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Strong Central Asian seasonality from Eocene oysters indicates early monsoons and aridification

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Climate models suggest that the onset of Asian monsoons and aridification have been governed by Tibetan plateau uplift, global climate changes and the retreat to the west of the vast epicontinental Proto-Paratethys sea during the warm Eocene greenhouse period (55-34 million years ago). However, the role of the Proto-Paratethys sea on climate remains to be quantified by accurate and precise reconstructions. By applying a novel intra-annual geochemical multi-proxy methodology on Eocene oyster shells of the Proto-Paratethys sea and comparing results to climate simulations and sedimentology analyses, we show that the Central Asian region was generally arid with a high seasonal contrast characterized by hot and arid summers and wetter winters.

Hotter and more arid summers despite the presence of the Proto-Paratethys may be explained by warmer Eocene global conditions with a strong anticyclonic Hadley cell descending at Central Asian latitudes and a stronger Foehn effect from the emerging Tibetan Plateau to the south. This implies that the shallow sea did not have a strong dampening thermal effect on the monsoonal circulation in contrast to previous circulation models results but in agreement with recent evidence for Eocene summer monsoons.

Enhanced winter precipitations, relative to modern, is linked to a westerly moisture source coming from the Proto-Paratethys sea at that time. Additional bulk sediment stable isotope data from marine limestones and pedogenic carbonates suggest a gradual decrease in this westerly moisture source, which is in line with the retreat of the Proto-Paratethys followed by the Oligo-Miocene orogeny of the Central Asian ranges (Tian Shan and Pamir) shielding the westerlies.