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North Atlantic circulation at the last glacial maximum from magnetic and modeling approaches

B.A. Maher (1), S.J. Watkins (1) and G.R. Bigg (2)

(1) Lancaster Environment Centre, Lancaster University, UK, (2) Department of Geography, Sheffield University, UK (b.maher@lancs.ac.uk / Fax: +44 1524 510269

Formation of N. Atlantic Deep Water (NADW) is an important component of the ocean thermohaline circulation but debate exists over the ocean circulation state during glacial stages. Some geological and modelling studies suggest decreased NADW and increased formation of Southern Ocean deep water during the Last Glacial Maximum (LGM); others indicate similar, or higher, rates of NADW advection. Here, we test two different potential LGM ocean states by comparing the modelled iceberg trajectories each produces with magnetically-mapped patterns and sources of LGM ice-rafted debris (IRD). One LGM state is characterised by vigorous NADW formation; the other by dominant deep water production in the Southern Ocean. Cluster analysis of sediment magnetic properties was used to characterise N. Atlantic IRD patterns and sources, which match most closely iceberg trajectories arising from the 'southern-sinking' ocean circulation state. The magnetic data indicate two major IRD sources, Fennoscandia and Greenland/Iceland, and one minor source, the St Lawrence region. The model and magnetic data suggest that the LGM N. Atlantic circulation was dominated by a cyclonic central N. Atlantic gyre, separated from the N. Atlantic Current which was displaced south of $\sim 42\ ^{o}$N.