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Anisotropy of remanent and induced magnetization in hematite ore deformed in torsion

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Induced and remanent magnetization measurements, e.g. shape of hysteresis loops, FORC diagrams and decomposition of isothermal remanent magnetization (IRM) acquisition curves, became routine tools in rock-magnetic measurements, interpreted mostly in terms of composition and grain-size distribution of iron oxides. It is assumed that the substances investigate are with respect to these measurements isotropic and single measurement of one sample is sufficient for interpretation. This assumption is valid for powdered samples, but solid rock samples in general behave anisotropically. In our contribution we report on magnetic measurements of hematite ore samples deformed in torsion, which show significant anisotropy of shape of hysteresis loops and IRM acquisition curves; the degree of anisotropy reflecting the degree of deformation. Samples, measured in different directions, showed different shape of hysteresis loop, from regular, which may be interpreted either as randomly oriented multi-domain grains, or with different degree of distortion (wasp-waistedness), reflecting different distribution of contrasting coercivities. Also decomposition of IRM acquisition curves, measured in different direction, yielded different interpretation in terms of relative contributions of components with different coercivities. The increasing strain is reflected in the strength and orientation of microstructure and crystallographic preferred orientation (CPO). The AMS in deformed samples is not controlled by hematite CPO. It is rather dominated by occurrence of magnetite grains along samples edges parallel to shear plane, probably due to the diffusion of Fe ions from iron jacket, even though samples were shielded by a silver (70)/palladium (30) sleeve of 0.5 mm thickness. We interpret this anisotropy as result of deformation, causing preferred orientation of basal planes of hematite. Moreover, the anisotropy is asymmetric. Our results suggest that, at least in deformed rocks containing minerals with high shape and/or magnetocrystalline anisotropy, the effect of anisotropy should be considered and verified before induced and remanent magnetization measurements are interpreted.