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Neoproterozoic massif-type anorthosites and related magmatic suites from the Eastern Ghats Belt, India: Implications for slab window magmatism at the terminal stage of collisional orogeny

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ABSTRACT

The Jugsaipatna massif-type anorthosite complex (JAC) in the Eastern Ghats Belt of India comprises anorthosite–leuconorite–norite in the central part and gabbros, gabbronorites and porphyritic granites in the periphery. In this study, we report laser ablation ICP-MS zircon U–Pb data and REE geochemistry from the anorthosites, gabbros and porphyritic granites from the JAC. The zircon data yield weighted mean $^{207}Pb/^{206}Pb$ ages of 918 ± 33 Ma (MSWD = 2.2) for the anorthosite and 931 ± 38 Ma (MSWD = 2.2) and 928 ± 35 Ma (MSWD = 0.99) for two leuconorites. The gabbros bordering the anorthosite body yield weighted mean $^{207}Pb/^{206}Pb$ ages of 984 ± 10 Ma (MSWD = 0.41) and 969 ± 12 Ma (MSWD = 1.5). Zircons from the associated porphyritic granites define two concordant age groups: an older group with $^{207}Pb/^{206}Pb$ weighted mean age of 996 ± 11 Ma (MSWD = 2.1) and a younger group with an age of 964 ± 29 Ma (MSWD = 2.1). Zircons from another granite sample yield an age of 957 ± 17 Ma (MSWD = 1.1), identical to the Neoproterozoic age data obtained from the zircons in the anorthosites and gabbros of the JAC. The zircons from anorthosites show moderate REE contents, prominent HREE enrichment and a conspicuous positive Eu anomaly. The zircons from the granites show high REE contents, prominent HREE enrichment and a conspicuous positive Eu anomaly, suggesting a common melt source. The ages reported in study correlate well with similar ages of 983 ± 2.5 Ma for the anorthosites from Chilka Lake complex and the ca. 930 Ma for Bolangir anorthosite in the Eastern Ghats Belt. The early Neoproterozoic ages reported from the magmatic suite in this study remarkably coincide with the timing of ultrahigh-temperature metamorphism reported from various localities in the Eastern Ghats Belt in recent studies. The coeval nature of mantle-derived magmatism and ultrahigh-temperature metamorphism in a collisional orogen following a prolonged subduction-accretion history along the eastern periphery of the Indian lithosphere suggests asthenospheric upwelling, probably through a slab-window mechanism. We correlate the geodynamic setting to post-collisional slab-break off at the terminal stages of the orogeny.

1. Introduction

Proterozoic massif-type anorthosites are typically associated with coeval granites and charnockites in addition to mafic rocks such as troctolite, norite and gabbro, constituting anorthosite–mangerite–charnockite–granite (AMCG) suites that offer important constraints in understanding the secular evolution of Proterozoic mantle and crust (Emslie, 1991; Ashwal, 1993; Duchesne, 1999). Although some of the felsic plutonic rocks associated with massif-type anorthosites are reportedly younger than, and genetically unrelated to, the latter, representing crustally derived anatectic melts, the various magmatic suites are broadly coeval (Ashwal and Seifert, 1980; Duchesne et al., 1985; McLelland et al., 2004). However, some workers (e.g., Demaiffe and Hertogen, 1981) argue that the massif-type anorthosite and the bordering granitoid suite are co-magmatic.

The Eastern Ghats Belt (EGB) in India has figured in models related to the assembly of the Neoproterozoic Rodinia supercontinent (e.g., Dasgupta et al., 2013 and references therein), as well as in studies related to extreme crustal metamorphism under ultrahigh temperature conditions (e.g., Sengupta et al., 1990; Dasgupta et al., 1994, 2013; Rickers et al., 2001; Bose et al., 2011; Das et al., 2011; Korhonen et al., 2011; Dharma Rao et al., 2012). Several Mesoproterozoic ophiolite and arc-magmatic suites related to

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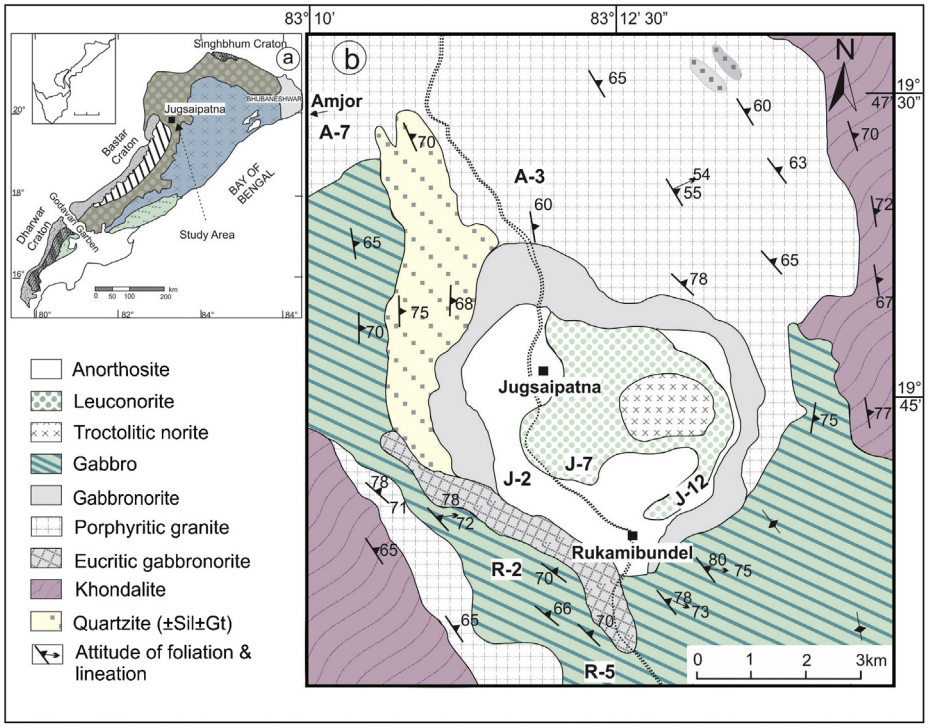

Fig. 1. (a) Generalized geological map of the Eastern Ghats Mobile Belt (EGMB) showing longitudinal lithozones (modified after Ramakrishnan et al., 1998) (b) Geological map of the Jugsaipatna anorthosite complex and enveloping granulite (after Mahapatro et al., 2010) showing the locations of samples dated in this study.

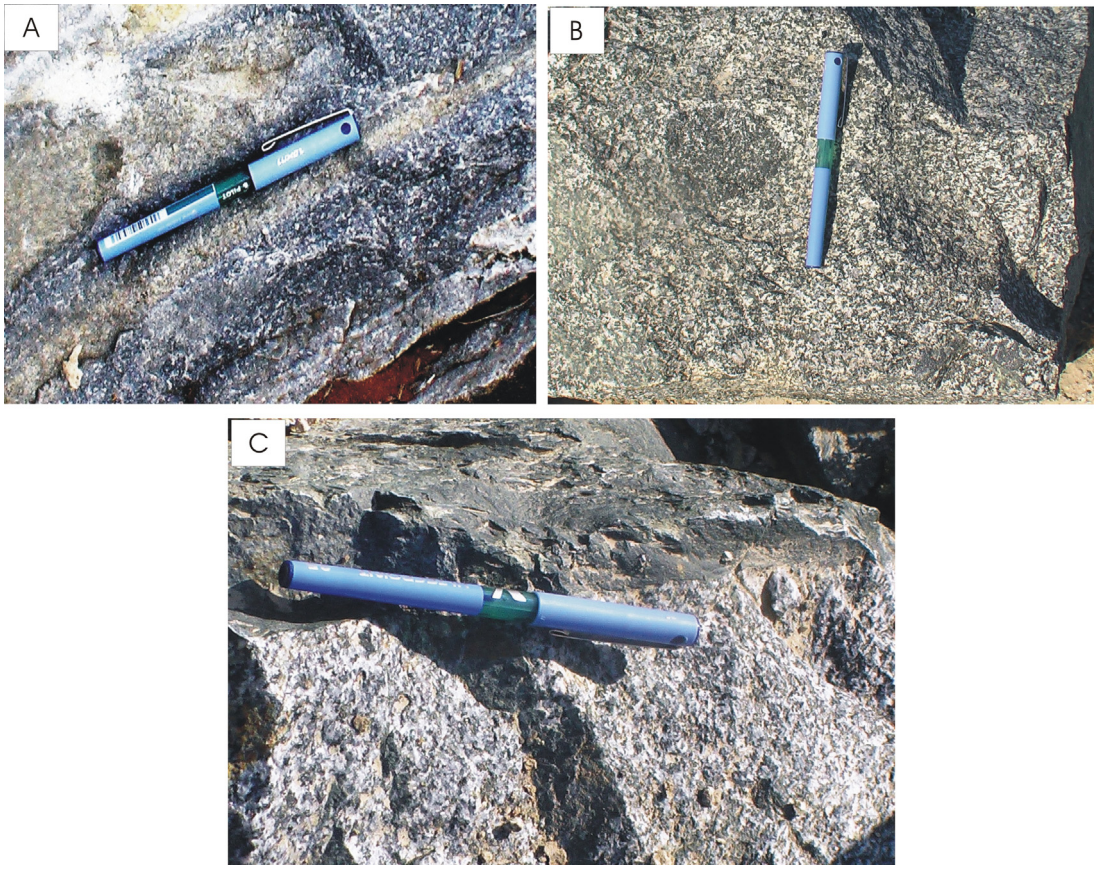

Fig. 2. Representative field photographs (with pen for scale). (a) Anorthosite outcrop exhibiting magmatic layering. (a) Dark patches of segregated mafic phase imparting blotchy appearance in leuconorite. (c) Small dyke of ferrodiorite intruding the gabbro with sharp contact.