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FLUID SYSTEM OF THE VITKOV II URANIUM DEPOSIT (BOR PLUTON, WESTERN PART OF BOHEMIAN MASSIF, CZECH REPUBLIC)

by

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The Bor pluton forms part of Variscan granitoid magmatism of the Moldanubian zone of the Bohemian Massif. It forms a N - S elongated body that was emplaced along the western Bohemian shear zone during the Lower Carboniferous. The predominating rock type is porphyritic, medium- to coarse-grained biotite monzogranites. Younger, NW-SE trending faults divide the Bor pluton into three structural blocks. Uranium deposits of zoned or metasomatic type are developed along its western, mostly tectonic, contact with the Moldanubian metamorphics. The Vítkov II deposit is the representative of the metasomatic type associated with hydrothermally altered monzogranites (episyenites).

The Vítkov II deposit is situated in the central structural block. It comprises mostly metasomatic ore bodies lying between two N - S striking shear zones. Majority of the ore bodies occur in the vicinity of the zone 0-30, situated in the east, which strikes NNE - SSW and dips at 75° towards WNW. Its thickness varies from several centimetres to 7 m. The shear zone is infilled by strongly crushed and altered magmatites (monzogranites, lamprophyres), by quartz, carbonates, clay minerals and hematite. Four vein systems crosscut the deposit and are infilled by aplites, biotite or biotite-muscovite granites and lamprophyres. The steep, east dipping dykes of medium-grained, at places finely porphyritic, granites are oldest, the two aplite vein systems are younger and the youngest system comprises two lamprophyre veins filling above all the 0-30 structure. All the vein systems strike N - S and except for the lamprophyre veins, they dip east.
All the ore bodies are formed by finely disseminated uranium minerals in intensely hydrothermally altered monzogranites. Coffinite accompanied by uraninite predominates among the primary uranium minerals. Age of the oldest uranium mineralization is 230 - 290 million years. Total quantity of uranium ores at the Vítkov II deposit has been estimated to be 4500 t of uranium, at an average content of 0.15 - 0.30% U in the ore (PLUSKAL 1992). Development of the deposit with depth was verified to levels of c. 1500 m.
Hydrothermal alterations of the granites started with removal of the original magmatic quartz and with the transformation of biotite into chlorite I. The oldest ore bearing phase was marked by an intense influx of Mg, Fe and Na-rich fluids and by the genesis of chlorite II, hematite and by a large-scale albititization of the original feldspars (orthoclase and plagioclase).
According to the geothermometer of WALSHE (1986), the temperature of genesis of chlorite I was estimated at 190 - 240°C, that of chlorite II at 220 - 260°C, assuming a pressure of 1 kbar.

The accompanying sericitization led to the development of secondary muscovite or phengite. Thicker parts of the shear zone 0-30 show a characteristic zoning of the hydrothermal alterations. The external belt comprises the chlorite - muscovite and chlorite - muscovite - zeolite zones, the middle belt comprises the chlorite - muscovite - albite zone and the internal belt is formed by the chlorite - quartz - leucoxene and by the chlorite zones. The authigenic quartz II is cogenetic with chlorite II, and veinlets of quartz III developed during younger mineralization stages. The en masse development of carbonatization and of vein-type carbonates (calcite, less frequently dolomite) along with argillization, is characteristic for younger mineralization phases which yielded U-Pb dates of 120 - 190 Ma and 59 - 88 Ma (ORDYNEC et al. 1987). The argillites are dominated by montmorillonite and contain lesser amounts of kaolinite and illite (BAREŠ & FIALA 1979).

Measurement of decrepitation of quartz II by the low frequency acoustic emission method yielded values between 250 and 500°C, the most frequent value being 420°C. Homogenisation temperatures of quartz III (TOPP 1993) give values of 66 - 210°C. Higher content of salts (21 - 28 weight % NaCl - $CaCl_2$ equivalent) are characteristic for these inclusions. The f_{O2} value is controlled by the magnetite-hematite buffer and according to the composition of chlorite, it corresponds to -33 to -39 log f_{O2}. The transfer of uranium took place in HPO_4^{-2} rich solutions in the pre-ore and in the ore bearing phases, the post-ore stages were dominated by a greater role of CO_3^{-2} rich solutions.

Occurrence of fossil solutions belonging to the system of deep, slow fluid circulation has been identified at the Vítkov II deposit in the course of exploration drilling (MARKOVIČ 1977). These considerably mineralized saline fluids of Ca-Na-Cl-SO_4 type have been found in underground boreholes reaching down to depths of 1300 - 1400 m below today's surface. The saline fluids correspond in their composition both to the fluids found in the KTB-VB1 borehole at a depth of 3500 - 4000 m (FRITZ et al.. 1991) and to the fluids occurring in the inclusions of uranium deposits of the western part of the Bohemian Massif (GERLER 1990).

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