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Thermal Conductivity of Soils Over Boreal Larch Forest and Disturbed Sites Near Yakutsk, Siberia (Extended Abstract)

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Evolution of landscapes in permafrost areas is of increased interest due to the global warming and human impact on the environment. The forest fires are one of the reasons of the formation of thermokarst depressions, which are widely distributed in the Eastern Siberia. The disturbance of surface vegetation and organic layer by fire change thermal conductivity of soil and influence on the thermal regime and status of permafrost.

A non-steady-state technique used to study thermal conductivity of soils at different depths in the Lena river valley. A field research was carrying out at the depth of 5 cm in the soil horizon A, enriched by organic material, and for alluvial sandy silt at the depth of 30 cm in active layer (soil horizon B).

Testing of Yakutsk soil taken from Neleger site at different temperatures were carried out, as well as a comparison with properties of other soils. Sample of Yakutsk soil was taken at the depth of 30 cm, from B soil horizon on experimental forest fire site ; it presents alluvial sandy silt. The water content of the sample was about 0.26 and density was 1.76 g/cm^3. A temperature dependence on thermal conductivity was found for Yakustk soil as well as a difference between frozen and unfrozen samples properties (Figure 1).

The value of thermal conductivity of organic layer at the depth of 5 cm depends on

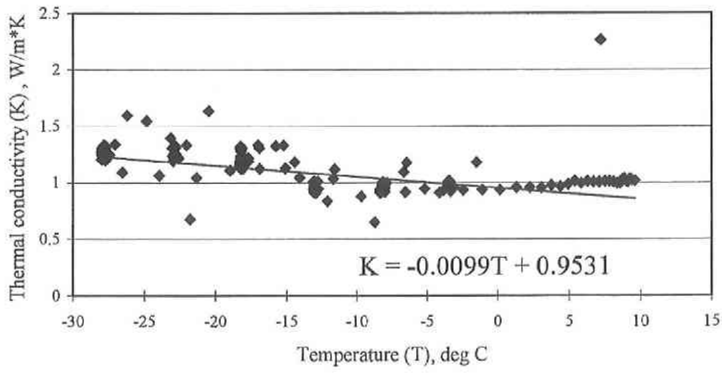

Figure 1. Thermal conductivity of Yakutsk soil at $W=0.25$, $d=1.76$ g/cm^3

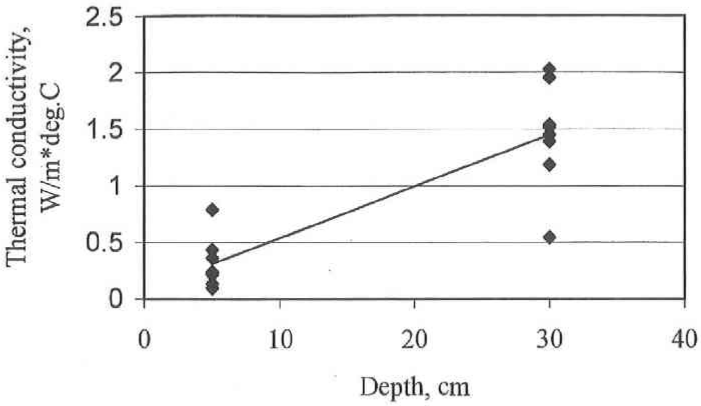

Figure 2. Thermal conductivity of soil at different depth before the experimental fire

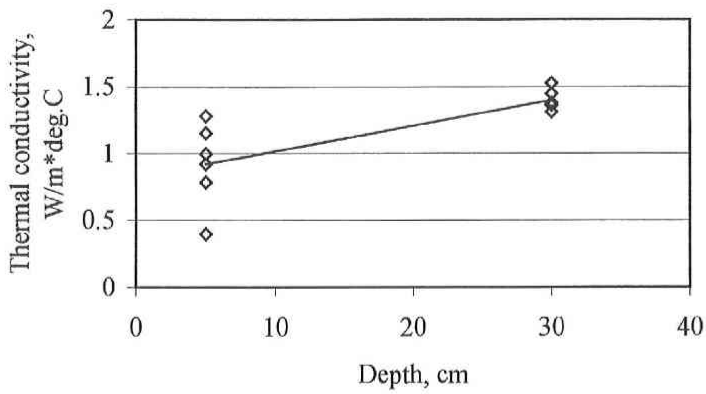

Figure 3. Thermal conductivity of soil at different depth after the experimental fire

type of landscape; lowest values were obtained for old larch forest. Thermal conductivity of thawed soil increases in active layer at the depth of 5 and 30 cm within 2 weeks after fire, especially for organic layer (horizon A) due to changes of soil properties (Figures 2–5).

The difference between thermal conductivity of soil on the depth of 5 cm and 30 cm is larger before fire than after. Thermal conductivity of soil on the depth of 5 cm has increased almost twice after the fire (Figure 3). Water content, soil density and mineral content increase after the fire at the depth of 5 cm (Figures 4 and 5); heat impact normally obviously leads to drying of soil and consequent compacting of soil particles. However, relationship between thermal conductivity and volumetric water content is not clear, probably because of density influence (Figure 6). Density affects thermal conductivity at the depth of 5 cm more (Figure 7), than at the depth of 30 cm. Thermal conductivity is enlarged at swamp and alas sites at the depth of 30 cm in comparison to

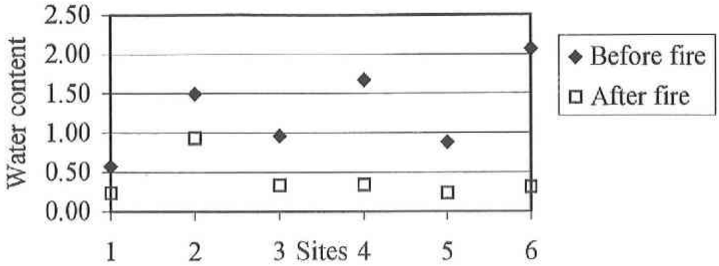

Figure 4. Average water content in active layer at the depth of 5 cm

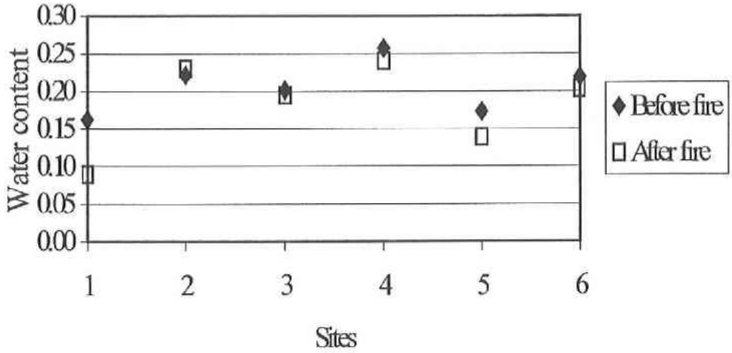

Figure 5. Average water content in active layer at the depth of 5 cm

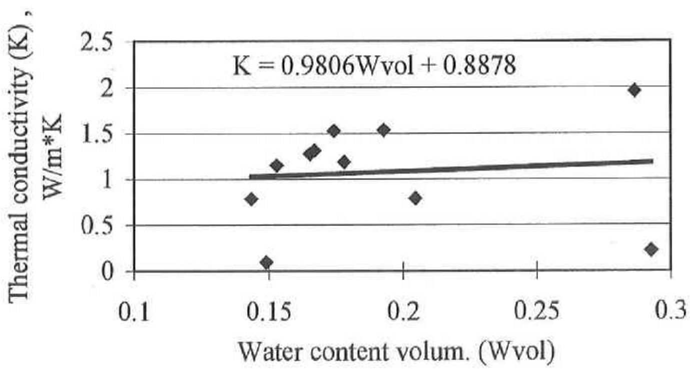

Figure 6. Thermal conductivity of the organic layer at the depth of 5 cm; water content is volumetric

the forest; value of the thermal conductivity depends on water content and density of the samples, increasing in the range of density of 1.2–1.6 g/cm^3.

An increase of thermal conductivity result to greater than before thawing of the active layer and raise of the temperature of permafrost; it has many effects at the surface and trigger erosion of the ice-rich Siberian landscapes. Permafrost is a source

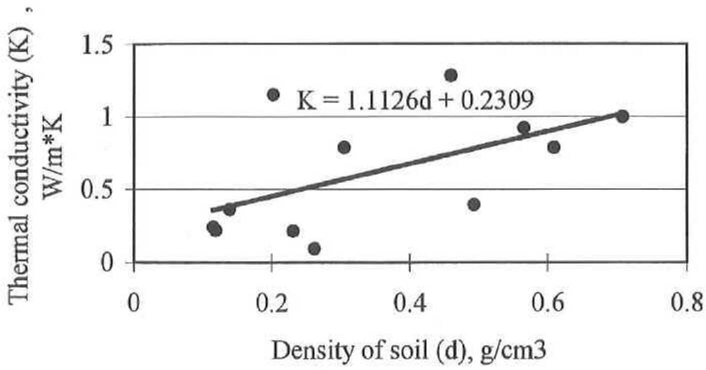

Figure 7. Thermal conductivity of soil vs. density at the depth 5 cm

of greenhouse gases, thus thawing of the frozen soils affect the global carbon cycle. Organic material in thawing permafrost decays quickly, releasing carbon dioxide and methane.

An increase of thermal conductivity of organic layer (horizon A) after fire as well as higher water content at alas and swamp areas in summer result to greater than before thawing of the active layer and raise of the temperature of permafrost. Significant changes occur after the fire at the depth of 5 cm, however mechanism of the changes is not completely clear. Heat impact leads to drying of soil and consequent compacting of soil particles, but the observed changes are strong and probably need to be studied experimentally.