Geophysical Research Abstracts
Vol. 13, EGU2011-8043, 2011
EGU General Assembly 2011

Multiple-Isotope labelling (13C, 18O, 2H) in a Controlled Environment (MICE) as a new tool for studying the allocation of organic molecules within the plant-soil system?

Mirjam Studer (1), Samuel Abiven (1), Rolf T. W. Siegwolf (2), and Michael W. I. Schmidt (1)

(1) University of Zurich, Soil Science and Biogeography, Geography, Zurich, Switzerland (mirjam.studer@geo.uzh.ch), (2) Paul Scherrer Insitute, Ecosystem Fluxes, Laboratory of Atmospheric Chemistry, Villigen, Switzerland

Terrestrial ecosystems have a large carbon sequestration potential, but many processes and fluxes of organic matter (OM) cycling within the plant-soil system are not yet well understood [1]. Stable isotope analysis e.g. in combination with biomarkers is a powerful tool to study complex interactions within the plant-soil system [2]. The use of multiple isotopes has proven to lead to further insights in plant physiological processes and on OM cycling [3-4]. We constructed two labelling chambers to apply a new continuous multi-isotope labelling (13C, 18O and 2H) in a controlled environment (MICE) for compound specific analysis to trace organic compounds (e.g. lignin, cellulose) from the leaf to the soil and within soil organic matter (e.g. suberin, photolipid fatty acids).
The MICE facility consists of two labelling chambers. The upper parts (shoot) of the plant-soil system are separated hermetically from the lower parts (roots, soil) to prevent the diffusion of the labelled gas or water vapour into the soil. Each chamber carries 15 plants in single pots, which can be sampled at 5 sampling dates (3 replicates) with minor disturbance to the labelling atmosphere. Each chamber has a separate upper gas circuits by which the label added is recycled and the CO2 concentration and air humidity within the chambers is automatically regulated and monitored. Thus the two labelling chambers can be used to conduct multi-labelling experiments with controls (background measurements, optimal environmental conditions) for each sampling date or with different environmental conditions (e.g. drought simulation). In the lower part of the labelling chamber each pot is aerated to prevent anaerobic conditions. With a combined gas sampling system the total CO2 efflux is monitored and the isotopic signature of the soil respiration can be assessed frequently.
The multi-labelling technique has been successfully tested in preliminary experiments on bulk material and a complex chamber system (MICE) has been developed to apply this technique.
The new multi-labelling approach and the labelling facility developed represent a powerful tool to address still open questions in plant and soil research such as the allocation of organic molecules within the plant-soil system under changing environmental conditions or the influence of plants on soil organic matter stabilization and destabilization processes.

References

[1] Bahn, M., Janssens, I. A., Reichstein, M., Smith, P., & Trumbore, S. E. (2010). Soil respiration across scales: towards an integration of patterns and processes. New Phytologist, 186 (2), 292–296.
[2] Amelung, W., Brodowski, S., Sandhage-Hofmann, A., & Bol, R. (2008). Combining biomarker with stable isotope analyses for assessing the transformation and turnover of soil organic matter. In D. L. Sparks (Ed.), Advances in Agronomy (Vol. 100, pp. 155–250). Burlington: Academic Press.
[3] Saurer, M., & Siegwolf, R. T. W. (2007). Human impacts on tree-ring growth reconstructed from stable isotopes. In T. E. Dawson & R. T. W. Siegwolf (Eds.), Terrestrial Ecology Series: Stable Isotopes as Indicators of Ecological Change (1st ed., pp. 49–62). Oxford: Academic.
[4] Bird, J. A., & Torn, M. S. (2006). Fine roots vs. needles: a comparison of 13C and 15N dynamics in a ponderosa pine forest soil. Biogeochemistry, 79 (3), 361–382.