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Petrogenetic and geochemical constraints of high-Mg Granitoids from Bundelkhand craton, central India

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High Mg-granitoids are widely distributed on Earth. The series of these rocks are found in many Archaean cratons and are emplaced in late- to post-kinematic settings, sometimes in association with felsic alkaline magmatism, like in the Archaean-Proterozoic Bundelkhand craton, which is a multi-phased granitoid batholith in central India. The geochemically diverse crustal growth and secular evolution of the granitoids in the complex ranges from emplacement of sodium-rich TTGs produced from metabasaltic material after which, there was a fundamental change in the geodynamics in the area due to variable sources with inputs from mantle-derived material and recycled crustal lithologies. This sudden appearance of compositionally different granitoids, constituting calc alkaline granitoids, variety of plutonic rocks derived from enriched mantle with high Mg (e.g. sanukitoids) as well as crustal sources (intracustal granites) [1], mark the late-Archaean evolution in the region (3.3-2.5 Ga). Geochemical and age data from Bundelkhand suggests that TTGs were progressively replaced by a great variety of granitoids and finally to stabilization of crust at ~2.5Ga.

Examination of the geochemical database of high-Mg granitoids provides their compositional range from diorites to granodiorites with SiO_2 (49.29 - 71.45 wt.%), K_2O+Na_2O (3.11-8.37 wt.%), MgO (0.54-5.48 wt.%), Fe_2O_3 (1.73-11.85 wt.%) and Al_2O_3 (14.22-16.75 wt.%). They are subalkaline granitoids and dominantly show magnesian character with Mg# (31-62), Ni (~5.25ppm) and Cr (~173.07ppm). They have higher concentrations of incompatible elements and high LILE concentrations (Ba: 111-1070 ppm, Sr: 208-585 ppm, K_2O: 0.46-4.87 wt%). They follow a classical calc-alkaline differentiation trend on the AFM diagram [2].

The diorites have chondrite-normalized REE patterns enriched in LREE [(La/Yb)n = (12.66-25.28)] with negative Eu anomalies. This character indicates that the depth of melting is at a deeper level with some mantle input. Their primitive mantle normalized spidergram patterns are characterized by depletion of HFSE marked by negative Nb, P and Ti anomalies and positive Pb anomaly. Other Archaean high-Mg granodiorites are believed to be derived via partial melting of subducted oceanic crust. In conclusion, the Bundelkhand craton grew intensively due to a new type of tectono-magmatic event near the Archaean-Proterozoic boundary. Thus, understating the origin of these rocks is needed to unravel the crustal evolution of the region even if they are a minor component of the batholith.

References:

[1] Heilimo and Halla (2010), Lithos 115 (2010): 27-39.

[2] Irvine and Baragar (1971), A guide to the chemical classification of the common volcanic rocks. Can. Jour. Earth Sci. 8, 523-548.