鉄還元境界を含む海底表層堆積物中における生物源マグネタイトの分布

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Distribution of magnetofossils in deep-sea surface sediments with Fe-redox boundary

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Magnetotactic bacteria are considered to be microaerophilic and most commonly live near or below the Fe-redox boundary (the oxic-anoxic transition zone). However, common occurrence of magnetofossils in Pacific red clay (Yamazaki and Shimono, 2013), which contains abundant dissolved oxygen and does not have a Fe-redox boundary, suggest that some species of magnetotactic bacteria live in an environment without a strong chemical gradient. In order to contribute to better understanding of the ecology of magnetotactic bacteria in deep-sea sediments, we have studied magnetofossils within surface sediments of the Japan Sea, where the Fe-redox boundary is known to occur several to tens of centimeters below the seafloor, with rock-magnetic techniques and TEM observations. Undisturbed surface sediments were taken with a multiple corer during the R/V Shinsei-maru KS-14-13 cruise in 2014. From dissolved oxygen and Fe (II) contents of interstitial water and color reflectance of the sediments, the Fe-redox boundary was clearly detected at 7 to 25 cm below the seafloor at three sites. The sediments consist of silty clay, and water depths of the three sites range between 1770 to 2710 m. In the component analyses of IRM acquisition curves, a magnetic component that has a mean coercivity of ˜65 mT and a small dispersion parameter (DP) occurs, which corresponds to the biogenic hard (BH) component of Egli (2004). At all three sites, the proportion of this component increases just below the Fe-redox boundary, which is associated with an increase in the ratio of ARM to SIRM. These results suggest increased abundance of magnetofossils with elongated morphologies like hexagonal prism and tear drop. On the other hand, FORC diagrams show sharp central ridges indicative of magnetofossils throughout the sediment columns regardless of the distance from the Fe-redox boundary, even at the sediment-water interface. The occurrence of magnetofossils was confirmed by TEM observations; magnetofossils are abundant in all samples, and all three major morphologies, octahedron, hexagonal prism, and tear drop, were observed. These results suggest that although some species of magnetotactic bacteria living in marine sediments prefer a chemical condition near the Fe-redox boundary, others may be aerotolerant and live in oxic environments. Where the Fe-redox boundary occurs at a large depth, say tens centimeters or more, a zone of remanent magnetization acquisition in sediments rich in magnetofossils is expected to be very wide, which results in much delayed remanence acquisition with loss of high-frequency signals.