Characterization of soil organic matter with different degrees of humification using evolved gas analysis-mass spectrometry

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Abstract:

Evolved gas analysis-mass spectrometry (EGA-MS) provides a direct connection between the pyrolyzer and mass spectrometer through a deactivated capillary tube, and provides both a thermal profile relating to the differential thermogravimetric curve of the sample and a mass spectrum of evolved gas from the sample. In this study, EGA-MS was performed to obtain thermal profiles and identify the pyrolysis products of 12 humic acids (HAs) with different degrees of humification extracted from 5 Andisols, 3 Entisols, and 3 Inceptisols, as well as soil samples. All HAs were thermally decomposed gradually over a wide temperature range (100-700ºC), and the EGA curves showed four peaks and shoulders at around 250, 350, 450, and 550ºC. The peaks at around 550ºC were observed for the Andisol HAs only. Carboxyl groups, carbohydrates, and short chain alkanes and alkenes of the HAs and bulk soil samples evolved at a relatively low-temperature region (200-300ºC). On the other hand, aromatics including benzenes and lignin derivatives evolved at a relatively high-temperature region (300-600ºC). While the shapes of the EGA curves were different between the soils and extracted HAs, the major components of the evolved gas and the pyrolysis behavior of the constituents in the HAs and soil samples were similar. The amount of evolved gas from the Andisol HAs, which mainly consisted of CO_2, was very low in comparison to that from the Entisol and Inceptisol HAs. The amount of evolved gas and the molecular weight of the pyrolysis products decreased as humification progressed, but the proportion of CO_2 in the total area of the EGA curves increased. The results demonstrated that humification reduces the proportion of volatile components and increases the amount of carboxyl groups. As a result, the molecular structure of HAs is found to be mainly composed of non-volatile components and carboxyl groups. Since EGA-MS can provide information about the chemical structure and pyrolysis characteristics of a small sample without pretreatment, it is a useful tool for soil organic matter research.

* Excerpted from online journal website (Click the title)

Frontier Labs Products used:

Multi-Shot Pyrolyzer (EGA/PY-3030D), AS-1020E, Eco-cup LF, UA$^+$-5, UA-DTM-2.5N