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Millennial-scale effect of microbes on soil organic matter buried by volcanic ash

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Soil is considered to be the major carbon (C) reservoir accounting for about 70% of terrestrial C. Turnover time of C accumulated in soil often exceeds thousands years, thus much concerns have recently been directed to the mechanism of long-term sequestration and preservation of organic matter in soil. Microbes are the major contributor for changing the characteristics of preserved organic matter and influencing its stability. However, because soil typically comprise a mixture of old and young organic residues, it is difficult to analyze long-term effect of microbes on soil organic matter. Buried soil allows us to study the long-term changes in soil organic matter, because supply of young organic matter is limited. Thus, in this study, we analyzed hydrolyzable amino acids (AA) and amino sugars (AS) in soils buried for hundreds to thousands years in order to clarify the long-term effect of microorganisms on soil organic matter. Buried soils were sampled in Tomakomai, Memuro, and Abashiri in Hokkaido Island. Carbon content in buried soil ranged from 1.12 to 8.06%, unrelated to the soil age or the type of volcanic ash, suggesting strong influences other than time and parent material. The positive correlation between yield of AA and AS suggests a strong influence of microorganisms on chemical changes in organic matter in buried soils. Ratio of GlcN/GalN was lower in older soils, suggesting grater progress of diagenesis in soils buried for a longer period. This was supported by the lower yield of AA and AS in older soils. These observations suggest that soil organic matter sequestrated for hundreds to thousands years is influenced partly by microorganisms, and is diagenetirally altered to more uncharacterizable compounds.

Keywords: Soil organic matter, Carbon sequestration, Buried soil, Microbial contribution, Diagenetic alteration