

## **A 6 million-year biomarker record of monsoon rains and vegetation on the Indian Peninsula**

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The global monsoon varied dramatically since the late Miocene, but its effects on the Indian Peninsula are not well known. To address this gap, we reconstruct a ~6 Myr long paleorecord in the Bay of Bengal (BoB) at IODP Site U1445. Major, trace, and rare earth elements fingerprint the origin of the sediment as being from the Mahanadi River, located in the Core Monsoon Zone (CMZ) of the Indian Peninsula. Compound-specific biomarkers ( $\delta^{13}\text{C}$  and  $\delta\text{D}$  of fatty acids, alkenones, alkanes) reconstruct changes in rainfall, vegetation, and marine productivity.

Our record shows the CMZ dried since the late Miocene and, on this aridification background,  $\text{C}_4$  vegetation expanded from the mid-Pliocene to mid-Pleistocene. Concurrently, productivity in the BoB increased probably as a result of reduced freshwater input and less salinity stratification promoting enhanced mixing and nutrient export to the sea surface. The Pliocene-Pleistocene  $\text{C}_4$  flora expansion is also observed in East Africa and the Chinese Loess Plateau, suggesting that vegetation remained sensitive to changes in monsoon hydroclimate after the global  $\text{C}_4$  increase in the late Miocene. The step in aridification occurred as summer monsoon winds weakened over the Arabian Sea, which supports the coupling between summer Indian Monsoon winds and precipitation. Wet early Pliocene conditions with a subsequent weakening of the Indian Monsoon are synchronous across East Asian and Australian Monsoons, arguing for a meridional contraction of the range of inter-tropical convergence zone annual migration.