Soil Carbon in the Ecological Transition
International symposium
24 - 26 January 2024

Characterization of organic matter in peat samples with Pyrolysis gas chromatography coupled to mass spectrometry **(Py-GC/MS): from methodological challenges to identification of relevant molecular indicators.**

Perrine COLOGON[a], Anthony ALBOUY[a], Pascal HAYRAULT[a], David SEBAG[a], Isabelle KOWALEWSKI[a], Maira ALVES-FORTUNATO[a], Valentine SCHAAFF[b], Guillemette MENOT[b].

a. IFP Energies Nouvelles, Rueil-Malmaison, France
b. Université de Lyon, ENS Lyon, UCBL, CNRS, UMR 5276 LGL-TPE, 69364 Lyon, France

It is commonly agreed today that there is a need for advanced characterization techniques for organic matter. The aim of this study is to develop an analytical methodology based on a thermal analysis, the Pyrolysis gas chromatography coupled to mass spectrometry (or Py-GC/MS), while avoiding sample preparation steps. Sample preparation approaches like extraction or fractionation can result in bias in compositions and thus in conclusions. Thermal analysis combines the advantages of being a direct analysis for solid samples, and of thermal stability, which is directly correlated to biogeochemical stability (Albrecht et al., 2015; Cécillon et al., 2018; Sanderman and Grandy, 2020).

An analytical workflow based on Py-GC/MS was optimized, involving six pyrolysis temperature steps ranging from 240°C to 1200°C. The separation of compounds over the GC column was optimized, as well as the detection with mass spectrometry, providing a thorough workflow for molecular identification.

It was then applied over ten peat samples from Ngaoundaba peat from Cameroon to characterize the organic matter preserved in this sedimentary sequence (0 to 10.000 years). Several molecules from different families (lignin, polysaccharides, aromatics, phenols, proteins) could be identified at pyrolysis temperatures comprised between 350 and 550°C.

Doublet peaks with alkenes/alkanes of increasing carbon chain lengths were identified at pyrolysis temperatures of 450°C (Figure 1). This observation was also made by Albignac et al. (2023), who used this result to distinguish between natural and synthetic organic matter like polymers. Molecular indicators were searched as markers of sample features, like age/depth or climatic conditions for example. These promising results pave the way for future research in this field, as the coupling of thermal analysis with a powerful molecular analysis like GC/MS gives valuable insight into complex solid sample composition.

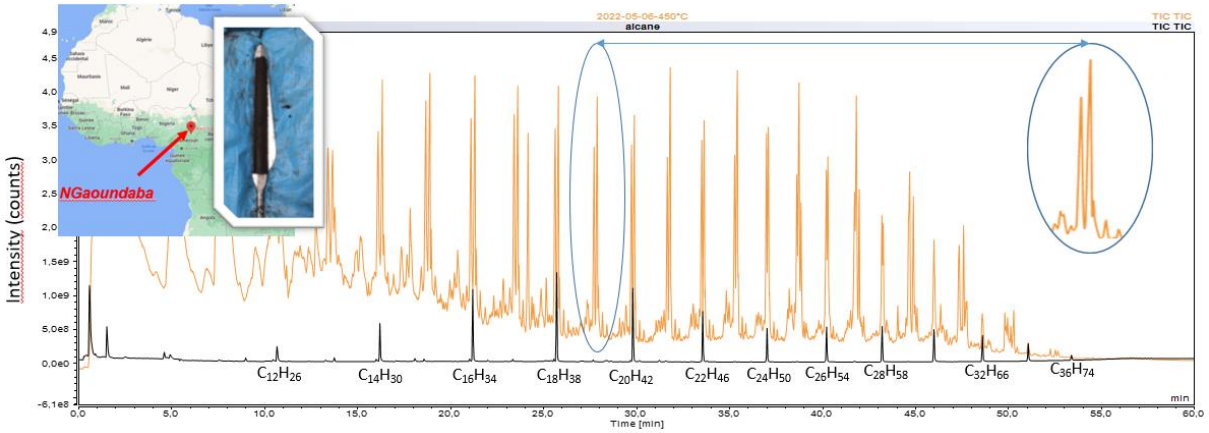

Fig. 1 - GC/MS results after a pyrolysis at 450°C for a 7500 year-old peat sample