CHAPTER-I
INTRODUCTION

1.1 Introduction

The Shillong Plateau covers parts of the states of Assam and Meghalaya. The southern edge of the plateau is the Dawki lineament (fault), and the northern edge is covered by alluvium of the Brahmaputra river. Precambrian rocks crop out throughout the plateau and in isolated areas in surrounding terrains. They are separated from the Chotanagpur area of the Singhbhum craton by the north-south trending Garo-Rajmahal gap. Along the eastern boundary of the plateau the Precambrian rocks disappear beneath folded sediments of the Assam area (Naqvi and Rogers, 1987, p. 163).

The area under review, Nongpoh is situated midway between Guwahati and Shillong and constitute an ideal section of the Precambrian metamorphic complex. Lithologically, the area is made up of quartzofeldspathic gneisses, hornblende biotite gneisses, dioritic rocks and granites, both porphyritic and non-porphyritic types and their late derivatives. The Nongpoh granite pluton which is intrusive into the Gneissic complex is one of the several shallow mesozonal plutons that intrude the Precambrian rocks of the Assam-Meghalaya Plateau (erstwhile Shillong Plateau), Mazumder (1986), (Figure 1.1).

1.2 Location and accessibility

The Nongpoh area is situated 60kms south of Guwahati city and is defined by the graticule lines 25°51' N - 25°52'30'' N (latitude) and 91°50'25'' E - 91°53' E (longitude). The total area studied as about 100 sq.kms.(approx.).
Nongpoh (544m MSL) is the headquarter of the Ri-bhoi district of Meghalaya a small town lying on the valleys of Umran and Umparli rivers. The area is connected with Guwahati and Shillong by allweather G-S Road (NH 40) with regular bus services from morning till evening. However, the interior parts of the area are not easily accessible as feeder roads are few and far between and are accessible through hired auto-rickshaws and Jeeps.

1.3 The Problem

The granites and the associated rocks viz. hornblende biotite gneiss, quartzofeldspathic gneiss (country rock) and dioritic rocks which occur as enclaves within the granites, are the main lithologic units. Within the granites there are different varieties such as porphyritic, coarse grained, medium grained and fine grained granite (aplitic type). Pegmatites, quartz and quartzofeldspathic veins are found to occur associated with these granites. Near the Southern boundary of the pluton migmatitic granitoids are found to occur which extends further south of the study area (Mazumder, 1976).

The different varieties of granites among themselves and with respect to the gneissic complex constitute a subject of considerable interest. Whether the variation among the different varieties of granites is due to difference in grain size or there is a space time relationship are the research queries.

Detailed geochemical work in the study area is lacking and the present work of the author is an endeavour to investigate the origin and emplacement of granites and the enclaves within
them, of the area under study in the light of contemporary concept of evolution of orogenic belts following a geochemical approach.

1.4 Objective and purpose

The main objective of the present work is to review the processes involved in generation and emplacement of Nongpoh granite pluton and its relationship with the associated rocks which occur mostly as enclaves within granites. The presence of country rock i.e., quartzofeldspathic gneisses within these granites is also an interesting feature. The present work is also an attempt to identify the diagnostic features of syn and post-orogenic phases of the local orogenic history which may serve as a model to decipher similar ambiguous relations between the granites and the gneisses that exist elsewhere in the plateau.

The purpose of the present work are as follows -

a) Detailed Geologic mapping of the granites and other lithologic units of the area with special emphasis on their field relations and contacts.

b) Attempts will be made to decipher the prominent episodes of magmatism involved in the basement gneisses on the basis of chronology of developments of different types of granites. Similar attempts will be made to identify the various macro and microstructural features and correlate them with deformational phases.

c) Detailed petrographic work on the various lithologic units of the area from thin section studies.
d) Geochemical studies will be made for important rock units, viz., the granites, the quartzofeldspathic gneisses (country rock) and the various types of enclaves in order to interpret their origin.

e) To establish the physico-chemical parameters controlling the crystallisation of granites on the basis of geochemical studies.

f) Whole rock Rubidium-Strontium isotopic systematics will be made on various types of granites to find out the age and source rock composition.

g) To compile and integrate data from previous works on comparable occurrences of granites of various parts of the world of known tectonic setting and to propose a model for the evolution of the granites in the study area.

1.5 Methodology

1.5.1 Collection of literature

The contacts between Gneissic complex and granites has always been a stratigraphical problem for the Indian Geologists since early times. On a controversial problem such as this where explicit hypotheses have not been formulated, it is often necessary for a researcher to make a review of the available literature in order to develop a hypothesis from it. The researcher has to take stock of these hypotheses to evaluate their usefulness for further research (Wilkinson et al., 1993). Keeping this in mind the author collected all relevant publications on the above mentioned subject from the published journals from India and abroad and their reprints were collected from the libraries.
of various organisations like A.M.D. Shillong, A.M.D. Bangalore, G.S.I. Nagpur, G.S.I. Jaipur, P.R.L. Ahmedabad, W.I.H.G. Dehradun, Geological Society of India, Bangalore, Indian Academy of Science, Bangalore and Universities like J.N.U. New Delhi, Delhi University, Osmania University, Anna University, M.S. University of Baroda and I.I.Sc. Bangalore during the authors visit to these places for attending workshops / Seminar / Presentation of papers.

1.5.2 Designing a Database

A computerised database on granites was designed on WINDOWS platform using MICROSOFT ACCESS in the Department of Geology, Delhi University during SERC Summer School (NMCMP-V) for quick retrieval of required data on granite case studies, which is still in process (Appendix A).

1.5.3 Field Survey

Extensive field survey was carried out with the help of the Geologists and staff members of the Directorate of Mineral Resources, Govt. of Meghalaya to trace the contacts of different lithological Units. Altogether about ten months were spent in the field to complete the field work in four phases in the year 1995, 1996, 1997 and 1999. Mostly the work was done in the months of October to March to cover an area of 100 sq.kms. (approx.).

A base map of the area was prepared enlarged from Toposheet no.78 0/13 in 1:50,000 scale published by the Survey of India (Figure 1.2). No major change in the topography and relief of the area was observed except minor changes in the alignment of the streams.
Thick vegetative cover, paucity of outcrops inaccessible terrains and severe restrictions imposed by weathering were the main hurdles faced by the author. Systematic sample collection and field studies were made on exposures on the road and stream cuttings as well as several working and abandoned quarries at places like Garikhana, Pahamrioh, Nongpoh Proper, Umden Road, Marangar and Saiden. Field facilities rendered by the Geologists and staff members of the Directorate of Mineral Resources (D.M.R.), Govt. of Meghalaya, base camps at Saiden including the service of the departmental jeep made the task much easier and time saving for the author. A number of drill core samples collected from the D.M.R. provided valuable sub-surface informations and needed reliability for geochemical and geochronological investigation. The field relations of the various rock units were investigated with due emphasis on contacts and important structural features were recorded and photographed wherever found necessary.

Representative rock samples were collected from various exposures for petrographic and chemical analyses. In the porphyritic granites, the length and breadth of K-feldspar phenocryst more than 20 sq.cm.size (ascertained through staining) within areas of 900 sq.cms. were measured at places to incorporate the value in the thin section modal analysis of the granite (Hibbard 1965). Elongation direction of the phenocrysts (200 grains) of porphyritic granites were recorded at several places for statistical analysis.

Special attention was given to the enclaves / xenoliths of mafic rocks within granites and samples were collected wherever
possible for petrographic study and geochemical analysis.

1.5.4 Analytical methods

Four sets of thin sections were prepared from each representative rock samples collected in the field and detailed petrographic studies were made under microscope.

Volume percentage of minerals present in the various rock types were carried out with the help of Swift's point counter. The stage with an east-west point spacing of 0.3\text{mm} was used with a microscopic magnification of 40X for the mafic rocks and 10X for the porphyritic granites and quartzofeldspathic gneisses.

In the case of porphyritic granites thin sections of phenocrysts and ground mass were prepared separately for modal analyses. These sections were stained for potash-feldspar following the procedure given by Chayes (1952) and Rosenblum (1956).

The study of the grain contacts between constituent minerals and the occurrences of sodic rim (albite) around plagioclase, in the granites were studied.

For geochemical analyses 28 nos. of rock samples were selected on the basis of thin section studies so that each of the major rock units are represented. The rocks were broken into small chips which are quartered and coned were crushed in high grade rock crusher containing agate plates followed by an agate mortar and pastle till all materials pass through a 200 mesh sieve. In case of porphyritic granite where phenocrysts are very large, samples weighing about 8 to 10 kgs were crushed and the volume is reduced by sequential quartering and coning.
Chemical analyses for Major and trace element were carried out at the laboratories of Wadia Institute of Himalayan Geology, Dehradun, Keshav Dev Malaviya Institute of Petroleum Exploration, ONGCL, Dehradun and U.S.I.C. Gauhati University on X-ray fluorescent Spectrometer.

Geochronological studies were made for few samples of granitic composition with the help of Mass Spectrometer at Geochronological Laboratory of KDMIPE, ONGCL, Dehradun.

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