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Komatiite from Mesoarchaean Badampahar-Gorumahisani greentone belt, Singhbhum craton, eastern India: Petrogenetic affinity with 'Barberton type'

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Komatiites are ultramagnesian (MgO > 18%), extrusive, rare ultramafic rocks formed commonly during Archaean and seldom in Proterozoic and Phanerozoic. Study of komatiites has created enormous interest and attention of many researchers, particularly for understanding mantle geodynamics and evolution of the continental crust. Following the recognition of these primitive rocks within the famous 3.5 Ga old Barberton greenstone belt (Kaapvaal craton, South Africa) from their type locality along the Komati River, reports of komatiites are available from many other Archaean greenstone belts of the world viz., Commondale, South Africa, 3.3 Ga; Ball, Canada, 2.9 Ga; Munro, Canada, 2.7 Ga; and Tisdale, Canada, 2.7 Ga. In Indian subcontinent, spinifex textured Archaean komatiites are mostly reported from the Dharwar craton, besides few occurrences in the Singhbhum craton. The present study documents the field, petrographic and geochemical data of komatiite, reported near Kapili, in the Mesoarchaean Badampahar-Gorumahisani Greenstone Belt (BGGB), Singhbhum craton, eastern India.

The BGGB is a ~120 km long arcuate belt with maximum width of 10 km, comprising bimodal volcano-sedimentary sequence associated with minor spinifex textured peridotitic komatiite (STPK). Field evidences such as pillow structures in mafic metavolcanics are attributed to subaqueous extrusion of the lava. The STPK at Kapili (~800 m X ~500 m) occurs concordantly with metamorphosed mafic and ultramafic rocks. It displays well preserved cumulate zone, platy and random spinifex zone. The cumulate zone is characterised by prominent cooling cracks and fractures filled with secondary talc-serpentine. Platy and random spinifex zones are respectively characterised by parallel arrangement of olivine plates and criss-cross arrangement of olivine needles, ranging in size from 1 cm to 10 cm in length and 0.5 mm to 2 mm in width.

Petrographic study reveals that primary mineralogy is altered due to metamorphism under greenschist to lower amphibolite facies. Spinifex texture is exhibited by network of acicular primary minerals like olivine and pyroxenes, which are altered to serpentine, tremolite, chlorite and secondary magnetite at places. Olivines are rich in magnesium (X_{Mg}: 0.72 - 0.95 in upper random spinifex zone and 0.78 - 0.88 in lower platy spinifex zone). The high compositional range in X_{Mg} is attributed to differential alteration of olivine to serpentine. The cumulate texture is defined by olivine (X_{Mg}: 0.78 to 0.95) pseudomorphs replaced by serpentine (mostly antigorite) and secondary magnetite, whereas, the inter-cumulus space is occupied by tremolite, augite, enstatite, chlorite, serpentine and secondary magnetite. Besides, mesh texture is also typical of this zone, formed due to the breakdown of olivine into a felty mass of serpentine and secondary magnetite.

Major, trace and REE data of Kapili komatiite suggest that most of the primary geochemical features are preserved with minor influence of post-magmatic alteration and contamination. The komatiites are quite enriched in SiO_2 (38.48 - 47.79 wt %) and MgO (20.62 - 36.87 wt %); depleted in Al_2O_3 (2.51 - 6.75 wt %) and TiO_2 (0.21 - 0.57 wt %) with significantly higher Al_2O_3/TiO_2 (8 - 30), CaO/Al_2O_3 (0.73 - 1.82),

Sm/Nd (0.27 - 0.34), $(Gd/Yb)_N$ (0.79 - 2.65), $(La/Yb)_N$ (1.18 - 2.59), $(Sm/Yb)_N$ (0.82 - 2.70), $(La/Sm)_N$ (0.72 - 0.99) and $(Zr/Sm)_{PM}$ (0.36 - 2.01) ratios indicating resemblance with the Barberton type komatiites. These elemental characteristics indicate derivation of komatiitic magma in a mantle plume geodynamic setting during the Mesoarchean in the Singhbhum craton with moderate contamination by continental crust and/or sub-continental lithosphere.