Geophysical Research Abstracts, Vol. 7, 04120, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04120

Stress demagnetization experiments: Toward a better understanding of magnetic anomalies of meteorite impacts

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Stress demagnetization is commonly used to explain the reduced crustal magnetizations associated with meteorite impact craters. However, understanding the effect of stress demagnetization on magnetite is poorly known, especially above 1 GPa pressures. Previous experiments on whole rock samples have found important differences between uniaxial and hydrostatic loads, with uniaxial loads demagnetizing faster than hydrostatic loads. Our preliminary experiments on pure magnetite under hydrostatic loads show the added complication that stress demagnetization also depends on domain state and stress history. For samples never subjected to significant stress, single domain (SD) grains demagnetize faster than multidomain (MD) grains. When decompressed, remagnetized and then subjected to a second compression, MD magnetite exhibits roughly the same decrease in moment (-dM/dP) as the initial case, while SD magnetite becomes more resistant to demagnetization the second time around. After stress demagnetizing the samples, then resaturating the sample's remanence while under pressure, then compressing to even higher pressures, MD magnetite demagnetizes more rapidly than when starting from ambient pressure, whereas SD magnetite is more resistant. During decompression, SD grains follow the same trend, regardless of the compression path or number of compressions. Given these results, caution should be used when estimating shock pressures associated with meteorite craters.