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U-Pb zircon ages from the Aravalli Craton and Vindhyan Supergroup sediments, Rajasthan – discussion of tectonic implications

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The Precambrian geology of the Aravalli region of Rajasthan in western India comprises the Banded Gneissic Complex (BGC) and associated granites and the overlying Aravalli and Delhi Supergroups of rocks (Roy and Purohit [1] and Meert and Pandit [2]) and is commonly referred to as the Aravalli Craton. These rocks are tectonically bordered to the east along Great Boundary Fault (GBF) by the Vindhyan Supergroup of sediments, which overlie the Bundelkhand Craton to the east. We report U-Pb ICPMS zircon ages of 12 rock samples from the Aravalli Craton and zircon provenance geochronology from the Vindhyan Supergroup sediments. The zircons were separated at the De Beers Laboratory in India and the analysis was conducted at the De Beers analytical laboratory in Johannesburg. Only the results with less than 10% discordance are reported and errors reported are at 2σ level.

Amongst the basement lithologies, quartzofeldspathic paragneisses from BGC (unit BGC-1) yielded Archean zircon ages with Mesoarchean and Neoarchean components (3340 Ma-2500 Ma). The Berach granite intrudes the BGC and showed well constrained and concordant crystallisation ages of 2520 ± 37 Ma and 2529 ± 52 Ma, the latter for a small granite body close to the Vindhyan Supergroup outcrop.

Aravalli Group metasediments show an Archean provenance age (3430 Ma and 2500 Ma) comparable to the ages obtained from the BGC-1 and the Berach granite components. There is a distinct population of zircons in the psammo-pelitic and psammitic units with a weighted average age of 2354 Ma. Another population shows a weighted average age of 1843 ± 25 Ma. Delhi Supergroup quartzites and quartz mylonites are dominated by the 2510 ± 25 Ma zircons. Weighted average ages of 2325 ± 6 , 1802 ± 16 Ma, and 1687 ± 30 Ma are also recovered from the Delhi Supergroup sediments, with the youngest zircon grain at 1636 ± 21 Ma providing a maximum age to the time of deposition. Pegmatites intruding both the Aravalli Supergroup and Delhi Supergroup metasediments show a weighted average age of 1605 ± 23 Ma, which is in agreement with the results from the youngest zircon grain). Distinct semi-concordant populations with weighted average ages of 2544 ± 45 Ma, 2311 ± 89 Ma, and 1801 ± 94 Ma are interpreted to be Inheritance ages and correlate with the tectonothermal events within the craton.

The geochronology record in the Aravalli area shows a geological history between 3400 Ma to 1600. It is possible that the 2300 Ma event recorded from all the rock units corresponds to the onset of basin opening with Aravalli sedimentation probably continuing until about 1840 Ma. The 1600 Ma ages of pegmatites intruding both Aravalli and Delhi Supergroups indicate the closure of Delhi Supergroup sedimentation earlier than 1450 Ma as postulated earlier (Roy and Purohit, 2015[1]).

Amongst the Vindhyan lithologies, the Semri Group sandstones bordering the Berach granite are characterized by a dominance of 2500 Ma zircons and a small Mesoarchean component (3246 Ma). In contrast, Semri Group sediments bordering the Aravalli Supergroup show a dominant Mesoarchean component (3197 Ma) with the youngest zircon of 1470 Ma providing a maximum age for sedimentation. Various units within the Semri Group has been dated as between 1721 and 1599 Ma (Malone et al., 2008 [3]). We propose that Semri sedimentation at least in the study area continued

until at least about 1450 Ma. The overlying Rewa Group shows a dominant peak at 1568 Ma and a subordinate peak at about 2400 Ma (2540-2200 Ma). The youngest zircon of 1119 ± 16 Ma represents the maximum age for the Rewa Group.

References:

- [1] Roy A B and Purohit R (2015) Geological Society of London Memoirs, 43, 55-65
- [2] Meert J and Pandit M K (2015) Geological Society of London Memoirs, 43, 29-54
- [3] Malone S J et al. (2008) Precambrian Research, 164, 137-159

