Investigating the influence of instrumental parameters and chemical composition on pyrolysis efficiency of peat

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To track changes in organic matter (OM) in peat soils, analytical techniques are needed that effectively characterize their chemical components. Pyrolysis-gas chromatography/mass spectrometry is a useful method for obtaining a chemical ”fingerprint” of OM. To obtain representative fingerprints, the pyrolysis process should be highly reproducible and representative of the original sample; however, these key indicators for successful volatilization are underreported in the literature. We investigated the influence of instrumental parameters (temperatures, heating rates, sample mass), original organic C and nitrogen (N) content, and instrument type (”slow” vs ”flash”), on volatilization of different peat samples by monitoring sample mass loss and changes in organic C and N content before and after pyrolysis. Average percent C by mass volatilized (”C pyrolysis efficiency”) across all pyrolysis experiments conducted (mass, instrument types, and settings) was 47.8 +/- 1.8%. Sample mass was not a major driver; however, instrument temperatures, heating rate, and original N content had a significant influence on pyrolysis efficiency. N pyrolysis efficiency occurred at significantly higher rates (56.7-75.8%) than C pyrolysis efficiency (45.1-51.6%). N pyrolysis efficiency was also negatively influenced by decreasing concentrations of original sample N, suggesting that N-containing compounds may undergo preferential volatilization in high pyrolysis temperatures. Our data suggest that C pyrolysis efficiency is relatively insensitive to instrumental parameters; whereas when seeking to identify N-containing compounds, appropriate temperatures and heating rates must be chosen. These results provide an expected range for pyrolysis efficiency as a reference for peat samples analyzed with this technique.
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