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Understanding the mineral sources of remanent crustal magnetic anomalies

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Magnetic exploration on local and global scale is focused on interpreting magnetic anomalies in terms of induced magnetization in today's geomagnetic field. However, numerous anomalies in Norway, Sweden and USA originate from rocks with oxide exsolution intergrowths with an overwhelmingly dominant magnetic remanence. In these rocks different magnetic minerals control induced versus remanent magnetization. Although, different types of magnetic interaction control the details of their potential to create anomalies, little is known about the detailed interplay between them. Using a newly developed giant-magnetoresistance micro-scanner, it is now possible to map remanent and induced magnetization at the mineral size scale from 10 micron up to several millimeters. In case studies presented here, Lamellar Magnetization (LM) accounts for the strong and stable magnetic signal in the rhombohedral oxides which produces significant large-scale negative anomalies. We explore experimentally and theoretically how the co-existing multi-domain magnetite and LM contributes to these anomalies, and correlate the mineral-scale maps with ground-magnetic traverses and high- resolution airborne surveys. This combination of methods provides a new paradigm for interpretation of remanence -dominated magnetic anomalies in Earth and planetary applications.