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Picroilmenite xenoliths and xenocrysts in Yakutian kimberlites.

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IIlmenite-bearing mantle xenoliths found in kimberlite pipes of Yakutian Province were studied in representative collection of samples (over 50), forming a wide spectrum of petrographic varieties, including dunites, harzburgites, wehrlites, lherzolites, pyroxenites, eclogites, websterites, glimmerites from pipes Mir (Malaya Botuobia field), Udachnaya, Dalnya (Daldyn field), Obnazhennaya, Sludyanka, Poiskovaya (Kuoika field). Silicates demonstrate high FeO content, relatively low $Cr2O_3$ excluding metasomatites in lherzoltes and high TiO_2 concentrations. Typical (Ol) 13,8 % Fa; (Gar) 12 to 18,32 % FeO (0,12-1,44. % TiO_2);0,19-6,55 % $Cr2O_3$).in lherzolite trend. (Cpx) FeO (2,77-6,12 %) and TiO_2 (0,19 - 1,06 %), low $Cr2O_3$ (0,15-1,10); (Opx) TiO_2 (0,07-0,63 %), $Cr2O_3$ (0,01-0,36 %), CaO (0,3-1,47 wt. %), Na2O (0,01-0,68 wt. %), $Al2O_3$ (0,29-4,52 wt. %).
Ilm modal proportion is 0-35 %. Ilm from xenoliths possesses wide TiO_2 (30-57 %), $Al2O_3$ (0,00-2,09), $Cr2O_3$ (0,2-8 wt. %), MgO (5,42-15,22 wt. %), FeO (26,9-56,7 wt. %), Mg'= 26,31-49,01. The ilmenite from xenoliths shows higher MgO and low hematite minal compared to ilmenites from kimberlites indicating reduced conditions. Major part of picroilmenites from kimberlites is not associated with the diamondiferous mantle rocks. Ilmenites bearing rocks are common in northern kimberlite fields producing abundant xenocrysts. Distribution of trace elements in garnets and clinopyroxenes from Ilm xenoliths indicates common HFSE – melt metasomatism. The ilmenite TRE sho high peaks in TA, Nb and les Zr – Hf. REE patterns vary from flat to moderately inclined.
Calculated PT-conditions of Ilm bearing rocks with geothermobarometers: Brey & Kohler (1990), Krogh (1988), Nickel & Green (1985) using on the representative database of chemical composition of Ilm xenolith minerals show the wide range of PT condition mainly close to SCLM base and relatively high temperature conditions >40 mWm-2. But the lower temperatures and pressure associations occurs mainly as disseminated metasomatites. Xenoliths from pipes of the north fields (Sludaynka and Obnazhennaya) are marked by relatively low temperature and low-pressure crystallization conditions. Xenoliths from the Poiskovaya pipe turned out to be high-temperature. Ilmenite xenoliths from the Udachnaya pipe are high pressure formations and belong mainly to the pyroxenitic associations . Large megacrysts from Udachnaya pipes are mainly Mg- rich $\sim$10 % but smaller show wider range of compositions (7-13%). Similar ilmenites in intergrowths with the low Cr garnets and pyroxenes occur in the Dalnya pipe (Rodionov et al., 1993). In Daldyn field the histograms of Mg and Fe for ilmenites are similar in the different pipes as it was determined for Zarnitsa cluster (Amshinsky , Pokhilenko, 1983; Alymova et al., 2004).
Abundant ilmenites from the Alakite kimberlites are mainly Cr –rich and belong to the metasomatic associations and veins to 8% $Cr2O_3$. They show wide range of compositions starting from 14 to 6% MgO. Even wider compositional range is determined for the xenoliths and xenocrysts from Malaya Botuobia field. They are vainly found in the pyroxenitic associations similar to Udachnaya. But the Cr- rich associations sometimes occur as well. In the Upper Muna fields the metasomatic Cr- bearing Ilmenites and Cr- less are common. Each kimberlite field reveals distinct ilmenite compositional variation.
lmenite-bearing mantle xenoliths found in kimberlite pipes of the Yakutian Province were studied in the representative collection of samples (over 50) of ilmenite xenoliths, forming a wide spectrum of petrographic varieties, including dunites, harzburgites, wehrlites, lherzolites, pyroxenites, eclogites, websterites, glimmerites from pipes Mir (Malaya Botuobia field), Udachnaya, Dalnya (Daldyn field), Obnazhennaya, Sludyanka, Poiskovaya (Kuoika field). Silicates demonstrate high FeO content, relatively low $Cr2O_3$ excluding metasomatites in lherzoltes and high TiO_2 concentrations. Typical (Ol) 13,8 % Fa (Gar) 12 to 18,32 % FeO (0,12-1,44 wt. % TiO_2);0,19-6,55 wt. % $Cr2O_3$).in lherzolite trend. (Cpx) FeO (2,77-6,12 wt. %) and TiO_2 (0,19 - 1,06 wt. %), low $Cr2O_3$ (0,15-1,10). (Opx) TiO_2 (0,07-0,63 wt. %), $Cr2O_3$ (0,01-0,36 wt. %), CaO (0,3-1,47 wt. %), Na2O (0,01-0,68 wt. %), $Al2O_3$ (0,29-4,52 wt. %).
Ilm reaches high values (to 30-35 %). Ilm from xenoliths possesses wide variations of TiO_2 (43,30-57,32 wt. %), $Al2O_3$ (0,00-2,09), $Cr2O_3$ (0,32-5,28 wt. %), MgO (5,42-15,22 wt. %), FeO (26,86-56,69 wt. %), Mg/(Mg+Fe) *100 (26,31-49,01) values. The ilmenite from xenoliths shows higher magnesium content and low concentration of hematite minal as compared with ilmenites from kimberlites, i.e. it was crystallized in more reduced conditions (fig. 5). These data suggest that in the south diamond-bearing fields the major part of picroilmenite from kimberlites is not associated with the disintegration of ilmenitebearing mantle rocks, while for ilmenites from

kimberlites of the north fields the disintegration had a visible role. Distribution of rare earth elements in garnets and clinopyroxenes from Ilm xen indicates a common high-iron and high-titanium paragenesis as well as equilibrium crystallization and magmatic origin.We calculated PT-conditions of forming rocksvia geothermo-barometers: Brey & Kohler (1990), Krogh (1988), Nickel & Green (1985) using on the representative database of chemical composition of Ilm xen minerals (fig. 6). Xenoliths from pipes of the north fields (Sludaynka and Obnazhennaya) are marked by relatively low temperature and low-pressure crystallization conditions. Xenoliths from the Poiskovaya pipe turned out to be high-temperature. Ilmenite xenoliths from the Udachnaya pipe are high pressure formations nad belong mainly to the pyroxenitic associations . Large megacrysts from Udachnaya pipes are mainly Mg- rich !10 % but smaller show wider range of compositions (6-13%). Similar ilmenites in intergrowths with the low Cr garnets and pyroxenes occur in the (Dalnya pipe Rodionov et al 1993) In Daldyn field the hystograms of Mg and Fe for ilemenites are similar in the different pipes as it was determined for Zarnitsa cluster (Amshinsky , Pokhilenko , 1983; Alymova et al., 2004).

Abundant ilmenites from the Alakite kimberlites are mainly Cr –rich and belong to the metasomatic associations and veins to 8% $Cr2O_3$. They show wide range of compositions starting from 14 to 6%. Even more wider compositional range is determined for the xenoliths and xenocrysts from M Botuobiskoe field. Mainly they are found t he pyroxenitic associations similar to Udachnaya , But the Cr- rich associations sometimes occur as well. In the Uppert Muna fields the metasomatic Cr- bearing Ilmenites and Cr- less are common. Each field have distinct variations.