

## **PERMIAN BIOTIC ASSOCIATION FROM THE MOULMEIN LIMESTONE IN PAWTAW TAUNG, HPA-AN TOWNSHIP, KAYIN STATE**

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### **Abstract**

The prominent rock unit, the Moulmein Limestone is well exposed in the Pawtaw Taung which is located in the northeastern part of Hpa-an Township, Kayin State. The present study recovered the coral-brachiopod-foraminifer association for the first time from the fossiliferous limestone of the Pawtaw Taung. The Middle Permian coral faunas of solitary rugose coral (*Pavastehphyllum* sp.) and compound rugose corals (*Polythecalis* sp. and *Waagenophyllum* sp.) are dominated. These corals are typically Tethyan. The occurrence of brachiopod fauna (*Retimarginifera* sp. *Stereochia* sp. and *Spiriferella* sp.) and the fusuline fauna (*Parafusulina* sp., *Eopolydiexodina* sp. and *Yangchienia* sp.) are regarded as an indicative of the transitional biotic province of Shan-Thai Terrane. From the paleobiogeographical point of view, it is assumed that the coral-brachiopod-foraminifer association of the Moulmein Limestone, including the present study area, represents the western part of Sibumasu Block, as a whole, are treated as a mixed transitional fauna (Gondwanan and Cathaysian fauna affinities) which flourished in warm temperate conditions during Middle Permian time.

**Key words:** Moulmein Limestone, Coral-brachiopod-foraminifer association, Sibumasu, Middle Permian

### **Introduction**

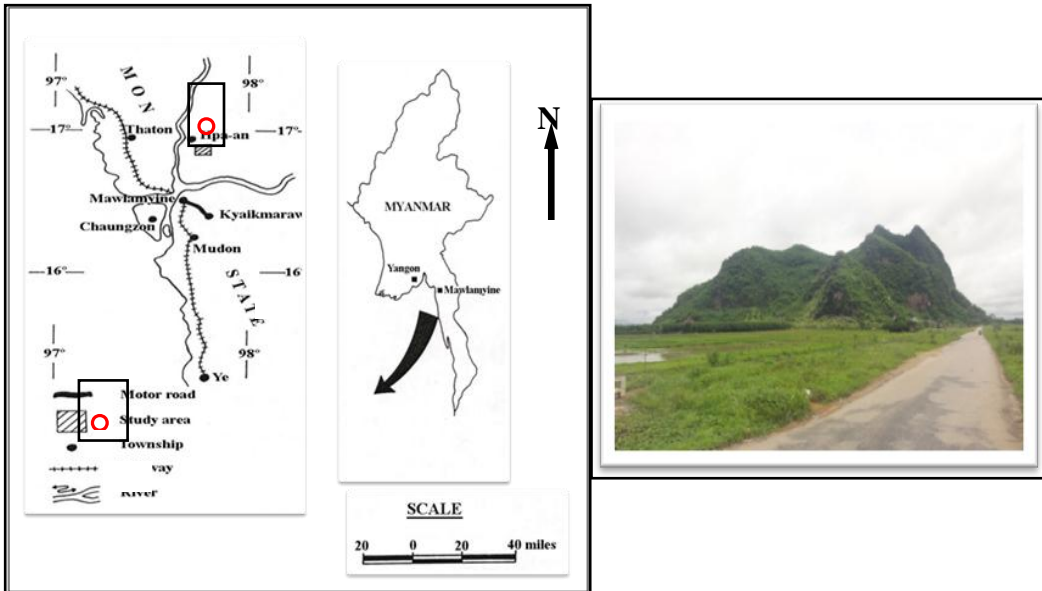
The study area, Pawtaw Taung which is located in the northeastern part of Hpa-an Township, Kayin State. The Permian rocks of Kayin State including Pawtaw Taung are dominantly limestone that commonly exhibit isolated karstic landforms and have been formalized lithostratigraphically as the Moulmein Limestone. The Moulmein Limestone gradationally overlies the clastic rocks of the Taungnyo Group. It is mainly composed of well-bedded dark grey limestone and silicified argillaceous limestone. The biotic association such as coral, brachiopod and foraminifera occurs in light to dark grey fossiliferous limestone and micritic limestone. The samples and data are systematically collected at five localities situated on the eastern and

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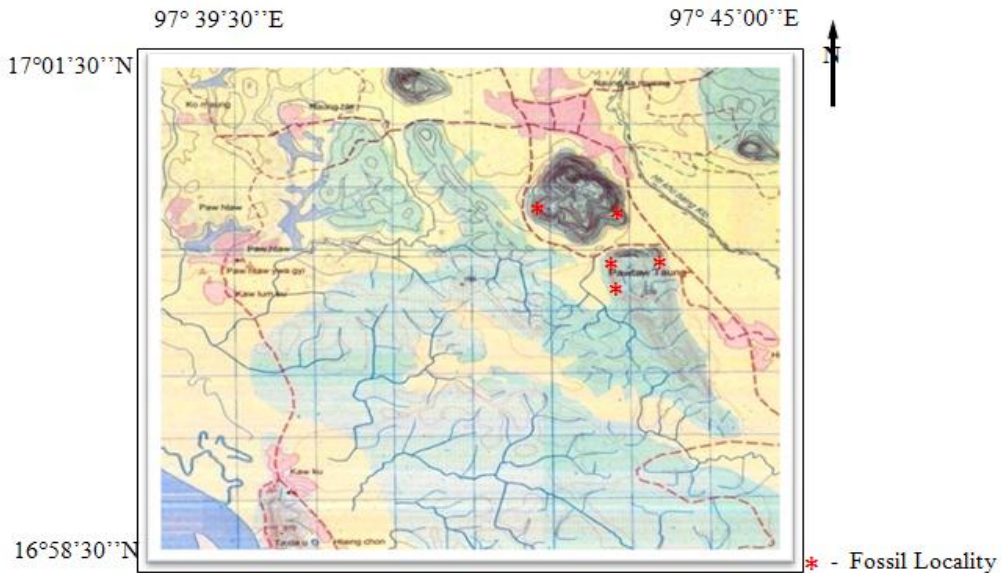
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western foot hill of the Pawtaw Taung. The location and topographic maps of the research area are shown in figure (1).



**Figure 1:** Location map and panoramic view of the Pawtaw Taung cropping out in the low-lying alluvial plain



**Figure 2:** Map showing the localities of fossil of the study area (From UTM index no: 1797-12 and 1697-09)

### **Previous Studies**

A few previous studies have been reported Permian fossils in Moulmein Limestone in Hpa-an area. Tin Tin Latt et al. (2014) mentioned the presences of Middle Permian Cimmerian foraminifers (*Parafusulina*, *Minojapanella*, *Yangchienia*, *Chenella*) in the Zweekabin Range.

### **Moulmein Limestone**

The prominent rock unit, the Moulmein limestone of Permian age is well exposed in the study area. T. Oldham (1856) firstly proposed the name Moulmein system for widespread clastics and limestones. It was later designated as Moulmein Limestone (Brunschweiler, 1970) representing a middle Permian age. The stratigraphic classification of the Hpa-an Township (Cited from Maung Thein, 2014) is shown in below.

<b>Stratigraphic Units</b>	<b>Geological Age</b>
Moulmein Limestone	Permian
.....gradational.....	
Taungnyo Formation	Carboniferous-Early Permian

In the study area, Moulmein Limestone includes two different lithologies of the fossiliferous limestone and micritic limestone. The fossiliferous limestone unit of the Moulmein Limestone is exposed in the southwestern and eastern parts of the Pawtaw Taung (Figure 2). It is medium-to thick-bedded, fine-to medium-grained, gray to black coloured limestone. The rock unit is highly fossiliferous and foraminifera, brachiopods and rugose coral are the observed fossils (Figures 3-7). The micritic limestone unit also occurred in the western part of the Pawtaw Taung. It is well-bedded, fine-grained, reddish brown coloured on weathered surface and gray in fresh coloured (Figure.8) This unit is mostly hard and compact, calcite veinlets and fusulinid and small foraminifera are present. Genera of large Fusulinidae, such as *Parafusulina*, *Eopolydiexodina*, and *Yangchienia* which are associated with small foraminifers as *Palaeotextularia* sp., *Endothyra* sp. *Climacammna* sp. and *Tetrataxis* sp., corals (*Pavastehphyllum*, *Waagenophyllum*,

*Polythecalis*) and brachiopods (*Retimarginifera*, *Steoehia* and *Spiriferella*) are collected from the Pawtaw Taung.



**Figure 3:** Fossiliferous limestone of the Moulmein Limestone, at the Pawtaw Taung



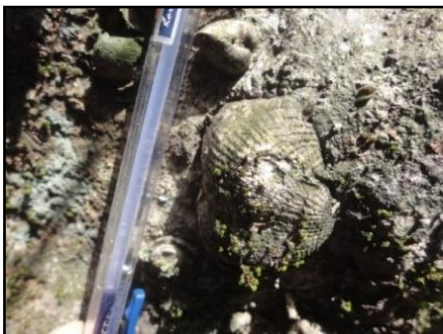
**Figure 4:** Solitary rugose coral from the Moulmein Limestone, at the Pawtaw Taung



**Figure 5:** Calyx of solitary rugose coral from the Moulmein Limestone, Pawtaw Taung



**Figure 6:** Solitary rugose coral from the Moulmein Limestone, Pawtaw Taung



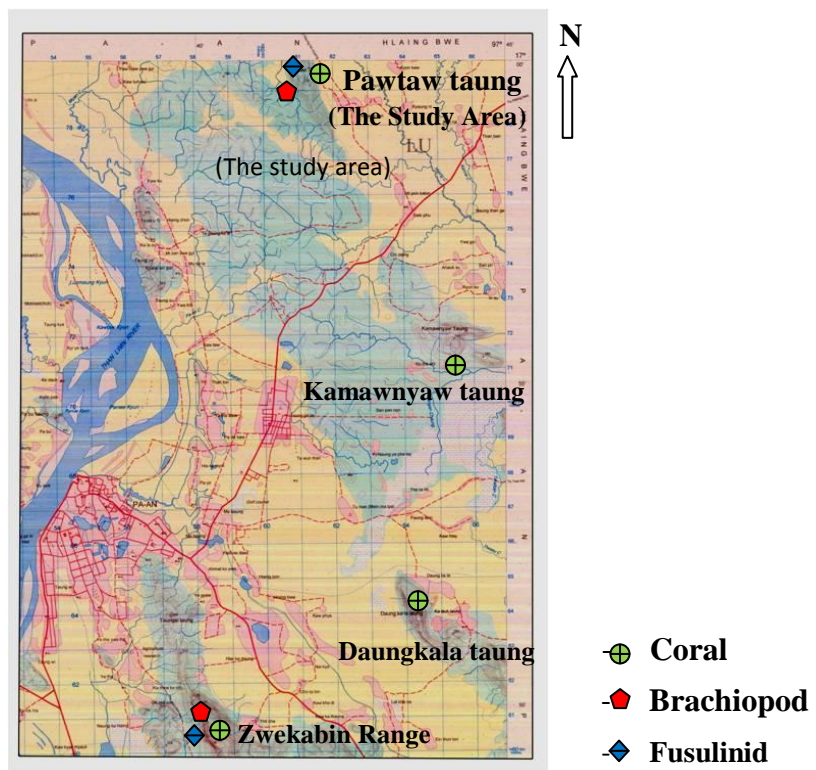
**Figure 7:** Brachiopod from the Moulmein Limestone, at the Pawtaw Taung



**Figure 8:** Micritic limestone of Moulmein Limestone Group, at the Pawtaw Taung

### Fossil Distribution in Moulmein Limestone, Hpa-an Area

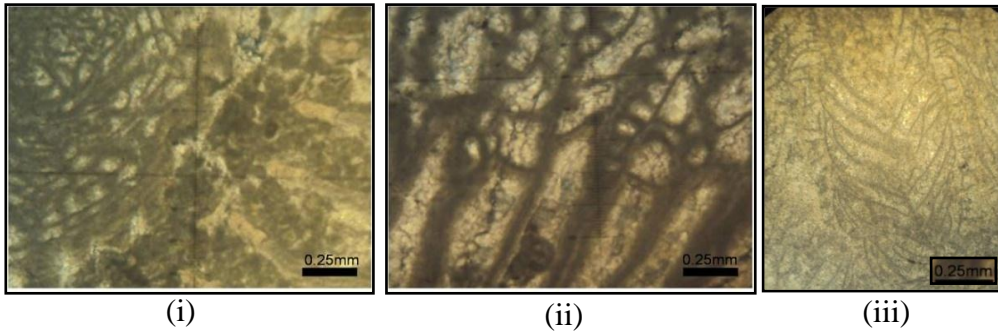
Moulmein Limestone exposures are exposed at the Pawtaw taung, the Kamawnyaw taung, the Daungkala taung and the Zweekabin Range in the Hpa-an area (Figure 9). The present research area, the Pawtaw taung which is located in northeastern part of the Hpa-an township, is composed of thick-bedded to massive limestone containing rugose coral (*Pavastehphyllum* and *Polythecalis*) (Figures,10 and 11), brachiopod fauna (*Retimarginifera*, *Steoehia*, *Spiriferella*) (Figures, 12,13,14) and fusuline fauna (*Parafusulina*, *Eopolydiexodina*, *Yangchienia*) (Figures 15-17) with a small foraminiferal fauna (*Tetrataxis* sp., *Palaeotextularia* sp., *Endothyra* sp. *Climacamma* sp.) (Figures 18-21).



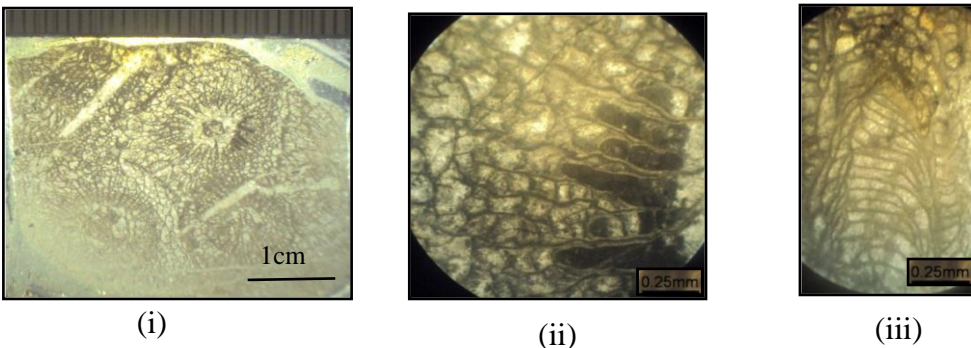
**Figure 9:** Fossil Distribution in Moulmein Limestone, Eastern part of the Hpa-an area



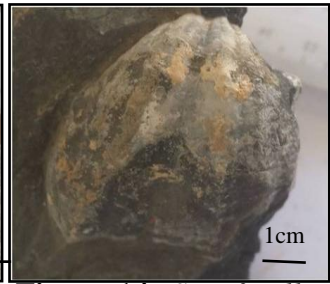
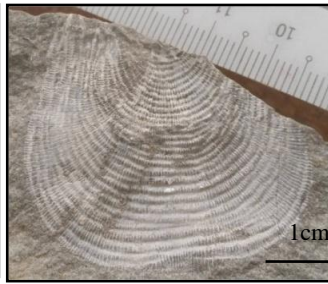
At Kamawnyaw taung, northeastern part of the Hpa-an township, grey colored, thickly bedded to massive limestone contains colonial rugose coral (*Waagenophyllum*) (Figure 22) but some are almost completely destroyed by recrystallization.



**Figure 10:** (i) Transverse section of well constructed axial structure of *Pavastehphyllum*, (ii) Rhopaloid major septa and distinct carine of *Pavastehphyllum*, (iii) *Pavastehphyllum* sp. Longitudinal section showing steep inclined tabulae



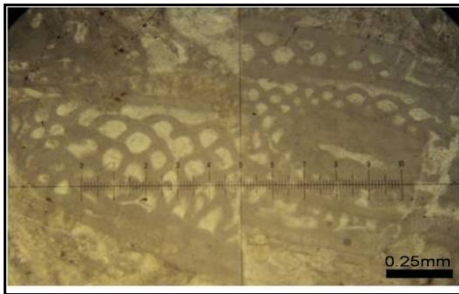
**Figure 11:** (i) *Polythecalis* sp. Transverse section showing small globose to somewhat circular dissepiments, (ii) *Polythecalis* sp. Transverse section showing septa are wavy or zigzag at the periphery, (iii) *Polythecalis* sp. Longitudinal section showing transverse tabulae



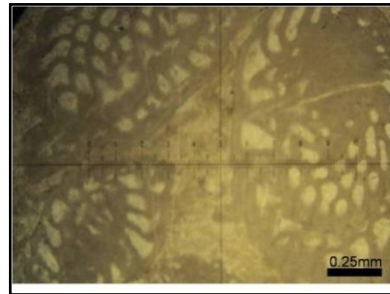
**Figure 12:** *Retimarginifer* sp., ventral external valve

**Figure 13:** *Steochia* sp., dorsal external valve

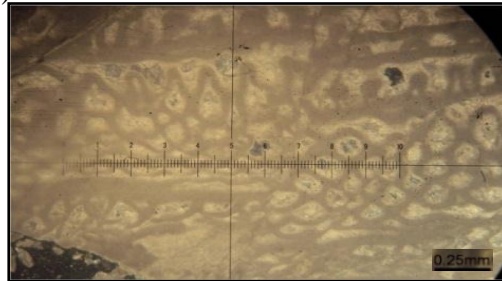
**Figure 14:** *Spiriferella* sp., ventral external valve



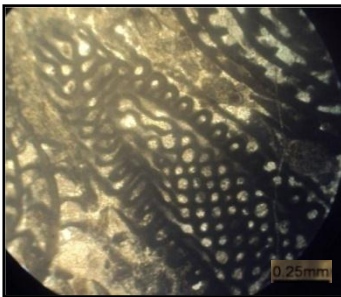
(i)



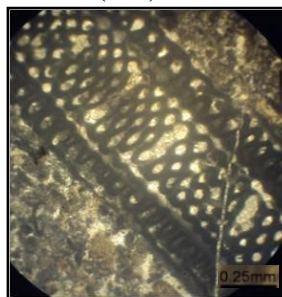
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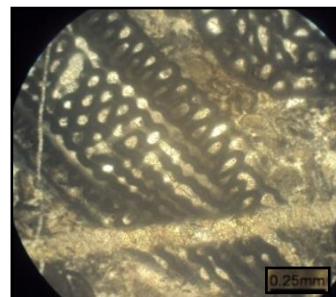
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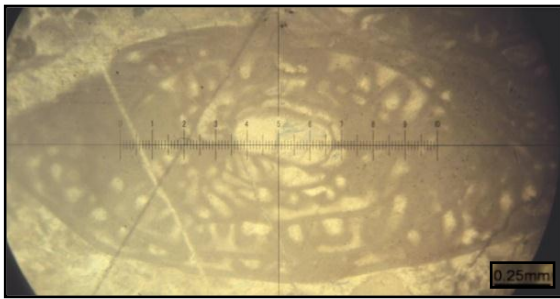


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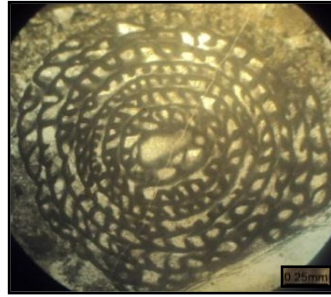


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**Figure 15:** (i-vi) *Parafusulina* spp. showing elongate species, septal fluting in advanced stage with cuniculi present.

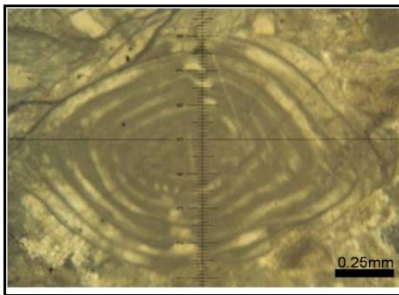


(i)

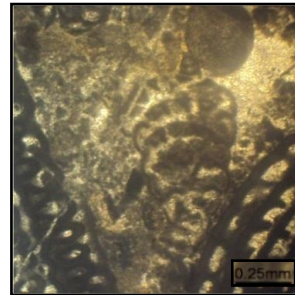


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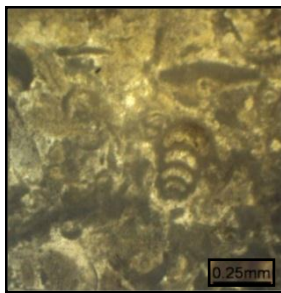
**Figure 16:** (i) *Eopolydiexodina* sp. showing axial section, septa are intensely fluted and folds of septa divide the early part of chambers into small chamberlets ; (ii) showing sagittal section, proloculus large



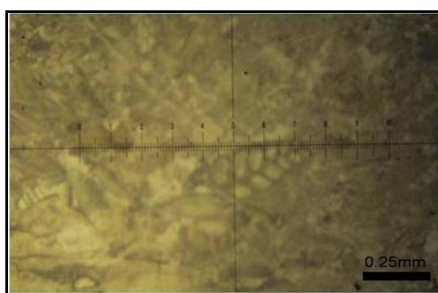
**Figure 17:** *Yangchienia* sp. showing axial section, distinct chomata in the fusiform whorls



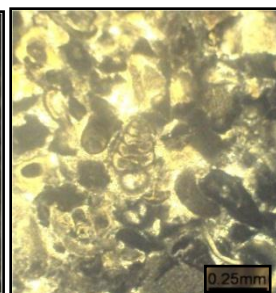
**Figure 18:** *Tetrataxis* sp. showing chambers strongly overlapping on the umbilical side



(i)



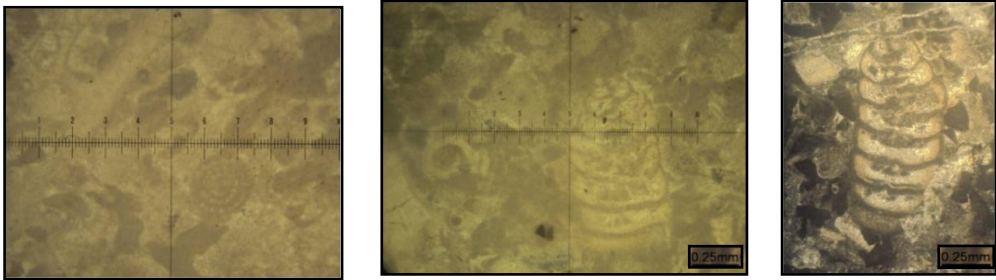
(ii)



(iii)

**Figures 19:** (i) *Palaeotextularia* sp. showing uniserial chamber, (ii&iii), showing biserial chamber



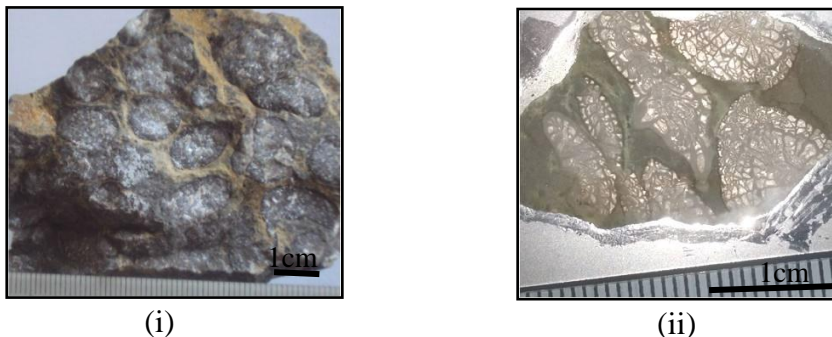


**Figure 20:** *Endothyra* sp. showing partially involute **Figure 21:** (i,ii) *Climacammna* spp. showing and planispiral. biserial stage followed by a uniserial stage,

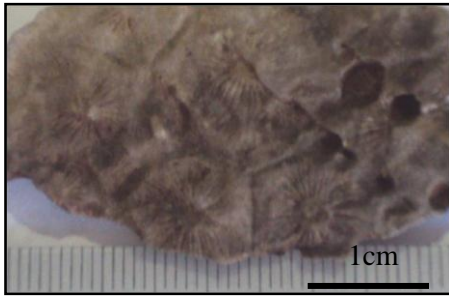
At the southeastern part the Hpa-an Township, a large hill, Daungkala taung which is composed of grey colored, bedded limestone contains colonial rugose coral (*Polythecalis*) (Figure 23).

At Zwekabin Hill, southern part of the Hpa-an Township, grey colored, well bedded to massive limestone is partly dolomitized, but elsewhere contains Brachiopods (*Orthotetes*, *Neospirifer*, *Kutorginella*) (Figures 24-26), solitary rugose coral (? *Cyathoxina*) (Figure 27), colonial tabulate coral (*Syringopora*) (Figure 28) and fenestrate bryozoans. These rugose coral *Cyathoxina* faunas, which are typically composed of small, solitary and non-dissepimented rugose, occur in the Early Permian of the Lhasa block belong to the Cimmerian continent. (Wang *et al.*, 2001)

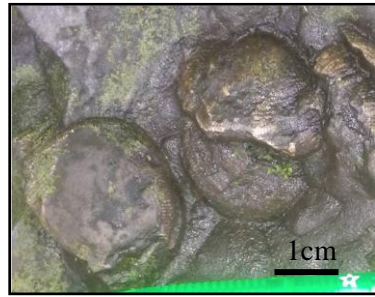
The localities mentioned up to now in this research belong largely to the Permian and mainly to Early-Middle Permian.



**Figure 22:** (i) Megascopic view of *Waagenophyllum* (ii) transverse section showing thin corallite walls and a comparatively small axial column



**Figure 23:** Megascopic view of *Polythecalis* showing the corallum is compound, massive and cerioid and some calicular pits.



**Figures 24:** *Orthotetes* sp. showing internal dorsal moulds



(i)



(ii)

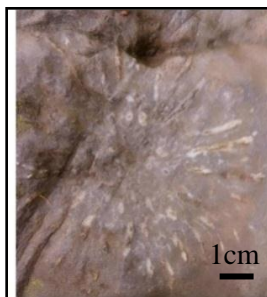
**Figures 25:** (i and ii) *Neospirifer* spp. showing external moulds of ventral valves



**Figures 26:** *Kutorginella* sp. showing internal moulds of ventral valve



**Figures 27:** ?*Cyathoxina* of rugose coral



**Figures 28:** *Syringopora* sp. of tabulate coral

### **Faunal Affinity and Paleobiogeography of Hpa-an Area Including Pawtaw taung**

The Pawtaw taung fauna consists mainly of Middle Permian foraminifers, corals and brachiopods occurring in the Moulmein Limestone. A small foraminiferal fauna is known from the Moulmein Limestone and includes *Palaeotextularia* sp., *Endothyra* sp. *Climacammna* sp. and *Tetrataxis* sp. A low diversity fusulinacean fauna occur in the Pawtaw Taung. This fauna is dominated by genus *Parafusulina* and is associated with *Eopolydiexodina*, and *Yangchienia*. The genus *Eopolydiexodina* is considered as one of the most typical taxa during the late Middle Permian of the Cimmerian continent (Wang *et al.*, 2001). The Tethyan realm contained relatively fusulinid genera of *Parafusulina* and *Yangchienia* is restricted to Tethyan-Boreal trends of fusulinides.

Three indeterminate coral species were recovered from the Moulmein Limestone of Pawtaw Taung, Kamawnyaw taung and Daungkala taung. They are *Pavastehphyllum* sp., *Waagenophyllum* sp. and *Polythecalis* sp. (Ezaki., 1991). *Pavastehphyllum* occur widely in the Middle Permian of the Cimmerian continent such as West Sumatra, Peninsular Thailand, Shan States of Burma and Baoshan (Fontaine *et al.*, 2002). In the study area of Pawtaw taung, *Pavastehphyllum* occur associated with *Parafusulina* but it seems never accommodate taxonomically higher neoschwagerinids. The occurrence of *Waagenophyllum*, *Pavastehphyllum* and *Polythecalis* indicate some paleobiogeographic link of the Sibumasu coral fauna during Middle Permian. The Middle Permian coral faunas in the Sibumasu Terrane are dominated by

both solitary and compound Waagenophyllidae. The latter is a common element in the Cathaysian continent (Shi and Archbold, 1998)

A few diverse brachiopod fauna from the study area were described and named *Retimarginifera* sp., *Steochia* sp. and *Spiriferella* sp. The presence of *Retimarginifer* from the Pawtaw Taung is substantially different from the coeval cold and poorly diversified assemblages of Gondwana regions.

Summing up the above faunal association of the study area clearly exhibits Tethyan aspects and the Middle Permian faunas of the Sibumasu show mixed affinities to Cathaysia and Gondwana in terms of corals and brachiopods (Metcalf, 1998). Occurrence of some distinctive species such as *Waagenophyllum*, *Polythecalis* and *Parafusulina* in Pawtaw taung indicate paleobiogeographic independence of the Sibumasu Block from Cathaysia.

### Conclusion

Moulmein Limestone are well exposed in the Pawtaw taung. It consists dominantly of well-bedded, fine to medium grained fossiliferous limestone and hard, compact reddish brown coloured micritic limestone. The collected samples at five sample localities were examined for coral-foraminifer-brachiopod study. The occurrences of biotic associations are *Pavastehphyllum*, *Waagenophyllum*, *Polythecalis*, *Paleotextularia*, *Endothyra*, *Climacamma*, *Tetrataxis*, *Eopolydiexodina*, *Parafusulina*, *Yangchienia*, *Retimarginifer*, *Steochia* and *Spiriferella*. Based on above these fauna, the Moulmein Limestone of the study area can be dated as Middle Permian (Wordian to Capitanian) in age. From the paleobiogeographical point of view, it is assumed that the study area includes in the mixed Gondwanan-Cathaysian fauna of the Sibumasu province.

### Acknowledgements

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