Geophysical Research Abstracts
Vol. 20, EGU2018-1402, 2018
EGU General Assembly 2018

Organic carbon stability in Podzolic and Luvisolic subsoils

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Deep soil carbon below 20 cm represents more than half of the total carbon stored in forest soils globally. While it has been shown that carbon present in forest floors can turnover rapidly, the stability of carbon stored deeper in forest soil profiles remains largely unknown. Furthermore, the link between specific pedogenic processes leading to carbon accumulation at depth and carbon stabilization mechanisms has rarely been explored for forest soils.
Podzols and Luvisols represent 38 % and 19% of Canadian forest soils, respectively. The B horizons of Podzols are formed by the accumulation of carbon, iron and aluminum leached under dissolved forms from upper horizons, while the main process corresponding to the formation of B horizons in Luvisols is the lessivage of clay particles associated or not with carbon. We therefore hypothesized that organic carbon would be more stable in Luvisolic B horizons because of the stronger interactions of carbon with clay minerals.
The aim of this work was to compare carbon stability in the B horizons of three Podzols sampled in Quebec and three Luvisols sampled in Alberta, Canada. Carbon in each soil was characterized by density and particle size fractionation procedures. Soils were incubated in lab-controlled conditions for four months, and total CO_2 respiration was measured in order to quantify carbon mineralization rate. The natural isotopic composition of carbon (δ13C) was recorded in each carbon size fraction and in the CO_2 respired over time, in order to estimate how these different fractions contributed to the overall soil respiration.
Contrary to our hypothesis, carbon mineralization rates were shown to be higher in Luvisolic than in Podzolic B horizons. This suggests that the association between carbon and clay minerals in the deep soil horizons may be of lesser importance than previously thought, and that other parameters, e.g. the quality of carbon inputs to the subsoil, may play a larger role in the overall stability of deep organic C in forest soils.