LAMPROPHYLLITE MELTING AT ATMOSPHERIC PRESSURE

Zaitsev V.A., Krigman L.D., Kogarko L.N. *(GEOKHI RAS)*
alkaline@geokhi.ru; fax: +7 (095) 938-20-54; tel. +7 (095) 939-70-63

Alkaline rocks are caracteresed by big variety of titanosilicate minerals. But data about stability conditions is absent for the majority of them. The typical representative of this group is lamprophyllite ($(Sr,Ba,K,Na)_2$ Na $(Na.Fe,Mn)_2Ti[Ti_2(Si_2O_7)_2O_2](O,OH,F)_2$).

We execute melting experiments for determination of its stability field. We obtain initian data of melting of lamprophyllite-nepheline and lamprophyllite- silica systems (fig.1).

The initial substanses were natural lamprophyllite, SiO_2 and synthetic nepheline. The bulk compositions are indicated in the table 1.

Table 1.

Initial compositions, used in the experiments

	Lam	7Lam:1Ne	13Lam:2Q
SiO_2	31.78	32.79	40.42
TiO_2	29.49	26.66	25.76
Al_2O_3	0.17	3.59	0.14
FeO	2.15	1.94	1.88
MnO	4.02	3.64	3.51
MgO	0.63	0.57	0.55
CaO	0.87	0.79	0.76
SrO	15.05	13.61	13.15
BaO	1.05	0.94	0.91
Na_2O	12.07	13.00	10.54
K_2O	0.49	0.44	0.43
Nb_2O_5	0.21	0.19	0.18
F	2.05	1.86	1.79
Sum	100.03		

Experiments were performed in platinum capsules by a quenching method. The duration was 5-9 hours. We approached the quilibrium by a number of experiences “up” and “down”, and others only “up”. We studied crushed samples in immersion oils and by EMA.

We found incongruent melting of lamprophyllite with formation of melt, tausonite (Sr-analogue of perovskite), rutile (TiO_2) and freudenbergite ($Na_2Fe_{2-x}Ti_{6+x}O_{16}$).

Lamprophyllite relicts were found in the samples experiences «down» up to temperature 870°C. New lamprophyllite was found in experiments "up" with Lam composition at the temperatures 831 and 848°C. The composition of new lamprophyllite was close, but not identical, to the composition of initial substance (see tab. 2) Lamprophyllite synthesis was executed for the first time.

Table 2.

The formulas of the new and the relict lamprophyllite

	(Sr	Na	K	Ba)	(Na	Mn	Fe	Mg	Ti	Nb)	(Si	Al)
New lamprophyllite	1.33	0.58	0.03	0.06	2.50	0.46	0.13	0.19	2.91	0.00	4.00	0.00
Relict lamprophyllite	1.05-1.19	0.65-0.76	0.06-0.18	0.01-0.06	1.81-2.24	0.23-0.46	0.18-0.36	0.14-0.25	2.75-2.98	0.00-0.06	3.92-3.98	0.02-0.08

It is possible to evalute the distribution coeffitients of additiondal elements between lamprophullite and melt basing on the data of glass composition and new lamprophyllite/

It is for K2O-0.16 for MgO - 1.52 for Al2O3 0.04 for MnO - 0.97 for FeO - 0.19. Dawson gives the similar data for lamprophyllite in combeite nephelenite of Oldonio-Lengai [1]: 0.29, 1.06, 0.06, 0.74 and 0.18 accordingly.

Using our data we estimate also $K_d^{Lam/L}(Sr/Ba)$ as 0.54.

The first phase crystallised from melts of Lam and 7Lam:1Ne is nonstechiometrically tausonite. Its formula (recalculated for two cations) is $Sr_{0,77}Na_{0.12}Ti_{0.97}Nb_{0.01}Fe_{0.01}Mn_{0.01}O_{2.83}$ Then rutile and

freudenbergite are crystallized. These phases in immersion oil are hardly identified, therefore we don't divide crystallization fields of their in the diagram. However, as microzond swow prevalence of rutile, it is possible to assume, that it is first to crystallise.

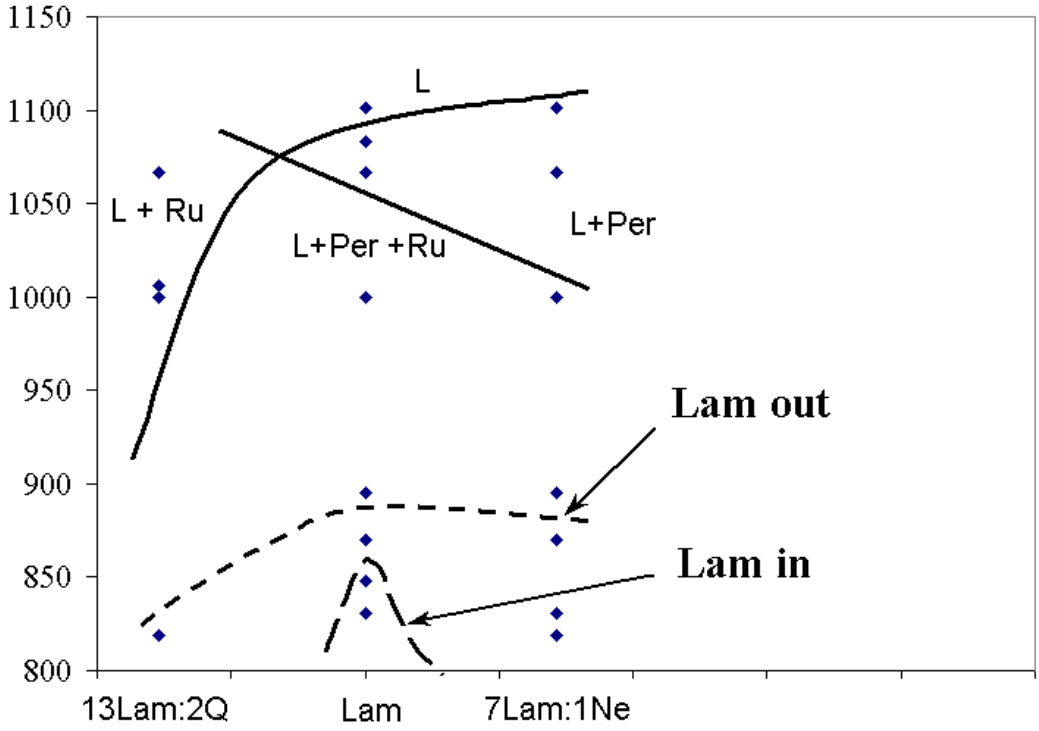

Fig. 1. Phase relations in lamprophyllite-nepheline and lamprophyllite- silica systems

The freudenbergite composition $Na_{1.66}Sr_{0.04}K_{0.01}Fe_{0.68}Mn_{0.35}Mg_{0.16}Ti_{7/00}$ – $Na_{1.95}Sr_{0.02}K_{0.01}Fe_{0.91}Mn_{0.25}Mg_{0.17}Ti_{6.51}$ is similar to the composition of high-Ti freudenbergite in alkali syenite dikes of Katzenbuckel volcano [2].

Addition of silica to the system changes the crystallisation sequence: the first phase is routile.

Correlation of crystallization fields of rutile and tausonite correspond to the D.S.Korzhinskii theory of the acid-basic interaction. Addition of silica (an acid component) to the system increases activity of acid oxide (TiO2) and promotes crystallisation of rutile. Addition of nepheline results in increase of activity of the basic oxides (SrO and Na2O) and causes crystallisation of tausonite.

References:

1. *Dawson J.B.* Peralkaline nepheline-natrocarbonatite relations at Oldonio Lengai, Tanzania. Jounal of petrology, 1998vol.39 № 11-12 pp. 2077-2098.
2. *Stähle V., Koch M., McCammon C.A., Mann U. Markl G.* Occurrence of low-Ti and high-Ti freudenbergite in alkali syenite dikes from the Katzenbuckel volcano, SW Germany Canadian Mineralogist, 2002, Volume 40, №6.

Electronic Scientific Information Journal "Herald of the Department of Earth Sciences RAS" № 1(21)'2003
Informational Bulletin of the Annual Seminar of Experimental Mineralogy, Petrology and Geochemistry – 2003
URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2003/informbul-1_2003/magm-3e.pdf
Published on July 15, 2003