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Determination of thermal stability of specific biomarker lipids of the freshwater fern Azolla through hydrous pyrolysis

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Enormous blooms of the free-floating freshwater fern Azolla occurred within the Arctic Basin during an extended period of ∼1.2 Ma during the middle Eocene (Brinkhuis et al. 2006; Speelman et al., GB, 2009). The sustained growth of Azolla, currently ranking among the fastest growing plants on Earth, in a major anoxic basin may have substantially contributed to decreasing atmospheric CO2 levels by burial of Azolla-derived organic matter. Speelman et al. (OG, 2009) reported biomarkers for Azolla (1,w20 C32 - C36 diols, structurally related C29 20,21 diols, C29 1,20,21 triols, C29 dihydroxy fatty acids as well as a series of wax esters containing these mono- and dihydroxy lipids), which can be used to reconstruct palaeo-environmental conditions. Here we assess the thermal stability of these compounds, to extend their biomarker potential.

We specifically focused on the thermal stability of the Azolla biomarkers using hydrous pyrolysis in order to determine which burial conditions allow reconstruction of past occurrences of Azolla. In addition, hydrous pyrolysis was also performed on samples from the Eocene Arctic Ocean (ACEX core), to test if and how the biomarkers change under higher temperatures and pressures in situ. During hydrous pyrolysis, the biomass was heated under high pressure at temperatures ranging between 220 and 365°C for 72 hours. Four experiments were also run using different durations to explore the kinetics of biomarker degradation at specific temperatures. First results indicate that the Azolla specific diols are still present at 220°C, while the corresponding wax esters are already absent. At 300°C all Azolla specific biomarkers are destroyed. More specific determination of the different biomarkers' stability and kinetics would potentially allow the reconstruction of the temperature and pressure history of Azolla deposits.

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