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First kimberlite pipe in Central Yakutia (Russia)

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About 1000 kimberlite bodies have been discovered in western and northwestern Yakutia. This portion of the Siberian platform is known as the Yakutian kimberlite province. Drilling done by geologists from "Yakutskgeologiya" in 2007-2008 revealed the first kimberlite pipe in Central Yakutia located 800 km southeast of the Yakutian kimberlite province. The Manchary pipe was drilled at a depth of more than 100 m on the right bank of the Lena r. not far from Yakutsk. It was explored by three drill holes to 150-170 m depth. It breaks though Upper Cambrian carbonate deposits and is overlain by Jurassic terrigenous masses.

The pipe is composed of greenish-gray kimberlite breccia with a serpentine-micaceous cement of massive structure. The rocks in the upper parts are mudded to varying degree. Kimberlite breccia typically hosts serpentinites, micaites, as well as micaceous and garnet serpentinites up to 2-5 cm in size. The porphyry texture of kimberlite is due to the presence of serpentinized olivine, phlogopite, picroilmenite, and garnet phenocrysts (macrocrystals). The rock texture in these areas resembles autolithic texture. The least altered rocks from the pipe are typical noncontaminated kimberlites, judging by the content of SiO2 (20-35 wt.%) and Al2O3 (<5 wt.%). The first Rb-Sr isochrone determinations of unaltered kimberlites yielded the age of 359±50 Ma (Io+0.7052), which is close to that of diamondiferous kimberlite pipes such as Mir, Aikhal, Udachnaya, etc. from the Yakutian province.

Fe- and Cr-spinels are rounded, with elements of octahedral faceting. Spinellid macrocrystals include both high-titanium (TiO2 >1.0 wt.%) and low-titanium (TiO2 < 1.0 wt.%) varieties. According to the ratio of Fe2 /(Fe2+Mg) to Cr/(Cr+Al) two groups of spinellids form a kimberlite trend.

Picroilmenite macrocrystals have irregular boundaries. Around picroilmenite, reaction rims are constantly observed. They consist of fine grains of perovskite, ferrospinels, and magnetite. The picroilmenits have a high content of MgO, 8.2 to 11.5 wt.%. According to MgO/TiO2 ratio, the composition points of all ilmenites under study plot along the "kimberlite trend" of ilmenites.

Chemically, pyrops are of lherzolite, wehrlite, or nondiamondiferous dunite-harzburgite parageneses. We did not find pyrops typical of deep-seated xenoliths of deformed peridotites from the Udachnaya pipe. Neither did we find high-chromium subcalcic pyropes analogous to diamond inclusions, which could show the diamond potential of those kimberlites. Eclogitic garnets were not found either. Part of pyrop grains of lherzolite paragenesis are compositionally close to those from diamond inclusions.

P-T crystallization parameters were estimated with the use of monomineralic garnet thermometers as well as choromite and ilmenite thermobarometers. From chemical composition of garnets we established a conductive geotherm (35 mw/m2) typical of the mantle beneath the Paleozoic pipes in Yakutia, and a layered structure of the mantle column to a depth of 230 km (70 kbar) consisting of 8 intervals. In the middle part, they are separated by a 50-40 km thick horizon (35-65 kbar) with little garnet. The horizon is supposed to have a pyroxenite composition. That structure of lithosphere is typical of the Arkhangelsk diamondiferous province and the Nakyn kimberlite field. P-T parameters estimated by chromite and ilmenite geothermobarometry trace a high-temperature line of geotherm which is due to the heating of mantle rocks by protokimberlitic melts. In general, the estimated P-T parameters and geotherms show that lithosphere in Central Yakutia has thicknesses of a mantle root corresponding to the diamond stability area.