**ON ALTERED CARBONATITIES FROM CATANDA, ANGOLA**

***Wolkowicz K.1, Jackowicz E.1, Wolkowicz S.1***

*1Polish Geological Institute-National Research Institute, Warsaw, Poland, [krystyna.wolkowicz@pgi.gov.pl](mailto:krystyna.wolkowicz@pgi.gov.pl)*

**Geological setting**

Catanda carbonatites belong to the lithological unit located at the intersection of four fault systems of Lucapa transcontinental rift structure extent of NE-SW. The structure and the carbonatite complexes were dated to Cretaceous period. Our recent geochronological determination based on pyrochlore indicates much younger age of this intrusion (Paleogene). Carbonatites cover an area of approximately 80 km2 and occur on the Precambrian basement consisting mainly of granite and acid metamorphic rocks; their overburden consists of eluvial-alluvial sediments. In the present morphology of the carbonatite complex one can distinguish hills surrounding the circular depression, within which there are relics of volcanic vents.

Catanda carbonatite complex is dominated in the volume by pyroclastic rocks, represented by the pyroclastic fall, flow and surge deposits. Carbonatite lavas - calcio- and silicocarbonatites, alternating with pyroclastic deposits, are formed in the most part by welding or agglutination of spatter, which particles are distinguish by positive relief on the surface of layers (Campeny, et al. 2012, 2014).

**Object of investigation**

The objects of this study were altered silicocarbonatites (12,5 -21,8% SiO2), occurring in the Ngonge and Viallala hills. The phenocrysts and xenocrysts components are pyroxenes (augite, diopside), amphiboles (hornblende, kaersutite), phlogopite, biotite, olivine, apatite, calcite, magnetite and titaniferous magnetite, plagioclase, K-feldspars and rarely quartz. Phenocrysts of mafic minerals, apatite, as well as numerous compounds of groundmass (spinel, perovskite, pyrochlore, zirconolite) exhibit compositional zoning and corroded edges. From the core to the mantle, augites display the increase in En and decrease in Fs content (with Wo52-54), olivines the increase in Fe content, perovskite in Fe, Nb and LREE.

**Products of alterations**

Silicocarbonatite lavas are altered in the different ways. Some of them underwent above all secondary carbonatization - the numerous veinlets cutting lavas are filled with calcite, which also forms irregular, often discontinuous and not complete rims around phenocrysts. On the mafic minerals there are mixed calcitic-chloritic rims or calcitic rims surrounding thin rims of earlier generation consist of chlorite or smectite.

Another common alterations of lavas resulted in replacing of feldspars (sometimes calcite) by calcium-aluminium-silica hydrated (CASH) minerals (locally with admixture of carbonates) and developing layered rims, containing monticellite and calcium silicates around mafic minerals, plagioclases, potassium feldspars and calcite. These calcium silicates and CASH are recognized, on the base of WDS analysis. The chemical composition suggests, that CASH minerals are probably represented by tobermorite group, though their structural formulae are not correct due to the admixture of others ingredients in pseudomorphs, rims and fissure cracks, where they occur. Among the calcium silicates, cuspidine is predominate, but locally the minerals of Ca-humite group (perhaps kumtyubeite) occur and rarely wollastonite, only as infilling the veinlets in altered phenocrysts. Monticellite from the rims of different phenocrysts have similar composition.

**Alteration rims**

The rims have different thickness, from thin (several tens of mikrometres) on pyroxenes, amphiboles and phlogopite to relatively wide (up to ~400 mikrometres) on feldspars. Their contact with phenocrysts (or pseudomorph) is sharp, but their opposite margins are locally not clear, because of the presence of very thin, irregular overgrowths, sometimes looking like coronas. They enter into the groundmass, which also contains minerals forming the rims.

The rims of olivine consist mainly of monticellite; pyroxenes and amphiboles have partly discontinuous rims of monticellite and cuspidine, overgrown with inclusions, mainly of Ti-magnetite and apatite. In the rims surrounding feldspars, the inner band is formed of cuspidine or minerals of Ca-humite group (locally with inclusions of Ba-mica), the outer band contains mainly monticellite (locally overgrown with minerals from the inner band). In some rims, particularly around feldspars, one can observe, that monticellite was growing from outer to inner margins of the rims, on the contrary to thin corona.

In less altered lavas, the rims don't contain monticellite. The relics of pseudomorph of tobermorite, probably after feldspars, with the rims consist of cuspidine and remnants of this pseudomorphs.

**Conclusions**

- Two facies of altered silicocarbonatite lavas have been distinguished; they are characterized by assemblages of the following secondary minerals: 1. chlorites and smectites - calcite; 2. CASH minerals, calcium silicates and monticellite.

- The mentioned minerals form rims on phenocrysts and xenocrysts; monticellite and cuspidine form also thin haloes overgrowing rims. They also occur in the groundmass and with the exception of monticellite, infill the fissures crack. It indicates the genesis of this mineralization after emplacement of lavas.

- Chlorites, smectites, calcite and CASH minerals are the products of postvolcanic activity, but cuspidine, minerals of Ca-humite group and monticellite represent high-temperature assemblage, typical to skarn.

- Features of some phenocrysts relics and their rims suggest the influence of pyrometamorphism on their formation. This process could be caused by coal combustion (Ciesielczuk et. al., 2015) or by another factors, related with the fire activity.

**References**

Campeny M., Alfonso P., Melgarejo J.C., Mangas J., Bambi A., Manuel J. (2012) Carbon and oxygen isotopes of the carbonatitic lavas from Catanda, Kwanza Sul, Angola: genetic implications. European Mineralogical Conference Vol. 1, EMC 2012-438.

Campeny M., Mangas J., Melgarejo J.C., Bambi A., Alfonso P., Gernon T., Manuel J. - 2014. The Catanda extrusive carbonatities (Kwanza Sul, Angola): an example of explosive carbonatitic volcanism. Bull. Volcanol. 76: 818-832.

Ciesielczuk J., Kruszewski L. Majka J. (2015) Comparative mineralogical study of thermally-altered coal-dump waste, natural rocks and the products of laboratory heating experiments. Int. Jour. of Coal Geology 139: 114-141.