

PALYNOSTRATIGRAPHY OF THE SEDIMENTARY FORMATIONS OF ASSAM, INDIA: 4. AGE OF THE LAITRYNGEW-MAWKMA COAL-BEARING SANDSTONES AND THEIR RELATIONSHIP WITH THE CHERRA FORMATION*

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ABSTRACT

The present paper deals with the age of the coal-bearing sandstones of the Laitryngew-Mawkma area and their relationship with the Cherra Formation. Climatic condition and depositional environment at the time of deposition have been summarized. Since Medlicott first distinguished the coal-bearing sandstones of Laitryngew-Mawkma area, the age of these rock units have tacitly been accepted as "Lakadong Sandstone Stage" (Lower-Middle Eocene). On the basis of stratigraphical similarity they have been equated with the coal-bearing sandstone of Mawmluh (Lower Cherrapunji; Longitude 91°42'30"E; Latitude 25°15'15"N). Recent palynological and palaeontological studies of the sedimentary formations of the South Shillong Plateau have shown that these coal-bearing sandstones may be slightly older than what they were previously regarded. The results of the heavy mineral studies also seem to conform to the palynological dating.

Since these sandstones apparently seem to be older than the Lakadong Sandstone, they may be a continuation of the sedimentary succession developed at Cherrapunji, and hence Palaeocene in age. The fossils suggest prevalence of sub-tropical climate and a shallow, fresh-water or lagoonal environment of deposition.

INTRODUCTION

IN the absence of lithological markers, the identification and correlation of the Upper Cretaceous-Lower Palaeogene rocks of the South Shillong Plateau have, so far, been largely based on marine invertebrate fossils. The invertebrate fossils are restricted to the Mahadeo, Langpar (Cretaceous) and the Lakadong Limestone member (Lower-Middle Eocene) of the Sylhet Limestone Formation. There is a thick development of non-marine sediments between two limestone bands, the lower belonging to the Langpar Formation (Danian) while the upper limestone band forms the basal member of the Sylhet Limestone Formation

(Lower-Middle Eocene). This non-marine section consists primarily of sandstones, intercalated with three coal-seams, shales and clays. Considerable difficulties have been encountered in the recognition and lateral tracing of this succession even in nearby sections. This is because of absence of distinctive marker beds, absence of palaeontologic fossils and the nature and development of this succession at different parts of the basin. The Cherra sequence, best developed near Cherrapunji, could not be reliably correlated with another well-developed sequence at Therriaghat, a few miles south-east of Cherrapunji. Consequently two formation names were erected for these local developments. The sequence at Cherrapunji was named as Cherra Formation while the other was named as Therria Formation. From a perusal of relevant literature it becomes apparent that similar difficulties were encountered in attempts to correlate, from surface exposures, the coal-bearing succession of Laitryngew-Mawkma area. As a result the age and stratigraphical position of the Laitryngew-Mawkma sequence has remained an open question. Correlation based on palynological markers, however, seems to provide a reliable basis for dating this sedimentary sequence.

The first reference to the age of the sandstones at Laitryngew and Mawkma was made by Medlicott (1869) who first recognized these stratigraphic units and assigned a Nummulitic age (equivalent to the Shylhet Limestone Formation).

Palmer (1923) indicated that these sandstones were equivalent to the Cherra Formation and placed them at the top of the Cretaceous sequence.

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Ghosh (1940) mapped the area and on lithological and structural grounds regarded the Laitryngew-Mawkma coal-bearing sandstones as equivalent to the Lakadong Stage (Lower-Middle Eocene).

Evans (1932) suggested an Upper Eocene age for these coal-bearing sandstones.

Based on the occurrence of an angular unconformity between the underlying Langpar Formation and the overlying Cherra Formation, together with palaeontological evidence, Dutta (Dutta *et al.*, 1964) first opined that the limestones occurring at Laitryngew, Umstew and Mawkma belong to the Langpar Formation and the coal-bearing sandstones that immediately overlie these limestones formed the base of the Tertiary sequence.

Later, in the same year Bagchi made a comparative study of the invertebrate fossils from the type area of Langpar with those of the Laitryngew Limestone. He supported Dutta and concluded that the Laitryngew Limestone is a lateral continuation of the one occurring at Langpar.

This paper presents the results of geological and palynological studies of the clastic sediments of the non-marine sandstone group exposed at Laitryngew-Mawkma area and their correlation with the Cherra succession.

GENERAL GEOLOGY

The area in which the present geological and palynological investigations have been carried out forms the southern part of the Shillong Plateau. It lies between Lat. 25°15'30" and 25°20'30"N: Long. 91°40'0" and 19°45'30"E and is covered by Survey of India toposheet 78 0/11, in one-inch scale.

The general geology of the area has been described in detail a number of times (Ghosh, 1940; Biswas, 1962; D. G. M. Bulletin 1964) and hence will not be discussed in the present paper.

STRATIGRAPHY

The basement Archaean rocks and the overlying Jurassic Sylhet traps are exposed only at the gorges or river sections. Overlying the traps are the Cretaceous conglomerate and reddish to purplish sandstones, forming the Mahadeo Formation. This stratigraphic unit is succeeded by the Langpar Formation which is characterized

by a massive fossiliferous limestone band and a thin shale band at the top. The Langpar section is overlain by a coal-bearing sandstone sequence, which in turn is conformably overlain by another fossiliferous limestone, known as the Lakadong Limestone.

PALAEONTOLOGY

The Lakadong Limestone that immediately overlies the coal-bearing sandstones is dated as Lower-Middle Eocene because it contains the following fossils:

Nummulites thalicus, *N. sindensis*, *Lockhartia haimeii*, *Miscellania miscella*, *M. meandrina*, *Operculina cf. canalifera*, *Alveolina*, *Orbitosiphon tibetica*, *Discocyclina ranikotensis*, *Gypsina* sp. and some calcareous algae (Krishnan 1960, p. 518). According to Wadia (1961, p. 340) "The Lakadong beds contain foraminifers which indicate a Ranikot age". Based on palaeontological evidence Rama Rao (1964, p. 18) also suggested an Upper Ranikot age for these beds.

Dutta *et al.* (1964, pp. 51-52) recorded fossils like *Cypraea* sp., *Solariella cf. radiatula* Forb., *Exogyra cf. suborbiculata* Lam., *Cardium cf. pilatum* Stol., *Plicatula* sp. from the underlying Langpar Limestones. Of these, *Solariella cf. radiatula* Forb. ranges from Cenomanian to Turonian; *Exogyra cf. suborbiculata* Lam. is indicative of Turonian to Senonian age, while *Cardium cf. pilatum* Stol. is a Danian form (Pascoe, 1959, pp. 1237, 1248 and 1258). These genera have, so far, not been recorded from any other horizon younger than the Upper Cretaceous.

HEAVY MINERAL COMPOSITION

Heavy mineral analysis of the coal-bearing sandstone shows that the sandstone is characterized by *zircon*, *rutile*, *magnetite*, *hematite*, *ilmenite*, *apatite*, *tourmaline*, *garnet*, *kyanite* and *sphene*. The composition of this suite is thus more or less identical to that of the Cherra Formation.

PALYNOLOGICAL COMPOSITION

The coal-bearing sandstone unit of Laitryngew-Mawkma area contains a rich and varied flora. The assemblage is characterized by the abundance of angiospermic pollen and pteridophytic spores while the

gymnosperms are meagrely represented. The palynological fossils shall be described elsewhere. The stratigraphically significant palynological markers and their relative abundance are given below.

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| 1. <i>Nymphaeoipollis crassimurus</i> | — dominant |
| 2. <i>Polypodiisporites mawkmaensis</i> | — dominant |
| 3. <i>Retialetes emendatus</i> | — dominant |
| 4. <i>Nymphaeacidites clarus</i> | — dominant |
| 5. <i>Polycolpites ornatus</i> | — dominant |
| 6. <i>Lakiapollis matanmadhensis</i> | — common |
| 7. <i>Lycopodiumsporites palaeocenicus</i> | — common |
| 8. <i>Triorites inferius</i> | — common |
| 9. <i>Talisiipites wodehousei</i> | — rare |
| 10. <i>Corrugatisporites formosus</i> | — rare |
| 11. <i>Sestrosporites dettmanii</i> | — rare |
| 12. <i>Foraminisporis medius</i> | — rare |
| 13. <i>Araliaceoipollenites reticulatus</i> | — rare |
| 14. <i>A. psilatus</i> | — rare |
| 15. <i>Droseridites parvus</i> | — rare |
| 16. <i>Monolites (Laevigatosporites) discordatus</i> | — rare |
| 17. <i>Tricolpites crassireticulatus</i> | — rare |
| 18. <i>Trifossapollenites constatus</i> | — rare |
| 19. <i>Foveotriletes pachyexinous</i> | — rare |
| 20. <i>Polycolpites speciosus</i> | — rare |
| 21. <i>Engelhardtoidites parvus</i> | — rare |
| 22. <i>Palaeosantalaceaeipites dinoflagellatus</i> | — rare |

The most striking feature of the Laitryngew-Mawkma assemblage is the dominance of three species, viz. *Nymphaeoipollis crassimurus*, *Retialetes* and *Polypodiisporites mawkmaensis*. These species have approximately the same relative abundance as in the *Nymphaeoipollis crassimurus* Cenozoone (Lower Zone 1) of the Cherra Formation (Sah & Dutta, 1973).

The distribution and frequency of the other palynological taxa, e.g. *Nymphaeacidites clarus*, *Polycolpites ornatus*, *Lakiapollis matanmadhensis*, *Triorites inferius*, *Talisiipites wodehousei*, *Corrugatisporites formosus*, *Sestrosporites dettmanii*, *Lycopodiumsporites palaeocenicus*, *Foraminisporis medius*, *Araliaceoipollenites reticulatus*, *Tricolpites crassireticulatus*, *Trifossapollenites constatus*, *Foveotriletes pachyexinous*, *Polycolpites speciosus*, etc., in the Laitryngew-Mawkma assemblage, is also the same as in the Cherra Formation.

The coal-bearing sandstone unit at Laitryngew-Mawkma area overlies a marine

limestone which on faunal evidence is considered to be equivalent to the Langpar Formation. This excludes the possibility of the Laitryngew-Mawkma Sandstone unit being Cretaceous in age. The other two possibilities are whether this coal bearing succession is equivalent to the Cherra Formation or the Lakadong Sandstone member of the Sylhet Limestone Formation. Palynological cenozoone correlation indicates that the Laitryngew-Mawkma coal bearing unit is more or less identical to the Cherra coal bearing unit. Palynological markers like *Couperipollis*, *Retialetes dubius*, together with high frequencies of *Dandotiaspora* complex, *Palmaepollenites communis*, *Cyathidites minor*, which characterize the Lakadong sandstone interval are missing from the Laitryngew Mawkma coal bearing unit.

On the other hand, the Lakadong assemblage is characterized by the dominance of *Retialetes dubius*, *Dandotiaspora* spp. and a large number of monosulcate spinose grains which in the Cherra assemblage are either absent or very rare. All the dominant species of the Cherra assemblage are absent in the Lakadong assemblage, hence the coal bearing sandstone succession at Laitryngew-Mawkma area does not correspond to the Lakadong Sandstone member of the Sylhet Limestone Formation.

In view of the above comparisons it becomes apparent that the Laitryngew-Mawkma coal bearing stratigraphic unit is equivalent to the Cherra Formation. This interval is, therefore, Paleocene in age. The microfloral and lithological identity together with close proximity of the Laitryngew-Mawkma Sandstone unit with the Cherra Sandstone unit indicates that the former might be the northern and north-western continuation of the latter.

CONDITIONS OF DEPOSITION

In 1940 Ghosh (p. 15) suggested that Lower Eocene time was a period of oscillation of land and sea in the Khasi Hills when marine conditions alternated with those of estuarine and deltaic. The ecological environment of the palynological taxa recovered from the Laitryngew-Mawkma Sandstone unit clearly indicates that the sandstones were deposited under continental conditions. As these sandstones are underlain and overlain by marine limestones it is reasonable to assume that they

were deposited during the temporary withdrawal of the sea from the area. The presence of pollen of *Potamogeton*, *Nymphaea*, *Lentibulariaceae*, etc., indicates a fresh-water aspect. This is also borne out by the presence of a plant bearing bed at Laitryngew from where a rich megafloora (palm leaves, etc.) have been collected. The absence of brackish-water or marine elements further substantiates a fresh-water environment. The presence of pollen grains referable to the Palmae, Rhizophoraceae, Chenopodiaceae, etc., indicate coastal aspect. The occurrence of ripple-marks and current bedding in these sediments suggest shallow water deposition. It is therefore reasonable to deduce that these sandstones were laid down under near-shore, fresh-water to estuarinal or lagoonal conditions.

The palynological composition of the Laitryngew-Mawkma assemblage further indicates the prevalence of humid sub-tropical climate during the time of deposition of this stratigraphic interval.

CONCLUSION

The assembled data (palynological, palaeontological and heavy mineral) clearly indicate that the stratigraphical position of the Laitryngew-Mawkma sandstone unit is younger than the Langpar Formation (Danian) and older than the Lakadong Limestone member of the Sylhet Limestone Formation (Lower-Middle Eocene). This coal bearing sandstone interval appears to be the equivalent of the Cherra Formation. The close lithological and microfloral identity between the two clearly indicates that the Laitryngew-Mawkma coal bearing sandstone unit is the northern and north-western continuation of the Cherra Formation and hence Palaeocene in age.

The geological and palynological data indicate that the place of deposition was a shallow, fresh-water to estuarinal or lagoonal environment and that humid sub-tropical climate prevailed during the time of deposition.

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