Pit observations of active layer of tundra wetland near Tiksi, Siberia

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1. Introduction

The permafrost is overlaid seasonal thawed layer so-called active layer. Characters of soil and soil water in the active layer are important to consider water cycle in tundra region. However, there are few places in the Siberian tundra where sufficient, high-quality soil data exist. Here, we report morphology and properties of soil of the active layer in tundra wetland.

2. Observation site and Methods

Survey was carried out at tundra wetland near Tiksi, Russia. Figure 1 shows soil observation sites in surveyed area. There are 30 observation sites on the 3km line with 100m intervals. Each observation site was given a number from 1 to 210 as shown in figure.

Observation pit with size of 50cm x 50cm were dug to the frozen ground at each site. Then, surface condition, thickness and horizons of the active layer were directly observed. The surface condition was recorded typical vegetation in the order of rate. The horizons were described according to standard techniques (E. M. Bridges; 1978) but modified for Arctic conditions. Using the wall of the pit, profiles of temperature, water content, density, hydraulic conductivity of soil were measured. The temperature was measured for several depths by thermistor, which was horizontally inserted into the wall with length of 10cm. The water content and density were measured by using undisturbed pedons taken to sampler with volume of 100cc. The hydraulic conductivity was measured in the filed by falling head permeability test. A few days past after dug the pit, the ground water level was measured from collected water in the pit.

3. Results

3.1 General and mother rock

In the surveyed area, sedges grew in the site where ground water level was low or the ground was inundated, while mosses grew in the site where ground water level was a few centimeters. Gravel spread at the elevation of higher than 150 m in stead of the vegetation. Soil mainly consisted of living plant, peat, clayey silt that should be weathering material by freeze-thaw effect and frozen parent material and the horizon is not so advanced. There is almost unitary mother rock consists of sandy mudstone in the surveyed area. The mudstone sometime has quartz vein. Table 1 shows mineral component of these materials defined from thin section observations.

3.2 Ground water level and vegetation

Table 2 shows elevation, slope, thaw depth, ground water level, air temperature near ground surface, ground water temperature, dissolved oxygen and ground surface condition of soil observed at each pit. Site 1-10, 20-30, 60-106 and 110-210 were made on August 17, 18, 20 and 22, 1997. Slope was measured staff with clinometer put on the pit. Air temperature, water temperature and DO of site 1-190 and site 200-208 were measured on August 29 and September 2, 1997, respectively. Soil profile type is classification from soil water regime and surface condition (Watanabe et al. 1998).

Table 3 shows variation of the soil water conditions for several sites. Site 197 indicates water of T River on cross point of the observation line.

3.3 Horizon and physical properties

Table 4 shows horizons and the thickness of soil in the active layer at each site. In the column of horizon, abbreviation "P" indicates living plant layer. Texture of horizon was estimated into four steps: gravelly, sandy, loamy, and silty. Boundary condition between horizons was estimated into 3 steps: abrupt, clear and gradual. Soil temperature of each depth was measured when the observation pit was made. Air temperature at this moment is shown in table2.

The temperature in the living plant layer was about the air temperature. It decreased with depth and reached 0 degree Celsius at frozen ground surface. Although soil was not so formed in this area, it was approximately divided into four horizons: living plant layer, peat or upper horizon of B layer, lower horizon
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of B layer and frozen ground. The upper horizon tended to have a lot of roots and decomposed organic. The lower horizon generally consisted of clayey silt that weathered freeze-thaw effect and had gley color and high viscosity. Gravel, which sometimes found horizons, became smaller with depth. And some layers, for instance Bo layer (dark brown, organic-rich) and Bwg layer (gley, high viscosity), is clearly divided. When living plant layer thick, active layer was apt to become thinner.

Table 5 shows water content, density and hydraulic conductivity of each horizon for several observation sites. And, Fig. 2 shows annual variation of each horizon's temperature at same observation pits. Except for gravel rich site, physical property of each site had similar tendency as follows. Water content was high in the surface and the lower horizon while it was low in the upper horizon. Bulk density was low in the surface and the lower horizon, while it was high in the upper horizon. Hydraulic conductivity decreased with depth

CONCLUSION

Soil of active layer on tundra wetland was surveyed. Morphology and some properties of the soil were summarized in Tables. These soil characters will be useful for make practical hydrological model.

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