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LA-SF-ICP-MS zircon U–Pb geochronology of granitic rocks from the central Bundelkhand greenstone complex, Bundelkhand craton, India

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ABSTRACT

The central Bundelkhand greenstone complex in Bundelkhand craton, northern India is one of the well exposed Archaean supracrustal amphibolite, banded iron formation (BIF) and felsic volcanic rocks (FV) and associated with grey and pink porphyritic granite, tonalite–trondhjemite–granodiorite (TTG). Here we present high precision zircon U–Pb geochronological data for the pinkish porphyritic granites and TTG. The zircons from the grey-pinkish porphyritic granite show three different concordia ages of 2531 ± 21 Ma, 2516 ± 38 Ma, and 2514 ± 13 Ma, which are interpreted as the best estimate of the magmatic crystallization age for the studied granites. We also report the concordia age of 2669 ± 7.4 Ma for a trondhjemite gneiss sample, which is so far the youngest U–Pb geochronological data for a TTG rock suite in the Bundelkhand craton. This TTG formation at 2669 Ma is also more similar to Precambrian basement TTG gneisses of the Aravalli Craton of north western India and suggests that crust formation in the Bundelkhand Craton occurred in a similar time-frame to that recorded from the Aravalli craton of the North-western India.

1. Introduction

The genesis of continental crust started very early in the Earth's history, as demonstrated by the Hadean ages (4.4–4.0 Ga) of the Acasta gneisses of north-western Canada (Iizuka et al., 2006; Wilde et al., 2001; Zeh et al., 2014). This is the time when continental crust was first formed, but the development of this continental crust (i.e., growth rates and mechanisms) has changed through time. The end of the Archaean aeon was between 3.0 and 2.5 Ga. Prior to 2.5 Ga, most of the continental crust was formed which appears as the present-day continental material (Armstrong, 1981; Taylor and McLennan, 1985, 1995; Dhuime et al., 2011; Guitreau et al., 2014). The Archaean cratons reckon in a different variety of igneous rocks that record various tectonic indications, intrusive and extrusive magmatic crustal evolution, and various stages of metamorphism (Pearce, 2014).

The Indian Shield consists of two vital crustal blocks of Archaean cratons: a northern (Bundelkhand and Aravalli) crustal block and a southern (Dharwar, Singhbhum and Bastar) crustal block separated by the Central Indian Tectonic Zone (Fig. 1a; Naqvi and Rogers, 1987; Sharma and Rahman, 2000; Mondal et al., 2002; Rajesh et al., 2009; Ramakrishnan and Vaidyanadhan, 2010; Kaur et al., 2015). Naganjaneyulu and Santosh (2010) described the amalgamation of the continental fragments along this Central Indian Tectonic Zone as a complex collage of Archaean/Paleo-Mesoproterozoic subduction–accretion–collision tectonics between the Northern and Southern Indian crustal blocks. The Bundelkhand craton also preserves a crustal fragmented record of the Archaean (3.55–2.7 Ga) for tonalite–trondhjemite–granodiorite (TTG) to the Palaeoproterozoic (2.5–1.8 Ga) for several phases of granites, gabbros, and basaltic pillow lavas and komatiites (Sarkar et al., 1996; Mondal et al., 2002; Rao et al., 2005; Malviya et al., 2006; Kumar et al., 2010, 2013; Saha et al., 2011; Mohan et al., 2012; Pradhan et al., 2012; Joshi et al., 2013). The craton consists dominantly of 2.55–2.52 Ga granitic rocks (sanukitoids, high-K granites, diorites, granodiorites) and basic dike swarms (Mondal et al., 2002; Joshi et al., 2013; Kumar et al., 2013). Singh and Slabunov (2015a) had made the first attempt to describe the greenstone belts (GB) and their tectonic evolution, based on SHRIMP-dating of zircon from fel-

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sic volcanic rocks of the Babina greenstone belt in central part of the craton. They proposed a Neoarchean age (2542 ± 17 Ma) for the felsic volcanic rocks. The Neoarchean period is the peak period of continental crustal growth in Indian cratons (Naqvi, 2005).

Therefore in this work, we studied new U–Pb zircon ages for granitic rocks from central Bundelkhand greenstone complex to support prior findings of the Babina greenstone belt and to discuss its tectonic evolution during end of Neoarchean period.

2. Geological setting of Bundelkhand craton

The Bundelkhand craton occupies the north-central region of the Indian sub-continent, and is situated between 24°11′ to 26°27′N and 78°10′ to 81°24′E, covering about 26,000 km^2. It consists mainly of granitoids (Sarkar et al., 1996; Mondal et al., 2002; Kaur et al., 2014; Fig. 1a) of Archaean to Palaeoproterozoic age (Fig. 1b), with a few occurrences of supracrustal rocks and older crust (Basu, 1986, 2007; Kumar et al., 2010). It abuts against sedimentary cover of the Vindhyan Supergroup (Meso-Neoproterozoic; Fig. 1a) and small outcrops of low grade metamorphic rocks of the Bijawar Group (Paleoproterozoic; Fig. 1b) (Basu, 1986; Sarkar et al., 1996; Ramakrishnan and Vaidyanadhan, 2010). The Vindhyan Supergroup and Aravalli craton are demarcated by Great Boundary Fault on the western side. The rocks of the Gwalior and Bijawar Groups were deposited in marginal basins towards NW and SE of the Bundelkhand craton, respectively. The Bijawar Group and Vindhyan sediments are tectonically amalgamated with the central Indian Tectonic Zone. The Vindhyan sediments are also covered with Deccan traps in SW (Fig. 1a). Basu (1986) indicated that intrusive granites make up most of the craton, with scattered small enclaves, mainly of banded iron formation (BIF), metaultrabasics, rare quartzites, some carbonates, and calc-silicates. Small metabasic enclaves with sharp boundaries are common in intrusive porphyritic granites. Enclaves of pelitic rocks are rare in the craton. The northern part of the craton is covered with Indo-Gangetic Plain soils and Himalayan rocks (Fig. 1a; Sharma and Rahman, 2000; Mondal et al., 2002; Saha et al., 2011; and references therein). The central part of the Bundelkhand craton contains TTG, BIF, metabasites, felsic volcanics, pink granite, quartz reefs, and basic dykes (Fig. 2). A fragment of a greenstone belt was revealed in the central Bundelkhand craton near the town of Babina and can be traced further eastwards up to Mauranipur. In central Bundelkhand craton, the rocks of greenstone complex are exposed along the basement rocks which are essentially TTGs.

Recently, Singh and Slabunov (2015a) recognised two greenstone complexes in the Bundelkhand craton: (i) the central Bundelkhand (Babina-Mauranipur); and (ii) the Southern Bundelkhand (Girar). These complexes consist of metamorphosed ultrabasic and basic igneous rocks, banded iron-formations (BIF), multiple phases of felsic volcanic (FV) rocks in the central part and metasedimentary (supracrustal) rocks in the southern zone. In central Bundelkhand greenstone complex; the basalts, komatiites, and BIF are exposed in the Mauranipur greenstone belt which were formed in an ensimatic island-arc environment (Malviya et al., 2006). Two magmatic phases of felsic volcanics in the form of dykes are found in the Mauranipur greenstone belt (Singh and

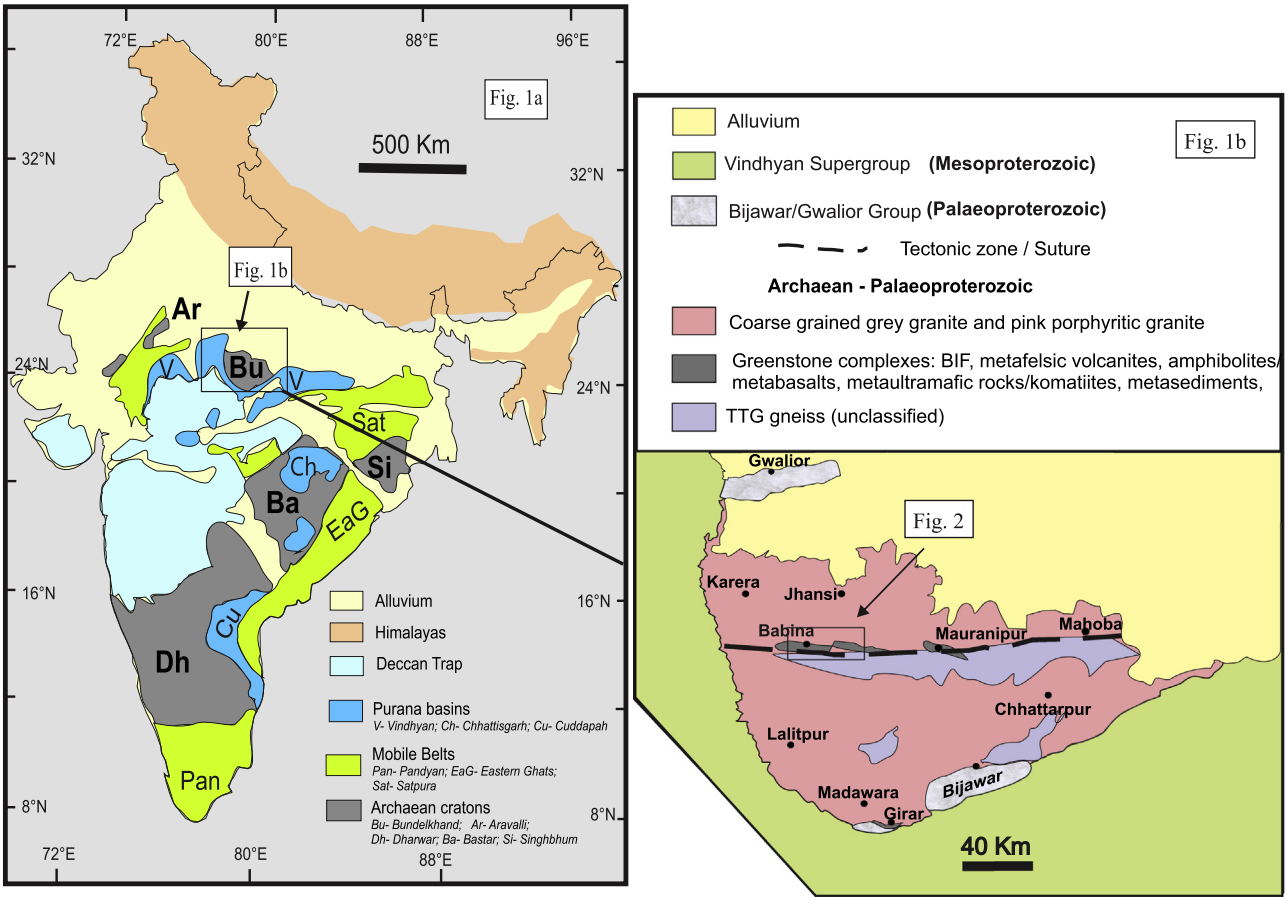

Fig. 1. (a and b) Geological map of India showing Archaean cratons and Tectonic Divisions and simplified map of Bundelkhand craton (after Malviya et al., 2006; Saha et al., 2011).