A STUDY OF EVAPORATION OF MURCHISON CHONDRITE AND CAI INCLUSIONS IN EFREMOVKA USING THE KNUDSEN EFFUSION CELL.

S. I. Shornikov and O. I. Yakovlev, RAS Vernadsky Institute of Geochemistry & Analytical Chemistry, Kosygin st., 19, Moscow, 119991, Russia. E-mail: sergey.shornikov@gmail.com.

Introduction: Vaporization (condensation) is among the key physicochemical processes that form the meteorite substance composition. These processes played an especially important role at formation of the substance of white inclusions in carbonaceous chondrites (CAI). The problems of the origin and physicochemical conditions for CAI formation remain the subject of continuous discussions [1]. A weak side of various genetic models of CAI is their construction on a purely theoretical basis without due reliance on experimental data. Therefore, of special interest are the results of the study on evaporation of CAI substance from the Efremovka meteorite [2].

Experiment: The experiments were performed by the mass spectrometric method at evaporation from a Knudsen effusion tungsten cell of CAI inclusions in Efremovka and Murchison sample. To reduce the interaction of cell material the samples were placed in a rhenium boat on the bottom of a tungsten cell. It did not fully rule out the reducing action of tungsten. The temperature dependence of changes in the studied melts was determined at temperatures up to 2900 K. Experiments were spent in the conditions of step temperature lifting with step of 50 K at the constant temperature about 15 minutes. The chosen conditions of step heating allowed to keep a molecular mode of the expiration of steam at the given weight of the sample and optimum to reduce the experiment duration.

Results and Discussion: We identified the gas phase composition (monoatomic forms: K, Na, Fe, Mg, Ca, Al; oxide forms: FeO, SiO, TiO, TiO_2, CaO, AlO, Al_2O) and found the partial pressure values of vapor species.

Results of experiments on the Murchison chondrites have shown that the temperature sequence of evaporation components melt to a gas phase is almost identical to the known data on evaporation of the lunar basalt [3]. The maximum concentration of silicon dioxide in melt is observed to temperature 2000 K. At high temperature its concentration sharply falls at increasing of concentrations CaO and Al_2O_3 (to 60–65 wt. % Al_2O_3).

The CAI inclusions in Efremovka evaporation characterized of silicon monoxide presence in the gas phase with the high partial pressure (10^{-6} atm) at the temperature range 2400–2700 K. The partial pressure values of p(SiO) are closed to the same of p(Ca) and p(Al). It is obviously the such unusual values of p(SiO) are due to the high values of $p(O_2)$ in comparison to typical for evaporation of Murchison chondrite and lunar basalt. For example, at temperature 2350 K the value of $p(O_2) = 1.0 \cdot 10^{-6}$ atm for CAI inclusions in Efremovka, and the value of $p(O_2) = 2.0 \cdot 10^{-7}$ atm for Murchison chondrite.

The obtained result has a genetic importance which showed of the special conditions of formation of CAI inclusions in Efremovka. The CAI inclusions in Efremovka feature is in their formation in the regions with high oxygen concentration.

References: [1] Shornikov S. I. and Yakovlev O. I. 2010. Abstract #1408. 41st Lunar & Planetary Science Conference. [2] Yakovlev O. I. et al. 1984. 15th Lunar & Planetary Science Conference. pp. 945–946. [3] Markova O. M. et al. 1986. Geokhimiya, No. 11, pp. 1559–1569 (in Russian).