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Mantle structure and composition beneath Udachnaya pipe reconstructed by mantle xenoliths from the brown breccia

Igor Ashchepkov (1), Theodoros Ntaflos (2), Dmitri Ionov (3), Lyudmila Pokhilenko (1), Nikolai Vladykin (4), Sergey Kuligin (1), Sergey Mityukhin (5), and Stanislav Plessky (1)

(1) Institute of Geology and Mineralogy, Novosibirsk, SD RAS, Russia, (2) Dept. of Lithospheric Research,University of Vienna, Austria, (3) Université J. Monnet & Umr-Cnrs 6524, 23 P. Michelon, 42023 Saint-Etienne, France, (4) Institute of Geochemistry SD RAS, Favorsky str. 1a, Irkutsk, Russia, (5) Stock Company "ALROSA", Chernyshevsky Str,7, Mirny, Russia

New original unpublished collection of >200 xenoliths from Udachnayakimberlite pipe, Yakutia analyzed for major and trace elements as well as the previous data (Sobolev et al., 1994; Jacob et al., 1994; Pokhilenko et al ,m 1993- 2000; Boyd et al., 1997; Smith, 1999; Kuligin et al ., 1995; Malygina et al ., 2000; 2008; Pokhilenko et al ., 2006; Shatsky et al.,2008; Ionov et al ., 2010 etc) including ∼1700 associations an xenocrysts was used for the deciphering of the mantle structure, layering and composition beneath this pipe. The most deep seated and fresh mantle xenoliths in the pipes were found in brown breccia. They have been entrained in kimberlites starting at depths corresponding to 80 kbar and continuing at 5 individual shallower depth intervals. In the lowermost part of the mantle sections prevail dunite – eclogite lenses together with the porphyroclastic harzburgites that have been affected by Ti - enrich melts which produced Cr-rich associations (to 1.8% TiO2 and 14% Cr2O3 % garnets). Deep seated metasomatites ilmenite – clinopyroxene pyroxenites (eclogites) and sheared peridotites are developed within 75-55 kbar intervals. Two peridotite lenses occurring at depths that correspond 40-55 kbar have xenoliths with high Fe# and an unusual high frequency of pyroxenites, implying multiple melt percolation, which is reflected in the Cpx and Garnet compositions. Interaction with differentiated melts before entraining in kimberlites resulted to the formation of Ti – Cr enriched green garnets and Ti association in porhyroclastic peridotites. The latest protokimberlite melt intrusion had as consequence the heating and shearing of the peridotites, the remelting of the deep seated eclogites, and possibly the creation of newly formed population of the diamonds. The phlogopite metasomatism is the last event of this interaction. Using high precision olivine major- and trace element analyses from 64 xenoliths can be divided into 3 major groups. Group 1 is characterized by high Ca- and Ti- porphyroclastic and/or sheared peridotites. Group 2 consists of coarse grained garnet peridotites that have low Ca- and high Ni- olivines. Group 3 are low pressure garnet-spinel peridotites with low Ni-olivines. Phlogopite metasomatism is a major process and characterize the whole section of the mantle column beneath the pipe. Melt formed phlogopites in the spinel facies probably were related to the ancient stages of the melt percolation like those found in the peridotite xenoliths from Alakite field (Ashchepkov et al ., 2010) or to the plume or subduction related melts affected peridotites long before kimberlite magmatism. Xenoliths captured from the SCLM base (80 kbar) have been affected by protokimberlite melts with composition close to kimberlite II (H2O and K bearing) and are responsible for Ti-Ca enrichments not long before the eruption and accompany last stages of hearing. The deep seated phlogopite breccia were formed at the deep level of the mantle column due to the H2O rich fluid interaction with the mantle peridotites. The trace elements patterns for the minerals from the deep seated xenoliths are highly varying and differ for peridotites, pyroxenites and eclogites. Clinopyroxenes from peridotites show mainly highly inclined (La/Yb)n patterns with the small hump shifted to the left part of the REE patterns. The TRE are complex and varying. Most of the diagrams show prominent Zr and occasionaly Hf dips. They show also small or pronounced depressions in Nb and Ta. Cpx REE patterns from the pyroxenites of sheared and some porhyroclastic peridotites are nearly uniform (parent melts created as « 1% fussion of nearly primitive mantle source). Some samples show very low HREE due to the presence of high amounts of garnets in association. Zr *<1 is common due to fractionation in the some minor minerals and garnets. Eclogite's Cpx differ in TRE diagrams. The TRE level is lower for those with the signs of the primary subduction origin showing Eu, U , Sr peaks. The others show high level of the TRE and highly inclined REE patterns, TRE with fluctuation in Ta and elevated LILE. They may be differentiates from plume melts probably protokimberlite or derived from magma contaminated in metasomatic association. Grant RBRF 05-05-64718; projects 77-2, 65-03, 02-05 UIGGM SD RAS and ALROSA