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Coercivity-dependence of remanence anisotropy: Implications for anisotropy corrections in paleodirectional and paleointensity studies

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Two fundamental assumptions in paleomagnetism are that a rock's magnetization is parallel to the inducing field at the time of remanence acquisition, and that the intensity of the magnetization is proportional to the field strength. Magnetic remanence anisotropy can deviate the magnetization direction away from the field and towards the easy magnetization axis, and also affects the intensity of magnetization. Traditionally, these effects are corrected using the bulk anisotropy tensor for a specimen, characterized either by anisotropy of magnetic susceptibility (AMS), or, preferably, anisotropy of remanent magnetization (most commonly using anisotropy of anhysteretic remanent magnetization AARM). It has been shown that it is crucial to choose an appropriate representation of remanence anisotropy to reflect and correct for the anisotropy of the remanence-carrying minerals specifically.

Here, we investigate AARM in rocks with multiple remanence carriers. In particular, we examine how AARM measured for discrete coercivity intervals may capture the preferred alignment of different magnetic minerals and grain sizes within a specimen. Anisotropy of anhysteretic remanence was measured over seven coercivity intervals in >80 samples of different lithologies. Large variations in the orientation of the AARM principal axes, degree, and shape of anisotropy are possible between the different coercivity intervals in a specimen. The contributions of each coercivity interval to the overall AARM are additive, and the bulk AARM measured over the entire coercivity range is a superposition of these individual contributions. When specimens with different sub-fabrics are magnetized in a known laboratory field, the anisotropy deflection and magnetization directions differ for each subpopulation, resulting in seemingly multiple-component magnetizations. Based on these findings, we propose a new anisotropy correction that takes into account the coercivity-dependence of AARM. These corrections will improve paleodirection and paleointensity estimates, and thus, have important implications for paleomagnetic studies on rocks with multiple remanence carriers and complex magnetic fabrics.