Contribution of magnetic minerals originated from magnetotactic bacteria to the magnetic properties of sediments

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Magnetotactic bacteria (MTB) are widely detected in marine and freshwater sediments. They have magnetite or greigite in their vesicles called magnetosomes, which are used to orient to the geomagnetic field. MTB’ s magnetites have particular morphologies (octahedral, hexagonal prism, and bullet shape), pure chemical composition, and single- domain state, and are arranged in line. Since single domain magnetites are suitable for acquiring remanent magnetization, magnetofossils in sediments, originated from MTB, probably have important roles in paleomagnetic records. Recent studies showed that biogenic magnetites are a major constituent of magnetic mineral assemblages in deep-sea sediments from TEM observations and rock magnetic analyses. There are, however, few studies that compare magnetic properties of MTB and sediments collected at the same place. In this study, rock magnetic analyses and TEM observation were conducted on sediments including MTBs and MTBs collected from the sediments in a pond at the botanical garden of Kyoto University. TEM observation showed that typical 3 types of biogenic magnetites (octahedral, hexagonal prism, and bullet shape) are contained in the sediments. Thermal demagnetization of isothermal remanent magnetization (IRM) imparted on MTB samples indicated the presence of magnetite and mgheminte. The decomposition of IRM acquisition curves showed that the studied MTB have a characteristic Gaussian coercivity distribution, and a similar component was found in the sediment samples. The comparisons of the coercivity distributions between the MTB and sediment samples suggested that MTB carrys around 70% of the magnetization in surface sediment samples(~2cm in depth) and the contribution of MTB becomes smaller in the deeper sections in the sediments, which suggests higher MTB population in the topmost sediment at the studied site.

Keywords: paleomagnetism, magnetotactic bacteria, biogenic magnetite

