INVERSE THERMO-REMANENT MAGNETIZATION OF EXTRATERRESTRIAL ALLENDE MATERIAL

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Introduction: Allende's parent body has been suggested to contain magnetic dynamo in its history [1,2]. The magnetic Allende data may contain more detailed information that could constrain the magnetic history of Allende. .

Material: Allende meteorite fragment was obtained as a leftover from previous work on this meteorite [3]. Fragment had its original remanence record and no demagnetization or magnetization is known to take place prior to this magnetic analysis. We used superconducting rock magnetometer (2G), vertical configuration, for obtaining both rock magnetic data as well as cryogenic measurements. .

Results: The measurements on Allende chondrules reveal an existence of Inverse Thermo-Remanent Magnetization (ITRM) acquired during the meteorite transit to terrestrial conditions. Both the pyrrhotite carrying magnetic remanence intensity and direction of the chondrules change erratically when subjecting the Allende meteorite's chondrules to temperatures near 77 K and back to room temperature. Chondrules with more intense original magnetization were denser and contained larger ITRM. Temperature dependent monitoring of ITRM revealed that ITRM was acquired at temperature near 270K. Such temperature is consistent with the condition when, in addition to temperature increase, the atmospheric uniaxial pressure applied during the meteorite entry on the porous material was responsible for meteorite break up in the atmosphere. During this process, collapse of the pore space in the matrix and some chondrules would generate crystalline anisotropy energy accumulation within pyrrhotite grains carrying the magnetic remanence.

Conclusions: Magnetic record of the Allende chondrite and by analogy perhaps all meteorites [4] is complicated be the fact that it may contain magnetic material capable of acquiring ITRM. In this work we found that ITRM was acquired at temperature near 270K. While the observed magnetization increase over the relevant temperature range is modest, the data demonstrated that Allende meteorite acquired measureable ITRM that is previously unrecognized magnetic component in Allende.

Allende has parent body deformation evidence in the form of uniaxial shortening responsible for collapse of the voids and strain accumulation. We argue that deformation processes during the Allende's terrestrial descend are capable of reaching local pressures in GPa range. Such pressures would be capable of triggering accumulation of the crystalline anisotropy energy within the involved pyrrhotite grains. This process is consistent with acquisition of measurable ITRM in Allende meteorite.

Acknowledgements: This work was supported by grants GACR 17-05935S, RVO 67985831

References:

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