EXPERIMENTAL SHOCK METAMORPHISM OF THE L4 ORDINARY CHONDRITE SARATOV INDUCED BY SPHERICAL SHOCK WAVES UP TO 400 GPA. N.S. Bezaeva[1], D.D. Badjukov[2], P. Rochette[3], J. Gattacceca[3], V.I. Trukhin[1], E.A. Kozlov[4] and M. Uehara[3]. [1]Earth Physics Department, Faculty of Physics, M.V. Lomonosov Moscow State University, Russia. E-mail: bezaeva@phys.msu.ru. [2]Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Russia. [3]CEREGE CNRS/Aix-Marseille University, France. [4]Russian Federal Nuclear Center, All-Russian Research Institute for Technical Physics (Chelyabinsk-70), Russia.

Hypervelocity impacts are a major mechanism for the evolution of the solid matter in our solar system. Shock waves generated during impacts can induce changes in texture and physical properties of extraterrestrial materials. So, understanding shock metamorphism of meteorites is a key issue in planetary sciences.

We carried out shock experiments on a bulk and a crushed macroscopic spherical samples of the L4 ordinary chondrite Saratov (natural shock stage S2-S3) using explosively generated spherical shock waves with maximum peak pressure up to 400 GPa and shock-induced temperatures >800°C (up to several thousand °C). The evolution of shock metamorphism within a radius of the spherical sample was investigated using optical and scanning electron microscopy observations, microprobe and magnetic analyses as well as Mössbauer spectroscopy and X-ray diffraction techniques. Petrographic analyses revealed a shock-induced formation of three different concentric petrographic zones within the shocked sample: zone of total melting (zone I), zone of partial melting (zone II) and zone of solid-state shock features (zone III). We found a progressive pressure-induced oxidation of Fe-Ni metal, whose degree increased with increasing shock peak pressure. Petrographic and microprobe analyses as well as Mössbauer spectroscopy showed that in the melted heavily shocked central part of the bulk sample (zone I) the amount of oxidized iron (FeO) increased by the factor of 1.4 with respect to its amount in the unshocked bulk sample of Saratov suggesting that about 70 wt% of the initial metallic iron was oxidized within zone I. Further magnetic analyses, carried out on experimentally shocked Saratov samples, showed that in the zone I about 10 wt% of the initial metallic iron remained intact. This strongly supports the hypothesis that apart oxidation, a migration of metallic iron droplets from the central heavily shocked zone towards less shocked peripheral zone took place as well. Magnetic measurements also showed shock-induced reduction of Fe-Ni grain size and shock-induced transformation of tetrataenite to taenite within all shocked sub-samples resulting in magnetic softening of these sub-samples (decrease in the coercivity of remanence B_{cr}). Implications of these results for planetary sciences and extraterrestrial paleomagnetism are dicussed.

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