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Evidence of high-pressure metamorphism along the Mahanadi Shear Zone in the Eastern Ghats Province, eastern India: implications on tectonics and continental assembly involving India and East Antarctica.

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Mafic granulites occur as enclaves within host mylonitized felsic rocks along the WNW-ESE trending, northerly dipping (40°-80°) Mahanadi Shear Zone (MSZ) of the Eastern Ghats Province (EGP), eastern India. Mafic granulite enclaves are characterized by the mineral assemblages Grt+Cpx+Pl+Qtz±Opx±Hbl±Bt (type-1) and Opx+Cpx+Pl+Hbl±Bt (type-2). The type-1 mafic granulite is the focus of the present study and this rock occurs as small enclaves (up to a few tens of meters in maximum size) within mylonitic augen gneiss, finer grained felsic gneiss (Qtz+Kfs+Pl+Bt±Grt), and type-2 mafic granulite. The type-1 mafic granulite is partially to completely recrystallized, massive to crudely foliated rock containing the peak metamorphic assemblage of coarse granoblastic garnet (Grt), clinopyroxene (Cpx), plagioclase (Pl) and quartz (Qtz). Coarse Grt contains inclusion of hornblende (Hbl) which suggests that the peak assemblage was formed by Hbl-dehydration melting. While the peak assemblage is stable in most of the samples, coarse Grt shows partial decomposition to a symplectic intergrowth of Cpx+Pl±Opx (orthopyroxene) in a few samples. Phase chemical data suggest that the rim compositions of coarse Grt show small but significant drop in pyrope content (ΔPrp = 2-3 mole%) from the core, while the coarse Cpx shows more magnesian core (X_{Mg} = 0.76) than the rim (X_{Mg}=0.68). Plagioclase core is more albitic (X_{Ab} = 0.40) compared to the rim composition (X_{Ab}=0.16). Geothermobarometric calculations show that the peak pressure of metamorphism was 14-12 kbar at a temperature of ~760-840°C, whereas the rim compositions of Grt in association of coarse Cpx+Pl+Qtz and symplectic Cpx+Pl±Opx yield pressure of 8-9 kbar at ~700-750°C. This suggest a near-isothermal (ΔT=60-90°C) decompression (ΔP=3-6 kbar) of the thickened lower crust indicating exhumation related to thrusting. This regional-scale thrusting was followed by an event of cooling that produced Hbl- and Bt-bearing assemblages. Combining the inferred prograde and retrograde histories, we reconstruct a clockwise P-T path from the studied type-1 mafic granulites. Identification of such clockwise P-T path with characteristic high-temperature decompression from the MSZ is a first of its kind from the interior of the EGP which is otherwise characterized by ca. 1000-900 Ma ultrahigh temperature metamorphism (UHTM; T>900°C) at 7-8 kbar pressure. This study thus shows convincing evidence of a hitherto unrecognized early (> 1000-900 Ma) collisional tectonometamorphic history of the MSZ vis-à-vis the EGP, and hints that the former could represent a fossilized suture zone linked

with possible terrane accretion and collision between India and East Antarctica.