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Geochronology of emplacement and charnockite formation of the Margate Granite Suite, Natal Metamorphic Province, South Africa: Implications for Natal-Maud belt correlations

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ABSTRACT

The Margate Granite Suite underlies much of the Margate Terrane of the Natal Metamorphic Province, SE South Africa. It consists of foliated granites grouped into four main lithotypes: garnet leucogranite, garnet-free leucogranite, charnockite and garnet-biotite augen gneiss. In this study we present new U-Pb (SHRIMP) zircon geochronological data on each of the four lithotypes to constrain the timing of emplacement of the various granite phases and of charnockite formation. Magmatic zircon ages span a period of about 125 Ma, indicating that the Margate Suite does not comprise a single coeval group of plutons. The oldest crystallisation age of 1169 ± 14 Ma, obtained from the garnet-biotite augen gneiss phase, is statistically similar to that of the Sikombe Granite which is exposed to the south of the Margate Terrane, with which a correlation is made. This implies that the magmatic history of the Margate Terrane is longer and more complex than previously thought. The original granite protolith of a sample from the charnockitised granite in the thermal aureole of the (*ca.* 1040 Ma) Oribi Gorge granite yielded an age of 1135 ± 11 Ma, which is statistically similar to the published age of the gneissic Mzimilo Granite in the Mzumbe Terrane. Zircon overgrowths in this sample, dated at 1037 ± 13 Ma are coeval with the age of the Oribi Gorge granite and are interpreted to date the secondary charnockitisation of the Margate granite. A sample of a partly charnockitised garnet leucogranite provided an age of 1088 ± 9 Ma. This granite contains a pervasive foliation (S_2), partly obliterated in charnockitic patches, indicating that both the D_2 event and the charnockitisation are younger. This confirms previous work in which the maximum age of the main fabric-forming deformation was constrained by the 1091 ± 9 Ma age of the Glenmore Granite. A sample from the garnet leucogranite in the type area of the Margate Granite Suite yielded an age of 1043 ± 4 Ma, which is statistically similar to that of the previously dated, garnet-free leucogranite of the Portobello granite, and zircon metamorphic dates of the secondary charnockitisation event associated with emplacement of the Oribi Gorge Suite. Our new data show that the Margate Terrane was subjected to at least four magmatic/thermal events, at ~1170 Ma, ~1135–1140 Ma, ~1082–1093 Ma, and 1025–1050 Ma. These events can be correlated with coeval magmatic and thermal episodes in surrounding crustal blocks within Rodinia and Gondwana. In particular the Margate Terrane appears to correlate well with the Vardeklettane Terrane of Dronning Maud Land, East Antarctica and furthermore that the Natal belt may be up to 80 Ma older than the Maud belt east of the Heimefront Shear Zone, which is made up of younger crust which was accreted westwards against the Natal belt. In this scenario, the Cape Merdith Complex, West Falkland, which shows no zircon evidence of crust older than *ca.* 1135 Ma, forms part of the Maud belt, not the older Natal belt.

1. Introduction

The Natal Metamorphic Province (NMP) is a 1.2–1.03 Ga metamorphic belt situated on the southern margin of the Kaapvaal Craton in southeast South Africa (Fig. 1a) associated with the

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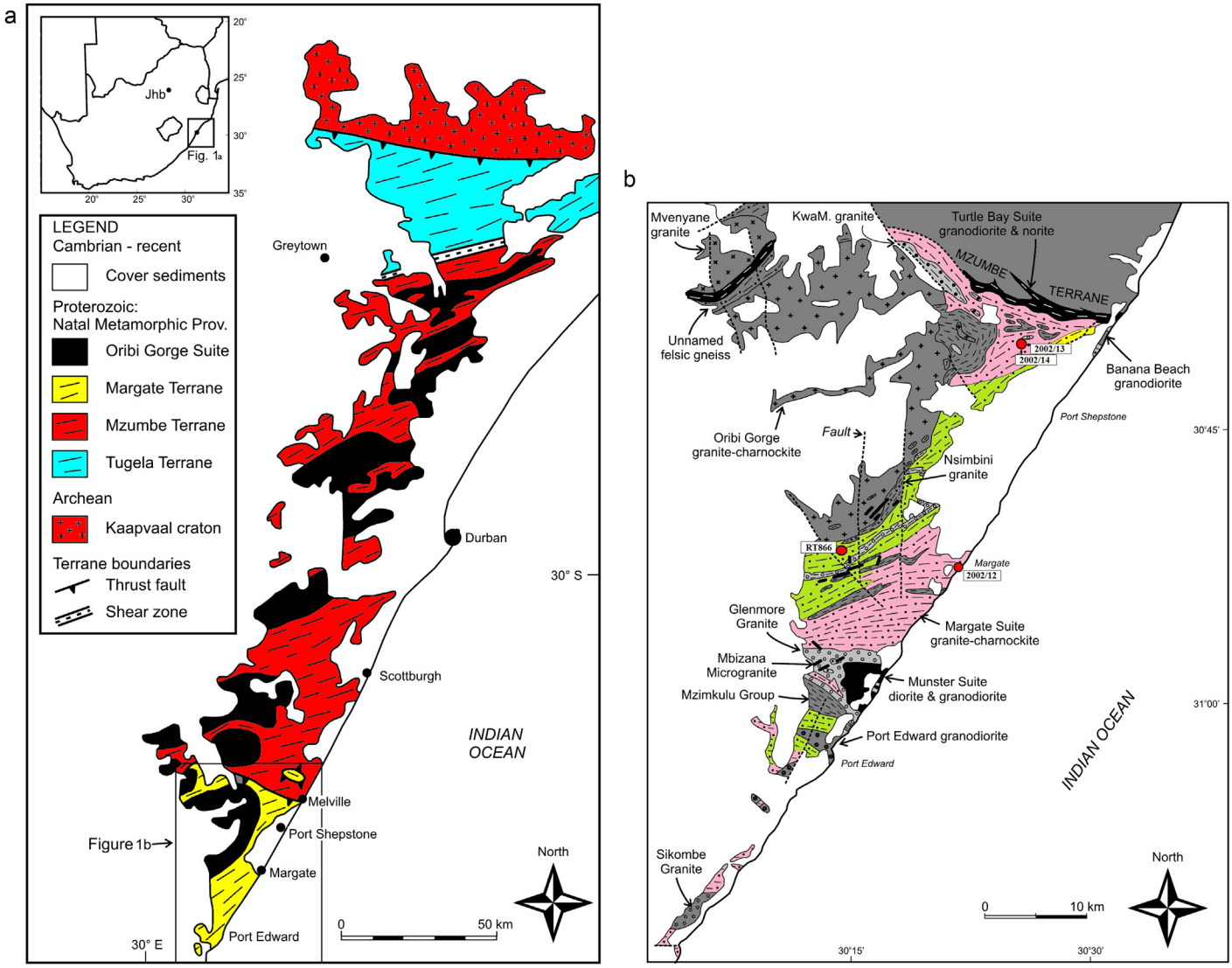

Fig. 1. (a) Geological map of the Natal Metamorphic Province (modified after Thomas, 1989). (b) Geological map of the Margate Terrane (modified after Thomas, 1988a), showing the distribution of the Margate Granite Suite and sample localities.

assembly of the supercontinent Rodinia. It extends laterally westwards into the Namaqua Province under the Phanerozoic cover rocks of central South Africa. In Gondwana reconstructions it extends eastwards into Western Dronning Maud Land, East Antarctica, (Jacobs et al., 1993; Grantham et al., 1997), via the Falkland microplate (e.g. Thomas et al., 1997) and the Haag Nunatak Block (Grantham et al., 1997; Bauer et al., 2003). The NMP is considered to comprise several island arc terranes that were accreted onto the southern margin of the Kaapvaal Craton over a protracted period of time from ±1230 Ma until ±1030 Ma (Thomas, 1989; McCourt et al., 2006). Although the timing of events in this complex terrane collage has to a large extent been unravelled through various dating techniques, the ages of events in the southernmost, Margate Terrane remain uncertain. In particular, the age of emplacement of the voluminous syntectonic Margate granite and associated charnockites has not been ascertained. In this study we present new U-Pb SHRIMP zircon dates for the various phases of the Margate Granite Suite in order to constrain the timing of the intrusion and metamorphic events and to test whether the Margate Suite, as presently defined, forms a coeval igneous suite. We then assess possible correlations of the suite with adjacent crustal segments of Gondwana and discuss the implications for crustal evolution in this complex region and its bearing on Rodinia development.

2. Regional geological setting

The NMP has been divided into three tectonostratigraphic blocks named (from north to south) the Tugela, Mzumbe and the Margate Terranes (Thomas, 1989) (Fig. 1a). Geochronological information indicates that the intrusive and deformational histories of the three terranes are different suggesting diachronous accretion over a period of about 200 million years (Fig. 2).

The **Tugela Terrane** consists of four thrust-bound tectonostratigraphic packages (Johnston et al., 2001) comprising intra-oceanic arc and oceanic island material (Arima et al., 2001) which were obducted northward onto the southern margin of the Kaapvaal Craton (Matthews, 1972). Intrusive tonalitic and dioritic orthogneisses were emplaced between 1209 ± 5 Ma and 1155 ± 1 Ma (Johnston et al., 2001) and obduction was complete by ~1135 Ma (Jacobs et al., 1997; Johnston et al., 2001; McCourt et al., 2006). The **Mzumbe Terrane** (Thomas, 1989) is separated from the Tugela Terrane in the north by the major sinistral ductile Lilani-Matigulu Shear Zone, which marks the geophysical southern margin of the Kaapvaal