

Plant wax evidence for monsoon precipitation and the expansion of C4 ecosystems in the late Miocene

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We report results from organic geochemical analyses on Indian Ocean sediments from IODP Expedition 354 that drilled sediment cores on a W-E transect across the Bengal Fan at 8°N, with over 20 million years of sedimentary recovery. We find the late Miocene C4 grassland expansion represented in three deep holes, providing corroborating evidence for the nature and timing of the transition.

We have extracted lipids from 469 samples and generated compound specific isotopic analyses to reconstruct paleohydrology and paleoecology. Hydrogen and carbon isotopic analyses on the same plant wax molecules test whether hydrologic changes were coincident with the transition in photosynthesis pathway – from C3 to C4 – that occurred during the late Miocene. The cause of the late Miocene transition has been long-debated, and our new plant wax data provide critical evidence for a major change in the hydrological cycle. We find a ca. 30‰ shift in plant wax hydrogen isotopic composition that was in-step with ecosystem change.

The widespread establishment of C4 grasses in the Himalayan foreland basin constitutes the largest transformation of these tropical ecosystems before human intervention and provides an opportunity to consider ecosystem response to climate change in the monsoon region.