Regional age zonation and multiple tectonic pulses of Neoproterozoic-Cambrian age from the western boundary of Eastern Ghats Belt, India: A comprehensive tectonic model for final amalgamation

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Eastern Ghats Belt (EGB), India is a Proterozoic orogenic belt characterised by the UHT-HT metamorphism. The status of EGB evolving in between the proto-India and its Precambrian neighbours (e.g., East Antarctica) is important and intriguing in terms of the Proterozoic “supercontinent” cyclicity. Although, the precise timing of cratonisation of northern EGB with Proto-India is still unclear. The timing of final thrusting of EGB on adjacent Proto-India (Bastar Craton=BC) is intuitively correlated at ~500-550 Ma (Upadhyay et al., 2008 among others). This cratonisation history is obscured as the tectonic model of cratonisation, tightly constrained by high-precision geological time, is absent from the marginal rocks. To delineate the exact age and tectonic model of cratonisation of EGB with respect to Proto-India, a detailed study of microtextural evolution coupled with high precision dating techniques (U-Pb SHRIMP zircon and U-Th-total Pb EPMA monazite dating) were carried out on the rocks along an east-west transect at the western boundary between EGB and BC.

At the eastern side of the western boundary, zircon and monazite grains of charnockite yield ~950 Ma age, which roughly coincides with the granulite metamorphism of Eastern Ghats Province of EGB. The youngest date recorded from the zircon and monazite grains of the charnockite is ~775-850 Ma. On the western side, the monazite grains closely associated with garnet grains in the sillimanite-bearing pelitic granulite exhibiting ~800 Ma ages from the Y-rich portion. The Y-enrichment in monazite grains and development of symplectite texture around garnet grains in mafic granulite is possibly in the response of garnet breakdown during an early phase of exhumation at ~800 Ma (Chatterjee et al., 2017). The appearance of late-hornblende in mafic granulite and the presence of fibrolite inclusion within ~500-550 Ma zircon grains in pelitic granulite suggest retrogression from granulite facies to granulite-amphibolite transitional facies occurred during ~500-550 Ma. However, this age of retrogression was exclusively confined near the western boundary due to the presence of adjacent shallow and cold craton. Thus, a spatially high-resolution geochronological data from the systematically sampled rocks exhibits a domainal age zonation across the western boundary of EGB for the first time. Eventually, textural evolution combined with geochronological data facilitate to construct a *P-T-t* path of the granulites.

Zircon dating of migmatitic hornblende gneiss of BC suggests that the rock formed at ~2400 Ma, which later suffered a younger thermal event at ~550 Ma due to thrusting of deep crustal EGB rocks on shallow crustal BC rocks during cratonisation (“hot” on “cold” thrusting, Gupta, 2012). On the other hand, detrital zircon and monazite of foliated quartz breccia (parallel to the local shear fabric) near the thrust contact exhibit a wide age span with multiple age peaks in between ~3100 and ~500 Ma. Since the quartz breccia preserves the thrust-related foliation, it is inferred that the quartz breccia deposited contemporaneously with the thrusting in an incipient basin adjacent to thrust front. The youngest detrital monazite grain record ~495 Ma age, which imply that thrusting was continued overstepping the Precambrian-Cambrian boundary. Finally, collating all the textural and geochronological results from the marginal rocks of EGB and BC, a comprehensive tectonic model of deep to shallow crust related to the cratonisation of EGB with Proto-India is offered.

References:
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