EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF EVAPORATION OF CHONDRULE MELTS OF THE SARATOV CHONDRITE.

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The question of the chondrule formation is one of the most important in meteoritics. Despite the success of modern experimental studies, formation and evaporation conditions of chondrule melts remain unclear [1]. It is believed that the study of the alkali evaporation will provide a key for understanding physical and chemical conditions of the chondrule formation. Potassium in elementary, oxide, chloride, and other simple forms is more volatile than sodium, that was also observed in the evaporation experiments of basaltic and more basic melts [2–4]. Other authors suggest the higher volatility of sodium than the potassium volatility[1].

In this regard, the results of a single mass spectrometric study [5] of evaporation of pyroxene chondrules of the Saratov chondrite from a tungsten cell (according to Knudsen) at 1000–2100 °C are of particular interest. The experiment details were described in [6]. The chondrules of the Saratov chondrite belong to IIB-type and have the following composition (wt. %): SiO_2 (54.44), TiO_2 (0.13), Al_2O_3 (3.20), FeO (13.17), MgO (24.98), CaO (2.24), Na_2O (1.44), and K_2O (0.40). The temperature dependences of the partial pressures (p) of vapor species over the chondrule melts at evaporation are shown in Fig. 1. As it is shown on Fig. 2, the obtained experimental data are in agreement with those calculated at 1100–1500 °C for the K_2O–Na_2O–SiO_2 melts, containing from 35 to 55 wt. % SiO_2 at different K_2O / Na_2O ratios [7]. The developed model was based on the theory of associated solutions and is presented in details in [8]. Fig. 2 shows the ratios of the partial pressures of K and Na, prevailing in the gas phase over the K_2O–Na_2O–SiO_2 melts, *vs*. the melt composition (Fig. 2a) and temperature (Fig. 2b). Comparing the p_K / p_{Na} ratios at 1200 °C over compositions simulating ultrabasic and medium-acid melts (containing 35 and 55 wt. % SiO_2), it is possible to see the preponderance of p_K over p_{Na} at evaporation of the ultrabasic melt (p_K / p_{Na} > 1). In the case of the medium-acidity melt evaporation at relatively low K_2O contents, the ratio of p_K / p_{Na} < 1 (Fig. 2a). Thus, the p_K / p_{Na} ratio over the melts with different acidity can experience an inversion of relative volatility, which also depends on the content of alkalis in the melt. In our opinion, this is the reason for the different ideas about the relative volatility of K_2O and Na_2O at the chondrule evaporation. It follows from the calculations that the temperature dependence of the p_K / p_{Na} ratio can be determined by the acid-base parameters of the melt. Fig. 2b shows decrease in the p_K / p_{Na} ratio with the temperature increasing in the ultrabasic melt and the absence of such in the medium acidity melt.

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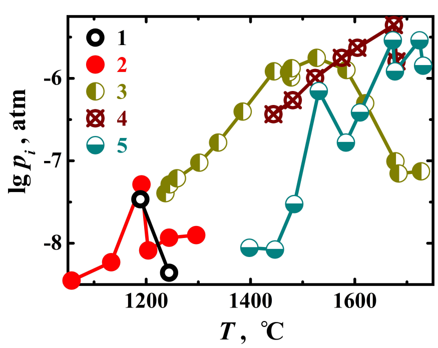

Fig. 1. The partial pressure of vapor species over the chondrule melts of Saratov chondrite at evaporation from tungsten effusion cell [5]: K (**1**); Na (**2**); Fe (**3**); SiO (**4**); Mg (**5**).

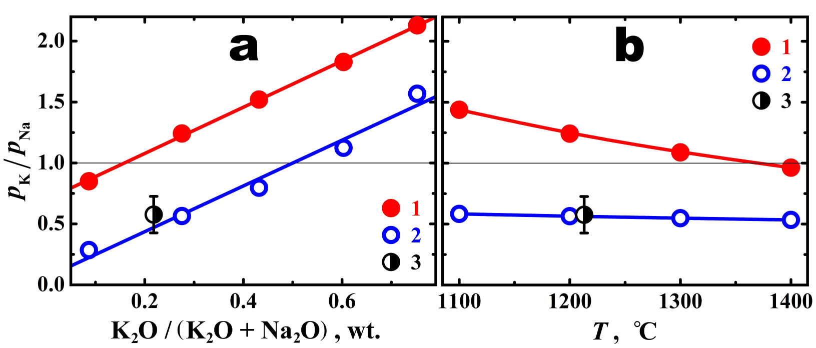

Fig. 2. The p_K / p_{Na} ratio over the K_2O–Na_2O–SiO_2 melts (**1**, **2**) and the chondrule melts of Saratov chondrite (**3**) *vs*. the melt composition at 1200 °C (**a**) and *vs*. temperature (**b**). Compositions contained 35 (**1**) and 55 (**2**) wt. % SiO_2 (**a**, **b**) with a ratio of K_2O / Na_2O ≈ 3 / 4 (**b**); data for chondrul of Saratov chondrite (**3**) are taken from [5].

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