

# MINERALOGY OF OXIDES FROM THE GROUND MASS OF KIMBERLITES OF JAKUTIJA AND NORTHERN EUROPEAN PART OF THE USSR.

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The complex approach towards kimberlite studies taking into account their geologico-structural position in the combination with the detailed mineralogical investigations is thought to be the most reasonable approach during the search for the deposits of diamonds and the evaluation of their productivity on the basis of the indirect mineralogical criteria and with the substantial shortage of the expensive drilling. During the fulfillment of the complex approach to the kimberlite studies a series of the laws of the kimberlite formation is being discovered and it provides the scientifically based methods for the purposeful mineralogical search for the diamond bearing evaluation with ones available now (on the chrome content of garnets and chrome spinels - N.V.Sobolev with co-authors; on the IR-spectra of chrome spinels - I.J.Nekrasov and others) has set up the basis for the introduction of the methodology of the forestalling testing of the kimberlite bodies with small volume of drilling. It is reasonable to introduce this methodology at the preliminary stage of the kimberlite testing to find out the first priority objects for their further detailed geological survey and evaluation of the perspectives of the diamond bearing of a region in general.

Many theoretical problems of the kimberlite formation and some practical tasks call for fundamental research of ilmenite and spinels from the kimberlite ground mass. The authors have carried out a considerable volume of the analytical work widely using the electron-probe analysis method and image analysis for ilmenite and spinels in the association with olivine, rutile, perovskite and other minerals from the ground mass of the kimberlite rocks.

The representative data have been chosen from the kimberlite pipes of the central regions (Malo-Botuobinski, Daldyno-Alakitski) and peripheral regions (Kuonamskoje, Kharamaiskoje) of the Jakutian diamond bearing provinces and from the central field (Zolotizkoje) and frontier fields (Verkhotinskoje, Kepinskoje, Sojanskoje) of the Arkhangelsk kimberlite province. The carried out investigations allowed to define the position of spinels and in the process of the kimberlite formation evolution. The peculiarities of the space distribution and oxides composition in the kimberlite bodies of the Jakutian and Arkhangelsk diamond bearing provinces have been defined.

In the Jakutian diamond bearing province :

1. Spinels from the kimberlite ground mass show typomorphism of the composition. The peculiarities of the chemical and phase composition of these minerals are sensitive indicators of the changes of the conditions of the mineral formation surroundings.
2. The increase of the share of magnetite mineral in the spinel composition from the kimberlite ground mass is definitely accompanied by the decrease of the original productivity of the kimberlite pipes.

3. The highly productive central regions are characterised by the prevailing role of ilmenite in the cement composition, including the zonal separation of this mineral with the borders of titanomagnetite; the similar zonal structures are not practically marked for the peripheral regions of the province where titanomagnetite is most widely spread among oxides.

4. Typomorphism of the composition of the investigated minerals in the kimberlite bodies of the central and frontier parts, emphasizing the zoning of the Jakutian diamond bearing province and conforming the poor productivity of kimberlites along the periphery has been established.

In the Arkhangelsk kimberlite province:

1. In the heavy fraction of the Zolotizkoje field diatremes spinels prevail sharply in amount over the other minerals-satellites of diamond. Picroilmenite occurs only in single signs.

Only magnesian Al-Ti containing chrome spinels are spread in the kimberlite ground mass. Chrome ulvospinel (as a rule on the upper horizons of diatremes) is formed in the borders round the nuclei of Al-Ti containing chrome spinels for some diatremes.

2. In the diatremes of the northern ground of bodies the minerals of the heavy fraction are represented by spinels, garnets, chrome diopside. The content of the heavy fraction minerals is considerably less than in the central field. Picroilmenite is absent.

Cr-Al-containing titanomagnetite with clearly subordinate (single extractions of Al-Ti containing chrome spinels is the prevailing ore mineral of the kimberlite ground mass. The diatremes are poor diamond bearing.

3. In the diatremes of the south-eastern group among the heavy fraction minerals picroilmenite, sometimes, picroilmenite and garnet (mainly red-orange, typical representative of ilmenite hyperbasites and sheared lherzolites) prevail. Chrome spinels are considerably less spread.

There's a rather wide set of ore minerals in cement (as compared with central and northern fields); there are single grains of magnesian Al-Ti containing chrome spinels and magnesian ulvospinel. Titanomagnetite and picroilmenite with the increased manganese content are spread to a greater extent. Rutile is the prevailing ore mineral. Diatremes are very poor diamond bearing.

4. Recently non diamond bearing diatremes of effusive appearance, represented by basaltoids have been discovered in the Arkhangelsk province on the eastern frontier of the craton (east-northern-east).

The single signs of the minerals-satellites of diamond are discovered in the heavy fraction of these bodies (garnet and chrome spinels). Al-Mg-containing titanomagnetites with complete absence of magnesian Al-Ti-containing chrome spinels are widely spread in cement.

As the result of the carried out investigations the general scheme of the kimberlite fluid evolution of the basis of the crystallised sequence of oxide separation has been offered, the new mineralogical criteria of the diamond bearing evaluation of the kimberlite bodies have been developed according to the peculiarities of ilmenite composition (determination of MgO and MnO) and spinels (determination of magnetite  $\text{FeFe}_2\text{O}_4$  and ulvospinel  $(\text{Mg,Fe})_2\text{TiO}_4$  components) from the kimberlite

ground mass effective for usage in combination with other indirect mineralogical methods (on xenocrystals of olivine, garnet, clino- and orthopyroxene, chrome spinels and others minerals), especially when the "outcome" of the core is very small and the content of the mineral-satellites in the concentrations of the enrichment of kimberlites is not representative enough.

High information capacity of ilmenite and spinels from the kimberlite ground mass has been established in genetic and applied aspects. It proves some disadvantage of narrow investigations (only spinels, only ilmenite, only phenocrysts, only nodulars, etc.) and this narrow investigation is opposed by the complex one (the most complete one) for studying different mineral phases in kimberlites.

The discovered mineralogical specialization of the fields is correlated with the diamond bearing and allows to region the provinces and to sort out the new bodies with the high degree of reliability and to define the most perspective ones for diamonds among them.