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### **The Campanian-Maastrichtian Foraminifers from the Exotic Limestone of Naothalung Block in Hungpung Village Ukhrul District, Manipur State, Northeast India**

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#### **ABSTRACT**

Planktic and benthic foraminifers of the Upper Cretaceous (Early Maastrichtian – Late Campanian) from the exotic limestone block of the Naothalung area, Ukhrul region, Manipur Ophiolite Belt, have been studied the foraminiferal assemblages and age determined. The presence of the exotic limestone blocks varies in size a few centimetres to tens of meters compiled of micritic limestone, sandstone, marl, basic rocks and conglomerate embedded in matrix of flyschoid rocks were recognised in the mélangé zone and usually the limestones from these blocks are mostly calcitic, hard, crystalline and creamy white, greyish in colour. Planktonic foraminiferal zonation from bottom to top of the succession consist of the zones defined by *Gansserina gansseri*, *Globotruncana aegyptiaca*, *Globotruncana aegyptiaca*, *Globotruncana aegyptiaca*, *Globotruncana aegyptiaca*, *Globotruncana aegyptiaca*.

**KEYWORDS:** Campanian, Maastrichtian, Exotic Limestone, Manipur Ophiolite Belt, NE India

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## INTRODUCTION

The occurrences of cretaceous flysch associated limestone in Manipur, Northeast India was first reported and one of the early workers of a broad geological account of Manipur. Further, He correlated the limestone bearing bed around Ukhrul as “Axials of ArakanYoma”, the southern tectonic equivalent of the Manipur Hill ranges.<sup>1</sup> and it has been reported that similar limestone from the adjoining Burma (Myanmar) part of the Indo- Burmese range and suggested a cretaceous age to these exposures.<sup>2</sup>

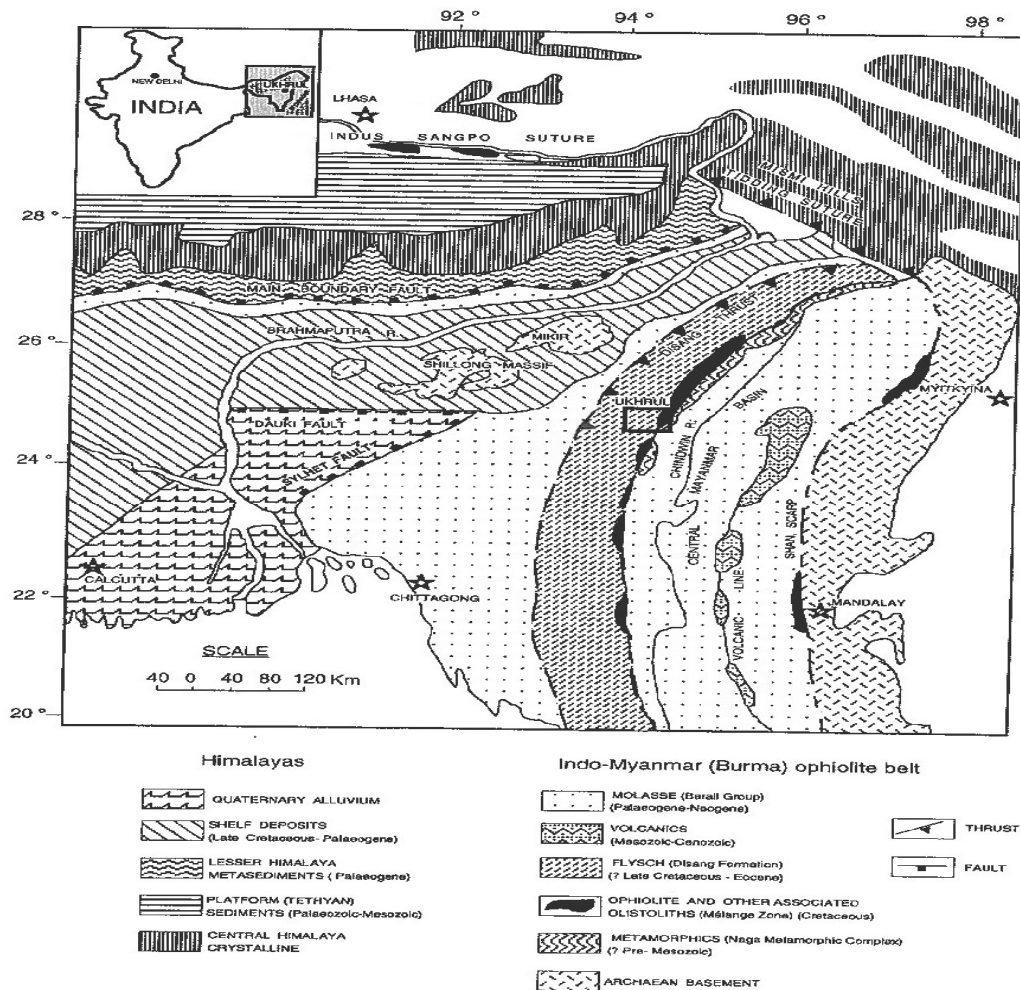


Figure 1. Geotectonic Sketch Map of North-Eastern India and the Adjoining Regions (After Acharyya et al<sup>3</sup> and Mitchel (1993)<sup>4</sup>).

It has been made a detail study of the stratigraphy and palaeontology of rocks of the eastern parts of Manipur<sup>5</sup>, They reconstructed the stratigraphic succession as follows: Shirui Formation, Ukhrul Formation and Lamlang Formation. A number of foraminifera, Corals, Ostracoda, Pelecypoda and Gastropoda from fossilized limestone blocks are recorded and they also opined that

the limestone of Manipur part of the Indo-Burma orogene are like those of the contiguous Chin hills, Arakan-Yoma and coastal Burma (Myanmar) where such exotic floaters have been noted within (Palaeocene-Lower Eocene) rock association (Shale-Siltstone geosynclinal flysch facies). The ophiolite suite rocks of the olistostromal blocks limestone have been reported that the radiolarians and foraminifers contains mainly foraminifers varying in age from Maastrichtian to Palaeocene and Lower to Middle Eocene<sup>6</sup>. Chungkham Prithiraj et al (1992)<sup>7</sup> found that the foraminiferal assemblages of the exotic blocks in the Melange zone of Ukhrul area provided data on deep oceanic sediments in Late Cretaceous and their subsequent abduction along the eastern margin of the Indian plate. Similarly, Chungkham and Caron (1996)<sup>8</sup> compared the study of foraminifer assemblages of Ukhrul Melange zone of Manipur with the wildflysch zone of Switzerland, two distant parts of the Tethys Sea. Chungkham and Jafar (1998)<sup>9</sup> worked out the preserved assemblages of Foraminifera and Coccoliths from the pelagic limestones of Melange zone of Manipur ophiolite belt of Ukhrul area. The biostratigraphy of the exotic limestone blocks of Ukhrul area are extensively a Late Santonian, Early Campanian to Late Maastrichtian time slice was also postulated.

Whereas in this paper deals with the planktic foraminiferal, benthic foraminiferal assemblages and ages of the particular pelagic limestone blocks which lies on the exotic limestone blocks (olistoliths) of Naothermalung area at Hungpung village, Ukhrul region, Manipur Ophiolite Belt.

## **GEOLOGICAL SETTINGS**

Manipur is a small state situated in the Northeastern corner of India bordering with the Union Socialist Republic of Myanmar (Burma). It lies between 23°50' N – 25°41' N latitudes and 93°00'E – 94°45'E longitudes having an area of about 22,327 km<sup>2</sup>. The hills of Manipur lies between the Naga-Patkai hills on the north and northeast, and the Chin-hills on the South part of the Indo-Myanmar (Burma) Ranges (IMR). The ophiolites and the associated suite of rocks are exposed in Manipur which is in the eastern border between India and Burma (Figure.1), along these a part of northerly extension Sunda Arch – Trench System linking the Alpine - Himalayan and the Andaman – Nicobar Islands<sup>10,3,11,12</sup>. The edge of the eastern part of India plate collided with the Eurasia<sup>13</sup> and the ophiolites of Naga – Andaman belt are imputed to the ongoing Andaman – Java subduction activity which began since Cretaceous in time and extends northward in space Karig et al (1979)<sup>14</sup>, Curray et al (1982)<sup>15</sup>, Mukhopadhyay and Dasgupta (1998)<sup>16</sup>, and these ophiolites are located within the accretionary prism Moores et al (1984)<sup>17</sup>. And the state is dominantly made up of Tertiary and Cretaceous along with the minor igneous and metamorphic rocks associate with sediments such as limestone, chert, shale and sandstone<sup>18</sup>.

## STUDY AREA

The study area of Naothermal blocks are located in a hilly region which is (1750 meters above the MSL) and a part of the “Mélange zone” in Hungpung(erstwhile Hundung) village, Ukhrul District, Manipur. Where the limestones are exposed along with great thickness of Upper Disangshales on the eastern and western ridges. The upper part of Disang Group shows an olistostromal deposits with olistoliths of mainly fossiliferous limestone, varying in dimensions from a few meters to 1 km. It lies within 94°20'17" and 94°20'43" East longitudes and 25°02'43" and 25°02'71" North latitude and the regional trend of the beds is NNW-SSE with a westerly dip between 20° and 25°. The study area situated at 4 km from the HungpungKazipphung village and 76 kms from the east of Imphal city (Figure 3). In this area, it has three blocks and denote as Naothermal (NA) which is in the North, (NB) in the South west (middle) and (NC) in the south. The limestone are generally massive, fine-grained, cream white in colors, varying shades of grey, and brown, and highly jointed at places and the study area are well covered by vegetation (Figure 2). The microfossils of foraminiferal were recovered from these three limestone blocks comprise of planktic foraminifera and benthic foraminifera.

The presence of the exotic blocks compiled of micritic limestone, sandstone, marl, basic rocks and conglomerate embedded in matrix of flyschoid rocks were recognised in the mélange zone. The foraminiferal assemblage of limestone suggests a wide, upper Cretaceous (Maastrichtian) to Oligocene age range supporting their exotic nature in the mélange zone (Vidyadharan and Joshi (1984)<sup>19</sup>, Vidyadharan et al(1989)<sup>20</sup>. And it has been reported the olistolithic limestone deposit of pelagic limestones and chert could be hitherto dated as Late Cretaceous (Late Santonian to Late Maastrichtian) (Acharyya et al (1986)<sup>3</sup>; 1989)<sup>11</sup>, Mitra et al (1986)<sup>21</sup>, Chungkham et al (1992)<sup>7</sup>, Chungkham and Caron (1996)<sup>8</sup>, Chungkham and Jafar (1998)<sup>9</sup>.



**Figure 2. (a) Photograph Showing the Study Area Covered by Vegetation of the Exotic Limestone Blocks. (b) Sample Collection from the Study Area.**



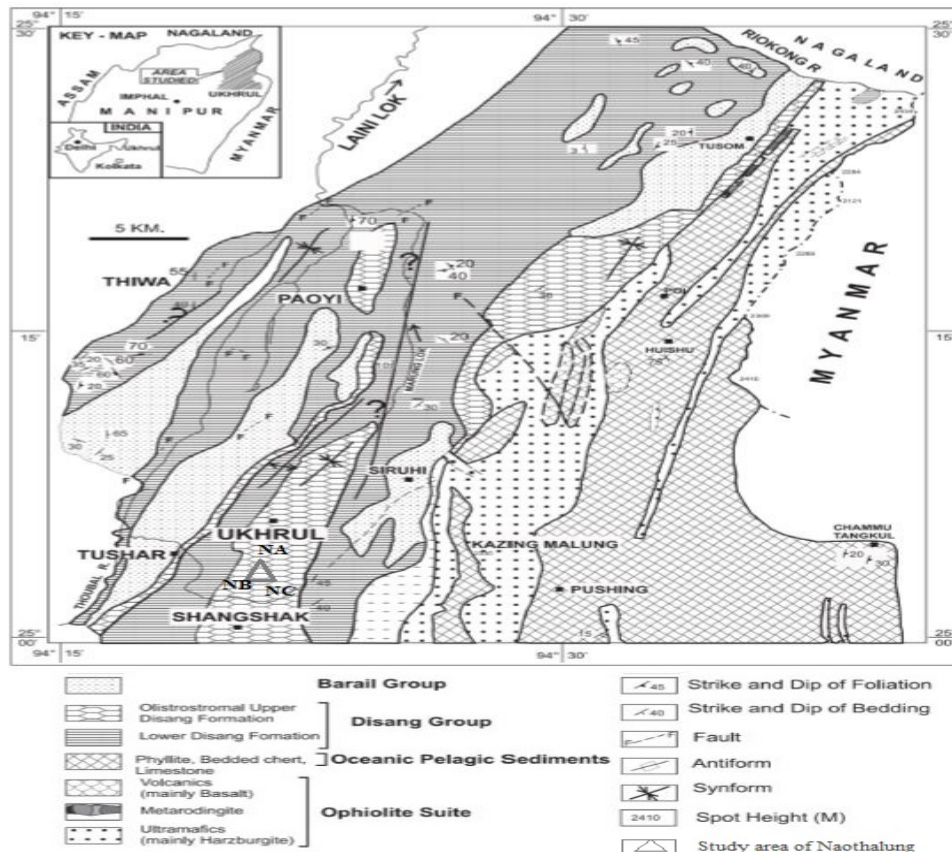


Figure 3. Geological Sketch Map of the Study Area, After Joshi and Vidyadharan, (2008)<sup>22</sup>

NA – Naothermalung A Block, NB – Naothermalung B Block, NC- Naothermalung C Block

## MATERIALS AND METHODS

Forty nine geological samples were collected and processed for the study of foraminifera from the three limestone blocks, Ophiolite mélangé zone at Naothermalung area Hungpung Village. In the field, the samples are collected in a systematic manner where the limestones are exposed. Due to hard and crystalline, they do not disaggregate under the process of normal treatment of Hydrogen Peroxide. After treatment various methods and persistent trials, finally the limestone could be disaggregated with the help of a modified version of a maceration technique developed by Zolnaj (1979)<sup>23</sup>.

The samples were collected from various litho-units. The relevant exposures/sections are marked in the field. Samples collected in the field in systematic manner. Before obtaining a sample, the surface of the exposure needs to be cleared of weathered material and packed in a sample bag. Usually 500 gm of each sample is taken for Micro paleontological analysis. According to Zolnaj (1979)<sup>23</sup> of a modified version of a maceration technique developed, the modified version is given as - The Limestone is broken into chips of 1 cm and slightly lesser sizes with the hammer. The Limestone chips and copper sulphate crystals are mixed and put inside a glass beaker of any size

depending on the quantity of the mixture. The quantity of copper sulphate crystals is approximately half of that limestone chips used. Concentrated acetic acid is poured up to the level to cover the mixture. This treatment is kept for 3 to 4 days till the whole mixture turns into a paste. Then the paste is washed and sieved. The undigested chips can be dried and treated again by the same procedure. After the samples were washed in ASTM 230 sieves, the washed samples were then dried in the Hot Air Oven (HAO). Further, the dry sieving was carried out in ASTM mesh no.20, 40, 60, 80,100 and 120. The different ASTM mesh dry sample poured into a tray in a single layer of grains and the fossils are picked with moistened brush by using Stereo Zoom Microscope. The brush should make pointed and place it in a hovering position over the field of the microscope. The moistened brush is lowered over the specimen desired and allowed to touch the surface, to which the specimen will adhere and transferred to Micro paleontological slides (24 squares) made up of cardboard, which is divided into compartments by white lines. Furthermore, it processed for the identification and SEM Photograph.

The basic reaction in this treatment is that the concentrated acetic acid attacks the rocks rapidly but it starts digesting the matrix of microcrystalline calcite (micrites) first and only later the calcified skeletal grains. If diluted acetic acid of any strength is used the reaction is much slower and the matrix and the skeletal grains are digested simultaneously. The copper sulphate acts as an anti-reactant to stop the complete digestion of the skeletal grains. However, if the treatment is kept for a long time or more than 6 days then the whole of the rock is digested.

## **PLANKTONIC FORAMINIFERA**

The foraminifers are taxonomically classified using the “Foraminiferal Genera and Their Classification” by Loeblich and Tappan (1988)<sup>24</sup> and Biostratigraphic classification followed by Robaszynski and Caron (1985)<sup>25</sup>.

### ***Gansserina gansseri***

**Category:** Interval zone

**Definition:** The zone of *Gansserina gansseri* Interval zone was defined by Bronnimann (1952). It defined that the zone marks the interval from first occurrence of *Gansserina gansseri* to first occurrence of *Abathomphalus mayaroensis*.

**Remarks:** This zone marks due to the occurrence of marker planktonic foraminiferal species *Gansserina gansseri* and *Abathomphalus mayaroensis*. not found in this blocks. The species found in the sample NC01, 02, 03, 04, 07 and 09. It ranges from Late Campanian to Late Maastrichtian. The associated planktonic foraminifera are *Contusotruncana contusa*, *Globotruncana aegyptiaca*, *G. arca*, *G. lapparenti*, *G. linneiana*, *G. ventricosa*, *Globotruncanita stuarti*, *G. stuartiformis*, *Heterohelix globulosa*, *Pseudoguembelina costulata*, *Pseudotextularia elegans*.

### ***Globotruncana aegyptiaca***

**Category:** Interval range zone

**Definition:** The zone of *Globotruncana aegyptiaca* Interval range zone was defined by Caron (1985). It defined that the zone marks the interval from the first occurrence of *Globotruncana aegyptiaca* to first occurrence of *Gansserina gansseri*.

**Remarks:** This zone marks the presence of the marker foraminiferal species *Globotruncana aegyptiaca*. The associated planktonic foraminifera are *Contusotruncana contusa*, *Globotruncana arca*, *G. bulloides*, *G. lapparenti*, *G. linneiana*, *G. ventricosa*, *Globotruncanita stuarti*, *G. stuartiformis*, *Heterohelix globulosa*, *Pseudoguembelina costulata*, *Pseudotextularia elegans*.

### ***Globotruncanella havanensis***

**Category:** Partial range zone

**Definition:** The zone of *Globotruncanella havanensis* Partial range zone was defined by Caron (1978) as the range was nominate taxon between the last occurrence of *Globotruncanitalcarata* to first occurrence of *Contusotruncana contusa*.

**Remarks:** Important planktonic foraminifera recognized in this zone are: *Gansserina gansseri*, *Globotruncana arca*, *G. bulloides*, *G. lapparenti*, *G. linneiana*, *G. ventricosa*, *Globotruncanita stuarti*, *G. stuartiformis*, *Globotruncanella havanensis*, *Heterohelix globulosa*, *Pseudotextularia elegans*.

### ***Globotruncanitalcarata***

**Category:** Total range zone

**Definition:** The *Globotruncanitalcarata* Total range zone was defined by Herm (1962).

**Remarks:** This zone marks the interval of total range of *Globotruncanitalcarata*. This zone assigned as Late Campanian in the NA block which is total range occurrence of marker foraminifera species *Globotruncanitalcarata* are found in the sample NA04, 05, 07, 09, and 10 (see Figure 3). Which represents first appearance NA04 and last appearance NA10. The important planktonic foraminifera recognized in this zone are: *Globigerinelloides prairiehillensis*, *Globotruncana arca*, *G. bulloides*, *G. lapparenti*, *G. linneiana*, *G. ventricosa*, *Globotruncanella havanensis*, *Globotruncanita elevata*, *G. subspinosa*, *G. stuarti*, *G. stuartiformis*, *Heterohelix globulosa*, *Pseudoguembelina costulata*, *Pseudotextularia elegans*.

### ***Globotruncana ventricosa***

**Category:** Interval Zone

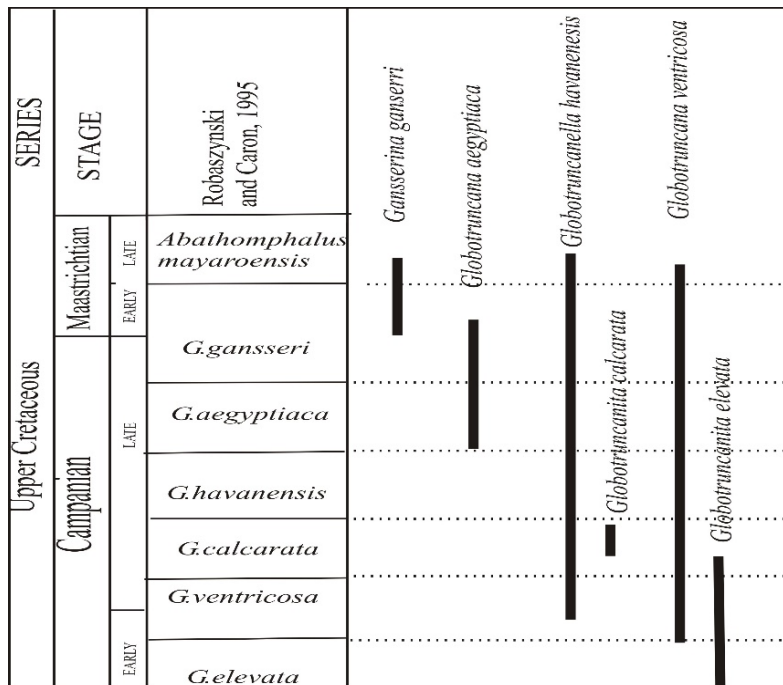
**Definition:** The zone of *Globotruncana ventricosa* Interval Zone was defined by Dalbiez (1955).

**Remarks:** This zone marks due to the occurrence of marker planktonic foraminiferal species *Globotruncana ventricosa*. It ranges from the *G. ventricosa* zone to *G. Gansseri* zone that is Early





Table.2.Stratigraphic ranges of the marker planktonic foraminifera species with the planktonic foraminiferal zonation.



## RESULT AND CONCLUSION

A wide distribution of planktic foraminifers are found to be vary from rare to high and well preserved whereas benthic foraminifers are found only in the Naothalung C Block. Foraminiferal are yield in good result of all the sample collected, 19 genera and 32 species planktic and benthic foraminifera are found in this study area. The study of Naothalung blocks reveals the age from the Early Campanian to Late Maastrichtian. Topmost NaothalungA Block found the oldest age (Late Campanian), Naothalung B block found the Early Campanian whereas Naothalung C Block found the youngest age (Late Maastrichtian). Presence of the marker planktonic foraminifera species established six biozone, (i) *Gansserina gansseri* Interval zone (ii) *Contusotruncana contusa* Interval range zone (iii) *Globotruncanella havanensis* Partial range zone (iv) *Globotruncanitalcalcarata* Total range zone (v) *Globotruncana ventricosa* Interval Zone (vi) *Globotruncanitalaelevata* Partial range zone.

The planktic foraminifera obtained in the present study are as follows: *Contusotruncana fornicata*, *Contusotruncana patelliformis*, *Gansserina gansseri*, *Globigerinelloides bentonensis*, *Globigerinelloides prairiehillensis*, *Globigerinelloides volutes*, *Contusotruncana contusa*, *G.arca*, *G.bulloides*, *G.lappararenti*, *G.linneiana*, *G.ventricosa*, *Globotruncanital calcarata*, *G.elevata*, *G.petteri*, *G.subspinoso*, *G.stuarti*,

*G.stuartiformis, Globotruncanellahavanensis, Heterohelixglobulosa, Marginotruncanaundulata, Pseudoguembelina costulata, Pseudotextulariasp., Pseudotextulariaelegans,*

And the recorded benthic foraminifera obtained in the present study are as follows: *Bolivinasp, Bolivinoideasp., Fissurinasp., Fissurinaorbignyana, Dentalinasp., Gaudryinapyramidata,, Nodosariaobscura, Pseudonodosariasp..*

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