VAPORIZATION OF LUNAR HIGHLAND ROCKS: EXPERIMENTAL INVESTIGATION.

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Introduction. Undoubtedly the chemistry of the lunar highland rocks is partly result of intensive impact bombardment. As we know the processes of selective vaporization and recondensation of vapor could lead to migration of alkalies, phosphorus, iron and silica. But until now the scale of chemical transformation of rocks produced by impact reworking is not clear. The peculiarities of selective vaporization of multicomponent melts are also not clear. The presented here experiments were carried out for obtaining data about partial pressures of some main components in the process of the vaporization of high-Al melts (or highland rocks). The analogous work was earlier carried out by De Maria et al[1] with the basalts of lunar mare.

Technique. The vaporization occured in the Knudsen cell.Mass spectrometry (MS-1301) has been use to quantative determination of vapor phase composition.Brief description of the experimental technique has been given in[2]. The heating rate was 3-7 grad/min. The compositions of initial samples are shown in the table. The principal peculiarity of these samples is the different contents of Al_2O_3. Full vaporization has been reached in all experiments.

Results. The following atomic and molecula forms of the components were observed in vapor phase:Na, K,PO,PO_2,SiO,Mg,Ca,Al,AlO,Al_2O,TiO,TiO_2,O,O_2. There were also identified FeO,CaO,MgO (?),Al_2O_2, but their quantities were insignificant. It's possible to infer that simple monatomic form in vapor is characteristic for basic components in melts; oxide and suboxide forms are characteristic for acid components. Amphoteric oxide Al_2O_3 has several forms of particles in vapor. Monoatomic form Al prevailed while the proportions of AlO and Al_2O were not higher than 10%. Fig.1,2,3,4 demonstrate the partial pressures of the components in the vapor over residual melts of terrerstrial anorthite, anorthositic gabbro and troctolite and Apollo-16 high-alumina basalt 68415,40 in dependance on temperature. In all cases the sequence of components release into vapor phase (or sequence of reaching of maximum pressure) was similiar: (Na,K)>Fe>SiO>Mg>Ca,TiO>Al. It's important to note that this sequence coincides in general with the row of volatilities of these substances taken in pure oxide forms. Fig.1-4 demonstrate that the dependances lg P_i-T^o do not coincide for different melts. Only mass-pyrograms for similiar compositions of anorthositic gabbro and Apollo-16 basalt are quite similiar. With increasing temperature the pressure of any component grows at first then it reaches maximum value and then drops.This dependence may be explained that a volatility of the substance in multicomponent melt dependes not only on its individual volatility but on its activity in the melt. The activity of the component is controlled by its concentration and activity coefficient. The latter is the index of the interaction of the component in the given chemical surroundings. In spite of decreasing of concentration the partial pressure at first increases as the temperature at this stage is the decisive factor forming the pressure.At the point of maximum pressure the low concentration compensates for the "temperature aspiration" to increase the pressure. At the higher temperature the concentration becomes already the decisive factor and the further concentration decrease leads to decreasing the the value of partial pressure.

The position comparison of the partial pressure curves for the same components on lgP_i-T^o diagramms shows clearly that the points of maximum pressure are schifted to high temperature the more, the high Al_2O_3 contents occured in the initial materials. It means that the less alumina rocks or more easy melted rocks among lunar anorthosites and troctolites should be more sensitive to the impact vaporization process

References. 1.De Maria., Balducci G., Guido M., Piacente V.(1972) Proc. of the 2nd L.S.C. v.2, p.p. 1367-1380
2.Yakovlev O.I.,Markova O.M.,Semenov G.A., Belov A.N.(1983) LPSC,X1Y

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Table. The compositions of initial samples

Oxides	1	2	3	4
SiO_2	42.86	42.73	45.40	44.16
TiO_2	0.05	0.05	0.32	0.13
Al_2O_3	36.63	26.72	28.63	20.29
FeO	0.55	5.54	4.25	8.84
MnO	0.00	0.09	0.06	0.14
MgO	0.11	8.27	4.38	15.58
CaO	19.16	14.31	16.39	10.79
Na_2O	0.55	1.26	0.41	0.71
K_2O	0.06	0.11	0.06	0.08
	100.05	99.16	99.96	100.72

1-anorthite; 2-anorthositic gabbro; 3- Apollo-16 high-alumina basalt; 4-troctolite

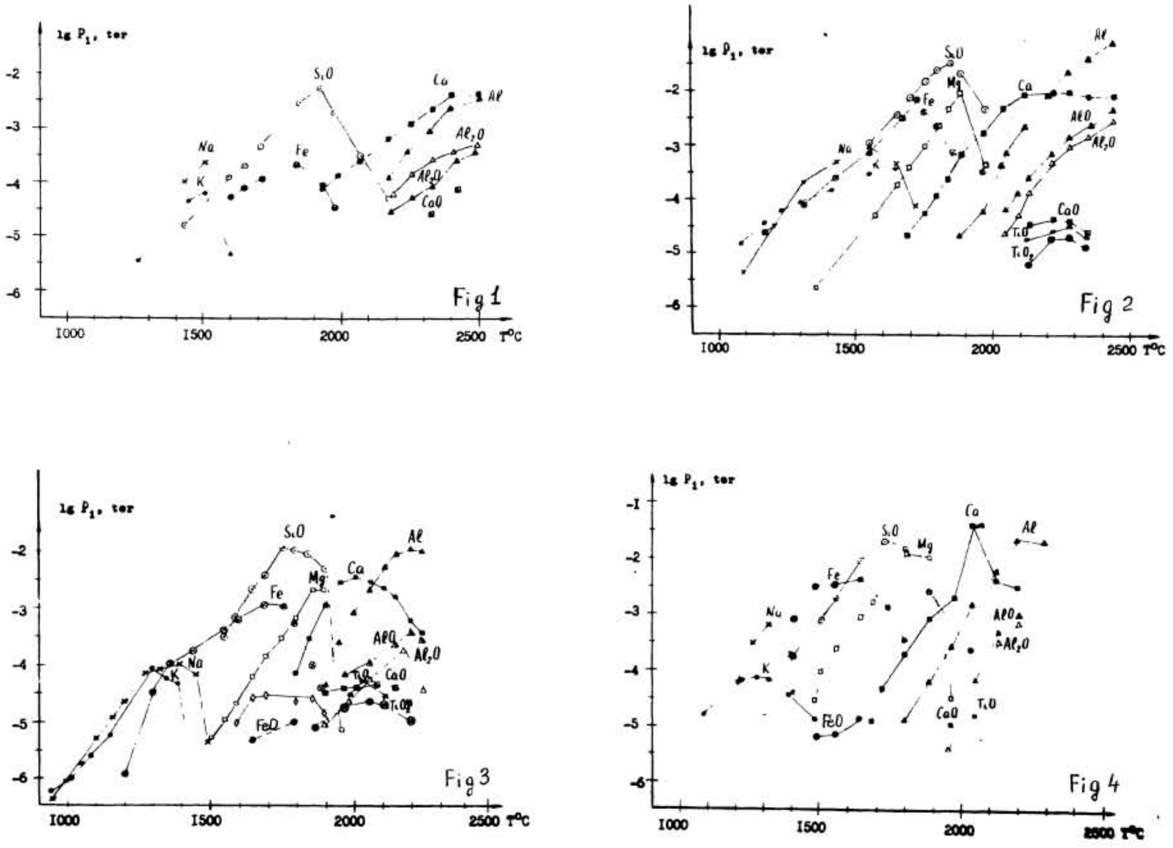

Fig.1, Fig.2, Fig.3, Fig.4. Partial pressures of major components in vapor phase released from heated samples: anorthite(1), anorthositic gabbro(2), Apollo-16 basalt 68415,40(3), troctolite(4)