



Paleoarchean crustal evolution of the Singhbhum Craton, eastern India: Insights from granitoid petrology and zircon U-Pb and Lu-Hf systematics

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Singhbhum Craton, eastern India, exposes some of the oldest known composite Paleoproterozoic granitoids. These granitoids range from sodic TTGs to evolved, potassic granites. The whole process of their formation, starting from nucleation of a juvenile continent to its evolution and final stabilization is documented. The central part of the craton started nucleating with the formation of 3.45–3.40 Ga juvenile (zircon $\epsilon\text{Hf}_t = +0.6$ to $+7.1$) TTGs. These TTGs characterized by slightly depleted HREE and Y, negligible Eu-anomaly ($\text{Eu}/\text{Eu}^* = 0.90$ to 1.00) and moderate Sr/Y (25–64), consistent with derivation from a low-K mafic crust at a pressure near the lower end of the garnet stability field, causing subordinate garnet retention in the residue and negligible role of plagioclase. During 3.32 Ga, deeper melting of a juvenile mafic crust (zircon $\epsilon\text{Hf}_t = +1.3$ to $+5.7$) caused emplacement of a second generation of TTG. Deeper melting is suggested by depleted HREE and Y, and high Sr/Y (52–155), implying significant amount of residual garnet retention. Subsequently at 3.28 and 3.25 Ga, melting of moderately old to juvenile (zircon $\epsilon\text{Hf}_t = -1.9$ to $+4.5$), mostly TTG sources at variable depths generated potassic, LILE-enriched, high-silica granites. Intrusion of these potassic granites resulted in a stable and buoyant crust that marked the final Cratonization of the Singhbhum Craton. The sequence of events is interpreted in terms of repeated intracrustal melting and granitoid generation in a gradually thickening oceanic plateau with a progressive change in granitoid source from mafic to felsic in composition. Combination of rock assemblage, regional geology, and structural pattern also supports intraplate nature of the magmatism in Singhbhum Craton, which might have been a significant mechanism of crustal growth worldwide during Paleoproterozoic.