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Equatorial seawater temperatures and latitudinal temperature gradients during the Middle to Late Jurassic: the stable isotope record of brachiopods and oysters from Gebel Maghara, Egypt

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The Jurassic climate has traditionally been described as equable, warmer than today, with weak latitudinal temperature gradients, and no polar glaciations. This view changed over the last decades with studies pointing to distinct climate fluctuations and the occasional presence of polar ice caps. Most of these temperature reconstructions are based on stable isotope analyses of fossil shells from Europe. Additional data from other parts of the world is slowly completing the picture.
Gebel Maghara in the northern Sinai Peninsula of Egypt exposes a thick Jurassic succession. After a phase of terrestrial sedimentation in the Early Jurassic, marine conditions dominated since the end of the Aalenian. The stable isotope (δ18O, δ13C) composition of brachiopod and oyster shells was used to reconstruct seawater temperatures from the Bajocian to the Kimmeridgian at a palaeolatitude of ca. 3°N. Throughout this time interval, temperatures were comparatively constant aorund an average of 25.7°C. Slightly warmer conditions existed in the Early Bathonian (~27.0°C), while the Kimmeridgian shows the lowest temperatures (~24.3°C). The seasonality has been reconstructed with the help of high-resolution sampling of two oyster shells and was found to be very low (<2°C) as can be expected for a tropical palaeolatitude.
A comparison of the results from Egypt with literature data enabled the reconstruction of latitudinal temperature gradients. During the Middle Jurassic, this gradient was much steeper than previously expected and comparable to today. During the Kimmeridgian, temperatures in Europe were generally warmer leading to weaker latitudinal gradients. Based on currently used estimates for the δ18O value of seawater during the Jurassic, reconstructed water temperatures for localities above the thermocline in Egypt and Europe were mostly lower than Recent sea-surface temperatures. These results improve our understanding of the Jurassic climate and its influence on marine faunal diversity patterns.