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The bivalve *Glycymeris planicostalis* as a high-resolution paleoclimate archive for Rupelian (Early Oligocene) of Central Europe

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Abstract

Current global warming is likely to result in a unipolar glaciated world with unpredictable repercussions on atmospheric and oceanic circulation patterns. These changes are expected to affect seasonality as well as the frequency and intensity of decadal climate oscillations. To better constrain the mode and tempo of the anticipated changes, climatologists require high-resolution proxy data of time intervals in the past, e.g. the Early Oligocene during which boundary conditions were similar to those predicted for the near future. As demonstrated by the present study, pristinely preserved shells of the long-lived bivalve mollusk *Glycymeris planicostalis* from the late Rupelian of the Mainz Basin, Germany, provide an excellent archive to reconstruct changes of sea surface temperature on seasonal to inter-annual time scales. Their shells grew uninterruptedly during winter and summer and therefore recorded the full seasonal temperature amplitude that prevailed in the Mainz Basin 30 Ma ago. Absolute sea surface temperature data were faithfully reconstructed from $\delta^{18}O_{shell}$ values assuming a $\delta^{18}O_{water}$ signature that was extrapolated from coeval sirenian tooth enamel. Extreme values ranged between 12.3 and 22.0 °C and agree well with previous estimates based on planktonic foraminifera and shark teeth. However, summer and winter temperatures varied greatly on inter-annual time-scales. Winter and summer temperatures averaged over 40 annual increments of three specimens equaled 13.6 ± 0.8 °C and 17.3 ± 1.2 °C, respectively. Unless many samples are analyzed, this variability is hardly seen in foraminiferan tests. Our data also revealed decadal-scale oscillations of seasonal extremes which have – in the absence of appropriate climate archives – never been identified before for the Oligocene. This information can be highly relevant for numerical climate studies aiming to predict possible future climates in a unipolar glaciated or, ultimately, polar ice-free world.

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The bivalve *Glycymeris* sp. – a high-resolution paleoclimate archive

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