CHAPTER – III
METHODOLOGY AND DATABASE

3.1 INTRODUCTION

Research activity requires a properly designed methodological approach to fulfill the aim of the research. A strong, nearly complete, reliable database is essential for a good study. The present chapter dwelt with methodology and database used to achieve the goal of the present research. The methodologies applied and database used in the study are outlined in this chapter. In the present piece of work, the adopted sequence of approach are broadly outlined below –

(a) Selection of study area and establishing a complete stratigraphic section in the Weiloi-Mawsynram to examine the character of K-T boundary from Cretaceous Mahadek to Langpar/ Therria Formations of Palaeocene age.

(b) Survey of India (Sol) toposheets in 1 inch=1 mile (Surveyed period 1910-11) scales to prepare a base map of the study area and its surroundings. However, Weiloi-Mawsynram section is adopted from Sol toposheet No.78O11/SW on 1:25,000 scale (Surveyed period 1979-80).

(c) Geological field work for detail investigation of the study area along with collection of rock samples and than generation of field database.

(d) Laboratory works involving study of the physical properties, texture, petrography and geochemistry of the sedimentary rocks in the transition section.

(e) Collection of secondary data from different sources, viz. published documents, research articles etc.
Finally to integration of the data obtained from the field survey as well as from the laboratory has been made and interpretations and conclusions are drawn there from.

3.2 METHODS OF INVESTIGATION

The investigation of the study area has been carried out in three distinct segments – (i) pre-field work; (ii) field work, and (iii) laboratory work. Most of the times the above works continues simultaneously, due to inherent nature of the research work.

3.2.1 Pre-field work

At the very beginning literature survey on the research problem has been carried out which covering international and national level works. Than for proper selection of the study area a base map is prepared with the help of Survey of India Toposheets No.780/11 surveyed in 1910-11 and 78011/SW surveyed in 1979-80 along with some published works of several workers mentioned in Chapter-I of this thesis.

3.2.2 Field work

Field work has been carried out to obtain information on the litho-units, such as, colour, grain size, sedimentary structures etc. Attitudes of the sedimentary beds and structural features, thickness of individual litho-units have been measured and documented. Collection of rock samples were carried out along several vertical sections in the Cretaceous-Tertiary transition stratigraphic sequence along Weiloi-Mawsynram transect in Meghalaya. Hand held GPS (Global Positioning System) was used to note location points during field work. Field photographs of important features have been taken. As the research problem is related to Characterization of Cretaceous-Tertiary transition boundary, so initially the field work is divided into three parts-
(i) Study of the Bottom Conglomerate Formation (Cretaceous)

Pebble analysis was done by measuring the Long (L), Intermediate (I) and Short (S) axis of pebbles as well as orientations are taken for long axis of pebbles in the studied section. Samples were collected depending on colour variation of matrix material and also from sandstone lenses present in the studied section.

(ii) Study of the Mahadek Sandstone (Cretaceous)

Above the Bottom Conglomerate Formation the fluvial and marine deposits of Mahadek sandstones lies and shows a conformable relationship with it. Samples were collected depending on the colour, grain size variation etc. Also sedimentary structures observed in the sandstones have been measured using Brunton compass, protectors, scales and tapes, and photographed for documentation.

(iii) Study of the Langpar Sandstone (Cretaceous-Tertiary)

The Langpar sandstone shows an erosional contact/hiatus with the underlying Mahadek Sandstone as observed in the field locally, though in general they have conformable relationship. Samples from the section have been collected through vertical profiling at close spacing depending on their distinct, visible physical variations.

Since the Langpar sandstone has been considered as a transitional section from Cretaceous to Tertiary, the vertical sampling has been carried out at much narrow intervals. In one of the sections in the present study a red shale laminae has been identified within the Langpar Sandstone Formation and careful sampling was done to evaluate it for meteoritic dust (if any) largely acclaimed as a product of catastrophic meteoritic impact of K-T transition time (Alvarez et al., 1980, 1982; Bhandari et al., 1994). In this section, samples
were collected at an interval of about ~25 cm from sandstone beds, and samples were collected at about ~10-80 mm intervals from the shale unit along with the limonitic layer and the immediately underlain and overlain associated shale lamina. To avoid contamination during sampling of the shale unit very thin and sharp needle like bamboo sticks were used for sampling the shale layers.

3.2.3 Laboratory work

The samples collected from the field work were utilized for various laboratory investigations of which some were done in the Department of Geological Sciences and USIC (University Sophisticated Instrumentation Centre), Gauhati University and also in NGRI (National Geophysical Research Institute), Hyderabad.

The following tests have been carried out in the laboratory –

(i) Grain-size analysis for the unconsolidated sediments.

Grain-size analyses of the collected samples were first air dried and then sieving is done at half-phi interval using the conventional sieve and pipette method (Krumbein and Pettijohn, 1938) in the laboratory of Department of Geological Sciences, Gauhati University, Guwahati.

(ii) Thin section preparation for petrographic, heavy mineral study.

Thin sections are studied under the Laborlux 11 pol microscope and Carl Zeissss's Axioskope 40 pol microscope in the laboratory of Department of Geological Sciences, Gauhati University, Guwahati.

(iii) XRFS (X-ray fluorescence spectrometry), XRD (X-ray diffractogram) study of sandstone, clay and shale samples for geochemical and mineral identification study.

XRD is carried out for mineral identification (especially for clay minerals). In the present study samples were analyzed in the USIC
(University Sophisticated Instrumentation Centre) of the Gauhati University. For XRD study, powdered samples were gently pressed in a sample holder of size 20x15x0.2 mm³. The samples are irradiated by the Cu-\(\alpha\) radiation of wavelength 1.54056 \(\AA\) in Philips model X'Pert Pro and when the Bragg's diffraction condition is satisfied the peaks were arrived at different position which are shown in the diffractogram. Comparing the d-values and intensity values obtained from the ICDD database finally the results are found. Software used for this analysis are X'Pert High Score Plus as well as using Standard book for XRD data correlation—"Selected Powder Diffraction Data for Minerals" (1st Edition), Published by Joint Committee on Powder Diffraction Standards, 1601 Park Lane, Swarthmore, Pennsylvania 19081.

XRF spectroscopy techniques of analysis were carried out for major oxides. The XRF spectroscopy is widely used for the qualitative and quantitative elemental analysis of powdered samples. In the present study, the samples were analyzed at SAIF (Sophisticated Advance Instrumentation Facility) in the USIC Department of the Gauhati University using XRF machine (PAN analytical make, Model-Axios) using beads prepared from the powered sediment samples. The bead is prepared by 4g Lithium tetra-borate, 1g Lithium carbonate, 1g sample (powder). The beads were fused in a Au-Pt crucible at 1100°C. All the analyses were done by using X40 software.

(iv) ICP-MS (Inductively Coupled Plasma Mass Spectrometry) analysis for trace elements, rare earth elements (REE) and Platinum group of elements (PGE) for geochemical study.

ICP-MS is one of the advanced analytical techniques used for the estimation of elements from Li to U in the periodic table in a variety of samples. The ICP-MS is the most simple and direct method of chemical analysis. The sample to be analyzed is introduced into argon-based high temperature plasma by a nebulizer spray chamber system. The sample stream causes desolvation, vaporization, atomization and ionization of target elements. Ions, thus generated, are extracted from the plasma into a low-pressure region through a sampler and skimmer cones and are allowed to pass through an
electrostatic lens system, which extract positively charged ions. These ions are separated on the basis of their mass-to-charge ratio by quadrupole mass analyzer. A detector counts the filtered ions and a computer processes the resulting information. All the samples are analyzed at NGRI (National Geophysical Research Institute), Hyderabad. Instrument used for this analysis is: PerkinElmer Sciex ELAN DRC II.

(v) EPMA analysis in search of Glauconite mineral.

Only one slide for EPMA was carried out in GSI (Geological Survey of India) Laboratory, Kolkata.

(vi) Preparation of lithological profiles from the field data.

(vii) Preparation of geological map of the study area using field data, satellite image (IRS LISS-III, 2008) as well as other published maps. After compilation of the data, maps were prepared using EARDAS 8.7 and Arc-GIS 9.0 softwares.

(viii) Topographic profiles were prepared from SRTM (Shuttle radar topographic mission) digital elevation model using Global Mapper 9 software.

3.3 DATABASE

The databases used in the study are of two types – (i) primary data, and (ii) secondary data, and discussed under the following heads.

3.3.1 Literature survey and collection of secondary data

Literatures have been collected from the libraries of the Gauhati University, various journals and E-journals. Secondary data have been collected from different authors published maps; survey data; diagrams and plots for petrographic as well as geochemical studies from journals and books, etc. and references has been given in respective position in the text.
3.3.2 Primary data

Primary data have been collected in the field, derived from the laboratory works of the collected samples, and also derived from the analysis of the satellite based remote sensing data using digital image processing and geographic information system.

3.4 SYNTHESIS AND INTEGRATION OF DATA

Synthesis and integration of data have appropriately been done and interpreted to characterise the Cretaceous-Tertiary transition boundary in the Weiloi–Mawsynram area of Meghalaya, India.