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The Il’meno-Vishnevogorsky miaskite-carbonatite complex: origin and sources (Urals, Russia)

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Il’meny-Vishnevogorsky Alkaline Complex (IVAC) was intruded into the rocks of crystal fundament (PR1) at the final stages of continental rifting and has undergone significant reworking during Urals Fold Belt formation. The isotope dating the means of different isotope systems of the whole-rocks samples and minerals from the IVAC has been detected a numerous age clusters (Ma) – 446-410, 390-360, 335-325 and 280-230. Thus the present geochronological data for the IVAC specify the magmatic intrusion of alkaline rocks and carbonatites (3) and long-lasted metamorphic stage of the IVAC formation, with which are connected the processes of anatexis, pegmatite genesis, metasomatose, and re-loading of carbonatites, wide developed within the IVAC at collision (D2-3, C1) and post-collision (P-T) stages of the Urals Belt evolution.

Geological, geochemical and isotopic data indicate a possible separation of cabronatite liquid from miaskitic magma IVAC. Compositions of the IVAC rocks are clustered along the line of immiscibility between silicate and carbonate melts at T =1000oC and P = 5 kbar (Kjarsgaard and Hamilton 1989). Partitioning coefficients D between the IVAC early carbonatite and miaskite – Sr (4.5-6), Ba (0.44-1.92), Zr (0.01-0.33), Nb (0.5-0.8) are similar to the experimentally determined D for silicate-carbonate liquid immiscibility in alkaline melts at same PT-parameters (Veksler et al.1998). Similar isotopic data for carbonatites and miaskites also indicate a possible separation of cabronatite liquid from miaskitic magma. Later IVAC carbonatites show higher D – Ce (10-38), Sm (11-18), Tb (14-28), close to coefficients of partitioning between carbonate fluid and silicate melt (Wendlandt and Harrison 1979), indicating the significant role of alkali carbonate fluid in the formation of late carbonatites of the IVAC.

Carbonatites and miaskites of the IVAC differ in geochemical features from carbonatites of the ultramafic-alkaline complexes and have much in common with carbonatites localized in linear post-collision zones. This is manifested in the high Sr contents in miaskites and early carbonatites; depletion in Ba, Nb, , Ti, Zr, Hf in carbonatites relative to carbonatites of ultramafic-alkaline complexes.

Our isotope data for the IVAC rocks and minerals with εSr between -6 and -10, εNd between +3 and +6 and εHf between +4 and +6 require a depleted mantle source with a long-lasted time integrated low Rb/Sr, high Lu/Hf and Sm/Nd ratios. A close resemblance exists between the isotope characteristics of the IVAC and carbonatites of ultramafic-alkaline carbonatite complexes (Kola, Maymecha-Kotuy Alkaline Provinces et al.), which are located within Precambrian cratons. This suggests that the origin of these alkaline-ultrabasic complexes is connected with deep seated mantle sources, possibly to an upwelling mantle plume and/or further mixing plume component with enriched component EM1 (Bell, Blenkinsop 1989; Kramm 1993 et al.). Therefore it is very possible the IVAC has the similar source. But at the present the origin of alkaline magmas of the IVAC due to melting of the rocks of carbonatites- ultramafic-alkaline complexes or rocks of oceanic crust which have the same isotopic characteristics is not ruled out.