THE BULK COMPOSITION OF THE DUST COMPONENT OF COMET HALLEY; L.M.Mukhin, G.G.Dolnikov, E.N.Evlanov, M.N.Fomenkova, O.F.Prilutsky, Space Research Institute, Academy of Sciences, Moscow, USSR

Comets traditionally are concerned as the most primitive material of Solar system and, hence, their bulk elemental composition for main rock-forming elements is expected to be similar to solar (or CI) composition. The average ionic composition of comet Halley dust grains has been determined by a number of authors (1-3) using data from dust-impact time-of-flight mass-spectrometers PUMA-1,2 of VEGA mission and PIA of GIOTTO mission. These results point to a large difference between the average ion ratios in mass-spectra and the corresponding elemental ratios in carbonaceous chondrites.

In all previous papers equal weights has been used in procedures of mass spectra averaging. But if the mass of registered dust particles is in the range from $5\cdot10^{-17}$ g to $5\cdot10^{-12}$ g (the mass of individual grains is determined in (4) from data on dust particle impact on target rather than from ions intensity in spectrum), then, evidently, this mass distribution should be taken into account when average bulk composition is calculated.

We have used the next averaging procedure. At the 1st step the sum of charges of the 10 main elements (see Table 1) was accepted as 100% and the percent abundances of these elements in every spectrum were found. It enabled to eliminate effects of intensity variations in spectra of the same mass group. At the 2nd step these abundances were averaged separately for spectra obtained in wide and narrow energy windows, the weighting factor being the derived in (4) mass of dust grain. The resulting values normalized to Mg are given in Table 1.

Table 1. Average ion abundances for PUMA 1,2 with weighting factor.

	H	C	N	O	Mg	Al	Si	S	Ca	Fe
Puma 1, wide	2937	548	74	491	100	19	93	64	13	87
Puma 1, narrow	205	143	8.3	149	100	5.3	59	27	3.4	16
Puma 2, wide	203	137	45	151	100	18	71	53	8.2	51
Puma 2, narrow	117	50	13	48	100	13	57	49	7.1	29

The ion ratios of the main rock elements are: $Mg^+/Si^+ \approx Fe^+/Si^+ \approx 1$. Also, the ratio $S^+/Si^+ \approx 0.7$ is more close to the corresponding elemental ratio in CI. The upper limit of uncertainties in this ratios is estimated as $\sim 30\%$.

It is interesting to consider separately the average ion composition of the heavy and the light fraction of dust component. The comparison of ratios Mg^+/Si^+ and $Fe^+/(Fe^++Mg^+)$ for the heaviest and the lightiest particles (see fig.1, 2) reveals a large difference in composition, depending on the mass of the particles. So, the right values on Mg^+/Si^+ histograms show, that the light particles contain the noticeable fraction of magnesium without silicon and the mean ratio Mg^+/Si^+ for this group is much more than 1, while this ratio for heavy grains is almost solar and the number of grains with magnesium without silicon is less. Figure 2 shows that the heavy particles are more abundant by iron than the light ones. The full ion composition for the heavy and the light dust grains of comet Halley is given in Table 2.

Two explanation of this mass dependence are possible: either there is the real difference in composition of heavy and light particles, or there is a dependence of instruments' characteristics on mass of registered particles. We believe that the 1st explanation is more probable. The different weighting of the

Table 2. Average ion abundances for heavy and light grains (PUMA 1, wide).

	H	C	N	O	Mg	Al	Si	S	Ca	Fe
Heavy	3316	579	77	530	100	19	97	70	14	97
Light	258	252	18	103	100	17	47	27	9.5	22

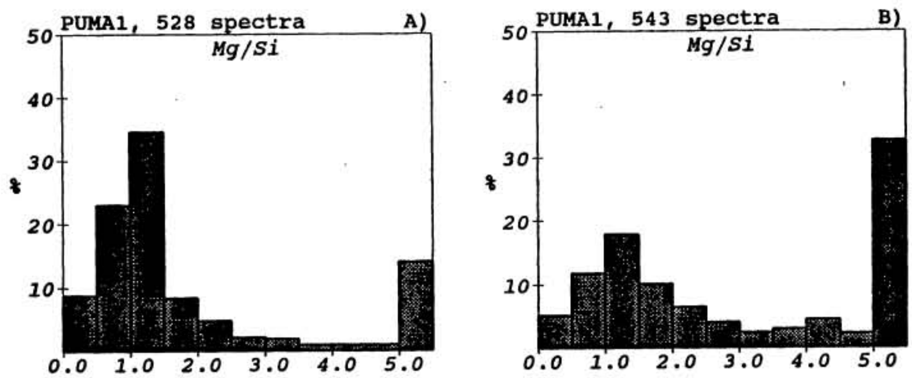

Fig.1. Dependence of ratio Mg^+/Si^+ on mass of particles:
A) $m > 10^{-13}$ g;
B) $m < 5 \cdot 10^{-16}$ g.

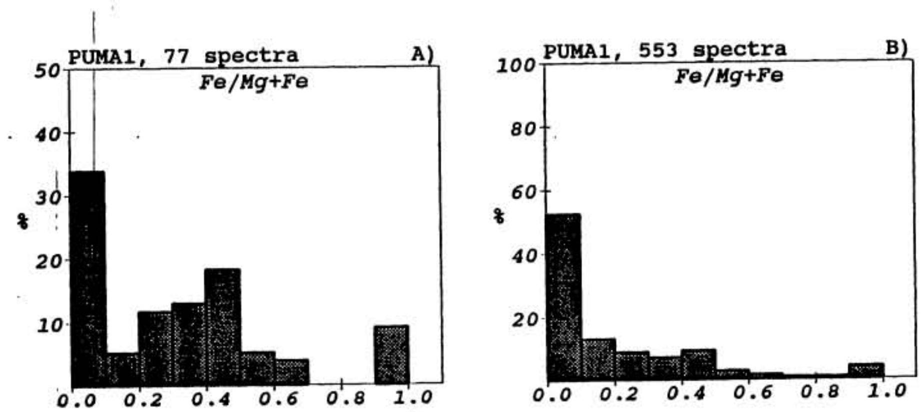

Fig.2. Dependence of ratio $Fe^+/(Fe^+ + Mg^+)$ on mass of particles:
A) $m > 2 \cdot 10^{-12}$ g;
B) $m < 5 \cdot 10^{-16}$ g.

individual particles explains the discrepancy between our results and the previous ones: light particles are more numerous, but only the group of the most heavy particles completely defines the average composition.

It should be noted here, that conversion of ion abundance to elemental ones using the ion yields factors of (3) would lead to the elemental ratio Mg/Si of about 0.3, which would be difficult to understand for cometary matter. Possibly, it means that processes of plasma transformation in PUMA instruments and resulting ion yields are dependent on dust particle mass.

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