GEOCHEMISTRY OF CLASTIC SEDIMENTARY ROCKS IN PARTS OF PALAEOPROTEROZOIC ALWAR BASIN, NORTHEASTERN RAJASTHAN

ABSTRACT OF THE THESIS

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ABSTRACT

The Aravalli craton comprising north western part of the Indian shield, is marked by the presence of ~800 km long NE-SW trending Aravalli mountain belt or ADFB. In this region the Archaean basement, referred to as the Banded Gneissic Complex (BGC), is overlain by numerous Proterozoic cover sequences belonging to the older Aravalli and younger Delhi supergroups. The northern part of ADFB, referred to as North Delhi Fold Belt (NDFB) is broadly constituted by three basins, which are from east to west: the Bayana basin, the Alwar basin and the Khetri basin. The volcano-sedimentary infill of these basins has been classified into Alwar and Ajabgarh Groups in each basin. In these basins, the sedimentary rock sequences are excellently preserved and stratigraphically well defined, thus are most suited for Proterozoic crustal evolution and palaeoclimatic studies.

The Alwar basin, occurring in the central part of NDFB, contains ~6000 m thick package of volcanic and sedimentary rocks comprising eleven formations. The lower most three formations are included in Raialo Group, overlying four formations in Alwar Group and the upper most four formations in Ajabgarh Group

The present study, is the first, to reports major and trace elements (including REE) compositions of clastic sedimentary rocks from the Alwar basin (~1800 Ma). Our aims are to report and utilize the geochemical data of the quartzites (meta-arenites) and metapelites of the Alwar basin (i) to constrain the composition of the source terrain, its weathering history and the tectonic setting at the time of their deposition and implication for continent assembly (ii) To examine the applicability of geochemical data in interpreting the nature of continental crust particularly during

Archaean and Proterozoic time and the implications of these data for evolutionary trends of early crust in northern part of Indian shield .

Geochemical data comprising major, trace and rare earth elements of 28 samples of quartzite, and 24 samples of metapelites from various formations of Delhi Supergroup of the Alwar Basin are presented. These data in combination with petrography are used to achieve the aims and objectives.

The Petrographic analysis suggests that the sediments of Delhi Supergroup of the Alwar basin were derived from relatively low – lying granitoids and gneissic sources, supplemented by recycled sands from associated pre-existing sediments of Archaean age. Geochemically, almost all the quartzite samples of the Alwar basin, comes under the category of quartz arenite (SiO_2 = 80-88 %, Al_2O_3 = 4-9 %, Fe_2O_3 = 0.04-7.7 %, CaO = 0.09-0.2510 % and Na_2O = 0.02-0.32 %). All samples have high SiO_2/Al_2O_3 ratio (6.05-319.67; avg. 56.94) which indicates high maturity, a feature consistent with petrographical results. In comparison with AUCC all the rock formations of Alwar basin are characterized by strong depletion in mobile elements such as CaO, Na_2O and Sr indicating high degree of weathering in the source area. In general the REE patterns of our samples of quartzite and metapelites are highly fractionated with $(La/Yb)_n$ = ~1- 51.25. Apart from few anomalous samples, the Alwar basin clastic sedimentary rocks are characterized by significant enrichment in LREEs, the distinctive negative anomalies, and flat HREE patterns. However, the quartzites of Alwar Group are more enriched in REE particularly in LREE and MREE relative to quartzites of Ajabgarh Group. Similarly the metapelites of Alwar Group are more enriched in LREE but the MREE and HREE of the two groups remain same. No systematic differences in the REE patterns among different stratigraphic

units are observed. However, $(La/Yb)_n$ ratio appears to show a stratigraphic control as it decreases with decreasing age.

The depletion of most mobile elements such as Ca, Na, Sr, values of CIA, PIA, CIW and Th/U ratios and A-CN-K diagram of Alwar basin clastic rocks suggest that the upper crust suffered variable degree of Chemical weathering at the time of their deposition. The weathering conditions, as indicated by clastic rocks of the Alwar basin is in conformity with worldwide humid and warm climate during the Palaeoproterozoic period. The geochemical data suggest that the quartzites were deposited in an oxygenated transgressive beach environment and the metapelites under anoxic conditions probably in a costal complex environment including lagoonal basins.

Various discrimination diagrams, involving major elements such as TiO_2 - Zr, TiO_2 - Al_2O_3 plots and immobile trace elements such as La, Sc, Th, Cr and their ratios such as Th/Sc, Cr/Th and Eu/Eu*, all suggest the dominance of felsic rocks in the source terrain of the sedimentary fill of the Alwar basin. These diagrams also suggest variable contribution from Berach Granite, TTG and mafic enclaves of Archaean Banded Gneissic Complex (BGC). Provenance modeling based on REE pattern, immobile element ratios, and multi-element patterns the source area of Alwar basin sediments was consisted of 50 % Berach granite, 30 % TTG gneisses and 20 % mafic enclaves of the BGC.

SiO_2-K_2O/Na_2O, Na_2O-CaO-K_2O, Th-Sc-Zr/10, Ti/Zr vs. La/Sc discrimination diagrams suggest a continental rift setting for the Alwar basin. Our geochemical data in combination with available information on geochemistry and geochronology of the mafic volcanic rocks of NDFB suggest that Alwar basin originated as as a continental rift at the margin of the BGC craton at about 1832 Ma back. This event appears to

represents an important extensional regime that triggered the commencement of dispersion of earth's first super continent which amalgamated at ~2.4 Ga involving cratons of South Australia, East Antarctica, India and North China.

The geochemical data of Alwar basin clastic sedimentary rocks generated during present study, in combination with available geochemical data of about 2800 Ma old Achaeans quartzite and about 1600 Ma old Vindhyan sandstones of the Aravalli Craton suggest that the compositional change of upper crust at Archaean-Proterozoic Boundary (APB) in Aravalli craton is characterized by evolution from TTG dominated crust of Mesoarchaean to a granitic crust during the Palaeoproterozoic.