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南太平洋の酸化的な遠洋性粘土に広く存在する生物起源マグネタイト
Biogenic magnetite prevails in oxic pelagic red clay core in the South Pacific Gyre

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Magnetotactic bacteria have been observed in wide variety of environments, including soils, freshwater lakes, and marine sediments, since Blakemore first described in 1975. Magnetotactic bacteria, which most commonly live within the oxic-anoxic transition zone (OATZ) of aquatic environments, produce intracellular crystals of magnetic minerals, specifically magnetite or greigite. It is considered that the magnetite/greigite crystals facilitate the bacteria's search for optimal conditions within the sharp chemical gradients of the OATZ. Petermann and Bleil (1993) reported living magnetotactic bacteria in pelagic and hemipelagic sediments near OATZ in the eastern South Atlantic at water depths to about 3,000 m, but they could not find actively swimming magnetotactic bacteria in sediments of deeper water depths.

The South Pacific Gyre (SPG) is far from continents and the lowest productivity region on Earth. IODP Site U1365 (water depth 5,696 m) cored pelagic red clay of 75.5 m thick above ~100 Ma basement (except for chart layers from ~42 to 61.5 m) in the western edge of the SPG. The core mainly consists of iron rich clay. The color is dark reddish and/or dark brown throughout the core. We conducted a paleomagnetic and environmental rock magnetic study of the pelagic clay core. The magnetostratigraphy revealed the top 5 m sediments cover the last 5 My, and sedimentation rate decreases downward from 1.7 to 0.6 m/m.y. Geochemical measurements of pore water indicate that dissolved oxygen was present throughout the core (>50 microM). Thus oxygen penetrates through the entire sediment column to the sediment/basalt interface, and there is no OATZ.

Magnetic mineral assemblage of this core is dominated by biogenic magnetite despite no OATZ. First-order reversal curve (FORC) diagrams of all specimens have a narrow central ridge along the Hc axis with very small vertical spread. This indicates very weak magnetostatic interaction (Roberts et al., 2000), and is the characteristic of biogenic magnetite (Egli et al., 2010; Roberts et al., 2011). Presence of biogenic magnetite was confirmed by TEM observation. Occurrence of biogenic magnetite was reported also in pelagic red clay of the North Pacific with TEM observations (Yamazaki and Ioka, 1997), and these samples also display the characteristic FORC diagrams. These observations suggest that biogenic magnetites commonly occur in oxic pelagic red clay without OATZ.

キーワード: 生物起源マグネタイト, 遠洋性粘土, 酸化的環境, 環境磁気研究, 南北太平洋環流, IODP Exp.329
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