

Interaction of millennial- and orbital-scale ice-sheet dynamics and the origin of the quasi 100-kyr cycle

D. A. HODELL^{1*}

¹ Godwin Laboratory for Paleoclimate Research, Department of Earth Sciences, University of Cambridge, Downing Street, Cambridge, CB2 3EQ United Kingdom (*correspondence: dah73@cam.ac.uk)

The Middle Pleistocene Transition (MPT) represents one of the great unsolved mysteries in paleoclimatology. It occurred between ~1250 and 650 ka and represented a shift in the spectral character of the climate signal from dominantly 41-kyr power before 1250 ka to the emergence of a quasi 100-kyr cycle at 650 ka. Accompanying this change was an increase in glacial benthic $\delta^{18}\text{O}$, representing the combined effects of decreasing deep-water temperature and increasing global ice volume. Most explanations of the MPT invoke a change in the size and dynamics of northern hemisphere ice sheets that introduced new sources of low- and high- frequency climate variability.

A pronounced change occurred in the composition and frequency of IRD in the North Atlantic at ~640 ka during marine isotope stage (MIS) 16, coinciding with the increased dominance of the 100-kyr cycle. At this time, “Hudson Strait” Heinrich layers first appeared in the sedimentary record of Site U1308. Ice volume may have surpassed a critical threshold during the MPT such that the domes of the North American Ice Sheet coalesced and were able to survive through local boreal summer insolation maxima, thereby lengthening the glacial cycle. As the ice sheet thickened through the extended glacial period, the fraction of the base of the ice sheet at pressure melting point slowly increased, rendering the ice sheet more susceptible to events that could trigger a dynamic response (i.e., surge).

“Hudson Strait” Heinrich layers generally occurred in the latter part of the glacial cycle and almost always at glacial terminations. This observation raises many questions. What role did the Hudson Strait Ice Stream play in the deglaciation process either directly by Laurentide ice-sheet drawdown or indirectly by fresh-water forcing to the North Atlantic? Why weren’t all Heinrich events followed by complete deglaciations? The broader question is how do millennial-scale climate events interact with orbital-scale variations to produce the observed record? In the presentation, I will discuss potential interactions among orbital forcing, Heinrich events, deep-water circulation and oceanic CO_2 feedback to explain terminations and the origin of the pseudo 100-kyr cycle following the MPT.