Available online at www.sciencedirect.com
ScienceDirect
Precambrian Research 161 (2008) 303–316
Precambrian Research
www.elsevier.com/locate/precamres

Geochronology of the 1.55 Ga Bengal anorthosite and Grenvillian metamorphism in the Chotanagpur gneissic complex, eastern India

Nilanjan Chatterjee [a,*], James L. Crowley [a], Naresh C. Ghose [b]

[a] *Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139, USA*
[b] *Department of Geology, Patna University, Patna 800005, India*

Received 13 November 2006; received in revised form 10 August 2007; accepted 7 September 2007

Abstract

The thermal-tectonic history of the eastern part of the Chotanagpur gneissic complex (CGC) in the eastern Indian shield was investigated through U–Pb dating of zircon in anorthosite, U–Th–Pb chemical dating of monazite in metapelite granulite, and metamorphic textural analysis. Gabbroic anorthosite in the Bengal anorthosite massif was emplaced at 1550 ± 12 Ma (2σ error, including error from decay constants), 50–150 Myr after an earlier metamorphic event probably related to the late stage of continental collision between the northern and the southern Indian blocks. Subsequent metamorphism in the CGC is recorded by 947 ± 27 Ma zircon growth in the anorthosite, and 950 ± 20 Ma and 995 ± 24 Ma monazite growths in the matrix and within garnet of metapelite granulite located north of the anorthosite. Peak pressures and temperatures of 7–10.5 kb and 775–825 °C in the metapelite granulite and 8.5–11 kb and 850–900 °C in the anorthosite indicate granulite facies conditions during the 995–947 Ma metamorphic event. Hence, as in the Eastern Ghats belt, Grenvillian granulite facies metamorphism played an important role in the thermal-tectonic evolution of the CGC.
© 2007 Elsevier B.V. All rights reserved.

Keywords: Chotanagpur; Bengal anorthosite; Proterozoic; Grenville; U–Pb geochronology; Zircon; Chemical age; Monazite; ID-TIMS; EPMA

1. Introduction

Interpreting the thermal-tectonic history of Precambrian metamorphic terrains and reconstructing their relative positions in erstwhile supercontinents is one of the major goals of geochronology. Geochronological and metamorphic data have been used by several researchers to argue that the Indian subcontinental block originated through a collision of the northern and southern Indian blocks between approximately 2.1 and 1.7 Ga (Yedekar et al., 1990; Jain et al., 1991; Mishra et al., 2000; Sarkar, 1982). Others present evidence for the proposed collision during the ca. 1–1.2 Ga Grenvillian orogeny (Bhowmik et al., 1999, 2005; Bhowmik and Roy, 2003) when the supercontinent Rodinia was assembled (Unrug, 1992; Yoshida, 1995; Moores, 1991; Sengupta et al., 1999; Dasgupta and Sengupta, 2003; Dobmeier and Raith, 2003). The crystalline gneissic complexes and mobile belts of central and eastern India preserve key evidence of Proterozoic tectonics on the Indian shield. The Eastern Ghats belt (EGB) is one of these high-grade metamorphic terrains that has been relatively well studied (review in Dasgupta and Sengupta, 2003; Dobmeier and Raith, 2003). Less is known about the Chotanagpur gneissic complex (CGC) and other similar terrains on the Indian shield.

We present new and high precision geochronological data from a massif-type anorthosite and metapelite granulite country rock to elucidate the thermal-tectonic history of the CGC. Combined with metamorphic textural data, the significance of the new dates is discussed with respect to anorthosite crystallization, granulite facies metamorphism and relation to the other Proterozoic complexes of the Indian shield.

2. Geological background

The CGC is located in the eastern part of the Indian shield (Fig. 1, inset). In the south, it is separated from the EGB by the Singhbhum mobile belt and the Archean Singhbhum craton (Saha, 1994). The EGB has a complex Paleo- and Mesoproterozoic history overprinted with Grenvillian and Pan-African metamorphism (Mezger and Cosca, 1999; Shaw et al., 1997). The eastern margin of the CGC is covered by the Ganges-

* Corresponding author. Tel.: +1 617 253 1995; fax: +1 617 253 7102.
E-mail address: nchat@mit.edu (N. Chatterjee).

0301-9268/$ – see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.precamres.2007.09.005

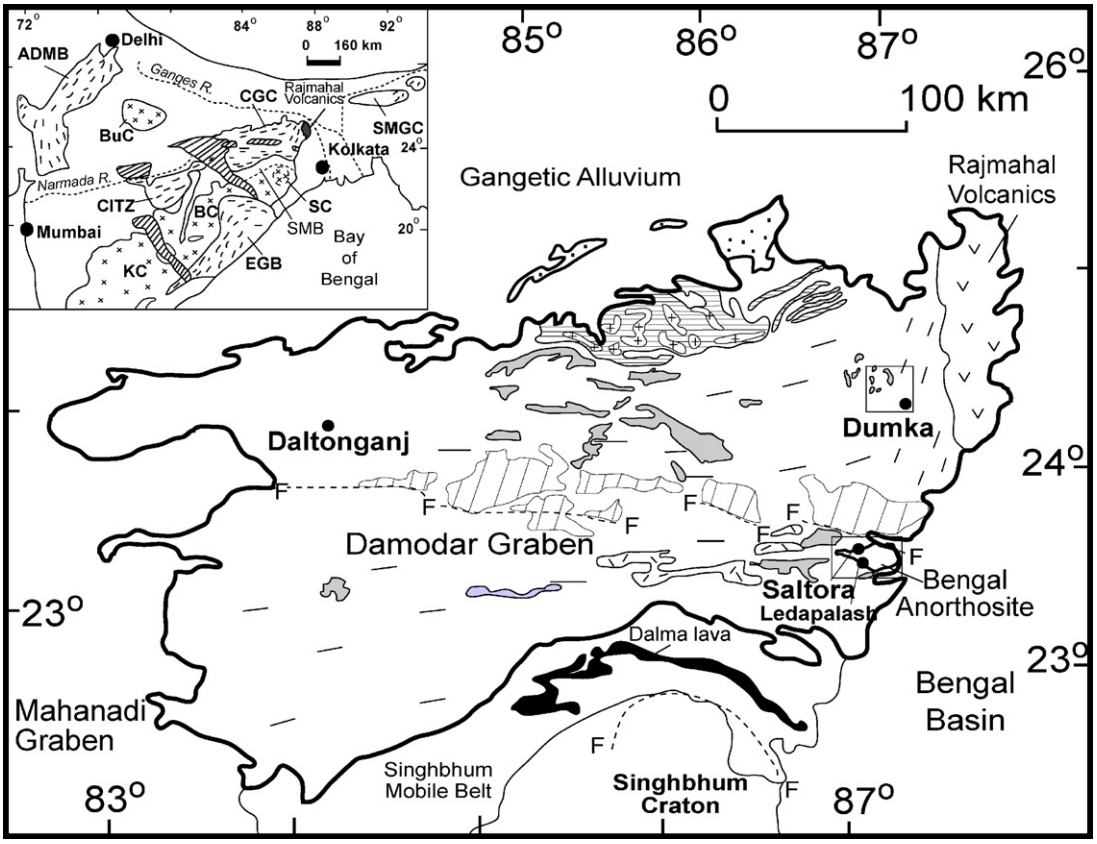

Fig. 1. Geological map of the Chotanagpur gneissic complex (CGC) showing the distribution of Archean-Proterozoic metasedimentary enclaves and granitic intrusives, and the location of Dumka and the Bengal anorthosite at Saltora (adapted from Acharyya et al., 1998). The marginal enclaves and some younger basins are not shown. Proterozoic Dalma lava in the Singhbhum mobile belt, the Cretaceous Rajmahal volcanics and Mesozoic Gondwana basins associated with the Damodar Graben are shown for reference. The metasedimentary enclaves are unclassified Archean-Proterozoic (grey shade), Paleo-Mesoproterozoic of the northern rift zone (horizontal lines) and Mesoproterozoic (dots); the granitic plutons are Mesoproterozoic (random dashes) and Neoproterozoic (plusses). The major foliation trends are shown by long dashes, and the dashed lines marked with 'F' represent faults. The boxed areas around Saltora and Dumka are shown in detail in Fig. 2. The inset shows the foliation trends (dashes) and location of the CGC and some other Proterozoic crystalline complexes including the Eastern Ghats belt (EGB), central Indian tectonic zone (CITZ), Shillong-Meghalaya gneissic complex (SMGC), Singhbhum mobile belt (SMB) and Aravalli-Delhi mobile belt (ADMB, Roy et al., 2005). Also shown are the Archean Singbhum (SC), Bastar (BC), Bundelkhand (BuC) and Karnataka (KC) cratons, and Gondwana basins (lines) on the Indian shield.

Brahmaputra alluvial deposits, which separates the CGC from the Shillong-Meghalaya gneissic complex (SMGC) consisting of early Mesoproterozoic granulites overprinted with Pan-African metamorphism (Chatterjee et al., 2007). In the west, the CGC is separated from the central Indian tectonic zone (CITZ) by younger Gondwana sediments. The foliation trends in the CGC and CITZ are approximately ENE-WSW to E-W and both complexes abut a common rift zone in the north (Acharyya, 2003).

The CGC is a complex collage of high-grade gneiss, migmatite and metasedimentary enclaves intruded by metabasic, anorthositic and granitic plutons (Fig. 1) (Mazumdar, 1988; Sarkar, 1988; Ghose, 1983, 1992). Younger mafic, ultramafic and alkaline (sodic and ultrapotassic) intrusives of early Tertiary age are also present. The metasedimentary suite includes metapelite, quartzite and calc-silicate rocks. Both the gneiss and the metasediments show polyphase deformation, metamorphism and partial melting. The E-W Damodar Graben hosting several Gondwana basins dissects the CGC into two subequal parts. Granulite domains are present on both sides of the graben. The graben originated after the major phase of metamorphism as indicated by cross-cutting relationships between the graben-related faults and the fabric of the metamorphites (Sarkar, 1988). The dominant foliation trend in most of the CGC is ENE-WSW except in the northeastern part, where the trend is NNE-SSW (Bhattacharyya, 1975; Ghose, 1992) (Fig. 1). From the fold patterns in several parts of the CGC, three distinct deformational episodes have been recognized (Roy, 1977; Prasad, 1976; Sarkar and Jha, 1985; Pyne et al., 1991; Ray Barman et al., 1994).

Gneiss from the central (1717 ± 102 Ma, Mallik et al., 1991) and granite from the western (1741 ± 65 Ma, Ray Barman and Bishui, 1994) and northern (1590 ± 30 Ma, Pandey et al., 1986) parts yield the oldest dates in the CGC, as determined by the whole rock Rb–Sr isochron method. Migmatite (1580 ± 33 Ma), hypersthene granite (1599 ± 33 Ma) and granite gneiss (1522 ± 71 Ma) from the northeastern granulite domain near Dumka (Fig. 1) also yield early Mesoproterozoic Rb–Sr dates (Mallik et al., 1991). These dates correspond with a 1700–1650 Ma galena Pb-isotope date from metasediment in the northeastern part (Singh et al., 2001). Despite the limitations of the Rb–Sr isochron technique in high-grade granulite-facies terrains, these dates appear to suggest a major tectonothermal event

Download English Version:

https://daneshyari.com/en/article/4724290

Download Persian Version:

https://daneshyari.com/article/4724290

Daneshyari.com