

Structural evolution and tectonic context of the Mfongosi Group, Natal thrust front, Tugela terrane, South Africa

I.J. Basson^{a,*}, M.K. Watkeys^{b,1}, D. Phillips^{c,2}

^a Department of Geological Sciences, University of Cape Town, P.B. Rondebosch 7701, South Africa

^b School of Geological and Computer Sciences, University of Natal, Durban 4041, South Africa

^c School of Earth Sciences, The University of Melbourne, Victoria 3010, Australia

Received 16 December 2004; received in revised form 31 August 2005; accepted 2 September 2005

Available online 2 November 2005

Abstract

The Mesoproterozoic Natal Metamorphic Province of Kwazulu–Natal in South Africa is an assemblage of several tectonic units, including accreted oceanic island arcs, obducted oceanic crust and deformed basin material. The highly deformed Mfongosi Group occurs at the leading edge of collision (the Natal thrust front), against and directly overlying the southern margin of the Kaapvaal Craton. Structures within the Mfongosi Group record “local” D_1 and D_2 events, the first of which was “oblique obduction”, with predominantly N- to NNE-verging thrusting (D_1). This was followed by sinistral transpression combined with vertical constriction, forming SW-plunging kink folds and SW-plunging prolate pillow basalts (D_2). The third and final event (D_3) was E–W to ESE–WNW extension in a post-thrusting phase, defined by fibrous antitaxial quartz–calcite veining. The westernmost portion of the Mfongosi Group, the Ngubevu area, shows significantly higher finite strains (up to $R_f = 12$) compared to central Mfongosi and eastern Nkandha areas ($R_f = 1.5$ and less), suggesting highly oblique, largely NE-directed initial collision. Deformation of the NTF in the context of nappe emplacement is constrained by $^{40}\text{Ar}/^{39}\text{Ar}$ dating of post-cataclastic nematoblastic/porphyroblastic hornblende of the Manyane amphibolite close to the thrust between the Tugela nappe and the Mfongosi Group in the Mfongosi area. Hornblende overgrew the products of low-temperature deformation during the “local” D_1 and D_2 . A minimum age of 1171 ± 16 Ma (95% conf., including J -error; weighted by $\sqrt{\text{MSWD}}$; $\text{MSWD} = 4.3$) is obtained for the tectonic juxtaposition of the Tugela nappe against the southern portions of the “Mfongosi Basin”. This “local” D_1 and D_2 of the Mfongosi Group pre-dates the regional “oblique D_1 ” and “left-lateral D_2 ” previously determined for the central and southern terranes of the Natal Metamorphic Province by other researchers. Comparison of the 1171 ± 16 Ma age, with ages for shearing and intrusion, suggests that thrusting and/or mylonite-forming events migrated southwards throughout the Natal Metamorphic Province, being separated by approximately 25 million years. Thrusting and/or mylonite-forming events occurred in the nappe zone from ca. 1135 Ma to 1077 Ma, followed by a period of “quiescence” during which granites intruded, in turn followed by late-tectonic deformation of the southern Mzombe and Margate terranes from ca. 1004 Ma to 970 Ma. Such a scenario supports previously-proposed indentation models with their implications of oblique convergence and late-tectonic escape of island arcs to the E/ENE (African azimuths).

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Keywords: Mesoproterozoic; South Africa; Mobile belt; Structure; Natal thrust front; $^{40}\text{Ar}/^{39}\text{Ar}$ dating

1. Introduction

The Namaqua–Natal Metamorphic Province represents Mesoproterozoic collision in southern Africa between 1250 Ma and 950 Ma (Moores, 1991; Dalziel et al., 2000). This collision formed the Namaqua–Natal–Falkland–Maudheim Belt, to which researchers have assigned a

* Corresponding author. Tel.: +27 21 650 2921; fax: +27 21 650 3783.

E-mail addresses: ibasson@geology.uct.ac.za (I.J. Basson), watkeys@ukzn.ac.za (M.K. Watkeys), dphillip@unimelb.edu.au (D. Phillips).

¹ Fax: +27 31 260 2080.

² Tel.: +61 8344 7455.