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Late Eocene arid climate in Asia inferred from multi-proxy sclerochronology using oyster shells from the Tarim Basin

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The Asian climate is characterized by a strong duality between monsoon dominant climate in southeastern Asia and arid climate in central Asia. Based on climate modelling, this pattern has been explained by two main driving mechanisms associated to the Indo-Asia collision: uplift of Tibetan Plateau and/or retreat of an epicontinental sea formerly covering Asia. However, climate proxies are lacking to test these hypotheses and understand how and when this climate pattern was established.

The aim of this study is to develop a new method to understand the Late Eocene climate in central Asia, when the Paratethys was still covering the continent. A crucial task to this end is to reconstruct the climate seasonality in central Asia: when and how the climate changed from a probably temperate climate, due to the sea presence, to an arid climate? Did this climate change have an impact on the monsoon intensification in southestern Asia?

Here we use bivalve sclerochronology to assess the Eocene climate variability on seosonal time scales in Central Asia. Well preserved oyster shells (*Sokolowia buhsii*, Grewingk) were sampled in marine sediments from Lutetian to Bartonian age in southwestern Tarim Basin, Xinjiang, China (Aertashi and Kezi sections).

The Paratethys sea was shallow and partially closed, thus the challenge is to distinguish temperature from salinity effects on the biomineralization. Here, we present a new method using multi-proxy approach. The fossils were cut perpendicularly to the maximum growth axis to expose incremental yearly growth lines of the shell to be analysed. We first obtained Mg/Ca record using LA ICP-MS indicative of the temperature variations. We then recovered an isotopic sclerogeochemistry ($\delta^{18}O_c$) record using micromilling extraction to assess the $\delta^{18}O_w$ (and thereby the salinity) of the sea.

Results show that seasonal temperature variability was considerable. Furthemore salinity increase during summers indicating a negative water balance. Thus, we infer that central Asian climate was already very arid during the Late Eocene, although the Paratethys sea was still covering the Asian continent. This is an apparent contradiction with the first assumption of a temperate climate before sea retreat but is in agreement with coeval palynological data from the Tarim Basin and with recent climate models of Eocene Asian monsoons.