CHAPTER I

INTRODUCTION

The Precambrian gneissic complex of the Shillong plateau is unconformably overlain by the Proterozoic (Baruah and Goswami 1972) Shillong group of metasediments, which have suffered low-grade metamorphism. The group is mainly composed of phyllites, quartzites and conglomerates. The conglomerates occur as basal, interformational and intraformational units. The Shillong group was later intruded by Khasigreenstone followed by series of late Proterozoic granite (Awati *et al* 1995), Sylhet traps and alkaline intrusive (Sung Valley Alkaline Complex). The development of major and minor folds with associated cleavage and linear structures are the result of low-grade metamorphism and tectonic deformation of the area. The trends of the foliation of the rocks are NE-SW.

The area under investigation lies in the eastern part of the East Khasi Hills district of Meghalaya (Fig-1.1). The area, which is geologically mapped, is about 72 sq.km. and this is an interesting association of Shillong Group of rocks in terms of structure and lithology.

1.1 Location of the area

Mawryngkneng and its surrounding area bounded by latitude $25^0$32'N to $25^0$37'N and longitude $92^0$01'E to $92^0$06'E and covered by top sheet number 83$^c/_2$ published by the Survey of India in 1:50,000 scales have been investigated for the present study. It lies on the western side of Sung valley (Sung Valley Carbonatite Complex) and both sides of the National Highway No. 44 around Mawryngkneng. The Mawryngkneng is 33 km from Shillong.

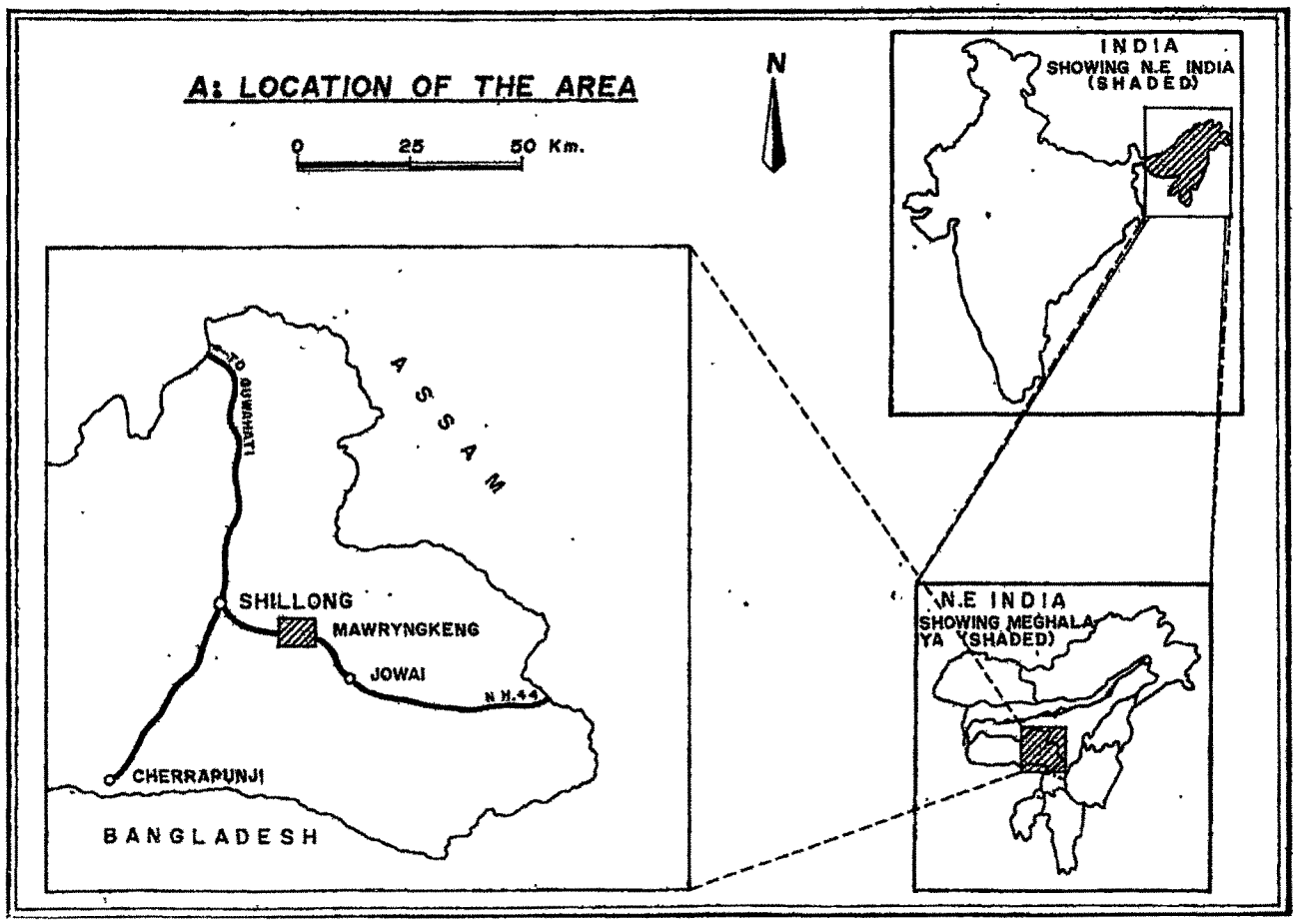
A: LOCATION OF THE AREA
0 25 50 Km.
N
INDIA
SHOWING N.E INDIA
(SHADED)
ASSAM
GUWAHATI
SHILLONG
MAWRYNGKENG
JOWAI
N.H.44
CHERRAPUNJI
BANGLADESH
N.E INDIA
SHOWING MEGHALA
YA (SHADED)

Figure 1.1

1.2 Communication and Accessibility

The area, which has been studied, is 30 km away from Shillong, lying on both sides of the NH-44. The area is very well communicated with Shillong and Jowai. The main ways of communication are the buses (private and government), taxies and trucks, which plies to and from Shillong at a very appreciated frequency. The Assam State Transport Corporation (ASTC) bus services connecting Guwahati and Jowai have also made the area more accessible. The northern part of the area is situated far away from National Highway (No. 44) and is approachable partly by narrow metalled roads, but mostly by narrow graveled roads and footpaths. The villages connected mostly by narrow graveled roads are approachable any time of the year. The footpaths at the hills help in carrying out the survey works during dry seasons. During monsoons, these paths and approaches become muddy and slippery. These footpaths and tracks have been developed by animals and local people for interior areas. Some of the exposures are also accessible through streambed, road cutting and quarries.

1.3 Geography and Geomorphology

1.3.1 Physiography

The area under investigation comprises of a high hilly terrain formed by elongate ridges and a few valleys in between these ridges. These ridges and valleys are more or less parallel to the strike direction of the litho-units of the Shillong Group. The maximum contour height of the area is above 1400 meters and minimum contour is less than 935 meters above mean sea level. The ridges, as a whole, trend along NE-SW direction. An elevation model of the area is prepared with the help of 3D Analyst extension of Arc View GIS (Fig-1.2). This classifies the area into 5 elevation classes with 100 m intervals. A gradual decrease in elevation from the southern part to the northern part is observed. The landforms in the southwestern quadrant mark the maximum

elevation. Deep valleys are also present, which are occupied by rivers. A few elongated topographic features of various elevations are seen, which might indicate that these rocks have suffered differential weathering and erosion.

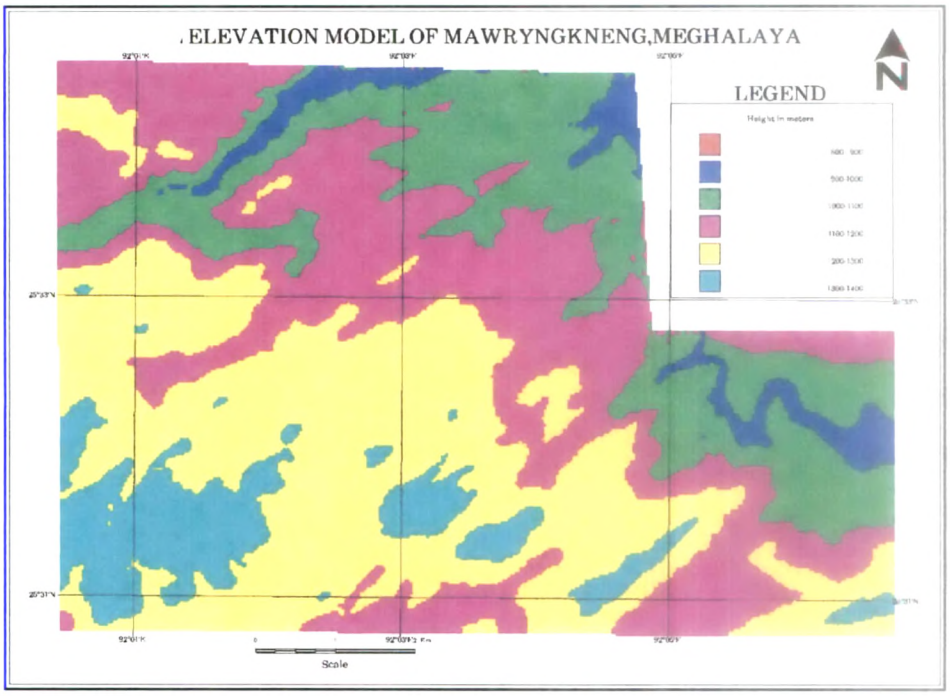

Figure 1.2 : Topographic representation with elevation ranges of the study area. The topography has a north-easterly slope.

1.3.2 Drainage

The area is crisscrossed by a number of streamlets. They generally originate at higher altitudes and flow ultimately towards the northern part of the area, which is comparatively of low altitude comprising the Umkhen river, which make the north, and northeast boundary of the area and flows from west to east direction (Fig-1.3). The streamlets of the area have developed a contorted pattern of drainage and first to fifth order streams are seen in the area. Moreover, most of streams are seasonal and dry out during winter

seasons. Most of the streams flow towards the valley and meet Umkhen river in the northeastern side of the area.

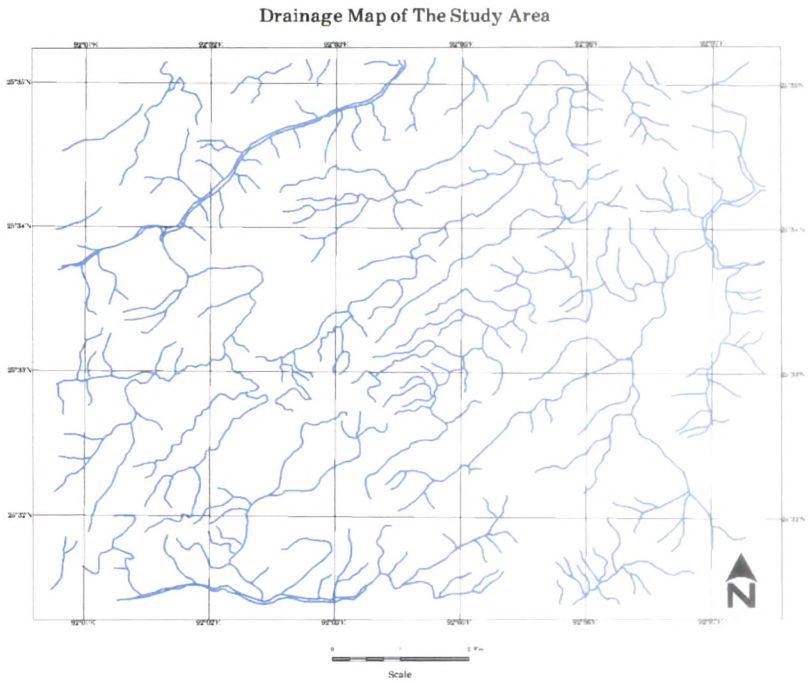

Figure 1.3 : Drainage map of the study area.

1.3.3 Climate and Vegetation

The area experiences generally a monsoon type of climatic conditions. As the area is located at a higher elevation, it enjoys a very healthy and pleasant climate during the winter season. During this season the rainfall becomes very thin. The summer season starts at March and continues up to September. Heavy rainfall occurs during this season due to southwest monsoon.

The temperature in the area is almost same as Shillong proper. But slight variation of climate is also present due to its elevation. The daily temperature of the Shillong varies between 17.11^{0}C (64.6^{0}F) and 24.94^{0}C (96.9^{0}F) during

the summer months and between 3.22^{0}C (37.8^{0}F) and 16.55^{0}C (61.8^{0}F) during the winter season.

The climatic condition of the area favors the growth of some valuable plants like pine, sal, tita sapa, nahar, some, nooni, betel nut, plum, orange etc Rice, maize, potato, ginger and various vegetables are common agricultural products of the region. The people of the region are practicing terrace cultivation. The area contains various kinds of rare orchids and rare species of butterflies.

One of the most important factors that govern the growth of the flora is the elevation above mean sea level. Heavy to medium rainfall is favorable for the luxuriant growth of coniferous plants (pines) in the area.

Geological formation and the resultant soil types are also factors that favor the growth of vegetation. On the basis of lithology, the area comprising Shillong Groups can be divided into quartzitic country and schistose country The vegetation may also be divided into deciduous and evergreen types. The present area is dominated by quartzites and phyllites

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The most characteristic plant is the pine, which is predominant on the plant kingdom. They generally grow on the hill slopes, which have sufficient soil cover. Besides these, the xerophytes and spiny shrubs are also seen in smaller quantity. Generally quartzite country is characterized by barren hillocks with grass and shrubs on them. The vegetation flourishes more luxuriantly over the basic rock (khasigreenstone) than over the quartzites.

An important point to be noted in this regard is the type of vegetation that varies with the variation of rock formations. So, in the field one will be able to delineate the geological formations only by observing the vegetation and topography of the area.

The climate in November to March thus seems to be the most suitable period for undertaking the fieldwork in this area

1.3.4 Weathering of the rocks

The Shillong Groups of rocks are highly weathered due to physical, chemical and biological factors. Rapid temperature variations, heavy rainfall and fracture plane of rocks through which percolation takes place, are the factors that help weathering of the rocks. The fractured rocks become loosened due to the penetration of trees. The agents of denudation like surface and rainwater are active in weathering the rocks of the area. Weathering in the present area is mainly due to the presence of well-developed foliation and joints planes.

The phyllites and schists of the Shillong group are very susceptible to weathering as they are soft and loose. These rocks are therefore found exposed on the lower elevations because of the easy erosion.

The quartzites are sometimes soft but generally they are hard and compact. Different types of joints are present in quartzites. Rainwater is penetrating through the vertical joints plane and has loosened the quartzite and hence become friable at various places. In many places, soft and friable quartzites with brownish gray colour, which are due to chemical weathering. Due to horizontal joints rectangular blocks and slabs are formed and joints are formed along the slopes and foothills are seen. This is due to chemical weathering.

The amphibolites or khasigreenstones, which are intruded into the quartzites, are also weathered. Although, they are very hard and compact. They are affected by spheroidal weathering. This is because of the irregular joints developed in the rocks due to shrinkage. They seem to be ball like bodies. The ball then speel off some skins. The skins are then gradually decomposed

to soil. The decomposed products of the amphibolites are easily recognized in the field by their particular reddish color soil. This reddish color is due to high iron content. The formation of this soil is on effect of chemical weathering.

1.3.5 Inhabitant and occupations

The area is sparsely populated. There is a small town in Mawryngkneng. Some inhabitants along with the tea stalls are residing beside the highway. The inhabitants are mostly Khasi. They belong to a typical matriarchal society. Most of them are Christians. Their mother tongue is Khasi. Some people can understand Hindi and English also.

Agriculture plays a vital role in the economy of the people. They are mostly cultivators and practice terrace cultivation. They cultivate rice in the low-lying areas. They use to plough the land with the traditional methods. Shovels are used in hill slopes for terrace cultivation. Poultry keeping is also familiar among them. They rear pigs, cows, hens etc.

1.4 Aims and Objectives

The area is important from geological point of view. Hence, the study has helped to bring out the relationship of intrusive body with the country rocks and associated structure present in a small area. As such, the proposed study may focus on the multiple themes. A brief outline of objectives of the research work is given below:

- Systematic mapping of different rock type of the area and analysis of the mutual field relationship of the litho units.
- Study of important structural features in different rock types encountered in the area and the tectonic deformation history of the area and strain analysis of pebbles.

- Study of the tectonosedimentary environment of the area in the light of palaeocurrent analysis.
- Analysis of lithofacies variations in space and time.
- Stratigraphic correlation of the sequence encountered in the area with that of the other part of the Assam-Meghalaya plateau.

1.5 Methodology and Database

The study of the rocks and their structural features has been carried out with the following techniques:

1.5.1 Field techniques

The field investigation has been carried out during the year 1999 to 2005. A period of four months starting from November to March was selected each year for the field trip. Approximately 72 sq.km. area was covered for geological mapping and detail investigation. In order to carry out the fieldwork, a base map has been prepared from Survey of India top sheet no. 83 $^{c}/_{2}$ in the scale of 1:50,000 for plotting various geological features.

Preliminary reconnaissance survey and detail fieldwork of the study area are chalked out. Accordingly, the whole area has been segmented into five blocks for convenience. Each block was covered following traverse criss-crossing of the area. The field investigations were confined mainly to the mapping of different geological outcrops by traversing method noting their field relationships and related features in detail. During the traversing, all the major and minor structures were noted and recorded with the help of sketches and photographs. In well-developed exposures and insitu rocks the attitude of formation, lineation, foliation, joints, etc. have been measured and recorded with the help of clinometer and Brunton pocket transit compass. While carrying out the investigation and to locate the outcrops of different rock

types, attempts have been made to follow river beds, river banks, road cuttings, hill slopes, streams and tracks developed by local people.

Fresh and oriented samples were collected for laboratory studies and these were numbered properly. Readings of pebbles and current bedding also collected for strain analysis and palaeocurrent analysis from different stations of the area are as follows:

- Dip and strike of the normal bedding (current bedded strata).
- Dip and strike of the fore set beds.
- Thickness of the current bedded unit.
- Length of the fore set bed.
- Long axis orientation of the pebbles.
- Measurement of three intercept of pebbles (X.Y.Z.) with the help of slide caliper and scale.

All the important details of litho logical variations as well as structures have been plotted on the base map.

1.5.2 Laboratory techniques

The field data collected relating to lineation, foliation, joints and other structures were used for detailed analysis. About 150 representative samples collected from the field were used for the preparation of thin sections. Petrographic studies were carried out with the help of good quality microscope available in the laboratory. For better coverage, oriented thin section were prepared and structural morphology worked out with accuracy. Model analysis of various rocks was determined with the help of Swifts point counter. Altogether 10 samples were analysed for ascertaining the

geochemistry of the different representative rock samples of the area and samples were analysed for major element oxide by XRF equipment. Niggli values (Niggli, 1954), CIPW norm (Johanssen, 1939) were calculated from the chemical data and diagrams were constructed to ascertain their petrographic history. The recorded attitude of the different planar, linear, folds, joints, fracture, etc. from the field were plotted on the Schmidt equal area projection and different diagrams were prepared.

Photomicrographs were taken to illustrate typical textural as well as other important characteristics of the rock units.