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Melting of trachyrhyolite from Central Mongolia (experimental study)

Топене на трахириолити от Централна Монголия (експериментално изследване)

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Introduction

The melting of trachyrhyolites has been investigated and belong to Dzunbainsky suite of Early Cretaceous discovered among effusive rocks of Nilginsky depression in Central Mongolia. In trachyrhyolites of one of overtrusts the rocks anomaly enriched in Ca and F were discovered. In these rocks the content of CaO and F run to 15–20 and 10–15 wt% respectively. The composition of the trachyrhyolite used in the experiments is as follows (wt%): SiO_2 48.96, TiO_2 0.15, Al_2O_3 7.96, Fe_2O_3 0.34, FeO 0.30, MnO 0.06, CaO 22.76, K_2O 3.56, Na_2O 2.59, F 15.0, H_2O^- 0.09, H_2O^+ 0.90. For the 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 are presented by light-gray or light-lilac porphyric rocks with phenocrysts of quartz and 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 T 1250 °C and P 5.5 kbar during of 6 h and then isobaric quenching procedure was produced. The samples 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 by electron probe X-ray spectral analysis (EZRSA) using a Tescan Vega II XMU scanning electron microscope (Tescan, Czech Republic) equipped with the INCA Energy 450 X-ray microanalysis system with energy-dispersion (INCAx-sight) and crystal diffraction (INCA wave 700) X-ray spectrometers (Oxford Instruments, England) and software platform INCA Energy +.

Experimental data

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

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 °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 our runs liquid immiscibility was obtained (Fig. 2). But in the sample with 5.15 wt% F content minimum amount of drops of fluoride-Ca phase was observed. These data show that liquid immiscibility can arise when the system contain F content >5 wt%.

The study of REE (La, Ce, Y, Gd, Dy) partitioning between immiscibly split phases at the indicated parameters (1250 °C and 5.5 kbar) dem-

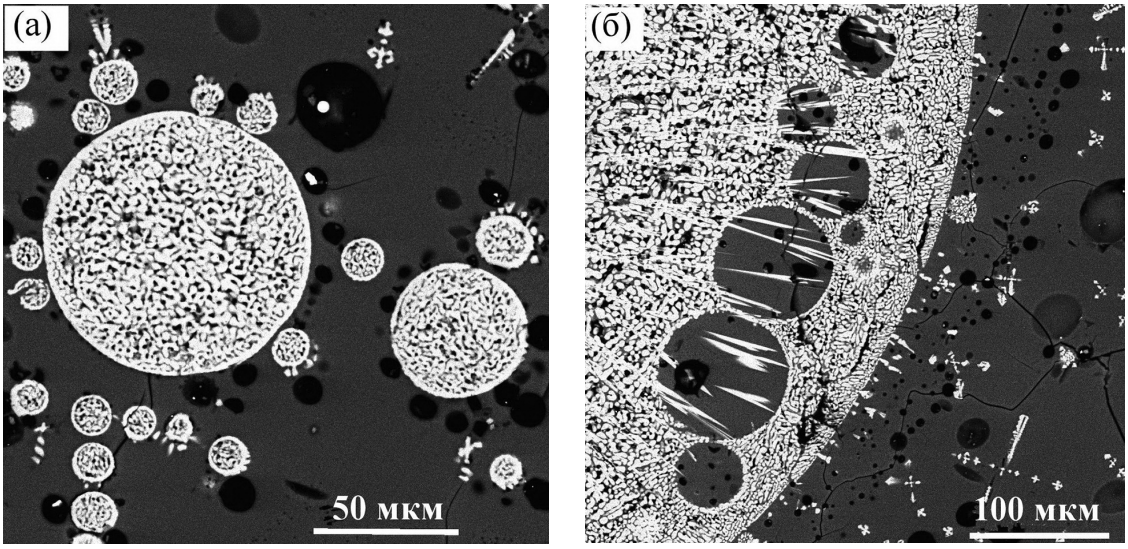

Fig. 1. (*a*, *b*) Liquid immiscibility between silicate (dark) and fluoride-Ca (light) melts, obtained at T 1250 °C and P 5.5 kbar. BSE image.

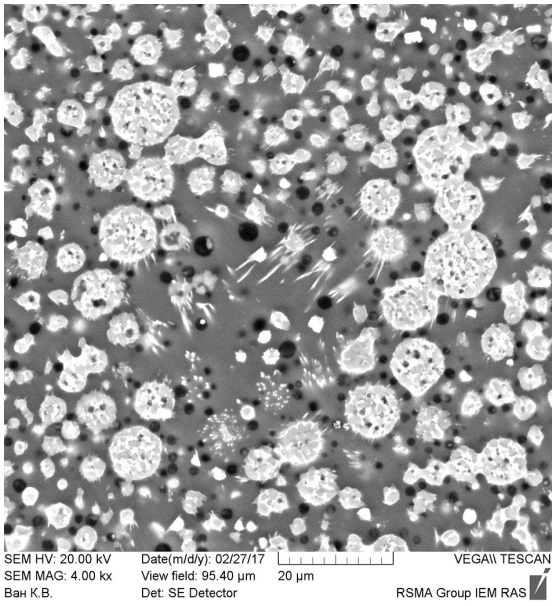

Fig. 2. Liquid immiscibility between silicate (dark) and fluoride-Ca (light) melts, obtained during melting of mixtures of trachyrhyolites with minimum and maximum F contents in ratio 1:2 (9.40 wt% F) at T 1250 °C and P 5.5 kbar. BSE image.

onstrates their accumulation mainly in the fluoride melt (Suk et al., 2017). The estimated REE partition coefficients between aluminosilicate and fluoride–Ca melts ($K_i^{REE}=C_i^{LF}/C_i^{Sil}$) are as follows: Y 20.5 (17–24), La 17.5 (11–24), Ce 14.5 (13–15), Gd 17 (12–23), Dy 20 (16–25), with variations of *K* values shown in parentheses.

Instead of a monotonous decrease, the *K* value shows an increase, for instance for Y and HREE (Gd, Dy). Based on the comparison of these results with data obtained in the systems with essentially Na fluoride phase (Shapovalov et al., 2019) we may conclude that a change in the REE partitioning is likely related to the different Na and Ca contents in the fluoride melt.

Petrographical observations and data of study of melting inclusions in minerals from trachyrhyolites (Peretyazhko et al., 2018) evidence about coexistence of trachyrhyolite (aluminosilicate) and fluoride-Ca melts as at the stage of mineral phenocrysts growth in magma chamber and also at lava eruption. This fact is proved out by our experimental investigations. Thus, the studied trachyrhyolites with the maximum F content could be formed only with the participation of liquid immiscibility.

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