Magnetotaxis in oxic pelagic red clay? Assesment from magnetic anisotropy

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Abundant biogenic magnetite produced by magnetotactic bacteria has been reported from oxic clayey pelagic sediment (red clay). On the other hand, red clay often fails to give reasonable paleomagnetic records. Because biogenic magnetite is an ideal, stable ferromagnet enabling efficient magnetotaxis, it is a mystery why red clay is a poor paleomagnetic recorder. One hypothesis is that the bacteria may not use the magnetite for magnetotaxis in the fully oxic sediment, and the alignment of biogenic magnetite is not strongly controlled by the geomagnetic field. To test this hypothesis, I analyzed magnetic anisotropies of red clay collected around Minamitorishima. Anisotropy of magnetic susceptibility (AMS) shows simple sedimentary fabric for most of the samples without preference in azimuth. However, at a depth corresponding to the highest biogenic magnetite content, AMS shows inverse fabric with a clustering of minimum direction to a certain azimuth. Furthermore, anisotropy of anhysteretic remanence (AARM) yields horizontal foliation, and the maximum AARM shows clustering to a direction similar to the minimum direction of the inverse AMS. Preliminary comparison with the core orientation recorded by orientation tools indicates that the AARM-max direction broadly agrees with the North-South direction. This demonstrates that the biogenic magnetite preferentially aligns along the geomagnetic field, suggesting that the bacteria performs magnetotaxis even in the fully oxic sediment. The poor paleomagnetic results should be explained by other factors such as slow and intermittent sedimentation, or oxic diagenesis. The result also demonstrates that paleomagnetic direction except polarity may be recovered by magnetic anisotropy from biogenic magnetite even when remanence is completely overwritten.