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The magnetic behavior of synthetic magnetite induced by shock recovery experiments

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Shock-induced changes in magnetic properties of rocks and minerals play an important role in modeling and understanding the magnetic anomalies of impact structures, in interpreting the magnetic anomalies of planetary bodies such as the Mars, and in understanding the paleo-magnetic data of meteorites. Here we report preliminary results of shock experiments with synthetic fine grained magnetite of SD to PSD magnetic behavior (magnetite powder courtesy of D. Dunlop). For the experiments, we have used surface-polished pellets (D 10 mm, h 4 mm), consisting of well characterized synthetic magnetite powder mixed with Al2O3 and sintered into disk-type pellets. With those pellets we have performed a series of shock recovery experiments in the pressure range from 10 to 45 GPa using a conventional high-explosive set-up with an ARMCO steel sample container, surrounded by an ARMCO steel momentum trap. Since the samples were shocked inside the highly magnetic steel container, the prevailing magnetic field was roughly five times higher than the ambient field. After the shock, the containers cooled down slowly. The estimated post-shock temperatures of the samples range from close to ambient temperatures (10 GPa) up to about 1400 K (45 GPa). The given pressures correspond to the respective equilibrium pressure that would be reached in a disk of single crystal quartz using otherwise identical experimental parameters. Evaluating the real pressures in our experiments requires a model to account for the rather high porosity of the pellets compacted from the magnetite powder, as porosity significantly influence the post-shock T. Independent of the fact that p, shock- and post-shock T are insufficiently constrained yet, the experiments form a well-characterized series of shots at systematically increasing pressure. Surprisingly enough, the sample disks

were not friable and could be removed by retaining shape largely unchanged.

So far we have only investigated the effect of shock on magnetic susceptibility and SIRM. Tentative results suggest that, with increasing shock pressure both the susceptibility and the pre-shock SIRM are decreasing. While the first result confirms our previous measurements on real (basaltic) rock, the decrease of SIRM is opposite what has been previously seen. We are now investigating what part of this decrease is due to shock demagnetization.