Tectonomagmatic Evolution of the Continental Lithosphere of Bastar Craton of Indian Shield: Evidence from Geochemistry of the Neoarchaean-paleoproterozoic Volcano-sedimentary Rocks of Sonakhan Greenstone Belt

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The Sonakhan greenstone belt of Neoarchaean-Paleoproterozoic age of Bastar craton of the central Indian shield comprises volcano-sedimentary rocks. Geochemical studies of the volcanic rocks have revealed that the rocks belong to two distinct tectono-magmatic associations: (1) the lower unit consists of rocks of basaltic composition having ocean plateau association and (2) the upper unit rocks consist of basalt-andesite-dacite-rhyolite series having island arc associations. The geochemical characteristics of the ocean plateau basalts include near flat rare earth element patterns, tholeiitic nature with depletion in highly incompatible elements, Nb-maxima (Nb/Nb* = 0.93-1.48, relative to Th and La) and those of the island arc associations include light rare earth element enrichment patterns, enrichment in highly incompatible elements, large negative high field strength element anomalies and depletion of Nb (Nb/Nb* = 0.10-0.68) relative to Th and La.

The sedimentary rocks which are mainly clastic in nature unconformably overlie the volcanic rocks. Detrital modes of the clastic rocks reveal that the sediments were derived from volcanic arc. Numerical modeling has been done to know the source composition of the clastic rocks. It is observed that the source of the sediments is a mixed one having abundant mafic and subordinate felsic components (70 % basaltic rocks and 30 % felsic rocks). Our study has also revealed that lower unit oceanic plateau basalt has not contributed detritus to the Sonakhan clastic rocks, whereas the upper unit island arc basalt and the felsic rocks have shed the sediments for the Sonakhan clastics. This study also highlights the caution that should be taken to delineate provenance of clastic rocks using classical paleocurrent analysis, as both the lower unit and upper unit basalts are spatially related without any unconformity in between them.

It is proposed that the Sonakhan greenstone belt initiated with the formation of an oceanic plateau which served as a base for subduction of oceanic crust at its margin producing subduction-related mafic and felsic melts in an island arc setting. This island arc shed sediments for the clastics. Our study reveals that Sonakhan greenstone belt vis-a vis Bastar craton evolved by accretion and amalgamation of oceanic plateau and ocean island arcs against the older continental crust.