CHAPTER-II

GEOLOGICAL SETTING

2.1 REGIONAL GEOLOGIC SETTING:

The Assam-Meghalaya plateau is believed to be the northeastern wedge of the Precambrian shield of India and forms a composite tectonogeomorphic entity comprising the Meghalaya plateau together with the monadnocks in the Brahmaputra plains and the adjoining uplands of Karbi-Anglong district (Mikir Hills) of Assam. The domain is bound by Yamuna megasuture in the west (Rajmahal-Garo gap), Brahmaputra rift in the north, Dauki megasuture in the south and Naga-Disang megasutures in the southeast (Sengupta and Agarwal, 1998). According to Evans (1964), the plateau was uplifted and moved to the east over a distance of about 250 km along the east-west trending, transcurrent Dauki megasuture during the Himalayan orogeny. The Precambrian rocks of the plateau have been variously interpreted as a part of the Eastern Ghat charnockitic terrain (Crawford, 1974) or a continuation of the Satpura belt of Bihar prior to the eastward movement (Krishnan, 1960). Deep drilling and geophysical data show that Precambrian rocks of the Assam-Meghalaya plateau extend for several km northeast, beneath the Brahmaputra alluvium and also westward to the Chotanagpur area (Evans, 1964; Desikachar, 1974). The connection between Chotanagpur and the Precambrian rocks of the Assam-Meghalaya plateau has been designated as the Malda-Dinajpur ridge. The presence of this continuous ridge contradicts the proposal
of Evans (1964) of the separation of the Assam-Meghalaya plateau from remainder of Peninsular India (Auden, 1974; Desikachar, 1974). The Precambrian rocks of the plateau are subdivided into the Gneissic Complex, nonporphyritic granites, the Shillong Group of supracrustal rocks, the Khasi Greenstone and porphyritic plutons (Anon, 1974; Choudhury and Narayana Rao, 1975; Murthy et al. 1976a; 1976b; Mazumdar, 1976; 1986). The Gneissic Complex and the nonporphyritic granites form the basement for the Shillong Group. The Gneissic Complex is an agglomeration of high grade schists/gneisses (sometimes migmatised) with minor granulitic components. Both paragneisses (Gogoi, 1975) and orthogneisses (Choudhury & Narayana Rao, 1975; Maswood, 1981; Agarwal, 1996) have been reported. The paragneisses apparently form from a variety of pelitic, impure calcareous and banded ferruginous rocks. These rocks now occur as hornblende (+ biotite) schists; amphibolites, quartz-magnetite schists (banded iron formations), tremolite schists, cordierite-anthophyllite schists, garnet-mica schists and a variety of granulites (Lal et al. 1978). The orthogneisses are quartz-feldspar-mica gneisses which show overprints of two events of migmatisation, an older event characterised by prograde metamorphism upto sillimanite grade and a younger event related to a widespread acid magmatic activity that postdates the Shillong Group (Agarwal, 1996). This younger event has produced minor and localised anatectic-partial melting-induced coarse-grained granitoids. Migmatisation front, involving slow influx of quartzofeldspathic material and in situ growth of megacrysts in interfolial open spaces has transformed large segments
of the Gneissic Complex into "Megacrystic Gneiss" throughout the Meghalaya plateau. They occur as topographic highs. Such "Megacrystic Gneissic highs" have been called "plutons" by earlier workers (Anon, 1974; Mazumdar, 1976; 1986; Ghosh et al. 1991) with a Late Proterozoic to Early Palaeozoic (700-500Ma) age (Ghosh et al. 1991). However, the younger end of the date segment represents the last thermal event, i.e. the generation of anatetic-partial melting. The "Megacrystic Gneiss" does not show discordant field relationships with the enveloping suite of rocks while the coarse grained granitoid (last event) cuts through the former as well as the Shillong Group. This young granitoid, often shows porphyritic texture and consists of large K-feldspar phenocrysts in a matrix of quartz-plagioclase-biotite and subordinate hornblende with accessory minerals such as apatite, zircon and opaque phases (Maswood, 1979). The northeastern part of the plateau hosts Proterozoic intracratonic metasediments of the Shillong Group with a suite of coeval mafic intrusives known as the Khasi Greenstone. The Shillong Group, overlying unconformably the Precambrian basement gneisses, consists mainly of sandy and clayey rocks that have undergone low grade metamorphism (Ahmed, 1983). The dominant rock type is quartzite consisting of quartz grains in a sericitic matrix. The Khasi Greenstone occurs as hornblende and plagioclase bearing amphibolite and dolerite dykes within the gneisses (Rahman, 1981). This Precambrian–Early Palaeozoic milieu forms the basement for the succeeding Upper Palaeozoic-Cretaceous-Tertiary sedimentary package with a profound Jurassic volcanic affiliation comprising the Sylhet Traps (Anon,
1974). The general stratigraphy of the Assam-Meghalaya plateau (after Mazumdar, 1976; 1986) is shown in Table-2.1.

2.2 DISTRIBUTION OF THE ROCK TYPES AND THEIR FIELD RELATIONSHIPS:

The rock types in the study area in order of abundance are: quartzofeldspathic gneisses (occasionally migmatised), metacalcareous rocks (calc-silicate gneisses and hornblende gneisses), metabasic rocks (amphibolites), banded iron formations, basic dykes and quartzofeldspathic veins, pods and lenses. The geological map (Map-1) depicts the disposition of these rock types. Due to the absence of continuous key horizons or top and bottom criteria, the stratigraphic sequence of quartzofeldspathic gneisses, metacalcareous rocks, metabasic rocks and banded iron formations could not be established.

2.2.1 Quartzofeldspathic Gneiss:

This group includes northeast (NE) - southwest (SW) striking and subvertically to vertically dipping, monotonous bands of quartz-feldspar-biotite (occasionally hornblende) bearing gneiss. The rock is medium to coarse grained, well foliated and strongly banded. The bands consist of alternate layers of dark coloured ferromagnesian minerals and light coloured quartzofeldspathic minerals. The thickness of the individual layer varies between few mm and few cm. Concordant veins, thin bands of quartzofeldspathic minerals are conspicuous all throughout these rocks. At very few places, the finely foliated quartzofeldspathic gneiss grades into migmatite with distinct layers of palaeosome
and neosome measuring in cm (Plate 2.1a). The contact relationship with respect to the intercalated and co-folded metacalcareous rocks is generally gradational which was detected from the gradual change of colour of the quartzofeldspathic gneiss at the contact regions.

2.2.2 Metacalcareous Rocks:

The metacalcareous rocks include both calc-silicate gneiss (sensu-stricto) and hornblende gneiss. The spectacular feature on the mode of occurrence of these rocks is their intimate association in the field. These rocks are so closely associated that they can be expected in single exposure or even in thin section scale. However, the calc-silicate gneiss can be distinguished from the hornblende gneiss by its greenish colour which is due to high concentration of clinopyroxene in the former while the garnetiferous variety is easily identifiable on the basis of randomly oriented garnet porphyroblasts. There are general gradations of the metacalcareous rocks from one type to another within bands. Therefore, all these rocks were mapped together as a single unit along with the metabasic rocks (Map-1). The various modes of occurrence of the metacalcareous rocks in the area are: (a) small patches (Plate 2.1b) and boudins within the quartzofeldspathic gneiss, (b) fairly continuous outcrops of 10 m to 50 m in width and 30 m to 150 m in length and (c) discontinuous lenticular bands measuring several km in length (see Map-1). These prominent bands, conformable to the NE-SW striking quartzofeldspathic gneiss are located: (i) at the
southwestern part (north of Rangshai; longitudes: 90°24' E to 90°25'42" E; latitudes: 26°01'06" N to 26°03'26" N) which are 130 m to 800 m in width and their strikewise continuation reaches the length of ~ 4.5 km; (ii) at the middle part (north of Maladhara; longitudes: 90°27'30" E to 90°28'06" E; latitudes: 26°03'20" N to 26°04'56" N) where the band is ~ 3.5 km long and 330 m to 800 m wide; (iii) at the southeastern part near Deoli (longitudes: 90°29'20" E to 90°30'49" E; latitudes: 26°03'17" N to 26°05'13" N), the band runs discontinuously over ~ 4 km and (iv) at the north and northeastern part, several parallel bands run over 5 km, the continuity of these bands is, however obscured due to soil cover.

2.2.3 Metabasic Rocks:

The metabasic rocks which occur sporadically throughout the area represent amphibolite and garnetiferous amphibolite. These rocks occur as lenticular bodies of different dimensions and discrete layers within metacalcareous rocks and quartzofeldspathic gneisses. Amphibolites are difficult to distinguish from hornblende gneisses in the field. In general, amphibolites are massive or crudely foliated showing sharp contact relationship with the surrounding rocks (Plate 2.2a). However, garnetiferous variety can easily be identified by the presence of pink garnet porphyroblasts. The occurrence of the garnetiferous amphibolite is restricted to the vicinity of the banded iron formation. The metabasic rocks, although ubiquitous in the area, are not mappable separately and hence were considered as a single unit along with

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the metacalcareous rocks in the geological map (see Map-1).

2.2.4 Banded Iron Formation:

Several modes of occurrence of the banded iron formation include: (a) small inclusions (1 m to 2 m in dimension) within the metacalcareous-metabasic rocks; (b) thin layers (measuring a few cm) within large bands of the metacalcareous-metabasic rocks and (c) prominent band measuring up to hundreds of meters. The banded iron formation is distributed sporadically throughout the area. The most prominent band is located in the central part of the area (north of Maladhara; longitudes: 90°27'36" to 90°29'10"; latitudes: 26°3'30" to 26°5'; see Map-1). The band, traversing a good part conformably to the regional strike, is discontinuously exposed and gradationally merged into the metacalcareous and metabasic rocks which are exposed at the central part of the area.

2.2.5 Basic Dykes:

The rocks of the area are traversed by three prominent basic dykes in the southeastern part (see Map-1). The trends of the dykes are nearly north-south and they are characterised by chilled borders and straight and steep dispositions of walls. The dyke rock lacks any metamorphic imprint.

2.2.6 Quartzofeldspathic veins, pods and lenses:

This group includes pegmatite, aplite and quartz veins and pods (could not be shown in the geological map of the area; Map-
1). The modes of occurrence of quartz veins and pegmatites are as veins (Plates 2.2b; 2.3a), small lenses and patches (Plate 2.3b) within the quartzofeldspathic gneiss and sometimes in the metacalcareous-metabasic rock association. A few pegmatites are garnetiferous while majority of them are nongarnetiferous. Aplite occurs as thin concordant veins and pods, localised chiefly in the quartzofeldspathic gneiss.
## TABLE-2.1

### GENERAL STRATIGRAPHY OF THE ASSAM-MEGHALAYA PLATEAU

*(after Mazumdar, 1976; 1986).*

| Porphyritic Granite Plutons throughout Meghalaya and Assam, intrusive into all older suites; post-tectonic intrusions at the end of a major orogeny; extensively recrystallized. |
|---|---|
| **Intrusive Contact** | **Unconformity** |
| Khasi Greenstone | Mafic sills and dikes, mostly within Shillong Group; emplaced before metamorphism of Shillong Group but of uncertain relationship to major folding. |
| Shillong Group | Metamorphosed conglomerates, sandstones, siltstones and shales; metamorphism increases near Porphyritic Granite plutons; persistent NE strikes, with open folds alternating with areas of steep dips. |
| Nonporphyritic Migmatitic Granitoids | Amphibolite facies rocks within the Gneissic Complex; mobile, syn- to late- tectonic gneiss domes formed during the youngest phase of regional deformation. |
| Gneissic Complex | Various gneisses that represent a major deformational event; enclaves of augen gneisses may represent relics of an earlier orogeny. |
Plate 2.1a: Photograph showing migmatitic structure in the quartzofeldspathic gneiss. (Sectional view; Locality: Southeast of Nalanga Singimari; see Map-1).

Plate 2.1b: Photograph showing small patch of metacalcareous rock (MR) within the quartzofeldspathic gneiss. (Plan view; Locality: Near Chhat Damal; see Map-1).
Plate 2.2a: Photograph showing sharp contact relationship between the quartzofeldspathic gneiss and the metabasic rock (amphibolite). Hammer is on the quartzofeldspathic gneiss and pen, on the amphibolite. (Plan view; locality: Near Chatabari; see Map-1)

Plate 2.2b: Photograph showing quartz vein within the quartzofeldspathic gneiss. (Plan view; Locality: Northeast of Bamandanga; see Map-1)
Plate 2.3a: Photograph showing pegmatite vein within the quartzofeldspathic gneiss. (Plan view; Locality: Southeast of Chhat Damal; see Map-1).

Plate 2.3b: Photograph showing patches of pegmatite within the quartzofeldspathic gneiss. (Plan view; Locality: Rangshai; see Map-1).