Geochronology and geochemistry of Palaeoarchean TTGs from the Singhbhum craton, India

S. CHATTOPADHYAY[1]*, D. UPADHYAY[1], E. E. SCHERER[2] AND K. MEZGER[3]

[1]Department of Geology and Geophysics, Indian Institute of Technology, Kharagpur, 721302 Kharagpur, India
(*correspondence: sabyasachi@gg.iitkgp.ernet.in) (dewashish@gg.iitkgp.ernet.in)
[2]Institut für Mineralogie, WWU Münster, Corrensstrasse 24, 48149 Münster, Germany (escherer@uni-muenster.de)
[3]Institute for Geology and Center for Space and Habitability, University of Bern, Baltzerstrasse 1+3 CH-3012 Bern, Switzerland (mezger@geo.unibe.che)

The Singhbhum Craton in eastern India hosts expansive Paleoarchean tonalite-trondhjemite-granodiorite (TTG) rocks which were emplaced in two pulses at 3.45-3.44 Ga and 3.35-3.32 Ga [1]. The granitoids underwent an early phase of high-grade metamorphism at 3.30-3.28 Ga followed by low-grade tectonothermal overprints at 3.19-3.12 Ga and 3.02-2.96 Ga [1], contemporaneous with the emplacement of potassic granitoids (e.g., the Mayurbhanj granite) [2].

The TTG suite mostly comprises trondhjemites and granites with moderate K_2O/Na_2O (0.19-1.57), relatively high Yb (0.26-1.4 ppm), Y (3.5-20 ppm), Nb (4.1-13 ppm), and Ta (0.30-2.1 ppm) concentrations and low La_N/Yb_N (6.5-72) and Sr/Y (3.1-87) ratios. On the basis of their trace element geochemistry, the majority of the rocks can be classified as low-P sodic type [3].

The TTG rocks have chondritic to moderately positive initial ε_{Nd} and ε_{Hf} values of 0.0-2.6 and 0.7-4.3, respectively, consistent with a juvenile source. The younger potassic Mayurbhanj granite, which has negative initial ε_{Nd} and ε_{Hf} values (ε_{Nd}: -2.7 to -3.4; ε_{Hf}: -2.7 to -5.2), was derived by melting of the Paleoarchean TTGs, indicating that the Archean crust in Singhbhum did not become thick enough to undergo intracrustal melting until ca. 3.1 Ga.

The low-P sodic TTGs are the products of shallow melting under a high geothermal gradient [4]. The large ion lithophile and light rare earth element-enriched nature of the Singhbhum TTGs may be explained by plume-induced partial melting at the base of an oceanic plateau [5].

[1] Upadhyay *et al.* (2014) *Prec. Res.* **252**, 180-190. [2] Misra *et al.* (1999) *Prec. Res.* **93**, 139-151. [3] Moyen (2011) *Lithos* **123**, 21-36. [4] Moyen & Martin (2012) *Lithos* **148**, 312-336. [5] Martin *et al.* (2014) *Lithos* **198-199**, 1-13.