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Evidence of enriched mantle in the Archaean beneath eastern Indian Singhbhum Craton: constraints from geochemistry and Sr-Nd isotopic studies of mafic-ultramafic rocks from Bangriposi, Orissa, India

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Mafic-ultramafic rocks around Bangriposi (22° 9' N; 86° 32' E) are found to have been emplaced within poly-deformed metasedimentary rocks of Singhbhum Group, belonging to the North Singhbhum Mobile Belt (NSMB) assemblage. Recent studies have assessed Mesoarchaean (∼3.09 Ga) age of these rocks and categorized the ultramafic unit as ultrahigh-pressure obducted bodies. The rocks are exposed mainly in two separate locations- Layered gabbroic rocks are found in an area SE of Bangriposi, and a well foliated, N-S trending Cr-spinel bearing wehrlite body is found S of Bangriposi. The gabbroic body (dubbed as "Kuliana Gabbro") is modally layered, contains plagioclase, clinopyroxene and orthopyroxene, and shows petrographic evidence of adcumulus growth and textural coarsening mechanisms. Cr-spinel bearing wehrlite rocks are highly serpentinized, containing serpentinized olivine, clinopyroxene, phlogopite, Cr-spinel, magnetite, and displays textural evidence of tectonic deformation. Geochemically, the Kuliana gabbro shows effects of fractional crystallization, and has relatively unfractionated REE patterns. The ultramafic rocks have high LOI contents (8- 9.3 wt%), with low Mg# (0.72- 0.77), and LREE enriched REE patterns. Parental melt calculations of the Kuliana Gabbro rocks have yielded an enriched-MORB like liquid, a product of low degree partial melting (8- 30%) in garnet facies. Cr-spinel bearing wehrlite rocks on the other hand exhibit ample evidences of modal and cryptic metasomatism in the mantle depth. Presence of phlogopite, diopside as reaction rims around serpentinized olivine, lack of primary orthopyroxene and presence of apatite are considered effects of modal metasomatism. Elevated LREE contents define cryptic metasomatism, which is also conspicuously visible in LREE enriched patterns of clinopyroxene separates from wehrlite. The metasomatism in the mantle may be due to multiple events involving separate melts or a single event of re-fertilization by interaction with an alkali-carbonatite melt. Enriched nature of the mantle region is also revealed in the highly negative εNd (T) values (-2.5 to -16.6), low initial 143Nd/144Nd (0.507895- 0.508615), and high but variable initial 87Sr/ 86Sr (0.7025- 0.7232). Calculated 147Sm/ 144Nd of the source region of the gabbroic rocks (0.1869; 5% less than CHUR) corroborate with enriched nature and the Fractionation Factor (α) of 1.05 corresponds with melting from a garnet bearing source region. Depleted mantle model age (TDM) calculations of the mafic-ultramafic rocks yield a span of 3.6- 5.6 Ga. Lack of Nb-Ta anomaly and complete absence of any field evidence of emplacement in a liquid state (Chilled margins, feeder dykes) in both cases precludes enrichment due to crustal contamination. Overall it can be stated that, these mafic-ultramafic rocks represent tectonic slices of ancient oceanic crust and enriched lithospheric mantle, together constituting a partly preserved ophiolite complex from eastern India.