

LITHOSTRATIGRAPHY OF THE TERTIARY SEDIMENTS EXPOSED ALONG JOWAI-BADARPUR ROAD IN JAINTIA HILLS (MEGHALAYA) AND CACHAR (ASSAM)

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ABSTRACT

The paper includes the field observations on the sediments along Jowai-Badarpur Road section in Jaintia Hills and Cachar, depicting their lithostratigraphy. Starting from Jowai towards Badarpur various Tertiary sediments were observed. In ascending order, these are: Therria, Sylhet Limestone, Kopili, Laisong, Jenam, Renji, Bhuban, Bokabil, Tipam Sandstone and Recent alluvia. The lithology, nature and location of contacts and fossil contents of each of these formations are discussed.

At Sonapur, 76 km from Jowai, the section is crossed by Dauki Tear Fault, which separates the Palaeocene-Eocene rocks of the shelf facies to the north from Oligocene-Miocene rocks of the geosynclinal facies to the south.

Key-words — Lithostratigraphy, Tertiary sediments, Jaintia Hills, Cachar (India).

सारांश

जयन्तिया पहाड़ियों (मेघालय) एवं कछार (असम) में जोवाई-बदरपुर मार्ग के साथ-साथ विगोपित तृतीयक अवसादों का शैल-स्तरीकीय अध्ययन - रमेश कुमार सक्सेना एवं सुर्यकांत मणि त्रिपाठी

इस शोध-पत्र में जयन्तिया पहाड़ियों एवं कछार में जोवाई-बदरपुर मार्ग खंड के साथ-साथ स्थित अवसादों की शैल-स्तरीकी व्यक्त करते हुए क्षेत्रीय प्रेक्षणों का विवेचन किया गया है। जोवाई से लगाकर बदरपुर की ओर को विभिन्न तृतीयक युगीन अवसाद प्रेक्षित किये गये। आरोही क्रम में ये थेरिया, सिल्हट चूना-पत्थर, कोपिली, लाइसांग, जेनाम, रेन्जी, भुवन, बोकाबिल, तिपम बालुकाश्म एवं वर्तमान जलोढ़ मिट्टी हैं। इन शैल-समूहों में प्रत्येक की शैलिकी, संस्पर्श का स्थान एवं प्रकृति तथा उपलब्ध जीवाश्म भी विवेचित किये गये हैं।

जोवाई से 76 किलोमीटर दूर सोनापुर में यह खंड डोकी-टियर-भ्रंश द्वारा काटा गया है। यही भ्रंश उत्तर में उपतट संलक्षणी की पुरानतन-आदिनतन चट्टानों को दक्षिण में भू-अभिनत संलक्षणी की अल्पनतन-मध्यनतन युगीन चट्टानों से अलग करता है।

INTRODUCTION

THE Jowai-Badarpur Road section, located in the south-east of Shillong, represents one of the classical sections exposing the Tertiary sediments in north-eastern India and constitutes part of Shillong-Badarpur highway (National Highway-44). The section is 136 km long and is shared by Jaintia Hills District of Meghalaya and Cachar District of Assam.

Dasgupta *et al.* (1964) published the geological map of the area along Jowai-Badarpur Road with a summarized description. Sein and Sah (1974) published

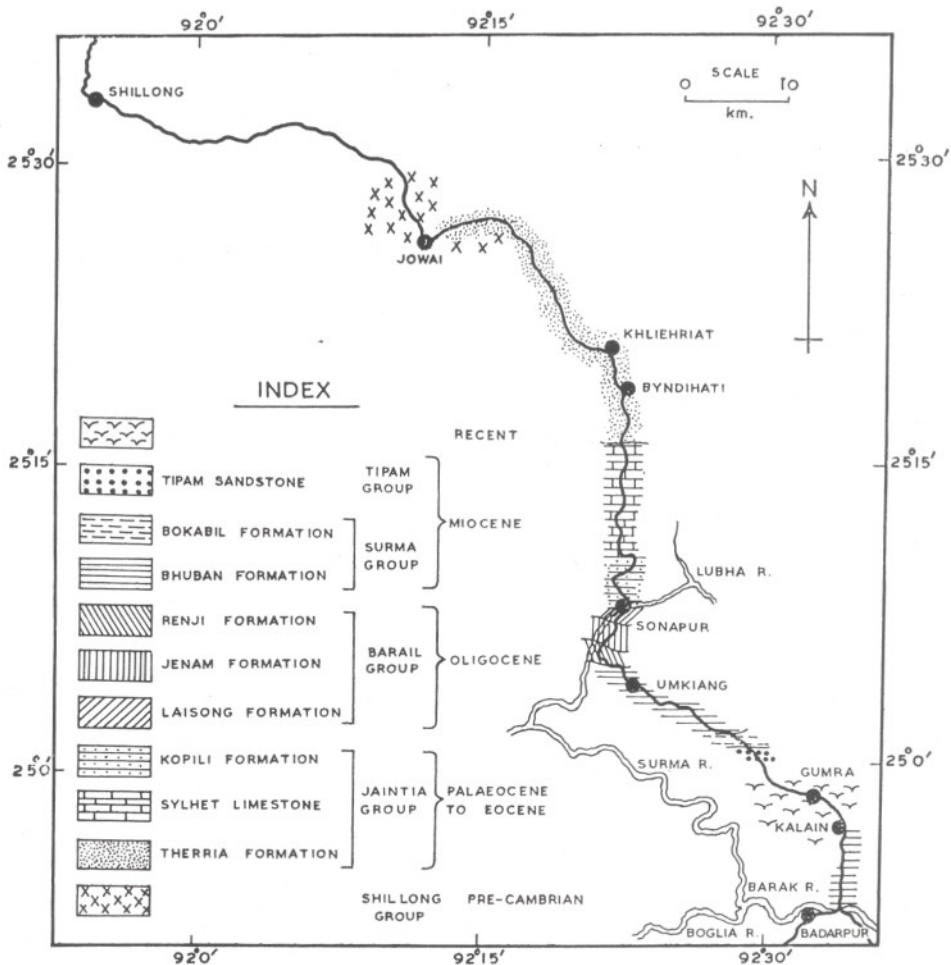
a paper dealing with the palynological demarcation of the Eocene-Oligocene sediments exposed along a part of Jowai-Badarpur Road, between Lumshnong and Sonapur. Dutta and Jain (1980) described 17 genera and 31 species of dinoflagellate cysts and acritarchs from the Sylhet Limestone and Kopili formations exposed in Lumshnong area near this road section and elucidated the biostratigraphic potential of the assemblage. However, more elaborated studies are required to fully understand the stratigraphy and palynology of the area and to build up standard palynostratigraphic controls for the demarcation of various

stratigraphic levels and their correlation with the isochronous sediments of the other parts of north-eastern India. With this objective, the authors undertook a geological excursion of the area in January-February, 1978. A geological map of this road section was prepared on a base map of 1:363640 scale (Text-fig. 1). Besides, over 600 stratigraphically located samples were collected for palynological studies from all the rock formations exposed along the road, which include various lithic types, viz., grey sandy shale, carbonaceous shale, coaly shale, coal, clay, limestone, etc. The lithostratigraphy of the area, based on our own field observations, is discussed in this paper.

Distances given in this paper represent the distance of a locality from Shillong along Shillong-Badarpur Highway, unless mentioned otherwise. The distances are taken from roadside kilometrestones and not from the toposheets.

LITHOSTRATIGRAPHY

The basin for the deposition of the Tertiary sediments of the Jowai-Badarpur Road section is provided by the Shillong Group, which is continuously exposed along the road from Shillong to Jowai except at 54 km from Shillong where an exposure of brown, coarse to very coarse grained, ferru-



TEXT-FIG. 1 — Geological map of the area along Jowai-Badarpur Road in Jaintia Hills (Meghalaya) and Cachar (Assam) districts.

ginous sandstone of Therria Formation was observed. Near Jowai, the Shillong Group is unconformably overlain by the Therria Formation. Further southward, the Therria Formation is overlain by Sylhet Limestone, which is followed by the Kopili Formation. The Jaintia Group comprising Therria, Sylhet Limestone and Kopili formations is overlain by the Barail Group which is represented by Laisong, Jenam and Renji formations. The Barail Group is overlain by the Surma Group which is divisible into lower Bhuban Formation and upper Bokabil Formation. Near Sonapur, the road is crossed by the Dauki Tear Fault separating Jaintia Group of shelf facies to the north from Barail and Surma groups of geosynclinal facies to the south. The Surma Group is overlain by the Tipam Sandstone, which constitutes the lower part of the Tipam Group. The other formations of Tipam Group, viz., Girujan Clay and Dupi Tila, are not exposed along the road and therefore could not be studied. The stratigraphic succession along the Jowai-Badarpur Road is summarized in Table 1. The description of various stratigraphic units is also given.

SHILLONG GROUP

This group, occupying the major portion of Shillong Plateau, is constituted by quartzite with subordinate phyllite, slate and schist. It rests over an Archaean gneissic basement complex and near Jowai it is directly overlain by Jaintia Group (Palaeocene-Eocene).

JAINTIA GROUP

It represents the Palaeocene-Eocene sequence of the shelf facies and is continuously exposed in road cutting between Jowai (64 km) and Sonapur (140 km). This group is divided into 3 formations, viz., Therria, Sylhet Limestone and Kopili.

THERRIA FORMATION

The Therria Formation constitutes the oldest stratigraphic unit of the Tertiary sequence in Jowai-Badarpur Road section and also the oldest among the 3 rock formations of the Jaintia Group. The exposures of this formation were observed

in the form of outliers near Jowai (64 km) along with the inliers of Shillong Group. Continuous exposures of Therria Formation were observed up to 46 km from Jowai (110 km), except near 83 km where an inlier of steeply dipping quartzite of Shillong Group was observed. The rocks of this formation show low rolling dips ranging between 3 to 10 degrees and averaging 4-5 degrees.

Lithology—This formation is made up of white, brown and pale-red, medium to very coarse grained, often gritty, cross-bedded, ferruginous sandstone alternated by subordinate shale and fine-grained carbonaceous sandstone. The shale is mostly bentonitic, sulphurous, occasionally pyritous and generally carbonaceous without megafossils. The carbonaceous sandstones are generally associated with thin coal seams. At places, the sandstone is highly weathered and lateritic. Many coal seams are also observed in this formation. Their location and thickness are: (i) at 81.5 km, 0.80 m; (ii) at 85 km, 0.90 m; (iii) near 86 km, 2 seams, 0.90 m and 0.15 m respectively; (iv) near 88.5 km, 0.20 m; (v) near 92.7 km, 4 seams, 1.10 m, 1.15 m, 0.15 m and 0.25 m respectively; (vi) near 93.5 km, 0.30 m; (vii) near 94.5 km, 0.75 m; (viii) near 100.25 km, 2 seams, each 0.15 m; (ix) near 105 km, 0.25 m; (x) near 106.5 km, 0.60 m; and (xi) near 109.5 km, 0.65 m.

Nature of Contacts—The Therria Formation unconformably overlies the Pre-Cambrian Shillong Group. This contact can be observed near Jowai (64 km). The upper contact of the Therria Formation with the overlying Sylhet Limestone is conformable. This contact is marked at the base of the grey limestone bed of Lakadong Limestone Member and is exposed near 110 km.

Fossil Contents—This formation is devoid of animal fossils or plant megafossils. However, an extensive collection of rock samples made by the authors has yielded a rich palynoflora.

SYLHET LIMESTONE

The Sylhet Limestone is the next unit in the sequence after Therria Formation and constitutes the middle part of the Jaintia Group. It appears at 110.0 km and

TABLE 1 — LITHOSTRATIGRAPHIC SEQUENCE OF THE TERTIARY SEDIMENTS EXPOSED ALONG JOWAI-BADARPUR ROAD

AGE	GROUP	FORMATION	MEMBER	LITHOLOGY	REMARKS
Recent	Recent	--	--	Alluvium	Exposed between 182 and 194 km.
Plio-Pleistocene	Dihing Group			—	Not exposed along the road.
		Dupi Tifa Formation		—	Not exposed along the road.
	Tipam Group	Girujan Clay			Not exposed.
		Tipam Sandstone		Medium to coarse grained ferruginous sandstone with subordinate shale bands and streaks of lignitic coal.	Poorly exposed between 180 and 182 km.
Miocene		Bokabil Formation		Alternations of thick shales and very fine grained laminated sandstone. Coarse ferruginous sandstone absent.	Poorly exposed between 177.5 and 180 km.
	Surma Group		Dona Member	Fine grained sandstone alternated by thin grey and carbonaceous shale.	
		Bhuban Formation	Umkiang Member Lubha Member	Predominantly argillaceous sediments Hard, fine to very fine grained sandstone alternating with thin shale bands	Good, continuous exposures between 147.5 and 177.5 km. and between 194 km and Badarpur (200 km).
			Renji Formation	Mainly arenaceous sediments. Fine to medium grained, hard, massive sandstone, alternated by shale bands.	Continuously exposed between 145.6 km and 147.5 km.
Oligocene	Barail Group	Jenam Formation		Thick, sandy shale with fine to medium grained sandstone.	Exposed between 143.2 and 145.6 km.
		Laisong Formation		Very fine to medium grained sandstone with subordinate shale and intraformational conglomerate.	Well exposed between 140 and 143.2 km.
		Kopili Formation		Alternations of fine to very fine grained grey sandstone and splintery shales of the same colour with occasional bands of limestone, carbonaceous shale, coal and ironstone.	Excellent exposures between 128.5 and 140 km.
Palaeocene to Eocene	Jaintia Group		Prang Limestone	Grey fossiliferous limestone.	
			Nurpuh Sandstone	Medium to coarse grained sandstone with calcareous bands.	Exposed between 110 and 128.5 km.
		Sylhet Limestone	Umlatodoh Limestone	Grey fossiliferous limestone with thin sandstone bands.	
			Lakadong Sandstone	Fine to coarse grained sandstone with coal-seam.	
			Lakadong Limestone	Hard grey limestones with thin sandstone bands.	
		Therria Formation	Medium to very coarse grained gritty sandstone, alternated by carbonaceous shales. A few coal seams also occur.	Exposed between Jowai (64 km) and 110 km.	
Pre-Cambrian	Shillong Group	--		Quartzite with subordinate phyllite, slate and schist.	Exposed between Shillong (0 km) and Jowai (64 km).

continues up to 128.5 km, where it is overlain by Kopili Formation.

Lithology—This formation is made up mainly of limestone with thin alternations of sandstones. On lithological ground, this formation is divisible into 5 members.

Lakadong Limestone Member—It is made up of grey, fossiliferous limestones and conformably overlies the sandstone of Therria Formation.

Lakadong Sandstone Member—It consists of fine to coarse grained, brown-grey sandstone. This sandstone is very much similar with the sandstone of the Therria Formation. Near 111 km, a 1.10 m thick coal seam, overlain and underlain by sandstone was observed within this member.

Umlatodoh Limestone Member—It includes hard, compact, grey and brown, fossiliferous, limestone with thin sandstone bands.

Nurpuh Sandstone Member—It consists of pinkish-white, grey and black, medium to coarse grained, sandstone with calcareous bands.

Prang Limestone Member—This is the youngest member of Sylhet Limestone and consists of grey fossiliferous limestone.

Nature of Contact—The uppermost member of Sylhet Limestone, i.e. Prang Limestone Member, is overlain by the Kopili Formation at 128.5 km. This contact is conformable.

Fossil Contents—A rich foraminiferal assemblage is recorded in the limestone beds of this formation including *Nummulites* spp., *Alveolina* sp., *Lockhartia* sp., *Ranikothalia* sp., *Discocyclina* sp., *Assilina* sp., etc.

Plant megafossils from this formation are not known. During the present field excursion the authors collected a large number of rock samples from this formation for palynological investigation. The analysis of these samples has proved the presence of a palynoflora.

KOPILI FORMATION

Kopili Formation is the youngest stratigraphic unit of the Jaintia Group. The exposures of this formation were observed between 128.5 km and 140 km.

Lithology—This formation is made up of grey, fine to very fine grained, massive to laminated, compact, sandstone alter-

nating with shales. Lenticular bands of limestones and calcareous splintery shales occur at the base of this formation. The shale presents ellipsoidal laminated, concretionary structures. These structures do not disturb the original bedding and therefore appear to be post-depositional.

Nature of Contact—On its upper limit, this formation is conformably overlain by the arenaceous Laisong Formation of Barail Group. This contact, exposed near Sonapur (140 km), is gradational. The criteria for distinguishing the Laisong Formation from the underlying Kopili Formation are: (i) the sandstone in Laisong Formation is coarser and thicker than that of Kopili Formation; and (ii) the amount of shale is much less in Laisong Formation while in Kopili Formation shale occurs almost as well in amount as sandstone.

Fossil Contents—This formation is devoid of animal and plant megafossils. Sein and Sah (1974) reported the occurrence of 20 spore-pollen species from this formation. Of these, pteridophytic spores (63%) show dominance over angiospermous pollen (37%). Many more species of spores-pollen have been recorded by the present authors.

BARAIL GROUP

The geosynclinal facies in the section begins with the Barail Group south of the Dauki Tear Fault. The nearest exposures of the Eocene Disang Group of geosynclinal facies are 3 km from the road and, therefore, they could not be studied. The Barail Group is represented by Laisong, Jenam and Renji formations. The rocks of this group are very thick and steeply dipping and are exposed in road cutting between 140 and 147.5 km.

LAISONG FORMATION

The Laisong Formation constitutes the lower, mainly arenaceous, part of Barail Group and is exposed between 140 to 143.2 km. The rocks are steeply dipping to almost vertical.

Lithology—The formation is made up of grey, very hard, thinly bedded, very fine to medium grained, sandstone alternating with subordinate hard, sandy shale and intraformational conglomerate. Massive

and moderately thick-bedded sandstones are also common. The shales are generally carbonaceous.

Nature of Contact—The upper contact of Laisong Formation with the overlying, mainly argillaceous, Jenam Formation is conformable. This contact is exposed at 143.2 km, where thick shales were observed overlying the sandstone.

Fossil Contents—Megafossils—animals or plants—are not found in this formation in the present area. Sein and Sah (1974) recorded the occurrence of 10 spore-pollen species from the entire sequence of Barail Group. However, they did not give the assemblages of the different formations of Barail Group separately. We have also recovered a very rich palynoflora from this formation.

JENAM FORMATION

It constitutes the middle part of the Barail Group and is exposed between 143.2 and 145.6 km. The formation is conspicuous being argillaceous between arenaceous underlying Laisong and overlying Renji formations. The shale beds of this formation are thick and steeply bedded.

Lithology—The formation is mainly argillaceous and is made up of shales and sandy shales with fine to medium grained, massive to flaggy sandstones. The shale is generally carbonaceous and leached with iron. The proportion of shale is much more than that in Laisong Formation while sandstone beds similar to those in Laisong are thinly bedded. Streaks of coal occur along the base of a few sandstone bands.

Nature of Contact—The Jenam Formation passes up into the Renji Formation near 145.6 km. This contact is also conformable. The contact was marked where thickly bedded or massive, ferruginous sandstone of Renji Formation first appears.

Fossil Contents—During field work, no plant or animal megafossil could be observed in this formation. A palynoflora from this formation has been recovered by us.

RENJI FORMATION

The Renji Formation forms the upper, mainly arenaceous part of the Barail Group and is exposed between 145.6 and 147.5

km. It shows steep dips ranging between 56 to 87 degrees in south-west direction.

Lithology—This formation is characterized by thickly bedded or massive, fine to medium grained, hard, ferruginous, occasionally cross-bedded, sandstone with alternation of thin shales. The shale is mostly carbonaceous.

Nature of Contact—On its upper limit, the Renji Formation is unconformably overlain by the Bhuban Formation of Surma Group. This contact was marked near 147.5 km, between Sonapur and Umkiang.

Fossil Contents—No plant or animal megafossil could be traced in this formation. However, the palynofloral studies on this formation, being carried out by the authors, have proved these sediments rich in palynofossils.

SURMA GROUP

Near 147.5 km, the Renji Formation, the upper part of Barail Group, is overlain by the Bhuban Formation of Surma Group. The Surma Group appears at 147.5 km and continues up to 180 km. This group is divisible into two formations.

BHUBAN FORMATION

This formation constitutes the lower part of the Surma Group. It is, in general, mainly arenaceous except in the middle part where it is made up of thick shales. This formation is continuously exposed between 147.5 and 177.5 km. The rocks of this formation exhibit steep southerly dips.

Lithology—The formation consists of hard, very fine to medium grained, sandstone alternating with shales. The middle part of the formation is more argillaceous. On lithological grounds, Saxena (1981) divided it into following 3 members.

Lubha Member—It is made up of thin to fairly thick beds of fine to very fine grained, fawn, grey or brown sandstone with subordinate shales. The shales are at places carbonaceous. This member is continuously exposed between 147.5 and 151.1 km.

Umkiang Member—It is made up of thick shale beds with brown, fine to medium and occasionally coarse grained, thinly bedded, lenticular sandstones and a few thin intraformational conglomerates.

Umkiang Member is continuously exposed between 151.1 and 155 km.

Dona Member—It consists of grey and brown, very fine to medium grained, often argillaceous, fairly hard, sandstone, alternating with thin, sandy and carbonaceous shales and is excellently exposed between 155 and 177.5 km.

Nature of Contact—The Bhuban Formation passes into argillaceous Bokabil Formation near 177.5 km. This contact is conformable.

Fossil Contents—No megafossil could be recovered from this formation of the present section. Study on palynoflora from these sediments is being done by the authors.

BOKABIL FORMATION

This formation constitutes the upper part of Surma Group. In contrast to the underlying Bhuban Formation and overlying Tipam Sandstone, this formation is mainly an argillaceous one. The formation is poorly exposed between 177.5 and 180 km.

Lithology—This formation is made up of thick sandy shales with alternations of very fine grained laminated sandstone. Coarse sandstone is occasional. Alternating laminae are at times very thin. Coarse ferruginous sandstone reported elsewhere from this formation was not observed in the section.

Nature of Contact—The Bokabil Formation is overlain by Tipam Sandstone. The contact between the two seems to be conformable and can be observed near 180 km.

Fossil Contents—The fossils from this formation of the present section are not known. Fresh samples collected from these sediments by the authors have proved to be rich in palynoflora.

TIPAM GROUP

Near 180 km the Tipam Group overlies the Surma Group and continues to be poorly exposed up to 182 km where Recent alluvia covers it. The Tipam Group is divisible into 3 formations: (i) Tipam Sandstone, (ii) Girujan Clay, and (iii) Dupi Tila Formation. In the present section only Tipam Sandstone is exposed.

TIPAM SANDSTONE

The Tipam Sandstone constitutes the lower part of the group. Poorly exposed sediments of this formation were observed between 180 and 182 km.

Lithology—Tipam Sandstone consists of brown, medium to fairly coarse, occasionally gritty, ferruginous, sandstone with numerous thin partings of shale and occasionally of moderately thick shale and sandy shale. Thin bands and streaks of lignitic coal also occur in this formation.

Nature of Contact—The upper part is covered by Recent alluvia near 182 km and, therefore, the nature of the upper contact could not be studied.

Fossil Contents—Although elsewhere, the Tipam Sandstone is reported to yield a good amount of fossil woods, but in the present section not a single fossil specimen could be recovered. The formation is devoid of animal fossils too.

It has already been stated that the upper part of the Tipam Sandstone is not exposed along the road. The other formations of the Tipam Group, viz., Girujan Clay and Dupi Tila, being covered by Recent alluvia, could not be observed.

RECENT

The Tipam Sandstone is directly overlain by Recent alluvia near 182 km, which continues up to 194 km, where the Bhuban Formation is again exposed.

Lithology—The Recent deposits consist of alluvia mainly deposited by Barak River. It includes sandy soil, kankars and occasional pebble beds.

Organic Matter—The alluvia contain Recent organic remains, like root, stem and leaves of plants, smaller invertebrates and bones of vertebrates.

CONCLUSIONS

The preliminary observations, made on the Tertiary sediments exposed along Jowai-Badarpur Road Section, lead to conclude the following:

1. The shelf (Palaeocene-Eocene) and geosynclinal (Post-Eocene) sediments are separated by Dauki Tear Fault. This fault crosses the section at Sonapur and is responsible for bringing out the sediments

of shelf and geosynclinal facies in juxtaposition without any transitional zone.

2. The Therria Formation shows low rolling dips towards south-east and consists of many coal seams ranging in thickness from few centimetres to as thick as 1.30 m. It indicates that these sediments were deposited under shallow water coastal environment which was receiving sufficient vegetable matter for the formation of coal seams. The palynoflora recovered from these sediments also supports this contention.

3. The Sylhet Limestone consists alternate limestone and sandstone beds (the limestone being thicker and more dominant). It seems to represent the calcareous shelf facies being deposited in a transgressive phase. The presence of foraminifera and hystrichosphaerids (authors' unpublished data) are the supporting evidences.

4. The Kopili Formation is made up of typical sandstone and shale alternations and for this reason it is sometimes referred as 'Kopili Alternation Stage'. These beds frequently contain ellipsoidal structures, as

long as 1 m. Since these structures do not disturb the original bedding, they may be inferred to be post-depositional.

5. Barail and Surma groups represent the geosynclinal facies, being much thicker than the shelf sediments and show steep dip southwards.

6. The Tipam Group is represented only by Tipam Sandstone while other formations of this group are probably covered by Recent alluvia. Tipam Sandstone is poorly exposed and consists of ferruginous, friable sandstones indicating a regressive phase of depositional environment and a dry climate.

7. The Dauki Tear Fault is the main structural feature in the present area. It produced a smash zone, mainly north of the fault, and effecting Kopili Formation, making them difficult to distinguish from overlying Barail Group of geosynclinal facies. While traversing along the road, a few minor faults were also observed but they were local and did not disturb much the stratigraphical setting of the area.

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