«Populational» model of kimberlites : an application to diamondiferous kimberlites of regions with various geodynamic history.

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Petrochemical features of kimberlites from main diamond deposits of Yakutia having been investigated, simultaneous character of distributions of rock - forming oxides and coincidence of distributions' extremums have been observed. Stability of these peculiarities relatively to vast number of cases (totally as much as 5,600 Xray-fluorescence analyses have been examined) has made possible to form hypothesis suggested by occurrence of stable rock varieties among diamondiferous kimberlites likely biological populations [Vasilenko,Kuznetsova,1986;Vasilenko,1995]. As a whole, 7 kimberlite «populations» have been separated, and main interpopulational variability agency has been refered to as TiO_2 content (table 1). It was CaO/MgO ratio that has been suggested to be main factor of diversity within each «population».

Table1. Average compositions of kimberlite populations of Yakutia [Vasilenko, 1995].

Populations	1	2	3	4	5	6
n	331	1443	535	440	435	259
SiO2	25,96	27,53	28,92	30,27	28.15	28,58
TiO2	0,43	0,86	1,18	1,43	1,73	2,09
Al2O3	2.64	2.25	2.12	2,11	1.74	1,99
Fe2O3	4,73	6,53	7,71	8,06	7,81	9.30
MgO	22,52	26.40	28.37	29,19	28,30	30,44
CaO	16,15	13,64	10,58	9,34	10,46	7,91
Na2O	0,52	0,16	0,17	0,18	0,14	0,18
K2O	0.83	0,50	0,54	0,53	0,22	0,53
P2O5	0.50	0,30	0,38	0.34	0,27	0.47

Analysis of general features of populational model has shown that decrease of TiO_2 average contents in «popultions» is accomplished by decrease of Fe_2O_3 average contents and elevation of Al_2O_3, K_2O contents, and diamondiferousness [Vasilenko et al,1994; Vasilenko, 1995; Vasilenko et al, 1996]. Mechanism of this phenomenon is believed to has been determined by changing of clinopyroxene (CPx) composition with depth increase. CPx, in turn, is assumed to be main (with olivine) source of kimberlite smelts have been formed by partial melting of mantle matter.

Results of number of experiments [Solov'eva et al, 1994; Ringwood, 1975] as well as investigations of composition of CPx from diamond - bearing parageneses [Sobolev, 1974] suggest that under high pressures CPx contains elevated admixture of Al_2O_3 and jadeite; moreover, K-jadeite has been founded in CPx constitution under pressure higher than 40 Kbars. Ultra-high pressures give rise to dissolving of titano-magnetite in CPx; and this solid solution finally transforms to garnet. Behaviour of Ti in solid solution Perovskite+CPx under ultra-high pressures is believd to be simultaneous with that in CPx.

Mentioned above data show that with increase of depth Ti has contained in pressure-stable phases (garnet). As a results, deepmore smelts become enriched by Al_2O_3, K_2O and exhausted by TiO_2, unlike to restites.

Populational model of kimberlite constitution makes possible to compare petrochemical features of kimberlites of various regions on the base of statistically correct juxtaposition. Taking into account mentioned above, it means comparison of features of geodynamic history and genesis. Furthermore, investigation of kimberlites within concrete province (field) may be substituted by studying of only one separate pipe with the same set of «populations».

E.g., petrochemical peculiarities of diamondiferous kimberlites of Yakutia, South Africa, Lesotho, and West Africa have been investigated. Kimberlites of African regions prove to be characterized by the same populational structure, as Yakutian ones (tables 2-4). Some differences have been occurred are caused by abundance of concrete «populations» which, in turn, are depended on tectonic position of regions have been dealed with (craton areas for Yakutia and South Africa , transition craton-middleproterozoic orogenetic belt for Lesotho, continental margin for West Africa) during kimberlite intrusions epochs [Janse, 1984].

Table 2. Average compositions of kimberlite populations of South Africa.

Populations	1	2	3	4	5	6	7
n		64*	42*	8	18*	21*	34*
SiO2		33.91	37.93	33.20	35.49	29.23	33.63
TiO2		0.68	0.96	1.41	1.76	2.09	2.43
Al2O3		4.32	5.05	3.88	3.49	2.30	3.68
Fe2O3		6.29	6.02	5.64	6.21	5.42	7.71
MgO		18.63	23.51	25.70	23.64	28.61	24.21
CaO		12.85	6.56	8.47	9.96	11.66	9.34
Na2O		0.28	0.99	0.52	0.43	0.25	0.43
K2O		0.95	1.07	2.44	1.63	0.89	1.81
P2O5		0.59	0.56	1.58	1.14	1.07	1.51

Table 3. Average compositions of kimberlite populations of West Africa.

Populations	1	2	3	4	5	6	7
n	3	33*	13*	13*	37*	21*	12*
SiO2	40.82	37.09	36.92	35.20	33.22	32.37	31.99
TiO2	0.36	0.78	1.07	1.34	1.68	2.17	2.63
Al2O3	8.22	4.01	5.18	4.81	4.84	3.15	2.85
Fe2O3	6.51	5.57	7.64	6.91	7.25	8.49	6.63
MgO	22.40	28.55	24.19	21.51	24.92	28.31	27.00
CaO	2.97	5.21	6.89	10.43	8.24	6.37	7.42
Na2O	0.65	0.54	0.95	0.82	0.27	0.32	0.31
K2O	1.04	1.03	1.46	1.81	1.52	1.13	0.74
P2O5	0.23	0.35	0.59	0.61	0.57	0.87	0.57

Table 4. Average compositions of kimberlite populations of Lesotho.

Populations	1	2	3	4	5	6	7
n				4	3	4	9
SiO2				32.14	31.55	29.68	31.85
TiO2				1.42	1.79	2.08	2.67
Al2O3				2.38	3.44	3.74	4.22
Fe2O3				5.48	4.26	6.50	7.59
MgO				29.29	31.09	23.56	23.52
CaO				8.05	7.13	10.09	8.77
Na2O				0.11	0.19	0.15	0.17
K2O				2.04	1.34	0.39	1.15
P2O5				0.81	0.74	0.84	0.24

* - averages by pipe has been used as well as simple analyses

Shift of «population» sets passing from Lesotho to South African kimberlites correlates with data of lithosphere thickness (150 and 180 km accordingly) [Solov'eva et al, 1994]. The same depth (180-175 km) for lithosphere boundary has been observed for Udachnaya kimberlite pipe in Yakutia which populational structure completely coincides with that of South African kimberlites. West African kimberlites differ by multipopulational composition with high alkali content of 4^{th} , 5^{th} and 7^{th} «populations». These petrochemical features make kimberlites of West Africa close to Mir pipe kimberlites [Vasilenko et al, 1996], and simultaneously may be explaned by impurity of unexhausted material [Vasilenko et al, 1996].

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