AGU FALL MEETING
San Francisco | 14 – 18 December 2015

GP43A-1233: Rock magnetic effects induced in terrestrial basalt and diabase by >20 GPa experimental spherical shock waves

ABSTRACT

Thursday, 17 December 2015
13:40 - 18:00
Moscone South - Poster Hall

Understanding how shock waves generated during hypervelocity impacts affect the magnetic properties of rocks is key for interpreting the paleomagnetic records of lunar rocks, meteorites, and cratered planetary surfaces. Following ref. [1], we conducted spherical shock experiments at the RFNC-VNIIFT (Snezhinsk, Russia) on (titano)magnetite-bearing basaltic lava flow and diabase dike samples from the Osler Volcanic Group of the 1.1 Ga North American Midcontinent Rift [2]. The experimental setup allows for rock magnetic and petrographic changes to be assessed for a range of shock pressures 20 GPa and above.

Consistent with prior spherical shock experiments on the Saratov ordinary chondrite [1], both shocked samples exhibited concentric zonation: a central void space was surrounded by an inner layer of impact melt (Zone I, most shocked), a middle partially melted layer (Zone II), and an outer layer of unmelted rock with solid-state shock features (Zones III and IV, least shocked). These zones are petrographically different. Like Zone IV, Zone III is characterized by an intact texture, but the plagioclase grains have been transformed into diaplectic glass. Zones I-III acquired thermoremanent magnetization from shock heating. Zone IV may have undergone shock demagnetization of the pre-shock magnetization without substantial remagnetization. Shocked samples had higher coercivities than unshocked samples of the same rocks. Magnetic force and electron microscopy reveal fracturing of the Fe-Ti oxides, which likely contributes to the observed increase in coercivity in the shocked samples.

Our spherical shock experiments build on prior work to show that shock at pressures greater than 20 GPa results in coercivity increase, shock demagnetization and thermal remagnetization. This work can guide future interpretations of the remanent magnetization and bulk magnetic properties of highly shocked materials from planetary surfaces.

References: [1] Bezaeva N.S. et al. 2010. *MAPS* 45:1007-1020. [2] Swanson-Hysell N.L. et al. 2014. G^3 15:2039-2047.

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