POSSIBLE COMPOSITION OF HALLEY COMET DUST (SI-POOR PARTICLES) ACCORDING TO THE DATA OBTAINED BY MASS-SPECTROMETER PUMA-2

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Combinations of elements' ions and their relationships have been studied for 511 cometary particles, which had been registered by PUMA-2 instrument (1) in non-zero modes in the "narrow" and "wide" energy windows (2). Only the amplitude and position in the spectrum are known for each recorded peak.

All the following conclusion are made basing on the analysis of elements' ions concentrations, assuming that if the quenching temperatures of ions in plasma cloud are high enough than ionic composition is adequate to elemental composition of dust particles. It is possible that such condition is not realized completely, although, to our mind, ionic composition reflects atomic one to significant extent. Detailed character of corrections remains unclear, but corrections used by the authors (3) hinder greatly PUMA-2 data interpretation, at least for some elements.

Data on ions of Na, Ca, C, H, N, S, Si, Mg, Fe, Cr and Al were taken into consideration. Unfortunately, the data on ion of oxygen are not reliable (2), but the presence of oxygen may be supposed in all the particles. During the systematization it was assumed that if ratio (ion of element)/Mg < 0.1, then such a particle does not contain this element; and if this ratio for the ion with maximum concentration is above 10, then this particle contains neither Mg not any other elements for which this ratio was also above 10.

Theoretically possible number of combinations of the elements mentioned above is 1023, if [Mg,Fe] association is assumed as an "element". Only 138 combinations are realized in cometary particles out of this number. That definitely indicates the presence of certain mineral phases and their paragenesises in the comet dust.

170 paricles were discovered, where Si is either absent or is present in a very low concentration. 65 particles of this type contain only sulphur and light elements. In other particles in 92% cases [Mg,Fe] are present in association with light elements, as a rule. Chromium was discovered in 28 particles, sodium was discovered in 15 ones.

The particles, comprised of light elements in this group, are (<O> means implied presence of oxygen independently of it's real presence in spectra): [H,C,<O>] - 38, [H,C, N,<O>] - 8, [H,C, S, <O>] - 4 and [H,C,N,S,<O>] - 2. These particles consist mostly of organic matter. Besides, the particles containing only [C,<O>] - 5 (carbon matter) and [H,<O>] - 8 (water ice?) were identified.

The particles, containing Mg and Fe, contain sulfur and light elements in 70% cases. Most usual compositions of this type of particles are: [Mg,Fe] - 16, [Mg,Fe,H,C] - 15, [Mg,Fe,H] - 7, [Mg,Fe,C]-6. Other combinations are observed in isolated cases.

[Mg,Fe] - particles may be interpretted as oxide particles, fused magnesia mainly, because only two oxide particles with high Fe content were discovered, i.e. magnetite and magnesioferrite. But it should be noted that the discovered oxide particles were usually very small and the majority of their spectra were obtained in a narrow window. Thus, presence of light elements should not be excluded and such dust particles may actually consist of more complicated phases, as carbonates and hydroxides.

The association [Mg, Fe, H] indicates definitely the existance of brucite. Carbonates, mainly magnesite or hydromagnesite may occur in the [Mg,Fe,C]- or [Mg,Fe,C,H]-particles. Certainly, carbonaceous and organic matter may exist in the particles of this type, but it is unlikely that their composition is defined only by organic compounds mixed with fused magnesia. Judging from the prevalence of [Mg,Fe,C,H]-, [Mg,Fe,C]-, [Mg,Fe,H]-particles, brucite and carbonates may be basic non-organic components in Si-poor cometary particles.

The presence of [Mg,Fe,S], [Mg,Fe,H,S], [Mg,Fe,H, N] associations, observed in some particles, indicates that Fe and Mg sulphides, sulphates, nitrates or their hydrated analogues are possible accessory phases in Si-poor particles. Typically, Fe content increases in the particles, containing sulphur. This correlation is an evidence of sulphide and sulphate Fe in cometary matter.

High Cr of some Si-poor particles can be explained by the presence of magnesiochromite, as [Mg,Cr] association is typical for such particles. However, some particles were discovered containing only Cr in association with light elements. It is quite possible that such particles may contain escolaite.

Na carbonates, sulphates, nitrates, cianides or rhodanides may be present in Si-poor particles as accessory phases, as this element is usually associated with C, H, N and S. Na compounds content of Si-poor particles is not high, because in all the cases they are associated with Mg-Fe phases.

REFERENCES 1. Venus-Halley project. Ed. by Balebanov V.M., Vorontzova E.N., Scuridin G.A., 1985, Lui-Jean, Paris. 2. Sagdeev RZ et al, Kosm. issl., 25, 849-855 (1987) (in Russian) 3. Jesberger EK et al, Nature, 332, 691-695 (1988)