Composition law of oblique anhysteretic remanent magnetization and its relation to the magnetostatic interaction

*Masahiko Sato¹, Nobutatsu Mochizuki², Minako Watanabe³, Hideo Tsunakawa⁴


The basic properties of oblique anhysteretic remanent magnetization (OARM) acquired in a weak and steady magnetic field with an arbitrary angle to the alternating field direction were studied. OARM and rock-magnetic experiments were conducted on samples of basalt, granite, and sediment containing non-interacting single-domain (SD), interacting SD, pseudo-single-domain, and multidomain low-Ti titanomagnetites. The intensity of OARM \( M_{OARM} \) systematically increased or decreased with increasing angle between alternating and steady field directions \( \theta_{SF} \), while the angle between alternating field and OARM directions \( \theta_{OARM} \) increased with increasing \( \theta_{SF} \) for all samples. During stepwise alternating field demagnetization, the OARM vector shows a single component parallel to the steady field direction for \( \theta_{SF} = 0° \) (\( \text{ARM}_|| \)) and 90° (\( \text{ARM}_\perp \)). The median destructive field of \( \text{ARM}_\perp \) is larger than that of \( \text{ARM}_|| \). For intermediate angles \( \theta_{SF} = 30°, 45°, \) and 60°\), the OARM vector was not parallel to the applied steady field; instead, it gradually increased with coercivity. These experiments indicate that the OARM vector is approximately given by the sum of two orthogonal magnetizations coinciding with \( \text{ARM}_|| \) and \( \text{ARM}_\perp \), respectively. Thus, the OARM vector can be determined by acquisition efficiencies of \( \text{ARM}_|| \) and \( \text{ARM}_\perp \) in an individual sample. Based on these experiments and associated rock-magnetic measurements, non-interacting SD samples show lower \( \text{ARM}_\perp/\text{ARM}_|| \) ratios, compared to other samples. This result suggests that OARM can be used as a conventional tool to detect non-interacting SD particles in the paleomagnetic samples.

Keywords: Anhysteretic Remanent Magnetization, Magnetostatic Interaction, Rock Magnetism