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U–Pb SHRIMP ages and tectonic setting of the Munster Suite of the Margate Terrane of the Natal Metamorphic Belt

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ABSTRACT

New U–Pb Zircon SHRIMP ages of 1091±7.1 Ma and 1093.1±5.8 Ma have been determined for two discrete phases of the Munster Suite. The Munster Suite is a calc-alkaline mafic to intermediate suite of intrusive igneous rocks that form part of the southern-most tectonic Terrane of the Mesoproterozoic-aged Natal Metamorphic Belt. Previously published geochemical data indicate that the discrete phases of the Suite are consanguineous and that these rocks originated within an oceanic island arc environment. The new age determinations now show that the different phases are also coeval. Moreover, the ages also indicate that the intrusions were, within statistical error, coeval with S-type granites within the Terrane. This is interpreted to indicate that magmatic underplating provided both the magma by way of a number of progressively more evolved pulses to produce the Munster Suite, as well as the heat necessary for crustal melting to produce the S-type granites within an island arc environment. Therefore, these new age determinations indicate a period of crustal growth at *circa* 1090 Ma. This moreover, is a maximum constraint on the age of the northward-verging structures within the Margate Terrane.

1. Introduction

U–Pb zircon ages have proven to be invaluable in elucidating the timing and sequence of tectonic events in many metamorphic belts (Skridlaite et al., in press; Mallmann et al., 2007; D'el-Rey Silva et al., 2007; Wang et al., 2007; Santosh et al., 2006a,b). This type of information permits the interpretation of tectonic histories of individual belts, as well as the interpretation of their tectonic setting and an understanding of crustal processes that formed and deformed them (Mallmann et al., 2007; Paulsen et al., 2007; Santosh et al., 2006a,b). Moreover, this information constitutes important evidence on which global correlations are based, which in turn, are used for reconstruction of continental evolution (Paulsen et al., 2007; D'el-Rey Silva et al., 2007; Wang et al., 2007; Casquet et al., 2006). An example of this is the need for information on the tectonic evolution of the Natal Metamorphic Belt to resolve the, currently equivocal, Neoproterozoic position of the Khalahari craton in relation to Rodinia (Jacobs et al., 2003; Dalziel et al., 2000; Jacobs et al., 1999).

The Natal Metamorphic Belt (NMB) comprises remnants of island arcs that accreted onto the southern margin of the Kaapvaal Craton (Jacobs et al., 1993), and is considered to be an extension of the Namaqualand Metamorphic Province in Southwestern Africa and the gneiss terranes of Western Dronning Maud Land of East Antarctica (Nicholaysen and Burger, 1965; De Beer and Meyer, 1984; Jacobs et al., 1993).

There is a significant amount of literature on the intrusive and tectonic history of the Margate Terrane of the Natal Metamorphic Belt (NMB) (Gevers and Dunne, 1942; Du Toit, 1946; McIver, 1963, 1966; Grantham, 1983; Talbot and Grantham, 1987; Thomas, 1988a, 1989; Jacobs et al., 1993; Mendonidis et al., 2002; McCourt et al., 2006). In particular, the intrusive history of the southern part of the Margate Terrane has been documented in detail by Grantham (1983) and Mendonidis (1989) and an excellent summary of the salient events is provided by McCourt et al. (2006).

Previously published geochronological data has indicated that the maximum age of 1091±9 Ma for the tectonism in the Margate Terrane (Mendonidis et al., 2002) is far younger than the ages that constrain the timing of the tectonism in the Tugela Terrane where the Syn-D3 (obduction event), post-D2 Wosi granitoid Suite (now called the Mtungweni granitoids) yielded an intrusive age of 1155±1 Ma (Johnston et al., 2001), confirming the suggestion that the Margate Terrane was a younger accretion to the Natal Belt (McCourt et al., 2006).

Field-based studies (Grantham, 1983; Mendonidis, 1989) have provided a relative intrusive history for the southern part of the Terrane. However, poor preservation of early (S1) fabrics in the intrusive rocks that otherwise display only a very well defined S2 foliation has necessitated further geochronological data in order to further understand the tectono-magmatic history of this Terrane. To

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this end, U–Pb SHRIMP ages for two samples from the Munster Suite were acquired in this study.

2. Geological setting

The Natal Metamorphic Belt (NMB) consists of three tectonic terranes (Thomas, 1989) (Fig. 1) that are interpreted as the remnants of island arcs that accreted onto the southern margin of the Kaapvaal Craton (Jacobs et al., 1993).

The Tugela Terrane comprises supracrustals of igneous and sedimentary origin that have island arc geochemical signatures (Arima et al., 2001), and that were obducted onto the southern margin of the Kaapvaal Craton (Matthews, 1972). The oldest rocks in the Tugela Terrane are the Kotangweni Tonalitic Gneisses, which pre-dated the D1-event and have an age of 1209±5 Ma (Johnston et al., 2001). The syn-D2 Mkondeni Diorite provided an age of 1161±9 Ma (Johnston et al., 2001), and the post-D2 Wosi Granitoid Suite (now called the Mtungweni granitoids), which is considered to have intruded during the D3 obduction event, has an age of 1155±1 Ma (Johnston et al., 2001). The Dulumbe paragneisses, which form the structurally highest tectonic unit, yielded a detrital zircon age of 1276±10 Ma (Johnston et al., 2001). The southern margin of the Tugela Terrane is delineated by the Lilani-Matigulu shear zone. This shear zone also marks the southern extent of the underlying Kaapvaal Craton (Barkhuizen and Matthews, 1990), indicating that the entire Tugela Terrane overlies Archaean crust of the Kaapvaal Craton.

The Mzumbe Terrane covers a large area south of the Lilani-Matigulu shear zone. The oldest rocks of this terrane are supracrustals of the Mapumulo Group, of which the meta-andesites of the Quha Formation provided an eruption age of 1235±9 Ma (Thomas et al.,

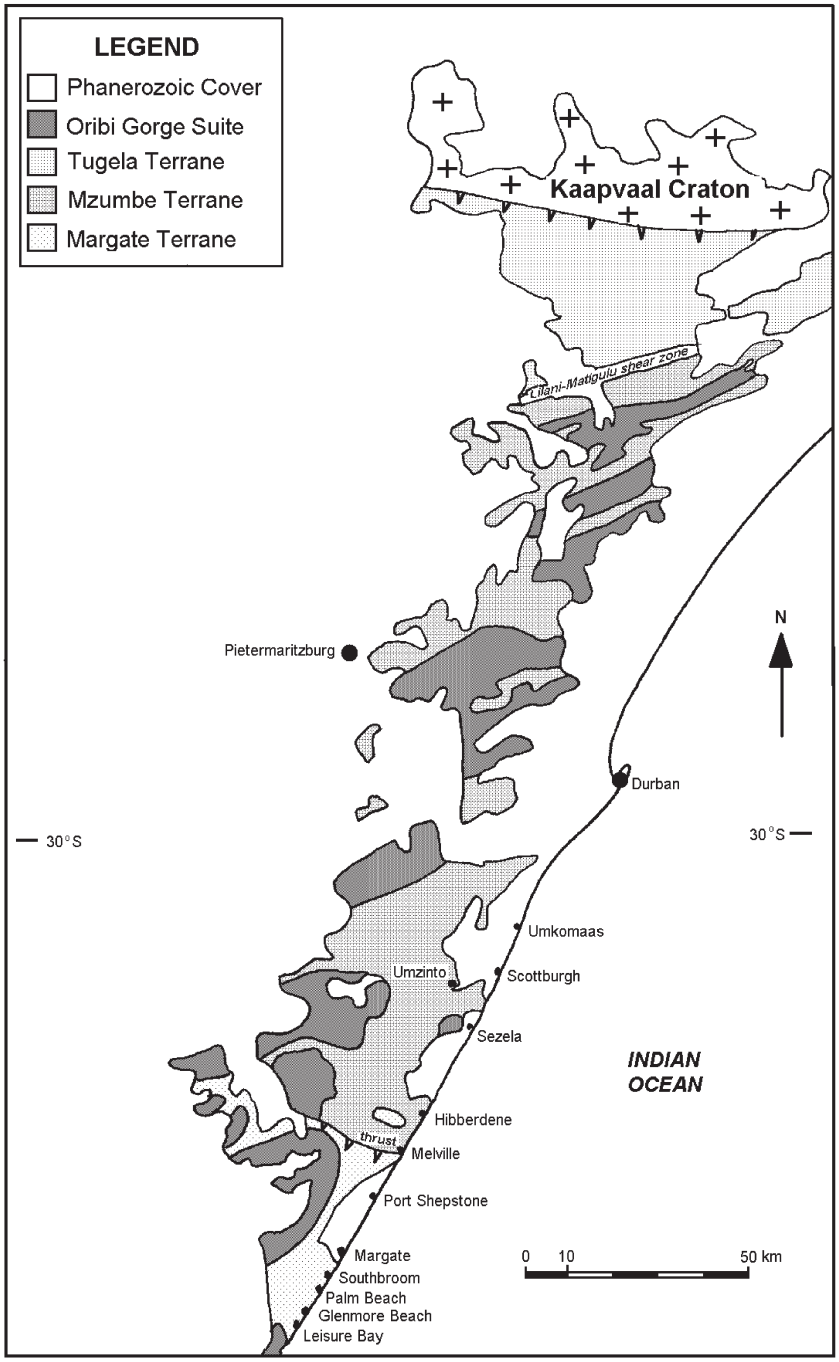

Fig. 1. Locality map showing the three terranes of the Natal Metamorphic Belt that accreted onto the southern Margin of the Kaapvaal Craton (McCourt et al., 2006).