EXPERIMENTAL STUDY OF CRYSTALLIZATION FOR MELANEPHELINITES OF THE MUNDUZHYAK VOLCANO (UDOKAN PLATEAU, RUSSIA)

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An aim of our research was an experimental study of crystallization peculiarities for melanephelinitic lavas of the Munduzhyak volcano (northern part of the Udokan Plateau). Liquidus temperature measuring, mineral crystallization sequencing, influence of melt supercooling order upon crystal composition, morphology, and structural peculiarities of newly formed rock were carried out.

Melanephelinites vastly dominate over lava types of the Munduzhyak volcano. They are composed of olivine (10-40 wt.%), clinopyroxene (30-70 wt.%), nepheline (10-20 wt.%), titaniferous magnetite (5-10 wt.%), chilled glass (up to 10 wt.%), and accessory phases, such as leucite, biotite, and apatite. The rocks are characterized by porphyric and glomeroporphyric textures. Matrix in-between phenocrystals has glassy-to-microlitic textures. Detailed mineralogical and petrologic descriptions are given in [1-3]. Thermobarogeochemical investigations were performed for determination of geochemical evolution paths of alkali lavas and presented in [4]. Melanephelinite melting and crystallization experiments were never processed until present.

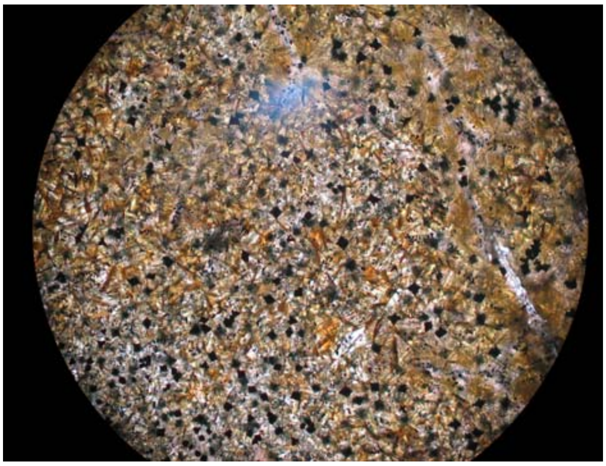
Experiments were carried out with original experimental gear described in [5]. Specimens were prepared using sample LV-18 described in [4]. Chemical composition of starting material is shown in Table 1. Over 30 high temperature experiments were processed under inert (Ar) atmosphere and normal pressure. As the starting lavas were basically dry (lost of ignition – 0.12 wt. %), 2 cm^3 platinum bowls instead of sealed capsules were used for experiments. First, the samples were crashed and milled in hard-alloy mortar to grain size less than 20 µm. Next, obtained powders were dried up during 2 hours under 120-140ºC to avoid an extraneous moister. 0.5-1 g portion of powder was placed into Pt bowl. The bowl was settled in heat chamber. Initial melt homogenization was processed during 4-6 hours under temperatures of 1400-1450ºC. Isothermal conditions of melt were withstood during 2-3 hours with 20-30ºC temperature interval. Chilling of sample portion was processed in heat chamber because of low thermal lag. Cooling rate was 1.5-2ºC/sec.

Table 1. The bulk composition of starting material prepared from melanephelinite LV-18 (XRF analysis, analyst L.D. Kholodova)

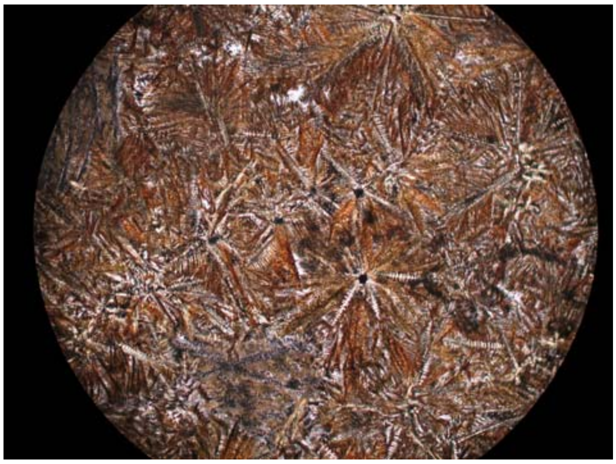
SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	LOI	Total
42.39	2.73	12.40	12.21	0.17	13.67	10.71	2.70	2.28	0.62	0.12	100.00

Two-side polished 50-100 µm thick plates of chilled melt samples were prepared for detailed optical and analytical studies. It was ascertained, that first crystallizing phase was presented by Fe-Mg-Al spinel, the second phase was Mg-rich olivine, the third was clinopyroxene. Liquidus temperatures for the melts of the above composition are within 1330-1350ºC. Primary and chilled phases may be easily identified optically. The first (spinels and olivine) are characterized by well-faceted and nearly isometric crystals. The second (mostly pyroxenes) form needles and dendrites. Chilled pyroxenes often have been crystallized around primary spinels forming fanlike and variolitic textures.

Besides melt liquidus temperatures, an important genetic value belongs to rates of supercooling from the beginning of crystallization and to morphology of newly formed crystals. Various morphologic types of olivine crystals formed during crystallization of basaltic and picritic melts under various rates of supercooling and crystal growth are described in [6, 7]. Both isometric prismatic olivines and coreless (boxlike) olivine crystals have been observed in the products of our experiments, as well.



Equigranular texture of melanephelinite after experiment. View size is 1 mm. Parallel nicols.



Variolitic texture of melanephelinite after experiment. View size is 1 mm. Parallel nicols.

Fig.1. Melanephelinite textures resulted from experiments of various cooling kinetics

It is concluded, that cooling kinetics and supercooling rates influence morphology of crystallizing phases, textural varieties of newly formed 'rocks' from equigranular, fine-to-middle grained textures to variolitic textures (fig.1). Similar textures have been observed in natural volcanic rocks.

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References

1. *Stupak F.M.* First finding of leucite-bearing lavas in the Cenozoic of Baikal Rift Zone // Proceedings of USSR Acad. Sci. 1980. V. 225. N 3. PP. 122-124. (In Russian).
2. *Rasskazov S.V.* Basaltoides of Udokan // Novosibirsk: Nauka. 1985. 142 pp. (In Russian).
3. *Stupak F.M.* Cenozoic volcanism of the Udokan Ridge // Novosibirsk: Nauka. 1987. 169 pp. (In Russian).
4. *Litasov Yu.D.* Peculiarities of evolution for alkali basaltoides of Ingamakit and Munduzhyak volcanoes (Udokan Lava Plateau) // Thermobarogeochemistry of mineral-forming processes. Ed. A.V. Simonov & V.Yu. Kolobov. UIGGM SB RAS. Novosibirsk. 1992. 2nd issue. PP. 16-29. (In Russian).
5. *Petrushin E.I., Bazarov L.Sh., Gordeeva V.I., Sharygin V.V.* Heat chamber for petrologic studies of alkali effusive rocks // Instruments and technique of experiment. 2003. N 2. PP. 108-112. (In Russian).
6. *Donaldson C.H.* An experimental investigation of olivine morphology // Contrib. Mineral. Petrol. 1976. V. 57. PP. 187-213.
7. *Jambon A. et al.* Olivine growth rates in a tholeiitic basalt: An experimental study of melt inclusions in plagioclase // Chem. Geol. 1992. V. 96. PP. 277-287.

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