

Geodynamic significance of Neoarchean Trondhjemite from Southern Bundelkhand Craton, North Central India and its implications

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The Neoarchean represents a pivotal period for the global expansion of continental crust. This work presents field investigation, petrography, whole-rock geochemistry, and SHRIMP U-Pb analysis of the Neoarchean TTGS and granites from the southern Bundelkhand Craton, North Central India. The trondhjemites are leucocratic/white and comprise plagioclase-feldspar, quartz, alkali-feldspar, and biotite in decreasing order of abundance. In contrast, the high-K granites exhibit a pink hue and consist of plagioclase-feldspar, alkali-feldspar, quartz, and biotite in descending order of prevalence. Apatite, epidote, sphene, and zircon are present as accessory minerals in both rock types. The SiO₂ and Al₂O₃ compositions in trondhjemite range between 67–70 wt.% and 14.09–14.32 wt.%, while in the granites they vary from 60–74 wt.% and 12–17 wt.%, respectively. The alkali oxides Na₂O and K₂O content in trondhjemite ranges from 4.19 to 4.68 wt. % and 2.67 to 3 wt. %, respectively, while in granite they range from 3.0 to 4.82 wt. % and 3.77 to 7.63 wt. .%, respectively. The trondhjemite and granites display negative anomalies in Nb, Ti, Eu, and Sr, alongside positive anomalies in Pb, Nd, and Th. The ΣREE content, (La/Yb)_n, and (Eu/Eu*) values range from 244 to 312 ppm, 18.26 to 67.14, and 0.53 to 0.87, respectively, in trondhjemite. In contrast, granites exhibit significant variability in ΣREE concentration, with values ranging from 42 to 972 ppm, (La/Yb)_n from 6.47 to 64.11, and (Eu/Eu*) from 0.36 to 1.26. U-Pb SHRIMP data indicates that the trondhjemite and granites are emplaced during late-Neoarchean crustal evolution at 2520 – 2540 Ma and 2516 – 2530 Ma. The geochemical findings suggest that trondhjemites originate from the partial melting of high-K mafic rocks. Conversely, granites are formed from a combination of magmas resulting from the partial melting of metasedimentary rocks and existing tonalitic rocks. The variation in composition is correlated with different source rock-melting, possibly in a convergent setting.