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Petrography of Metasediments and Associated Intrussive Rocks Exposed around Revdar Region, District Sirohi, Rajasthan

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Abstract: ***Northwest Indian shield has evidences of theirororgeniccycles pertainy to the Precambraian period. The Sirohi orogenic cycle is the youngest among the three orogenic cycles which is curtailed to Neoproterozoic besides the two Palaeoproterozoic Aravalli orogeny and the Mesoproterozoic Delhi orogeny. The metasedimentary and metavolcanic sequences of the Sirohi Orogeny are along as a gneissic-granatoid basement termed as veerwara Gneissic Complex, dating a 1000 Ma. TtheSirohioroganic cycle had a span of nearly 150 Ma ranging from 1000 Ma to 850 Ma. The Sirohi orogeny is the most dynamic period of the earth's history at the beginning of the Neoproterozoic. Globally this period has been turned as an amalgamation of the Rodinia Supercontinent which later fragmented at nearly 750 Ma. The present area of shield is one of the basins of Sirohi orogeny which most probably opened up with the other basins which are located in north. The Revdar area, which is present area of investigation has few exposures of the Neoproterozoic metasediments of the Sirohi Group but not documented so far. The sediments are metamorphosed to low-grade regional metamorphism and area confirmed as marbles, calc silicates, micaceous quartzite and garnet-mica-schist. The basin opening is denoted by occurrence of meta basalts in few pockets which have a granitic basement. The rocks show the single phase deformation like the other metasediments of sirohi orogeny.***

Keywords: Metasediments, Neoproterozoic, Precambrian Orogeny, Revdar, Sirohi Group

1. Introduction

The North-Western Indian Shield (NWIS) globally participated in the amalgamation. (Sharma 2004, 2005; de Wall et al., 2014) The split of Rodinia was followed by the amalgamation of Gondwana supercontinent but the participation of NWIS in this gloal cycle is debatable for long. This is further complicated bby the wast expanses of the Malani Magmatism (800-750Ma) this part of the Indian subcontinent.

The Revdar study area lies in south of Sirohi district of Rajasthan. The study area is located in the west of Mount Abu, Bhatana and Karoti region of Sirohi district. Toposheet No.45D/07, 45D10 and 45D/11. The Revdarmetasediments indicate well developed schistosity along with linear fabric. The oblique movement in regional terms is evidenced by the discontinuity in the outcrops. The Sirohi Group rocks are outcropping in the Revdar belt which lies west of the Mt. Abu massif. The rocks of the Malani Magmatic event represent a bimodal volcano-sedimentary sequence, dyke rocks and younger granites; these rest unconformably above the Sirohi Group. The tectonic grain of the Malani is north-south and does not follow either the Sirohi Group or the Delhi Supergroup.

The Investigation carried out in present work are aimed tom petrological classified their outcrop exposures and to understand their mutual relationship based on outcrop evidences. The basement-supercrustal relationship is attempted to study in this part.

2. Geology of the Study Area

Hacket (1889) described first time the geology of the Sirohi region. Hacket (1889) compared Sirohi-revadar region metasediments with Udaipur and introduced the term "Aravalli series". Hacket (1889) identified Malanirocks, which were earlier described as the `Malani beds' by Blanford (1877) from the Jodhpur region. Coulson (1933) classified the geology of the Sirohi region adopting terms introduced by Heron (1917, 1953;) for the rocks of the Aravalli Mountain region in the northeast.

Coulson correlated the rocks of the Revdar-Sirohi and Sindreth region to the Aravalli system of Archaean age (sensu Heron, 1935). Gupta et al. (1980) proposed a revision of the lithostratigraphy of the Aravalli region, and described theRevdar-Sirohi rocks as part of their Delhi Supergroup, constituting the upper part of the Delhi Supergroup.

Roy (1988, 1990) identified theSirohi Group as a separate tectonostratigraphic unit younger to the Delhi Supergroup.

Sharma (1996), Roy and Sharma (1999), a younger startigarphy status pertainy to new Proterozoic time period was given to the rocks of sirohi groups by Shrama (2004) and Purohit et al; (2012) on the basis of studies done on mapping, field relationship, petrography studies, geo chronological data and stable isotope studies. The outcrop of sirohi group constitutes younger stratigraphy as compared to the Delhi Super group rocks based on above criteria which resulted in contrasting deformation and metamorphic history. The Sirohi group of rocks also exhibit unique single phase deformation. This single phase deformation is in contrast to multiple deformation and high grade metamorphism of DlehiSupergroup rocks.

Purohit et al., (2012) on the basis of single zircon geochronology of granites and granite gneisses from the Veerwara near Sirohi reported 207Pb/206Pb age of 920.4 ± 0.8 Ma, with one xenocrystic grain having an age of 992.6 ± 1.3 Ma age of granite gneiss. The 993 Ma age for this xenocryst may be related to the thermal event around 1000 Ma as reported from different parts of the Aravalli Mountains (Buick et al., 2006; Bhowmik et al., 2010; Deb et al., 2001; Pandit et al., 2003; Sarkar et al.1989; Volpe and Macdougall, 1990). Purohit et al., (2012) suggested that the Sirohi basin opening occurred later than ca.920 Ma. Purohit et al., (2012) reported the single zircon age of 822.8±0.8 Ma from Jawai Bandh granite, near Sumerpur, this is interpreted youngest age for the Sirohi Group. The age of approximate 822 Ma of the Jawai bandh granite *Sensu Stricto* erinpura granite indicate feldspar growth granite which is synkinematic related to deformation in the Sirohi group of rocks. This age of 822 Ma is younger tha the earlier reported age of ca.835 Ma from the set of rocks by Choudhary et al; (1984)

The Malani granite outcrops along the Sirohi-Jalore district boundaries in the Revdar belt. The Sanchor tectonic depression lies west of Mt. Abu. The Rann formation is a large-scale neotectonic activity in the area. Bakliwal and Ramaswamy (1987) described major and minor lineaments from the Rajasthan. The Revdarmetasediments include both fine-grained phyllite and coarse-grained mica schist containing garnet and andalusiteporphyroblasts. The carbonate rocks, show an intensely sheared mylonitic characteratplaces. The fine grained carbonates are calcitic and dolomitic in composition and include subordinate amount of mica and quartz. The carbonates show ocalized presence of parallely oriented tremolite-actinolite needles, talc alterations, wollastonite laths, garnet porphyroblasts and in rare case diopside also. These assemblages are observed in the carbonates along the stress-free thermal metamorphic aureole zones which are locally metamorphosed to higher grade of metamorphism in comparison to the general low grade greenschistfacies metamorphism.

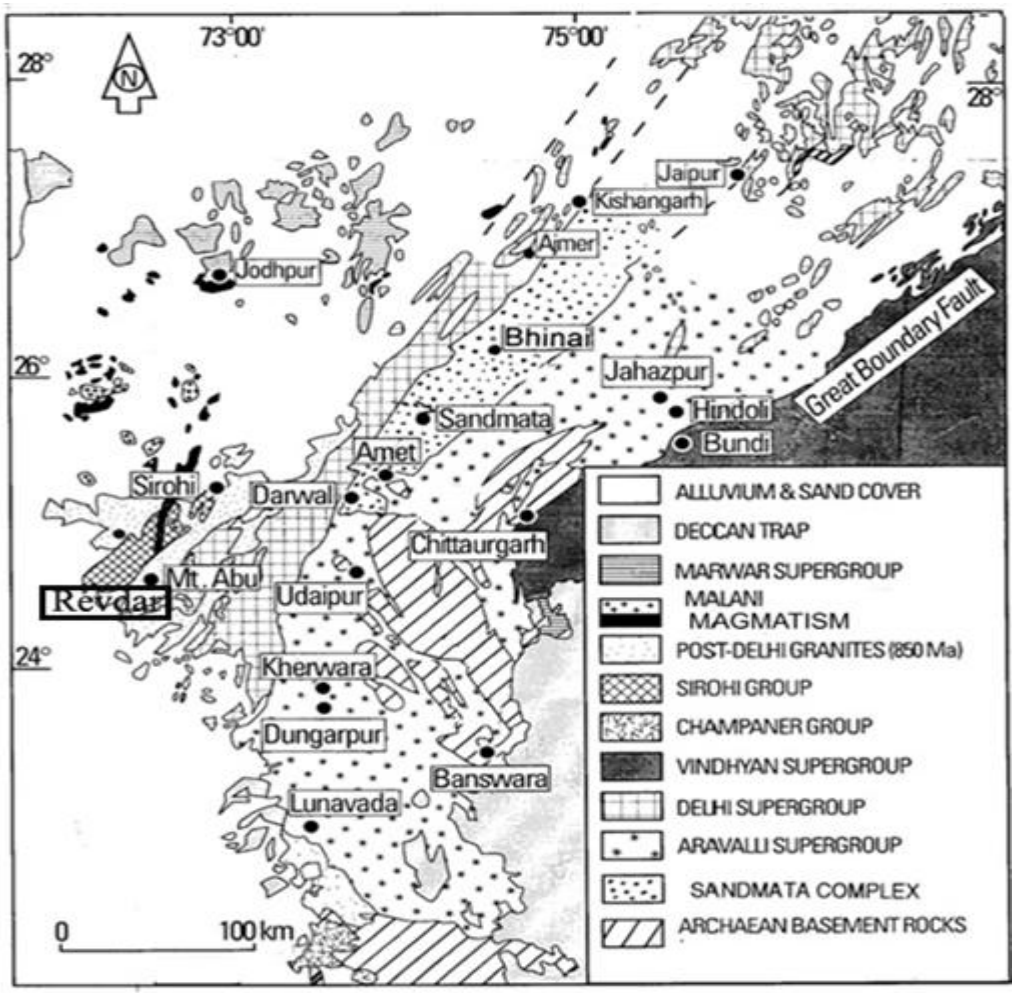

Figure 1: Generalized geological map of Aravalli Mountain belt (After Heron, 1935, Gupta et al., 1980, Roy, 1988, Sharma, 2004)

Lithological Characteristics

The Revdar region comprises basement granitoids and the Sirohi Group metasediments cover rocks. The metasediments are intruded by later dykes and younger granites. The metamorphosed carbonate rocks form significant minable marble deposit in the Selwara region. The basement-cover rocks relationship is tectonised and represented by Ductile Shear Zones. On the basis of lithological characteristics following rock types are identified-

a) **Basement** –
- Granites and Gneisses

b) **Sirohi Group**
- Mica-Schist
- Carbonate metasediments

c) **Younger Volcanics and Dykes**

a) **Basement** –

- **Granites and Gneisses**

Granites and granitic gneisses are dark grey in appearance and occur as low-lying peneplained outcrops against the high rising ridges of metasediments. Flattened and peneplained outcrops of granitic gneisses make the prominent character of the granitic terrain (Fig.2). Generally, the terrain is covered with the recent sandy alluvium. The contact between granitic-gneisses and cover metasediments is Sheared Moving away from the contact, the degree of mylonitization diminishes and granitic-gneisses tend to show more banded character. Foliated granitic gneisses are recognized on outcrop scale by parallel alignment of coarse grains of K-feldspar. K-feldspar porphyroblast occur as large rounded to sub-rounded and tabular grains measuring up to 5-6 cm along length in some cases. The porphyroblasts are set in a fine-grained groundmass of biotite–quartz. Under microscope the Rock is medium to coarse grained showing typical epideomorphic texture (Fig.3). The rock is essentially composed of quartz and potash feldspar with small amount of plagioclase biotite and muscovite. Quartz grains are generally unhedral and unaltered. Potash feldspar grains are subhedral, highly altered and showing cross hatched twinning. Mica (muscovite and Biotite) laths are invariably present in minor amount. This laths show well marked one set of basal cleavages, scattered grains of iron oxide minerals also present.

Figure 2: Field photograph of granite near Wanti village, on Revdar to Mandar National Highway 27.

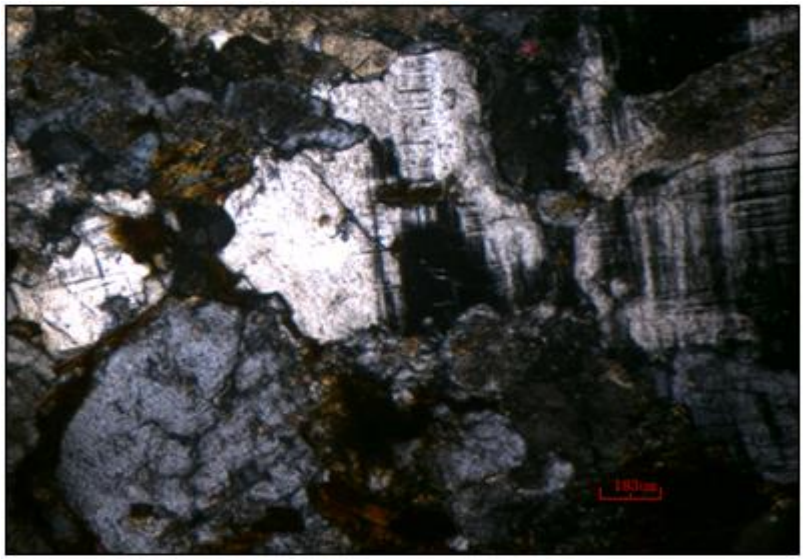

Figure 3: Microphotograpgshowing typical granitic texture with quartz, potash feldspar and biotite

b) Sirohi Group

The Sirohi group metasediments represent shale-carbonate facies and metamorphosed to mica schist, amrble and calc silicates. The contact of metasediments with basement is tectonised and there is total absence of paleosols or conglomerate at basal part. This indicates fault controlled basin formation in the ensialic crust in the region. The metasediments of the Revdar region is grouped as follows.

- **Mica Schist**

The mica schist forms almost flattened topography in the region. Due to weathering and these forms low lying area in the area. The mica schist composed dominantly micaceous minerals and shows well developed foliation plane. At places mica schist is rich in quartz and may be named as Micaceous Quartzite. The mica schist is affected by later thermal event; this caused development of garnet porphyroblasts and may be named as-Garnet Mica Schist. (Fig.4 to 7)

The Micaceous Quartzite is a fined grained rock showing schistos structures mainly composed of quartz and mica minerals. Quartz is fined grained and present in variable shape. Both type of mica that is muscovite and biotite are also present and showing strong foliation. There is few places muscovite and biotite are present as thin laths and showing parallel arrangement. Iron oxide grain are invariably present, The Garnet Mica Schist is fined to medium grained showing well marked schistos structure. The rock essentially composed of quartz and biotite. Plagioclase feldspar and garnet are present as minor minerals. Quartz grains are variable in size, shape, shattered and cracked. However at places elongated quartz grain also present. Biotite are generally fine grained showing more or less parallel arrangement and well-marked basal cleavages

Figure 4: Field photograph showing micaceous quartzite outcrop near Hara Magara, Selwara village

Figure 5: Microphotographs showing quartz, biotite and Muscovite minerals in micaceous quartzite rock.

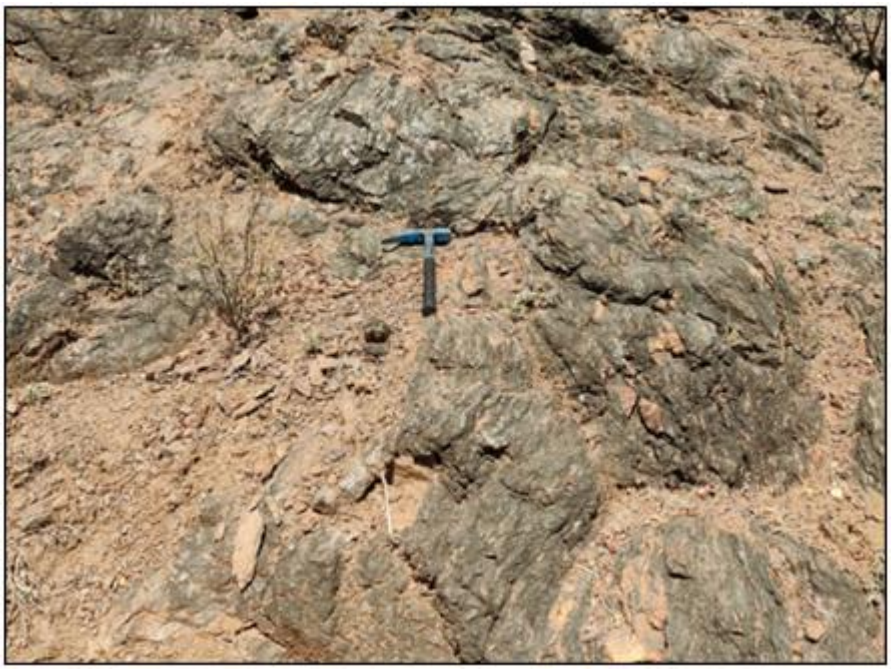

Figure 6: Field photograph showing garnet-biotite schist outcrop near Hara Magara, Selwara village

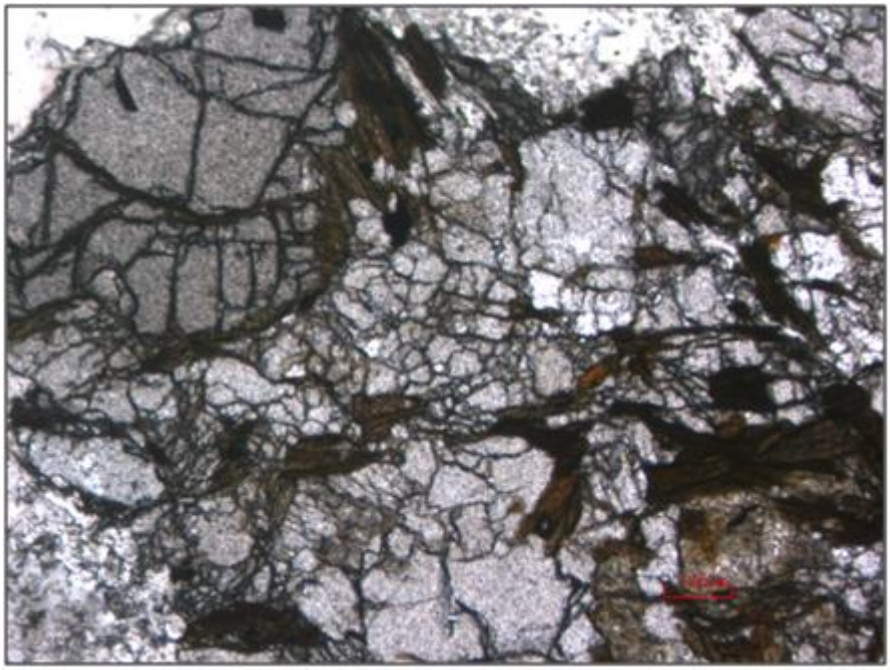

Figure 7: Microphotograph of garnet-biotite schist rock is showing Garnet grains with biotite flacks and iron oxide

- **Carbonate metasediments**

The carbonate metasedimts of Revdar region is rich in silicate minerals, which provides resistance to the weathering. This caused high topgrphay of carbonate metasediments in the region. The Selwara carbonate outcrop forms a linear hill in the Revdar region. There is calcitic and calcsilicate layers in the carbonate metasediments. After metamorphism these may be identified as marble and calc silicates (Fig.8 to 11). The marble is rich in calcite and dolomite, whereas calc silicates show bands of carbonate and actinolite and tremolite minerals. The thermal metamorphis caused development of wollastonite, garnet and diopside in the carbonate metasediments. The marble is mined at Selwara, Perwas and Serwa area. The marble mining in the area was operational during seventh centry. The Barman Sun Temple situated near revdar is of seventh century old and constructed by using the Selwara marble. Similarly, there are several ancient to medieval ruins of temple constructed from local marble. The wollastonite occur sporadically and does not form any workable depost in the region.

The Marble is medium to coarse grained showing characteristics granoblastic texture. These composed of carbonate minerals (Calcite and Dolomite) showing well marked rohmbohedral cleavages and twinning. The carbonate minerals are variable in size and shape, showing interlocking arrangement. There is diopsite grains are invariably present as inclusion in the dolomite ground mass. The CalcSiliate is fine to medium grained rock mainly consist of quartz with minor amount of carbonate minerals, muscovite and biotite. The quartz is variable in shape, size

and generally showing cracks. Small amount of fined grained carbonate material is present at places. The carbonate material is enclosed by the biotite and muscovite, Iron oxide is invariably present as isolated grain and cracks filling material. At some few palces rock mainly consist of carbonate with wollestonite minerals, wollestonite present as subhedral grain to elongated laths. Few grain of hornblende also present with apatite as a accessory mineral.

Figure 8: Field photograph of marble in Perwa village near Revdar block.

Figure 9: Microphotographs of dolomite grains showing well marked rombohedral cleavages and twinning.

Figure 10: Field photograph of calc silicate rock near wanti village, on Revdar to Mandar National Highway 27.

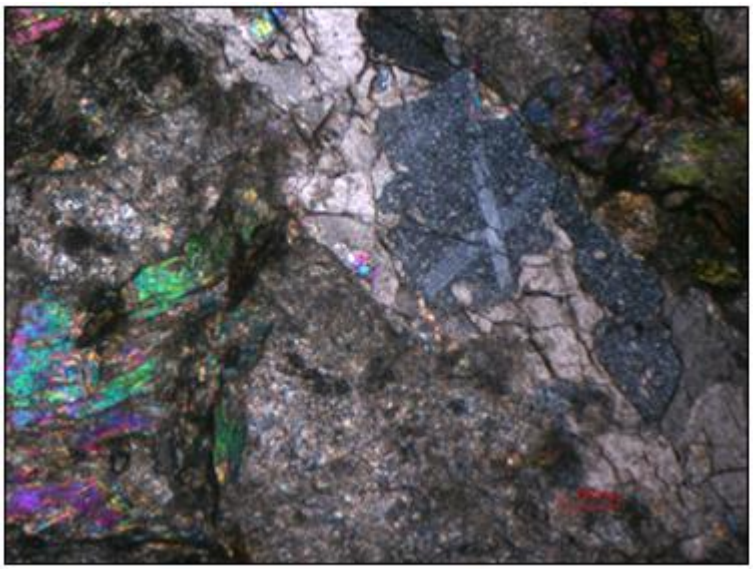

Figure 11: Microphotographs of calc silicate rock showing carbonate mineral with wollestonite

c) Younger Volcanicsand Dykes

The Malani magmatic event, which is equivalent to Sindreth Group caused flow of basalt and dolerite dykes in the Revdar region. Besides this, later thermal event resulted emplacement of quartz vein and pegmatitic vein in the region. These are described as follows –

- **Basalt**

The basalt forms low lying topography and highly weathered. At places weathered columnar structures may be observed, which indicate sub areal flow of the lava. The basalt is fine grained and shows plagioclase grains at outcrop. The phenocryst of altered plagioclase feldspar are embedded within the fine grained microcrystalline ground mass. The ground mass is mainly composed of plagioclase feldspar laths and cryptocrystalline grains of unidentified pyroxene. Iron oxide is invariably present in the rock (Fig 12-!3).

Figure 12: Field photograph showing thin bed of porphyritic basalt as a dyke near Hara Magara, Selwara village

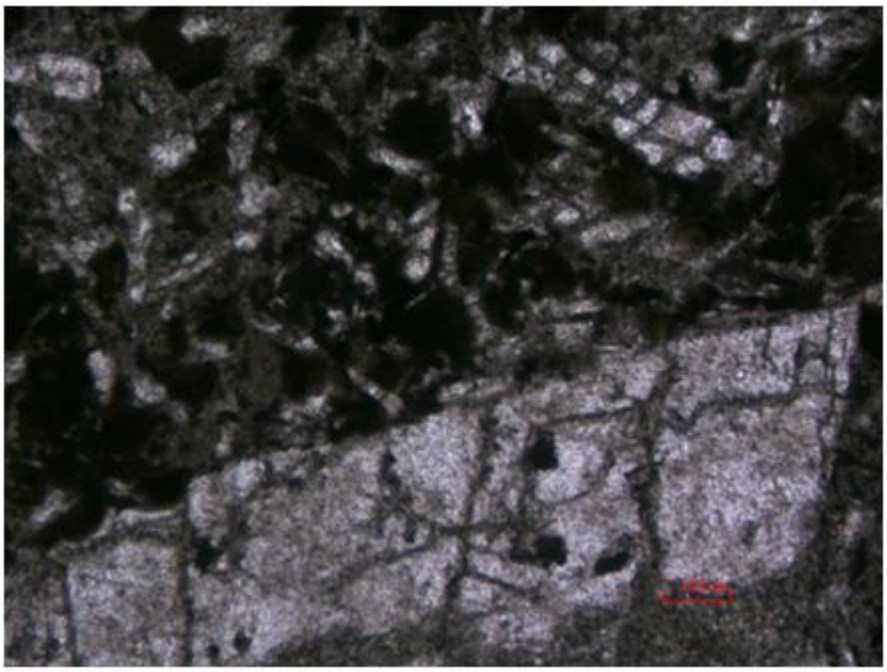

Figure 13: Microphotograph of porphrytic basalt showing phenocryst of plagioclase feldspar embedded within fine grained ground mass

- **Dolerite**

The emplacement of Dolerite dykes observed in the soutjhern part of the Revdar region. These dykes are generally east-west running and represents Malani closure event in the region. The dolerite is fine to medium grained rock showing ophitic texture where laths of plagioclase are lined on the large grain of augite pyroxene. The rock is mainly composed of plagioclase (lambrodiorite) and pyroxene (augite). Augite grain is showing two set of perpendicular cleavages. Scattered grains of iron oxide minerals are invariably present (Fig.14-15)

Figure 14: Field photograph showing dolerite dyke in Wanti village near Revdar block

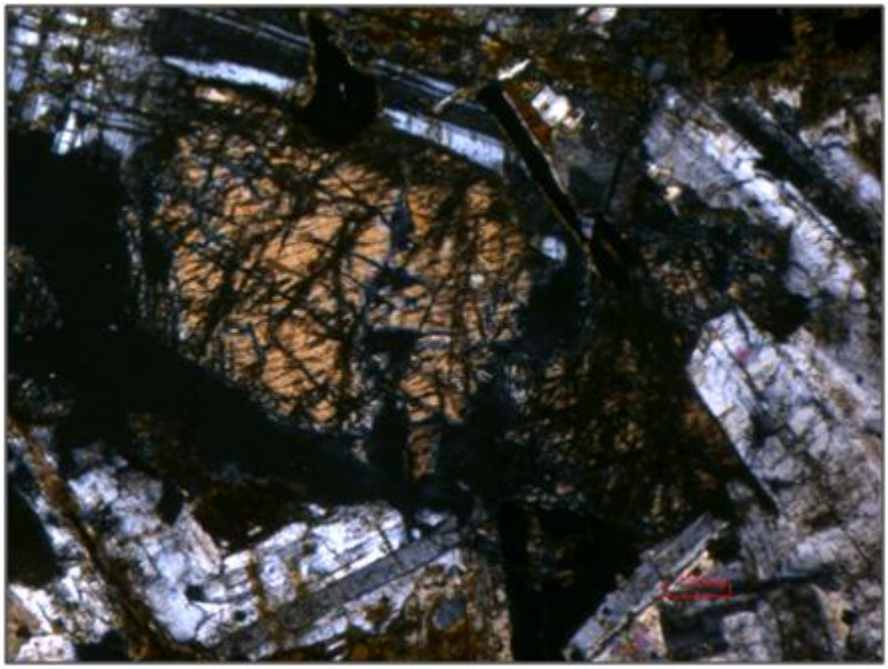

Figure 15: Microphotograpg showing laths of plagioclase lying within the megacryst of augite in dolerite

- **Quartz and pegmatite veins**

The quartz and pegmatite veins resulted during deformation and thermal event in the region. Generally, these veins follow structural trend of the metasediments and emplaced at closure of deformation. The Quartz Veins Occur with calc silicate, dolerite dyke and micaceous quartzite. These are composed solely of quartz grains which are of varying sizes from a few cm to about a few meter in length. Quartz veins show shearing (Fig.16). The pegmatite veins are not pervasive in the area. A fewpegmatite veins are observed in the metasediments and grnitic terrain. The pegmatites comprise plagioclase feldspar, microcline, tourmaline, muscovite and quartz (Fig-17).

Figure 16: Field photograph showing ridge of quartz vein in wanti village near Revdar block

Figure 17: Field photograph showing tourmaline present in pegmatite body in Perwa village near Revdar block

3. Conclusion

On the basis of field study of various rocks and petrographical characterstics the stratigraphy of the region is established (Tab-1). The basement is composed of granites and granitic gneisses. The metasediments are part of Sirohi group. The Sirohi group metasediments exihibits pervasive foliation plane, indicating regional deformation. The foliation plane is imprinted with garnet, wollastonite and diopside grain, indicating thermal event after development of foliation plane. The equivalent of Sindreth group is only scant outcrops of basalt.

Table 1: Stratigraphy of the Revdar Region

Tectono-stratigraphy	Events
Recent	Alluviam and Sand Dunes
Sindreth Group=Malani Magmatism	Emplacement of Dykes Basalt
Sirohi Group	Quartz and Pegmatitic veins Carbonate Metasediments Mica Schist
Basement	Granite and Granitic Gneisses

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