EFFECT OF POST-SHOCK ANNEALING ON MAGNETIC PROPERTIES OF SHOCKED MAGNETITE.

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Introduction: Hypervelocity impact events are widespread phenomena throughout the solar system and the interest in understanding shock demagnetization of crustal material has increased significantly in the last decade. Our study focused on the exploration of the chemical and magnetic stability of experimentally shocked magnetite after subsequent high-temperature (973 K) treatment above the magnetite Curie temperature (853 K) with special emphasis on defect annealing in stress-induced magnetite [1]. For this purpose magnetic properties were investigated using temperature-dependent magnetic susceptibility, magnetic hysteresis and low-temperature saturation isothermal remanent magnetization. Structural properties were analyzed using X-ray diffraction (XRD) and high-resolution scanning electron microscopy (HRSEM).

Results: A quartz-magnetite banded iron ore from the Sydvaranger mine (Norway) containing multidomain magnetite was subjected to shock recovery experiments using an air gun (5, 10 GPa) and high-explosives (20, 30 GPa) [2]. The shock-induced changes include magnetic domain size reduction due to brittle and ductile deformation features, an increase in Verwey transition temperature from 120 to 128 K due to lattice distortion, and a decrease in saturation magnetization (especially in the 30 GPa sample) mainly due to amorphization [3]. According to XRD data the crystal lattice is relaxed after heating, and apparent crystallite size is increased suggesting a recovery of lattice defects. These changes are in accordance with the formation of recrystallization textures observed by HRSEM. The structural changes correlate with a modification in magnetic domain state recorded by temperature-dependent magnetic susceptibility, hysteresis properties and low-temperature saturation isothermal remanent magnetization. Saturation magnetization increases again after heat treatment indicating crystallization of the amorphous phase. These modifications in both, magnetic and structural properties of magnetite can be used to assess impact-related magnetic anomalies in impact structures with a high temperature overprint.

References:

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