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# Tectonic setting of the Balaram-Kui-Surpagla-Kengora granulites of the South Delhi Terrane of the Aravalli Mobile Belt, NW India and its implication on correlation with the East African Orogen in the Gondwana assembly

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## ABSTRACT

Granulites are developed in various tectonic settings and during different geological periods, and have been used for continental correlation within supercontinent models. In this context the Balaram-Kui-Surpagla-Kengora granulites of the South Delhi Terrane of the Aravalli Mobile Belt of northwestern India are significant. The granulites occur as shear zone bounded lensoidal bodies within low-grade rocks of the South Delhi Terrane and comprise pelitic and calcareous granulites, a gabbro-norite-basic granulite suite and multiple phases of granites of the Ambaji suite. The granulites have undergone three major phases of folding and shearing. The  $F_1$  and  $F_2$  folds are coaxial along NE–SW axis, and  $F_3$  folds are developed across the former along NW–SE axis. Thus, various types of interference patterns are produced. The granulite facies metamorphism is marked by a spinel–cordierite–garnet–sillimanite–quartz assemblage with melt phase and is synkinematic to the  $F_1$  phase of folding. The peak thermobarometric condition is set at  $\geq 850^\circ\text{C}$  and 5.5–6.8 kb. The granulites have been exhumed through thrusting along multiple ductile shear zones during syn- to post- $F_2$  folding. Late-stage shearing has produced cataclases and pseudotachylites. Sensitive High Resolution Ion MicroProbe (SHRIMP) U–Pb dating of zircon from pelitic granulites and synkinematically emplaced granites indicate that: (1) the sedimentary succession of the South Delhi Terrane was deposited between 1240 and 860 Ma with detritus derived from magmatic sources with ages between 1620 and 1240 Ma; (2) folding and granulite metamorphism have taken place between ca. 860 and 800 Ma, and exhumation at around ca. 800–760 Ma; and (3) the last phase of granitic activity occurred at ca. 759 Ma. This shows, for the first time, that the granulites of the South Delhi Terrane are much younger than those of the Sandmata Granulite Complex of the northern part of the Aravalli Mobile Belt, the Saussar granulites of the Central India Mobile Belt and the Eastern Ghats Mobile Belt. Instead, they show similarities to the Neoproterozoic granulites of the Circum Indian Orogens that include the East African Orogen (East Africa and Madagascar), the Southern Granulite Terrane of India and much of Sri Lanka. We suggest that the South Delhi Basin probably marks a trace of the proto-Mozambique Ocean in NW India within Gondwana, that closed when the Marwar Craton, arc fragments (Bemarivo Belt in Madagascar and the Seychelles) and components of the Arabian-Nubian Shield collided with the Aravalli-Bundelkhand Protocontinent at ca. 850–750 Ma.

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## 1. Introduction

Granulitic terranes play an important role in correlation across cratonic blocks within supercontinental assemblages. The tectonic

history of granulites, including deformation, metamorphism and exhumation, in conjunction with geochronology, has been used as criteria in such correlation studies. The granulites represent the lower crustal rocks and have been formed in various tectonic setting including compressional setting, as is the case for the Eastern Ghats Mobile Belt (Bhattacharya et al., 1994; Biswal et al., 2007) or the Saxonian Granulites (Franke, 1993), as well as in extensional setting (Weber, 1984) and subduction setting (Santosh et al., 2009b). Similarly, exhumation of the granulites has occurred

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