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Gondwana Research 10 (2006) 57–65
www.elsevier.com/locate/gr

A palaeomagnetic study of charnockites from Madras Block, Southern Granulite Terrain, India

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Received 11 April 2005; accepted 17 November 2005
Available online 3 May 2006

Abstract

The South Indian Craton is composed of low-grade and high-grade metamorphic rocks across different tectonic blocks between the Moyar–Bhavani and Palghat–Cauvery shear zones and an elongated belt of eastern margin of the peninsular shield. The Madras Block north of the Moyar–Bhavani shear zone, which evolved throughout the Precambrian period, mainly consists of high-grade metamorphic rocks. In order to constrain the evolution of the charnockitic region of the Pallavaram area in the Madras Block we have undertaken palaeomagnetic investigation at 12 sites. ChRM directions in 61 oriented block samples were investigated by Alternating Field (AF) and Thermal demagnetization. Titanomagnetite in Cation Deficient (CD) and Multi Domain (MD) states is the remanence carrier. The samples exhibit a ChRM with reverse magnetization of $D_m = 148.1$, $I_m = +48.6$ ($K = 22.2$, $\alpha_{95} = 9.0$) and a palaeomagnetic pole at 37.5 °N, 295.6 °E (dp/dm = 7.8°/11.8°). This pole plots at a late Archaean location on the Indian Apparent Polar Wander Path (APWP) suggesting an age of magnetization in the Pallavaram charnockites as 2600 Ma. The nearby St. Thomas Mount charnockites indicate a period of emplacement at 1650 Ma (Mesoproterozoic). Thus the results of Madras Block granulites also reveal crustal evolution similar to those in the Eastern Ghats Belt with identical palaeopoles from both the areas.

Keywords: India; Pallavaram; Granulites; Palaeomagnetism; Madras Block; Palaeopoles

1. Introduction

The igneous and metamorphic rocks exposed over the South Indian Shield span a geological time interval extending from 3500–500 Ma. A large portion of this shield is classified as the Dharwar Craton and represents a landmass that has remained stable over the last 2000 Ma (Naqvi et al., 1974). It is made up of a mosaic of lithologic units, which are coherently juxtaposed crustal segments in which geologic activity can be traced continuously throughout the Precambrian period. On the basis of grade of metamorphism, the craton is divided into a low-grade northern and high-grade southern region with the Palghat–Cauvery lineament as the tectonic boundary. The bulk of this crust was formed prior to 2600 Ma and remobilized during 2600–2000 Ma (Early Proterozoic Mobile Belt, EPMB) and 2000–1500 Ma (Middle Proterozoic Mobile Belt, MPMB) (Radhakrishna and Naqvi, 1986). The EPMB was responsible for producing the low-grade and high-grade metamorphic terrains in the north and south respectively.

Systematic palaeomagnetic study of rock units from these terrains can help to constrain the development of events that led to the evolutionary history. With this in mind, we have undertaken a palaeomagnetic study of the entire granulitic region in the South Indian peninsular shield. Earlier results of palaeomagnetic study of charnockites from St. Thomas Mount from the Madras Block suggest a period of magnetization corresponding to the Mesoproterozoic (1650 Ma) era (Poornachandra Rao and Mallikharjuna Rao, 1999). Palaeomagnetic study of several charnockitic and other rocks from the Eastern Ghats Mobile Belt also reveal similar results indicating a contemporaneous evolution (Lakshmipathi Raju and Kedareswarudu, 1992 and references therein). A palaeomagnetic study of charnockites from Dharmapuri area indicates a remanence age of late Archaean (2600 Ma) era (Piper et al., 2003). We have undertaken palaeomagnetic study of charnockites around

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doi:10.1016/j.gr.2005.11.015

Pallavaram from the Madras Block with a view of its period of uplift related cooling and magnetization because of its multiple lithologies compared with that of St. Thomas Mount from the same Madras Block and results of our study are presented in this paper.

2. Geology and sampling

The Pallavaram–St. Thomas Mount area south of Madras city is the type area for charnockites and their distribution along with other lithologies are shown in Fig. 1 (Sugavanam and Venkata Rao, 1990). Several workers have studied the rocks in detail and presented mineralogical, petrological, geochemical, structural and tectonic information for these rocks (Subramaniam, 1960). The St. Thomas Mount area contains more basic charnockites and also shows retrograde metamorphic effects whereas the charonckite rocks of the Pallavaram area comprise acidic, basic and intermediate varieties with both prograde and retrograde metamorphic effects. Plagioclase, potash feldspar, orthopyroxene, clinopyroxene and opaque are the essential minerals in these rocks. Magnetite and ilmenite are the opaque minerals occurring as individual elongated grains or released products. Crawford

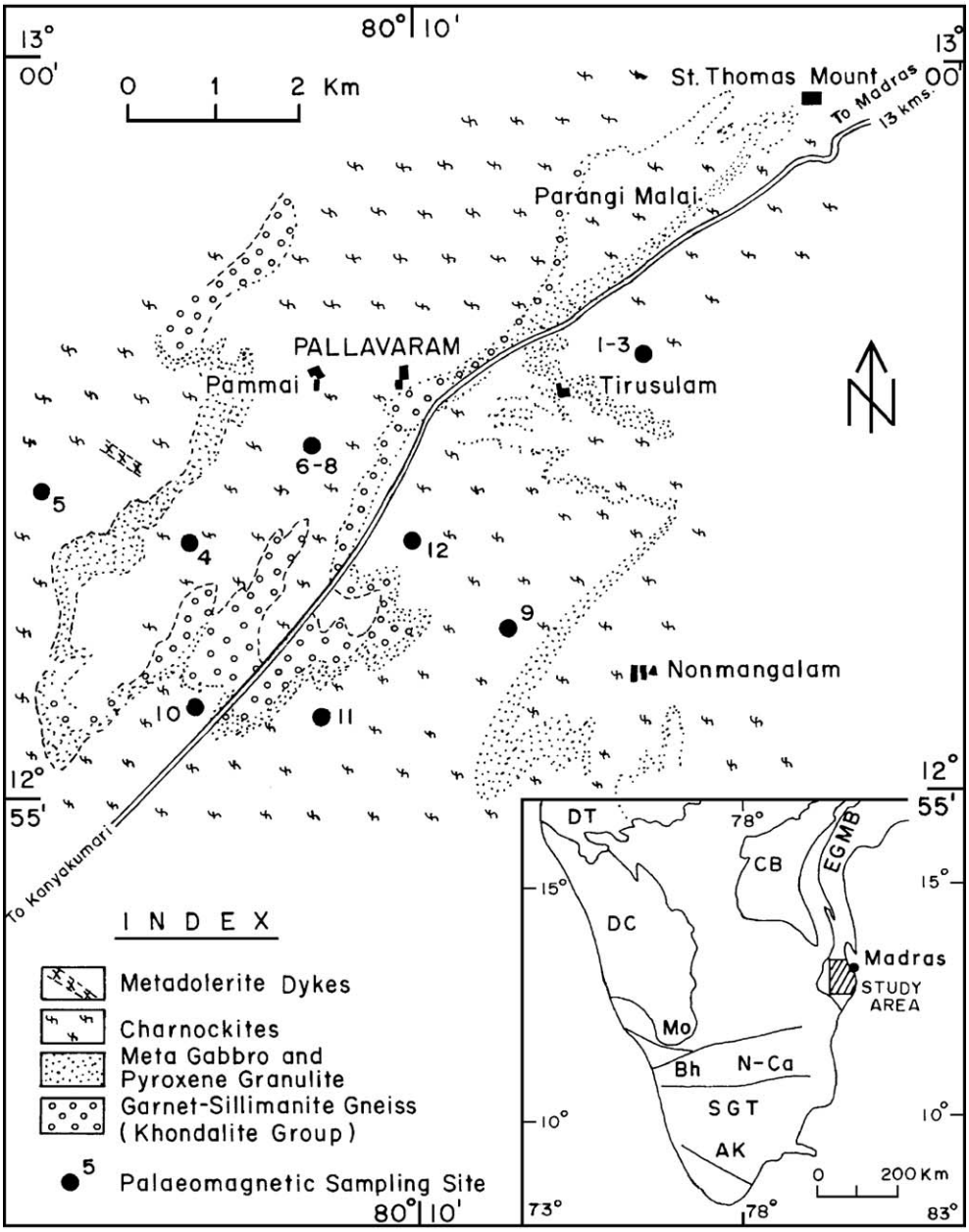

Fig. 1. Geological and structural map of Pallavaram–St. Thomas Mount area near Madras (after Sugavanam and Venkata Rao, 1990). Inset map shows the study area along with the other tectonic features in South India. The Proterozoic shear zones shown are 1) Mo — Moyar, 2) Bh — Bhavani, 3) N–Ca — Noyil–Cauvery and 4) AK — Achankovil. The other features shown are DT — Deccan Traps, DC — Dharwar Craton, CB — Cuddapah Basin, EGMB — Eastern Ghats Mobile Belt and SGT — Southern Granulite Terrain. Palaeomagnetic sampling sites are also shown.