PRESSURE MAGNETIZATION EXPERIMENTS AND A COMMON MAGNETIZATION DIRECTION IN MUTUALLY ORIENTED SAMPLES OF LUNAR TROCTOLITE 76535

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Introduction: The origin of remanent magnetic fields in lunar samples and in the lunar crust has remained an open question in planetary science [1]. The most viable explanations are an ancient dynamo and shock magnetization processes associated with impacts [e.g., 2]. If the core dynamo hypothesis is correct, it would have important implications for the thermal history of the Moon, as well as the generation of dynamos on small bodies [3]. If the impact fields hypothesis is correct, it would have broad implications for magnetic records in samples from all small bodies.

We recently reported on the magnetic remanence in a pristine lunar troctolite, sample 76535 [4]. In our first study, we did not measure mutually oriented subsamples. Measurements of mutually oriented samples allows one to determine if the magnetization direction in the rock is common across all subsamples, a very strong test for an external unidirectional magnetizing field. Here we report new experiments with mutually oriented subsamples of 76535, as well as pressure magnetization experiments as a proxy for acquisition of shock remanent magnetization (SRM).

AF Demagnetization Experiments: We performed alternating field (AF) demagnetization of three subsamples. As in our first study, we found a strong low coercivity (LC) isothermal magnetization overprint present in all samples and clustering around a common direction, suggesting the LC magnetizing field was homogenous at least on the scale of millimeters. There is also evidence for a medium coercivity component as previously reported, but its direction is harder to isolate, likely due to differences in the blocking temperature distribution in different samples. However, most important is the existence of a high coercivity (HC) component that clearly decays to the origin in at least one sample. The HC components of the three samples fall within a small circle with a diameter of 30°, indicating that this component was acquired in a uniform external field. These measurements were corrected for gyroremanent magnetization, but not yet for anisotropy.

Pressure Remanent Magnetization (PRM) Experiments: Sample 76535 is unshocked (< 5 GPa), but we can test for the possible effects of very low pressure (< 5 GPa) shock magnetization on 76535 with a PRM experiment. A sample was exposed to 1.8 GPa pressure in the presence of an 800 μT field [5]. The PRM was removed by AF demagnetization fields of just 20 mT, far below the coercivity of the HC component isolated in 76535. This indicates that the HC component is unlikely to be an SRM.

Conclusions: The common direction of an origin trending high coercivity component in mutually oriented subsamples, and the small remanence acquired through PRM, provides further evidence that 76535 records a long-lived unidirectional ancient magnetizing field, most easily explained by a dynamo.

References: [1] Fuller M. and Cisowski, S. M. 1987, *Geomagnetism* 2:307. [2] Hood, L. L. and Artemieva, N.A. 2008, *Icarus* 193:485. [3] Weiss B. P. et al. 2008, *Science* 322:713. [4] Garrick-Bethell et al. 2009, *Science*, 323:356. [5] Bezaeva et al. 2010, *PEPI* 179:7.