An experimental study of magnetic property and water chemistry changes with temperature in natural marine sediments

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Magnetic minerals in marine sediments are dissolved and/or formed during early diagenesis, thereby masking the original magnetic information on paleomagnetism and paleoenvironment. It is thus essential to clarify early diagenetic effects on magnetic properties of marine sediments. Early diagenesis is controlled by various chemical factors during sedimentation and post-depositional processes. For example, flux of organic matter, temperature, and diffusion of oxygen from oxic bottom water into sediments. Previous studies reported that the oxygen diffusion and organic matter affect magnetic properties of surface sediments (Kawamura et al., 2007; 2008). Temperature of sediments increases with burial depth, but its effect on magnetic properties is not fully understood. In order to clarify the effect of temperature on magnetic mineral alteration, experiments with controlled temperature were performed in this study. For the experiments, the sediment cores up to 28.5 cm in length were collected using a multiple corer at 51 16.00 N, 149 12.50 E, water depth 1250 m, in the central Okhotsk Sea during the R/V YOKOSUKA YK07-12 cruise in 2007. The sediments are composed of diatom ooze with silty clay. The color of the topmost sediments (0-3 cm) is brownish black, and the color changes downward from olive brown (3-15 cm) to dark olive (15-28.5 cm). The data of pH, Eh, and dissolved oxygen (DO) in bottom and pore water were obtained from one core onboard within a few hours after the core recovery. The value of pH gradually increases, and Eh decreases with depth. DO values rapidly decrease and reach the minimum at 12 cm. These results suggest that the sediments are under an anoxic condition with increasing burial depth. Other cores were immediately sealed up onboard. One core was frozen under -20C for six months, and was then thawed out at 5C. Other cores from the same location were put at 8C and 18-22C, respectively. In order to investigate water just above the sediments, pH and Eh were measured. Results show that the value of pH decreases, and Eh increases with temperature. To investigate magnetic mineral alteration with chemical changes of water, low-temperature magnetometry, the measurements of remanent coercivity (Hcr), coercivity (Hc), remanent magnetization (Ms), and saturation magnetization (Mr) were performed on the topmost sediments. Results of the low-temperature magnetometry show the occurrence of the Veywey transition at 110 K. However, the transition is not clear on the samples taken from the cores kept at 8C and 18-22C. The Hcr/Hc and Mr/Ms ratios of the sediments at 5C and 8C are not significantly different. However, the Mr/Ms ratio of the sediments at 18-22C is higher than those of the sediments at 5C and 8C, suggesting that magnetic grain size becomes finer. This suggests that magnetic grain size is affected by changes in the chemistry of water.