Late to the party: Australia's tardy expansion of C_4 vegetation linked to Australian summer monsoon

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Since the late Miocene, plants using the C_4 photosynthetic pathway have increased to become major components of many tropical and subtropical ecosystems. However, the drivers for this expansion remain under debate, in part because of the varied histories of C_4 vegetation on different continents. Australia hosts the highest dominance of C_4 vegetation of all continents, but little is known about the history of C_4 vegetation there. To characterise the expansion of C_4 plants in north-western Australia, we analyse carbon isotope ratios of leaf wax *n*-alkanes and pollen assemblages dating from 9-1Ma from Ocean Drilling Program Leg 122, Site 763A on the Exmouth Plateau.

Analysis of plant wax carbon isotopes in scientific ocean drilling sediments off north-western Australia reveal the onset of Australian C_4 expansion at ~ 3.5 Ma, later than in numerous other regions. Pollen analysis from the same sediments reveals increasingly open C_3-dominated biomes preceding the shift to open C_4-dominated biomes by several million years. The driver of Pliocene C_4 expansion in north-west Australia is unlikely to have been aridification, as arid condition were also prevalent in the late Miocene when we do not see any evidence for C_4. Instead, we hypothesize that the development of a summer monsoon climate beginning in the Late Pliocene promoted a highly seasonal precipitation regime favorable to the expansion of C_4 vegetation.