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Central Ukraine Uranium Province: The genetic model

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Ukraine produces ˜1,100 t U per year from the Michurinske, Centralne, Novokostantynivske and Vatutinske U deposits in the Kirovograd U district of the Central Ukraine Uranium Province (CUUP) consisting of about 20 U deposits and numerous U showings related to ˜1,8 Ga sodium metasomatites developed in the Lower Paleoproterozoic granite-gneiss and iron formations of the Ingul Megablock of the Ukrainian Shield. Two deposits (the Zhovta Richka and Pervomayske) were mined out tens kilometers eastward in iron formations of the Kryvy Rig –Kremenchug mining district. Na-metasomatite fields with scarce subeconomical U-mineralization were revealed by geophysical (magnetometry and gravimetry) and drilling programs northward in granitised gneisses around the younger Korsun-Novomyrgorod rapakivi pluton consisting of A2-type within plate granitoids which were emplaced during decompression melting at ˜1.75 Ga.

The present work aims to demonstrate structural and geochemical factors related to Na-metasomatism, and to mark out geochemical and tectonical parameters which were favorable for U-accumulation using data on deep seismic survey, geological structure analysis, and mineralogical and geochemical investigations of metasomatites.

In the Ingul Megablock, Na-metasomatites occur along shear fault zones mostly oriented N-S. Metasomatites form complicate systems of plate- and lense-like bodies of aegirine-riebeckite albitites surrounded by dequartzified host rocks. Elemental alteration during Na-metasomatism demonstrates simple exchange of Si, K, Rb, Ba and Cs by Na, Ca, and locally V and U. δ18OH2O (300-400°C) for albitizing hydrothermal solutions is near "zero", typically for surficial water. These data suggest host rock interaction with hot marine waters. Persistent Na-metasomatic alterations extend along major tectonic faults for several kilometers with variable thicknesses reaching some hundreds meters in the zones of intense brecciation developed in the places of fault ramifications or intersections. In such places albitites are often altered by superimposed calcic and potassic metasomatism resulting in the replacement of aegirine and riebeckite by garnet, epidote, actinolite, calcite and lamellar phlogopite accompanying U-mineralization. All types of the metasomatic alterations gradually pinch out with depth. U-mineralized metasomatites are enriched in a complex of elements typically accumulated in the crust during regional metamorphism, and partial melting as indicated by pegmatite dike swarms in the Ingul Megablock. From seismic data interpretation, all U deposits in the CUUP are located over latitudinal mantle "deep"or in the zones where the base of the lithosphere contrastingly subsides. In conclusion, Na-metasomatism is interpreted as a regional process resulting from the deep penetration of marine waters down along crustal scale shear zones during an extensional tectonic regime causing the regional collapse of the Ingul Megablock. Calcic and potassic alterations and U-mineralization are possibly connected with the crust dehydration and probable hotspot partial melting in the mantle initiated by the most unstable P-T conditions within zones of contrasting thickness of the lithosphere. The proposed models of Na-metasomatism and U-accumulation are useful for delineation of prospective territories having the potential to host U deposits associated with Na-metasomatites in Proterozoic terrains.

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