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Geochemistry and petrogenesis of Paleo-Proterozoic granitoids from Mahakoshal Supracrustal Belt (MSB), CITZ

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Voluminous granitic magmatism of Proterozoic age occupies a vast expanse at the southern margin of Mahakoshal Supracrustal Belt (MSB), CITZ. The present study focuses on eastern part of this belt and discusses possible crustal evolution processes based on the geochemical, geochronological and Sm-Nd isotopic constraints on these rocks. The rocks present are predominantly granites and gneisses viz. grey to pink granite gneiss and leuco- to mesocratic granites. In general these rocks are medium to coarse grained and microscopically show typical granitic assemblages with apatite, titanite, zircon and allanite as accessories. Mineralogically these rocks are grouped into three categories viz. Hbl-Bt granite gneiss, Bt- granite gneiss and Bt-granite.

Major oxide characteristics show that the Hbl-Bt granite Gneiss are metaluminous (ASI$\sim$0.98), whereas Bt- granite gneiss (ASI=1.05-1.22) and Bt- granite (ASI=1.03-1.21) are weakly peraluminous to strongly peraluminous. In terms of Fe* number and alkali-lime index these rocks belong to magnesian and calc-alkalic series respectively. Overall these rocks range from 59.43 to 72.01 wt.% SiO_2 and have low Na_2O content (average $\sim$2.60 wt.%) with average $\sim$4.02 wt.% K_2O and high K_2O/Na_2O ratio. On Harker variation diagrams, all rock types show negative correlation for TiO_2, P_2O_5, CaO, MnO, MgO, $Fe_2O_3^T$ and Al_2O_3 against SiO_2 suggesting fractionation of Pl-Hbl-Ttn-Mag-Ap during evolution of these rocks. On chondrite-normalized Rare Earth Element (REE) plot, the Bt-granite is enriched in LREE ($(La/Sm)_N$ $\sim$10.21) and show negative Eu anomaly (Eu/Eu*=0.39) with depleted HREE ($(Gd/Yb)_N$ $\sim$4.38). The Hbl-Bt granite gneiss shows LREE ($(La/Sm)_N$ $\sim$6.68) depletion and enriched HREE ($(Gd/Yb)_N$ $\sim$2.05) patterns compared to Bt-granite, with negative Eu anomaly (Eu/Eu*=0.44). Whereas Bt-gneiss is moderate in comparison with LREE enrichment ($(La/Sm)_N$ $\sim$9.17) and HREE depletion ($(Gd/Yb)_N$ $\sim$3.02) with weak negative Eu anomaly (Eu/Eu*=0.60). Multi-elemental plot shown for all rocks have positive U, Th and Pb anomalies and negative Nb and Ti anomalies, commonly interpreted as continental crust involvement in their genesis.

Sm-Nd analysis on two samples of Hbl-Bt granite gneiss show $^{143}Nd/^{144}Nd$ ratio ranges from 0.511384-0.511394 with a corresponding $^{147}Sm/^{144}Nd$ ratio of 0.118109–0.118762. The analyzed samples yield T_{DM} model ages of 2807-2804 Ma with present day ε_{Nd} values being negative, whereas the initial ε_{Nd} values (calculated at T_{DM} ages) are positive. The positive initial epsilon values indicate its derivation from depleted mantle source but this magma must have incorporated crustal material during their ascent and probably had a longer crustal residence time to have the observed evolved ε_{Nd}lower values. However $^{143}Nd/^{144}Nd$ ratios when compared with present day enriched mantle values of EM-I ($<$0.5112) and EM-II (0.5121) (Rollinson, 1993) indicate that the samples were derived from EM-I. This implies that their protoliths might have been derived originally from depleted mantle source before melting again as an enriched source within the crust. Although the age for all the rock types are not available, but as of now U-Pb ID-TIMS zircon date for Bt-granite gneiss shows a concordant age of 1873$\pm$13 Ma. The evolutionary relationship between gneisses and granites remain unclear and will hopefully be resolved by further U-Pb and Sm-Nd data.