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Research paper

Petrogenesis of shoshonitic granitoids, eastern India: Implications for the late Grenvillian post-collisional magmatism

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ABSTRACT

Many elongated, lenticular plutons of porphyritic granitoids are distributed mainly near the southern and northern margin of the Chhotanagpur Gneissic Complex (CGC) which belongs to the EW to ENE–WSW tending 1500 km long Proterozoic orogenic belt amalgamating the North and South Indian cratonic blocks. The late Grenvillian (1071 ± 64 Ma) Raghunathpur porphyritic granitoid gneiss (PGG) batholith comprising alkali feldspar granite, granite, granodiorite, tonalite, quartz syenite and quartz monzonite intruded into the granitoid gneisses of southeastern part of CGC in the Purulia district, West Bengal and is aligned with ENE–WSW trending North Purulia shear zone. Mineral chemistry, geochemistry, physical condition of crystallization and petrogenetic model of Raghunathpur PGG have been discussed for the first time. The petrographic and geochemical features (including major and trace-elements, mineral chemistry and $^{87}Sr/^{86}Sr$ ratio) suggest these granitoids to be classified as the shoshonitic type. Raghunathpur batholith was emplaced at around 800 °C and at 6 kbar pressure tectonic discrimination diagrams reveal a post-collision tectonic setting while structural studies reveal its emplacement in the extensional fissure of North Purulia shear zone. The Raghunathpur granitoid is compared with some similar granitoids of Europe and China to draw its petrogenetic model. Hybridization of mantle-generated enriched mafic magma and crustal magma at lower crust and later fractional crystallization is proposed for the petrogenesis of this PGG. Mafic magma generated in a post-collisional extension possibly because of delamination of subducting slab. Raghunathpur batholith had emplaced in the CGC during the final amalgamation (~1.0 Ga) of the North and South Indian cratonic blocks. Granitoid magma, after its generation at depth, was transported to its present level along megadyke channel, ways within shear zones.

1. Introduction

Proterozoic tectonics and crust formation have been the subjects of much discussion during the last thirty years or so. The Indian sub-continent contains a number of well-preserved Proterozoic fold belts which are beginning to yield valuable insights into their evolution. The Chhotanagpur Gneissic Complex (CGC) is one such belt in which the present study of Raghunathpur granitoid batholith of Purulia district, eastern India belongs. The 1500 km long E–W to ENE–WSW trending Proterozoic orogenic belt, which stretches from the Central Indian Tectonic Zone (CITZ) in the west, through the composite Chhotanagpur Gneissic Complex (CGC)–North Singhbhum Mobile Belt (NSMB) in the east, to the Shillong Plateau Gneissic Complex (SPGC) in the northeast of India (Fig. 1a). It is exceptional in the sense that the North and South Indian cratonic blocks (NIB and SIB, respectively) were amalgamated in this domain to produce the Greater Indian Landmass during late Grenvillian time (1100–900 Ma) (Naganjaneyulu and Santosh, 2010; Bhowmik et al., 2012). Recent petrological and geochronological studies from different sectors of the CGC reveal all-encompassing late Grenvillian (1.1–0.9 Ga) metamorphic and magmatic overprints, which have reworked early Mesoproterozoic

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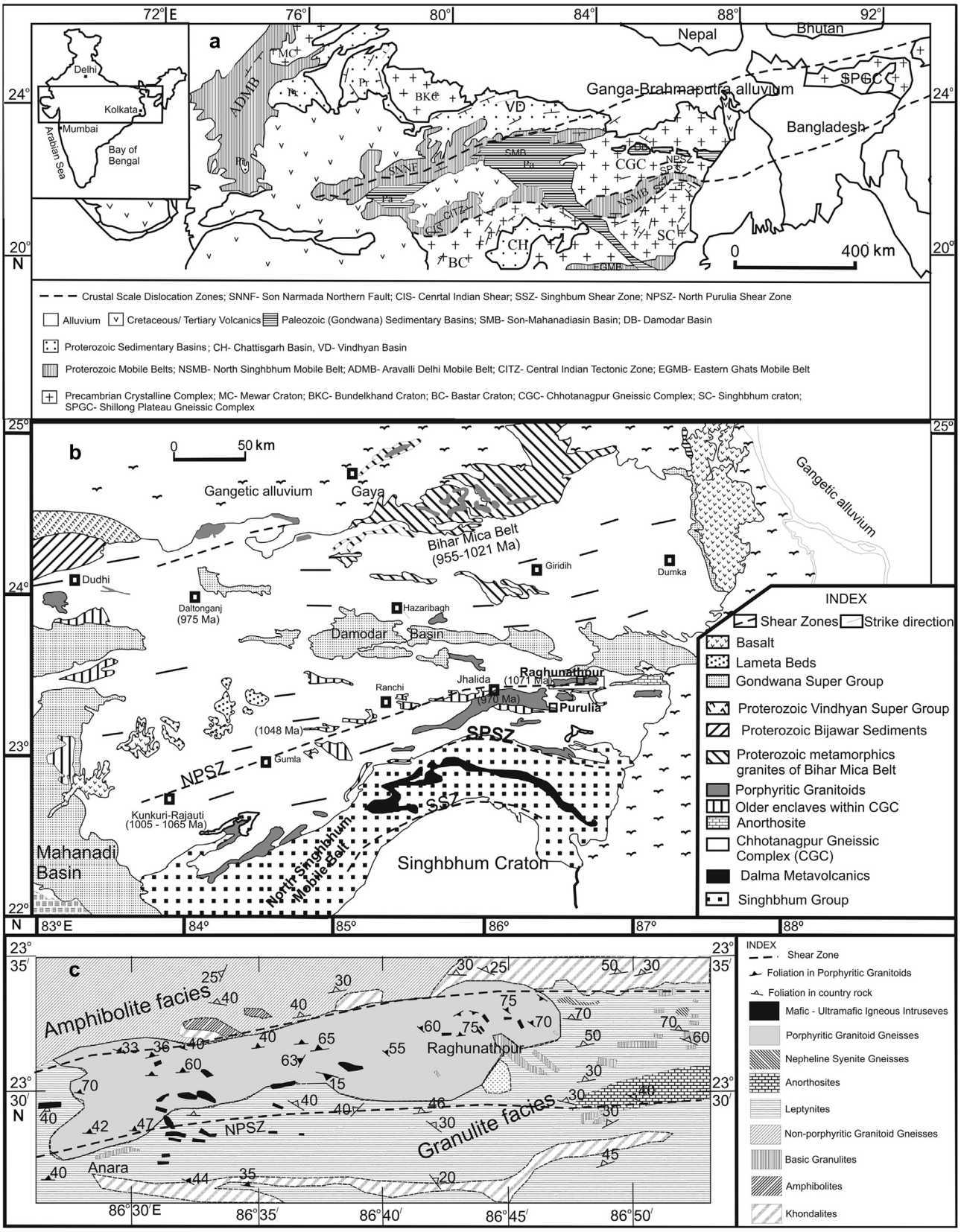

Figure 1. (a) 1500 km long E–W to ENE–WSW trending orogenic belt, comprising the Central Indian Tectonic Zone (CITZ), the Chhotanagpur Gneissic Complex (CGC)–North Singhbhum Mobile Belt (NSMB) and the Shillong Gneissic Complex (SGC). (b) Generalised geological map of the CGC showing the distribution of Archean–Proterozoic meta-sedimentary enclaves and granitic intrusives. Proterozoic Dalma lava in the Singhbhum mobile belt, the Cretaceous Rajmahal volcanics and Mesozoic Gondwana basins associated with the Damodar Graben are shown for reference. Distribution of Grenvillian dates of granite emplacements in the CGC is also shown (See Fig. 9 of Chatterjee and Ghose, 2011 for reference). (c) Simplified geological map of the area in and around Raghunathpur.