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THE USAGE OF INDICATOR MINERALS IN DETERMINING OF THE DIAMONDS PRESENCE IN KIMBERLITE PIPE

There exists an important issue in diamond exploration processes: how to improve the exploration stage and quickly differ between empty and fertile diamond kimberlites. The best decision is to use indicator minerals. Structures ofindicator minerals, such as Mg-ilmenite, chromite, garnet and diopside, are associated with thediamonds presence in kimberlites. Nevertheless, research made by Robles-Cruz (2008) showed that mineral analysis on ilmenite is not suitable for determining diamonds in some kimberlite pipes. But still, it is important to know the chemical analysis of indicator minerals in exploration.

Such researchers as *M.C. Oliver, J.C. Melgarejo, A.O.Goncalves* (2011), K.N.*Egorov, E.F. Roman'ko,V.T., Sablukov, S.M., Garanin, V.K., and professor of our university V.T. Podvysotsky* worked on this issue *(2007).* My research is based on the analysis of scientific works of mentioned above researchers. Their research was performed on fertile and empty kimberlite deposits in Angola (2007 and 2011). Fourkimberlites were sampled, twofrom the Lunda province (NW Angola) and two from Bié (the centre of Angola) [1]. Such indicator elements as chromite, ilmenite, garnet, Cr-diopside and perovskite were found. So, how can we use these minerals to prove or refuse diamonds presence in researched kimberlite pipes?

In the first place we shall discuss the location of these four pipes. The given pipes are located on the extensionaltectonic structure which stretchesfrom NE (Lundas) to SW (Namibe) for more than 1100km. These pipes are assumed to beCretaceous and kimberliticeruptions were noticed therein 2010 [1]. All geologists know that active volcanic zones are necessary condition for diamond forming. Thus, according to the research made by Spain scientists: *M.C. Oliver, J.C. Melgarejo, A.O. Goncalves* (2011) we can predict that four kimberlite pipes from Lunda and Bie provinces can be diamondiferous. However, to prove presence of diamonds in researched kimberlite pipes we need to examine the texture and geochemistry of indicator minerals.

The first found indicator mineral is *chromite*. Four types of chromite were found: *chromite as olivine inclusions* (smallcrystals <30μm), *atoll chromite* (5 μm), *fine grained chromite in xenoliths* and *euhedral chromite in xenoliths* [1].It is known that fertile pipeshave low TiO_2 and high Cr_2O_3 content [2]. But the research on chromite showed increased TiO_2 and decreased Cr_2O_3 contents. Thus, we can make a conclusion that chromite in investigated pipes does not prove the presence of diamond grains.

One more found indicator element is *ilmenite.* Four textural kinds of ilmenite were characterized by Spain researchers: *anhedral ilmenite xenocrysts* (size from 50 to *600*μm), ilmenite *with spinelinclusions, ilmenite exsolutions in spinel,* ilmenite *cumulates* [1]. *M.C. Oliver, J.C. Melgarejo, A.O. Goncalves*(2011),proved thatilmenite grains have ahigh Mg content, thus, they are included in the"kimberlitic" ilmenite-field in the MgO-TiO_2diagram (Wyatt, 2004)[3]. However, ilmenite with spinel

inclusionsfalls out of this field [1]. Considering mentioned above facts it is not certainly that ilmenite is a useful mineral for determining presence of diamonds in researched kimberlites.

Garnet, one more indicator element, can occur both as xenocrystand inside a xenolith [1]. They also occur in many other types of xenoliths andtherefore, can give more information onthe composition and characteristics of researched kimberlite pipes. Research data showed that garnet is usually very poor in Cr_2O_3 (<1wt %) and has a wide range of CaOcontent (1.23-14 wt %) [1]. These conditions are favorable for diamonds presence in kimberlite pipes. However, according to the research there is a lack oflherzolite and harzburgite garnets, which can be explained by insufficient sampling [1]. Thus, because of this reason we can not prove the presence of diamonds in Angola kimberlite pipes.

*Cr-diopside*is also an important indicator element in the research of diamond presence. Only few diopside grains werefound. However, 3 different textural types of diopsidecould are distinguished: *clinopyroxene in xenoliths* (foundcommonly with garnet in deep xenoliths), *groundmass diopside* (grainsize ranging from 20 to 100 μm), *Groundmass skeletal diopside* [1]. The research showed different geochemical types of clinopyroxene minerals: those with Cr_2O_3>1wt%, and those with lower content of Cr_2O_3. Decreased content of Cr_2O_3 witnesses to presence of diamonds in kimberlite pipes. This indicator element proves the availability of diamonds in kimberlite pipes in Angola.

The last researched indicator element is *perovskite.*Only some small (<40μm) perovskitegrains were found in samples [1]. All perovskite grains are kimberlitic [1]. But we can not use this indicator element for proving the presence of diamond, because the amount of found elements is too small.

For better understanding of the usefulness of given indicator elements some conditions essential for akimberlite to be diamondiferous should be considered:

- sample rock must be fertile (C-source must be present) [1];
- prolonged oxidisingprocesses should be absent at high temperature during the kimberlite formation [1];

The geochemicalcomposition of the indicator minerals was studied independently on their texturalfeatures. The criterion of indicator mineralstudy is suitable only for Cr-diopside. Thus, to have efficient results the textural features of these elements should be studied. But it is the topic for further investigations.

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