

Organic Carbon Accumulation in Andosols: (1) Unaccounted Andosols in Japanese forest soil

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The soils are major absorbers, depositories, and releasers of organic carbon (OC) on the earth surface. The amount of OC in soils is more than four times that of carbon in terrestrial biota and three times of that in the atmosphere. The content of OC in soils varies greatly, from less than 1% by mass in some arid-zone soils to 50% or more in waterlogged organic soils (Hillel and Rosenzweig, 2009).

Andosols, which occur in volcanic regions all over the world, show the highest amount of OC density aside from the organic soils. Rapid weathering of porous volcanic ejecta or glasses results in accumulation of stable organo-mineral complexes and/or short-range-order minerals such as allophane, imogolite and ferrihydrite. Because of the stability of organomineral complexes, Andosols largely accumulate OC.

Andosols, whose area is estimated about 975,000 km² or 0.8% of the world soils, contain approximately 1.8% of global soil carbon. Even though Andosols' contribution of OC stock is not so large at a global level, it is relatively important in Japan. Andosols cover 17% of national land in Japan and therefore they would play an important role in the domestic carbon storage.

An Andosol with a thick dark-brown horizon called the fulvic horizon is classified into Fulvic Andosol. Fulvic Andosols have been identified in Chile, Indonesia, Japan and New Zealand. In Japan, Fulvic Andosols commonly form under forest ecosystems and often show a biosequential relationship with Melanic Andosols which have a thick black horizon called the melanic horizon. Fulvic horizons are rich in OC but colors lighter than the melanic ones, and have andic properties and 30 cm or more cumulative thickness, therefore Fulvic Andosols also largely store OC alike other Andosols.

Unfortunately, Fulvic Andosols in Japanese forest soil remain in a state of unaccounted for. The forest soil covering 60% or more of national land in Japan has been classified into 15 soil units by the Classification of Forest Soil in Japan (1975). In this classification, about 70% of forest soils are occupied by Brown forest soils correlated with mostly Cambisols and some Andosols, while Black soils (Andosols) are the second largest group at 13%. Because of the criteria used to classify soils are mainly morphology-oriented characteristics or properties, it is difficult to distinguish the area of Andosols from that of Cambisols within the area of Brown forest soils (Morisada et al., 2004). Since most of Andosols included in Brown forest soils will be potentially classified as Fulvic Andosols, they should be counted as superior OC accumulators.

Brown Kuroboku soils, which were correlated with Fulvic Andosols (WRB) or Fulvudands (Soil Taxonomy), were newly defined in the Unified Soil Classification System of Japan –2nd Approximation (2002)–. However, the distributional area of Brown Kuroboku soils is almost unaccounted for in Japanese forest soil yet. For an accurate estimate of the OC stock in Japanese soil, further study is necessary to distinguish the area of them from that of Brown forest soils and assign map units in the soil map of Japan.

References

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