Stratigraphy of Pane Chaung Group in Bhopi Vum Area, Tiddim Township, Chin State

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Abstract

The research area is situated about 16 miles east of Tiddim. The area is bounded by N latitude 23° 12' 41" to 23° 26' 30" and E longitude 93° 54' to 94° 00'. Peridotites, mafic intrusives, mafic volcanics, pelagic sediments and podiform chromitites are the dominant lithologic units of ophiolite (Jurassic age) in the area. We present the stratigraphy of Pane Chaung Group in Bhopi Vum Area, Tiddim Township, Chin State. The oldest unit of the study area, Pane Chaung Group is made up of turbidite sandstones, mudstones, carbonaceous mudstones, and rare thin grey to black and locally crystalline limestones and chert. The age of the Pane Chaung Group of the study area can be fixed as Middle to Upper Trassic age as indicated by Halobia sp., Daonella sp., Posidonia sp., and ?Judicarites sp.

Keywords: Pane Chaung Group, Halobia sp., Daonella sp., Thanbaya Formation

Introduction

The research area is situated about 16 miles east of Tiddim. The area is bounded by the N latitude 23° 12' 41" to 23° 26' 30" and the E longitude 93° 54' to 94° 00'. It lies in UTM map sheet No.2393 15 and 2393 16 composite. It covers a surface area of about 96 square miles (240 square kilometers) with 15 miles long and 6.34 miles wide. It is easily reach by car in all season due to nearing of the Kalay-Tiddim car route. The location map of the study area is shown in Fig (1).

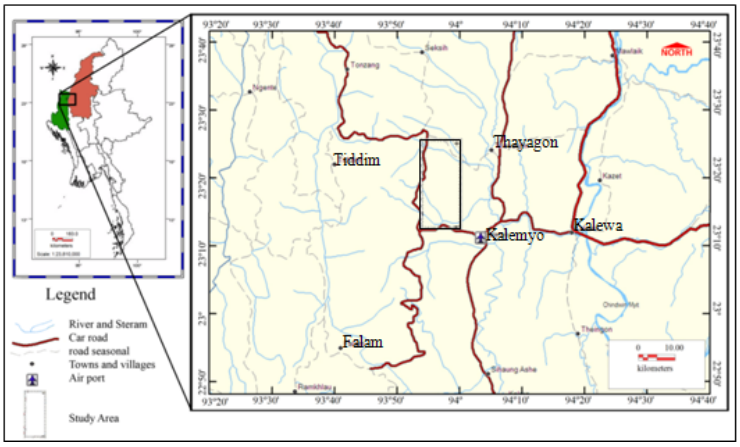

Figure (1). Location map of the study area

Methods of study

Due to the lack of detailed geological map of the study area, mapping is carried out during the field season and the representative samples of rocks units were collected. The lithologic boundaries, sample localities, fossil locality and thickness of rock units. The geological map of the area was made then using one-inch topographic map. The lithostratigraphic measurements were done by tape and compass method. Several detail section for stratigraphy was made along the stream section and car road section.

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Regional Geologic Setting

In Kalaymyo, the ophiolite is thrust westward to the Indo-Burma Range, which comprises a western belt of Cretaceous to Eocene sedimentary rocks and an eastern belt of schists and Ladinian to Carnian turbidites (Mitchell, 1981). The Triassic schists and turbidites are quartz-rich and lack abundant volcanic and plagioclase detritus, in which the Holabia was reported (Bender, 1983). An assemblage of graphite-biotite schists (i.e., Kanpetlet Schist) occurs as a folded dome underlying tectonically folded Triassic flysch and ophiolites (Mitchell, 1993). The ophiolitic rocks are overlain unconformably by Albain sandstone. A K-Ar age of 158±20 Ma has been reported for hornblende pegmatite intruding serpentinite (Mitchell, 1981). The Kalaymyo ophiolite complex mainly consists of big peridotite massifs, such as Mwe Taung, Bhopi Vum and Webula Taung. Both pillow lavas and gabbros are locally exposed in Yazagyo area, which are overlain by pelagic sediments, e.g., cherts. In Khwekha, the ultramafic rocks are underlain by plagioclase amphibolites.

Stratigraphy

The study area is composed of the igneous rocks (ophiolitic rocks), metamorphic rocks (biotite schist) and sedimentary rocks (Pane Chaung Group and Falam Mudstone Micrite Formation). Peridotites (harzburgite, lherzolite, dunite), mafic intrusive (diabase), mafic volcanic (basalt), pelagic sediments and podiform chromitites are the dominant lithologic units of ophiolite in the study area. Some sporadic exposures of plagiogranite were observed in the study area. Upper Jurassic radiolarians from the Naga Ophiolite in NE India and recent U–Pb dating of zircons (oldest zircon groups ages are 163.2±3.3 Ma) from the Jade Mines belt of northern Myanmar (Ghose et al., 2014) supports the long held contention of Mitchell (1993) that the ophiolites are of Jurassic age.

The geological map of the study area is shown in Fig. (2), and stratigraphic sequence of the study area is shown in Table (1). Stratigraphic units of the Indoburman Ranges and Innerburman Tertiary Basin (Western Burma Plate) in Myanmar are shown in Table (2).

Table (1). Stratigraphic sequence of the study area

Rock Units	**Age**
Sedimentary Rocks	
Alluvium	Holocene
Falam Mudstone Micrite Formation	Upper Cretaceous
Pane Chaung Group	Middle to Upper Triassic
Metamorphic Rocks	
Biotite schist	? Triassic
Igneous Rocks	
Ultramafic Rocks (including serpentinites)	Late Jurassic
Basic Rocks (diabase and basalt)	? Late Jurassic

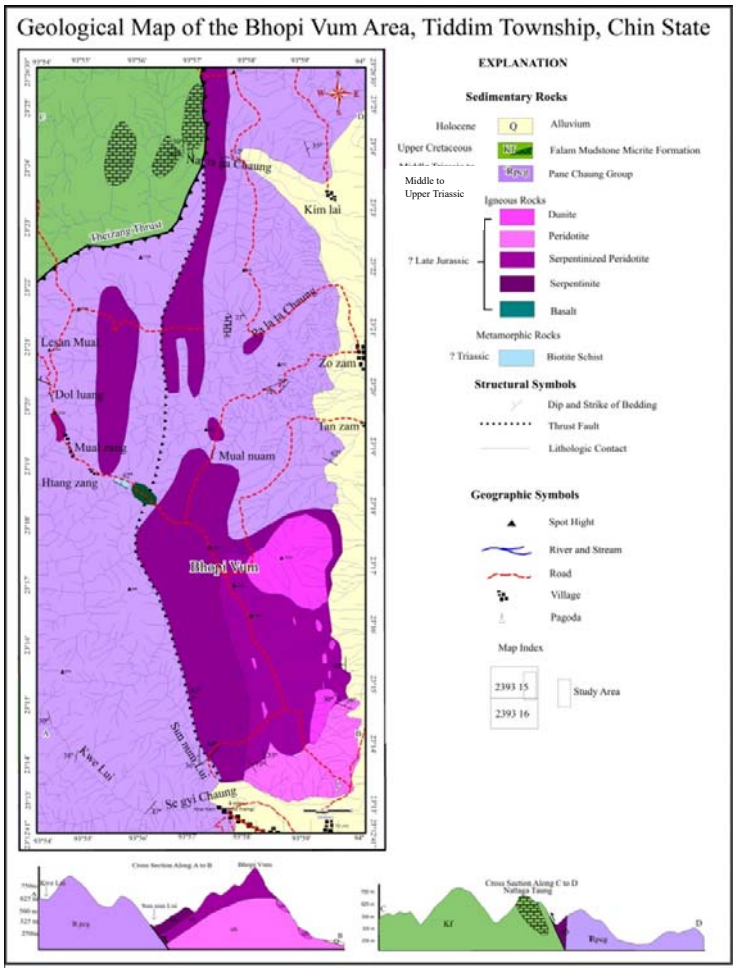

Figure (2). Geological map of the study area (modified after U.N., 1979).

Table (2) General stratigraphic units of the Indoburman Ranges and Innerburman Tertiary Basin (Western Burma Plate) in Myanmar. (Modified after Bannert *et al*., 2011)

System	Epoch		Indoburman Geosyncline		Western Burma Plate		
			Indoburman Ranges			Innerburman Tertiary Basin (western outcrops)	
			Rakhine Coast	Western IBR	Eastern IBR	*Minbu Basin*	Chindwin Basin
Neogene	Pliocene			Molasse in the northern Chin Hills	metamorphic event (Socquet *et al.* 2002)	Irrawaddy Fm.	Irrawaddy Fm. (Mingin Fm.)
	Miocene	L	Yenangdaung Fm.				Shwethamin Fm.
		M	Sane Fm.			Obogon Fm.	
		E	Nga Ok Congl.			Kyaukkok Fm.	Natma Fm.
	Oligocene	L	Kalangyan Fm.			Pyabwe Fm.	Letkhat Fm.
		M	Yechangyi Fm.			Okhmintaung Fm.	Tonhe Fm.
		E				Padaung Fm.	
						Shwezetaw Fm.	
Paleogene	Eocene	L	Kalaba Fm. (Konbwe Shale)	Kennedy Fm.		Yaw Fm.	Yaw Fm.
		M	Madekyun Fm.			Pondaung Fm.	Pondaung Fm.
			Kyaukkale Fm.			Tabyin Fm.	Tabyin Fm. Laungshe Fm.
		E				Tilin Fm.	
				Chunsung Fm.		Laungshe Fm.	
	Paleocene					Paunggyi Cgl.	Paunggyi Cgl.
Cretaceous	Maastrichtian		Kyauknimaw Fm.	Falam Fm.		Kabaw Fm.	Kabaw Fm.
	Campanian		Ophiolitic seafloor	Olistostromes		Paung Chaung Ls.	Unknown basement
	Aptian/Albian					Orbitolina limestone	
Jurassic	L					(Gondwana metamorphics?) ophiolitic seafloor	
	M						
	E						
Triassic	L				Pane Chaung Group		
	M						
	E						

Pane Chaung Group

Nomenclature

A sedimentary unit of Triassic age was first recognized by Theobald (1871), who reported a Triassic fauna from his "Axial" series of altered sandstones, shales and limestones from a locality beyond the northeastern corner of the Rakhine area. Later, he (1873) restricted the term Axial to certain rocks exposed in western Thatyetmyo. Chhibber (1934) gave a brief description of this unit in the eastern Rakhine. Further details of the characters of the Axial groups rocks in Thatyetmyo area was given by Clegg (1938).

The term "Chin Flysch" was used by Ngaw Cin Pau (1965) (in Hang Khan Lian, 1983) for the monotonous, apparently unfossiliferous, sequence of slate and shale and Kyaw Win (1969) for the alternating sequence of shale, slate and fine-grained sandstone present in the east of the Kanpetlet Schist with generally faulted contact. In contrast to Myint Aung (1982) (in Hang Khan Lian, 1983) stated that the Thanbaya Formation of this "Chin Flysch" occurs to the west of Kanpetlet Schists. Moreover, Thanbaya Formation is used by Myanmar Oil Cooperation for these sediments. The "Chin Flysch" was further divided on the evidence of the fossils into Triassic and Cretaceous rocks (Tsung Aung et al, 1976) and also proposed the "Pane Chaung Group" by G.S.E.P. (1972) (in Hang Khan Lian, 1983).

U.N (1979) named from a sequence in the Pane Chaung northwest of Kan in the Falam-Kalemyo Area, although later work showed that in this section other rocks are probably tectonically juxtaposed with the group. Pane Chaung Group is named by U. N (1979) for the sediments that consist mostly of turbiditic sandstone and mudstone of flysch origin which have been thrust along the eastern flank of Chin Hills.

Distribution

The Pane Chaung Group is the oldest sedimentary sequence in the study area. The topographic feature of this group is characterized by deeply dissected rugged mountains with steep "V" shaped valleys. The Pane Chaung Group forms a discontinuous belt along the eastern foothills of the Western Ranges, disappearing eastward beneath alluvium and Quaternary deposits. This underlies a plain with their soil cover lying between Cretaceous rocks of Chin Hills to the west and raised gravel and alluvium of Myittha River to the east.

Lithology

This group consists dominantly of monotonous succession of turbidite sandstone, shale, mudstones, carbonaceous mudstones, rare cream colour and locally crystalline limestones and chert. The sandstones are mostly greywacke that are fine- to medium-grained, hard and compact, light grey color when fresh. But the weathered surface show buff color. The sandstones are mostly medium- to thick-bedded that ranges from 30 cm to over 100 cm in thickness. Some show massive character with highly jointed and that are filled with numerous veinlets of quartz. They are intercalated with various colors of mudstone and shale (Fig. 3 & 4). The shales and slaty shales are dark grey to black and compact. It can be characterized by buff to grey color, softness, lamination, and jointed nature. Parts of the Pane Chaung Group are associated with conglomerate. Melanges or broken beds are one of the most widespread lithologies in the group within the study area (Fig.5).

In some places, fine-grained to micritic and cream or white to pink colour crystalline limestone could be observed in the bank of the Kwe Lui Chaung of the Pane Chaung Group of

the study area. Shale with Upper Trassic fossil (Halobia sp., Daonella sp. and Posidonia sp.) is known at two localities; one place along the road from Kalemyo to Taingen and near the flank of the south of the Se gyi Chaung (Fig.6). Chert occurs as huge boulders (up to 6m in diameter) at several localities. Outcrops of chert could only be detected at the bank of Se gyi Chaung in SW of study area. Moreover, chert is mostly white to pale green or reddish, slope hill of the west of the Mual zang village could be observed (Fig.7). Serpentinites are exposed as narrow linear belts in N-S in the rocks of Pane Chaung Group of the study area.

The sandstones show a better section of parallel lamination, and some with flute, load, and grove casts are exposed near Kwe Lui and Sun num Lui Chaung. Sole marks are fairly common in the Pane Chaung Group. Moreover, the greywacke sandstones show isoclinal fold and slump structures.

Nature of Contact

The contact between the Pane Chaung Group and intruded ultramafic rocks is found in the west of Bhopi Vum. The contact of the ultramafic body to the surrounding Pane Chaung Group is characterized by the change of vegetation. The contact dips steeply to the W. The sediments at the contact are highly compressed and folded. In the NE the presence of flysch sediments at the eastern base of Bhopi Vum indicates a complete surrounding of the ultramafites by flysch sediments which cannot be traced further to the S due to the alluvial plain.

Thickness

This group is about 17,000 ft thick according to the type section done by M.O.C (in I.G.C.P Field Excursion, 1981). Measured thickness of the Pane Chaung Group 3,000-8,000 ft (930-2490 m) recorded from Gangaw area (Than Htut, 2015). The Koe maing (9 miles)-Pum pi road section are showed in (Fig. 8).

Fauna, Age and Correlation

Fauna content of the Pane Chaung Group of the study area are Halobia dalliana, Halobia styriaca, Halobia dilatata, Halobia austriaca, Halobia tozeri, Halobia comata, Halobia mediterranea, Halobia austriaca, Daonella sp., ?Judicarites sp. and Posidonia sp. (Fig. 9A-B). The age of the Pane Chaung Group of the study area can be fixed as Middle to Upper Trassic age as indicated by Halobia sp., Daonella sp., Posidonia sp., and ?Judicarites sp.

The Pane Chaung Group is also correlative with the Axial Group of Theobald (1871) on the basis of lithology and paleontology. It is also equivalent to Thanbaya Formation of Tsung Aung, Kyaw Kyaw Myint and Tin Myint (1976) (in Hang Khan Lian, 1983) from the Saw, Tillin, Gangaw, and Mindon areas, by the correlation of stratigraphy, lithology and age. Rocks of similar lithology to the Thanbaya Formation are present in the Saw and Kyauktu areas which described as “Halobia Series” by Graman (1974).

Theobald (1871) reported the first occurrence of Halobia specie in the rock units exposed at the western part of Thayetmyo area. Fossils were also collected from dark grey slaty shale in the west of Kalemyo and identified as Titahia birminica THEIN,n,sp. and Daonella lommeli by Myin Lwin Thein (1970). Halobia cf. comata, Gondolella polygnathiformis and micro fauna such as Bathysiphon sp. and Halplophragmoides sp. were collected in the Saw-Kyauktu area and they were assigned to Carnian age (Graman, 1974). Halobia fauna of Carnian

(Upper Triassic age) had been recovered from the Thanbaya Formation of Mindon area (Myint Aung, 1982; in Hang Khan Lian, 1983).

Pane Chaung Group of the study area is also equivalent to Thanbaya Formation. The occurrence of Daonella in the clastic facies of the Upper Chindwin area recalls the occurrence of such genus in the similar facies of the Himalayas, Malaya and Japan.

Figure (3).Medium- to thick-bedded sandstone intercalated with mudstone exposed at Dol Luang village (23° 20 ' 37.6" N & 93° 54' 00.7"E).

Figure (4).Thin- to medium- bedded sandstone intercalated with black shale (23°13' 04.1" N & 93° 56' 08.2"E).

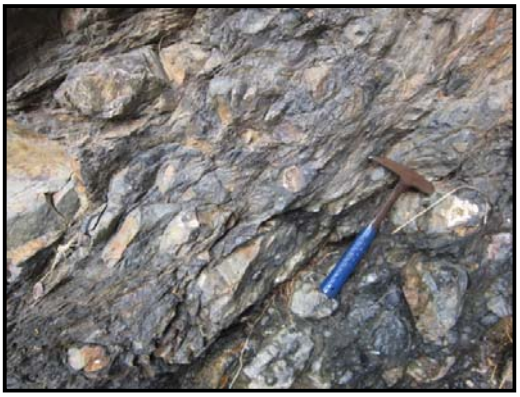

Figure (5).Melanges in which sandstone clasts are mixed with mudstone (23° 13' 58.1" N & 93° 56' 50.7"E)

Figure (6).Exposure of *Halobia* bearing black shale in the Pane Chaung Group (23°18'16.5"N & 93°58'34.6"E).

Figure (7). Chert occur near west of the Mual zang village of the Bhopi Vum Area (23°17'52.6"N&93° 56' 29.2"E)

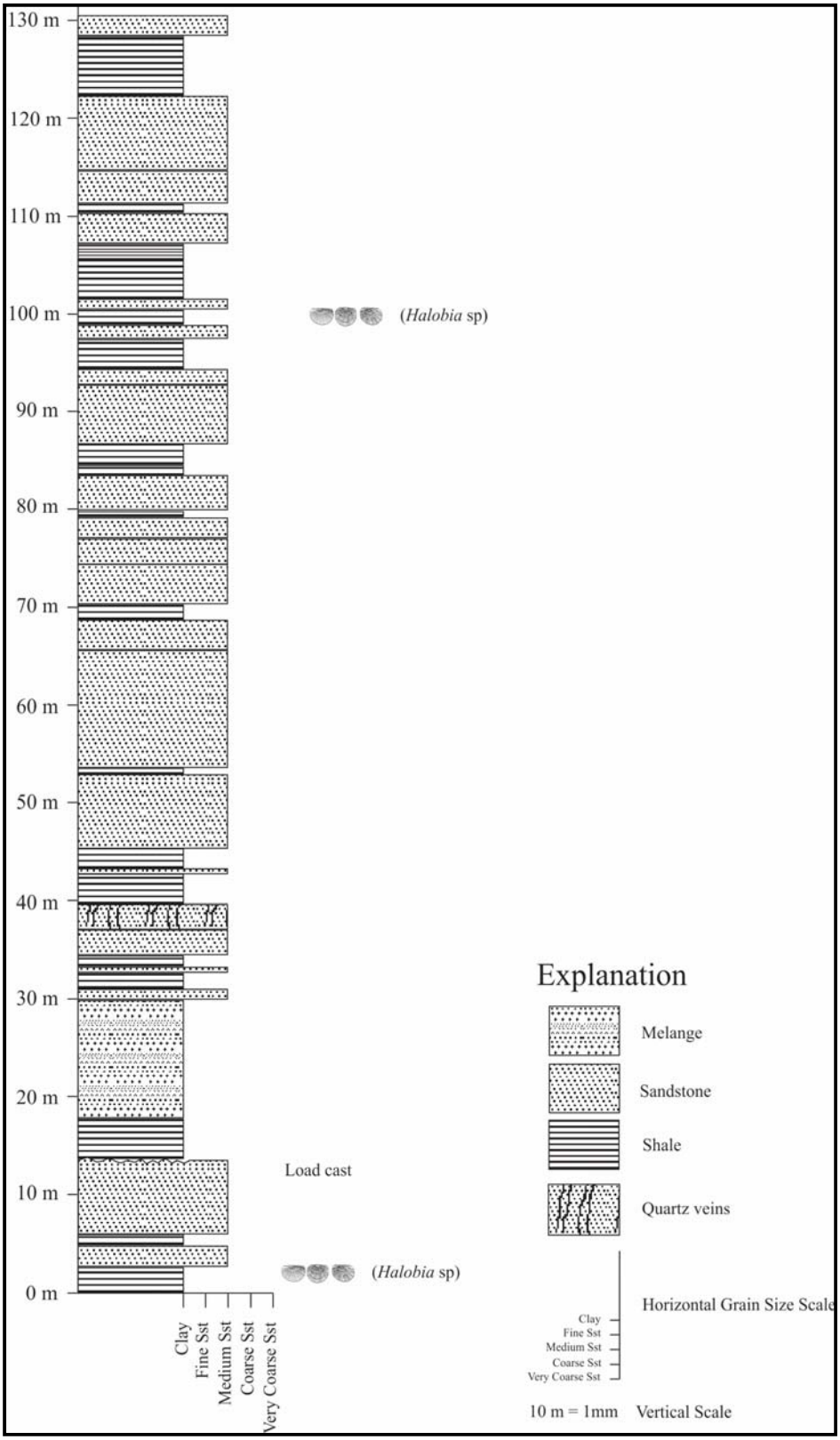

Figure (8). Measured stratigraphic section of the Pane Chaung Group along Koe maing-Pum pi road. (23°12' 53.5" N & 93° 57' 37.8"E to 23°14' 48.4" N & 93° 53' 42.9"E)

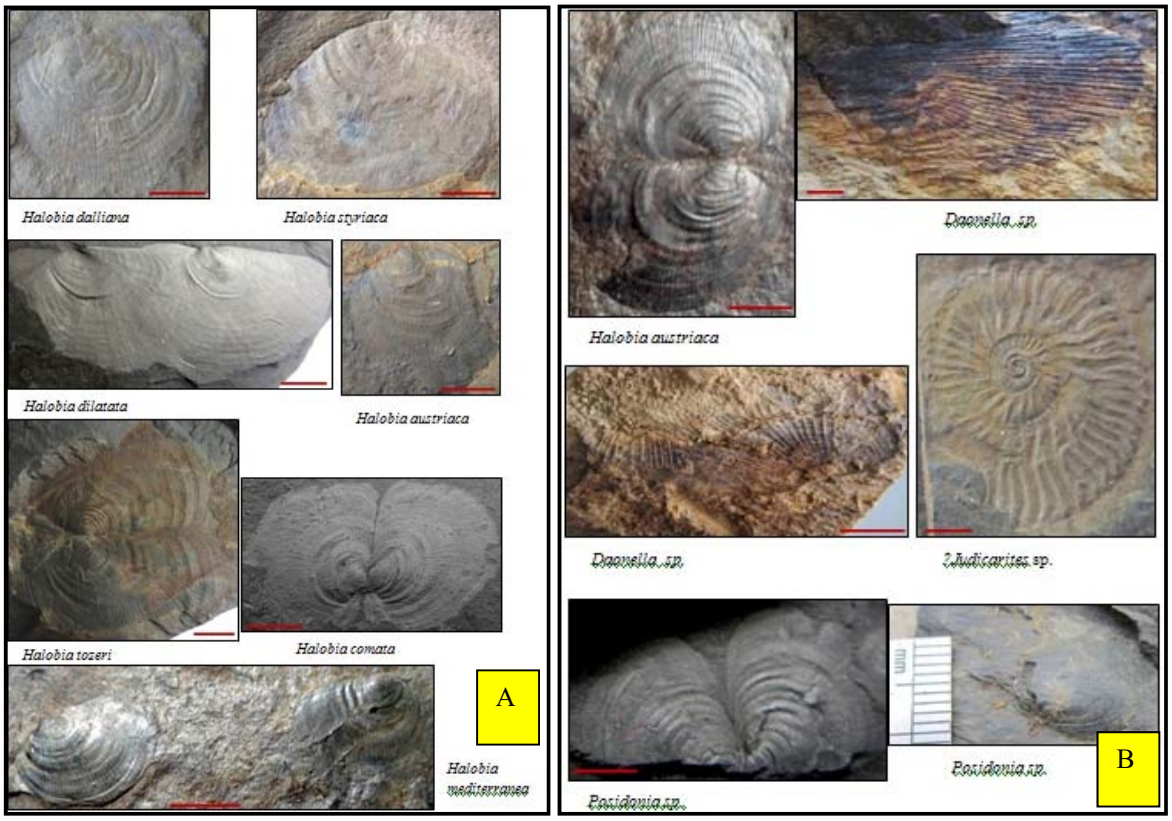

Figure (9). (A) Halobia sp. from Halobia bearing shale of the Pane Chaung Group of the study area. (Scale bar= 1 cm) (B) A Halobia sp., Daonella sp., Posidonia sp., and ?Judicarites sp. from shale of the Pane Chaung Group of the study area. (Scale bar= 1 cm)

Conclusion

Field observation and stratigraphy of the Pane Chaung Formation result in the major conclusions as follow:

1. The age of the Pane Chaung Group of the study area can be fixed as Middle to Upper Trassic age as indicated by Halobia sp., and Daonella sp..
2. The depositional age of the Pane Chaung Formation is Late Triassic, indicated by the Carnian-Norian Halobia fossils and maximum depositional ages between 233.0 ± 2.5 Ma and 206.2 ± 1.8 Ma and marine depositional environment (Sevastjanova et al., 2015).
3. The Pane Chaung Formation was deposited in a Late Triassic submarine fan along the northern margin of Australia, between West Papua to the east and Australia-India to the south (Cai et al., 2016).
4. Depositional environment of the Pane Chaung Formation is deep marine environment by the radiolarian fauna such as ?Striatojapanocapsa sp., Eucyrtidiellum sp., Eucyrtidiellum circumperforatum, Praezhamoidellum cf. buekkense, Unuma cf. gordus, ?Praeconocaryomma sp., Eucyrtidiellum sp., and Tricolocapsa sp..

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