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Static stress demagnetization of single and multidomain magnetite with implications for meteorite impacts

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Stress demagnetization effects on ferromagnetic minerals are poorly known, especially above 1 GPa, and when initially magnetized under pressure and then subjected to further stress. Our experiments on pure magnetite under quasi-hydrostatic loads in the presence of a small (Earth's) field show that stress demagnetization depends on domain state and stress history. Viewed globally, the results follow a simple law where the percentage loss in magnetic moment is the inverse of pressure (e.g., 50% loss in moment at 1 GPa, 67% loss at 2 GPa, etc.). Our experiments also quantify the effect of demagnetization upon stress release, where the moment upon full decompression is three times less than the moment when decompression first began. Given the magnitude of the stress demagnetization effect, we conclude that the presence or absence of a planetary magnetic field cannot be deduced from the magnetic fields measured at high altitudes over meteorite craters, such as those on Mars.