

Vladimir Zinchenko,
(CATOCA Mining Society; vladimir.zin@mail.ru)

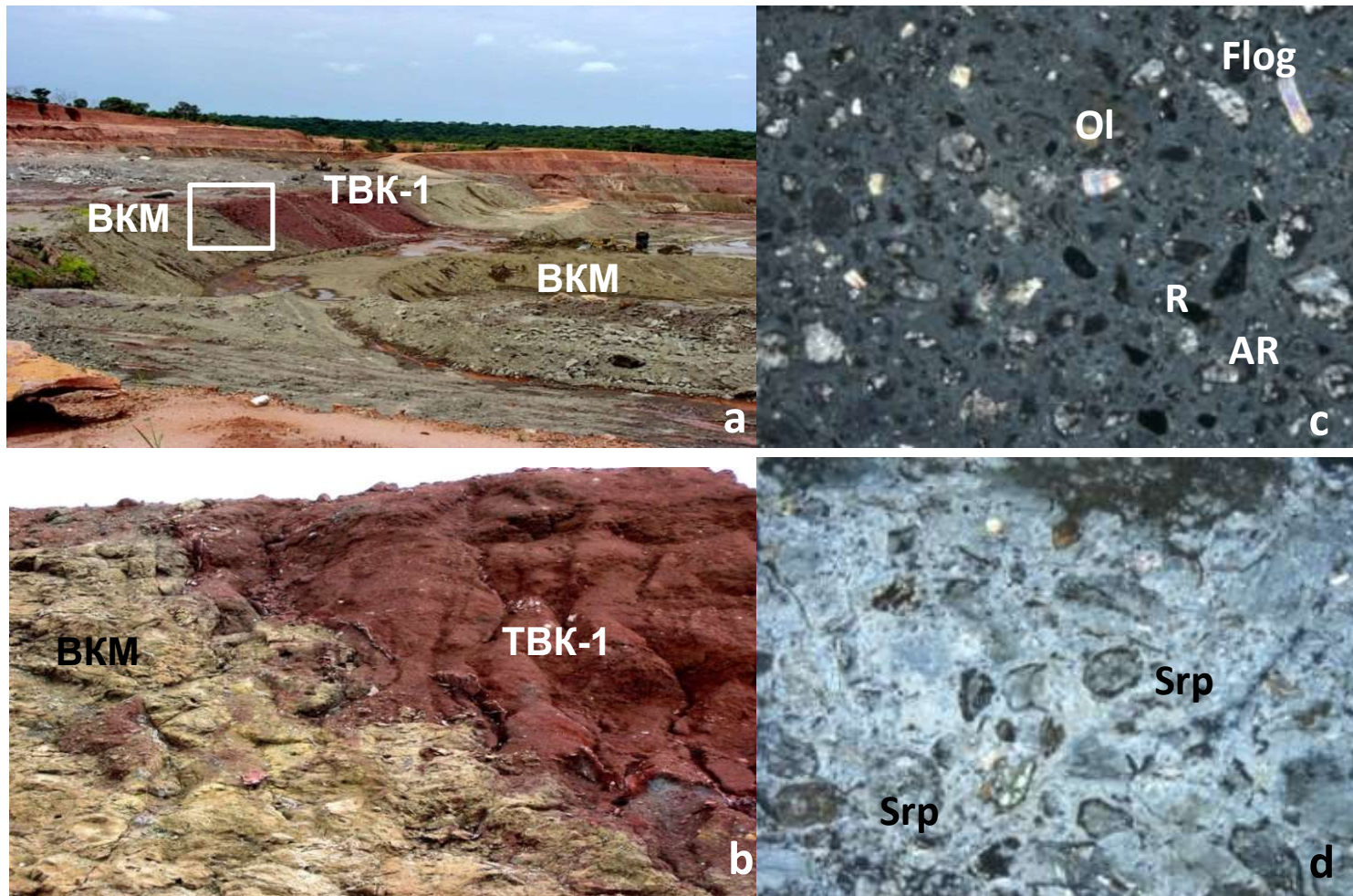
Alexander Ivanov,
(AK ALROSA)

Larisa Nikitina
(Institute of Precambrian geology and geochronology, RAS)

Composition of pyroxenes from kimberlite and eclogite xenoliths of Catoca kimberlite pipe (Angola)

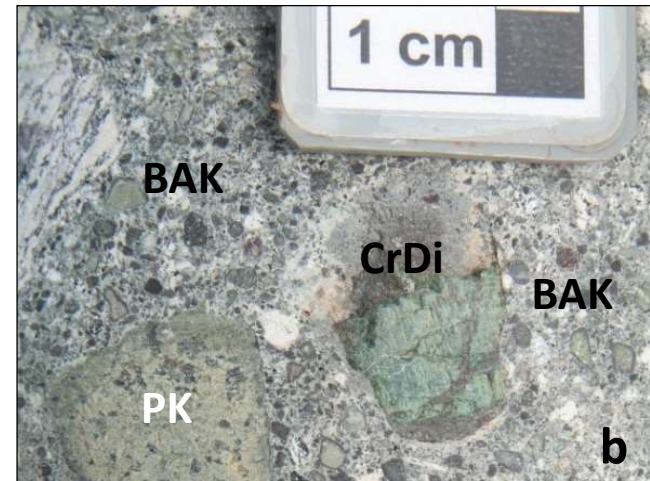
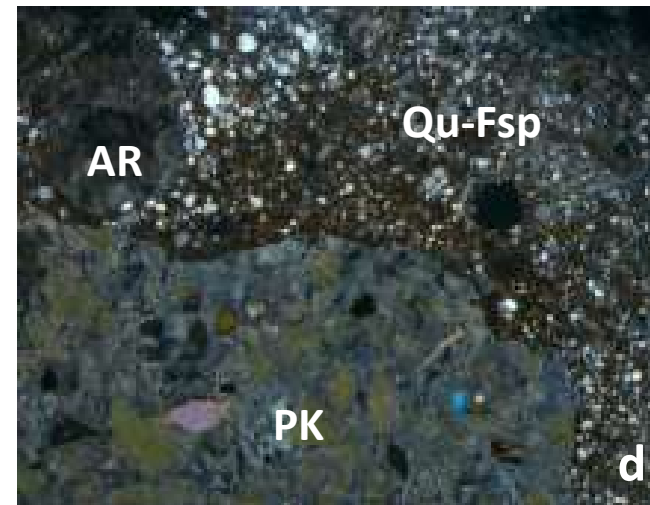
Viena 2021

Catoca pipe massive kimberlites (BKM)



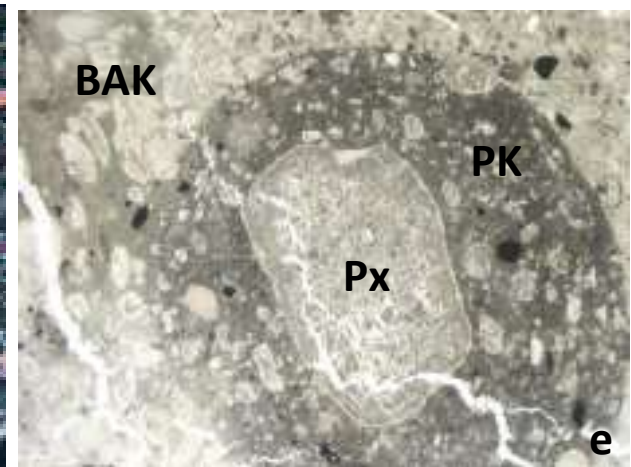
Massive kimberlite breccias in contact with tuff breccias of the first phase of penetration in Catoca mine (a, b); massive fine porphyry breccias with phenocrysts of serpentinized olivine (Ol), rare phlogopite (Phl) laths and grains of opaque ore minerals (R), small xenoliths of gneisses (AR), the matrix is serpentinized (c - N $\times$, d - NII) (Zinchenko, 2017)

Porfiric kimberlites (PK)



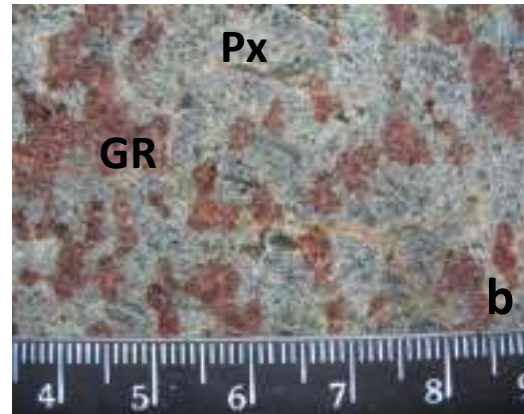
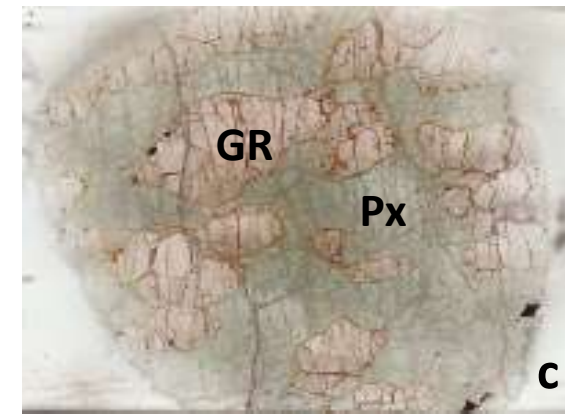
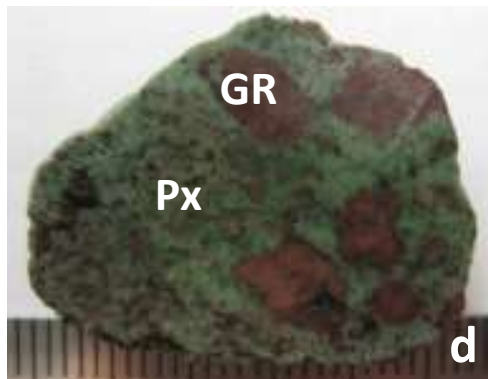
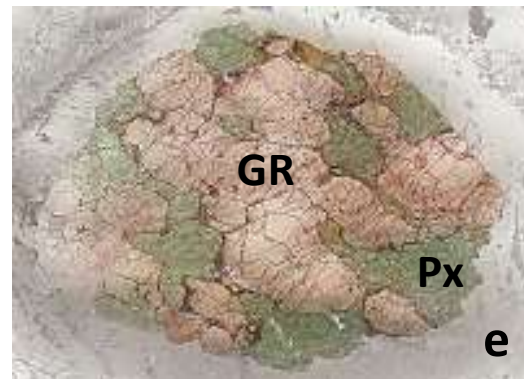
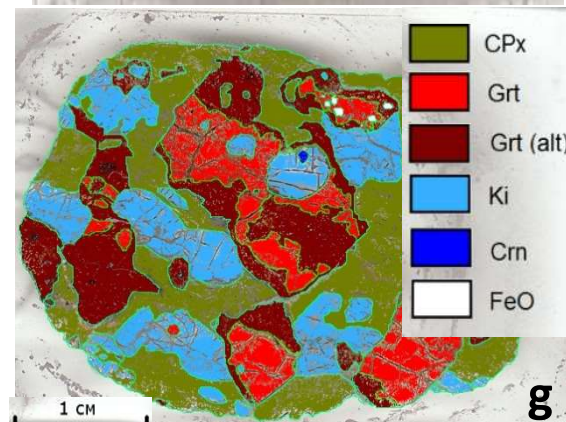
Inclusion of "kimberlite in kimberlite" in BAK breccia – a fragment of dark gray breccia PK with autolithic rim (a); chrome diopside CrDi, fragment of PK and serpentinized olivine in BAK, borehole 050/34, depth 471.6 m (b); crystal clasts of olivine (Ol) serpentinized in a fine-porphyry matrix with microcrystalline carbonate-serpentine-ore cement (c – N $\times$); heterolithic breccia from fragments of metamorphic rocks (AR), sandstones and siltstones (Qu-Fsp), fine-porous kimberlite (PK) (c – N $\times$) (d) (Zinchenko, 2017) .

Autolithic kimberlite breccias



Autolithic kimberlite breccias with highly fractured pyrope megacrysts, borehole № 050/34, depth 443.0 m (a), and olivine – depth 502.2 m (b); magmatic breccia with film-type autoliths and porphyroclasts of olivine replaced by serpentine (Srp), borehole 050/37, depth 387.0 m (c – NII); magmatic breccia with film-type autoliths, angular porphyroclasts of fresh olivine (Ol) (d – N $\times$); rounded inclusion of finely porfirico kimberlite (PK) 10.0 mm in diameter with pyroxene megacryst in the center (Px) in autolithic breccia (BAK) (e – NII).

Garnet-pyroxene mantle eclogite xenoliths from kimberlites



High magnesium eclogite, Cat-18 (a,b) and its thin section (c); H-MgO eclogite, granoblastic structure of garnet and clinopyroxene grains, sample kat-6 (e) and its section (f); high-alumina eclogite, sample No Cat-9, thin section (f) and its mineral composition (g): CPx - clinopyroxene, Grt - garnet, Grt (alt)- altered garnet, Ki- kyanite, Crn- corundum, FeO-FeO phases (Zinchenko, 2017).

Kimberlite pyroxenes



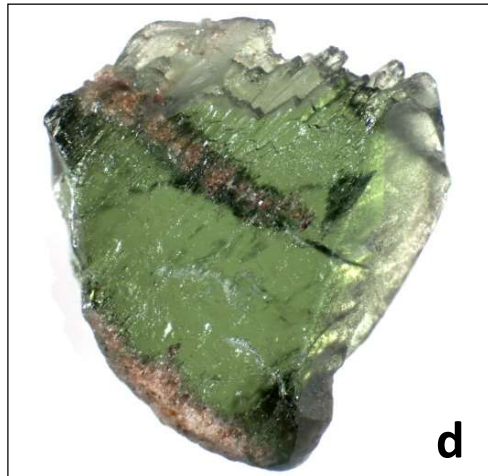
a



b



c



d



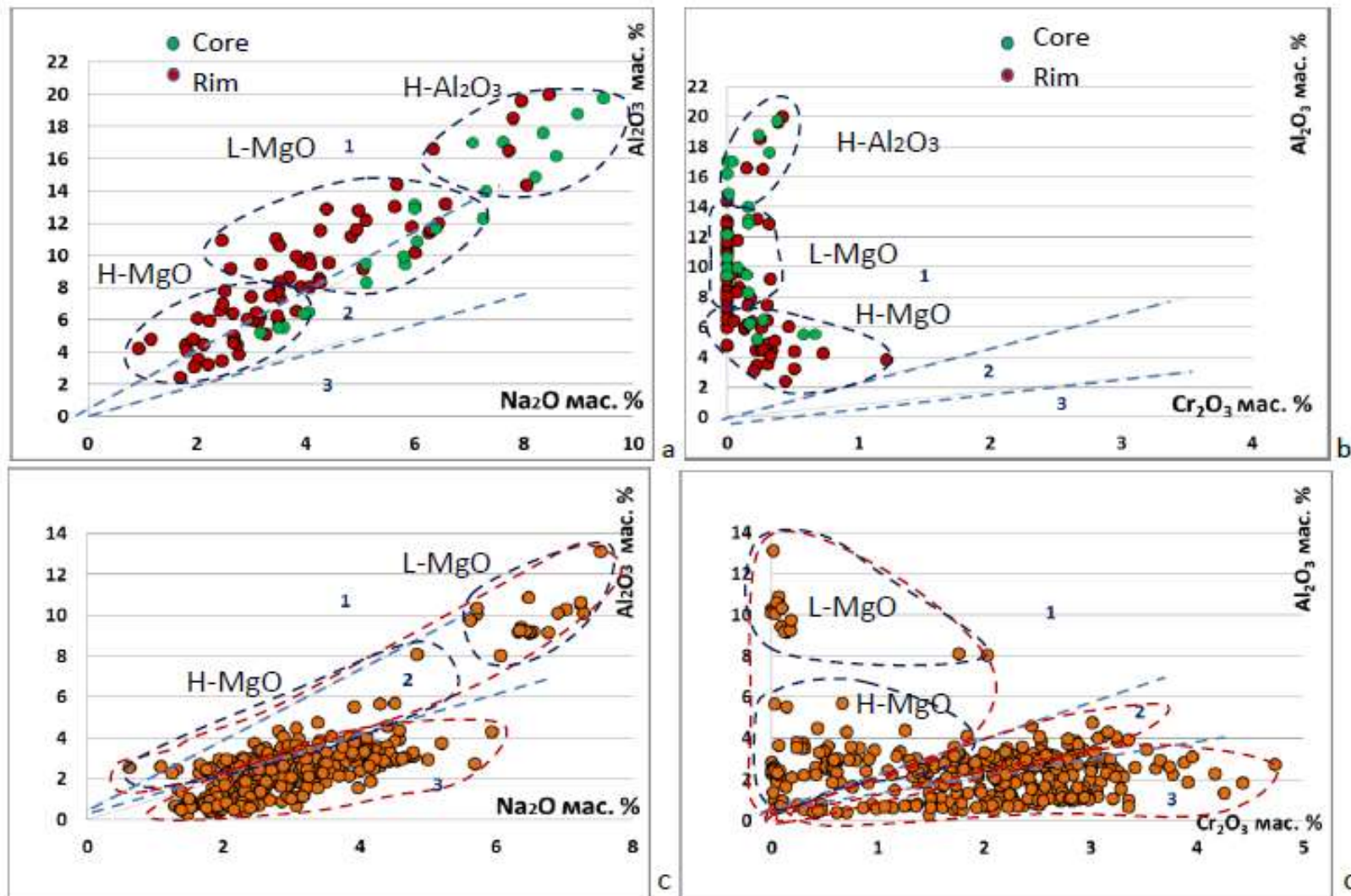
e



f

Megacrysts of diopside (b) e chrome diopside (a); splice of chrome pyrope with chrome diopside (c); green chrome diopside grain (d); aggregate of chrome diopside with pyrope (e); megacrysts of diopside and chrome diopside from heavy fraction concentrate (f); (Zinchenko et al., 2012).

Sobolev's Diopside Na_2O vs Al_2O_3 and Cr_2O_3 vs Al_2O_3 diagrams of mantle eclogites and kimberlites of the Catoca pipe



Compositions of Px from eclogite xenoliths (a, b) and kimberlites (c, d) of the Catoca pipe, depth facies after (Sobolev, 1974): 1 - pyroxene spinel (7–11 Kbar) and pyrope spinel (17 –21 Kbar); 2 – grosphidite (21 –34 Kbar); 3 – coesite (34–40 Kbar); eclogites: H-Al $_2$ O $_3$ – high-alumina; L-MgO – low magnesium; H-MgO – high-Mg (Nikitina et al., 2014).

Conclusion

Microprobe analysis (JSM 6510 LA/JET-2200) of rock-forming pyroxenes from eclogite xenoliths (Nikitina et al., 2014) and pyroxenes from kimberlites of the Catoca pipe (reveal absence of zonation of grains). Were identified two major genetic groups of this indicator mineral in the $\text{Na}_2\text{O}-\text{Al}_2\text{O}_3$ and $\text{Cr}_2\text{O}_3-\text{Al}_2\text{O}_3$ diagrams (Sobolev, 1974): high alumina (Hi- Al_2O_3), low magnesia (L-MgO) and high magnesia (Hi-MgO) (Nikitina et al., 2014), with a greater contrast in Na_2O than in Cr_2O_3 . At the same time, the most sodium-rich pyroxenes are H- Al_2O_3 , and chrome-Hi-MgO eclogites. Pyroxene grains from magnesian eclogites are zonal: their central zones are enriched with sodium and somewhat depleted of chromium in comparison with the marginal ones. Such zoning is not typical for pyroxene grains from Hi- Al_2O_3 eclogites.

Pyroxenes from kimberlites are more diverse in composition and generally have low Al_2O_3 and elevated Cr_2O_3 contents. In the classification diagrams, the fields of their compositions corresponding to eclogite pyroxenes are well identified, while the field of Hi- Al_2O_3 eclogites is absent.

To determine the genetic affiliation of pyroxenes from kimberlites of facies and 3 allows the method of identifying chemical-genetic groups (Garanin et al., 1991) on the basis of cluster analysis (Ivanov, 2017). This results showed that only 21% of pyroxenes from kimberlites belong to weakly diamondiferous eclogites, the most numerous – 52% – pyroxenes of weakly diamondiferous lherzolites, 10% – weakly diamondiferous ilmenite peridotites and pyroxenites, 15% – weakly diamondiferous lherzolites and websterites, 2% – integrowths with diamonds. This indicates multistage diamond generation environments represented not only by previously identified eclogite sources of diamonds in the kimberlites of the Catoca pipe (Korolev et al., 2013; Nikitina et al., 2014), but also by peridotites, pyroxenites, lherzolites, and websterites.

Bibliography

Sobolev N. V. Deep inclusions in kimberlites and the problem of upper mantle composition. Novosibirsk. The science. 1974. 264 P.

Nikitina L. P., Korolev N. M., Zinchenko V. N., Joao Tunga Felix. Eclogites from the upper mantle beneath the Kasai Craton (Western Africa): Petrography, whole-rock geochemistry and U-Pb zircon age. Precambrian Research. 2014. Vol. 249. P. 13-32.

Garanin V. K., Kudryavtseva G. P., Marfunin A. S., Mikhailichenko O. A. Inclusions in diamond and diamond-bearing rocks. Moscow State University Publishing House, 1991, 240 p.

Korolev N. M., Nikitina L. P., Zinchenko V. N., Francisco Joao. Eclogite xenoliths of the Catoka and Cat-115 kimberlite pipes, Kassai craton, West Africa. Part 1: Mineralogy, formation conditions//Regional geology and metallogeny. No. 54. 2013. P. 51-64.

Zinchenko V.N.

Зинченко В.Н., Деч В.Н., Шафрановский Г.И. Кимберлиты и алмазы трубки Катока. Петрогенез, рудогенез и моделирование распределения алмазов. Саарбрюкен (Германия), Palmarium Academic Publishing, 2012, 277 с.

Зинченко В. Месторождения алмазов из кимберлитов северо-востока Анголы. Изд-во С-Пб ГУ, 2017, 465 с.

Зинченко В.Н. Месторождения алмазов из кимберлитов северо-востока Анголы. Изд-во С-Пб ГУ, 2017, 465 с.