PRE-ACCRETION AND/OR REGOLITH HISTORY OF THE PESYANOE OBRITE MATTER.

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Introduction. We are continuing our fossil track and artificially induced thermoluminescence (TL) studies of the radiation-thermal history of the meteoritic material. Early it was indicated on the significant effect of the local shock-thermal events, e.g., [1,2]. As a result of this influence in a number of meteorites it was observed of silicate grains with the certain cosmic ray fossil tracks and TL characteristics. A general conclusion of our previous work is that the radiation-and shock-thermal history of some meteorites is very complex and multi-stage process and this history for the individual silicate grain is practically different. In this context it is interesting to investigate the shock induced features, observed in the *En* crystals of different chemical-petrology and size separated fractions of the achondrite Pesyanoe. This meteorite characterized by the presence of very high solar gases concentration, that indicate the irradiation of this meteorite matter on the non-shielding conditions Now we report here on new results of the physical-chemistry analysis of this meteorite with the aim to further investigation of the irradiation, shock and thermal history of cosmic matter by common petrology.-.chemical – track - TL methods.

Samples, method. For investigation it was taken a matrix sample N217 of the Pesyanoe achondrite, which was presented as a fine-grained material. The sample was handle isolated from the bulk meteorite mass and was treated by physical and size separation analysis. By this manner three group of size fraction from 45 μm up to 360 μm were searched. Track investigation were performed by the standard procedure: for the *En* crystals chemical etching of tracks it was used boiling solution of $NaOH:H_2O$ (2:1) during 3h. Account of tracks was doing with help of optical microscope under ~1200^x-magnification. TL measuring were performed by the method, described in detail in [3]. The statistical errors of measuring of peak temperature (T_p), of the TL peak width (full width at half maximum, FWHM) and of the intensity TL (area under peak in a given interval of temperature, S_p) did not exceed 3%. Chemical analysis was performed with help 0f the INNA method.

Results and discussion. The wide track studies of the Pesyanoe achondrite was done by us earlier. Now it was interesting to measure the chief track parameters in some *En* grain groups, which then are received TL study. Track density values, obtained for *En* grains, covered interval from $5x10^5$ cm^{-2} to ~10^8 cm^{-2} (see Fig.1)

Artificial TL, induced by X-rays, in separate matrix and *En* grains fractions, isolated of Pesyanoe achondrite was executed. The TL glow curves of all grains have shown presence of two sharp peaks with temperature of maximum at ~150 ^oC and ~270 ^oC (see Fig2) The values of the relation of the peak area measured in a temperature interval 50-210 ^oC (S_{P1}/S_{P2}) allows to separate (3-4) groups of grains, differ each other by parameter $S_{P!}$ / S_{P2}, total interval of which is 0.7 – 4.6.

As it was obtained early [4,5], comparison of track-density and TL characteristics, measured in the same of some tenths *En* grains do not give some quantitative correlation. It was interpreted, as a results of relatively small degree of the shock-thermal influence on the crystals during their history.

More interesting results, obtained from the new complex investigation of the some matrix samples consists in the certain relation between concentration of some chemical elements of the different degree of volatility and TL-parameters. The first are the indicators of the possible high-temperature (connected or not with the shock events) influence on the *En*-grains contained samples under investigation. The second are very sensitive indicator of the shock-induced events starting from the low (under than 10-20 GPa) levels of influence. Obtained for six searched matrix samples relations: concentration of the element *vs.* TL-parameter S1/S2 are presented in Fig 3. Among searched elements Na is volatile, in contrast to him two other Ca and Sm are practically refractory elements. As it seen, for all these elements it is not registered some correlation in relation to TL-parameter S1/S2, the value of which for investigated samples varies from~0.9 up to ~1.5. The absence of the visual relation and chiefly, the quite the same (in the $\pm 1\sigma$ interval) content for elements of different volatility, can be considered as indicator of the absence of the high-level (>20 GPa) shock-pressure influence on the investigated material. This is correlated with the measuring of very high-track density and track-density gradients in some *En* crystals from the Pesyanoe meteorite. The achondrite Pesyanoe matter during all his geology history, starting from the early irradiation in the regolith or more early environment conditions, do not underwent to influence of the shock-thermal events, stronger than: P≈20 GPa and T≈500K during of the short-time interval.

Conclusions: Obtained nuclear-track, TL and chemical data allow making the next:

1. The initial Pesyanoe meteorite constrain material was contained the compounds of the essentially different irradiation and shock-thermal pre-history.

2. There are a high probability that the Pesyanoe individual *En*-grains fossil track characteristics refer to their history of a radiation, thermal and shock-thermal influence chiefly occurred on pre-accretion and/or regolith stages of a parent body formation of this achondrite.

3. The possible "pure thermal" metamorphism inside a parent body, would result about the same manner in all *En* grains. But quite essential difference of TL-parameters, measured for the several matrix samples, indicate on very small influence of this process in comparison with the more effective and heterogeneous shock-thermal process during of exogenic reworking of this meteorite material.

4. Absence of the visual variation of concentration of some volatile-refractory elements in a number of the matrix samples of different sizes correlate with the low-level shock-thermal reworking of material consisting investigated achondrite in their metamorphic history.

5. The achondrite Pesyanoe matter during all his geology history, starting from the early irradiation in the regolith or more early environment conditions, do not underwent to influence of the shock-thermal events, stronger than: P≈20 GPa and T≈500K during of the short-time interval. As it was obtained early [6] the En group IV of the Pesyanoe probably undergoes a shock-pressure treatment with shock stage S1. This conclusion is confirmed by our TL study of experimentally shock loaded oligoclase, quartz and calcite [6].

References: [1]. Kashkarov L.L. et al. (1994) Lunar Planet. Sci. XXV, Houston: LPI V. 1, pp. 669-670. [2]. Kashkarov L.L, et al. (1991) Lunar Planet. Sci. XXII, Houston: LPI V.2, pp. 693-694. [3] Kashkarov L.L. et al. (1993) Meteoritica (in Russian), V.50, pp. 95-104; [4]. Kashkarov L.L. et al. (2000) Geochemistry International, V.38, Suppl.3, pp. S310-S321; [5]. Ivliev A.I. (1995) Geochimiya (in Russian) No.9, pp.1368-1377. [6]. Ivliev A.I. et al. (1996) Geochimiya (in Russian) No.10, pp. 1010-1018.

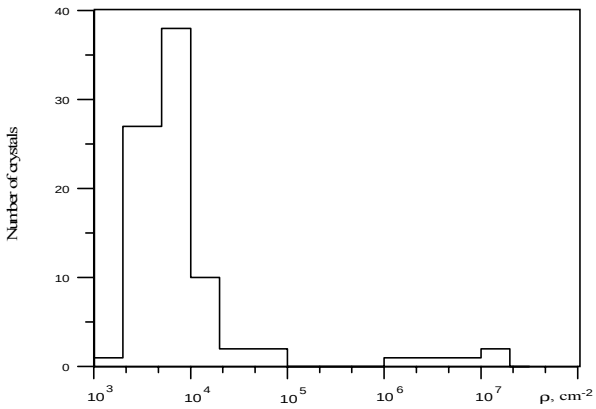

Fig.1. Fossil VH-nuclear track-density distribution in the *En* crystals from the Pesyanoe chondrite.

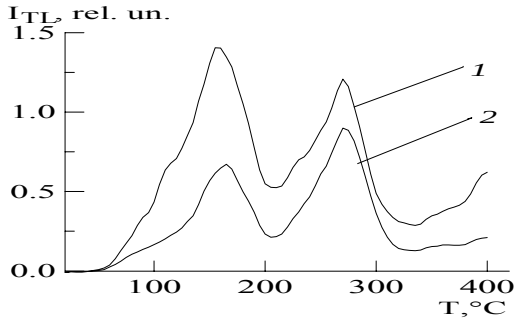

Fig.2. The TL-glow-curves in different matrix Pesyanoe samples: 1 – sample N 3 (81a) и *2* – N 9 (82a), differs each other by the TL- intensity of the peak in the temperature intervals: (50-210) ^{o}C and (210-320) ^{o}C.

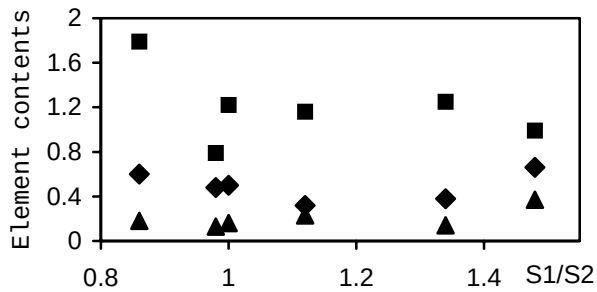

Fig.3. TL parameters S1/S2 *vs.* the concentrations of Na (◆), Ca (■) and Sm (▲) – elements in six investigated matrix samples of Pesyanoe achondrite. For each average value of concentration the zone of ±1σ equal to: Na (0.48±0.12), Ca (1.20±0.30), and Sm (0.20±0.08).