DEEP-SEATED XENOLITHS, XENOCRYSTS IN KIMBERLITES AND CRYSTALLINE INCLUSIONS IN DIAMONDS FROM "UDACHNAYA" KIMBERLITE PIPE, YAKUTIA

N.V. Sobolev, N.P. Pokhilenko, Yu.G. Lavrent'ev and E.S. Yefimova (Institute of Geology and Geophysics, Siberian Branch of the USSR Academy of Sciences, Novosibirsk, U.S.S.R.)

A representative collection containing more than 1000 specimens of xenoliths recovered from the deep-seated rocks of "Udachnaya" kimberlite pipe in Yakutia has been examined. The following mineral associations have been identified as a result of studies: 1) olivine-garnet-enstatite-diopside, 2) olivine-garnet-enstatite-diopside-chromespinel, 3) olivine-garnet-enstatite-diopside-ilmenite, 4) olivine-enstatite-diopside-chromespinel, 5) olivine-garnet-enstatite-chromite, 6) olivine-garnet, 7) olivine-garnet-chromite, 8) olivine-garnet-diopside-chromite, 9) olivine-chromite, 10) enstatite-diopside-spinel, 11) enstatite-garnet, 12) garnet-chromespinel, 13) enstatite-diopside garnet, 14) diopside-garnet-ilmenite, 15) garnet-diopside-chromespinel, 16) garnet-omphacite-kyanite-rutile, 17) garnet-omphacite-rutile. Several diamondiferous specimens were found among the xenoliths belonging to associations 3,5,6,7,9,16,17. Most of the xenoliths from the ultramafic rocks are fragments of varying sheared pyrope peridotites belonging to associations 1,2, 3 among which are the rocks containing garnets with clear zoning relevant to Cr-contents (8.2 wt % of Cr_2O_3 in the core and 1.4 at the periphery), Ti(0.3-1.4 wt% of TiO_2) as well as Ca,Fe Mg,Al. There also occur the sheared peridotites containing garnets of tremendously varying though uniform composition within a single grain (Sp. Uv-97/76, Table 1). Table 1 lists the analyses of minerals which compose rather uncommon peculiar xenoliths of spinel (chromespinel) garnetites (Sp. Uv-958 and Uv-71/76). One of the samples contains garnet whose composition approaches to pure pyrope with extremely low iron contents (Table 1). The sheared lherzolite Uv-6 (Table 1) contains clinopyroxene with uncommonly low Na contents and rather high K-admixture. The Mg-garnets from the kimberlite concentrate of "Udachnaya" Pipe have varying CaO content ranging from 0.98 to 25.4 wt %, Cr_2O_3 (0.1 to 18.7 wt %) with some variations in Ti-contents (Sobolev et al., 1973). A majority of garnets by their CaO and Cr_2O_3 contents (about 75%) belong to lherzolite paragenesis, while about 20% belong to harzburgite-dunite paragenesis and about 5% belong to wehrlite paragenesis (Fig. 1b). The variation range of CaO and Cr_2O_3 contents of the garnets from kimberlite concentrates exceeds those of garnets of xenoliths from the ultramafic rocks of "Udachnaya" Pipe (Fig. 1a).

Chromespinels (N=76) from "Udachnaya" kimberlite pipe are characterized by exceptionally varying contents of all the oxides (wt %): Cr_2O_3 (12.7-65.9), Al_2O_3(2.1-48.9), TiO_2(0.01-6.3), MgO(7.8-20.5), FeO(7.8-24.3), Fe_2O_3(3.8-20.5) (Sobolev et al., 1975).

Ilmenites (N=146) have varied TiO_2 contents as well (42.3-54.3 wt %), MgO(7.0-13.2); Cr_2O_3(0.1-4.4) with some variations in Al_2O_3 contents (0.04-0.60 wt %).

The crystalline inclusions in diamonds examined by electron probe technique (over 100 analyses) are represented by olivine, chromite, garnets (mostly Ca-poor chrome pyropes, see Fig. 1c) and pyroxenes. We have also studied along with single inclusions the compositions of coexisting minerals included in diamonds, garnets and omphacites, in particular.

Some of magnesial garnets from diamonds were found to have similar CaO and Cr_2O_3 contents with lherzolite garnets (see Fig. 1c) but proceeding from the peculiarities in the contents of some other oxides, harzburgite-dunite paragenesis predominates among the inclusions in diamonds with no indications of the presence of diamonds in the sheared lherzolites. The equilibrial conditions were established for the sheared lherzolites by geothermometry and geobarometry techniques as T=1100-1350°C and P=30-45 kbar (Sobolev,1974).

REFERENCES

Sobolev N.V.,1974. Deep-seated inclusions in kimberlites and the problem of the composition of Upper Mantle,Nauka, 264 p.

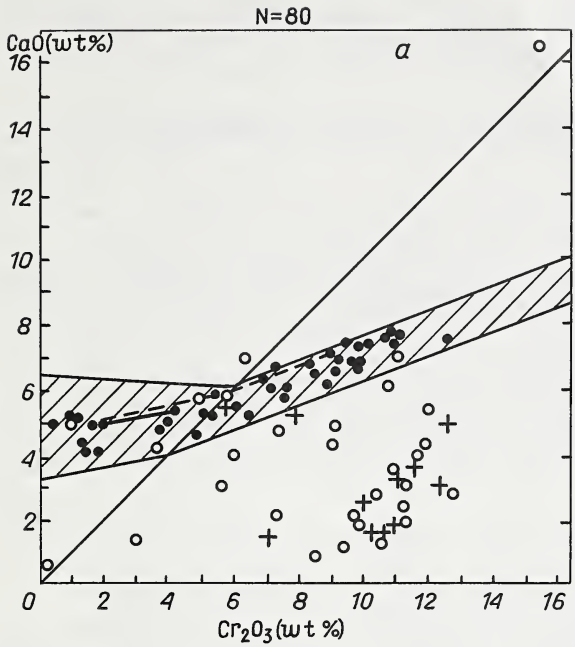
Sobolev N.V.,Lavrent'ev Yu.G., Pokhilenko N.P. and Usova L.V., 1973, Contr. Mineral. Petrol. 40, pp. 39-52.

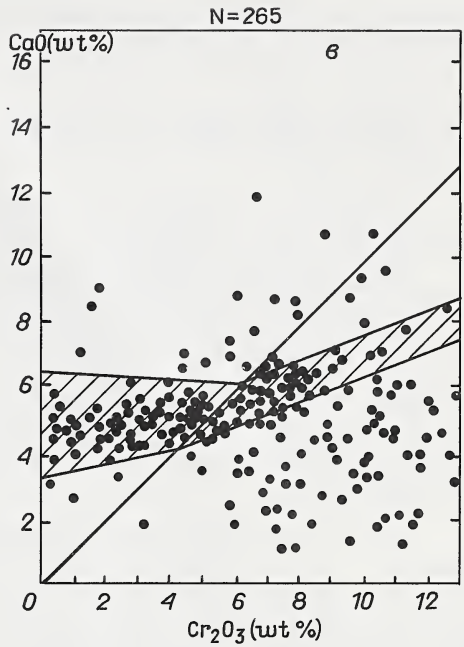
Sobolev N.V., Pokhilenko N.P., Lavrent'ev Yu.G. and Usova L.V., 1975. Geologia i Geofiz. Novosibirsk, N11.

Table 1

Selected analyses of minerals from uncommon xenoliths of the deep-seated rocks from "Udachnaya" Pipe

Sp.	Uv -958		Uv -71/76		Uv -97/76			Uv -6		
Min.	ga	sp	ga	chr	ga1	ga2	ga3	ga	cpx	en
SiO_2	43.9	n.d.	42.2	n.d.	42.3	41.3	41.0	41.4	55.1	59.1
TiO_2	0.01	0.01	0.01	0.42	1.12	1.24	1.61	0.03	0.04	0.01
Al_2O_3	24.3	66.8	21.1	7.64	20.4	17.8	14.3	16.0	0.41	0.40
Cr_2O_3	0.14	1.12	3.71	58.5	1.67	5.45	8.99	9.60	0.35	0.24
FeO	5.16	5.57	7.14	19.1	10.6	8.54	8.47	7.24	2.64	5.24
MnO	0.28	0.01	0.36	0.25	0.27	0.27	0.28	0.27	0.14	0.11
MgO	26.0	26.8	21.4	12.8	19.9	20.3	18.7	18.6	20.0	35.3
CaO	0.64	-	4.19	-	4.89	5.79	7.05	7.37	20.9	0.89
Na_2O	-	-	0.02	-	0.10	0.09	0.10	n.d.	0.16	0.03
K_2O	-	-	-	-	-	-	-	-	0.13	-
Total	100.4	100.3	100.1	98.7	101.2	100.8	100.5	100.5	99.9	101.3
$Fe/Fe+Mg$	10.0	5.4	15.8	39.5	23.0	19.1	20.2	17.9	6.9	7.6





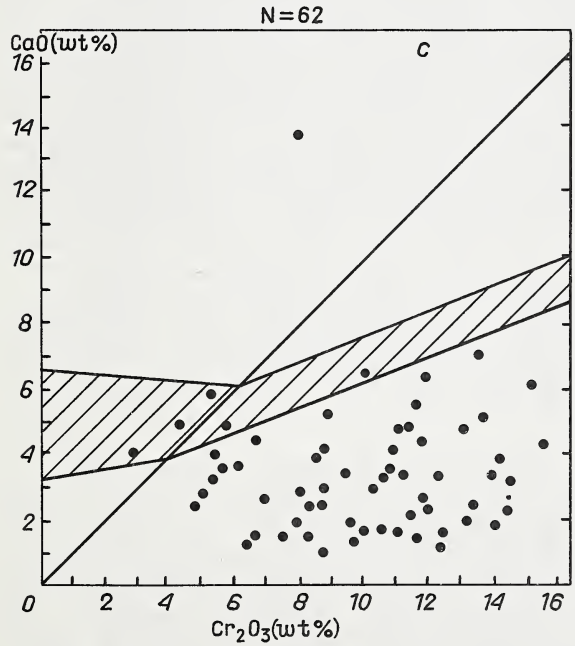


Fig.1 Features of the amounts of Cr_2O_3 and CaO in Mg-garnets from "Udachnaya" kimberlite pipe.

a. Garnets from xenoliths of ultramafic rocks: sheared lherzolites (black points), granular peridotites (open circles), granular diamondiferous peridotites (crosses).

Points of compositional variations of zoned garnet are joined by continuous line.

b. Cr-bearing garnets from kimberlite concentrate.

c. Cr-bearing garnets included in diamonds.

Shaded areas - compositions of garnets of lherzolitic paragenesis.