Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11591

Paleoaltitudinal reconstructions of the Himalayas during the Late Miocene to Pliocene based on biomarkers

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The uplift of the Himalayas is a crucial driver of global climate change during the Neogene. However, paleoaltitudinal history of the Himalayas remains controversial. Ongoing disputes about paleoaltitudinal reconstructions arise from the difference in paleoaltimeters. The stable isotope paleoaltimeters has indicated that the Himalayas reached its modern height as early as Middle Miocene, and were ~1-2 km higher than at present during the Late Miocene to Mid-Pliocene. Conversely, the mammalian and plant fossils supported that the Himalayas were warmer, wetter and lower during the Late Miocene. In this study, we use glycerol dialkyl glycerol tetraethers (GDGTs) which derived from archaea and some unknown bacteria to provide new evidence from paleotemperature reconstructions. In the Gyirong basin, an Intermountain basin located in central Himalayas, the distribution of GDGTs we detected in the Late Miocene to Mid-Pliocene sediments are completely different from that of modern soils in this region. The lower $R_{i/b}$ values (the relative ratio between isoprenoid and branched GDGTs) in sedimentary rocks indicated that the paleoenvironment was wetter than it is today. Meanwhile, the paleotemperatures reconstructed based on the branched GDGT proxies were warmer than today's. In addition, similar results were obtained from the Zhada and Dati basins in the Himalayas, which preserved sedimentary archives spanning the Late Miocene to Pliocene. Taking into account the source and seasonality, we reconstructed the paleoaltitude from the paleotemperature records. The results show that there were low altitude areas in the Himalayas during the Late Miocene to Pliocene.