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Direct identification of stable remanence carriers: MI magnetic microscopy with demagnetization tests

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Pristine magnetic records in meteorites and pre-Cambrian rocks provide information of evolution of the early solar nebula and planetary paleomagnetism, though the reliability of paleomagnetic records decrease with increasing their age. Thermal and alternating field (AF) demagnetization experiments are essential techniques for a paleointensity estimation and a discrimination of the magnetic grains that can hold a stable remanence over geological times (c.a. 4.5 b.y.). However, the understandings of the relationship between microscopic and macroscopic magnetic stability of a rock are still lacking. We have developed a scanning MI (magneto-impedance) magnetic microscope that has a spatial and a magnetic resolution of 400um and 10 nT, respectively. This magnetic microscope can image surface magnetic field distributions leaked out from magnetic minerals. Therefore, the MI magnetic microscopy combined with demagnetization experiments will be able to clarify the carrier of the stable remanence at microscopic scale. To test this idea, we conducted magnetic microscopic observations combined with a stepwise furnace-based and a stepwise green-laser spot heating (532nm, spot size = 100um, 4W max) thermal demagnetization on a Vredefort shocked granite, a stepwise AF demagnetization on a Tenham (L6) chondrite. The laser spot heating system succeeded the stepwise and selective demagnetization of the magnetic grains in the magnetic image. Throughout these demagnetization experiments, we can decide which grains actually hold the stable component in heterogeneously distributed magnetic minerals in chondrites and granites.