CHAPTER-VII

SUMMARY AND CONCLUSION

The area under investigation lies in the eastern part of the East Khasi Hills district of Meghalaya covering approximately 72 sq. km. The study area is covered under the survey of India topsheet no. $83^{C}/_{2}$ is geologically mapped on scale of 1: 50,000.

The area under investigation comprises of a high hilly terrain formed by elongated ridges and a few valleys in between the ridges. The area is criss cross by a number of streamlets. The streamlets of the area have developed a contorted pattern of drainage and streams up to fifth order are seen in the area.

The main rock types of the area are the metasediments of the Shillong Group which are intruded by the amphibolites and the granites. The study is focused on the petrology and structure of the rocks found in the area.

The study of various structural elements and their mutual relationship has immensely helped in deciphering the tectonic history of the area under study in particular and that of Shillong Group of rocks in general.

The presence of non-diastropic structure like current beddings, ripple marks, graded bedding, etc., indicate the fluvial depositional regime. It is also found that the palaeocurrent direction was from NE to SW at the time of deposition of sediments. The presence of structure produced by penecontemporaneous deformation reveals that the land mass was not stable at the time of deposition of sediments.

The Shillong Group composed of low-grade metamorphic rocks deformed and metamorphosed initially mostly from sedimentary rocks. The formation of major and minor folds with associated cleavages, and lineations are the resultant fabrics caused due to the impact of deformation and metamorphism. The structural analysis has revealed that the dominant foliation is trending in a NE-SW direction and dipping towards both NW and SE directions with varying angles from 10^0 to 80^0 due to folding. The force responsible for such folding, might have probably acted from NW-SE direction. This is quite clear from the orientation of the dominant slaty-cleavage, flattening type of pebbles in conglomerate, joint orientation diagrams and trend of quartz veins.

The strain analysis of pebbles reveals that pebbles are of the flattening type and the XY-plane of the pebbles are approximately parallel to the beddings.

The diastrophic structures observed in the rocks of Shillong Group show four major phases of deformation (D).

During the first phase of folding movement the sediments were subjected to different environment of deformation. The sub horizontal simple shear acted in NW-SE direction acting on horizontal beds. This gave rise to recumbent isoclinal F_1 folds with a NE-SW axial trend. The development of early cleavage S_1 i.e. strong axial plane schistosity is associated with the formation of F_1 folds. The other associated structures formed are intersection lineation, mineral lineation, etc.

In the second phase of deformation minor open asymmetrical to symmetrical folds F_2 were developed due to refolding of S_0 and S_1, where F_2 is generally co-axial with F_1 folds (Fig-4.18). This requires that the direction of shortening during the formation of F_2 folds is approximately perpendicular to the F_1 fold axes. Thus, the simple shear which gave rise to the F_1 folds gave place to

pure shear with NW-SE compression which formed the F_2 folds with a northeasterly axial trend The F_2 folds are associated with the development of slaty-cleavage or crenulation cleavage which is axial planar to it

The movements of third phase represent the last major event in the tectonic history of the area. This deformation is responsible for the development of large open symmetrical fold (synform) F_3, in the metasediments of the area The maximum compression along NW-SE direction is responsible for the formation of F_3 fold. The another associated structures produced due to this phase of deformation are pukers, slikensides, kink bands, fracture cleavage (S_3),etc.

The fourth phase of deformation culminated in cataclasis which gave rise to deformation of rocks in the semi-brittle or brittle conditions. The deformation D_4 is related to the action of intrusive bodies of the area. This phase is responsible for the development of joints, fracture cleavage and crushing the rocks of the area.

The quartzite of the Shillong Group is the dominant rock type in the study area. The presence of structures like current bedding, ripple marks, Graded bedding indicated the sedimentary derivation. This arenaceous rock was originally composed of quartz set in a clayey matrix. Due to regional metamorphism the clayey matrix was recrystallized to sericite, muscovite along with coarsening of the quartz grains. Nearer to the amphibolite and granite, development of granoblastic mosaic of quartz grains, often meeting in triple points and sericitic cement recrystallizing to muscovite.

The metapelites of the Shillong Group occur as layers within the quartzites This argillaceous rock was originally composed of clay minerals with minute quartz grains. Due to regional metamorphism the development of fine sericite,

muscovite with quartz, chlorite and iron oxides were formed from pelitic sediments.

The conglomerate of the Shillong Group is also affected by regional metamorphism. This is clear from the presence of recrystallized quartz in pebbles as well as quartz developed along with muscovite prisms. Due to high pressure the pebbles of the conglomerate were deformed and gave rise to flat shaped pebbles. The quartz grains in some of this pebbles also show cracks and are mostly found arranged in linear order. The long axes of the pebbles in the conglomerate are also arranged approximately parallel to the foliation showing a good lineation.

The presence of intrusive rocks in the Shillong Group could be clearly observed in the course of the study. These intrusions were mainly of amphibolite and granite. The early intrusion was of the metabasic rock amphibolite as dolerite and gabbroic rocks, which also suffered regional metamorphism along with the Shillong Group. The original mineral assemblages in the doleritic and gabbroic rock are dominated by calcic plagioclase and augite. These minerals underwent retrogressive metamorphism, which effected in the formation of the mineral assemblage hornblende – plagioclase – epidote - iron oxides – quartz belonging to amphibolite facies.

The later intrusive in to the Shillong Group in the area of study, was that of granite. The granite occurs as minor intrusions in the quartzites of Shillong Group. The main character of the granite body is that it contains hypersthene. Under microscope, the rock is even-grained and is composed of quartz and potash feldspar with oligoclase, orthopyroxene and iron oxides and occasional crystal of zircon and apatite. A typical hypidiomorphic granular texture was exhibited by the groundmass. The presence of hypersthene in the granite may be regarded as a significant occurance.

Geochemical studies of the various rocks of the area give us an idea of their origin. The metapelite of the Shillong Group showed affinity to sedimentary parentage, a siliceous shale. The amphibolites were derived from original basic igneous rocks. It shows tholeiitic trends, very similar to the Karroo Dolerites and Palasides Sill, in Island-arc settings.

It is considered in view of the above, that after the prolonged denudation of the Basement Complex, the whole area might have submerged beneath a shallow sea. At first, during Proterozoic times, deposition of gravels, sands and muds took place over a weathered base of crystalline rocks in a shallow marine environment (self) conditions. After the lithification and diagenesis, these sediments were transformed into sandstone, mudstone and conglomerate sequence. This sequence of rocks was then subjected to tectonic activity and dynamothermal/ regional metamorphism. Subsequently, because of diastrophism, the sediments were folded and eventually moved from the sea to form land. In the earlier phase of folding the metapelites were affected by generating small-scale folds. In the later stage of folding all the metasediments were affected by generating large open folds. The regional metamorphism transformed the original sandstone, mudstone and conglomerate into quartzite, metapelite and metaconglomerate.