Expression of extreme global warming: The Early Eocene Climatic Optimum

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The Early Eocene Climatic Optimum (EECO), which occurred between 53 and 49 million years ago, was the warmest period of the Cenozoic era. Since then, temperatures have decreased. Therefore, these warmer periods can be used as an analogy for the different IPCC scenarios (***Fig.1***) **[1]**. During the EECO, climatic conditions were like those described by the most extreme IPCC scenario, RCP8.5/SSP5-8.5, with temperatures 10-15°C higher than today and a pCO_2 of around 1,600 ppm at the peak of the optimum (~51 Ma).

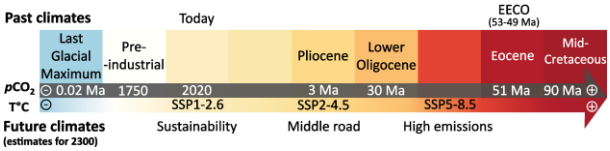

Fig. 1: *Comparison between past and future climate scenarios according to* ***[1]****.*

This period is clearly defined in marine environments and has been documented through the analysis of deep-sea benthic and planktonic foraminifera **[2]**. In contrast, the climatic context of this warming is less well defined in littoral and continental environments. The aim of my thesis is to provide details on the evolution of palaeotemperatures during the EECO in these environments.

In order to constrain climatic variability, the Paris Basin is the best choice, as sediments from this period are well preserved. Moreover, these deposits contain extremely well-preserved fossils, such as mollusc shells, which provide reliable climatic information. I selected fossiliferous sites that offer the best temporal coverage of the period under consideration. I chose sites around Soissons, Reims and Épernay, which provide the most continuous temporal zonation.

Three places have currently been sampled for their molluscs from various environments: Cuise-la-Motte, the Cuisian stratotype (formerly the Upper Ypresian); Mancy; and Soissons (***Fig.2***).

Fig.2: *Outcrop of Soissons showing a succession of sandy and sandy-clay deposits (from bottom to top).*

Geochemical analyses in the laboratory, especially $\delta^{18}O$ and Δ_{47}, will constrain the paleotemperatures. Moreover, high-resolution analysis of mollusc shells allows seasonal variability to be reconstructed **[3]**. Vertebrate fossils (particularly crocodiles and mammals) from Mancy, along with other climatic records, will also be used to supplement the data.

Alongside this paleoclimatic study, a sedimentological study of contemporary warming facies will be conducted to evaluate the effect of extreme warming on erosion and sedimentation in cratonic regions.

Références bibliographiques :

[1] Tierney *et al.*, 2020, Past climates inform our future, Science 370, eaay3701, doi: 10.1126/science.aay3701

[2] Westerhold *et al.*, 2020, An astronomically dated record of Earth's climate and its predictability over the last 66 million years, Science 369 (6509), 1383-1387, doi: 10.1126/science.aba6853

[3] Huyghe *et al.*, 2022, Clumped isotopes in modern marine bivalves, Geochimica Et Cosmochimica Acta, 316, 41-58, doi: 10.1016/j.gca.2021.09.019