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X-RAY DIFFRACTION AND GEOCHEMICAL STUDIES ON URANIUM MINERALS FROM JOGIPALLE PEGMATITE, NELLORE SCHIST BELT, ANDHRA PRADESH: PARAGENETIC IMPLICATIONS

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Abstract

The uranium ore sample used in this study occurs as hand-pickable lumps and grains in the Jogipalle pegmatite, Nellore Schist Belt, Andhra Pradesh. Powder X-ray diffraction (XRD) studies on separated uranium minerals (UMs) have revealed the presence of both primary (uraninite) and secondary (ianthinite, clarkeite, curite and â-uranophane) uranium minerals, which are mostly characterised by their sharply-defined reflections. The crystallographic parameters of various UMs are: Uraninite-1and 2 unit cell dimension (a_o) = 5.4758 and 5.4422 Å and unit cell volume (V) = 164.08 and 161.18 Å^3; clarkeite a_0 = 3.9473 Å, b_0 = 3.9473 Å, c_0 = 17.6835 Å, $\alpha = \beta = 90^0$, $\gamma = 120^0$, V = 238.628 Å^3; curite a_0 = 12.6292 Å, b_0 = 13.2035 Å, c_0 = 8.3646 Å, V = 1394.81 Å^3; and β-uranophane a_0 = 13.9481 Å, b_0 = 15.4688 Å, c_0 = 6.6362 Å, $\alpha = \gamma = 90^0$, $\beta = 91.3^0$, V = 1430.90 Å^3. Out of two, one uraninite has a_o of 5.4758 Å, which is more than the value given for the uraninite standard (5.4645 Å), suggesting its anomalous nature and formation of uraninite (primary) under high temperature condition (~500-550^{0}C). In contrast, another uraninite has a_o = 5.4422 Å, reflecting its oxidized nature. It, thus, suggests that after their formation, the uraninites have been subjected to oxidation leading to the formation of secondary uranium minerals (SUMs) with a relict core of black mineral (uraninite) encircled by successive zones of SUMs, namely, black (ianthinite, in traces), orange (clarkeite-curite) and yellow (β-uranophane). Based on available mineralogical data, the inferred paragenetic sequence of the investigated uranium minerals is: Uranium oxide (primary uraninite) > uranium oxide (altered uraninite) > uranium oxide hydrate (ianthinite) > sodium-potassium uranium oxide (clarkeite) - lead-uranium oxide hydrate (curite) > calcium uranyl silicate hydroxide hydrate (β-uranophane). Uraninite-1 contains high U_3O_8 (74.25%), ThO_2 (7.96%), PbO (7.73%) and rare earth elements (16214 ppm), whereas, SiO_2 (1.03%), CaO (0.82%) and Fe_2O_3 (0.33%) contents are low. Chemically, â-uranophane analysed 47.42% U_3O_8, 4.75% CaO, and 19.15% SiO_2.

Keywords: X-ray diffraction. Mineralogy. Uraninite. Ianthinite. Clarkeite. Curite. β-Uranophane. Nellore Schist Belt. Andhra Pradesh. Paragenesis.