

MASS-SPECTROMETRIC INVESTIGATION OF THE CHONDRITE AT THE HIGH TEMPERATURE. Yakovlev O.I., Markova O.M. (V.I. Vernadsky Institute of Geochemistry and Analytical Chemistry, Moscow, 117334 U.S.S.R.), Semenov G.A., Belov A.N. (Department of Chemistry, Leningrad State University, Leningrad, 199004, U.S.S.R.)

**Introduction.** Condensation and vaporization are the key physical processes which form meteorite in all stages of its complicated evolution. The condensation process is predominating in the cooling nebula but this process should be interrupted and/or go reverse side as the vaporization process. We cannot exclude the possibility of several cycles revaporization and recondensation in the meteorite before planetesimal formation. The impact process on the surfaces of parent bodies may again result in vaporization and recondensation of some part of matter that complicates the bulk chemistry of meteorite even more.

The understanding of the important role of the "vaporization metamorphism" [1] in meteorites has stimulated the experimental investigations [1,2,3] for obtaining physical and chemical data about meteorite-vapor system at various temperatures.

Experimental data presented here give additional information about vapor evolution depending on meteorite temperature and they are new for extremely high step of "vaporization metamorphism".

**Technique.** Heating and vaporization of "Krymka" chondrite (LL3)  $\text{SiO}_2$ -40.1;  $\text{Al}_2\text{O}_3$ -2.93;  $\text{MnO}$ -0.34;  $\text{MgO}$ -25.01;  $\text{CaO}$ -1.88;  $\text{Na}_2\text{O}$ -0.84;  $\text{P}_2\text{O}_5$ -0.21;  $\text{Cr}_2\text{O}_3$ -0.52;  $\text{S}$ -2.22;  $\text{Fe}_{\text{total}}$ -19.67;  $\text{Ni}$ -1.15;  $\text{FeS}$ -6.05 (wt.%) was studied using the Knudsen effusion cell. Narrow molecular beam emerging from the cell passed through ion source where the vapor was ionized by electrons with the energy 20 ev. The measurements of ion currents were taken using special high-temperature mass-spectrometric technique (MS-1301). Sample materials (8-30 mg) and Au standart were jointly heated in W cell. The heating was carried out by electron bombardment up to the temperature 2500°C. The temperatures were measured with optical pyrometer ( $\pm 5^\circ$ ). Based on the measured ion currents the partial pressure of the components vaporized at any given moment of the experiment was calculated.

The experiments were carried out in the regime of increasing temperature step by step till the full vaporization of the sample occurred. The temperature step was 80°. Duration of the temperature step was 15 min.

**Results.** Preliminary results are shown in fig.1 and 2. The pressures of the main components over residual chondrite in dependence on temperature are shown in fig.1. Here the segments of step heating are shown too. The direction of the segment points to the temperature and the size of the segment gives the scale of the period of the vaporization time. The results demonstrate clearly the temperature sequence of the vaporization of components of chondrite and the forms of components in vapor phase. The following sequence of vaporization of main components was established: (Na, K) > Fe > SiO > Mg > (Ca, Ti) > Al. The components have different volatilities and they may be conventionally divided in three groups: relatively volatile components-Na, K (maximum partial pressures are reached at 1250°C); moderate volatile components-Fe, SiO, Mg (maximum pressures  $10^{-1}$  tor at 1550-1875°C); nonvolatile components-Ca, Al, Ti (maximum pressures are reached at 2000°C). The monoatomic form of components in vapor is typical for Na, K, Fe, Mg, Ca. Silicon and titanium are present in forms of SiO and TiO correspondingly. Monoatomic form is typical for alumina, but forms AlO and  $\text{Al}_2\text{O}$  (fig.2) are also observed. The  $\lg P_i - T^\circ$  curves have in general increasing and decreasing "branches". The decreasing branches demonstrate the rapid impoverishment of the component in the residual melt and its escape off the cell. It is interesting to note that K and Na are present in vapor at 800°C when the chondrite is still in solid state. It is important to note that  $p_{\text{Na}} > p_{\text{K}}$  and ratio  $P_{\text{Na}}/P_{\text{K}}$  in vapor increases up to 1250°C. This fact permits to suppose that "vaporization metamorphism" at low temperature must result in decreasing alkali contents and increasing the K/Na ratio in residual chondrite material. The vaporization of iron is recognized at comparatively low temperature (1200°C). The  $\lg P_{\text{Fe}} - T^\circ$  curve has two maximums which may be indication on the vaporization of the two iron forms: Fe-metal (maximum pressure at 1550°C) and Fe in silicates (maximum pressure at 1720°C). Such interpretation is supported by coincidence of temperatures of maximum pressures for the second peak of Fe and FeO (fig.2). In fig.2 the position of  $\lg P_{\text{Cr}} - T^\circ$  and  $\lg P_{\text{Ni}} - T^\circ$  are also shown. The maximum pressure for Cr is observed at the same temperature as for SiO. Ni begins vaporize after Fe has reached high pressure near temperature of maximum pressure of Fe-metal. It is possible to suppose that "vaporization metamorphism" of chondrite in the temperature interval 1250-1500°C must result in decreasing contents of Fe-Ni phase in meteorites and increasing of Ni/Fe ratio.

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It is important also to note that according to the position of peaks of partial pressures the components can be subdivided into three distinct groups. A temperature gap as large as 100-150° is observed when the pressure of some components drop while the pressures of other ones have not yet reached its maximum. This fact may be useful for understanding the origin of isolated composition of white inclusions in some carbonaceous chondrites.

**References.** 1.Hashimoto A., Kumazawa M., Onuma N. Earth Planet Sci. Lett., 1979, 43, N°1, p.13-21; 2. Gooding J.L., Muenov D.W. Meteoritics, 1977, 12, v.4, p.400-408; 3. Tsuchiyama A., Nagahara H., Kushiro I. Geochimica et Cosmochim Acta, 1981, 45, N°8, p.1357-1367.

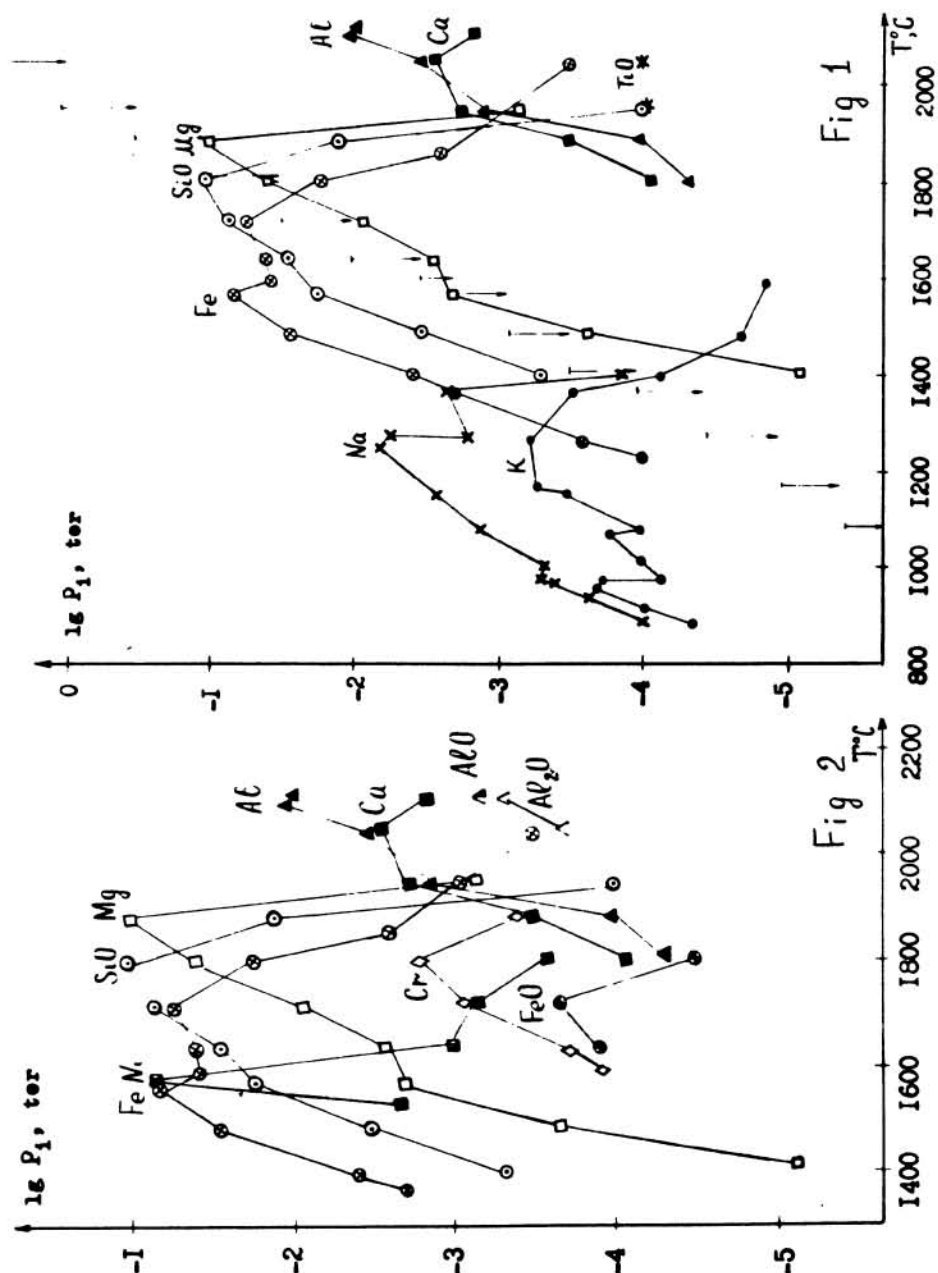


Fig.1, Fig.2. Partial pressure of the components in the vapor phase released from heated samples of the Krymka chondrite  
 The length of the vector corresponds to 10 min and the arrow points to temperature of the step.