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Soil microbes shape nitrogen isotopic signatures of soils: a linkage between the ecological stoichiometry and d15N.

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Nitrogen (N) is an essential, although ecologically limiting, nutrient in many terrestrial ecosystems. It is thus critically important to understand N cycles in terrestrial ecosystems to project their responses to expected changes in environments such as the increase in anthropogenic N input and CO2 concentration. Natural abundance of N isotopes (d15N) has been used to get insights into N cycles in the ecosystems because the d15N signature can provide unique information on the naturally-occuring processes in the intact ecosystem. Interpretations of global dataset of plant d15N (e.g. Craine et al. 2009) and soil d15N (e.g. Houlton and Bai 2009, Craine et al. 2015) have been proposed to explore the important flux/parameter in N cycles which are difficult to measure (such as N availability and denitrification loss). In most of these cases, the rule of the thumb in d15N interpretation is that soil loses 15N-depleted N during decomposition (more strictly, mineralization and leaching/denitrification loss), which is also the fundamental concept for marine sediment d15N (e.g. Robinson et al. 2012, Tesdal et al. 2013). Even this "15N-depleted N loss" concept is easy to follow, the direct (experimental) evidence for the isotopic fractionation during N mineralization or decomposition is suprisingly scarse. Although long-term lab incubation of soil samples revealed the expected d15N increase with the decrease in N concentration (Nadelhoffer and Fry 1988), litter-bag experiments (Melillo et al. 1989; Connin et al. 2001) did not show this expected d15N change during litter decomposition. Thus the gap between field observations and lab experiments in the d15N trend calls the review of the fundamental concept for the interpretation of soil d15N.

In the presentation, I will summarize the d15N data we obtained in the last five years on soil bulk N, several extractable organic N (EON), extractable inorganic N (EIN) in soils and soil microbial biomass (SMB), which are now relatively easy to measure with denitrifier method (Sigman et al. 2001, Houlton et al. 2006). The d15N of SMB is generally higher than d15N of other N compounds, which should be interpreted as a consequence of carbon and N stoichiometry (or N mineralization; Dijkstra et al. 2008). This high d15N of SMB can complement the interpretationo of soil d15N variations – the large d15N differences between organic layers and mineral soils often observed in soil profiles, the low d15N in wet/cold ecosystems and the high d15N in dry/hot ecosystems in the global soil d15N trend, and the high d15N of the microbially-processed soil fractions.