Multi-proxy approach for the reconstruction of past environmental change in a French peatland

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Résumé:

The aim of this study was to reconstruct past environmental changes via the high-resolution analysis of organic matter (OM) composition in a 4 m peat core collected in a temperate peatland (Frasne mire, French Jura Mountains) and covering the last 8,000 cal. BP. In addition to the determination of OM properties, several environmental proxies have been used: testate amoebae, branched GDGTs and pollen analysis. All the data indicated that an ecosystem shift occurred ca. 6,000 cal. BP from a fen to a Sphagnum-dominated bog. This is especially supported by (i) a strong increase in amorphous OM relative content and (ii) a significant decrease in mucilage and fungal hyphae relative contents, cellulosic sugar abundance and C/N ratio below this depth. In addition, at ca. 6,000 cal. BP, pollen analysis revealed a change in vegetation. Last, drier conditions were indicated by testate amoebae at the bottom of the peat core, whereas wetter conditions occurred at the top.

Mean annual air temperature (MAAT) and pH were reconstructed using the MBT and CBT proxies based on branched GDGTs. The gradual decrease in pH with decreasing depth is consistent with the transition from a fen with intermediate pH to a bog with acidic conditions. The MBT/CBT proxies were shown to overestimate temperature. Thus, in the surface peat, MBT/CBT-derived temperature (ca. 10 °C) was more consistent with spring and summer temperature (ca. 11 °C) than with MAAT (6.8 °C), suggesting that branched GDGT-producing bacteria might be more active during the warmest months of the year. Reconstructed MAAT showed a strong decrease at 6,000 cal. BP in agreement with the development of cooler and wetter conditions in the Jura Mountains after 6,200 cal. BP. This temperature shift very likely reflects both a change in the composition of the peat and in climatic conditions, consistently with the aforementioned geochemical and palynological indicators.