

MELT INCLUSION STUDY OF SOME LAMPROITE SPECIES FROM W.KIMBERLEY, W.AUSTRALIA AND LEUCITE HILLS, USA.

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Thermobarogeochemical investigations have been carried out for several species of lamproites from two localities: for olivine and leucite lamproites of Western Australia (the Ellendale-11 and -5 pipes, the Valgidee Hills massif), for wyomingites of Leucite Hills, USA (*Sharygin, 1991; Sharygin and Bazarova, 1991; Sharygin and Vladykin, 1994*).

Thermometric study of the rocks has shown that homogenization temperatures of secondary melt inclusions hosted by olivine phenocrysts of olivine lamproites are 950-1050°C, whereas primary inclusions in leucite lamproite minerals of Western Australia and Leucite Hills are homogenized at 1130-1250°C.

According to electron microprobe analysis, the secondary inclusion glasses hosted by olivine phenocrysts of the E-11 olivine lamproites essentially differ in composition from the host rock in MgO, TiO₂, BaO, ZrO₂, F, alkalis and correspond to olivine-leucite and leucite lamproites (excepting SiO₂ and Na₂O). The same compositional peculiarities of inclusion glasses are also typical of olivine lamproites both from other pipes of the Ellendale field and from Prairie Creek (*A.Sobolev et al., 1989; Solovova et al., 1989*).

In leucite lamproites (phlogopite-leucite lamproite of E-5, phlogopite-diopside-leucite lamproite of Valgidee Hills, wyomingite of Leucite Hills), the primary inclusion glasses trapped by the earliest phenocrysts (phlogopite, apatite, clinopyroxene) are closely similar in composition to the rocks investigated, and only glasses in late minerals (leucite, diopside) are rich in SiO₂, BaO, TiO₂, FeO_t, alkalis and poor in Al₂O₃, CaO, MgO. Natural analogues are found for some compositions of the latest inclusion glasses. For example, secondary inclusion glasses hosted by diopside of the Valgidee Hills phlogopite-diopside-leucite lamproite approximately correspond to veined pegmatoid lamproites of the massif (*Jaques et al., 1989*). The same compositional features were also indicated for inclusion glasses of other leucite lamproite species of these two localities (*A.Sobolev et al, 1989; Mitchell, 1991*).

In spite of the above-mentioned differences of olivine and leucite lamproites in composition of inclusion glasses, a general tendency is characteristic of both rock types from these occurrences of lamproitic magmatism: initial melt evolution during rock crystallization had an agpaitic nature and was directed toward a gradual depletion in Al₂O₃, CaO, MgO, P₂O₅ and enrichment in SiO₂, FeO_t, BaO, TiO₂, ZrO₂, alkalis. Such evolution character permitted formation of Al-undersaturated or Al-free silicates (Fe-rich K-feldspar, K-Ti-richterite, scherbakovite and wadeite) and K-Ba-titanates (priderite, jeppeite) at the latest stages of rock crystallization.

Chemical composition (wt.%) of lamproites and inclusion glasses in their minerals.

Locality	Rock	Host min.	Phase composition	n	SiO ₂	TiO ₂	Al ₂ O ₃	FeO _t	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	BaO	SrO	ZrO ₂	F	Total
E-11 W.Australia	Olivine lamproite			2	42.50	2.39	3.50	7.77	0.12	25.70	4.77	0.53	2.21	1.35	1.36	0.11	0.09	0.45	98.91
		Ol-1	Gl±Phl+g*	2	44.54	5.42	2.73	9.39	-	6.86	3.43	3.33	14.42	1.10	3.02	0.09	-	-	94.33
		Ol-2	Gl+Ks+g*	3	43.27	11.15	0.77	7.55	0.12	4.10	5.55	3.57	10.01	0.99	5.42	0.26	0.74	-	93.50
E-5 W.Kimberley, W.Australia	Phl-Lc lamproite			2	53.50	5.72	7.00	5.05	0.07	7.39	2.61	0.70	10.00	1.37	1.34	0.23	0.26	0.50	98.33
		Phl	Gl±Di+g	4	55.53	3.46	4.58	4.46	0.09	7.07	2.02	0.91	12.39	2.11	1.28	0.21	-	-	94.11
		Ap	Gl+g	6	55.86	6.53	3.67	6.73	-	6.86	2.09	0.70	10.64	1.85	1.44	0.17	-	-	96.54
Valdeee Hills W.Kimberley, W.Australia	Phl-Di-Lc lampr.			2	49.50	4.78	7.75	6.47	0.10	9.20	7.93	0.28	7.46	0.98	1.01	0.15	0.14	0.65	96.40
		Di	Gl±Phl+g	5	45.75	7.42	7.42	7.98	0.10	6.41	5.42	0.77	10.37	1.23	1.44	0.02	0.18	-	94.51
		Di	Gl+g*	2	58.67	7.20	6.58	8.72	0.13	1.84	0.76	0.96	10.89	0.33	1.18	0.02	0.21	-	97.49
Emmons Mesa Leucite Hills, Wyoming	wyomingite			6	51.12	2.11	11.28	5.43	0.08	6.48	4.87	1.56	10.95	1.32	0.78	0.28	0.26	0.58	97.50
		Phl	Gl+Di+g	10	56.87	0.73	10.99	5.03	0.14	5.38	0.08	3.07	11.23	0.48	0.78	0.15	-	0.19	95.12
		Ap	Gl+Bar+g	9	54.75	3.25	9.07	5.11	-	4.74	2.52	2.47	12.10	0.36	0.65	0.18	-	0.18	95.38
		Lc	Gl+g	10	53.29	7.53	1.73	7.15	-	7.37	1.11	3.61	8.26	1.81	3.75	0.12	-	-	95.73
		Di	Gl+San+g	4	60.23	7.04	3.65	6.49	0.12	1.55	0.86	2.32	9.23	0.65	1.46	0.07	-	-	93.67
	rock glass			2	60.89	7.47	2.52	7.97	-	2.05	0.83	1.30	6.17	0.69	2.14	0.08	-	-	92.11

Electron microprobe analysis for inclusion glasses, total iron as FeO. Gl, Gl_d- initial and fine-devitrified glass, respectively,

Phl - phlogopite, Ap - apatite, Lc - leucite, Ks - kalsilite, Di - diopside, Bar - barite, San - sanidine, g - gas.

* - secondary melt inclusions, n - number of analyses.

Besides glasses, crystalline phases of the melt inclusions and single crystal inclusions in phenocrysts of lamproites have been studied. Majority of them (phlogopite, enstatite, diopside, Cr-spinel, barite, K-richterite, etc.) are similar in composition to groundmass minerals of the rocks investigated. After *A. Sobolev et al. (1989)* and *Solovova et al. (1989)*, kalsilite as daughter phase of the inclusions has also been identified in olivine phenocrysts of the E-11 and E-7 olivine lamproites and in phlogopite phenocrysts of the Leucite Hills wyomingites (*Sharygin, 1991; Sharygin and Vladykin, 1994*). The finding of this mineral found in inclusions only is very interesting, as, according to *Mitchell and Bergman (1991)*, kalsilite is a prohibited mineral for lamproites. However, in contrast to kalsilites from other potassic rocks, the mineral from lamproites is essentially undersaturated in Al_2O_3 and rich in MgO (up to 2.5 wt.%), Fe_2O_3 (up to 8 wt.%) and SiO_2 (up to 43.4 wt.%), being a magnesioferrikalsilite. Its specific composition may be explained due to two substitutions:



Taking into account the experiments of *Wendlandt and Eggler (1980)*, the coexistence of kalsilite with olivine, enstatite, phlogopite, liquid and gas within inclusion (in particular, in olivine lamproites of E-11 pipe) is quite possible to be an evidence of high pressures (25-34 kb) and temperatures (1160-1425°C) during phenocryst formation in some lamproites.

On the whole, chemical peculiarities of glasses and crystalline phases from melt inclusions hosted by minerals and evolution of their composition from the earliest to latest minerals might be used as additional indications to distinguish lamproites and other rocks (especially, K-basaltoids) close to lamproites in chemical and modal compositions.

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