

高緯度北極二一オルスンの氷河後退域における植生発達と炭素貯蔵量の関係

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Relationship between vegetation development and carbon storage on a glacier foreland in the High Arctic, Ny-Ålesund, Svalbard

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As part of the study of ecosystem carbon cycle in the High Arctic (Nakatsubo et al. 2005), organic carbon distribution and effects of vegetation development on it were determined for a glacier foreland near Ny-Ålesund, Svalbard (79°N). We set 43 study plots in a 0.72 km² area along three ca. 1.8 km transects following the primary succession after deglaciation. Coverage (%) of total vegetation, vascular plants, mosses, lichen, and BSC were measured in all plots. Vegetation, organic soil, and mineral soil samples were collected from all the study plots and organic carbon contents were determined based on the organic carbon concentration and bulk density.

Cluster analysis based on the coverage datasets of vegetation type indicate that this area can be patterned roughly to ground surfaces of four types: I) almost bare ground with sparse vegetation at early stage of succession, and well developed vegetation at later stage of succession dominated by II) biological soil crusts (BSC), III) vascular plants, or IV) vascular plants and mosses. Organic carbon storage of these four groups was significantly different and tended to increase with the following order: bare ground at the early stage of succession (0.4 kgC m⁻²), BSC (2.5 kgC m⁻²), vascular plants and mosses (4.0 kgC m⁻²), and vascular plants (5.4 kgC m⁻²). In addition to the amount, allocation patterns of organic carbon differed especially between the group I and other three groups (II–IV): considerable amount of organic carbon was contained in organic soil layer and deeper layer of mineral soil in groups II–IV. These results indicate that vegetation development after deglaciation had strong effect on the organic carbon distribution at High Arctic glacier foreland.

Range and average value of the organic carbon storage in the later stages of succession in this study area was about 1.1–7.9 and 4.3 kg C m⁻² (to 20 cm depth of mineral soil), respectively. Although they were smaller than the values in the Alaskan Arctic area (up to 20 kg C m⁻², Chapin et al. 1980) and alpine area (up to 13 kg C m⁻², Grieve, 2000; Ohtsuka et al., 2008), it was comparable to the value in Greenland (7.0 kg C m⁻², Elberling et al., 2004). In addition, more organic carbon is expected to be contained in much deeper mineral soil layer (>20 cm) as raised beach deposits in this study area (Nakatsubo et al. 2008). These results suggest that non-negligible amounts of organic carbon were distributed in this High Arctic glacier foreland.

References

- Chapin, F.S. III, Miller, P.C., Billings, W.D., Coyne, P.I., Carbon and nutrient budgets and their control in coastal tundra, in: Brown, J., Miller, P.C., Tieszen, L.L., Bunnell, F.L. (eds.), *An Arctic Ecosystem: The Coastal Tundra at Barrow, Alaska*. Dowden, Hutchinson and Ross, Stroudsburg, pp. 458–486, 1980.
- Elberling, B., Jakobsen, B.H., Berg, P., Søndergaard, J., Sigsgaard, C., Influence of vegetation, temperature, and water content on soil carbon distribution and mineralization in four High Arctic soils. *Arct. Antarct. Alp. Res.* 36, 528–538, 2004.
- Grieve, I.C., Effects of human disturbance and cryoturbation on soil iron and organic matter distributions and on carbon storage at high elevations in the Cairngorm Mountains, Scotland. *Geoderma* 95, 1–14, 2000.
- Nakatsubo, T., Bekku, Y.S., Uchida, M., Muraoka, H., Kume, A., Ohtsuka, T., Masuzawa, T., Kanda, H., Koizumi, H., Ecosystem development and carbon cycle on a glacier foreland in the High Arctic, Ny-Ålesund, Svalbard. *J. Plant Res.* 118, 173–179, 2005.
- Nakatsubo, T., Yoshitake, S., Uchida, M., Uchida, M., Shibata, Y., Koizumi, H., Organic carbon and microbial biomass in a raised beach deposit under terrestrial vegetation in the High Arctic, Ny-Ålesund, Svalbard. *Polar Res.* 27, 23–27, 2008.
- Ohtsuka, T., Hirota M., Zhang, X., Shimono, A., Senga, Y., Du, M., Yonemura, S., Kawashima, S., Tang, Y., Soil organic carbon pools in alpine to nival zones along an altitudinal gradient (4400–5300 m) on the Tibetan Plateau. *Polar Sci.* 2, 277–285, 2008.