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Comparison of shock metamorphic effects in Mócs L6 chondrite and ALH-77005 shergottite meteorites. I. Gyollai[1], Sz. Nagy[2], Sz. Bérczi[2], A. Gucsik[3,4] [1]University of Vienna, Department of Litospheric Research, A-1090, Vienna, Althanstrasse 14., Austria, [2]Eötvös University, Institute of Physics, Department of Materials Physics, H-1117, Budapest, Pázmány Péter sétány 1/a, Hungary, [3]Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560-0043, Japan; [4]Konkoly Observatory of the Hungarian Academy of Sciences, H-1121 Budapest, Konkoly Thege Miklós út 15-17., Hungary

Introduction:

Shock metamorphism is caused by impact processes in which the texture and mineral structure could transform mainly in the outermost layers of the little planetary body [1]. The observed shock metamorphic effects in our samples are as local features, which have different scales in the whole rock. Based on Stöffler [2] we can classify the shocked minerals (olivine and plagioclase) into 6 shock stages.

The Mócs meteorite is an L6-type chondrite, which fell in 1882, in Kolozs county. The chemical composition of Mócs meteorite was determined by Electron Microprobe Analyses (EMPA) [3].

The ALH-77005 Martian meteorite (lherzolitic type) was found at around the Allan Hills, in South Victoria Land on Antarctica in 1977-1978 [4]. Nyquist et al. [5] indicated lherzolitic texture of ALH-77005. Moreover, Ikeda [6] suggested the shergottite formation in the plutonic subsurface environment of Mars.

The feather feature effect was discovered by Poelchau and Kenkmann [7] in low shocked quartz, but never was described in other minerals, especially in olivine. We observed kink bands in several olivine grains from the Mócs meteorite, which show strong mosaicism. In the ALH-77005 we observed kink bands and strong mosaicism too. This observation was not only in one grain like to Mócs, but also in most coarse-grained, brown olivine, where two each other perpendicular kink bands system can be observed.

Samples and Methods:

The mineral assemblages and textures were characterized with a Nikon Eclipse LV100POL optical microscope. The Mócs thin section was prepared to 35-µm in thickness.

Results:

The *ALH-77005* consists of pyroxene, olivine and feldspar. The ALH-77005 has coarse-granular texture with locally microgranular and poikilitic texture (Fig. 1) and melt pockets with recrystallized needle-like crystallites in glassy matrix. In the environment of melt pockets resorbtion rim can be observed with toast-like texture in some cases and infiltration of dark melt. The melt pockets are darker (dark-brown-black in plane polarized lights) than its environment (well-crystallized coarse crystals). In the vicinity and inside of melt pockets several textures can be observed. The needle-like crystals are feldspar and pyroxene in melt pockets. The length of needles range are between 10-75 µm, and their width falls into 1-5 µm. Near to melt pockets, isotropic lath-shaped plagioclase, maskelynite occur. In the olivines, parallel to the fractures, kink-band system can be observed. The poikilitic fractured pyroxene grain contains olivine with thick one-set kink bands. The large olivine grains have more set of kink bands, which boundaries are the fractures and cleveages. The width of kink band lamellae is between 1 and 6 µm and they show light curvature (Fig. 2). The kink-bands and fractures of olivine generated the first type of feather features (Fig. 3). In the second type feather features, the fractures are crossed by PFs (their distance is 12 µm, which crossed by thin, high dense of curved lamellae with distance about 2-5 µm. The PFs are crossed with strait, but short lamellae with distance of 1-3 µm in the third type of the feather features as it was decribed by Poelchau and Kenkmann [7]. Commonly, the lamellae crossed by each other with 45° angle in the feather feature system, which was observed near to the rim inside the olivine grains, respectively.

The major modal compositions of *Mócs* meteorite are as follows: olivine, pyroxene, plagioclase feldspars, and opaque minerals. There are a few chondrules and recrystallized groundmass. The meteorite is highly fractured and shock-induced veins are also discernible. The fractures are filled by iron rich material. The sample contains shock metamorphic effects (especially in olivine), which can be seen in the form of weak and moderate level indicated by the shock mosaicism. Moreover, other shock metamorphic effects are observable as planar fractures (PF's) and kink bands deformation lamellae. (Fig. 4) Reduced interference color in plagioclase and pyroxene are also observable in this sample. To find any evidences for the presence of the shock metamorphic effects in the structural changes of minerals of Mócs meteorite we have investigated mainly olivine grains enriched with deformation microstructures (kink bands). We found a forbidden vibrational range for olivine which might be show SiO_4 depolimerisation and dimerisation features.

Comparison of Mócs and ALH-77005:

Compared to the heavily shocked ALH-77005 meteorite, the Mócs meteorite exhibits only one olivine with shock deformation microstructures. In Mócs sample the peak shock pressure was concentrated near to iron-filled fractures, whereas in the ALH-77005 meteorite the shocked olivines are near to melt pockets. According to the optical microscope observations, the rate of shock metamorphism was classified to the Mócs chondrite as S3-5 shock stage and ALH-77005 as S5-6.

References:

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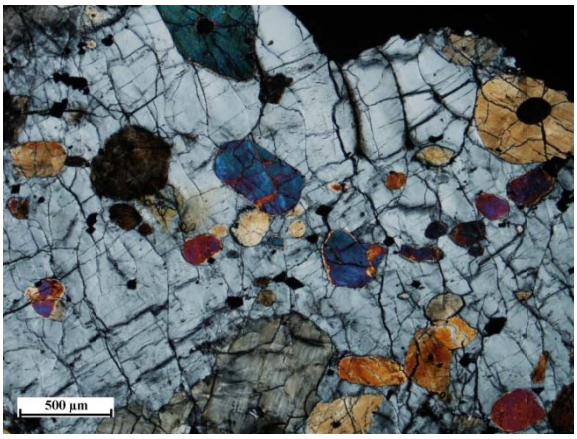

Fig. 1: Poicilitic texture in ALH-77005

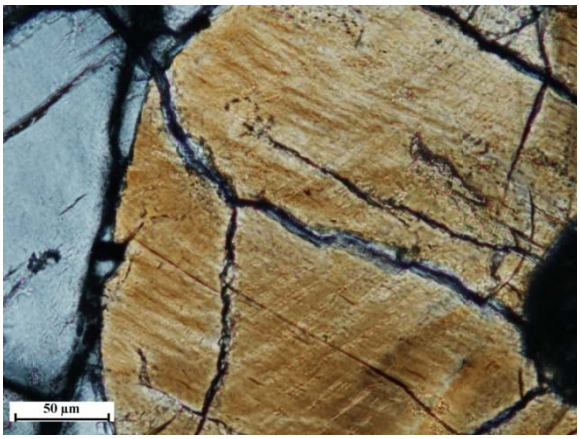

Fig. 2: Kink bands in a brown olivine in ALH-77005

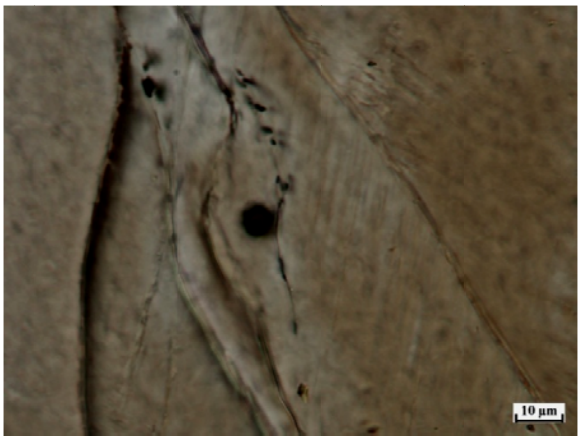

Fig. 3: Feather feature system in brown olivine grain in ALH-77005.

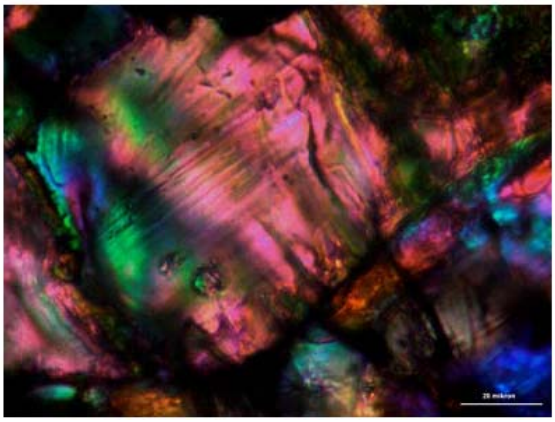

Fig. 4: Deformation microstructure in olivine showing strong shock mosaicism in Mócs meteorite.