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Magnetostratigraphic effects and artifacts of an inverse redox zonation in bottom-up oxygenated East Pacific mid-ocean ridge flank sediments

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Shipborne ex-situ oxygen measurements in mid-ocean ridge flank sediment cores from the eastern low-latitude North Pacific (Clarion-Clipperton Zone) revealed a downward increase of pore-water oxygen above the sediment-crust interface (Mewes et al., 2016, Kuhn et al., 2017). This inverse redox zonation is caused by an upward diffusion of oxygen (and other solutes) from fluids circulating through the underlying 20 Mio. Year old and still cooling ocean crust. In consequence, these sediments experience a cyclic change in redox-conditions from oxic seafloor conditions at the top through mostly suboxic conditions throughout the sediment column back to oxygen-rich pore water in the last few sediment meters above the rock basement.

We studied paleomagnetic records and bulk magnetic properties of three gravity cores from such settings that were collected during *RV Sonne* expedition SO-240 in 2015 and obtained high-quality magnetostratigraphic records covering the past 3.2 Ma. The generally very good preservation and interpretability of our reversal and RPI records, however, conflicts with a well-defined, but irregular 'ghost event' of normal polarity within the upper Gilbert reversed C2Ar section. This magnetic polarity and intensity artifact cannot be explained by sediment tectonics, but coincides with the present depth of the lower suboxic-to-oxic redox boundary. Although chemical overprinting could be considered as an obvious explanation of such findings, bulk magnetic analyses (FORCs, thermomagnetics) infer no diagenetic alteration of the magnetic minerals. Over the entire paleomagnetic record, bacterial magnetite appears to be the predominant NRM carrier. We therefore introduce a novel conceptual model of secondary biogenic magnetite formation at crustal depth, hypothesizing that microaerophilic magnetotactic bacteria live and biomineralize not only in the shallow subsurface, but also near the deep oxygen above the sediment-crust interface.

References

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