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Evaluation of carbon and nitrogen pools in different soil types amended with different organic inputs by thermogravimetric/calorimetric analysis

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The objective of this study was to assess the short-term changes in soil organic C (SOC) and N pools after incubation of three different soil types (Regosol, Luvisol and Kastanozem) treated with three amendments differing in organic matter stability (raw pig slurry (PS), manure, and biochar (BC), and to establish relationships between different chemical, spectral and thermal/calorimetric data to assess if thermal/calorimetric analysis could replace conventional analyses to monitor changes in SOC and N poos. Thermogravimetry–Differential Scanning Calorimetry (TG-DSC) analysis showed that amendments had little effect on volatile SOC and inorganic matter, compared to unamended samples in all soils. All amendments significantly increased the labile SOC in Regosol. Manure and BC increased recalcitrant SOC in Regosol and Luvisol. BC significantly increased recalcitrant SOC in all soils. Refractory SOC slightly increased with amendments in the Luvisol compared to the control. These results support the findings obtained with chemical analyses. Selected evolved ions (m/z 30 and 44) detected by quadrupole mass spectrometry (QMS) confirmed findings from TG-DSC. Emissions of C and N containing gases from the Regosol significantly increased with the amendments because this soil contains low SOC content, and the application of these amendments provided additional C. An increase in the CO_2 containing gas species (m/z 44) from volatile SOC was observed with PS application only in the Regosol. Carbon dioxide increments (m/z 44) from recalcitrant (380-475ºC) and refractory (475-550/600ºC) SOC pools were observed with all amendments in all soils especially with BC application. The evolved ions at m/z 44 were higher in the initial soil samples from Kastanozem than after incubation, suggesting a loss of organic compounds, mainly volatile and labile upon incubation. NO peaks (m/z 30) showed similar trends to the C containing gas species in all soils. We carried out linear regressions to estimate soil properties measured by conventional chemical procedures by the use of TG–DSC–QMS. We obtained accurate models to estimate SOC, soil carbonates, recalcitrant C, soluble C and soluble N. These results encourage the use of thermal analyses to study SOM dynamics in soils, since it provides feasible and accurate information about different organic and inorganic C and N fractions. Thermal methods are quite inexpensive, require little sample preparation, are rapid and give reproducible results. However, no relationship between thermal analyses and C and N mineralization and N volatilization was found, suggesting that this technique may be valid to assess the current value of different organic fractions in a soil in a concrete time, but not indicated to predict mineralization or volatilization trends after application of amendments.