LOW-TEMPERATURE HYSTERESIS PROPERTIES OF HIGH-COERCIVITY TITANOMAGNETITE BEARING ROCKS

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Extremely high coercivity, occasionally exceeding 100 mT at room temperature, can be found for some kinds of basalts or andesites. These samples contain titanomagnetite (or slightly altered to titanomaghemite) and usually come from quenched facies, e.g., a cryptocrystalline portion of pillow basalt or a surface clinker of subaerial andesite, suggesting that fine-grained titanomagnetite is responsible for the high coercivity. Low-temperature variations of saturation magnetization (Ms), saturation remanence (Mr) and coercivity (Hc) were measured for pillow basalts and subaerial andesites (originally containing ≈TM60 and ≈TM10, respectively) down to 20 K using MPMS in order to infer governing magnetic anisotropies.

Ms and Mr values were calculated after subtracting paramagnetic contributions by applying a maximum field of 5 T. For all the samples Mr/Ms ratios at room temperature were less than 0.5, which is expected for randomly oriented single-domain grains with uniaxial anisotropy. Cooling down the samples below room temperature, Mr/Ms ratios increase somehow beyond 0.5 but still remain well below 0.831 or 0.866 expected from multi-axial magnetocrystalline anisotropy. This suggests that multi-axial anisotropy might govern the ratios or that the maximum field of 5 T is still insufficient to saturate in the low temperature range. Coercivity at room temperature ranges from ≈10 mT of coarse-grained portions of pillow basalts and andesites to ≈90 mT of the cryptocrystalline portion. Basalts exhibit lower coercivity values than andesites with comparative Mr/Ms ratios. Upon cooling coercivity gradually increased up to several hundreds of mT especially for pillow basalts, implying that such magnetic hardening is likely magnetostrictively controlled.

titanomagnetite, hysteresis, magnetostriction

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