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Eemian seasonal temperature variations recorded by very high-resolution analyses of a MIS 5e stromatolite from Caours (Somme Basin, Northern France): combining petrography and stable isotopes.

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In many tufa formations, very well crystallised deposits called stromatolites are preserved. They generally present successive laminations thought to be linked to seasonal climatic and environmental variations in modern to sub-fossil deposits. They thus represent a huge potential for very high resolution records of Pleistocene climate. One of the very first investigations in this way has been performed on a 2.5 cm-radius stromatolite from the Eemian sequence of Caours (Somme Basin, Northern France), where precise petrographical observations have been combined with stable isotope analyse.

Lamina succession observed in macroscopic scale has been shown in thin section to be linked to two major facies. The first is built by well developed, elongate calcite spar crystals including imprints of cyanobacteral bushes. This facies alternates with laminae composed by fractured crystals or micritic layers. The first facies could be linked to summer development of cyanobacteria under optimal temperature and light conditions and the 'degraded' or micritic facies to less favourable winter conditions. Stable oxygen and carbon isotope analyses performed on 69 intra-lamina samples show variation strongly concordant with lamina succession. Facies with developed sparry crystals is associated to minimal isotopic values whereas the 'degraded' facies clearly record the highest. At seasonal resolution, carbon isotopic composition has been previously shown in modern tufa to covary positively with oxygen isotopic composition probably driven by temperature dependent phenomena in the aquifer: thus the positive correlation observed in the Caours stromatolites between the isotopic ratios is not surprising. Oxygen stable isotope composition in tufa calcite is known at this resolution to be directly linked to water temperature: increasing temperature related to decreasing values. This interpretation of geochemical results is thus strongly consistent with facies attribution to seasonal variations. Indeed, maximal temperatures are recorded in well developed calcite laminas assigned to summer conditions.

These preliminary results indicate that seasonal palaeoclimatic information should be available in fossil Pleistocene stromatolites. High-resolution studies combining petrographical and intra-laminae stable isotope analyses allow data comparison and strengthen their interpretations. At this resolution, the oxygen stable isotope composition is thermo-dependent and could be use to quantify water temperature. Analyses of a larger stromatolite from Caours covering several decades would provide a strong record of summer-winter water temperature variations during the Eemian.