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Alkaline Magmatism Versus Collision Tectonics in the Eastern Ghats Belt, India: Constraints from Structural Studies in the Koraput Complex

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Abstract

Linear domains of deformed alkaline rocks and carbonatites have recently been identified as representing sites of ancient suture zones. In peninsular India, the western margin of the Proterozoic Eastern Ghats Belt (EGB) is characterized by a series of alkaline plutons that are aligned close to the contact with the Archaean Craton. Most of the complexes were deformed and metamorphosed during a subsequent orogenic event. Unlike other plutons in the belt, the alkaline complex at Koraput reportedly escaped deformation and granulite facies metamorphism forming an anomalous entity within the zone. Multiply-deformed country rocks hosting this complex underwent syn-D_{1CR} granulite facies metamorphism followed by D_{2CR} thrusting, with pervasive shearing along a NE-SW trending foliation. A second granulite facies event followed localized D_{3CR} shearing. Within the Koraput Complex, strain partitioning was responsible for preserving igneous textures in the gabbroic core, but aligned magmatic amphibole needles and plagioclase laths occasionally define a S_{1AC} fabric. Along the margins, S_{1AC} is rotated parallel to a NE-trending, east-dipping S_{2AC} fabric in the gabbro, fringing syenodiorite and nepheline syenite bands. Locally, D_{3AC} shearing follows D_{2AC} deformation; S_{2AC} and S_{3AC} parallel S_{2CR} and S_{3CR} in the country rocks. High-grade metamorphism represented by recrystallization of amphibole and plagioclase, and breakdown of amphibole and biotite to garnet, pyroxene and K-feldspar in the complex follows D_{3AC}. Unlike earlier reports, therefore, the Koraput body is also deformed and metamorphosed. The aligned alkaline complexes in the EGB probably represent deformed alkaline rocks and carbonatites formed by rifting related to an earlier episode of continental break-up that were deformed during subsequent juxtaposition of the EGB with the Archaean Craton. This supports the contention that the western margin of the EGB and its contact with the Archaean Craton is a suture zone related to the Indo-Antarctica collision event.

Key words: Eastern Ghats Belt, alkaline magmatism, Koraput Complex, deformation, granulite-facies metamorphism.

Introduction

Suture zones demarcate domains of continent-continent collision; their existence reflects the demise of an intervening ocean basin and the site of terrane amalgamation. Identification of relatively recent sutures e.g., the Indus-Tsangpo Suture Zone in the Himalayas, or the Insubric Line in the Alps, is facilitated by the presence of slices of obducted oceanic crust or ophiolite complexes that can be demonstrated to root in the crustal-scale lineaments. In more ancient terrains, where deeper levels of erosion at the orogenic front have removed ophiolites and other shallow-level signatures of collision, identification of sutures is considerably more complicated. Recently, Burke et al. (2003) have suggested that such ancient sutures may be identified from linear zones of deformed alkaline rocks and carbonatites that were initially formed in early intra-continental rifts at the start of the Wilson cycle (e.g., Bailey, 1992), and are now preserved in zones of terrain amalgamation. During continental collision, subsequent to closure of the ocean basin, the alkaline rocks come to be disposed close to or within the suture zone. Hence, linear domains of deformed alkaline rocks may be interpreted as sites where oceans once opened and then closed.

In peninsular India, a series of alkaline complexes occur in the western part of the Proterozoic Eastern Ghats Belt (Leelanandam, 1989, 1993; Fig. 1), aligned along a prominent crustal lineament called the Sileru Shear Zone (SSZ of Chetty and Murthy, 1993). Alkaline magmatism along the SSZ has been explained by conventional models that invoke either ensialic rifting (e.g., Leelanandam, 1998) or hot spot activity (e.g., Bhattacharya and Kar, 2004).

The western boundary of the EGB that hosts the complexes, however, is a terrane boundary with the Archaean Craton and considered by some to be a suture zone related to Indo-Antarctica collision (Chetty and Murthy, 1994; Gupta et al., 2000; Bhadra et al., 2004). Some workers consider the SSZ to be linked to the collision front, with alkaline magmatism synchronous with movement along the shear zone (e.g., Bose, 1970; Chetty and Murthy, 1998; Chetty, 2001; Bhattacharya and Kar, 2004), with little or no post-emplacement deformation and metamorphism. However, post-emplacement deformation and metamorphism has been reported from many of the complexes (e.g., Subbarao, 1971; Czygan and Goldenberg, 1989; Madhavan and Khurram, 1989; Gupta and Bose, 2004). The deformed nature of the alkaline complexes in the EGB, and their association with the suture zone represented by the western boundary of the belt (Gupta et al., 2000; Bhadra et al., 2004) suggests that the complexes may represent deformed alkaline rocks and carbonatites similar to those originally reported by Burke et al. (2003) from Lake Malawi (Leelanandam and Burke, 2004).

Available radiometric age data suggest that most of the alkaline complexes in the EGB are Mid-Proterozoic (~1250–1450 Ma) in age e.g., Subbarao et al. (1989); Aftalion et al. (2000); Clark and Subbarao (1971). These ages predate the high-grade metamorphic events of Late Mesoproterozoic (~1000 Ma) and Late Neoproterozoic-Cambrian (~500 Ma) in parts of the EGB that host the complexes, and are correlated with specific collisional episodes in the Indo-Antarctica continent (Mezger and Cosca, 1999; Kelly et al., 2002; Dasgupta and Sengupta, 2003). In contrast to the other alkaline plutons, the Koraput Complex, located centrally with respect to the linear array of other alkaline bodies in the EGB, has been dated at around 856±18 Ma (Sarkar et al., 1989, Rb-Sr whole-rock isochron). This age is younger than that obtained in the other plutons, and supports previous structural studies that inferred syn- to late-tectonic intrusion of the Koraput body (e.g., Bose, 1971; Bhattacharya and Kar, 2004). The implication is that the undeformed and unmetamorphosed Koraput Complex was distinct from other complexes within the belt. In this paper, we attempt to resolve the apparent discrepancy surrounding the Koraput body vis-à-vis the other alkaline complexes in the EGB, and investigate if the Koraput Complex is incompatible with the concept of deformed alkaline rocks and carbonatites along the western margin of the EGB.

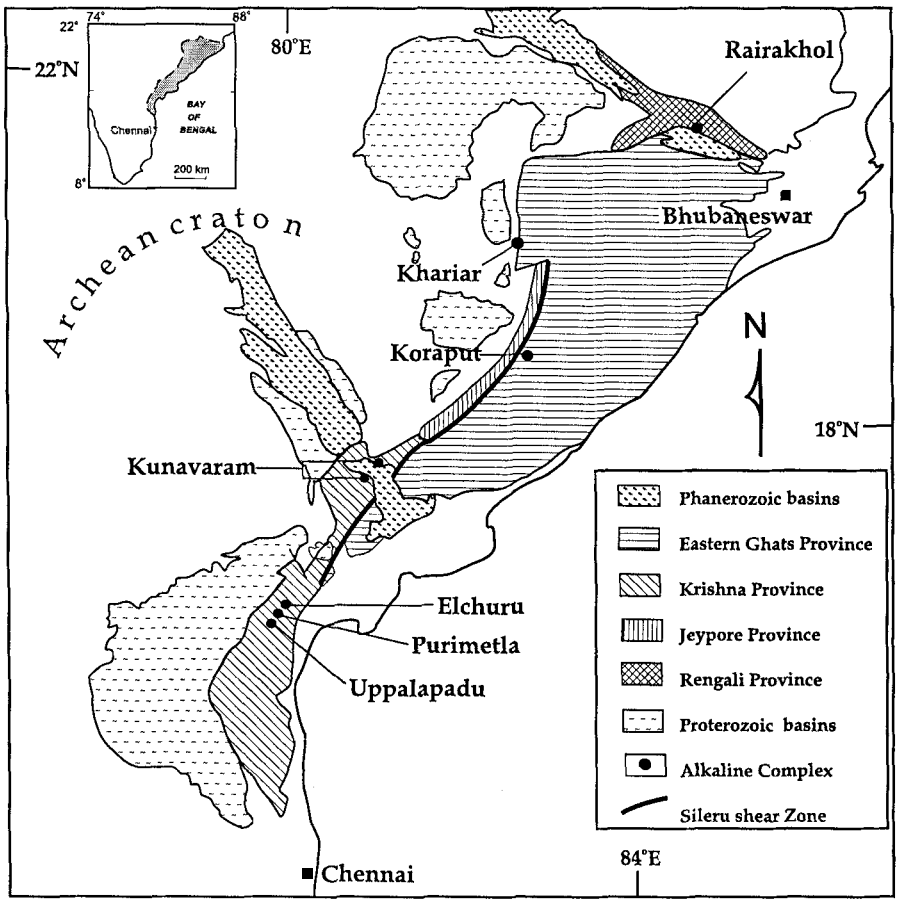

Fig. 1. Classification of the Eastern Ghats Belt (EGB) showing the provinces identified on the basis of available geologic and geochronologic data (after Dobmeier and Raith, 2003). The major alkaline complexes are shown along the western margin of the belt. Inset map shows the location of the EGB (shaded) in peninsular India.