学位論文内容の要旨

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学位論文題名

**Factors controlling change in soil organic carbon stock in various land uses on different soil types under different climate**

（異なる気候、土壌のさまざまな土地利用における土壌有機態炭素ストック変化の支配要因）

The decrease in soil organic carbon (SOC) and significant negative correlation between initial SOC and SOC change (ΔSOC) have been reported. The relationship showed the threshold of initial SOC for the decrease (x-intercept) and the stability of SOC (slope). Accumulation of SOC is achieved by balancing input carbon (C) and output C which is influenced by climate, soil type, land use, and management. This study aims to estimate the accumulated SOC stock and to clarify the factors controlling ΔSOC. In this study, the effect of organic matter (OM) application in Andosols of Toya, Hokkaido, and the effect of land use and forest disturbance in Permafrost affected soils of Central Yakutsk were evaluated, and the effects of soil and climate were also discussed.

In 2012, SOC at 34 sites of three types of Andosols [K (Vitric Andosols), K2 and HO (Silandic Andosols)] were measured, and ΔSOC were obtained using reference data collected from 2001 to 2003. At the all sites, OM was applied at the rate of 1.45 ± 1.27 Mg C $ha^{-1}$ $yr^{-1}$. The SOC stock increased, decreased, and unchanged in 10, 35 and 55% of the sites, respectively. The ΔSOC stock in K1, K2, and HO were 0.19 ± 0.79, -0.44 ± 0.88 and -0.44 ± 0.59 Mg C $ha^{-1}$ 15 $cm^{-1}$ $yr^{-1}$, respectively. There was a significant correlation between ΔSOC and initial SOC, and the slope and threshold were -0.054 and 36.1 Mg C $ha^{-1}$ $15cm^{-1}$, respectively. SOC stock in K1 in 2012 was lower than the threshold, indicating that the SOC may increase in the future. Conversely, in K2 and HO, the SOC stock may decrease.

In 2014, SOC at 18 sites of larch forest (LF), pine forest (PF), dry grassland (DG), wet grassland (WG), and pingo (PG) were measured, and ΔSOC were obtained using reference data collected in 1992 or 2000. The SOC stock increased, decreased, and unchanged in 28, 61, and 11% of the sites, respectively. The ΔSOC stock in LF, PF, DG, WG, and PG were -0.11 ± 0.41, -0.43 ± 0.04, -1.12 ± 2.17, -0.45 ± 4.05, -0.94 ± 1.18 Mg C $ha^{-1}$ 15 $cm^{-1}$ $yr^{-1}$, respectively. There was a significant correlation between ΔSOC and initial SOC, and the slope and threshold were -0.029, and 35.9 Mg C $ha^{-1}$ $15cm^{-1}$, respectively. SOC stock in LF, PF, and PG in 2014 was lower than the threshold, indicating that the SOC may increase in the future. Conversely, in DG and WG, the SOC stock may decrease.

Change in total soil carbon [TSC = SOC + soil carbonate carbon (SCC) + litter carbon (LIC)] was evaluated using the data from 81 sites (72 sites in 2014 and 2015 and 9 sites in 2013). Thermokarst formation accumulated C and flooding increases C. In the forest ecosystem, waterlogged damage increased SOC, but decreased LIC. Forest fires did not change SOC and SCC but decreased LIC. Arable land abandonment increased SOC.

The slope in Toya and Yakutsk was higher and lower, respectively, than that estimated in previous studies. There was a positive correlation between the slope and the temperature or precipitation, indicating that the smallest slope in Yakutsk attributed to lower NPP and slower OM decomposition under the low temperature and precipitation.

Comparison with previous studies shows the threshold in the cropland tended to be lower than those in forest and grassland. In Toya, specific features of Andosol (humus accumulation by Al-OH complex） and OM application increased the threshold. In Central Yakutsk, thermokarst formation and further flooding, waterlogged damage, and arable land abandonment may increase the threshold.

The threshold was controlled by the soil type, land use, disturbance, and management. And the slope was controlled by the climate.