
ABSTRACT

The Proterozoic Cuddapah basin in southern India holds high potential for unconformity-related U-mineralization. Huge reserves of low-grade stratabound dolostone-hosted U-mineralization have been established in the Vempalle Limestone of the Lower Cuddapah Supergroup at Tummalapalle in the southern Cuddapah basin. In the northern Cuddapah basin U-mineralizations occur in the Srisailam Quartzite of the Upper Cuddapah Supergroup and Banganapalle Quartzite of the Kurnool Group. This study is an attempt to explore the commonality, if any, between the U-mineralizations of the southern and northern Cuddapah basin through detailed petrography, geochemistry and, dating of uraninite, monazite and zircon at and around Koppunuru in the Palnad sub-basin.

The mineralization is predominantly chemically precipitated uraninite/pitchblende associated with co-precipitated sericite, quartz and pyrite, hosted in gritty quartzite. However, crosscutting brannerite veins, coffinite and later uraninite replacing pyrite, and formation of rhabdophane after zircon and apatite reveal considerable remobilization of U. Uraninite ages indicate >1.99 Ga age for the gritty quartzite, consistent with the discovery of siliceous stromatolites in it. Zircon U-Pb isotope ages suggest that the gritty quartzite was most probably deposited between 2.12 and 2.53 Ga. The Kurnool Group of rocks overlying the gritty quartzite is most likely younger than 708 Ma, the oldest age obtained for the rhabdophanes, indicating the presence of an unconformity between the two.

High LREE concentrations comparable to that in altered zircon and high Zr (~1.5 wt. %) in the uraninite, suggest that zircon was the probable source of U for mineralization. However, comparison with the expected Nb-U and Nb-Th trends it is revealed that both U and Th are enriched in the altered zones within zircon. Thus U, Th and LREEs were delivered to the altered zircon by the mineralizing fluid. The strong enrichment of the altered zircon zones in LREEs is consistent with these elements being derived from the altered monazites. Results of experiments on baddeleyite-solubility in Na- and Si-bearing solutions, combined with albitization of K-feldspar observed in the basement granite, suggest that K-zirconosilicate complexes were responsible for the transport of Zr and U. The mineralization was effected through microbially induced decomplexation reactions resulting in the deposition of sericite + quartz + uraninite/pitchblende.

The previously unrecognized contemporaneity of U-mineralizations in the southern and northern Cuddapah basin suggests that the U in the dolostone at Tummalapalle would have been remobilized from the stromatolite-building microbes assisted U-mineralization in the Gulcheru Quartzite. Thus the primary U-mineralization in the entire Cuddapah basin may have been syngenetic stratabound type deposited by active microbial mediation.

Keywords: siliceous stromatolite, uraninite, zircon, alkali-zirconosilicate complex, gritty quartzite