ISSN 0869-2904

EXPERIMENT In GeoSciences

Mineralogy Crystallography
Petrology Geophysics
Geochemistry Isotopy

2017 Volume 23 Number 1

Institute of Experimental Mineralogy
IEM RAS
Russian Academy of Sciences

EXPERIMENT in

Mineralogy
Petrology
Geochemistry
Crystallography
Geophysics
Isotopy

GeoSciences

Founded in **1991** by
INSTITUTE of EXPERIMENTAL MINERALOGY
Russian Academy of Sciences

EXPERIMENT IN GEOSCIENCES is the only journal in English that gives you the latest, most reliable information on advances in experimental mineralogy, petrology, geochemistry, crystallography and geophysics in Russia. The coverage of the journal includes:

- original research and review articles
- abstracts of scientific papers
- proceedings, abstracts and announcements of national and international conferences, symposia and workshop
- information about the leading experimental centers in Russia
- advertisement of new techniques and equipment

Institute of Experimental Mineralogy
Russian Academy of Sciences
142432 Chernogolovka
Academica Osip'yana str, 4,
Moscow region
Russian Federation

http://www.iem.ac.ru

TRANSLATED into ENGLISH by:
the authors

Suk N.I.[1], Kotelnikov A.R.[1], Peretyazhko I.S.[2], Savina E.A.[2] **Experimental study of melting of trachyrhyolite from Central Mongolia.**

[1] Institute of Experimental Mineralogy RAS, Chernogolovka Moscow district,

[2] A.P. Vinogradov Institute of Geochemistry SB RAS, Irkutsk (sukni@iem.ac.ru, kotelnik@iem.ac.ru, elen_savina@mail.ru)

Abstract. Experimental study of melting of trachyrhyolite was produced in high gas pressure vessel in presence of 10 wt% H_2O at two regimes: 1) at T=1250°C and P=5.5 kbar during of 6 h; 2) melting at T=1250°C and P=5.5 kbar (duration of 2 h) and then parameters were reduced to T=900°C and P=1 kbar (duration of 4 days). Starting materials were: trachyrhyolites of three types differ by F content (0.58, 2.45, 15.0 wt %) and mixtures of trachyrhyolites with minimum and maximum F contents in ratio 1:1, 2:1 and 1:2. It was obtained the immiscible splitting into aluminosilicate and fluoride-calcium melts which was observed when F content in the system was >5 wt%. Study of REE (La, Ce, Y, Gd, Dy) distribution between immiscible phases shows that REE predominantly concentrate in fluoride melt.

Keywords: experiment, melt, liquid immiscibility, trachyrhyolite, partition coefficients, effusive rocks

It has been investigated melting of trachyrhyolites discovered among effusive rocks of Nilginsky depression in Central Mongolia and belong to dzunbainsky suite of early Cretaceous. In trachyrhyolites of one of overtrusts the rocks anomaly enriched in Ca and F were discovered. In these rocks content of CaO and F run to 15-20 and 10-15 wt % respectively. To study trachyrhyolites of three types were selected. They differ in F content (0.58, 2.45 and 15.0 wt %). In thin sections these rocks have not symptoms of secondary changes and presented by light-gray or light-lilac porphyric rocks with phenocrysts of quartz and feldspars (sanidine). Mineral composition of selected rocks is identical and differs only in fluorite content.

Experimental method

Trachyrhyolite melting was produced in high gas pressure vessel in presence of 10 wt% H_2O at two regimes: 1) at T=1250°C and P=5.5 kbar during of 6 h; 2) melting at T=1250°C and P=5.5 kbar (duration of 2 h) and then parameters were reduced to T=900°C and P=1 kbar (duration of 4 days) and then isobaric quenching was produced. The triturations of trachyrhyolites of three types with different F content (0.58, 2.45 and 15 wt%) or mixtures of trachyrhyolites with minimal and maximal F content in proportions 1:1, 2:1 and 1:2 were used as starting materials.

Experiments to study phase distribution of REE have been produced in high gas pressure vessel at T=1250°C and P=5.5 kbar during of 6 h with addition of REE (La, Ce, Y, Gd, Dy) oxides (1 mg for each). The experimental samples were analyzed on a digital scanning electron Tescan Vega II XMU microscope.

Table 1. Compositions of initial F-contained trachyrhyolites of Mongolia (wt%).

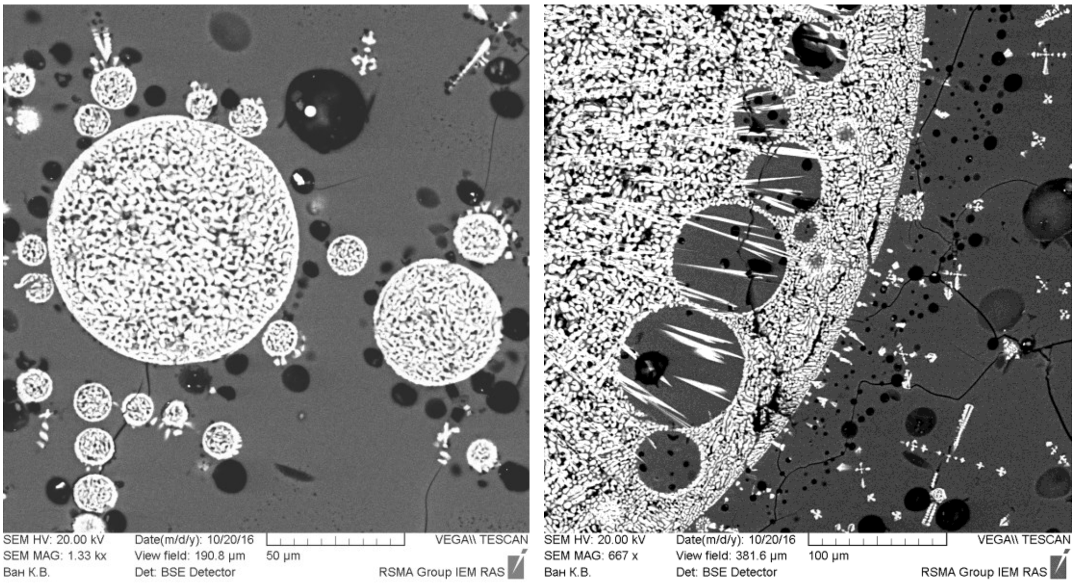
N	Mn1354	Mn1120	Mn1247
SiO_2	48.96	71.62	74.86
TiO_2	0.15	0.19	0.21
Al_2O_3	7.96	10.99	11.74
Fe_2O_3	0.34	0.67	0.70
FeO	0.30	0.80	0.63
MnO	0.06	0.09	0.05
CaO	22.76	5.27	1.21
MgO	-	0.03	0.05
K_2O	3.56	4.75	5.10
Na_2O	2.59	3.46	3.60
Li_2O	0.0082	0.0097	0.012
Rb_2O	0.014	0.022	0.023
P_2O_5	0.05	0.03	0.03
F	15.0	2.45	0.58
H_2O^-	0.09	0.21	0.11
H_2O^+	0.90	1.36	1.47
CO_2	0.17	<0.05	<0.05
∑(I)	102.51	101.89	100.38
O=2F	6.32	1.03	0.24
∑(II)	96.19	100.86	100.14

Experimental data

At T=1250°C and P=5.5 kbar in the sample with maximum F content (15 wt %) it has been obtained liquid immiscibility between silicate and fluoride-calcium melts, which produce drops of one liquid in another (fig. 1). Trachyrhyolites with F content of 0.58 and 2.45 wt % were melted forming homogeneous glass.

Second series to study trachyrhyolite melting was produced in conditions imitated volcanic process i.e. in decrease of temperature and pressure which is typical for the process of the magma rise to the earth surface and its eruption (T=1250°C, P=5.5 kbar => T=900°C, P=1 kbar).

In the sample of trachyrhyolite with maximum F content liquid immiscibility between silicate and fluoride-calcium melts appeared too, but segregations of immiscible phases were smaller (fig. 2) which approached experimental samples to natural trachyrhyolite image.



a **b**

Fig. 1. Liquid immiscibility between silicate (dark) and fluoride-calcium (light) melts, obtained at T=1250^{o}C and P=5.5 kbar. BSE image**.**

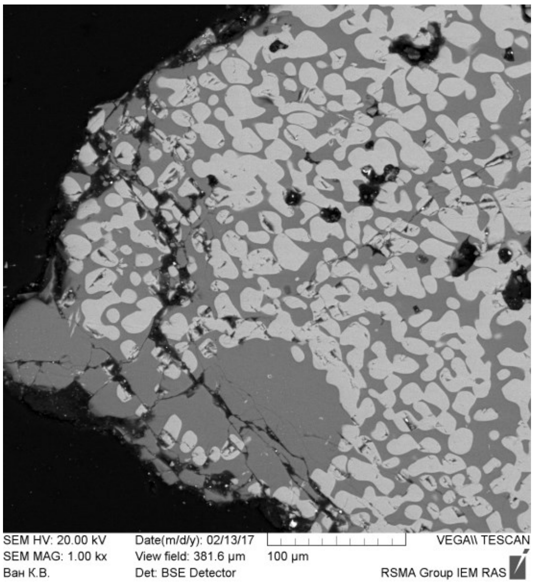


Fig. 2. Liquid immiscibility between silicate (dark) and fluoride-calcium (light) melts, obtained in conditions with decrease of temperature and pressure (T=1250^{o}C, P=5.5 kbar => T=900^{o}C, P=1 kbar). BSE image.

To estimate the minimum F concentration when liquid immiscibility can arise in the system the experiments with mixtures of trachyrhyolites with minimum and maximum F contents in ratio 1:1, 2:1 and 1:2 have been produced at T=1250^{o}C and P=5.5 kbar. Calculated F contents in the samples studied were 7.27, 5.15 and 9.40 wt % approximately. In all experiments liquid immiscibility was obtained (fig. 3). But in the sample with 5.15 wt % F content minimum amount of drops of fluoride-calcium phase was observed. These data show that liquid immiscibility can arise when the system contain F content >5 wt %.

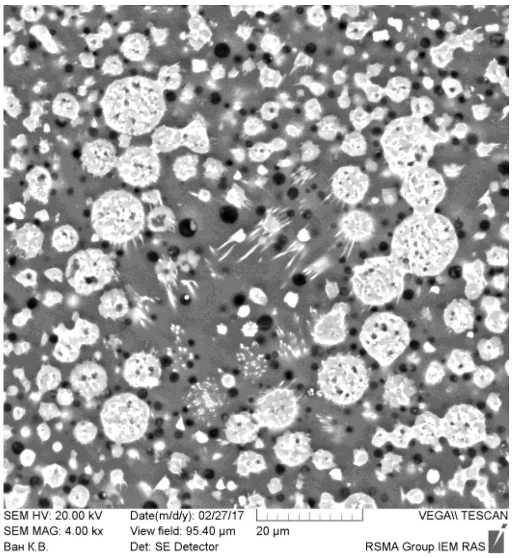


Fig. 3. Liquid immiscibility between silicate (dark) and fluoride-calcium (light) melts, obtained during melting of mixtures of trachyrhyolites with minimum and maximum F contents in ratio 1:2 (9.40 wt % F) at T=1250^{o}C and P=5.5 kbar. BSE image.

Investigation of REE (La, Ce, Y, Gd, Dy) distribution between layered phases at T=1250°C and P=5.5 kbar showed that they predominantly concentrate in fluoride melt. Preliminary estimations of partition coefficients of REE between aluminosilicate melt and fluoride-calcium phase ($K_i^{REE}=C_i^{LF}/C_i^{Sil}$) show that they are for Y ~ 20, La – 20-40, Ce –15-30, Gd – 20-30, Dy – 16-20.

In the sample with minimum F content (5.15 wt %) the emulsion looked like drops with 1-1.5 mkm in size has been distinctively observed (fig. 4). This phase was enriched in REE. Amount of this phase strongly decreases with increase of F content in the system. Mechanism of arising of such emulsion is apparently analogical to mechanism of titanate-silicate liquid immiscibility obtained by us previously (Suk, 2007, 2012).

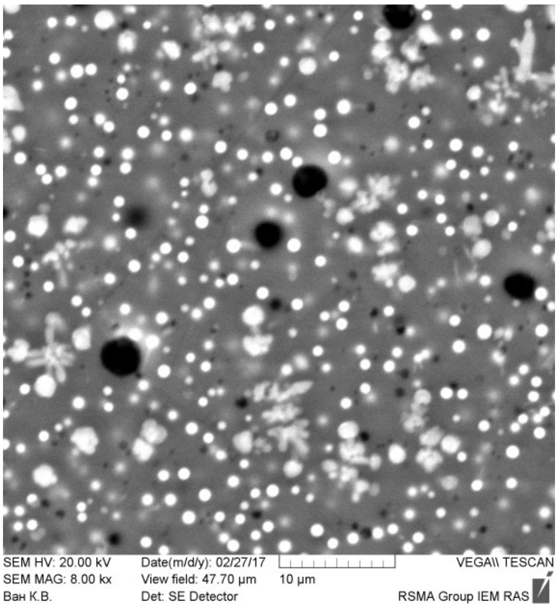


Fig. 4. Result of melting of mixtures of trachyrhyolites with minimum and maximum F contents in ratio 2:1 (5.15 wt % F) at T=1250°C and P=5.5 kbar. BSE image.

Petrographical observations and data of study of melting inclusions in minerals from trachyrhyolites evidence about coexistence of trachyrhyolite (aluminosilicate) and fluoride-calcium melts as at the stage of mineral phenocrysts growth in magma chamber so at lava eruption. This fact is proved out by our experimental investigations.

References:

1. Suk N.I. Experimental study of alkaline magmatic aluminosilicate systems with the connection of genesis of rare earth-niobium loparite deposits. Dokl. Akad. Sci. 2007. V. 414. N 2. P. 249-252.
2. Suk N.I. Liquid immiscibility in fluid-magmatic aluminosilicate systems containing Ti, Nb, Sr, REE and Zr (experiment). Petrology. 2012. V. 20. N 2. P. 156-165

Azarova N.S., Bovkun A.V. Typomorphic features of oxide minerals from the groundmass of kimberlite rocks of Kimozero (Karelia)

M.V. Lomonosov Moscow State University, Department of Geology, Moscow (nadiya-azarova@mail.ru)

Abstract. The results of the survey are reported of quantitative relations, phase and chemical composition of oxide minerals of kimberlite genesis proper from the groundmass of kimberlite rock of Kimozero pipe (Karelia). A typical feature of the composition of microcrystals chromite from Kimozero kimberlites is the extremely low content of magnesium. This feature distinguishes it from chromespinels of the kimberlite genesis proper from the groundmass of Russian kimberlites and kimberlites from abroad, usually containing from 5 to 15 wt. % MgO.

Keywords: Kimozero pipe, kimberlite, groundmass, oxide minerals, ilmenite, spinel

Paleoproterozoic Kimozero kimberlites, located within the Karelian craton, are one of the oldest original diamondiferous rocks in the world. The age of their formation corresponds to 1986 ± 4 million years (U-Pb dating of mantle zircons by the TIMS method) (Samsonov et al., 2009). Kimberlites contain diamond crystals larger than 1 mm (Ushkov et al, 1999), but the commercial significance of these rocks is still unclear.

The Kimozero occurrence is represented by a flattened elongated (~ 2 km) deposit and a series of steeply falling tubular bodies composed of kimberlite breccias, tuffs, massive kimberlites of at least two phases of intrusion (Ushkov, 2001, Putintseva, 2002, Putintseva et al., 2009, Ustinov et al. , 2009). Kimberlites penetrate the gabbro-dolerites of the Early Proterozoic and shungit-bearing terrigenous rocks of lydikovia (Onega Paleoproterozoic structure, 2011), they make up apophyses in them, contain a lot of their xenoliths and skalitites.

Petrographic features, chemical and phase compositions of oxide minerals have been studied in several samples of metamorphosed porphyritic massive kimberlites and kimberlite breccia of Kimozero, differing in the content of mica, carbonate, and ore minerals (Fig. 1). Porphyritic phenocrysts in the studied rocks are represented by pseudomorphs of serpentine in olivine up to 4 mm in size, as well as in large (up to 3 mm) grains of aluminomagnesiochromite, Mn-ilmenite and amphibole. In the groundmass of Kimozero kimberlites there's big amount of chlorite, serpentine and carbonates. Oxide minerals, apatite, baddeleyite, pentlandite, monazite and zircon are presented in a small amount. The kimberlite breccia differs from other studied samples with a low content of ore minerals and a wide occurrence of pseudomorphs of rutile and sphene in ilmenite and secondary iron oxides.