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New Insights into Iron Reduction Processes using FORC-PCA

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A b s t r a c t

Sedimentary environments preserve a record of climate change as reflected in the variations in magnetic mineralogy through time. Deconvolving the complex bulk magnetic signal is one of the primary challanges facing environmental magnetism.

The issue can be resolved by using a principal component analysis based method of unmixing the magnetic components using First Order Reversal Curve diagrams (FORC-PCA) (Lascu *et al*. 2015). The applicability of FORC-PCA is demonstrated in a high resolution case study of a marine sediment core obtained from the Iberian Margin spanning the past two glacial cycles. We identify three magnetic components, where the bulk susceptibility variations are controlled by a previously unreported magnetic mineral phase. Trabecular magnetite, named so for its characteristic skeletal internal structure (Fig. 1), exhibits a stable low coercivity single-domain signature and is prevalent throughout the core over the 200 000 years of sedimentary history in the Iberian Margin. Formed through reductive dissolution of goethite, it preserves a record of climate change as a remarkably sensitive proxy to changes in diagenetic redox conditions in surface ocean sediments.

The rock magnetic results are supported by Transmission Electron Microscopy experiments, which serve as ground-truthing methods for FORC-PCA. The magnetic signature is explained with the help of imaging techniques, electron holography and STEM-HAADF tomography experiments (Fig. 1).

Keywords: environmental magnetism, trabecular magnetite, FORC-PCA.

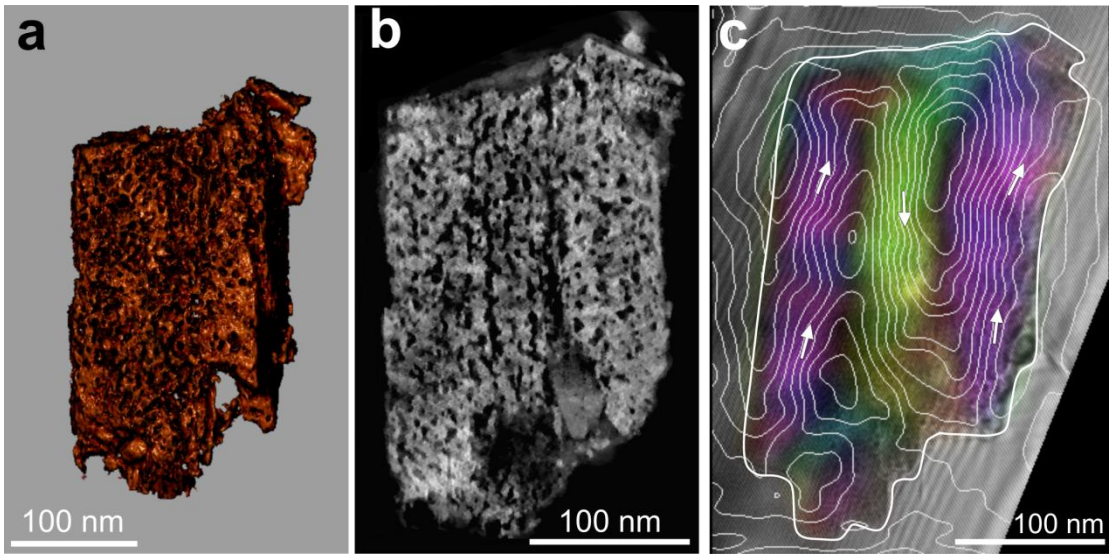

Fig. 1. Trabecular magnetite grain shown in: a) tomographic TEM reconstruction, b) cross section of the STEM-HAADF dataset, and c) electron holography.

References

Lascu, I., R.J. Harrison, Y. Li, J.R. Muraszko, J.E.T. Channell, A.M. Piotrowski, and D.A. Hodell (2015), Magnetic unmixing of first-order reversal curve diagrams using principal component analysis, *Geochem. Geophys. Geosyst.* **16**, 9, 2900–2915, https://doi.org/10.1002/2015GC005909.