14. Fate of dissolved organic matter (DOM) in forest tundra soil systems with differing permafrost regime

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Abstract

Dissolved organic matter (DOM) substantially produced in organic horizons probably pursues biodegradation, adsorption onto soil minerals, and is finally discharged into aquifers. These processes might relate to CO_2 production, carbon sequestration, and microbial food web in aquatic systems. The fate of the DOM may largely depend on the properties of the soil as well as those of DOM.

In forest tundra ecosystems, the properties of DOM and soils could be strongly controlled by permafrost regime concerning with soil temperature and moisture conditions. The higher the level of permafrost table, stronger hydromorphy and colder soil temperature are. The dynamics of permafrost regime affected by climatic change or forest disturbance might strongly influence the fate of DOM in forest tundra ecosystems. In this study, properties of water extractable organic matter (WEOM) and its sorption were investigated depending on the active layer thickness. Concurrently, the discharged DOM from the soil to tributaries were characterized by their biodegradation and composition of biochemical organic matters.

Less WEOC with larger share of hydrophobic carbon were extracted from thick organic horizons having thin active layers, consisting Gelisols. The opposites were confirmed in soils with well drainage, which is Inceptisols. Sorption of WEOM seems to be controlled by contents of iron oxides, soil pH and composition of WEOM. From the results, both types of soil tend to remove DOC, especially hydrophobic carbons, from initial DOC during its percolation through the mineral soils. Deeper mineral soils make discharged DOC from Inceptisols lower concentration with larger share of hydrophilic carbons than those from Gelisols. Concentration of discharged DOC decreased with increasing active layer thickness. In contrast, the rate of hydrophilic carbons in discharged water increased from south to north. Despite of preferential removal of hydrophobic carbons from initial DOC, the rate of hydrophobic carbons in northern tributaries were quite large. Direct input of DOM from organic horizons should compensate this DOC composition. Higher biodegradation in southern discharged DOC than northern one could be related to this DOC composition.

Thus the soil profile and its distribution in Siberia might considerably control the fate of DOM in terrestrial ecosystems in Siberia.