

Paleontological Reassessment of Bukit Bucu, Batu Rakit, Terengganu, Malaysia

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Abstract. Bukit Bucu is situated close to Terengganu's northern coast. The entire sequence comprises of minor slate, sandstones, and shales that have been gently folded to produce an anticline that plunges towards the NNW. These interbedded sandstones and shales are dipping ENE or WSW and striking NNW. There is evidence of slaty cleavage and well-preserved sedimentary formations in the rocks of Bukit Bucu, which are subjected to very low metamorphism grade. Fossils assemblages that have been identified in Bukit Bucu include brachiopods, trilobites, bryozoans, crinoids and bivalves, indicating a shallow marine depositional environment. This sedimentary rock also produced several plant fossils from our most recent visit. Some of the fossils that have been recognized were *Avonia* sp. and *Dictyoelustus* sp. (brachiopods), *Posidonia* sp. and *Euomphalus* sp. (mollusks), *Fenestella pahangensis* (bryozoan), *Phillipsia* sp. (trilobite) and *Calamites* sp. (plants). Bukit Bucu's most recent age has been determined to be Carbo-Permian, which is consistent with low-grade metamorphism sequences that extend from Terengganu's north to Johor's south. The purpose of this study is to bring Bukit Bucu's fossil record up to date since it was last kept in 1986.

1 Introduction

The carboniferous fossils assemblages at Bukit Bucu were studied by [1], with few shallow marine faunas found. In the previous study, the fossils were only found in shale bedding within the hill; however, from our recent visit, fossils were also found in the sandy bedding. The recent visit has also yielded some ammonoids and echinoderms fossils apart from the presence of bivalves, brachiopods, trilobites, bryozoans, and crinoids from previous literature. The age of Bukit Bucu successions was assigned as Permian to Triassic, or most probably Carboniferous by [2] and corrected by [1], to be Carbo-Permian, which is correlated to the sequences metamorphized from south Johor to the north of Terengganu. The

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paleoenvironments of Bukit Bucu was shallow marine environments, based on the fossils found and the lithology characteristics.

Bukit Bucu has an abundance of fossils and is well known for its Carboniferous shallow marine fossils' assemblages. The fossils are quite well-preserved and consist of high percentages in certain bedding. This research is primarily aim at collecting, revising and preserving the fossil assemblages of Bukit Bucu, because based on our recent site visit, there might be a chance to get plant fossils in addition to fauna fossils. The construction and demolition activities in nearby area has recently been high. The conservation of this site is important to protect the site from further excavation.

2 Materials and Methods

2.1 Location of study area

The study area is located in Bukit Bucu, Eastern Peninsular of Malaysia. It is close to Batu Rakit Town on the northern coast of Terengganu (Figure 1). The study area is situated in a hilly area nearby a residential area with coordinates of N 05° 27' 28.7", E 103° 04' 46.3" and elevation is 37m. It rose some 100m above sea-level and was slightly weathered. The fossils were found in a shale and sand horizon on the north-eastern face of the hill.

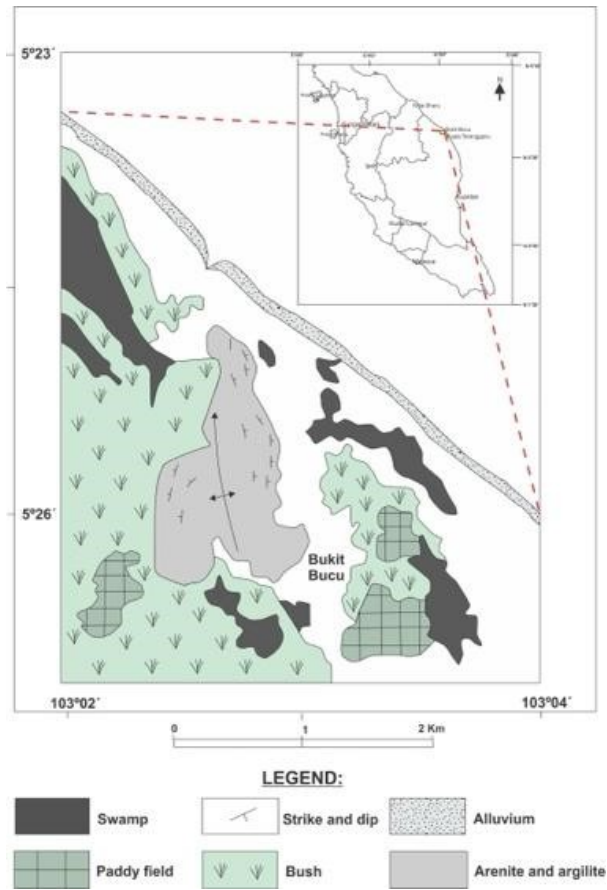


Figure 1. The map of study area together with few lithologies.

2.2 Geology and stratigraphy

The location of Bukit Bucu in Eastern part of Malaysia with the significant metasediments and arenaceous sequence has been assigned to the Sungai Perlis Bed. These metasediments was mapped as a part of an Eastern Belt with Carboniferous age. The first assignation age of Bukit Bucu successions was Permian to Triassic, or Carboniferous [2]. However [1] suggested it is as Carbo-Permian, referring to the metamorphism effect from south Johor to north of Terengganu.

Bukit Bucu is comprised of alternating sedimentary sequence of sandstone, siltstone and shale. The total thickness of the sequence is about 65 m thick, and the fossils were found at 10 m, 53 m and 63 m. In previous research, the fossil bearing stratum was at the 53 m level; however, in this study we found the fossils in two other beddings (Figure 2). The rocks suffered a low-grade metamorphism, as evidenced by slaty cleavages, and some of them can be referred to as slates. The structures of Bukit Bucu are involved in simple structures comprised of inter-bedded sandstones and shale, some minor folding [3], joint, cross bedding and mudclasts. The minor folding formed as an anticline on the top of the hill.

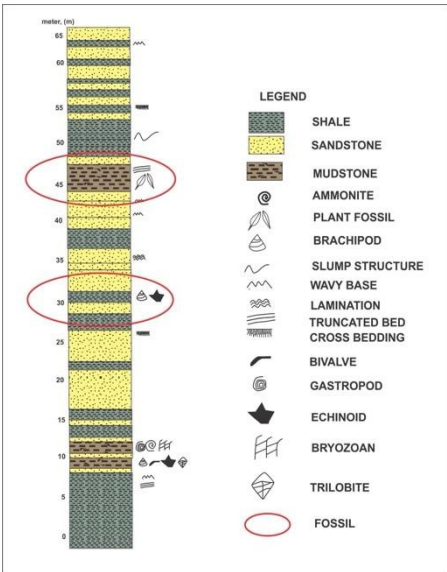


Figure 2. The lithology log of the study area.

2.3 Methods

Fossil sampling was done at two different sites within this area. Those fossils were brought to lab for further identification of fossil then analysis the fossil assemblages and determine the depositional environment. The fossils also had been collected during our fieldtrip with Second year students of Geoscience Program for their Palaeontology course and brought back to University Malaysia Kelantan for detailed identification. All the fossils were in situ and well-exposed on the outcrop.

3 Results

The Carboniferous sediments of the Eastern Belt extended from east Kelantan through Terengganu and east Pahang towards east of Johor. Most of the Carboniferous sediments in

Pahang belong to the Kuantan group consisting of Charu Formation, Panching limestone and Sagor Formation, Seri Jaya Beds and Kambing Beds. These formations have been compared with the Sungai Perlis beds of Bukit Bucu to determine the specific names of the fossils found here. Species that been identified from the previous study were bivalve; *Edmondia* sp., Brachiopod; *Braachythyryna strangwaysi*, *Chonetinella* sp., Bryozoa; *Fenestella retiformes*, Crinoid; *Poterocrinus* sp. (stems), Trilobite; *Paladin ophistops* and *Paladin veeravurusi* [1]. In this study, we found Brachiopod; *Antiquatonia* sp., *Derbyia* sp., *Avonia* sp., *Dictyoclostus* sp., *Buxtonia* sp. and *Chonetes* sp. Molluscs; *Aviculopecten* sp., *Myalina* sp., *Posidonia* sp. and *Euomphalus* sp. Bryozoa; *Fenestella pahangensis*, *Fenestella* cf. *tenax* and *Fistulipora* sp. Trilobites; *Phillipsia* sp. and Plant; *Calamites* sp., *Lepidodendron* sp., *Stigmara* sp., and *Cordaites* sp. together with previous mentioned fossils in previous literature.

3.1 Brachiopod

Brachiopods have high diversity in Bukit Bucu. The previous literature reported the presence of *Chonetinella* sp. and *Brachythyryna strangwaysi*, however in this study, we observed other genus of brachiopods which are *Antiquatonia* sp., *Derbyia* sp., *Avonia* sp., *Dictyoclostus* sp., *Buxtonia* sp., and *Chonetes* sp. The two spiriferida (wing-like) shapes, *Chonetinella* sp. and *Brachythyryna strangwaysi* are distinguished by a very clear growth line and rib for *Chonetinella* sp. and unclear growth line for *Brachythyryna strangwaysi*. Genus that have been found throughout this study have distinctive features which are to identify the genus. The presence of *Antiquatonia* sp., *Avonia* sp., *Dictyoclostus* sp., *Buxtonia* sp., and *Chonetes* sp. were correlated with Charu Formation [4], whilst *Derbyia* sp. was correlated with Aring Formation [5] which shown the age of Carboniferous respectively.

3.2 Molluscs

The molluscs in Bukit Bucu are diverse with bivalve, gastropod and ammonoids. The previous literature only recorded the presence of *Edmondia* sp., however during this study, we found another genus; *Aviculopecten* sp., *Posidonia* sp. and *Myalina* sp. Unlike brachiopods, these bivalves are rare throughout the succession, the respectively small sizes of *Posidonia* sp. and *Myalina* sp. make it hard to distinguish or observe. The gastropod, on the other hand, is much smaller, and we identified it as *Euomphalus* sp. based on the coiling shape, and one unidentified ammonoid has been collected. All the new finding molluscans fossils were correlated with Charu Formation [4].

3.3 Bryozoan

The bryozoans are high diversity as well like the brachiopods. These bryozoans mainly came from the *Fenestella* group, which been identified as *Fenestella retiformes* from the previous literature. The other bryozoans is *Fistulipora* sp., *Fenestella pahangesis*, and *Fenestella* cf. *tenax*. The presence of *Fistulipora* sp., and *Fenestella* cf. *tenax* were correlated with Charu Formation, whilst *Fenestella pahangesis* was correlated with Panching Limestone [4] which also gives a Carboniferous age.

3.4 Echinoids

Together with bryozoans and brachiopods, echinoids have high assemblages in Bukit Bucu. Most of the observed echinoids are crinoid stems, stalks, and arms. We found that the *Cyathocrinus* sp. are dominant in this study area, followed by *Poterocrinus* sp. Both of these genera were observed by their articular facets and the lateral view of both fossils.

3.5 Trilobite

Trilobites in Bukit Bucu are very rare. The size of these trilobites is small, around 1-2 cm each. From the previous literature, they recorded the presence of *Paladin veeravurusi* and *Paladin ophistops*, however during this study managed to get another additional genera; *Phillipsia*? sp. which was correlated with Charu Formation [4].

3.6 Plantae

The presence of plantae has been reported in Mineral and Geoscience Department Terengganu geosite information, however in any publication before. In this study, we managed to find *Lepidodendron* sp., *Calamites* sp., *Stigmaria* sp., and *Cordaites* sp. The presence of *Stigmaria* sp., can be correlated with Charu Formation [4], *Lepidodendron* sp. correlated with Charu Formation and Sungai Perlis Beds [6] whilst *Calamites* sp., and *Cordaites* sp. were correlated with Kambing Beds [7].

4 Discussion and Conclusion

In this study, we managed to collect many samples and specimens due to the fresh outcrops of the site. The comparisons of fossils collected in the previous study and this study are shown in Table 1. Brachiopods are dominant in this study area, followed by echinoids (crinoids), bryozoans and molluscs (bivalves). The other groups of fossils are rare through succession because of the smaller size or the time limitation for sample collection.

Table 1: The comparison fossils collection between the previous study (Idris & Zaki, 1986) and this study (noted that the □ symbol is showing that the species are present).

Previous study by Idris & Zaki, (1986)	This study
<i>Brachythyrina strangwaysi</i> , <i>Chonetinella</i> sp., <i>Paladin ophistops</i> , <i>Paladin veeravurursi</i> , <i>Edmondia</i> sp., <i>Fenestilla retiformes</i> and ' <i>Poterocrinus</i> ' sp.	□
	<i>Derbyia</i> sp., <i>Antiquatonia</i> sp., <i>Avonia</i> sp., <i>Dictyoclostus</i> sp., <i>Buxtonia</i> sp., <i>Chonetes</i> sp., <i>Euomphalus</i> sp., <i>Posidonia</i> sp., <i>Myalina</i> sp., <i>Aviculopecten</i> sp., <i>Fistulipora</i> sp., <i>Fenestella</i> sp., <i>Fenestella pahangensis</i> Sakagami, <i>Fenestella cf. tenax</i> Ulrich, Crinoid stem and stalks, <i>Phillipsia</i> sp., <i>Calamites</i> sp., <i>Cordaites</i> sp and <i>Stigmaria</i> sp.

The sequence at Bukit Bucu had been correlated with the Charu Formation based on the age and fossils presence. However, some of fossils that we found had been identified from the other Carboniferous age fossils in Malaysia for example the Namurian Panching Limestone, further south in Pahang Darul Makmur, with similar characteristics and features. The depositional environment of Bukit Bucu is shallow marine, based on previous work (Idris & Zaki, 1986). In this study, we identified the depositional environment in the delta front at the mouth bar based on the lithology and structural geology; for example, cross-bedding, slump structure, truncated bed, planar lamination and the existence of marine and terrestrial fossils. There was some argument on the age assignation of Bukit Bucu; Idris & Zaki (1986) confidently assigned it as the Carbo-Permian age, whilst in the much older literature MacDonald (1967), assigned it as Permian to Triassic and Carboniferous ages. In this study, we only found the Carboniferous and Permian fossils; therefore, we will stick with the Carboniferous to Permian age based on the evidence of fossils. However, extended research for age identification is highly recommended for future work.

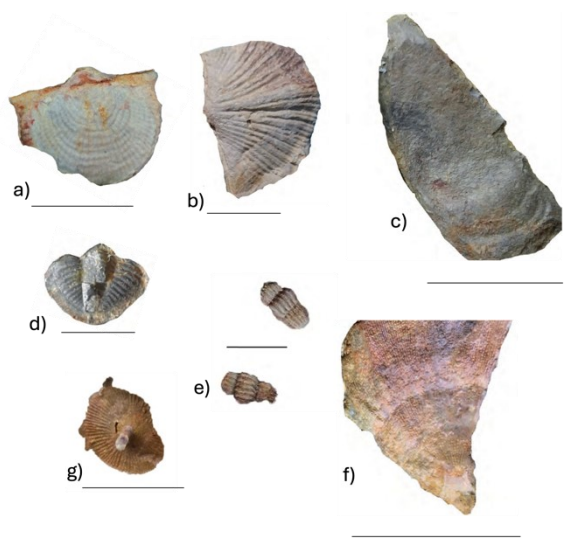


Figure 3. The previous fossils collected in Bukit Bucu [1]; a) *Chonetinella* sp., b) *Braahythyryna strangwaysi*, c) *Edmondia* sp., d) *Paladin veeravurusi*, e) *Paladin ophistops*, f) *Fenestella retiformes*, g) '*Poterocrinus*' sp. (stem).

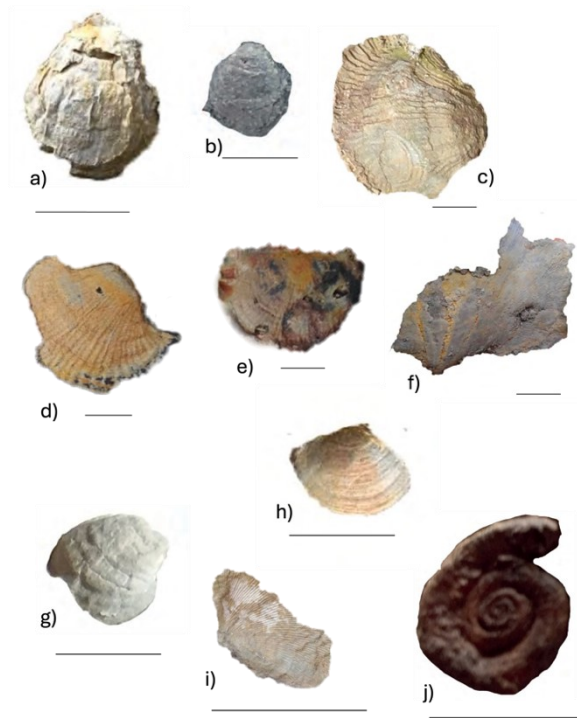


Figure 4. Brachiopod: a) *Antiquatonia* sp., b) *Avonia* sp., c) *Dictyoclostus* sp., d) *Buxtonia* sp. e) *Chonetes* sp. f) *Derbyia* sp.. Molluscs: g) *Myalina* sp., h) *Posidonia* sp. i) *Aviculopecten* sp. j) *Euomphalus* sp.

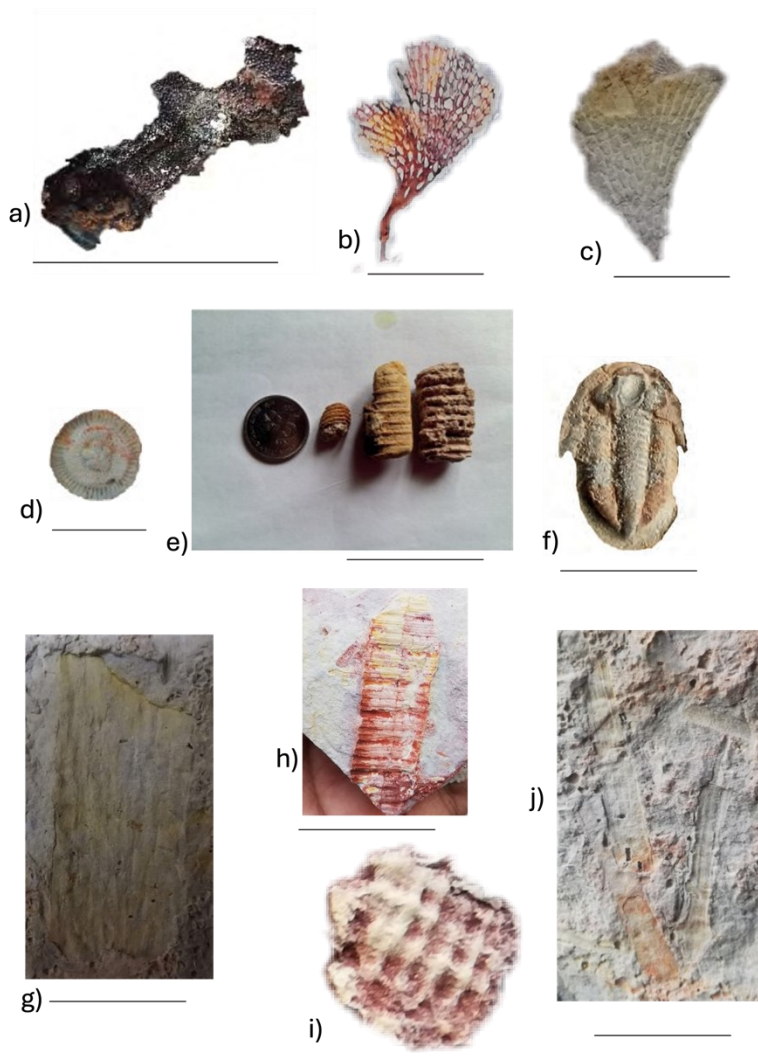


Figure 5. Echinoid: a) *Fistulipora* sp., b) *Fenestella* cf. *tenax* Ulrich, c) *Fenestella pahangensis* Sakagami, Crinoid: d) *Cyathocrinus* sp. Trilobites e) *Phillipsia* sp. f) Crinoid stems, Plantae: g) *Stigmaria* sp., h) *Calamites* sp., i) *Lepidodendron* sp. and j) *Cordaites* sp.

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