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Fenitization processes in Chernigovka (Ukrainian Shield), Dubravinka (Voronezh Massif) and Penchenga (Yenisey Range) linear carbonatite massifs: similarities and differences

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Linear carbonatite massifs are potential sources of phosphate raw material, LREE and a wide range of rare metals (Nb, Ta, Sr, etc.). The typical feature of these formations is the occurrence of thick fenite haloes, which are forming over different compositional primary rocks. Whereas fenite haloe dimensions are much more, than carbonatite bodies, usage of mineral association changes data and features of major and trace elements behavior during fenitization can contribute to prospecting work. The aim of the current research is to reveal and study such behavior regularities at the example of three linear carbonatite massifs: Chernigovka (Ukrainian Shield), Penchenga (Yenisei Range) and Dubravinka (Voronezh Massif).

All mentioned massifs are representatives of the linear structural-morphological type (Glevasskii *et al*., 1981; Shnyukov 1988; Vrublevskii *et al*., 2003; Dunaev, 2006). They are situated within a consolidated portion of the earth's crust, confined to deep-seated fault zones and occur as different morphology steeply-dipping bodies. Chernigovka and Penchenga have a linear form in a plan view, at the same time Dubravinka is crescent-shaped, which is considered as a similarity with classic carbonatite ring-complexes by some scientists (Dunaev, 2006). Thick exocontact fenite haloes are developed over different primary rocks, which are represented by migmatized Achaean metamorphic rocks in Chernigovka (amphibolite, gneiss, schist) and Dubravinka (gneiss) Massifs and Proterozoic metamorphic silicate (schist and amphibolite) and carbonate (marble) rocks in Penchenga Massif. So the most significant difference is the presence of marbles in Penchenga one, which considerably influences the character of fenitization products. The ore mineralization is partially different; apatite-rare metal in Chernigovka and Penchenga in contrast to apatite-magnetite in Dubravinka.

The formation age of the massifs of Chernigovka and Dubravinka are close – ~2.0 Ga (Glevasskii *et al*., 1981) and 1.99–2.19 Ga (Dunaev, 2006), respectively. Penchenga massif rocks have been formed later – 0.672±0.093 Ga ago (Vrublevskii *et al*., 2003).

Carbonatites mineral composition of the three studied massifs is similar: calcite-dolomitic, essentially dolomitic or calcitic; silicate minerals are micas, amphiboles and alkaline pyroxenes; all three massifs are apatite-enriched (its content varies from 5 to 25%, sometimes reaching 50%). Accessory and ore minerals are represented by magnetite, pyrochlore-gatchettolite, ilmenite, monazite, zircon, titanite, columbite, fersmite, sulphides (Glevasskii *et al*., 1981; Dunaev, 2006; Vrublevskii *et al*., 2003). However, a number of differences occur in each massif. Dubravinka Massif carbonatites are mainly calcitic and sufficiently melanocratic (silicate minerals content up to 50%), there is no pyrochlore-gatchettolite in them and garnet (schorlomite) occurs. Penchenga Massif carbonatites are calcite-dolomitic or essentially dolomitic, as Chernigovka Massif varieties, but in contrast to the last one, they are not containing alkaline pyroxene and olivine.

Fenitization in all massifs is also similar and is characterized by the disappearance of relict minerals (quartz, plagioclase, hornblende, micas, clinopyroxene) and the emerging of newly formed minerals (albite, microcline, amphiboles and alkaline pyroxenes, biotite, phlogopite, calcite) and considerable rising of apatite content (up to ore concentration). Accessory minerals assemblage are represented by apatite, pyrrhotite, pyrochlore, titanite, titanomagnetite, ilmenite, (Penchenga); titanite, apatite, allanite, magnetite (Chernigovka); and apatite, magnetite, titanite, garnet (Dubravinka). But each massif are characterized by certain specific features; the absence of alkaline pyroxene in Penchenga Massif; different amphiboles (Penchenga – arfvedsonite, richterite; Chernigovka – richterite, edenite, hastingsite; Dubravinka – arfvedsonite); and the absence of pyrochlore-gatchettolite and presence of schorlomite in Dubravinka Massif. In general, the main direction of the different host rocks changes during fenitization is a convergence of their mineral compositions.

Studying the major and trace element behavior during the fenitization of the host rocks allowed revealing different groups of elements for each massif: elements, which are gained, elements, which are lost, and elements, which are redistributed. Using such differentiation, the single multiplicative zonation index has been suggested:

$$K_{univ} = La \cdot Ce \cdot Sr \cdot Zn$$

It is composed of elements, which are characterized by stable gaining and are not responsible for rocks ore burden. This makes it possible to observe changing of main ore components during fenitization (Fig. 1.). Thereby, this universal for all three massifs index objectively displays the increasing of host rocks transformation level and can contribute to the process of area selection and target evaluation.

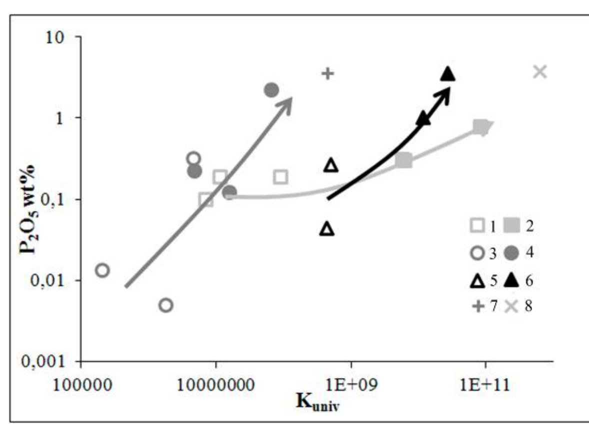

Fig. 1.: P_2O_5 concentration changes (average composition) during primary rocks fenitization. 1-2 – Chernigovka massif rocks; 3-4 – Dubravinka massif rocks; 5-6 – Penchenga massif rocks (1, 3, 5 – unaltered; 2, 4, 6 – altered); 7-8 – carbonatites of Dubravinka and Chernigovka, respectively. Arrows – the direction of host rocks composition changes.

Dunaev, V. A. (2006): Geol Prospect, 5: 30-33. (in Russian)

Glevasskii, E. B., Krivdik, S. G. (1981): Precambrian Carbonatite Complex, Pre-Azov Region, Kiev, Naukova Dumka (in Russian)

Shnyukov, S. E. (1988): Apatite, zircon and sphene from fenites associated with carbonatites, Ph.D. Thesis. Ivan Franko State University. Lviv, Ukraine. (in Russian)