Main mineralogical-petrological features of early-hercynian volcanic complexes of Archangelsk kimberlite-picrite region, NW Russia

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Archangelsk kimberlite-picrite Region is world-class source of diamonds, where two large diamond deposits in mining stage presently, with total reserves more than 300 mln carats. Besides that, there is more than a hundred occurrences of non-diamondiferous kimberlites, its convergent rocks and tholeiitic basalts (Fig.1) (Bogatikov et al., 1999; Garanin, 2006). Within this region based on main petrological characteristics, the largest regional formational taxons have been distinguished: (1) Zimneberezhny Mega-Complex of kimberlites-non-pyroxene alkaline picrites, (2) Nenokso-Chidvinsky Mega-Complex of feldspathic picrites-olivine melilitites (Fig. 2) and (3) Soyana-Pinezhsky dolerite-basalt Complex (Tretyachenko 2008; 2015).

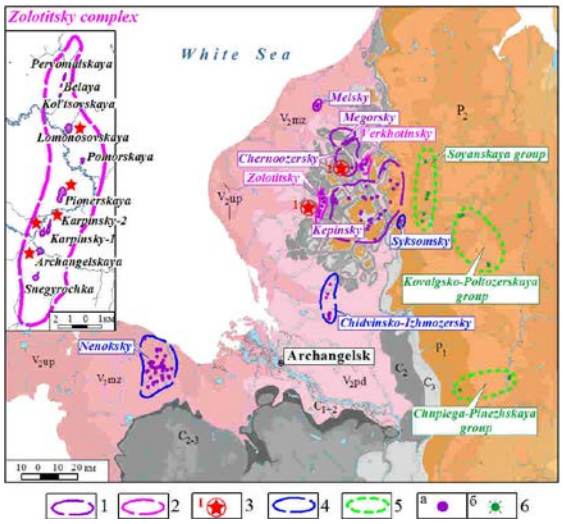

Figure 1: The location of kimberlites of Early-Hercynian volcanic complexes in Archangelsk kimberlite-picrite region.

1-3 – Zimneberezhny Mega-Complex: 1 – Fe-Ti-type (Kepinsky, Megorsy, Melsky, Chernoozersky Complexes); 2 – Mg-Al-type (Zolotitsky, Verkhotinsky Complexes); 3 – Diamond deposits (1 – M.V. Lomonosov, 2 – V. Grib); 4 – Nenoksko-Chidvinsky Megacoplex (Nenoksky, Chidvinsko-Izhmozersky, Suksomsky Complexes); 5 – Soyana-Pinezhsky basaltic Complex pipes groups (Soyanskaya, Kovalgsko-Poltozerskaya, Chuplega-Pinezhskaya); 6 – Diatremes: a – kimberlites, picrites, olivine melilitites, b – tholeiitic basalts

1. Diamond-bearing kimberlites of Zimneberezhny Mega-Complex presented by magnesia-aluminous (Al) Zolotitsky Complex (with M.V. Lomonosov diamond deposit) and ferrum-titanium (Fe-Ti) Chernoozersky Complex (with V. Grib diamond deposit). Typomorphic features of these Complexes are associations of high-barophilic accessories: Cr-diopside-pyrope-chromite (Zolotitsky Complex) and essentially pyrope-picroilmenite (Chernoozersky Complex). Diamondiferous kimberlites are characterized petrochemically by high magnesium, low alumina and very low silica lime concentrations, and potassium-sodium hydroxide alkalinity (Bogatikov et al., 1999). Zolotitsky Complex kimberlites are low-titanium - type I and Chernoozersky Comlex kimberlites are moderate-titanium - type II (Bogatikov et al., 2007).

With explicit domination of olivine-I phenocrysts, a very important feature of diamondiferous kimberlites is a typomorphism of microcrystalline oxides within groundmass: chromite for Zolotitsky Complex kimberlites and chromite-picroilmenite for Chernoozersky Complex kimberlites (Garanin et al., 2009).

In general, on a basis of petrological characteristics, Zolotitsky Complex diamondiferous kimberlites conform to Nakynskoe Area kimberlites (Yakutian Province, Russia) and Chernoozersky Complex diamondiferous kimberlites resemble to Malobotuobinsky and Daldyno-Alakitsy Areas (Yakutian Province, Russia), rather than.

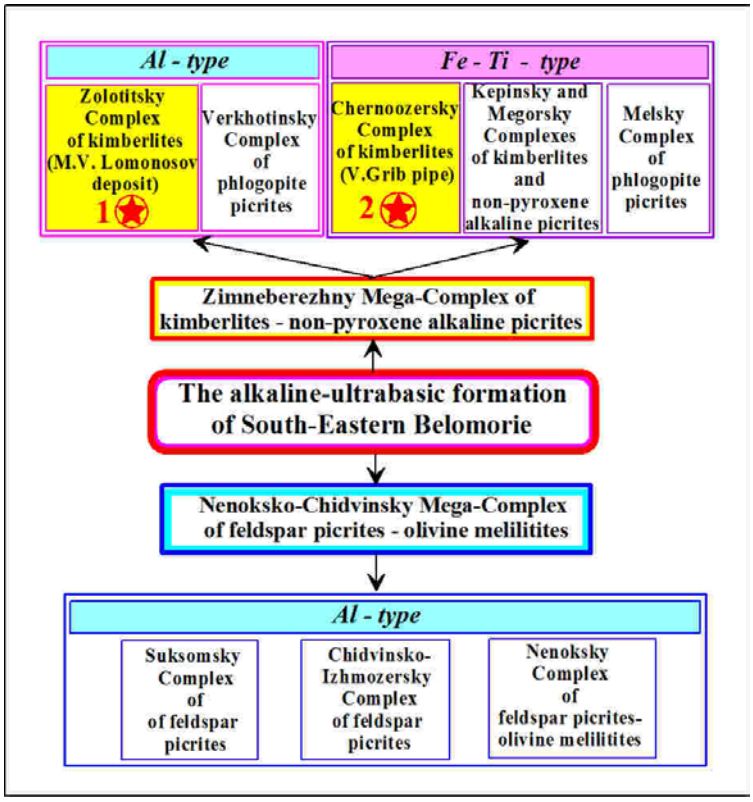

Figure 2:Scheme of structure of alkaline-ultrabasic formation of the Archangelsk kimberlite-picrite region.

2. Non-diamondiferous and poor-diamondiferous kimberlites, non-pyroxene alkaline picrites and feldspathic picrites-olivine melilitites unlike diamond-bearing rock types characterized by a clear predominance of olivine-II phenocrysts. Nenoksky pipes enriched by clinopyroxene I. Phenocrysts phlogopite diffuse in Verkhotina picrites and Mela sills.

In general, significant number of microliths of melilite, clinopyroxene and nepheline, as well as monticellite, richterite in some pipes is very typical for rocks of Nenokso-Chidvinsky mega-complex.

Fe-Ti Non-diamondiferous and poor-diamondiferous kimberlites and picrites Zimneberezhny Mega-Complex characterized by higher and high concentrations of total iron and titanium (Type III of high-titanium kimberlites (Bogatikov et al., 2007). Typochemism of Nenoksko-Chidvinsky Mega-Complex characterized by sharply high alumina, silica lime and the amount of alkali content with stable predominance of potassium over sodium.

There are significant differences for high-barophilic accessories. Thus, Kepinsky kimberlites characterized by significant preponderance of picroilmenites concentrations overpyropes, but low-chromium chromite dominates in Nenokso-Chidvinsky pipes.

An important feature of non-diamondiferous volcanic rocks is typomorphism of microcrystalline oxides within groundmass: Ti-magnetite-rutile for Fe-Ti type and chromite-Ti-magnetite for Al-type rockskimberlites (Garaninet al., 2009).

In general, non-diamondiferous kimberlites of mentioned Complexes are similar to non-diamondiferous kimberlites of the Northern part of Yakutian Province.

Kimberlites of Zolotitsky and Chernoozersky Complexes are greatly differfrom non-diamondiferous kimberlites of Archangelsk Region by geochemical characteristics, and located between Group I and II of South African kimberlites, according to Nb- and Zr-content, Sm-Nd and Rb-Sr systems' parameters (Fig. 3). Therefore, it is possible to emphasize unique Zimneberezhny type kimberlites (Bogatikov et al., 2007).

3. Soyana-Pinezhsky-dolerite-basalt Complex comprises three groups of pipes in the eastern part of the region, which are comparable to the petrological characteristics with intraplate tholeiitic basalts of continental environments, that allows to consider them as a part of Early-Hercynian dolerite-basalt formations of the East European platform (Tretyachenko 2008; 2015).

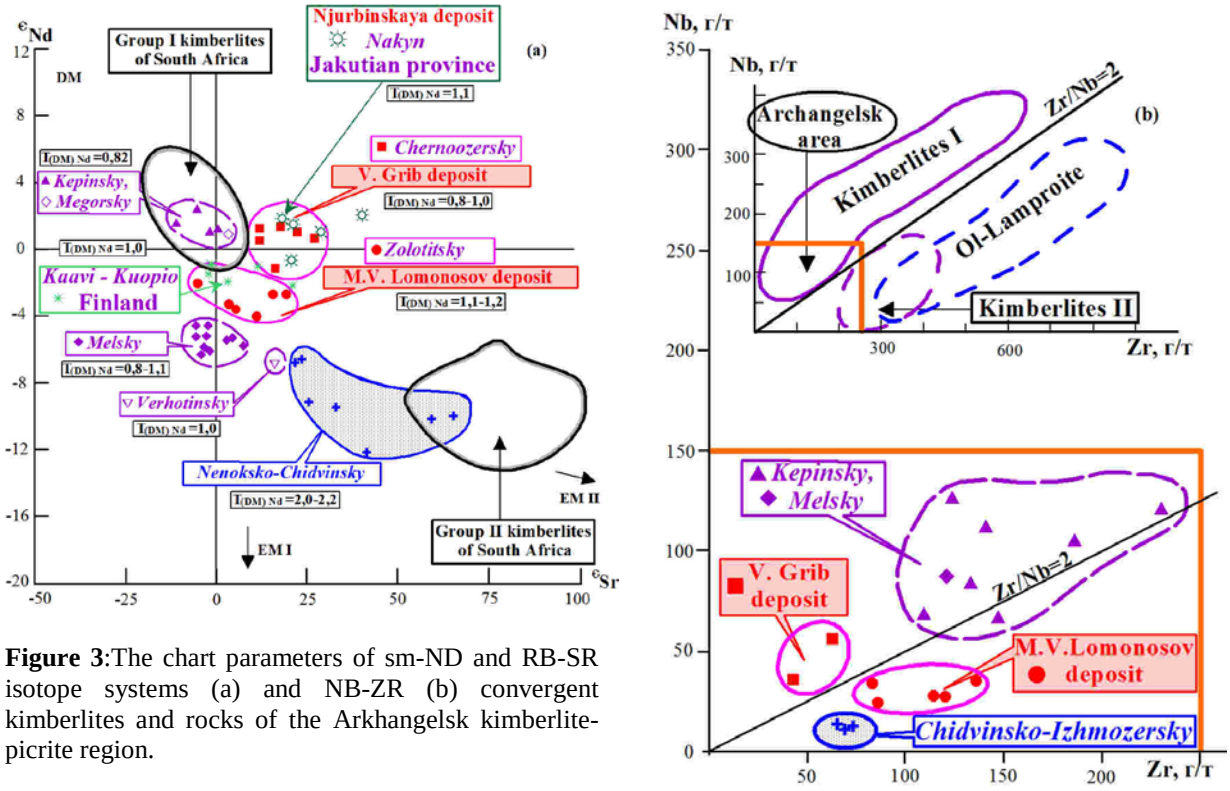

Figure 3:The chart parameters of sm-ND and RB-SR isotope systems (a) and NB-ZR (b) convergent kimberlites and rocks of the Arkhangelsk kimberlite-picrite region.

Is according: Bogatikov, 1999, 2007; Garanin, 2006; Sablukov, 2010

It should be pointed that diamondiferous kimberlites of Zolotitsky and Chernoozersky Complexes have been formed during Late Devonian-Early Carboniferous Eras (Frasnian -Visean Age, 375-340 ma), similar to kimberlites of Malo-Botuobinsky, Daldyno-Alakitsky and Verkhnemunsky districts (Yakutian Diamondiferous Province). The other bodies of kimberlites, its converged rocks and tholeiitic basalts have been formed earlier: Pragian-Eifelian Age, 410-390 ma (Kepinsky, Megorsky, and Melsky Complexes), Eifelian -Frasnian Age, 390-380 ma (pipes of Nenoksko-Chidvinsky Mega-Complex and Soyana-Pinezhsky Complex) (Tretyachenko, 2008; 2015).

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