends to preserve organic matter in a fresh state. Therefore, we suggest that the west to east increase in the dissolved methane distribution reflects the stage of permafrost degradation (the Lena watershed is almost completely located in continuous and island permafrost zones, while almost no permafrost in the Ob watershed, island and continuous permafrost in the low stream of the Yenisey) which determines freshness of SOC in watersheds of the Great Siberian Rivers and consequent involvement of old organic carbon in methane form in modern biogeochemical cycling