Resolving the components of the North Atlantic sediments by IRM acquisition experiments at room- and low-temperatures

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In general, a sediment sample is composed of various components. Resolving the components of the sediment sample is a fundamental issue in an oceanographic study. Since a coercivity of magnetic mineral varies sensitively with its state such as chemical composition, grain size, grain shape, stress, and so on (e.g., Dunlop and Ozdemir, 1997), sediments of different origin can be recognized by coercivity spectra. Therefore, coercivity spectra can be used as a proxy for the constituent spectra of the sediment sample. In this study we conducted rock-magnetic measurement of deep-sea sediments recovered from IODP Site U1314 on the Gardar Drift, to investigate the change in the sediment constituents.

The samples were collected at 16-50 cm resolution from 199.3 to 262.5 mcd of the core, which corresponds to the age between 2.22 and 2.75 Ma according to the age model by Hayashi et al. (2010). Rock-magnetic properties at room temperature were measured for these samples using a MicroMag 2900 Alternating Gradient Magnetometer at Kyushu University. The isothermal remanent magnetization (IRM) acquisition curve was obtained by the application of stepwise-increasing uniaxial fields to the sample at 30 steps from 1 mT to 1 T. The ratio of IRM acquired in a back-field of 0.1 T to that in a forward-field of 1 T (S-ratio) was measured for all samples. In addition, using an MPMS-XL5 Magnetic Property Measurement System at the Center for Advanced Marine Core Research, Kochi University, we carried out the IRM acquisition curve measurements at low-temperatures (50, 150, and 250 K) for selected samples.

In order to reveal constituents of the sediment, decomposition of coercivity spectra were conducted. The IRM acquisition curve was normalized by the IRM intensity at 1 T and then the first derivative of the curve was calculated with respect to log10 field (hereafter referred to as IRM gradient curve). A fitting calculation was performed so as to decompose the IRM gradient curve into linear combination of two end-members. The two end-member components were calculated by averaging the IRM gradient curves of selected samples. Samples with low S-ratio (less that 0.54) were chosen for component 1. Samples with high S-ratio (larger than 0.87), which were associated with the ice rafted debris, were chosen for component 2. These components were distinctly different from each other; coercivity distribution of component 1 was magnetically harder than that of component 2.

In consequence of the decomposition, the fitting error was significantly small for all samples. Thus it is confirmed that North Atlantic sediments in the Garder Drift during late Pliocene and early Pleistocene are explained by mixing of two end-member components. Taking into account temperature variation of the IRM acquisition curves at low-temperature, we will discuss change in the sediment constituents.