Thermal alteration effects of the large olivine grains of the Zagami meteorite.

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We have studied tracks and thermoluminescence of the olivine grains from the Zagami meteorite. Zagami belongs to the group of SNC meteorites, which, as it is assumed, have Martian origin (1, 2).

We have investigated olivine grains 200-800 μm in size. Olivine is one of the natural informative track detector because of the extremely low content of U and the clear identification of the VH - nuclei cosmic ray tracks.

After the chemical etching by standard method the track density for 10 investigated grains was in the interval of (0.9- 5.0) * 10^6 cm $^{-2}$ (ρ). To explain such high track density it is suggested to examine the following sources: 1) VH-nuclei of galaxy cosmic radiation; 2) and/or fragments of the spontaneous and neutron-introduced heavy elements fission.

As cosmogenic age of Zagami meteorite is not more then 2 MY (3) the shielding depth of the olivine grains for the accumulation of observed value ρ would not be more then 2-3 cm from the preatmospheric surface of meteorite body. However, the observed isotropic angle distribution of the tracks in single olivine grains contradicts to the notions of relatively large part of VH-nuclei of galaxy radiation in ρ for the body which preatmospheric radius ≥ 10 cm.

If the main sources of the observed tracks are the fragments of ^{235} U neutron-introduced fission, then for production of ρ 10^6 cm^{-2} the total flux of thermal neutrons would be 10^{18} n/cm^2(with assumption U concentration in olivine ≈ 1 ppb). One of the possible neutrons sources is a production of the secondary neutrons by nuclear interaction of solar and galaxy cosmic rays protons in the upper layer of the parent body. The estimation of fission track density which formed in olivine grains of Martian regolith due to GCR during 2 BY is not more then 5*10^2 cm $^{-2}$. Thus the needed flux of thermal neutrons is much more then those which were formed due to cosmic rays.

Comparison of tracks length distribution of the natural tracks and the ^{252} Cf fission fragments tracks shows that natural tracks were annealed (fig. 1); parameters of the heating correspond to 300 - 400^0 C in 1 hour.

Some surface zones (20-50 μm in thickness) were found in several olivine grains. Tracks density in this zones ≤ 10^{4} cm $^{-2}$. This, probably, can testify the local more efficient surface annealing of the tracks. Efficiency of the thermal influence is estimated as a heating up to 1000 ^{0} C in 10 sec. Moreover the crush traces were observed in these grains. Crush process occurred after the process of the surface grains heating or during it.

There is very high track density in the upper layer of some grains that interpreted as a result of the uranium nuclei fission in the neighbours uranium-rich minerals.

The TL-investigation of similar olivine grains showed the identity of olivine grains in sensitivity and accumulation of TL, produced by X-ray and Gamma-ray and also the complete coincidence of natural TL parameters.

Conclusion.

1. High tracks density and parameters of tracks volume distribution in each studied olivine grains indicate the complicated thermal history of these grains.

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2. The most possible process of the track accumulation with observed ρ is irradiation of the olivine particles by VH-nuclei of solar cosmic rays
in the space and the further falling of these particles on the surface of the Zagami parent body. Thus the origin of the local surface zones with annealed tracks becomes more clear.
3. In spite of difference of tracks characteristics data, TL data indicate that there is no essential difference in structure and composition between olivine grains.

References: **(1) Mc Sween H.**, - Geology v.12,pp.3-6,1984, **(2) Ott U.**, - GCA, v. 52, pp. 1937-1948, 1988, **(3) Shin C. et al,** - GCA, v. 46, pp. 2323-2344, 1982.

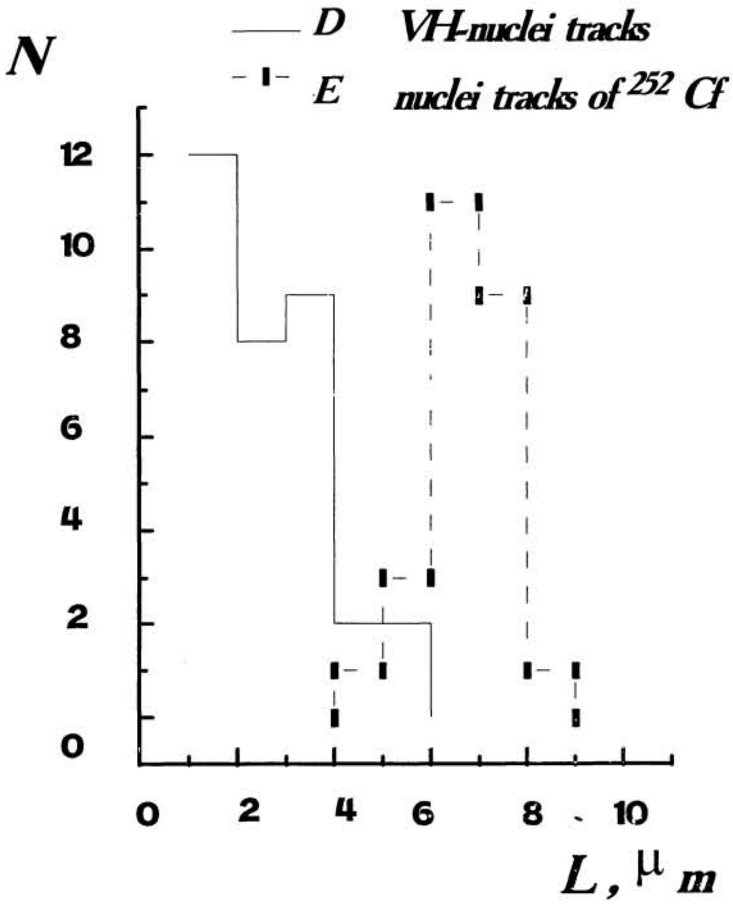

Fig. 1