FACTORS OF THE SELECTIVE VAPORIZATION OF MELTS IN VACUUM (ON THE EXAMPLES OF VAPORIZATION OF ALKALIS (K_2O and Na_2O)). 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 K_2O and Na_2O from basalt, granodiorite, granite, potash feldspar, plagioclase (Ab_{82} An_{18}) 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: $p_i = p_i^0 x_i \gamma_i$, where p_i is the partial pressure of the - i-th component in the vapor in equlibrium; $p_i^0(T)$ 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_{O_2} 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 - K_2O and Na_2O - it results in decreasing concentration in the remnant melt. The decrease of concentrations of K_2O and Na_2O in plagioclase and potash feldspar melts that depends on the temperature is shown in Fig.1. Experiments were carried out for

FACTORS OF SELECTIVE VAPORIZATION

Jackovlev O.I.

$P=5.10^{-6}$ torr and time interval ~ 50 minuts.

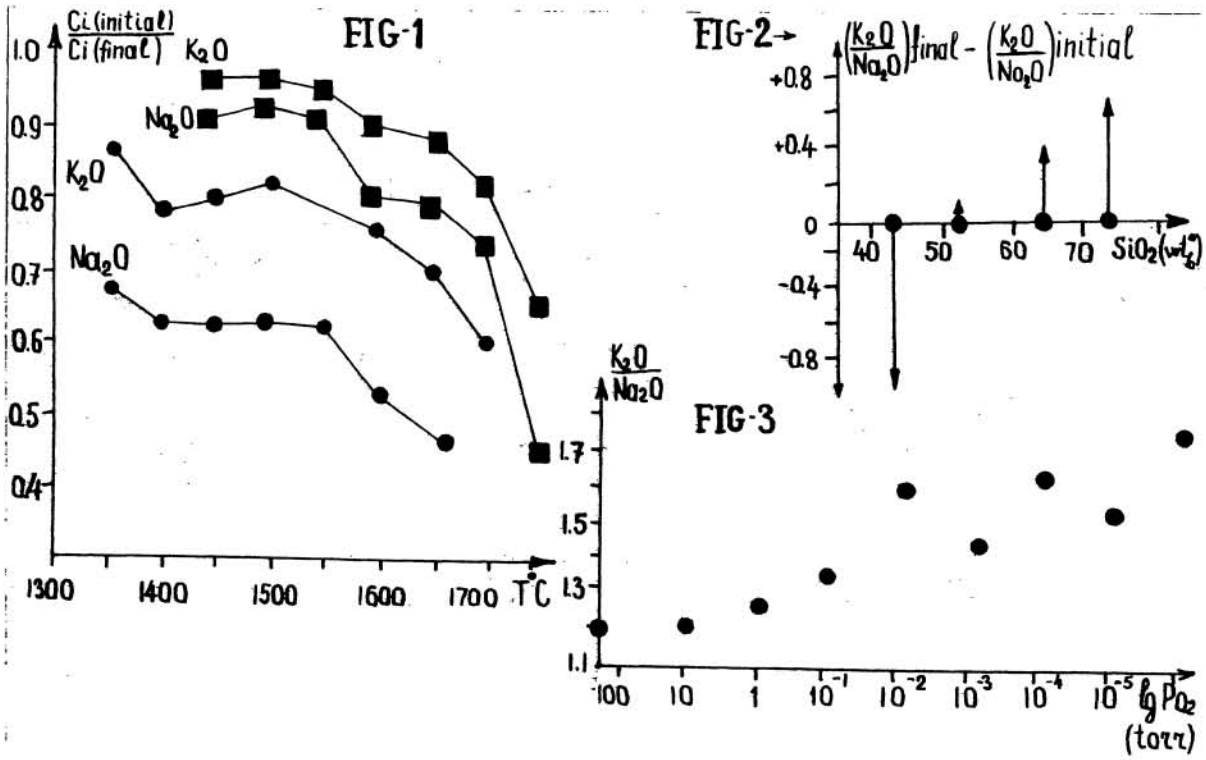
2) Concentration in the melt. Experiments show that low initial concentration of the components causes low volatility and, therefore, low vaporization even of volatile components. We could see the effect of the initial concentration in the case of the vaporization K_2O from different basalts. In our basalts the initial concentrations were 1.99; 1.32; 0.55 wt%. After vaporization (T=1500°C, $P \sim 10^{-5}$ torr) the concentration of K_2O were 0.11; 0.24; 0.16 wt%. Thus the change of the K_2O concentration was smaller in the basalt in which the initial K_2O 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 γ_i. Coefficient of the activity is related to the acid-base index of the melt ($a_{O^{-2}}$) (1): $\partial \ln \gamma_i / \partial \ln a_{O^{-2}} = \alpha_i$ where α_i is the ionization constant of one - or two - valent metal oxide in the melt. According to this formula γ_i 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_2O/Na_2O 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_2O is higher than that of Na_2O in basalt with SiO_2 up to ~50 wt%; on the contrary, relative volatility of Na_2O is higher than that of K_2O 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.Corginoki.

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 γ_i and, therefore, volatility of the components. Fig.3 illustrates the effect of P_{O_2} on vaporization of K_2O and Na_2O from granodiorite melt. Volatility K_2O, as compared with Na_2O, is seen to decrease with decreasing P_{O_2}. This fact proves that the decrease of P_{O_2} decreases

FACTORS OF SELECTIVE VAPORIZATION

Jackovlev O.I.



the alkalinity of the melts and also the activity of K_2O and Na_2O particularly that of K_2O.

Our experimental data may be used to explain some geochemical properties of lunar rocks, especially low concentration of K_2O and Na_2O in mare basalts, high concentration of K_2O in KREEP-basalts and lunar granites and specific features of the chemical composition of the lunar regolith.

Fig.1 Change of the K_2O and Na_2O 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 K_2O/Na_2O in the melts with different acidity. Pointer directed downwards shows decrease and upwards increase ratio K_2O/Na_2O. Length of the pointer shows the value of the change.

Fig.3 Change of the ratio K_2O/Na_2O in the granodiorite melt depending on external P_{O_2} (T=1550°C).

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