

Tectonic implications from the geochemistry of Mfongosi Group metasediments, Natal Metamorphic Province, South Africa

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ABSTRACT

The formation of the Mesoproterozoic Natal Metamorphic Province occurred during the closing stages of the assembly of the supercontinent Rodinia (~1150 to ~950 Ma), forming part of the ~1190 to ~950 Ma Grenvillian orogeny. This was preceded by the accretion, at ~1210 Ma, of Mesoproterozoic island arcs along the southern margin of the Archaean Kaapvaal Craton. The Mfongosi Group represents an enigmatic sequence of rocks found between the Kaapvaal Craton and the partially ophiolitic Natal Nappe Zone to the north of these accreted island arcs. Mfongosi metagreywackes adjacent to the Kaapvaal Craton have ocean island arc major element geochemical signatures. These contrast with metagreywackes approximately two kilometres further south, near the contact zone between the Natal Thrust Front and Natal Nappe Zone, which have active continental margin major element geochemical signatures. A third type of metasediment is represented in both areas by geochemically distinct low-Ca+Na, high-K meta-arkoses to meta-lithic arkoses, which were formed by relatively minor sedimentation from a passive continental margin. The Mfongosi Group is a fore-arc complex, incorporating elements of a fore-arc basin and an accretionary prism deposited in a trench, which filled during final oblique collision between the Kaapvaal Craton and an oceanic island arc to the south. The inclusion of an active continental margin signature in the metasediments is enigmatic, although the geochemistry of the metagreywackes suggests that the margin of the Grunehogna Province is a probable source. Subsequent closure of this basin resulted in inversion and accretion of the metasedimentary sequence onto the southern margin of the Kaapvaal Craton.

Introduction

The assembly of the supercontinent of Rodinia concluded with the amalgamation of a number of crustal fragments between ~1150 Ma and ~950 Ma. This assembly may have centred on the Namaqua-Natal-Falkland-Dronning Maudheim or Namaqua-Natal Maudheim Belt, which many researchers have suggested was continuous with East Antarctica and the Grenvillian Province of Laurentia (e.g. Groenewald *et al.*, 1991; Moores, 1991; Jacobs *et al.*, 1993; 1995; 1997; Roeser *et al.*, 1996; De Wit *et al.*, 1988; Dalziel *et al.*, 2000; Figure 1). The Natal Metamorphic Province (NMP) includes a number of island arcs, comprising the Mzumbe and Margate terranes, which were accreted against one another and thrust against the southern edge of the Kaapvaal Craton (Matthews, 1972; 1981a; b; Cain, 1975; Thomas, 1989a; b). The Natal Nappe Zone, also termed the "Tugela Terrane" occurs to the north of the Mzumbe Terrane (Mathews and Charlesworth, 1981; Johnston *et al.*, 2002). This zone comprises several tectonostratigraphic packages, consisting of highly deformed mafic and felsic gneiss, metapelitic schist and aplitic granitoid (Johnston *et al.*, 2002), which are

intruded and tectonically separated by serpentinized ultramafics, talc schist and podiform chromitite (Matthews, 1981). Ages obtained from the NMP include those for the obduction of the "Tugela Ophiolite" (Jacobs *et al.*, 1997) at ~1135 Ma, alkaline granitoids of the Tugela Terrane (Nicolaysen and Burger, 1965) at ~1100 Ma, syntectonic granite sheets in the Mzumbe and Margate terranes (Thomas *et al.*, 1995) at ~1090 Ma and the emplacement of the Oribi Gorge Suite (Thomas *et al.*, 1993; Jacobs *et al.*, 1997) at ~1050 to ~980 Ma.

The Natal Thrust Front (NTF) occurs to the north of the Natal Nappe Zone, forming a relatively thin bimodal metabasic/metasedimentary terrane overlying the south-dipping margin of the Kaapvaal Craton (Matthews, 1972; 1981a). Unlike most of the other Mesoproterozoic belts of the Rodinia supercontinent, neither the craton nor the NMP have been affected by subsequent Pan-African metamorphism and deformation (Jacobs *et al.*, 1997). Indeed, a major, regional metamorphic event has not been recorded in the craton for at least 2500 Ma, although Elworthy *et al.* (2000) document local resetting of Rb-Sr ages at ~990 Ma in the southern margin of the craton adjacent to the Natal Thrust Front. The Natal