Paper Number: 4401

Geochemical characterization and petrogenesis of Proterozoic Khairagarh Volcanics and the Sakoli Mobile Belt; Bastar Craton, Central Indian shield: implication for Precambrian crustal evolution

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The Bastar Craton in the Central Indian Shield comprises of Proterozoic supracrustal suites including the Sakoli and Kotri Dongargarh Mobile Belts. The Khairagarh volcano-sedimentary sequence is exposed in the east of the Sakoli Group and the southern part of the Central Indian Shear (CIS). The volcanic sequences are comprises of low-Ti, intermediate-Ti and high-Ti basalt–basaltic andesite series and High Magnesium andesite (HMA) type of rocks. The abundance of TiO_2 varies from 0.51 to 1.94 wt % for majority of the samples; HMA samples are unusually high in SiO_2 (54.21 to 59.97 wt %) as well as MgO (12.54 to 13.83 wt %) values. The LREE are enriched ~50 to 70 times, whereas the heavy rare earth elements are enriched ~15 to 30 times. The primitive mantle-normalized multi-element pattern shows enrichment of incompatible Large ion lithophile elements (LILE) and negative anomalies Nb, P, Ti and other High field strength elements (HFSE) such as Zr and Y indicating crustal influence. Based on the variable Ti, Si and Mg values the mafic volcanic samples shows co-genetic trends; however HMA samples plot separately indicating different magmatic trend. The Sakoli Group shows bimodal volcanic sequence which covers a stratigraphic position at the convergence of the Kotri Dongargarh Mobile Belt that runs north–south and falls parallel to the eastern margin of the Sakoli triangle. The bimodal volcanic rocks comprises of rhyolite, metabasalt, tuffs, epiclastic rocks with metapelites, quartzite, arkose, conglomerate, and Banded iron formation (BIF). The SiO_2 abundances of acid volcanics vary from 66.65 to 77.24 wt % and the mafic samples show lower SiO_2 range from 47.74 to 52.62 wt % indicating different type of magma genesis. Both the volcanics show similar geochemical trend in terms of enriched Light rare earth elements (LREE)–Large ion lithophile elements (LILE) such as Rb, Ba, Th, U, and K whereas Ba displays a slight negative anomaly. The consistent negative Eu anomaly in the REE patterns indicates involvement of feldspar fractionation. The εNd_t (t = 2000 Ma) varies between -0.19 and +2.22 for the basic volcanic rock and between -2.85 and -4.29 for the acidic volcanic rocks. The Khairagarh volcanics εNd_t (t = 2000 Ma) varies between −4.81 to 1.48, suggesting derivation of most of these rocks from a near chondritic to enriched mantle source have a longer crustal residence. Depleted mantle model ages for the Sakoli mafic volcanics and the Khairagarh volcanics indicate near contemporary ages varies from 2000 to 2275 Ma and 2489 to 2984 Ma respectively. It suggests possible similar sources and the time of extraction of their protolith for both the volcanic sequences in the Bastar Craton. The mantle extraction age of about 2.9 to 2.5 Ga, based on the Nd-model ages for the Khairagarh– Sakoli sequence, indicate the possibility of the Central Indian Shield was being a part of the Columbia Supercontinent. The near relation of Supercontinent Ur is also indicated by a relatively thick crust around 3.6 Ga in the Bastar Craton and the Amgaon Gneissic Complex, forming basement for the Khairagarh–Sakoli Proterozoic supracrustal belts.