Glendonites as archives of paleoenvironmental change in the aftermath of the PETM

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Glendonites are calcite pseudomorphs after the metastable mineral ikaite ($CaCO_3$ x $6H_2O$). Marine ikaite precipitation within sediments has primarily been described in near-freezing, high alkalinity environments with increased orthophosphate and magnesium concentrations. However, recent studies indicate that ikaite might also form at higher temperatures [1].

This study investigates glendonites in diatomaceous background sediments of the Early Eocene Fur Formation of Northwestern Denmark, well known for its more than 180 volcanic ash layers deposited during the opening of the North Atlantic Ocean. The glendonites of the Fur Formation provide an unique opportunity to get insight into the controlling factors of ikaite formation. $\delta^{13}C_{carb}$ values of the glendonites are around -24‰ and suggest ikaite formation due to organotrophic sulfate reduction. However, a contribution of carbon derived from anaerobic oxidation of methane cannot be excluded. Calcium and strontium isotopes are applied to characterize the calcium source of ikaites in the otherwise calcium carbonate free background sediment.

While glendonites occur in distinct horizons, authigenic carbonate concretions occur throughout the Fur Formation. High $\delta^{13}C_{carb}$ values, as well as abundant lipid biomarkers of archaea reveal that methanogenesis may have lead to the formation of the concretions in the lower part of the formation, which was deposited at the end of the PETM. Carbon isotopes of the sedimentary organic matter as well as C/N ratios show changes in the source of organic matter with periods of increased terrestrial input, most likely due to climate and/or precipitation changes.

[1] Teichert & Luppold (2013), *Paleo3*, **390**, 81-93.