Constraining the *P-T-t* architecture of a tectono-thermal event at the onset of Proterozoic Eon from mineral reaction history and diffusion modeling

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Precambrian rock records of High-Pressure Granulite Metamorphism (HPGM) are considered as proxies for horizontal plate movement [1]. The Southern Granulite Terrain (SGT) within peninsular India holds record of ca. 2.49-2.47 Ga HP-granulite metamorphism [2,3]. Here, we constrained thermal histories of such early subduction-collision dynamics using mafic granulites from SGT (Mahadevi Hills). Integrated observations from inclusion-petrography, mineral reaction history, geothermobarometry and pseudosection modeling, indicate that peak metamorphism (M_1) – exemplified by the stabilization of garnet (Grt) porphyroblasts within a matrix of aluminous clinopyroxene, calcic plagioclase, rutile – was attained at ~750-800 °C and ~12.5-14 kbar. This indicates burial of crustal rocks underneath a ~35-45 km thickened Archean crust, probably during horizontal plate movement. Subsequent cooling-exhumation history is marked by the – i) formation of clinopyroxene (Cpx_S) + plagioclase (Pl_S) symplectite at ~700-710 °C and ~10.5 kbar via - Grt + Quartz = Cpx_S + Pl_S and, ii) stabilization of amphibole at ≥ ~580-620 °C and >6-8 kbar. We employed 1D-Diffusion modeling of preserved compositional zonations within garnet-clinopyroxene grains and coupled it with the calculated P-T path to constrain the post peak *P-T-t* evolution of these mafic granulites. We identified single stage linear cooling rates in the order of 1's-10's °C/Myr from stage-M_1 (~750-800 °C) till the closure of Fe-Mg exchange between Grt-Cpx at ~620-660 °C. Our results indicate that continent-continent convergence was operating at the Archean-Proterozoic transition but were characterized by the sustenance of high-T conditions for a very long period of time unlike Phanerozoic orogenesis.

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