

Geochronology and protolith interpretation of high T granulites in the Eastern Ghats Granulite Belt, India

Naoshi Takano [1], # Makoto Arima [2]

[1] Department of Earth Sci., Yokohama Nat. Univ., [2] Geolo. Instit. Yokohama Natl. Univ.

Isotopic (Rb-Sr, Sm-Nd) and geochemical compositions of the high-T type granulites in the Eastern Ghats granulite belt, India, suggest; (1) two age clusters (~1900 and ~1400 Ma) for intrusion age of basaltic magmas formed in the plate convergent margin. and the extensional setting respectively, (2) intrusion ages 1100-1000 Ma of charnockite magma formed in the active continental margin.

EGGB forms a linear belt along the east coast of the Peninsular India. It consists of a variety of granulite facies meta-sedimentary rocks (khondalite, leptynite, and calc silicate gneiss) and meta-igneous rocks (charnockite and basic granulite), together with anorthosite, granite and alkaline intrusive rocks. An attempt was made to make protolith interpretation of high temperature type granulite facies meta-igneous rocks distributed in Visakhapatnam and its vicinity (Maruturu, Madhuravada) in EGGB. We determined geochemical characteristics of the charnockites and basic granulites. We also determined Nb-Sm and Sr-Rb isotopic compositions of the charnockite, basic granulite, and leptynite to obtain their Rb-Sr and Sm-Nd whole rock and mineral isochron ages. Then we integrated geochronological, field, petrographic and geochemical criteria to identify the nature of the original rock type and to interpret geological settings in which the rocks formed.

The present data suggest that the basic granulites in the Maruturu and the Madhuravada area have intrusion ages of ~1900 Ma (Sm-Nd whole rock isochron ages). These basic granulites are chemically comparable to basaltic rocks occurring in the present-day plate convergent margins. The data also suggest that the basic granulites in the Visakhapatnam area have intrusion age of ~1400 Ma (Sm-Nd whole rock isochron age). Their chemical characteristics well resemble the Phanerozoic continental flood basalts, suggesting the extensional setting for their protolith formation.

The charnockites in the Visakhapatnam area have intrusion ages of 1100-1000 Ma (Sm-Nd whole rock isochron ages). Metamorphic ages of ~550 Ma (Sm-Nd mineral isochron ages) are also obtained. The charnockites display systematic chemical variation probably inherited from their igneous protoliths. Their geochemical characteristics and $^{143}\text{Nd}/^{144}\text{Nd}$ initial ratios well resemble those reported from Mawson Coast charnockites in the East Antarctica. They are geochemically comparable to those of igneous rocks occurring in the present-day active continental margin, suggesting the plate convergent margin setting for their protolith formation. The sapphirine bearing leptynite from the Madhuravada area has a Sm-Nd mineral isochron age of ~700 Ma.

Initial $^{143}\text{Nd}/^{144}\text{Nd}$ ratios of the charnockites and basic granulites plot within an enriched mantle field. They form an Enriched Mantle Array that intersects with the depleted mantle evolution line at around ~3000 Ma, implying middle Archean enrichment events in the lithosphere mantle beneath EGGB.

Combining present data and data reported from other parts of the EGGB, following scenario is proposed for the geological evolution EGGB.

~2750 Ma: An inherited age of zircon grain in the metasedimentary rocks (Shaw et al., 1997) suggesting the formation of protolith of EGGB might started in this period.

~1900 Ma: Basaltic magma activity (protolith of Maruturu and Madhuravada basic granulites) in the plate convergent margin.

~1500-1400 Ma: Basaltic magma activity (protolith of Visakhapatnam basic granulites) under extension setting. Anorthosite intrusions and alkaline rock activities are reported in several parts of EGGB.

~1100-1000 Ma: Intrusion of charnockite magmas in the plate convergent margin (active continental margin). The geochronological data suggest that granulite facies metamorphism took place in this period (Shaw et al., 1997). Metamorphic data suggest collisional tectonic setting (Shaw and Arima, 1998).

~800-700 Ma: Possible metamorphic events associated with post-tectonic plutonic activities.

~550 Ma: The youngest metamorphic event related to the Pan-African orogeny.