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Abrupt intensification of North Atlantic Deep Water formation at the Nordic Seas during the late Pliocene transition

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Southward flow of dense North Atlantic Deep Water (NADW) and northward flow of warm surface water constitute the Atlantic Meridional Overturning Circulation (AMOC). The AMOC is an important component of the present climatic system because it plays a major role in controlling the northward transport of heat and moisture [Ramstorf, 2002]. In order to understand the evolution of the climatic system during the late Pliocene transition (LPT), during which the global climate changed from warm and relatively ice-free conditions to a colder and more glacial climate in the Northern Hemisphere [Lisiecki and Raymo, 2005], it is crucial to reveal changes in the NADW. However, details of the past evolution of the NADW during the LPT are still poorly understood because of the lack of suitable paleoceanographic proxy data.

Here, we developed a new rock-magnetic method to determine constituent of sediments and report on the evolution of NADW during LPT. North Atlantic deep-sea sediments drilled at the Gardar Drift (Integrated Ocean Drilling Program site U1314) were used for rock-magnetic measurements. We measured isothermal remanence (IRM) acquisition curves of 252 samples collected from 199.3 to 299.2 mcd of the core, which correspond to ages between 2.22 and 2.91 Ma at an average resolution of 3 kyr.

First derivatives of the IRM curves were decomposed into two end-member components. Consequently, residuals of the decomposition were sufficiently small throughout the study interval, thus confirming that the Gardar Drift sediments represent a mixing of the two end-member components: high-coercivity and low-coercivity components. Changes in the components agree well with those of the LR04 oxygen isotope data of benthic foraminifera [Lisiecki and Raymo, 2005]; the fraction of high-coercivity component periodically changed with the interglacial?glacial cycle. Variation trends of the sediment constituents drastically changed at ca. 2.68 Ma. Average values of the fraction of high-coercivity component increased after ca. 2.68 Ma from $38 \pm 13\%$ to $68 \pm 22\%$ because of the increase in high-coercivity component during the interglacial period.

Fraction changes of the high-coercivity component represent variation of the Iceland-Scotland Overflow Water, a branch of NADW formed at the Nordic Seas. The drastic increase in the high-coercivity component during the interglacial period suggests that intense NADW formation at the Nordic Seas abruptly started at ca. 2.68 Ma.

Keywords: North Atlantic Deep Water, Iceland Scotland Overflow Water, Nordic Seas, Late Pliocene transition, IODP Exp. 306