Introduction. Previous track-thermoluminescence (TL) investigations \([1, 2]\) of the lunar regolith silicate crystals demonstrate the possibility of measuring of the effects from the local shock-thermal events initiated chiefly by micrometeorite impacts. This note reports the continuous new results on investigation of the radiation shock-thermal history of the lunar regolith matter which were doing with help of the complex fossil track and artificially induced TL – method.

Samples and method. Olivine (Ol) and plagioclase (Pl) crystals (about 30 grains) from the Luna-24 soil sample No 24184 of 0.127-0.200 mm size fraction were taken for the investigation. Track and TL-technique have been described by us early \([1]\). Some additional details are the next: simultaneous measuring of the track and TL-parameters in the same micro crystals, the size of which do not give possibility to use "part by part" procedure of crushing, it was performed by measuring of track parameters after TL-investigation. Because during sample heating for TL glow-curve detecting crushed up to <30 \(\mu m\) microcrystals were under \(-300\) to \(-400\) \(^\circ C\) temperature only during about ten sec, that is not affected on the characteristics of the storage in these crystals fossil tracks. TL-intensity was detected for each individual Ol and Pl grain with help of the high-sensitivity modified equipment, described early \([3]\).

Results and Discussion. Tracks densities, detected in individual Ol and Pl grains, are showed as histograms in Fig.1. Practically all observed tracks are due primarily to VH nuclei (iron group with \(23\leq Z \leq 28\)) of galactic and solar cosmic rays. Portion from the spontaneous and induced fission track density of Th, U is negligible small (\(\leq 0.1\%\)) and was not take into account in our experiment. As it seen, the predominant part of crystals (in the case of Pl and Ol it is near 65\% and 90\%, correspondly) have \(\rho \geq 1 \times 10^7\) \(\text{cm}^{-2}\). Track data are characterized these grains, firstly, as undervented during history by the solar and galactic cosmic rays near the regolith surface (\(\leq 1\) mm) during only about 100 y. It is resulted from differential energy spectra \(J=8 \times 10^6\) \(\text{E}^{-3}\) \(\text{nuc}./\text{cm}^2\cdot\text{y} \cdot \text{sr} \cdot \text{MeV/amu}\) and corresponding integral VH-nuclei flux of \(10^5\) \(\text{nuc}./\text{cm}^2\cdot\text{y}\) for \(E \geq 20\) MeV/amu. So short radiation time interval indicate on small probability for intensive micrometeorite bombardment reworking of regolith surface layer (some mm of thick), that can be resulted in correspondly low percentage of the individual crystals which are undervented the local shock-events influence. In this connection it was very interesting to see these radiation parameters in comparison with TL-characteristics, obtained for the same silicate crystals.

TL glow-curve, corresponding to temperature interval up to 400 \(^\circ C\) have the low \((80\div160)\) \(^\circ C\) and high \((160\div340)\) \(^\circ C\) peaks of different intensity for individual Ol and Pl grains. The main TL parameter using in our investigation is the relation of the integral TL-intensity at low – and high-temperature intervals \((S1/S2)\), that is reflects the relation of crystals under investigation with different degree of its shock-induced disordering. Results of the special computer program calculations of the \((S1/S2)\) values were obtained for Ol (15 samples) and Pl (16 samples) individual crystals of Luna 24. On the base of these data it can be note: 1) The total interval of \((S1/S2)\)-variation both for Ol
and Pl crystals make up ~ (5-6)-fold; 2) More higher (up to ~ 4) absolute value of the (S1/S2)-parameter is obtained for Ol- crystals, that twice higher than in the case of Pl maximum (S1/S2)-values; 3) It can be demonstrated some grouping of crystals having near the same (S1/S2)-values, 4) Absolute values of (S1/S2)-parameter, received for Pl crystals of Luna-24, are practically the same with data, obtained by us early for the Luna-16 individual Pl crystals [5].

Conclusions. 1) Crystal grain by grain track-TL investigation gives the undoubted presentation about the real picture of radiation-shock-thermal history of the lunar regolith material on the local submillimeter level; 2) Short time of the near-surface cosmic ray irradiation and small portion of the relatively high-disordered Ol and Pl crystal grains demonstrate the correspondly low degree of the shock-thermal reworking of the Luna-24 sample under investigation.


Fig. 1. Track density distribution for the olivine (Ol) and plagioclase (Pl) crystals from the Luna 24 sample 24184.

Fig. 2. The variation in S1/S2 TL-parameter in the individual plagioclase crystals from the Luna 24 sample 24184.