

EXPERIMENTAL STUDY OF LOPARITE FORMATION OF THE LOVOZERSKII ALKALINE MASSIF

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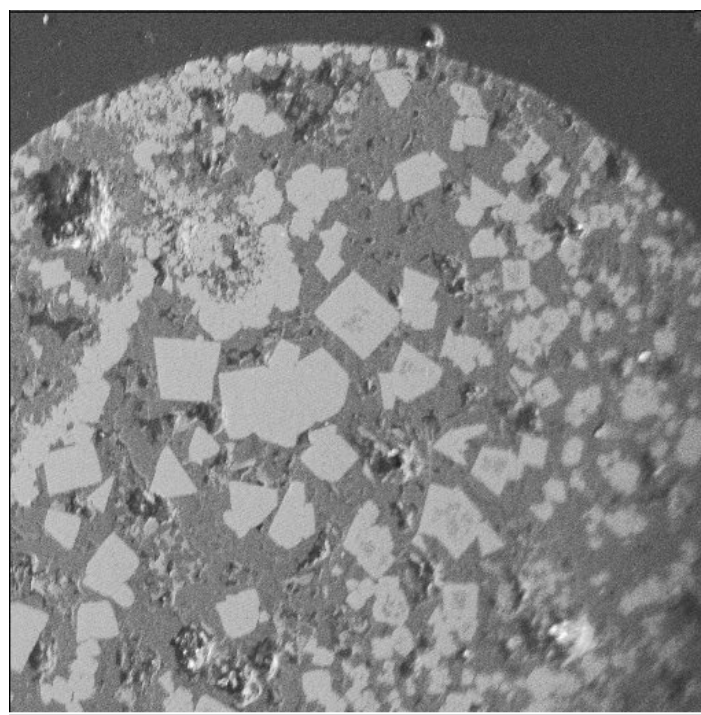
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Due to the problem of loparite ores genesis a number of samples of loparite-bearing rocks (luyavrites, uvites, foiyaite-uvites etc.) from the differentiated complex and partially from the eudialite luyavrites complex of the Lovozerskii alkaline massif have been investigated. Among rock-forming minerals of these rocks nepheline, feldspars (albite, microcline, K-Na feldspars), clinopyroxene (aegirine), alkaline amphibole have been distinguished. Among accessory minerals we can observe sphe, apatite, eudialite, loparite, sodalite, lowchorrite, iron sulfides. The mineralogenesis temperatures of loparite-bearing nepheline syenites have been estimated by different mineral geothermometers (Fsp-Ne, Fsp1-Fsp2, Amf-Cpx) and are ~ 400°C. It reflects more low-temperature conditions of formation as compared to sodalite nepheline syenites what could be related to the fluid treatment of loparite-bearing types of rocks. By composition clinopyroxenes from sodalite nepheline syenites on Aeg-Di-Hed diagram form two continuous trends: 1) high-temperature (~700-460°C) from 70 mole% of diopside mineral at average – 10-15 mole% of gedenbergite mineral to 30 mole% Di - 30 mole% Hed; 2) low-temperature (450-400°C) from 35 mole% Di - 10 mole% Hed to almost pure aegirine, but clinopyroxenes from loparite-bearing nepheline syenites correspond to the trend of compositions from 20 mole% Di – 10 mole% Hed up to pure aegirine what also reflects decreased temperature and increased alkalinity at their formation. In these rocks compositions of loparites which vary (by the content of Sr, REE and Nb) depending on the spatial location in the massif body have been studied: loparites of the eudialite luyavrites complex differ from loparites of the differentiated complex by higher contents of Nb and Sr and lower contents of Ce. In some samples from the eudialite luyavrites complex large grains of loparite with zoning, expressing in the change of the content of niobium, increasing from the centre to the periphery, and cerium, having a reverse regularity, are discovered.

On the basis of these data it can be concluded about the correlation of the loparite composition with physico-chemical conditions of their formation. To reveal this dependence modelling of loparite formation was performed in complicated silicate-salt systems containing carbonate, chloride, fluoride or sulfide of sodium. All the runs were produced at the hydrothermal high pressure vessel with external heating and cold seal at T=840°C и P=1.5 kbar during 5-7 days with a subsequent quenching. The accuracy of temperature control was ±5°C, pressure ±50 bar. The charge consisted of eutectic gel mixture of albite and nepheline (72.5 mas.% Ab, 27.5 mas.% Ne) with the addition of Nb, La, Ce, Y oxides, Ca and Sr carbonates and excess of Ti oxide which was placed at the bottom of the capsule, as well as with the addition of the corresponding salt (carbonate, chloride, fluoride or sulfide of sodium). The runs were performed in the presence of 20 mas.% of water. In all the runs a formation of loparite crystals located at the boundary of the layers of Ti oxide and silicate melt was observed. In the samples the isolated salt phase was also observed, but in sulfate-bearing systems – sulfate-sodalite as well. The largest loparite crystals were observed in the systems containing sodium fluoride (Fig. 1). A study of distribution of petrogenetic and ore elements between loparite and silicate melt shows that Ca, Sr, La, Ce and Y are predominantly concentrated in loparite crystals, but Na is in the silicate melt (Tabl. 1). Here a content of niobium in loparite is also connected with fluid composition (salt addition) in the run: the largest concentration of niobium in loparite was observed in the systems with fluoride addition, but the least one – in the systems with carbonate addition.



15kV x100 $\overline{100}_u$

Fig. 1. Loparite crystals, obtained at T=840°C and P=1.5 kbar in silicate-salt systems containing carbonate and fluoride.

Table 1

N sampl oxides	5394		5395		5396		5398	
	Lop	Sil	Lop	Sil	Lop	Sil	Lop	Sil
SiO ₂	-	48.18	-	56.75	-	49.36	-	52.67
Al ₂ O ₃	-	18.61	-	20.47	-	18.29	-	17.86
TiO ₂	52.23	3.62	46.55	1.30	41.73	3.66	45.31	5.95
Na ₂ O	8.07	21.35	2.8	10.88	10.10	12.61	6.92	12.70
CaO	8.30	0.70	10.25	0.61	1.62	0.16	12.65	0.27
SrO	6.05	0.27	34.45	0.0	5.43	0.0	9.82	0.0
La ₂ O ₃	8.54	0.0	0.95	0.08	13.00	0.15	1.10	0.03
Ce ₂ O ₃	5.16	0.0	0.87	0.10	14.85	0.14	1.25	0.0
Y ₂ O ₃	12.95	0.41	2.49	0.67	0.31	0.69	11.28	0.04
Nb ₂ O ₅	1.12	0.14	7.48	0.54	10.69	0.63	8.47	0.08
Cl	-	-	-	2.10	-	-	-	0.55
SO ₃	-	-	-	-	-	-	-	0.15
Summ	102.42	93.28	105.84	93.50	97.73	85.69	96.80	90.30

Compositions of loparite (Lop) and silicate melts (Sil), obtained experimentally at T=840°C and P=1.5 kbar in silicate-salt systems containing carbonate (N 5394), carbonate and chloride (N 5395), carbonate and fluoride (N 5396), carbonate, sulfate and chloride (N 5398). Fluorine does not analyzed by microzond.