OLIVINE FROM PALLASITES: STRUCTURAL AND NUCLEAR TRACK DETECTOR CHARACTERISTICS.
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Introduction: Uses of meteoritic olivine as one of the most effective solid track detectors is based on wide natural occurrence and structural properties of this silicate. Results of the structural and track experimental investigations of olivine crystals from the Marjalahti pallasite performed as a part of the OLIMPIYA project [1] are presented in this paper.

X-ray structural analysis: Ten olivine crystals from the Marjalahti pallasite were irradiated by accelerated 132Xe nuclei and exposed to X-ray structural analysis. The procedure was carried out to investigate the effect of the crystallographic axes orientation on the efficiency of track channel etching. The measurements were performed on diffractometer HZG-4 by the focusing diffractometry method [2]. Analysis showed: (i) six olivine grains are 100% single crystals; (ii) three grains have a highly regular texture; and (iii) one grain had roughly oriented microcrystallites. For these crystals the diameter Dm and track length L distributions of tracks were investigated. The experimental results indicate L quantities are independent on the crystalline texture. The mean L value is 80.6 ± 0.3 μm; and the corresponding track-length etch rate is Vtr =11.5 μm/h.

Thermoluminescence (TL) analysis: The main reason the TL method was used is the investigation of cosmic ray exposure and shock-thermal history of Brenham, Eagle Station, Ilimaes, Marjalalhti and Omolon pallasites. High-sensitive equipment [3] was used for the measurement of natural and artificially induced TL. There was determined the significant difference in the typical glow-curve shapes between the Omolon and other pallasites: the first one demonstrates the presence of high-density dotty dislocations in the individual olivine grains. Absolute difference was observed in TL glow-curves registered in artificially shocked olivine samples. Comparison of the obtained data indicates: (i) the high variability of TL-parameters chiefly connected with the microstructure characterizing olivine crystals from different pallasites, and (ii) very low level of possible shock influence recorded in all analyzed olivine crystal samples.

Conclusions: (i) The X-ray structural and track analyses shows that the track etching rate is practically independent from the track orientation to the crystallographic symmetry axes in the analyzed olivine crystals. It is shown that the track etching efficiency remains constant for any crystal types: single olivine monocrystals, olivine crystals with highly oriented regular texture and for olivines of polycrystalline structure. (ii) The measured peak values Lmax = 80 ± 5 μm and Lmax = 85± 5 μm obtained in olivine grains irradiated by the accelerated Xe and U nuclei with Emax = 11.4 MeV/nucleon [4] are in a good agreement with the ranges for these nuclei got by the SRIM and GEANT4 simulation programmes [5].

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