## ABSTRACT

The basement (i.e., Mangalwar Complex: MC) rocks, now comprising metasedimentary rocks, of the Samarkiya area experienced its first middle amphibolite facies metamorphism ($M_1$) at ~1.82 Ga, manifesting amalgamation of the Columbia supercontinent in the Aravalli-Delhi Fold Belt (ADFB). This was followed by sedimentation of the supracrustal rocks (i.e., Pur-Banera: PB) on the basement MC. Subsequently, both the rock suites underwent isothermal-loading and successive loading-heating at mid crustal levels under upper amphibolite facies condition, during the next metamorphic event ($M_2$) at 1.37–1.35 Ga, wherein the PB rocks underwent its first cycle of metamorphism. This $M_2$ event marks a collisional episode related to the final break-up of the Columbia supercontinent in the ADFB. Further, rocks of both the MC and the PB underwent their last phase of amphibolite facies metamorphism ($M_3$) at ~1.05–0.99 Ga, as a consequence of the Grenvillian orogeny, during amalgamation of the Rodinia supercontinent in the ADFB.

Texturally constrained uraninites from both the rock suites reveal, in addition to an older event at ~1.88 Ga from the basement, two major episodes of uraninite formation during ~1.24–1.20 Ga and ~1.01–0.96 Ga. Although none of the pristine/unaltered uraninites that formed during the above mentioned events contain significant amount of minor (Si, Ca, Fe, Na, K, and Al) or rare earth elements (REE), the basement uraninites are invariably enriched in Th compared to those from the supracrustals. This indicates that the pristine uraninites in the basement formed from a high temperature magmatic/metamorphic fluid, whereas those in the supracrustal precipitated from a low temperature, presumably oxidized fluid. Further, uraninite from both the rock suites demonstrate subsequent fluid-mediated alteration, following the major mineralizing event at ~1.24–1.20 Ga, which resulted ∑REE+Y- and Si (Ca)-enrichment in the ~1.24–1.20 Ga uraninites within the rocks of the basement and the supracrustal, respectively. This event possibly occurred between the second and third stages of uranium mineralization/mobilization (i.e., ~1.20 Ga and ~1.01 Ga, respectively). Major and trace element geochemistry of alteration halos in the basement reveals sequential influx of hydrothermal fluids, associated with $K^+ \rightarrow$LREE $\rightarrow H^+$ metasomatism, following the formation of uraninite, under near surface low-T (≤150 °C) conditions.

The first stage of uranium mineralization in the basement at ~1.88 Ga is associated broadly with the first Paleoproterozoic (~1.82 Ga) tectono-metamorphic event ($M_1$) in the area. Similarly, the last episode of uranium mineralization (i.e., ~1.01–0.96 Ga) in both the rocks is linked to the pervasive Neoproterozoic (~1.05–0.99 Ga) tectono-metamorphic event ($M_3$), which affected perhaps the entire ADFB during the amalgamation of the Rodinia supercontinent. The second and the major phase of uranium mineralization during the Mesoproterozoic (~1.24–1.20 Ga) is inferred to be associated with a post-peak metamorphic (of the $M_2$ event at ~1.37–1.35 Ga) hydrothermal event or even with a hitherto unknown new metamorphic event. The uranium mineralization in the Samarkiya exhibits a secular synchronicity with the evolving tectono-metamorphic stages, endorsing a metamorphic-hydrothermal model of uranium mineralization in the area.



***Keywords:*** Aravalli-Delhi Fold Belt, metamorphism, monazite dating, uraninite dating, alteration halo.