Thermal modeling for "Hot-on-cold" thrusting: Thermal structure during orogenic movement at the western boundary of Eastern Ghats Belt, India

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The boundary areas between the orogenic belts and pre-existing cratons preserve important information regarding the growth and evolution of old continents. The boundary areas experienced multiple phases of metamorphism, deformation, activities of crustal fluids, these hold the important key to understand continental evolutions. Regarding the orogenesis and its thermal structure, it is important to validate the petrogenetic evidence from rock records by computer simulation.
The Eastern Ghats granulite Belt (EGB) is a Proterozoic orogenic belt that extends ~1000km in the northeast-southwest direction along the east coast of India. Archean Baster craton (BC) is located just west of it. From the detailed structural geological, petrological and geochronological works, it is understood that “Hot-on-cold” thrusting occurred between the deep crust of EGB and the shallow crust of BC.
The present study area is north-western EGB, i.e. between the Phulbani domain and 10 km away from the boundary thrust. Monazite U-Th-total Pb (EPMA) dating and petrological data on the corundum + spinel + garnet-bearing granulite of this domain revealed that this area had undergone peak ultra-high temperature metamorphism in the deep crust during 1000-900 Ma. Following that the youngest thermal event is documented at approximately 650-500 Ma from the felsic gneiss. This youngest age was found inside EGB only within a few kilometers on both sides of the boundary, but most prominent close to the boundary.
We consider this age and its geographic spread is related to the final “Hot-on-cold” thrusting during the final amalgamation of EGB crust with the Indian continent. This thermal overprinting was up to the amphibolite facies. In order to understand the cooling process of after peak, we set this age distribution on the present erosional surface as the boundary condition of the thermal structure model and considered computer simulation of thrusting.
In this study, we present the results of the 2D/3D numerical simulations of “Hot-on-cold” thrusting and comparing it with the metamorphic rock records. The numerical model is carried out by computer calculation using the temperature equation obtained by discretizing the thermal advection and convection equations by finite volume method with progress in time.

Keywords: 2D/3D Thermal modeling, Hot-on-cold thrusting, Orogen-boundary shear zone, EGB, India

