

MAGNETIC PALEOINTENSITIES OF METEORITES: A NEW METHOD AND PRELIMINARY RESULTS

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Introduction: We propose a new relative magnetic paleointensity method that does not involve heating of the sample and can resolve multicomponent magnetizations. This non-destructive method is particularly well adapted to meteorites that have magnetic mineral assemblages that are often metastable under heating and are characterized by complex magnetic remanence.

REM' method: It is based on normalization of natural remanent magnetization derivative vs. alternating field by isothermal remanent magnetization derivative vs. alternating field (REM' ratio). This method has been calibrated using available data [1, 2, 3] and acquiring new ones on pyrrhotite. It is well calibrated for magnetite, titanomagnetite, and pyrrhotite. A remarkable feature is that the trend of REM' ratio vs. magnetizing field is the same for these minerals. The few pieces of data for Fe-Ni alloys [4] follow the same trend. The REM' method can thus be applied regardless of the magnetic mineralogy of the studied meteorite.

Preliminary results: After validating the method on terrestrial basalts, we studied a total of 65 meteorites (R, C and O chondrites, SNCs, HEDs, aubrites). H and L ordinary chondrites proved to be unsuitable for paleointensity studies. However, an upper limit of 1 μT can be set for the magnetizing field and former estimates around 50 μT must be definitively discarded. LL ordinary chondrites, with magnetization carried by tetrataenite, give paleofields in the range 0.1-1 μT . Rumuruti chondrites indicate a magnetizing field around 8 μT . A magnetic field of 15 μT may have been present during the cooling of the HED achondrite parent body. Martian meteorites give paleofields scattered between 1 and 24 μT that represent the Martian surface magnetic field of crustal origin after dynamo shutdown. Carbonaceous chondrites provided contrasted results, with possible record of strong field (mT) indicative of a T-tauri phase.

Limitations: A strong limitation is that the REM' method is calibrated for thermoremanent magnetizations (TRM), and that some meteorites probably carry shock remanent magnetizations (SRM). This is particularly true for Rumuruti chondrites, basaltic shergottites and some carbonaceous chondrites whose magnetic carrier (pyrrhotite) is totally remagnetized above 2.8 GPa [5]. This could also be the case for some SNCs, even if an impact related TRM cannot be excluded. What is the efficiency of SRM acquisition vs. TRM acquisition is an open question, but the paleointensities derived from these meteorites may be underestimated. Another limitation is the randomness of NRM directions that is the rule within OC, HED, and possibly carbonaceous chondrites, and leads to underestimated paleofields.

Perspectives: Much work remains to be done in the field of meteorite paleointensities and the REM' method may help in this task. Measurements on several individual mutually oriented chondrules are needed for carbonaceous and Rumuruti chondrites. More data are also needed on HEDs. Finally, more work is needed regarding the effect of shock on magnetization.

References: [1] Menyeh A., O'Reilly W. 1996. *Journal of Geophysical Research* 101:25045-25051. [2] Menyeh A., O'Reilly W. 1998. *Geophysical Research Letters* 25:3461-3464. [3] Kletetschka G. et al. 2003. *Meteoritics & Planetary Sciences* 38:399-405. [4] Wasilewski P. 1981. *Physics of the Earth and Planetary Interiors* 26:149-161. [5] Rochette P. et al. 2003. *Geophysical Research Letters* 30, doi:2003GL017359.