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Crustal root of the Eastern Dharwar Craton: Zircon U–Pb age and Lu–Hf isotopic evolution of the East Salem Block, southeast India

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ABSTRACT

The Salem Block represents the northern part of the Southern Granulite Terrane in SE India, adjacent to the southern Dharwar Craton. New zircon U–Pb and Lu–Hf results on charnockites, granitoids and migmatites from the eastern Salem Block indicate that it mainly consists of bimodal juvenile Neoarchaean – early Palaeoproterozoic (~2.75–2.65 Ga and ~2.55–2.48 Ga) crust that underwent peak metamorphism at ~2.53 Ga. These U–Pb ages and Lu–Hf isotopic signatures characterize the Salem Block as part of the lower crust of the Eastern Dharwar Craton. The oldest (~2.75–2.65 Ga) granulites can be traced along important shear zones (Salem-Attur and Gangavalli Shear Zones), which may thus expose deeper levels of Eastern Dharwar lower crust, in a way similar to that proposed for the Nilgiri granulites. An additional (minor) contribution of recycled Western Dharwar Craton in the Salem Block is suggested by the presence of limited ~3.65–3.35 Ga recycled crust and ~2.9–2.6 Ga detritus.

Younger intrusions within the Salem Block include the Cryogenian (~820–800 Ma) Yelagiri alkaline complex and the Ediacaran (559.1 ± 3.5 Ma) Sankari-Tiruchengode granitoid complex. These were sourced from recycled Neoarchaean protoliths of the Salem Block. Cryogenian-Tonian age magmatism is widespread within the Southern Granulite Terrane and is possibly related to initial subduction of the Mozambique Ocean. The Ediacaran A-type granitoids are thought to have formed during the Malagasy Orogeny that is related with the final consumption of the Mozambique Ocean and the collision of India with Azania-East Africa.

1. Introduction

The Dharwar Craton is a well-exposed, Neoarchaean, granite-greenstone terrane that forms the basement of much of peninsular India (Fig. 1). Considerable work over the last few years has shown that the craton has a Mesoarchaean nucleus in the west (the Western Dharwar Craton), with a central transitional region, that passes to a juvenile Neoarchaean terrane in the Eastern Dharwar Craton (Jayananda et al., 2013a,b; Anand et al., 2014). The Dharwar Craton is endowed with considerable gold mineralization (Deb, 2014) and, having an ancient core, mantled with Neoarchaean juvenile arc-related plutons (Jayananda et al., 2013a; Anand et al., 2014), it shares many similarities with the Neoarcheaen Yilgarn Craton of Western Australia (Czarnota et al., 2010). Unlike the Yilgarn Craton, and many other Archaean cratons, the southern margin of the Dharwar Craton is marked by a broadly coeval granulite belt, the limits of which cuts across the main tectonic boundaries in the craton (Fig. 1). A number of scenarios have been proposed to account for this. Either, the granulite belt is a later orogen superimposed on the craton soon after its formation (e.g. Rajesh and Santosh, 2004; Clark et al., 2009b; Noack et al., 2013), or the granulite belt simply reflects the exhumation of the lower crust of the Dharwar Craton along its southern margin due to uplift and differential erosion of this region sometime after the Archaean (e.g. Janardhan et al., 1982; Raase et al., 1986; Roy et al., 2008; Peucat et al., 2013).

The granulite belt is known as the Southern Granulite Terrane (SGT), and it consists of a number of Archaean to early Palaeozoic high-grade metamorphic blocks (e.g. Bartlett et al., 1998; Peucat et al., 1993; Clark et al., 2009b; Collins et al., 2014) that are stitched together by large crustal-scale shear systems (Chetty, 1996). Although the tectonic significance of these shear systems

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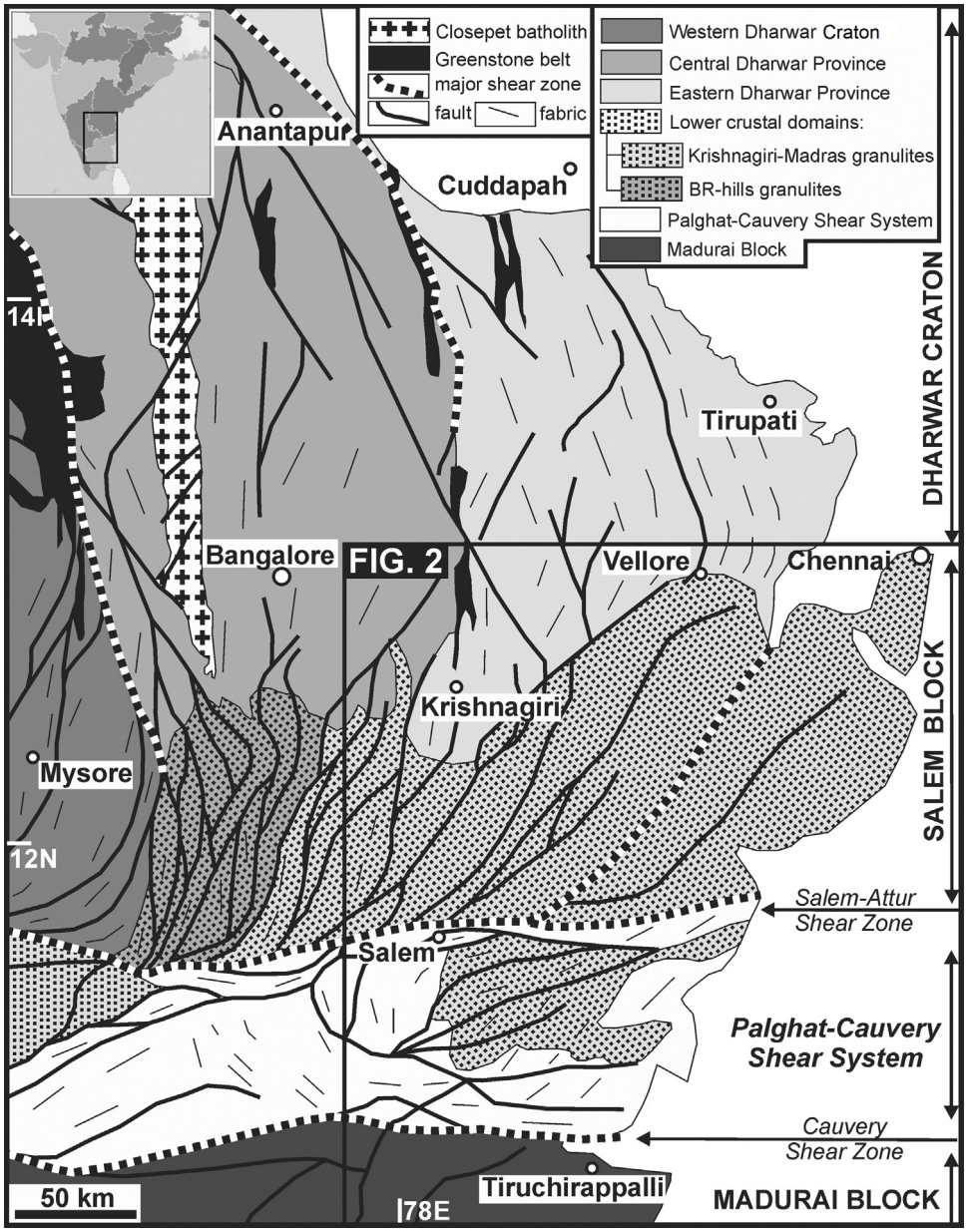

Fig. 1. Overview map of the southeastern Dharwar Craton and the Southern Granulite Terrane (SGT) to its south (after Chardon et al., 2008; Peucat et al., 2013; Collins et al., 2014; Deb, 2014). Both tectonic zones are separated by an amphibolite-granulite facies transition zone. This study focusses on the lower crustal domains (the Krishnagiri-Madras granulites) of the Dharwar Craton, within the SGT: the Salem Block and fragments in the Palghat-Cauvery Shear System.

is debatable (e.g. Bhaskar Rao et al., 2003; Ghosh et al., 2004; Noack et al., 2013), several of them, such as the Cauvery Shear Zone between the Salem and Madurai Blocks (Figs. 1 and 2), have been regarded as Gondwanan sutures (e.g. Meißner et al., 2002; Collins et al., 2007, 2014; Clark et al., 2009a; Plavsa et al., 2012, in press; Santosh et al., 2012). These suture-shear systems have been correlated with the East African, Malagasy and Kuunga orogens, linking up India with the Azania, Kalahari, Australia and Antarctic terranes, within the Gondwana amalgam (e.g. Powell and Pisarevsky, 2002; Collins and Pisarevsky, 2005; Collins et al., 2014).

The part of the Southern Granulite Terrane of interest here is called the Salem Block (Figs. 1 and 2) (Clark et al., 2009a,b) and stretches north from the Cauvery Shear Zone to the, so-called, 'Fermor Line' (Fermor, 1936), that marks the northern extent of granulite-facies rock exposures. Geochronological studies have yielded Neoarchaean and Palaeoproterozoic ages for deformation and metamorphism in the Salem Block (Mojzsis et al., 2003; Clark et al., 2009a,b; Saitoh et al., 2011; Anderson et al., 2012; Noack et al., 2013; Peucat et al., 2013). The available age data from the Salem Block is focussed along a north-south transect at its western margin (Fig. 2) while for the central and eastern part of the Salem Block, data is limited at best. In this study, new zircon U–Pb and Lu–Hf results were obtained from the central and eastern Salem Block to examine the timing of magmatism, metamorphism and protolith formation and to test the hypotheses of how the terrane relates to the Dharwar Craton.

2. Geological setting and geochronological summary

This section gives a brief summary of the geological setting and geochronological record of the Eastern Dharwar Craton (EDC) and the Southern Granulite Terrane (SGT). A more detailed overview can be found in Peucat et al. (2013) (EDC) and Collins et al. (2014)