海底堆積物において ARM/SIRM 比は磁気相互作用に支配される

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Magnetostatic interaction controls the ratio of ARM to SIRM in marine sediments

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The ratio of ARM to SRIM or magnetic susceptibility is often used as a magnetic grain-size proxy in paleomagnetism and rock magnetism, in particular for environmental applications. However, Sugiura (1979) showed that the ARM/SIRM ratio heavily depends on magnetic mineral concentration using artificial sediments that consist of magnetites dispersed in a non-magnetic matrix, and this is interpreted to be caused by a dependence of ARM acquisition efficiency on the strength of magnetostatic interaction. In natural marine sediments, the inverse correlation between the ARM/SIRM ratio and SIRM, similar to the experimental result of Sugiura (1977), has often been observed: for example, siliceous clay cores in the central North Pacific (Yamazaki, 1999), siliceous clay cores in the northwest Pacific (Yamamoto et al., 2007), and calcareous sediments from the Ninety-east Ridge in the Indian Ocean (Suganuma et al., submitted). Yamazaki (submitted) estimated the relative strength of magnetostatic interaction in the North Pacific sediments using FORC diagrams, and confirmed that the ARM/SIRM ratio decreases with an increase of interaction. These results suggest that the ARM/SIRM ratio dominantly reflects the strength of interaction rather than magnetic grain size. In order to confirm this, we compare magnetic properties of marine sediments from various regions with different lithologies and magnetic concentrations. The datasets are from siliceous sediments of the Okhotsk Sea, northwest Pacific, and central North Pacific, hemipelagic clay of the West Caroline Basin, and calcareous clay or ooze of the Manihiki Plateau, Ontong-Java Plateau, and Ninety-east Ridge. On a bi-logarithmic plot between the ARM/SIRM ratio and SIRM, the data from various regions align in inverse proportion, suggesting the overwhelming control of magnetostatic interaction. The differences of the strength of interaction estimated from FORC diagrams are consistent with the differences of the ARM/SIRM ratios. Magnetic hysteresis measurements showed that the distribution of the dataset on the Day plot is incoherent with the variations of the ARM/SIRM ratio if it is a magnetic grain-size proxy.