General pattern of carbon and nitrogen isotopic variation across a wide range of soils and its controlling factors

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Organic matter (OM) in soil represents the largest carbon pool on land. The production of CO2 via microbial degradation of soil OM therefore has a strong impact on global C cycle and anticipated global warming. Previous studies have shown that any soil holds multiple OM pools of varying stability against microbial attack. Growing number of studies suggests protective effect of specific mineral phases and mineral matrix. OM, however, interacts with soil minerals in highly complex ways including co-precipitation of organic ligands with multivalent metals at molecular scale and physical aggregation of OM with mineral particles at micron and larger scales.

Here we examined the relationship between the isotopic compositions (C-13, C-14, and N-15) and mineralogical characteristics (surface area and elemental composition, pedogenic metal oxides) among density fractions using a range of surface soils of contrasting mineralogy including volcanic soils rich in short-range-order minerals and much more weathered soils from both agricultural and natural systems. Each soil was separated into 4-7 density fractions after mechanical shaking with sodium polytungstate. From LF to higher-density fractions, We assessed how C aging is related to C13 and N15 enrichment and to what extent these isotopic variations among the fractions were controlled by the mineralogical characteristics.

Keywords: Soil, Carbon sequestration, organo-mineral interaction, stable carbon and nitrogen isotope, Radiocarbon, mineralogy

