

## LIST OF FIGURES

Figures	Page No.
<b>Figure 1</b> Map showing distribution of continents in Gondwana assembly (Gray et al., 2007; Meert and Lieberman, 2008).	2
<b>Figure 2</b> Sketch map showing linear Tectonic Zones in Aravalli-Delhi Orogenic Belt and Proterozoic sedimentary basins of surrounding area (After Sen 1980, 1981).	4
<b>Figure 1.1</b> Map of India showing tectonic architecture of the Indian shield. Note that a major tectonic zone referred to as Central Indian Tectonic Zone (CITZ) marks a tectonic boundary between the Northern (NIC) and Southern (SIC) parts of the shield. NIC – North Indian Craton, SIC = South Indian Craton. Great boundary fault separates the Aravalli and Bundelkhand blocks of NIC.	14
<b>Figure 1.2</b> Geological map of Aravalli Craton showing distribution of Aravalli – Delhi Supracrustals sequences, large sedimentary basins, and basement complex (After Roy 1988).	15
<b>Figure 1.3</b> Generalised Geological map of of Rajgarh area, northeastern Rajasthan. 1. Pre – Delhi Basement 2. Dogeta Formation (Marble Withlenses of Quartzite) 3. Serrate Quartzite 4. Tehla Formation (A. Volcanic B. Quartzite C. Schist), 5. Rajgarh Formation (A. Conglomerate, B. Quartzite) 6. Kankwarhi Formation, 7. Pratapgarh Formation, (A. Quartzite, B. Schist) 8. Kushalgarh Formation 9. Seriska Formation 10. Thanagazi Formation, 11. Bharkol Formation, 12. Aravali-Mandhan.	23
<b>Figure 1.4</b> Field Photograph of Large scale planer cross-stratification near Nagarbora village, Pinan, Rajgarh.	28
<b>Figure 1.5</b> Field Photograph of Large scale trough-cross stratification at Doroli village near Machari Rajgarh.	28
<b>Figure 1.6</b> Field Photograph of Symmetrical ripple marks near Machari, Rajgarh.	29
<b>Figure 1.7</b> Field Photograph of Asymmetrical ripple marks near Machari, Rajgarh.	29
<b>Figure 1.8</b> Field Photograph of Trough cross stratification in Rajgarh quartzite, near Almoda.	30
<b>Figure 1.9</b> Field Photograph of Planner cross strtficationm in in Pratapgarh quartzite, near Khori lakharni.	30

<b>Figure 2.1</b>	Microphotographs of A- Monocrystalline quartz grains, B- Biotite C- Feldspar grain, D- Tourmaline, E- Zircon.	40
<b>Figure 2.2</b>	Classification of Alwar Formation Sandstone, according to Dickinson (1985).	42
<b>Figure 2.3</b>	Classification of Alwar Formation Sandstone, according to Dickinson (1985).	42
<b>Figure 2.4</b>	Classification of Alwar Formation Sandstone, according to Dickinson (1985).	43
<b>Figure 4.1</b>	Chondrite- normalized REE patterns of quartzites of Delhi Supergroup from Alwar basin showing negative Eu-anomalies (A and B) and positive Eu-anomalies (C). Normalizing values after Sun and McDonough, (1989). Samples are plotted in A and B to avoid crowding.	62
<b>Figure 4.2</b>	Chondrite- normalized REE patterns of metapelites of Delhi Supergroup from Alwar basin showing negative Eu-anomalies (A and B) and positive or no Eu-anomalies (C). Normalizing values after Sun and McDonough (1989). Samples are plotted in A and B to avoid crowding.	66
<b>Figure 4.3</b>	Chondrite- normalized REE patterns of avg. Alwar quartzites compared with avg. Ajabgarh quartzites of Delhi Supergroup, Alwar basin. Normalizing value after Sun and McDonough (1989).	67
<b>Figure 4.4</b>	Average upper continental crust (UCC) - normalized multielement spidergrams of quartzites (A) and metapelites (B) of Delhi Supergroup of the Alwar basin. Normalizing values after Taylor and McLennan (1985).	70
<b>Figure 4.5</b>	Average upper continental crust (UCC) - normalized multielement spidergrams of avg. quartzites and avg. metapelites of different formations of Delhi Supergroup of the Alwar basin. Normalizing values after Taylor and McLennan (1985).	72
<b>Figure 4.6</b>	Average upper continental crust (UCC) - normalized multielement spidergrams of (A) avg. Alwar Group quartzites compared with avg. Ajabgarh Group quartzites (B) avg. Alwar Group metapelites compared with avg. Ajabgarh Group metapelites of Delhi Supergroup and (C) avg. Alwar basin quartzites compared with average Alwar basin metapelites. Normalizing values after Taylor and McLennan (1985).	73
<b>Figure 4.7</b>	Chondrite -normalized REE patterns of (A) avg. Alwar Group quartzites compared with avg. Ajabgarh Group	75

quartzites (B) avg. Alwar Group metapelites compared with avg. Ajabgarh Group metapelites of Delhi Supergroup and (C) avg. Alwar Group quartzites, avg. Ajabgarh Group quartzites, avg. Alwar Group metapelites and avg. Ajabgarh metapelites compared with that of PAAS. Normalizing values after Taylor and McLennan (1985).

- Figure 4.8** Average chondrite- normalized REE patterns of different formations of Delhi Supergroup of the Alwar basin. 76
- Figure 4.9** Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub> graph showing Alwar basin quartzites and metapelites. Note, the data define smooth graph and the sediments can be considered as the product of mixing of quartz and illite. 81
- Figure 5.1** Th/Sc vs. Zr/Sc plot for quartzites and metapelites of Delhi Supergroup of Alwar basin (after McLennan et al., 1993). 100
- Figure 5.2** A-CN-K (in molecular proportion) ternary plot (Nesbitt and Young, 1984) for metasedimentary rocks of Delhi Supergroup, of the Alwar basin. CaO\* is the silicate fraction of rocks. Nos. 1 to 6 denote Compositional trend of initial weathering profile of various rock types, 1- Gabbro, 2- Tonalite, 3- Diorite, 4- granodiorite, 5- Granite and 6- compositional trend for advance weathering profile. 105
- Figure 5.3** AK-C-N (in molecular proportion) ternary plot (Fedo et al., 1995) for KCB elastics.  $PIA = [(Al_2O_3 - K_2O)/(Al_2O_3 + CaO - NaO - K_2O)] \times 100$ . An (Anorthite), Ab (Albite), Og (Oligoclase), Ad (Andesine). 110
- Figure 5.4** Th/U- Th plot (Gu et al., 2002) of metasedimentary rocks of Delhi Supergroup from Alwar basin. 112
- Figure 6.1** Discriminant function diagram (Roser and Korsch, 1988) showing plots of clastic sedimentary rocks Alwar basin. Most of quartzites are lying in the field of P4 and metapelites in P3 and P4 suggesting their derivation from granitic – gneissic or sedimentary source area.  $F1 = (-1.773TiO_2 + 0.607Al_2O_3 + 0.76(Fe_2O_3)^{1-} - 1.5MgO + 0.616CaO + 0.509Na_2O - 1.224K_2O - 9.09)$  and  $F2 = (0.445TiO_2 + 0.07Al_2O_3 - 0.25(Fe_2O_3)^{1-} - 1.142MgO + 0.438CaO + 1.475Na_2O + 1.426K_2O - 6.861)$ . P1= Mafic igneous provenance, P1= Intermediate provenance, P3= Felsic igneous provenance, P4= Quartzose sedimentary provenance. 122
- Figure 6.2** TiO<sub>2</sub>-Zr plot of quartzites and metapelites of Alwar basin. Fields of various rock types after Hayashi et al., (1997). 122

<b>Figure 6.3</b>	TiO <sub>2</sub> versus Al <sub>2</sub> O <sub>3</sub> plot for sedimentary rocks of Alwar basin. The 'Granite line', Granodiorite and the '3 Granite +1 basalt line' are from Schieber (1992).	123
<b>Figure 6.4</b>	La-Th plot of shales and sandstone of Delhi Supergroup of the Alwar basin. Fields of PAAS and Archaean sediments after McLennan et al.,(1980).	126
<b>Figure 6.5</b>	Th/Sc versus Cr/Th plot (after Totten et al., 2000) for clastic sedimentary rocks of Alwar basin. Most of the samples fall near granitic component. For reference the data of BGC basement end members are also plotted as BG = Berach Granite, (Raza et al., 2010b) T = TTG gneisses (Martin et al., 2005) and M = Mafic Enclaves (Ahmad and Tarney 1994).	130
<b>Figure 6.6</b>	La/Sc vs. Sc/Th plot for quartzites and metapelites of Delhi Supergroup of Alwar basin. For reference the data of BGC end members are also plotted. TTG (T), Berach Granite (BG) and Mafic rocks (M) (Data sources as in Figure 6.5).	130
<b>Figure 6.7</b>	Th/Sc vs. Sc plot of quartzites and metapelites of Delhi Supergroup of Alwar basin. For reference the data of BGC end members are also plotted. TTG (T), Berach Granite (BG) and Mafic rocks (M) (Data sources as in Figure 6.5).	131
<b>Figure 6.8</b>	La-Th-Sc ternary plot for clastic sedimentary rocks of Alwar basin. For reference the TTG (T), Granite (G) and mafic (M) end members of BGC are plotted. (Data sources as in Figure 6.5).	131
<b>Figure 6.9</b>	REE patterns of average Alwar basin clastics (Mixture of 70 % pelites and 30% quartzite) and estimated provenance after mixing the end members in the proportion of 50BG:30T:20M. source: BG- Raza et al., (2010b); TTG- Martin et al (2005); M- Ahmad and Tarney (1994).	135
<b>Figure 6.10</b>	Multi-element spidergram patterns of average Alwar basin clastics (Mixture of 70 % pelites and 30 % quartzite) and modeled provenance after mixing the end members in the proportion 50 % Berach granite (BG), 30 % Tonalite-Trondhjemite-Granodiorite (TTG), 20 % mafic enclaves (M). (Data source same as in Figure 6.9).	135
<b>Figure 7.1</b>	SiO <sub>2</sub> versus K <sub>2</sub> O/Na <sub>2</sub> O discriminant diagram (Roser and Korsch, 1986) showing deposition of quartzites and metapelites of Alwar basin in a passive margin tectonic setting. ACM = Active Continental Margin, PM = Passive Margin, ARC = Magmatic arcs.	140

<b>Figure 7.2</b>	Na <sub>2</sub> O- CaO- K <sub>2</sub> O ternary diagram of Bhatia (1983), showing deposition of quartzites and metapelites of Alwar basin in a passive margin tectonic setting.	140
<b>Figure 7.3</b>	Th-Sc-Zr/10 ternary plot of elastic sedimentary rocks of the Alwar basin. Fields A-D are after Bhatia and Crook, 1986; A = Oceanic Island Arc (OIA), B = Continental Island Arc (CIA), C = Active Continental Margin (ACM) and D = Passive Margin (PM).	141
<b>Figure 7.4</b>	Ti/Zr vs. La/Sc discriminant diagram for the KCB Pelites and quartzites. Fields after Bhatia and Crook, 1986; A = Oceanic Island Arc (OIA), B = Continental Island Arc (CIA), C = Active Continental Margin (ACM) and D = Passive Margin (PM).	141
<b>Figure 7.5</b>	Cartoon illustrating development of sedimentary basins of NDFB and associated magma generation.	142
<b>Figure 8.1</b>	The contrast between Archaean and Post-Archaean REE patterns in clastic sedimentary rocks (Taylor, 1987).	148
<b>Figure 8.2</b>	Chondrite-normalized REE patterns of avg. quartzites/sandstones of Aravalli Craton ranging in age from Meso-Archaean to late Palaeoproterozoic. Source of data; Naharmagra Quartzite- Raza et al. (2010a); Vindhyan sandstone- (2010b); Alwar Basin Quartzite- Present Study.	148
<b>Figure 8.3</b>	Geochemical parameters showing compositional evolution of upper continental crust of Aravalli craton of North India Plate during the period from 2.8 Ga and 1.6 Ga. Note systematic decreasing trends shown by (La/Yb) <sub>n</sub> , (Gd/Yb) <sub>n</sub> , La/Th and Cr/Sc ratios and increasing trends shown by K <sub>2</sub> O/Na <sub>2</sub> O and Sm/Nd ratios from Mesoarchaeon to Palaeoproterozoic to late Palaeoproterozoic sedimentary rocks. Cr/Th ratio show a abrupt decrease and Rb/Sr and Th/sc ratios show abrupt increase from Archaean to Palaeoproterozoic. The temporal change shown by different ratios together suggest evolution of upper continental crust of Aravalli craton from TTG dominated composition during Mesoarchaeon to granitic dominated crust during Palaeoproterozoic / late Palaeoproterozoic.	152