Determination of the Charge Spectrum of Heavy Cosmic Ray Nuclei: New Results from the OLIMPIYA Program.

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Abstract.
New results on the spectrum of cosmic ray nuclei obtained in the framework of the OLIMPIYA program [1] are presented. In addition to the peculiarities of the method of the search and identification of heavy nuclei which was describe in [2], the simultaneous using of the precisely measured for each track values of L and V_{tr} allows for obtaining more reliable results for nucleus charges. From the present results on more than 300 studied tracks of the VVH cosmic ray group it is seen that the majority belongs to nuclei with $40 \leq Z \leq 45$. Comparision of this data with existing data on the relative abundance of elements in galactic CR [10] shows that both distributions are in reasonable agreement within ΔZ=3-5.

Introduction.
New results on the spectrum of cosmic ray nuclei obtained in the framework of the OLIMPIYA program [1] are presented. The early data from this investigation were reported in [2,3].

Procedure of the nucleus charge determination.
As regards the procedure, most attention has been concentrated on the elaboration of the method of nucleus charge estimate. The aim was to identify with the best accuracy the nuclei of chemical elements, whos tracks were revealed in olivin crystals from Maryalakhti pallasite. Precision measurements of the track geometric characterestics have been carried out on the PAVICOM facility [4]. As previously discussed [5,6], the track geometric parameters (its length L and diameter D etched under the standard conditions) depend both on nucleus charge Z and the energy which the nucleus enters the given olivin crystal of size 1-2 mm. Generally, the track length determined by optical microscope constitute only some fraction of the total etched length, which corresponds to the track of a nucleus with a certain Z, so that only some lower threshold value that minimum can be determined.
The second geometric parameter was not essentially used at this stage of our study. In this connection, for refining the charge of the track-producing nuclei, simultaneously with the L-parameter the etched rate V_{tr} of the olivin along the nuclei track was also used. V_{tr} value mainly depend on charge (Z) of producing track nuclei. It is worth noting that V_{tr} various essentially depending upon what section of the total track is being etched [7]. We have used the method of the step-by-step, lit-par-lit etching and “matching” of the long-range track coordinates after each successive removale of a layer of a certain thickness. The method is described in detail in [8,9].

Results.
The results on the determination of the nucleus charges for 326 tracks from 15 olivin crystals from the Maryalakhti pallasite are presented in the Table.
The results are presented for 3 successive stages adapted in our study: etching, measurements of the track parameters, and removale of layers of 30 to 50 mkm thick. The etching duration at each stage was 48 hours. In some cases, after 6, 12, or 24 hours, some intermediate, preliminary measurements have been done for some tracks with $L \geq 60$ mkm. The minimum value of V_{tr} = 10 mkm/hour determined in such appoarch allows for match more precise identification of nucleus charge.

Table. Charge groups of the GCR VVH-nuclei determined in the olivine crystals from the Maryalakhti pallasite

Charge group	Number of tracks N_Z (*)	Track length L, μm (**)	Track density, cm^{-3}	Abundance (***)
$36 \le Z \le 40$	32	≥ 20	2.9×10^{4}	3×10^{-5}
$40 \le Z \le 45$	213	≥ 100	1.9×10^{5}	2×10^{-4}
$45 \le Z \le 50$	74	≥ 200	6.7×10^{4}	7.5×10^{-5}
$50 \le Z \le 60$	5	≥ 300	4.5×10^{3}	5×10^{-6}
$60 \le Z$	2	≥ 500	1.8×10^{3}	2×10^{-6}

(*) Detected number of tracks in the total searched volume of ~1.13 mm^3 in 15 etched and analysed olivine crystals;
(**) L_{MIN} values for the incompletely etched tracks are given;
(***) Relative to the volume track density of VH-group ~ $9\cdot 10^{8}$ cm^{-3}.

Conclusion.
We would like to emphasize that in addition to the peculiarities of the method of the search and identification of heavy nuclei which was describe in [2], the simultaneous using of the precisely measured for each track values of L and V_{tr} allows for obtaining more reliable results for nucleus charges. From the present results on more than 300 studied tracks of the VVH CR group it is seen that the majority belongs to nuclei with $40 \le Z \le 45$. Comparision of this data with existing data on the relative abundance of elements in galactic CR [10] shows that both distributions are in reasonable agreement within $\Delta Z=3$-5.
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