THE MAGNETIC BEHAVIOR OF SYNTHETIC MAGNETITE INDUCED BY SHOCK RECOVERY EXPERIMENTS IN THE RANGE BETWEEN 10 AND 45 GPA. T. Kohout[1], A. Deutsch[2], L.J. Pesonen[1], U. Hornemann[3], [1] Division of Geophysics, Solid Earth Geophysics Lab., University of Helsinki, PO Box 64, FIN-00014 Helsinki, Finland, tomas.kohout@helsinki.fi, Lauri.Pesonen@helsinki.fi,[2] Institut für Planetologie, WWU Münster, Wilhelm-Klemm-Str. 10, Münster 48149, Germany, deutsca@uni-muenster.de, [3] Ernst-Mach-Institut, D-79588 Effringen-Kirchen, Germany, hornemann@emi.fhg.de.

Introduction: Shock-induced changes in magnetic properties of rocks, minerals, and meteorites play an important role in modeling the magnetic anomalies of impact structures (e.g., Vredefort), interpreting the magnetic anomalies of planetary bodies (e.g., Mars) and understanding paleomagnetic data of meteorites. We report results of shock experiments with synthetic fine-grained magnetite (mt) of SD (single domain) to PSD (pseudo-single domain) magnetic behavior. This study complement previous shock experiments on a diabase containing natural PSD-type magnetite [1, 2].

Experimental set-up: Well characterized synthetic mt powder, mixed with Al2O3, was sintered into pellets. The surface-polished disks (Ø 10 mm, h 4 mm) were embedded into an ARMCO steel container, surrounded by an ARMCO momentum trap; details of the set-up are given in [3]. The samples were shocked in series of experiments in the range from nominal pressures of 10 to 45 GPa using high-explosives. Inside the ARMCO container the prevailing magnetic field was ~five times higher than the ambient field. After the shock, the containers cooled down slowly to ambient temperatures. The estimated post-shock T of the samples range from ~ambient T (10 GPa) up to about 1400 K (45 GPa). The given shock pressures correspond to the resp. shock pressure that would be achieved in single crystal quartz using identical experimental parameters (i.e., thickness of the sample, driver, and flyer plates, mass and type of high explosive) [3].

Evaluating pressures actually reached in the experiments requires a model to account for the high porosity of the pellets compacted from the mt powder. Their original density was only 1.7 to 2.3 $g_{*}cm^{-3}$; post-shock densities are currently measured (a tricky task due to the small sample size). The high porosity significantly influences the post-shock T. Independent of the fact that p, shock- and post-shock T are insufficiently constrained, the experiments form a well-characterized series of shots at systematically increasing pressure. The driver plate and the sample holder were removed with a lathe. We have monitored cautiously T to avoid re-heating, and hence, a not shock- and/or post-shock change in the magnetic properties of the mt pellets. Surprisingly enough, the sample disks were not friable and could be removed by retaining their shape largely unchanged.

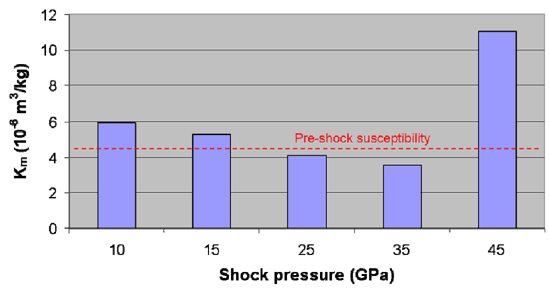

Figure 1. Variation in susceptibility with shock pressure.

Results: *Magnetic Susceptibility*. Tentative results indicate a progressive decrease in susceptibility with increasing shock pressure (Fig. 1). The exception is the 45 GPa sample showing a significant increase of susceptibility, an effect probably related to shock induced changes in mineralogy or to contamination of the sample by melted steel from the container.

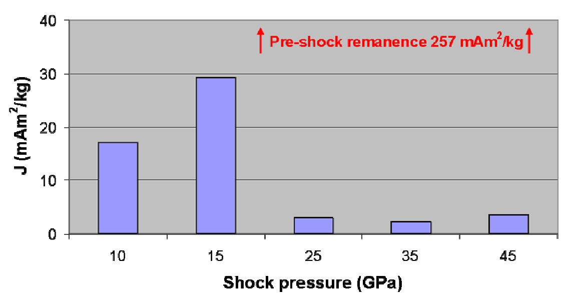

Figure 2. Variation in RM with shock pressure.

Post shock RM (Remanent Magnetization). The samples were given SIRM (Saturation Isothermal Remanent Magnetization) prior the shock. This remanence was significantly reduced due to shock demagnetization. There was more progressive reduction in the remanence observed at higher shock pressures (Fig. 2).

ARM (Anhysteretic Remanent Magnetization) and SIRM (Saturation Isothermal Remanent Magnetization): Analysis of the ARM (50 µT DC field / 100 mT AF field) demagnetization curves of the samples prior to and after the shock reveals a more soft behavior of the shocked samples, probably related to magnetite coarsening due to the shock. The same trend is observed in the case of the SIRM. The overall ARM intensities slightly increased while the overall SIRM intensities slightly decreased as the result of shock (Fig. 4).

References: [2] Langenhorst F. et al. (1999) *LPS XXX*, Abstract# 1241. [1] Pesonen L.J. et al. (1997). *LPS XXVIII*, 1087-1088. [3] Langenhorst F. and Deutsch A. (1994) *EPSL 125*, 407-420.

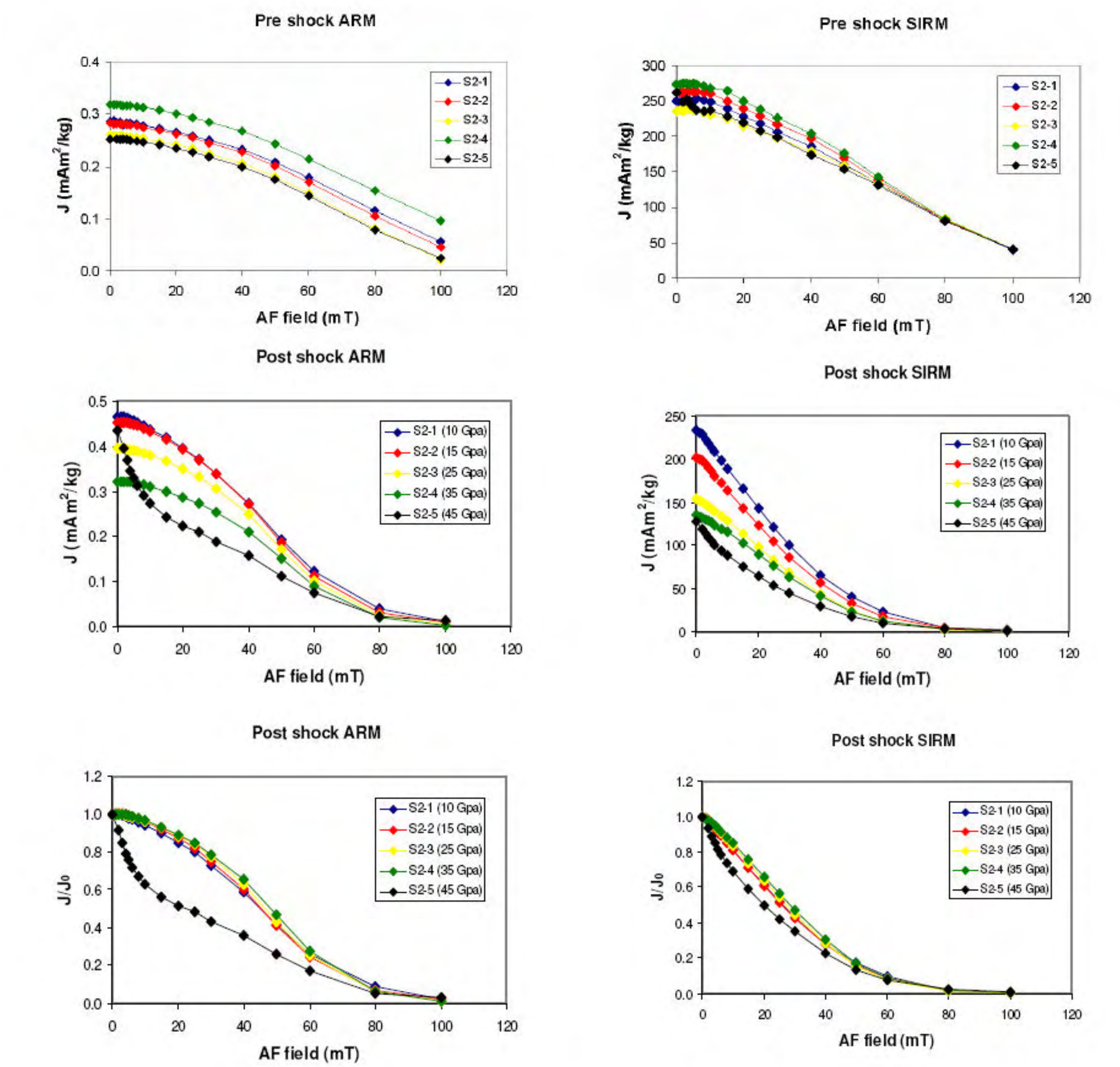

Figure 4. Variation in ARM and SIRM.

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