13. High DON concentration in stream waters in permafrost area in East Siberia

Osamu Nakahara[1], Fumiaki Takakai[1], Alexey R. Desyatkin[2]
Ryusuke Hatano[1,3] and Roman V. Desyatkin[2]

[1] Graduate School of Agriculture, Hokkaido University
[2] Institute for Biological Problems of Cryolithozone, SB, RAS
[3] Field Science Center for Northern Biosphere, Hokkaido University
e-mail : nakahara@chem.agr.hokudai.ac.jp

Abstract

Ecosystems around Yakutsk (62°N, 129°E) in the eastern Siberia, Russia, are characterized by widespread distribution of alas (circular grassland with lower elevation than that of surrounding forest) in Taiga forest. In this study, soil chemical properties and stream water chemistry are reported.

Soil survey was conducted at five alas-forest sequences on the west side of the Lena River in July 2005. A transect line was set up from the pond or pingo located near the center of alas to forest. Soil pits were made at different vegetations: wet meadow that surrounds pond and/or pingo, dry meadow that surrounds wet meadow, and larch forest outside alas. Accumulation of carbonate salts was examined by hydrochloric acid, and soil pH and electrical conductivity (EC) were measured for 1:2 water extract. In all soil profile, subsoil (50 cm - 100 cm) had carbonate accumulation and high pH (> 7), suggesting that downward leaching of soluble weathering products was interrupted by permafrost and that the interruption should be the main cause of alkaline properties of soils in this region. Surface soil pH at wet and dry meadow rose as surface soil pH in forest dropped. Surface soil pH at wet and dry meadow and surface soil EC at wet meadow rose as area of alas decreased. These results suggests that some of soluble weathering products, e.g., bicarbonate and carbonate anions, in forest soils had moved to alas soils and had made alas soils more alkaline than soils in surrounding forests.

Stream water samples were collected from east and west sides of the Lena River in May (high flow condition in late snow-melting season) and August (low flow condition in summer) 2005 and analyzed for dissolved nitrogen species. NO_3-N concentration ranged from 0.00 to 0.10 mg L^{-1} and the average was 0.01 mg L^{-1}, indicating that nitrate leaching from alas-forest ecosystems is very small. NH_4-N concentration ranged from 0.00 to 0.26 mg L^{-1} and the average was 0.03 mg L^{-1} that is higher than NO_3-N concentration. Dissolved organic nitrogen (DON) concentration ranged from 1.05 to 3.20 mg L^{-1} and the average was 2.05 mg L^{-1}, suggesting that leakage of nitrogen by dissolved organic form is dominant in alas-forest ecosystems. DOC/DON ratio ranged from 15 to 32 and the average was 24. DON concentration was higher in late snow-melting season (average was 2.13 mg L^{-1}) than in summer (average was 1.99 mg L^{-1}) by paired t test ($p < 0.05$), but the difference is small (0.14 mg L^{-1}), indicating that the surface run-off that is dominant in late snow-melting season and groundwater flow that is dominant in summer had fairly equal contribution to leakage of DON from alas-forest ecosystems to streams. One possible explanation for high DON concentration is that alkaline conditions in soils inhibited the adsorption of dissolved organic matter on soil Fe and Al oxide/hydroxide minerals by ligand exchange.