PETROCHEMICAL TYPES OF KIMBERLITES OF THE MAJOR DIAMOND DEPOSITS OF YAKUTIA

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The major diamond deposits in Yakutia are composed of basaltoid type kimberlites with a uniform set of rock-forming minerals. Variations in their amounts form substance types of kimberlites. Isolation and investigation of the substance types of kimberlites is entirely possible only on the basis of quantitative description of their composition and probability-statistical comparison. The chemical composition of rocks and taxonomic methods of establishing their petrochemical types appeared to be the best for these purposes.
Database on the considerable quantity of chemical analyses of kimberlites of major deposits is structured on the basis of taxonomic methodology, using dinamic cluster analysis [Diday, 1973].
Populations of kimberlites are separated as the main structural types (Table 1).

Table 1

Composition of kimberlite populations
(n = 3123)

Population	n	SiO2	TiO2	Al2O3	Fe2O3	FeO	MgO	CaO	Na2O	K2O	P2O5
1	398	28.69	0.44	2.65	3.14	2.21	23.98	13.77	0.55	0.74	0.48
2	1040	27.08	0.82	2.28	3.85	2.31	25.67	14.67	0.16	0.52	0.28
3	660	28.93	1.14	2.01	4.87	2.45	29.41	9.64	0.19	0.45	0.40
4	358	28.87	1.35	2.04	4.97	2.90	29.13	10.27	0.19	0.49	0.36
5	413	29.29	1.63	1.99	5.32	2.52	26.64	11.43	0.21	0.37	0.27
6	254	29.87	2.16	2.18	5.93	2.84	30.13	7.53	0.12	0.35	0.36

A typochemical feature of the populations is the TiO2 distribution -- rather stable inside the populations and discrete between them.
Compositional variations within populations are caused by antagonism of CaO and MgO. A discrete behavior of this antagonism governs separation of these populations into varieties.
Kimberlites of various populations are distributes irregularly in diatremes (Table 2). Kimberlites with lower titanium contents are typically surrounded by populations with higher titanium contents.

Table 2

Distribution of kimberlite populations (%) inside diatremes

Diatreme	Number of analyses	Populations 1	2	3	4	5	6
Aikhal	141	97.9	2.1				
Internatsi-onal'naya	171	96.9	3.1				
Udachnaya-west.	710		96.5	3.5			
Udachnaya-east.	441		13.4	32.6	54.4		
Yubileinaya	619			45.0	55.0		
Mir	547	4.4	4.6	23.0	21.9	33.8	12.2
Sitikanskaya	424		2.1			53.8	44.1

The diamond content of kimberlite populations decreases with increasing TiO_2 contents. Regressive analysis of 800 observations of chemical composition and diamond content, divided into 30 cluster groups allowed establishment of a close relation between the chemical composition of kimberlites and their diamond content. The correlation between real and calculated values of diamond content is + 0,75.

The composition of kimberlite populations reflects their genetic properties. A decrease in TiO_2 and Fe_2O_3 contents, accompanied by an increase in K_2O, in populations is a result of a successive deepening of melting of kimberlite melts.

When the pressure grows, the amount of titanium, redistributed into refractory phases of mantle peridotite, increases [Ringwood, 1981], while its content in selective fusions must decrease.

The elevated K_2O content in clinopyroxenes of deep-seated assotiations [Sobolev, 1974] governs its level in selective fusions.

The established population types of diamondiferous kimberlites are reproduced (in main features) when used for structuring petrochemical database of software product SAS STAT.

The typochemical role of TiO_2 in kimberlites has a global character. This is indicated by the coincidence of distributions of TiO_2 concentrations for studied deposits with the distribution of TiO_2 in kimberlites of the Kimberley province (South Africa) (Fig. 1). The chemical composition of kimberlites of South Africa are characterized on the basis of literature data.

The variant of population structure of kimberlites of South Africa (Table 3) reproduces the main features of population types of Yakutian kimberlites. Some differences in the bulk composition of kimberlites of Yakutia and Kimberley province are governed by the absence of the most deep-seated population in the latter and less exhausted mantle under this province.

Table 3

Average compositions of isotitanium populations
of kimberlites of Kimberley province

Population	n	SiO2	TiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	P2O5
1	Population 1 is absent in Kimberley province									
2	25	36.22	0.80	4.51	8.82	22.71	9.47	0.92	1.14	0.57
3	5	34.69	1.15	4.57	9.17	24.38	7.82	1.04	1.45	1.68
4	11	32.93	1.53	3.78	8.98	24.16	10.67	0.34	3.14	1.32
5	8	34.71	1.83	3.54	9.01	26.36	8.28	0.53	0.32	1.23
6	5	30.25	2.09	2.67	9.26	28.81	10.71	0.83	0.83	1.01

Note: n -- is the number of analyses; * -- the average for pipes included; all iron recalculated in terms of Fe2O3.

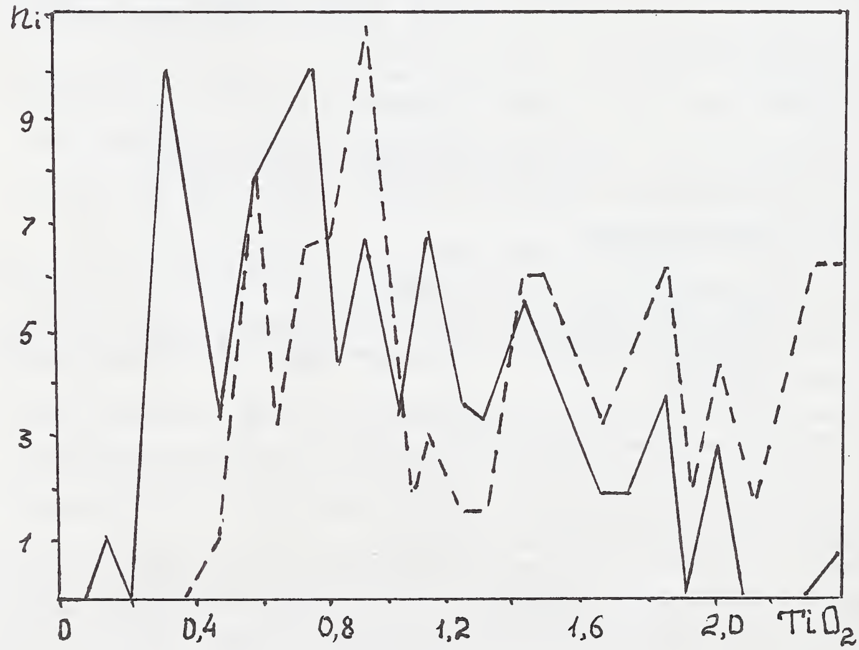

Fig. 1. Distribution (in relative percentage) of TiO2 contents in kimberlites of Yakutia (1) and Kimberley province (2).