In-situ U-Pb Dating of Monazite and Rutile: Implications to Depositional Age of QPC and U-Au Mineralization Potential, Singhbhum Craton, India

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Archean quartz pebble conglomerates (QPCs) may host significant uranium and gold mineralisation, depending on whether they were deposited before or after the Great Oxidation Event (GOE) at ~2.4 Ga. Determining the timing of deposition is challenging, as detrital mineral ages only provide maximum age limits, and resetting of these ages in the source rocks can result in dates that postdate actual deposition. In this study, we constrain the depositional ages of four QPCs from the Singhbhum Craton, eastern India, using in-situ U-Pb dating of monazite and rutile, as well as EPMA chemical dating of smaller monazite grains. The upper age limits for deposition vary due to differences in the emplacement ages of the source rocks: 3115 ± 52 Ma (Gorumahisiani–Badampahar), 3390 ± 123 Ma (Tomka–Daitari), 3322 ± 18 Ma (Bagiyabahal–Bartangra), and 2798 ± 48 Ma (Mankarchua). Hydrothermal monazite ages provide lower depositional age constraints: 2908 ± 83 Ma for the first three basins (EPMA) and 2484 ± 47 Ma for the Mankarchua Basin (LA-ICP-MS). The relatively younger age for the Mankarchua QPC may result from resetting of detrital monazite during a tectono-thermal event in the adjacent Rengali Province. Even if these QPCs were originally deposited before the GOE, subsequent geological events have overprinted them, as shown by the younger ages of both detrital and authigenic monazite. These findings suggest that despite post-depositional modifications, the QPCs of the Singhbhum Craton retain potential for modified placer-type uranium and gold mineralisation.