Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

BGM22-P04 Room:Convention Hall Time:May 26 18:15-19:30

Biodegradation activity of organic matter in the buried humic horizons in volcanic ash soils

HAYAKAWA, Chie[2*] ; FUJII, Kazumichi[2] ; SENOO, Keishi[1]

[1]Univ. Tokyo, [2]FFPRI

Over ten thousand years, Hokkaido soils have been formed through deposition of volcanic ash. The surface soil layer in the past has been buried in deeper part of soil profile. The buried humic horizons contain the high amounts of organic matter (OM) and they serve as a large C reservoir. The microbial degradation activity can generally decrease with soil depth, and OM in the deeper soil horizons is stable due to limitations of organic matter input. In contrast, microbial activity in the buried humic horizons may not be low, because the high amounts of OM can fuel soil microbial activity. We aim to examine the microbial mineralization kinetics in the buried humic horizon using ^{14}C-tracer incubation.

Soil samples (volcanic ash soil) were collected from the soil profiles in three forest sites and one pasture site in Hokkaido, Japan. These “fresh” field moist, un-sieved soils were used for mineralization kinetic studies. A ^{14}C-glucose solution (100 μL; 10 - 300000 μM) was added to 1 g of field-moist soil and incubated for 24 h at 20 ℃. The $^{14}CO_2$ production was trapped in the scintillation vial containing NaOH and determined by liquid scintillation counting. The experiments were performed in triplicate. The data of mineralization kinetics were fitted to a single Michaelis-Menten equation: $V = V_{MAX}C/(K_M+C)$, where V is the mineralization rate (nmol g^{-1} h^{-1}), C is the substrate concentration (μM) in soil solution, V_{MAX} is the maximum mineralization rate (nmol g^{-1} h^{-1}), and K_M is the Michaelis constant (μM) representing the concentration at which 1/2 V_{MAX} is achieved. We also measured soil microbial biomass, fungal/bacterial (F/B) ratio, and fine root biomass.

Fine root biomass in the soil profiles decreased with depth, suggestion the low rates of organic substrate supply in the buried humic horizon. Their Michaelis-Menten kinetic parameters (V_{MAX} and K_M) varied widely from 303 to 18598 nmol g^{-1} h^{-1} and 198 to 1294 μM. The parameters decreased with soil depth. The kinetic parameters of the surface soil horizon exhibited high mineralization capacity, while parameters of the buried humic horizons were similar to those of the other soil types (11 to 2406 nmol g^{-1} h^{-1} for V_{MAX} and 198 to 30786 μM for K_M). The both of V_{MAX} and K_M parameters were correlated positively with microbial biomass-C and -N, respectively. This indicates microbial biomass is a primary factor regulating the potential degradation activity in the buried humic horizons. Microbial biomass decreased with soil depth, consistent with the low input of fresh organic substrates in the deeper soil horizons. The higher F/B ratios were observed in the buried humic horizon, compared to the surface horizon. Since F/B ratios has influence on the mineralization kinetic parameters due to differences of substrate use efficiency and growth speed between fungi and bacteria, the high potential degradation activity relative to the other soil types may be due to high F/B ratios in the buried humic horizons. The high potential degradation activities of soil microorganisms in the buried humic horizons suggest that OM decomposition can be accelerated by addition of easily-biodegradable OM which stimulates soil microbial activity.

Keywords: the buried humic horizon, volcanic ash soil, 14C-glucose, microbial mineralization kinetics, soil organic matter