Origin of granitoids of the Kerala Khondalite Belt, southern India: Biotite as potential tectonomagmatic indicator

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The Kerala Khondalite Belt (KKB) is a Proterozoic mobile belt of the southern Indian granulite terrain. Dominant rock types (except sillimanite-bearing gneisses) are classified as sodic (tonalite-trondhjemite) and potassic (granite-granodiorite) granitoids and a general supracrustal origin is ascribed to these rocks. Composition of biotites from different groups of granitoids (variants of gneiss and charnockites) serves as a potential indicator of nature of the magma and the physical conditions of crystallization vis-à-vis their igneous parentage.

Biotites preserve primary igneous composition with primary magmatic characteristics [1]. Biotites from sodic group are Mg^{2+}–rich (X_{Mg}:0.47–0.63) in contrast to those from potassic groups, which are Fe^{2+}–types with much lower X_{Mg} (0.37–0.44). Biotites from the sodic group denote calc-alkaline host, whereas the potassic group an alkaline host [2]. Biotites in potassic group are poorer in $A1_2O_3$ than sodic, indicating evolved nature of the magmatic protolith. Prominent decrease in ΣAl with increasing Fe/(Fe+Mg) values of biotites indicate progressive oxidising condition during magma evolution. Potassic group define compositions with oxygen fugacity (fO_2) slightly higher than Ni-NiO buffer, indicating moderately oxidising conditions, while the sodic groups suggest fO_2 between QFM and Ni-NiO buffer, closely following that for the Ni-NiO, implying fairly reducing conditions during crystallization [3]. Compositional variation of biotite allow us to speculate the nature of the host magmas of sodic charnockites as calc-alkaline, arc-type with features typical of Archaean TTGs and potassic groups as partial melts of meta-igneous lower crust with little mantle contribution. The new mineral data integrated in a petrogenetic model indicate that the lower crust of KKB formed in an arc-accretion setting.

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Fe isotope composition of manganese nodules from the Central Indian Basin

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Iron cycling in the ocean has received attention as it is being one of the important limiting nutrients. The iron isotope compostions (δ^{56}Fe) of deep ocean Fe-Mn oxides were used to show the influence of terrigenous input [3], hydrothermal sources [1] and large variations in global ocean [2]. Fe isotope compositions of Fe-Mn oxides also record provinciality suggesting complex iron cyling (Chu *et al*. [1]). In this study, we report Fe isotope compositions of 16 nodule and 2 crust samples from the Central Indian Basin (CIB), which is the second largest and richest oceanic manganese nodule zone. The Fe isotope measurements have been carried out on the outer scrapings of these nodules to represent the variations pertaining to the most recent oxide accumulation. Samples are drawn from > 4500 m depth. Fe isotope measurments were performed on Nu MC-ICP-MS HR instrument (at NGRI, India) in pseudo-high resolution mode adopting standard-sample bracketing method with IRMM-014 as the reference material. Long term average of IRMM 014 is found to be -0.006±0.079 ‰ (1σ). All the Fe isotope compositions are reported against IRMM-014.

The δ^{56}Fe values of the nodules and crusts of the CIB show a large range from -0.63 to -0.06 ‰ indicating marked provinciality. The δ^{56}Fe values show positive correlation with their Mn/Fe ratios measured on the same fractions indicating diagenetic/hydrothermal source. Some of the nodules are characterized by very high Mn/Fe ratios (> 9), with the sample showing maximum δ^{56}Fe value (-0.06 ‰) having highest Mn/Fe (26) as well. These nodules with high Mn/Fe ratios may indicate influences of crustal fluids. The samples show strong positive Ce anomalies and fractionated chondrite normalized REE patterns. The average δ^{56}Fe value of CIB nodules seems to be enriched in heavier iron isotope when compared to those from the Pacific and Antarctic.

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