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CLAST PETROGRAPHY : BOULDER CONGLOMERATE STAGE OF UPPER SIWALIK AROUND UDHAMPUR

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Abstract. Murree and Siwalik sediments are well exposed around Udhampur, Jammu and Kashmir State. Some clasts collected at random were studied under petrological microscope. Schistose clasts were found to be dominating followed by sandstones, siltotones and clay and a limestone clast. These petrographic studies directly indicate the nature of distributive province.

Introduction. Murree and Siwalik sediments are well exposed around Udhampur, Jammu and Kashmir State.

The clasts from Boulder Conglomerate Stage of Upper Siwalik ; thirty in number were selected at random and their petrography was studied under microscope. It could throw some light on the source area of Upper Siwalik sediments. Out of the thirty clast samples, seventeen were of different types of schists such as quartz-sericite schist and chlorite schist, eight of sandstones, three of siltstones and shales and one of limestone. The petrography of different rock types is as follows :

Schists. Three different types of schists were encountered during the study of petrography of schistose clasts. These are quartz sericite schist, sericite schist, chlorite schist. The dominant minerals present in these schistose clasts are quartz, sericite, chlorite, plagioclase, mica, tourmaline and some opaque minerals. The schists in which quartz dominates, prefix quartz has been used in that such as quartz-sericite schist. In sericite quartz schist, the sericite dominates over quartz. The porphyroblasts of quartz are dominantly composed of two generations and chlorite gives the schistose structure (Figs. 1, 3). In one of the clasts some carbonaceous material is disseminated through the rock and minor amounts of sphene, calcite and micro-needles of rutile are present. The rocks show typical schistose structure defined by chlorite, muscovite, biotite and sericite in different clasts. In some cases these are at times marked by fine grained carbonaceous matter. The schistosity is further defined by stretched quartz grains showing strain effect.

The major part of schistose rocks in which quartz is dominating is occupied by xenoblastic grains varying in size from 0·002 to 0·03 mm. These quartz grains are flattened in the direction of schistosity. At times the schistosity is crenulated, which might be a later effect. Some times the alignment of quartz grains is oblique to the direction of schistosity. They look as if placed on fine grained sericitic mass, are sometimes augen shaped and when observed closely have sutured contacts indicating recrystallization. Sometimes very fine quartz grains are observed between coarser ones as irregular aggregates which could have recrystallized to coarser quartz grains with the increase in degree of metamorphism. The boundaries of majority of quartz grains are serrated (Fig. 3) and very commonly fine mosaic of quartz occurs at the margins within the coarse quartz grains along the fractures, sometimes as pockets between the coarse quartz grains. It indicates that probably the coarse quartz now present has also developed from finer siliceous material with increase in degree of metamorphism. The strain effect is indicated by the undulose extinction and presence of shadow zones (Figs. 1, 3). The two generations of quartz can be clearly distinguished from each other, the first having some opaque inclusions whereas second is inclusion free. The sutured contacts, stylolitic contacts defined by very fine chlorite needless indicate the role of pressure solutiong during deformation episode (Fig. 4).

A few plagioclase grains having sharp twinning, occur sometimes as flattened parallel to schistosity and sometimes oblique to it. Their size varies from 0·002 to 0·03 mm.

A few grains of tourmaline, sub-idoblastic to xenoblastic, showing pale brown to greenish brown pleochroism have been observed in some of the schistose clasts. The tourmaline xenoblasts show random orientation. In some of the clasts the tourmaline has been replaced by silica, chlorite and sericite. Generally the schistosity wraps around the porphyroblasts of quartz, plagioclase felspar, tourmaline etc. and at places the schistosity abuts against the porphyroblasts of quartz indicating its subsequent recrystallization.

Minor amouts of opaque minerals show the xenoblastic outlines and unoriented nature with respect to schistosity.

The crystallization of sericite to muscovite as also stressfree growth of chlorite (Fig. 2) have also been noticed in some of the clasts.

In one of the clasts, a quartz vein has been observed traversing the rock making a small angle with schistosity. The vein quartz is much coarser then the porphyroblasts present in the rock. The quartz grains present in the vein are highly strained, show irregular and sutured boundaries among themselves. Sometimes fine crystallized quartz occur along the periphery of larger ones showing marginal granulation. The quartz grains present in the vein are flattened at an oblique angle to schistosity exhibiting translation lamellae. A few grains of zircon have also been observed in the quartz vein.

Similar schists have been described by Pascoe (1949) in Salkhala series of Kashmir, which could be probable source of these schist-clasts present in Upper Siwalik Boulder conglomerate in the area.

Sandstones. Most of the sandstone clasts are very similar to each other in petrographical characters. Quartz grains form the major part of framework of grains. These are medium to fine sized, moderately sorted, subangular to subrounded. The framework quartz grains have straight and slightly undulose extinction. The overgrowth on the quartz grains can be observed by the presence of dustline, development of crystalline edges over subrounded quartz grains and occasionally slight variation in optical continuity. The siliceous cement is present in the rock in large quantities. The grains show sutured contacts with each other due to siliceous cements. Some of the quartz grains show etched surfaces and Bohem's lamellae. Most of the quartz grains show sutured contacts with the clay and chloritic matrix present in the rock (Fig. 5). The other cement present is ferruginous. It can be observed between the quartz grains and replacing the matrix. The calcic cement is altogether absent in these clasts. The chert transforming to quartz and replacing clay matrix can be clearly observed indicating that it is later addition to the rock.

A few plagioclase grains have been also observed. The plagioclase grains are fresh and show little alteration to sericite. Some of the plagioclase grains show overgrowth also.

The matrix consists of clay minerals, sericite and chlorite. The chlorite seems to be forming the secondary matrix produced during diagenesis by the reaction of clay and iron-oxides when favourable conditions existed (Sharda, 1975). The clay and chlorite darticles are observed eating into quartz grains in almost all the clasts (Fig. 6). The chlorite matrix replacing the clay and sericite matrix has been noticed.

Detrital muscovite, biotite and chlorite have been observed in the rock Some of these detrital mica and chlorite flakes are bent around the quartz grains showing undulatory extinction and are broken accross the cleavage (Fig. 5). These are bent due to overburden and some of them are bent due to pressure from overgrowing quartz grains. Few biotite grains record different stages of alteration. Zircon and epidote have also been observed.

Authigenic mica flakes developing along the contacts of quartz grains and chlorite in the matrix have been noted.

The rock fragments of schists, phyllites, quartzites, siltstones and some chert fragments have been noticed.

The sandstone clasts show all the stages of diagenesis such as redoxomorphic, locomorphic, and phyllomorphic (Dapples, 1962) as evidenced from the petrography.

The detailed petrography shows that these sandstone clasts are similar to Murree sandstones to a great extent indicating that Murrees have also supplied detritus to Upper Siwalik of this area.

Siltstones and Shales. Some of the clasts can be classed as siltstones and shales on the basis of their petrography. In these quartz grains of every small size form about twenty percent of the bulk. These have been observed floating in the matrix of clay, chlorite and sericite and ferruginous cement. This ferruginous cement is more dominating in the shales where the quartz grains are very small. The quartz grains are rounded and show irregular contacts with the clay and chlorite matrix. Some micaflakes (very tiny) follow a crude parallelism (bedding ?). Small chlorite flakes are also oriented in this direction.

Limestone Clast. In this the clastic grains and cement consist of same minerals. The clastic grains are rounded and turbid. The cement consists of well crystallized calcite showing twinning lamellae and is of micrite type. Some of the cement shows grumus texture also indicating that it partially crystaillized. Presumably these limestones were porous and the cement could have been deposited later during diagenesis shortly after deposition. Some of the detrital grains are in contact with each other whereas others are floating in the calcic cement (Fig. 7). The grains which are in contact with each other show that the cement has been reduced to minimum indicating that pressure and differential solution along the grain boundaries have produced a close packing of original grains before complete cementation (William *et al.*, 1969). Some of the detrital quartz grains showing straight and slightly undulatory extinction have been observed in calcic cement. A few quartz grains are cemented to clastic calcite/dolomite grains. They show highly sutured contacts with calcic cement. In some of the grains the replacement by calcic cement in advanced stages has been observed. Some quartz grains also show the surface etched by calcic cement. But percentage of quartz grains is very low. Cherty bands are also present in these clasts. The quartz in these bands is cryptocrystalline to microcrystalline and replaces calcite/dolomite crystals which are rhomb-shaped. Some quartz veins have been observed in these limestone clasts. The quartz in these veins is also cryptocrystalline. Some of these veins join some vugs present in these limestone clasts. These veins contain prismatic quartz crystals. Some coarsely crystalline carbonate (calcite/dolomite) grains in fine matrix have also been observed. These grains show irregular boundaries indicating replacement by surrounding cryptocrystalline mass.

Petrographically these limestone clasts are quite similar to Jammu limestones (Wadia, 1932) and Sirban Limestones (Sharma and Krishnaswamy, 1969) lying in north of Udhampur area which could have acted as one of the source rocks for Upper Siwalik of Udhampur.

Conclusions. The clast petrographic studies indicate that older rocks such as Murree sediments, Salkhala series of Kashmir and Sirban or Jammu Limestones exposed in north of Udhampur have also supplied detritus during Upper-Siwalik sedimentation in Udhampur area.

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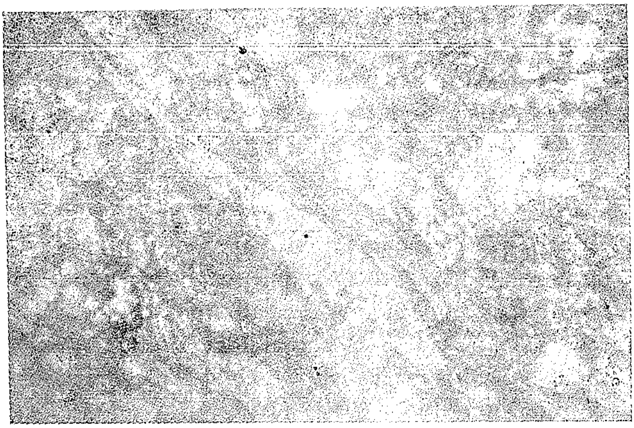

Fig. 1. Photomicrograph showing quartz grain forming pressure shadow zone wrapped up by chlorite altering to biotite. The ground mass is constituted of micro-crystalline quartz grains and sericite in schistose clast (x nicols) (10×8)

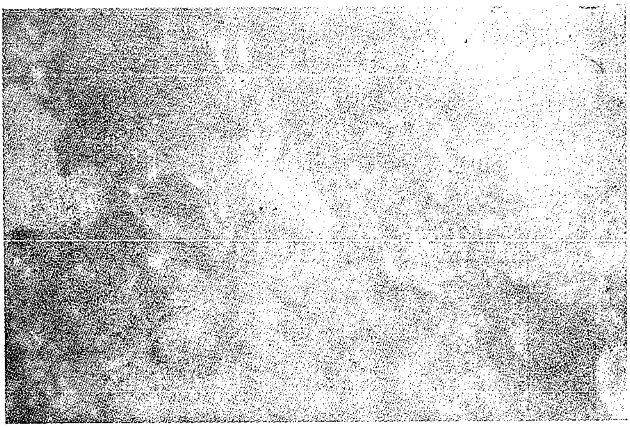

Fig. 2. Photomicrograph showing stressfree growth of chlorite and sericite into radiating fibres. Detrital felspar also shows partial replacement due to pressure solution phenomena. The groundmass consists of microcrystalline quartz in schistose clast (x nicols) (10×8)

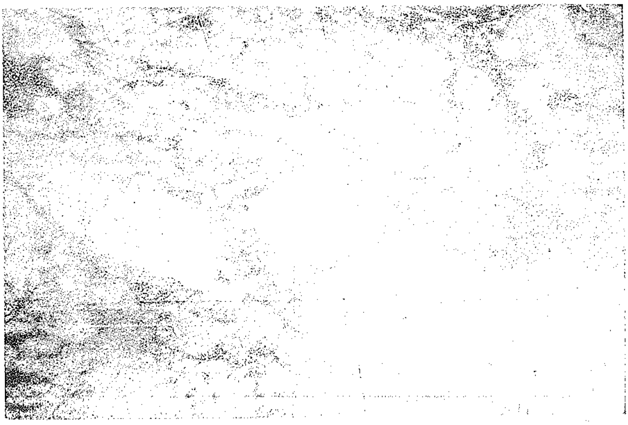

Fig. 3. Photomicrograph showing the schistosity defined by chlorite and biotite flakes wrapping around angular quartz grains being replaced by chlorite along two ends forming pressure shadow zones in schistose clast (x nicols) (10×8)

Fig. 4. Photomicrograph showing subangular quartz grains having sutured margins developed due to siliceous cement. The matrix is composed of chlorite and sericite in sandstone clast(x nicols) (10×8)

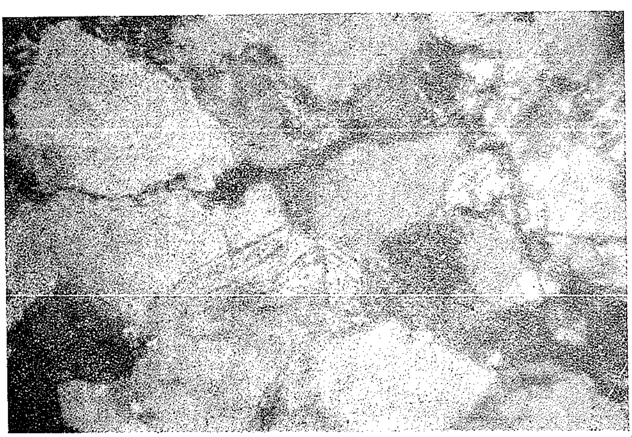

Fig. 5. Photomicrograph showing detrital chlorite flake in the matrix bent due to overgrowing quartz grain in sandstone clast (x nicols) (10×8

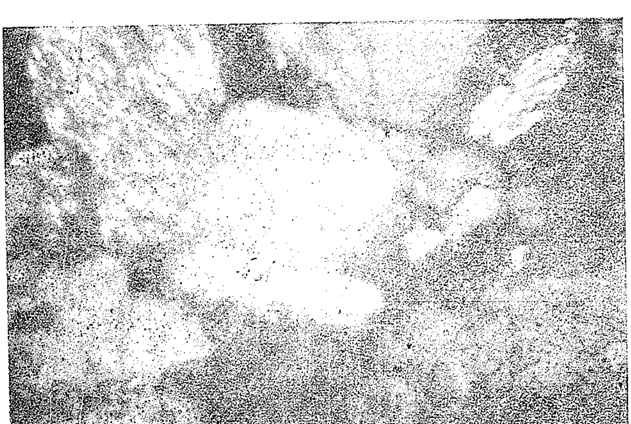

Fig. 6. Photomicrograph showing the chlorite particles eatinginto detrital quartz grain giving rise to embayed boundaries in sandstone clast (x nicols) (25×8)

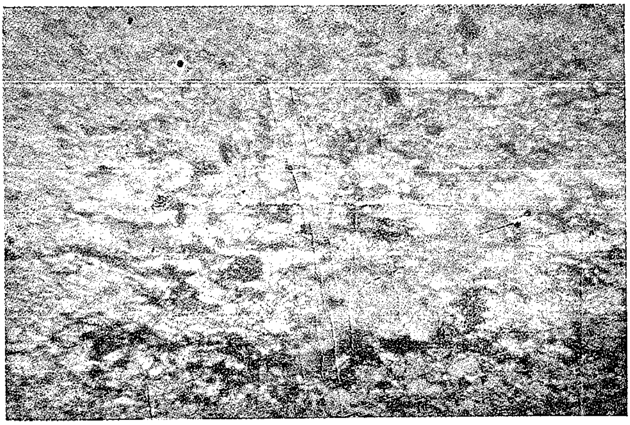

Fig. 7. Photomicrograph showing coarse grained sparitic calcite surrounded by fine grained micrite. The sparry calcite shows some stretching due to deformation in limestone clast (x nicols) (10×8)