SPATIAL AND TEMPORAL VARIATION IN PALAEOWEATHERING OF THE PROVENANCE OF THE VINDHYAN SUPERGROUP OF ROCKS AND ITS IMPLICATION IN URANIUM EXPLORATION: AN OVERVIEW

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Abstract

The presence of a palaeoweathering profile (paleosol), at the top of a crystalline basement, buried under clastic sedimentary succession in Mesoproterozoic intracratonic basins has long been recognized as one of the exploration guides for unconformity-associated uranium mineralization. However, by virtue of low preservation potentiality and stratigraphic position, direct use of the palaeoweathering profile in exploration is often constrained. The chemical index of alteration of clastic sedimentary rocks covering the basement crystallines can therefore be used as a proxy for assessing palaeoweathering of the basement and mineralization potentiality. The intracratonic Vindhyan Basin in Central India, formed during a protracted period of quiescence (1.8–1.4 Ga) after Hudson Orogeny, is globally considered potential for hosting unconformity-associated uranium mineralization. The chemical index of alteration (CIA) as a proxy to intensity of palaeoweathering has been used in this study to assess the potentiality of this basin for uranium mineralization.

The temporal and spatial variation in palaeoweathering of the basement has been studied and correlated with relevant palaeomagnetic data. On the basis of corrected (pre-metasomatized) CIA, a slight change in palaeoweathering from intense or moderately intense during lower Vindhyan times to moderately intense or moderate during upper Vindhyan times has been inferred. This also indicates marginal shift of palaeoclimate from semi-humid to semi-arid/arid. Spatial variation of palaeoweathering of the provenance is contrasting as indicated by gradual lowering of pre-metasomatized CIA from 82–99 in the north-western segment to 73–83 in the extreme eastern segment of the basin. Correlation with palaeomagnetic data indicates position of the north-western/western part of the Vindhyan Basin at lower latitudes during deposition of the Semri Group and relatively closer to the equator during the entire span of deposition of upper Vindhyan, thereby corroborating the observed variation in CIA. Considering chemical weathering of the crystalline basement as an important factor for the formation of unconformity-associated uranium deposits in Mesoproterozoic intracratonic basins, the north-western part of the Vindhyan Basin appears to have greater potentiality.

Keywords: Palaeoweathering, Palaeoclimate, Provenance, Mudrocks, Vindhyan Sediments, Uranium Exploration.

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