CLASSIFICATION OF ACTIVE LAYER SOIL ALONG A LINE IN SIVERIAN WETLAND

Kunio Watanabe, Masaru Mizoguchi
Department of Bioresources, Mie University, Tsu 514-8507, Japan
Norifumi Sato and Yuji Kodama
Institute of Low Temperature Science, Hokkaido University, Sapporo 060-0819, Japan
Telephone 81-59-231-9574
Fax 81-59-231-9571
Email: kunio@buturiPc6.bio.mie-u.ac.jp

Abstract Soil water regime, thaw depth and vegetation were surveyed along a 3-km line on tundra wetland in Siberian permafrost area during the summer of 1997. The soil water regime and the vegetation classified soil profiles in the study area into four types: Submerged soil covered with sedge in lowland, Waterlogged soil covered with moss in lowland, Unsaturated soil covered with sedge in middle-highland, and Highland soil. Our classification will be helpful to make a practical hydrological model in the tundra region.

Introduction The permafrost is overlaid seasonal thawed layer so-called active layer. Physical conditions of soil in the active layer are important to consider water cycle in tundra region, . In this paper, we report profiles and physical properties of soils in the active layer.

Study site and method Survey was carried out at tundra wetland near Tiksi, Russia, from August 12 to September 10, 1997. Thickness of the active layer, soil temperature and vegetation type were measured along a 3-km line with 25 m intervals. We directly observed horizons, hydraulic conductivity, water content and soil structure at 30 observation pits dug on the line.

Soil profiles Soil of the active layer can be classified to four types according to vegetation and ground water level. In addition, each type of the soil was divided into upper and lower horizons.

Figure 1a shows soil (a) found in lowland with water level of between -2 to 10 cm. The surface is covered by sedges. The upper horizon, consisted of dark brown low moor, had thickness of 20 to 30 cm. In this horizon, a lot of plant residue remained to be decomposed with low density and low viscosity. On the other hand, the lower horizon consisted of gleyed clayey silt with high viscosity. There was no clear boundary between these horizons. In this season, thickness of the active layer was 30 to 50 cm. Frozen ground, strongly kept feature of mother rock, lay under the active layer. Fine gravel was observed near thawing surface of the frozen ground.

Figure 1b shows soil (b) found in lowland without inundating. Their ground water level was 2 to 8 cm and living plant layer consisted of mosses 1 to 10 cm in thick. The upper horizon consisted of brown high moor 10 to 20 cm in thick with very low density, low viscosity and rich humus. In this horizon, some plant residue remained to be decomposed. The lower horizon consisted of gray clayey silt with a few board shaped gravel. There was clear boundary between these horizons. Thickness of

the active layer was 20 to 40 cm.

Figure 1c shows soil (c) found in middle-highlands with ground water level of 2 to 10 cm. Sedges covered the ground densely. The upper horizon was under a few centimeters plant residue layer and consisted of dark brown clayey soil with low density, middle viscosity and rich humus. The lower horizon consisted of gray silt with gravel. There was clear boundary between these horizons. The thickness of the active layer was 30 to 50 cm.

Figure 1d shows soil (d) found in highland and ground water level was lower than 50 cm. There was only piled up gravel under some lichen, and less horizontal soils were observed. The size of the gravel was decreased with depth. The thickness of the active layer was more than 50 cm.

Physical properties of soils Figure 2 shows profiles of temperature, water content, bulk density and hydraulic conductivity in soil (c). Temperature in the living plant layer was about air temperature. It decreased with depth and reached 0 degree at frozen ground surface. Water contents were high in the surface layer and the lower horizon while it was low in the upper horizon. Bulk densities were low in the surface layer and the lower horizon, while it was high in the upper horizon. Hydraulic conductivity decreased with depth. Such profiles were also observed in soil (a) and (b). Except for soil (d), the surface layers have low density and high hydraulic conductivity because they have a lot of plant residues and high porosity. Since soil pores keep water, water contents of the surface layers are high. Soils in the upper horizons are compacted and contained rich humus, so that they have high density, low water content and low hydraulic conductivity. Because of disturbance by freeze-thaw effect, the bulk density of the soil in the lower horizon is lower than the upper horizon. Since soil water is restricted to flow by the frozen ground, the water content of soil in the lower horizon may become high. The hydraulic conductivity in the lower horizon increased according to the amount of gravel.

Conclusion Soil of active layer on tundra wetland was surveyed. On the basis of vegetation and ground water level, we classified the soil of the active layer into four types and measured profiles and physical properties of the soil. Understanding these actual soil conditions is important for practical hydrological model.

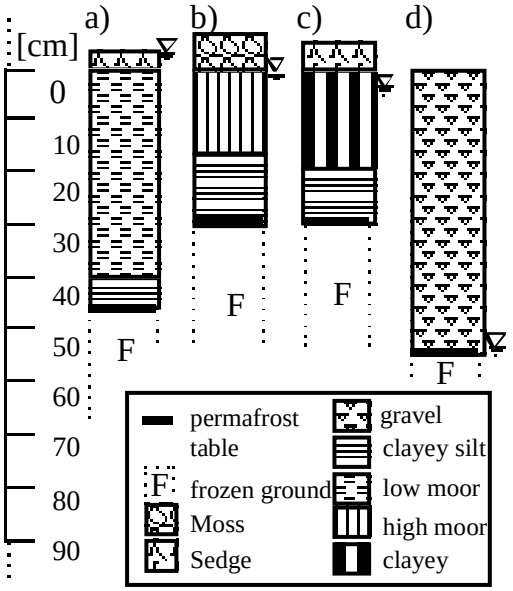

Figure 1 Soil profiles of each type of soil.

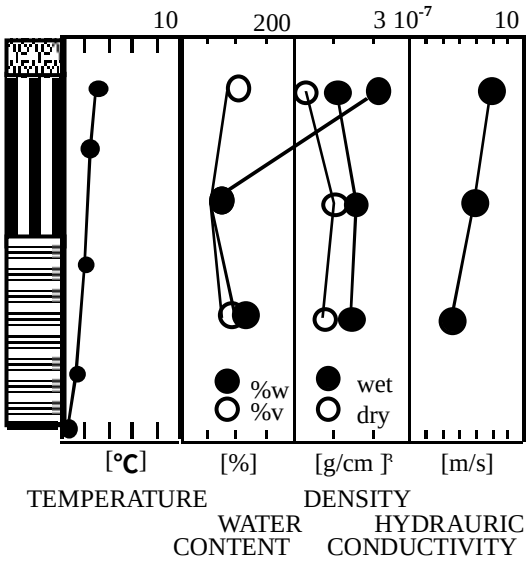

Figure 2 Physical properties of soil(c).