FACTORS OF THE SELECTIVE VAPORIZATION OF MELTS IN VACUUM (ON THE EXAMPLES OF VAPORIZATION OF ALKALIS (K₂O AND Na₂O)). O.I. Jackovlev, V.I. Vernadsky Institute of Geochemistry and Analytical Chemistry USSR Academy of Sciences, Moscow, USSR

Vaporization and condensation are important phenomena in forming geochemical properties of the Moon. The sphere where the knowledge about vaporization and condensation of complex natural objects can be applied comprises both materials which were melted up to very high temperature due to impact processes and magmas which were erupted in vacuum on the lunar surface. Moreover these phenomena are important for understanding the early accretionary history of the Moon.

This paper reports some preliminary experimental data about vaporization of K₂O and Na₂O from basalt, granodiorite, granite, potash feldspar, plagioclase (Ab₈₂ An₁₈) melts in the pressure range 760 to 1.10⁻⁶ torr and up to temperature of about 1800°C. These data permitted some conclusions to be made about the factors of vaporization which control the behaviour of the components in the melt.

The volatility of a component of the multicomponent melt can be described by generalized equation of Raul-Genry: \( p_i = p_i^0 x_i γ_i \), where \( p_i \) is the partial pressure of the \( i \)-th component in the vapor in equilibrium; \( p_i^0(T) \) is the vapor pressure of the pure \( i \)-th component (this pressure is only temperature-dependent); \( x_i \) is the concentration of the melt; \( γ_i \) is the coefficient of the activity or the measure of the interaction between the \( i \)-th component and other components in the melt.

The purpose of the experiments was to study the role \( T \), \( x_i \) and \( γ_i \). Coefficient of the activity was studied indirectly from the total composition of the melt and from \( P_{O₂} \) which have the functional correlation with \( γ_i \).

1) Temperature increase of the melt increases the partial pressure of the vapor of components above the melt as well as the velocity of the vaporization. For the volatile components - K₂O and Na₂O - it results in decreasing concentration in the remnant melt. The decrease of concentrations of K₂O and Na₂O in plagioclase and potash feldspar melts that depends on the temperature is shown in Fig. 1. Experiments were carried out for
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P=5.10^{-6} \text{ torr and time interval } \sim 50 \text{ minutes.}

2) Concentration in the melt. Experiments show that low initial concentration of the components causes low volatility and, therefore, low vaporization even of volatile components. We could see the effect of the initial concentration in the case of the vaporization K_{2}O from different basalts. In our basalts the initial concentrations were 1.99; 1.32; 0.55 wt%. After vaporization (T=1500°C, P \sim 10^{-5} \text{ torr}) the concentration of K_{2}O were 0.11; 0.24; 0.16 wt%. Thus the change of the K_{2}O concentration was smaller in the basalt in which the initial K_{2}O concentration was also smaller.

3) Acid-alkaline properties of the melt. Relative volatility of the component is controlled by its interaction in the melt or by its \gamma_i. Coefficient of the activity is related to the acid-base index of the melt (a_{1-2}) \text{ (1)}: \frac{\partial n \gamma_i}{\partial n a_i} = \alpha_i \text{ where } \alpha_i \text{ is the ionization constant of one - or two - valent metal oxide in the melt. According to this formula } \gamma_i \text{ of the metal oxide increases with increasing alkalinity of the melt, and the more so for a component with stronger base properties. Thus increasing of melt acidity would lower the effect of vaporization on alkalis and the stronger on alkali the more pronounced the effect is (2). Fig.2 shows how the ratio K_{2}O/Na_{2}O changes with vaporization of various melts of basalts, granodiorite and granite. SiO_2 concentration is an indirect index of acid-alkaline property of the melt. Experimental data show that relative volatility of K_{2}O is higher than that of Na_{2}O in basalt with SiO_2 up to \sim 50 \text{ wt%}; on the contrary, relative volatility of Na_{2}O is higher than that of K_{2}O in granodiorite and granite. On the whole volatility of alkalis in acid rock-melt and medium rock-melt is lower than in base rock-melts. Experimental data and regular features of vaporization are in conformity with the theory of acid-alkaline interaction by D.S.Corginski.

4) Partial pressure of oxygen. External pressure of oxygen is related to the activity of oxygen ions in the melt, this relationship determines the value of \gamma_i and, therefore, volatility of the components. Fig.3 illustrates the effect of P_{O_2} on vaporization of K_{2}O and Na_{2}O from granodiorite melt. Volatility K_{2}O, as compared with Na_{2}O, is seen to decrease with decreasing P_{O_2}. This fact proves that the decrease of P_{O_2} decreases
the alkalinity of the melts and also the activity of K₂O and Na₂O particularly that of K₂O.

Our experimental data may be used to explain some geochemical properties of lunar rocks, especially low concentration of K₂O and Na₂O in mare basalts, high concentration of K₂O in KREEP-basalts and lunar granites and specific features of the chemical composition of the lunar regolith.

**Fig. 1** Change of the K₂O and Na₂O concentration in potash feldspar (■) and plagioclase (○) as a result of the vaporization, depending on temperature (P=5·10⁻⁶ torr).

**Fig. 2** Change of the ratio K₂O/Na₂O in the melts with different acidity. Pointer directed downwards shows decrease and upwards increase ratio K₂O/Na₂O. Length of the pointer shows the value of the change.

**Fig. 3** Change of the ratio K₂O/Na₂O in the granodiorite melt depending on external P₂O₅ (T=1550°C).