A proposal for pedology of peat soils distributed in Japanese lowlands

(日本の低地に分布する泥炭土の土壌生成論に対する提言)

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Abstract

A large part of Japanese peat soils is distributed in agricultural fields on lowlands. Muck soils or sapric peat soils, that are well-decomposed peat soils, are typical in these regions owing to groundwater drainage for crop production. These soils in Japanese lowlands are characterized by high content of mineral materials in organic horizons due to frequent supply of alluvial sediments into peatlands. Mixed minerals in peat might promote peat decomposition in terms of aeration and nutrient supply. However, there are little or no pedological discussions about peat decomposition process in Japan from the viewpoint of the effect of minerals in peat. This low attention is reflected in conventional peat classification systems that have less focused to peat soils with high content of minerals as reviewed in the chapter 2. Hence, this study aimed to establish new pedology about peat decomposition in Japanese agricultural fields on lowlands, especially focusing on the effect of topographical condition on peat characteristics.

In the chapter 3, distribution trend of sapric peat soils in Japan was investigated by geospatial analysis from the view point of land-use and

topographical condition in order to understand the environmental factors related to peat decomposition. To this end, GIS (Geographical information system) and Quantification method type II were applied to calculate the discrimination model for distribution area of Sapric and non-Sapric peat soils. As a main result, the obtained discrimination model demonstrated that sapric peat tended to be distributed under good drainage conditions, in the floodplain, with coarse sediments, and without a mineral surface layer. This suggested that the distribution of sapric peat soils in lowland was controlled by groundwater drainage related to landform condition.

In the chapter 4, peat heterogeneity in micro-scale was analyzed. This viewpoint would be important to understand the decomposed state of peat with high content of minerals because mineral sediments in peat make micro-scale environment heterogeneous. To this end, "heterogeneity analysis" was conducted as follows: (1) analyzing decomposition index of individual peat micro-fragments using spectral data from Fourier transform infrared (FTIR) micro-spectroscopy, and (2) determining the distribution of peat decomposition index as an indicator of the heterogeneity of peat soils. As a result, the distribution range of micro-fragment decomposition degree (MDD) demonstrated the heterogeneous peat decomposition processes following micro-environment condition. Moreover, the bimodal distribution pattern of MDD represented heterogeneous state formed by mixed minerals in peat.

Above results demonstrated that mixed minerals in peat influence the peat decomposition process. Hence, this study proposed the new categorization of organic soils taking the minerals in peat into account as a

factor of pedogenesis of peat soils. In particular, it was pointed out that considering the decomposition process of peat with high mineral content (sub-peat) is necessary for further understanding in the pedology of peat soils in lowlands. Reconsidering the relationship between pedogenesis of peat soils and the topographical factor, which has been overlooked in the conventional pedology in peat soils, would be effective for understanding the interaction between natural and human-induced factors affecting on peat decomposition.