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North Atlantic and Pacific surface ocean circulation across the mid-Pleistocene transition: implications for northern hemisphere ice-sheet growth

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The Mid-Pleistocene Transition (MPT) marks the shift to a dominant glacial/interglacial period of 100-kyr and the development of larger northern hemisphere ice-sheets at ca. 0.9 Ma. The MPT marks a change in the climate system response to external insolation forcing, the latter unable to account for the strength of the 100-kyr cycles. Here, we present records of past surface ocean circulation changes associated with the MPT from the northern North Atlantic (ODP 983) and the north-west Pacific (ODP 882), using alkenone-derived proxies for subarctic/subpolar water mass distributions (%$C_{37:4}$ alkenone) and sea-surface temperature (U^{K}_{37}). We also compare our data to published sea-surface temperature records from the tropical Pacific and south-east Atlantic to investigate potential teleconnections and/or driving mechanisms for the MPT.

We identify changes to the extent of subarctic and subpolar water masses in both oceans from 1.2 Ma, which would have been detrimental to the transport of moisture to the ice-sheet source regions. This occurs alongside evidence for an intensification of Walker circulation, increasing Trade Wind strength in the southern hemisphere, and a shift in the position of the Antarctic Circumpolar Current. At all of the examined sites we also find evidence for a shift towards cooler SSTs from 1.2 Ma, supporting the hypotheses invoking cooling of both the atmosphere and deep-waters as a driver of

the MPT. Using modern teleconnections as an analogue for the past, the intensification of Walker circulation in the tropical Pacific would increase moisture transport to the ice-sheet source regions of boreal North America and encourage northern hemisphere ice-sheet expansion prior to 0.9 Ma. However, the changes to water mass distributions in the N Atlantic and N Pacific potentially modulated the ice-sheet response to these changes, delaying growth in the northern hemisphere ice-sheets until 0.9 Ma.