XENOLITHS OF DIAMONDIFEROUS ULTRAMAFIC ROCKS FROM YAKUTIAN KIMBERLITES

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Sixteen xenoliths of diamondiferous ultramafic rocks were found to occur in "Udachnaya" and "Aikhal" kimberlite pipes in Yakutia. Four xenoliths were found to occur in "Aikhal" pipe (2 - Sobolev et al., 1969; 1 - Sobolev,1974; 1 - a new sample of the authors), 12 - from "Udachnaya" pipe(1 - by I.P. Ilupin, personal communication; 1 - Pokhilenko et al.,1976; 10 - newly collected samples of the authors). The size of xenoliths varies between 1.4 and 14.3 cm. The xenoliths from "Aikhal" pipe belong to serpentinite containing Cr-pyropes and sometimes chromite (two samples). The xenoliths from "Udachnaya" pipe are of varied mineral composition. The rocks containing these xenoliths belong to the following mineral parageneses: 1) olivine-garnet-diamond (3 samples), 2) olivine-chromite-diamond (1 sample), 3) olivine-garnet-chromite-diamond (6 samples); olivine-garnet-enstatite-chromite-diamond (1 sample); olivine-enstatite-garnet-diopside-ilmenite-diamond (1 sample). All the xenoliths except ilmenite-bearing lherzolite contain more than 90% of olivine as fragments of the deep-seated extremely coarse-grained rocks, in which olivine grains sometimes attain 10 cm in diameter. It is merely xenoliths of ilmenite-bearing lherzolite that is composed of common granular texture with traces of deformations (Pokhilenko et al., 1976).

The electron probe technique was applied to studying the composition of minerals of these xenoliths. The minerals from 15 samples have similar compositions with those included in diamonds (Meyer, Boyd,1972), (Sobolev,1974), see Table 1. The lack of diopside from these samples along with low CaO content in the garnets indicates their relation to harzburgite-dunite paragenesis, which predominates in the ultramafic associations with diamond (Sobolev,1974). No analogues are,however,known among several hundred of crystalline inclusions in diamonds of the mineral compositions of xenoliths of diamondiferous pyrope lherzolite , which contains ilmenite (Table 2).

Extremely interesting structures were found in one of xenoliths characterized by regular strongly altered enstatite and chromite lamellar intergrowths. It is quite probable that these structures had formed as decomposition products of knorringite-rich garnet (70-80 mol %) after the following pattern:

$$Mg_3Cr_{2-x}Al_xSi_3O_{12} + Mg_2SiO_4 \longrightarrow 4(Mg)SiO_3 + MgCr_{2-x}Al_xO_4$$

On analysing the obtained data based on experimental investigation of knorringite component entering in Mg-garnets (Malinovsky et al., 1976) it may be concluded that the studied associations containing knorringite-richest garnets had been formed

at pressured not lower than 60 kbar.

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Table 1

Chemical composition of minerals composing typical xenoliths of diamondiferous ultramafic rocks from Yakutian kimberlite pipes

Min	Olivine			Garnet				Chromite		
Sp.	Uv--823	Uv-69/76	Uv--406	Uv--823	Uv-69/76	Uv--406	Uv--404	Uv--823	Uv-69/76	Uv-406
SiO_2	41.4	40.7	40.7	41.2	41.9	41.7	42.8	0.00	0.00	0.17
TiO_2	0.0	0.0	0.0	0.06	0.05	0.02	0.04	0.24	0.17	0.07
Al_2O_3	0.0	0.0	0.0	15.0	14.4	16.2	18.9	4.45	4.08	5.79
Cr_2O_3	0.05	0.04	0.03	12.7	12.4	9.95	7.10	64.5	65.3	63.0
FeO	6.15	6.96	6.44	6.74	7.56	6.88	6.56	17.9	18.2	20.5
MnO	-	-	-	0.39	0.40	0.36	0.30	0.25	0.23	0.36
MgO	52.0	51.2	51.5	20.0	21.4	22.8	22.8	12.0	11.8	11.0
CaO	0.02	0.01	0.01	4.99	5.05	1.71	1.52			
Na_2O					0.0	0.02				
NiO	0.28	0.27	0.27							
Total	99.9	99.2	99.0	101.1	101.0	99.6	100.0	99.5	99.8	100.9
f	6.2	7.1	6.6	15.8	16.2	14.3	13.3	45.6	46.5	46.9
Kn				23.2	30.6	26.5	17.1			

Table 2

Chemical composition of minerals composing xenolith of ilmenite-pyrope diamondiferous lherzolite and pyrope harzburgite xenolith

Sp.	Uv-255/75					Uv-198/76			
Min.	Ol	Ga	En	Di	Il	Ol	Ga	En	Chr
SiO_2	41.0	40.6	57.4	55.3	0.01	41.7	41.1	57.0	0.01
TiO_2	0.01	1.91	0.12	0.36	56.0	0.01	0.14	0.03	0.50
Al_2O_3	0.02	16.9	0.67	2.16	0.54	0.01	14.7	0.41	4.74
Cr_2O_3	0.09	5.99	0.41	1.97	5.45	0.06	11.6	0.50	61.7
FeO	8.74	7.22	5.12	3.16	21.8	6.76	6.85	4.08	19.4
MnO	0.09	0.24	0.09	0.09	0.25	0.01	0.36	0.12	0.22
MgO	50.4	20.5	34.3	17.8	15.6	51.5	21.3	36.2	11.4
CaO	0.03	5.41	0.86	15.9	0.01	0.01	3.72	0.22	0.01
Na_2O	-	0.19	0.30	2.37	-	-	0.03	0.13	
NiO	0.28	-	-	0.03		0.26			
Total	100.7	98.9	99.3	99.1	99.7	100.3	99.8	98.7	98.0
f	8.8	16.4	7.7	9.1	43.9	6.8	15.3	5.9	48.8

Table 3

Peculiarities in the Mineral Composition of Xenoliths of Diamondiferous Ultramafic Rocks (Harzburgite-dunite paragenesis) from Yakutian Kimberlites

	N	f		Cr_2O_3		TiO_2		CaO	
		min-max	x	min-max	x	min-max	x	min-max	x
Ol	10	6.2-8.1	6.9	0.03-0.09	0.05	0.01-0.02	0.01	0.01-0.06	0.02
Ga	13	12.3-16.1	14.7	7.1-14.1	10.8	0.02-0.19	0.07	1.52-6.24	3.07
Chr	7	44.6-48.8	46.6	61.7-65.4	64.0	0.07-0.50	0.21		