

## Plant fossils from Bukit Belah, Batu Pahat, Johor

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**Abstract:** The discovery of fairly well-preserved plant fossils from a rock sequence exposed at Bukit Belah, Batu Pahat, Johor can be utilised in interpreting the age of the rocks. The revised age proposed in this paper is Late Jurassic to Early Cretaceous. The identified plant fossils include *Gleichenoides* sp. and *Ptilophyllum* cf. *pterophylloides* Yokohama.

**Abstrak:** Penemuan fosil tumbuhan yang terawet baik dari jujukan batuan di Bukit Belah, Batu Pahat, Johor dapat digunakan untuk mentafsirkan usia batuan tersebut sebagai Jura Akhir hingga Kapur Awal. Himpunan fosil tumbuhan yang dikenal pasti termasuk *Gleichenoides* sp. dan *Ptilophyllum* cf. *pterophylloides* Yokohama.

### INTRODUCTION

The Bukit Belah area is about 5 km to the east of Parit Sulong, Batu Pahat, Johor (Fig. 1). It covers an area of approximately 25 km<sup>2</sup>. The study mainly deals with palaeontological aspect from the rock sequence at Bukit Belah. Based on field observations, no plant fossils are found in the rock sequence at Bukit Payong which is composed predominantly of reddish brown coarse-grained sandstone and conglomerate. Generally, the plant fossils are well-preserved in grey to dark grey, fine to medium-grained sandstone which is the dominant facies of the rock sequence at Bukit Belah.

The age and the sedimentological aspects of this area were reported by previous workers. Most of the correlation works were based on similar rock sequences reported from surrounding areas. Burton (1973) interpreted the rock sequence as mollase deposits of Upper Triassic age. It was also correlated and interpreted to be similar to the Bukit Resam Member of the Jurong Formation by Md. Shahid Ayub (1978). Noor Bakri Endut (1981), in his detailed sedimentological study estimated the thickness of the stratigraphic unit as approximately 2,000 m and divided the unit into three sections, namely lower, middle and upper section. According to Tan (1988), the sedimentation of Payong Formation was started after Peninsular Malaysia was uplifted in Late Triassic and subsequently stopped after the granite intrusion in Early Jurassic.

Syahrul Salehudin (2001) was the first researcher to suggest the age of study the area to be Valanginian-Aptian based on palaeontological evidence. He reported a considerable number of fairly well-preserved Late Jurassic-Early Cretaceous plant fossils namely *Gleichenites* (*Gleichenoides*) *pantiensis* Kon'no 1976, *Frenelopsis malaiana* Ko'no 1967, *Cupressinocladus acminifolia* Ko'no 1968, *Otozamites malayana* Smiley 1970, *Ptilophyllum* cf. *pterophylloides* Yokohama, and *P.* cf. *ayobanum* Smiley

1970. In a recent detailed palynological study by Uyop Said & Syahrul Salehudin (2001), the age of the study area was also interpreted to be Lower Cretaceous (Valanginian-Aptian).

### MATERIAL AND METHOD

A total of 30 samples were collected from one locality at Bukit Belah and 17 samples from four localities at Bukit Payong. However, only the rock sequence at Bukit Belah is discussed in this paper. Several plant fossils were collected and illustrated. The identification of the present plant fossils was mainly based on comparison with previous findings of Kon'no (1967 and 1968) and Kon'no and Asama (1975) from Ulu Endau, Gagau formation and Panti formation. A generalised rock section and sample horizons are shown in Figure 2.

### RESULTS AND DISCUSSION

The rock sequence has three main lithofacies namely conglomerate facies, sandstone facies and siltstone facies and these can be further divided into several subfacies. It is dominated by siltstone and fine to medium-grained sandstone. The horizons containing plant fossils are predominantly fine-grained sandstone and thickly bedded grey siltstone. Its fining upward sequence and the presence of sedimentary structures such as cross-bedding in medium to coarse-grained sandstone show that the sediments of the observed section were deposited in a braided river system.

#### Plant Fossils

Four samples were found containing fairly well-preserved plant fossils of *Otozamites gagauensis*, *Ptilophyllum* cf. *pterophylloides*, *Gleichenites* (*Gleichenoides*) *gagauensis* and *Gleichenites* (*Gleichenoides*) *pantiensis* (Plate 1 and Plate 2). Most of

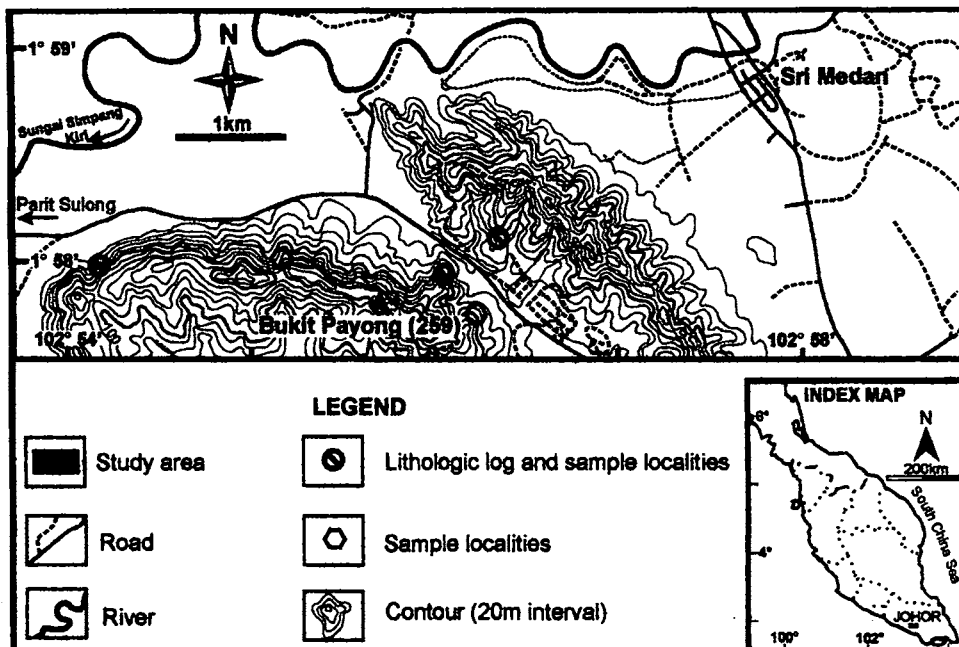


Figure 1. Map of the study area showing sample localities.

them were preserved in thinly-bedded grey to dark grey fine-grained sandstone. Generally, the identification of the plant fossils are based on the shape of pinnae as well as height and width of the frond. These plant fossils are compared to Mesozoic plants from Ulu Endau, Gagau formation and Panti formation by previous workers and their age range is from Upper Jurassic to the Lower Cretaceous (Fig. 3). *Ptilophyllum* cf. *pterophylloides* which was described by Kon'no (1967) from Ulu Endau was also recorded in the present study. Its age was interpreted to be Upper Jurassic to Lower Cretaceous.

### Brief notes on systematic study

Phylum: GLEICHENIACEAE Holttum, 1966

Genus: *Gleichenites* Seward, 1926

Subgenus: *Gleichenoides* Kon'no, 1967

*Gleichenites (Gleichenoides) pantiensis* Kon'no 1967 (Plate 1, figure 1-8)

Description: Frond (10-15 mm long) in tripinnate form. Pinna is asymmetry touching each other in penultimate form. The apex of frond is rounded or obtusely pointed are smaller than the lower basal part of the frond (10 specimens).

*Gleichenites (Gleichenoides) gagauensis* Kon'no 1967 (Plate 2, figure 4-6)

Description: Small frond 6 mm long and 3 mm wide. Ultimate pinna 1mm in length is asymmetry touching each other. The apex of frond is rounded or obtusely pointed and smaller than the lower basal part of the frond (five specimens).

Phylum: PTERIDOPHYTA

Class: PHELICARNIA

Order: BENNETTITALES

Genus: *Otozamites* Braun, 1842

*Otozamites gagauensis* Kon'no 1967 (Plate 2, figure 7)

Description: Pinnae are 5 mm high and 1 mm wide.

Laminations are touching asymmetrically to each other. The base of the broadly linear pinna is circular auriculate lower basal margin and not expanded to the upper corner. The apex of the pinnae is in half circle form and smaller than lower basal (one specimen).

Genus: *Ptilophyllum* Morris, 1840

*Ptilophyllum* cf. *pterophylloides* Yokohama (Plate 2, figure 1-3)

Description: The length of frond 15-20 mm and 10 mm wide in the middle part. The pinnae, which arise quite obliquely from rachis, have asymmetrical bases and obtusely rounded apices. The upper basal margin of pinnae are contracted proximally and lower basal margin are distinctly decurrent on the rachis (three specimens).

### CONCLUSION

Based on the occurrence of plant fossils especially *Ptilophyllum* cf. *pterophylloides* and *Gleichenites* sp., the rock sequence at Bukit Belah is interpreted to be Upper Jurassic to the Lower Cretaceous age.

### ACKNOWLEDGEMENT

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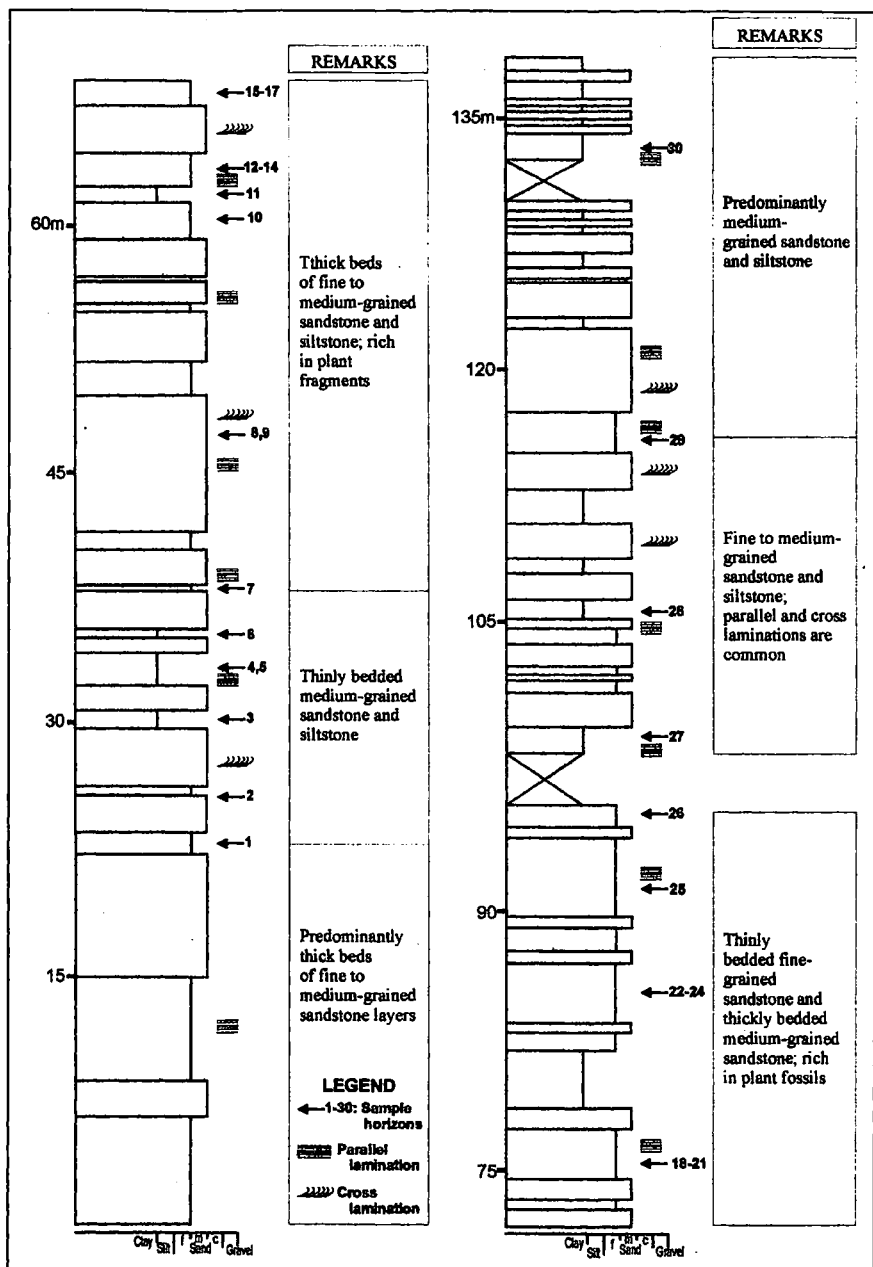


Figure 2. Simplified sedimentological log and sample horizons of the section studied at Bukit Belah.

Localities of Mesozoic plant fossils  Plant fossils taxa	Ulu Endau			Bukit Belah
	Gagau (Kon no, 1967 & 1968)	Panti (Kon no, 1967)	(Kon no, 1967) (Smiley, 1970) (Kon no and Asama, 1976)	
<b>A-EQUISETALES</b>				
1. <i>Equisetites Burchardti</i> DUNKER.....	X		X	
2. <i>E. SP.</i> .....			X	
<b>B-FILICALES</b>				
3. <i>Gleichenoides gagauensis</i> KON'NO.....	X		X	#
4. <i>G. pantiensis</i> KON'NO.....		X		#
5. <i>G. serratus</i> KON'NO.....	X			
6. <i>G. stenoplinnula</i> KON'NO.....	X			
<b>C-BENETTITALES</b>				
7. <i>Otozamites gagauensis</i> KON'NO.....	X		X	X
8. <i>O. malayana</i> SMILEY.....			X	X
9. <i>O. kondoi</i> OISHI.....			X	X
10. <i>Ptilophyllum cf. pterophylloides</i> (YOKOHAMA).....			cf.	cf.
11. <i>P. ayobanum</i> SMILEY.....			X	X
12. <i>Zamites buchianus</i> (Ettinghausen) SEWARD.....			cf.	
13. <i>Weltrichia</i> sp. Cf. <i>W. Whitbiensis</i> (NATH).....				X
14. <i>Nilssonia</i> sp. A.....				X
15. <i>N. Sp. b.</i> .....				X
<b>D-CONIFERALES</b>				
16. <i>Frenelopsis malaiana</i> KON'NO.....	X	X		
17. <i>F. malaiana</i> subsp. <i>Parvifolia</i> KON'NO.....		X		
18. <i>F. malaiana</i> subsp. <i>Tenuis</i> KON'O.....	X			
19. <i>Sphenolepis Kurmia</i> (Dunker) SCHENK.....	X			
20. <i>Pelourdea megaphylla</i> (PHILLIPS).....			cf.	cf.
21. <i>Cupressinocladus acuminifolia</i> KON'NO.....	X			
22. <i>Conites spinulosus</i> KON'NO.....	X	X		
<b>E-INCERTAE SEDIS</b>				
23. <i>Carpolithes</i> sp.....	X			

Figure 3. The occurrence of plant fossils by previous workers (#-also recorded from the study area).

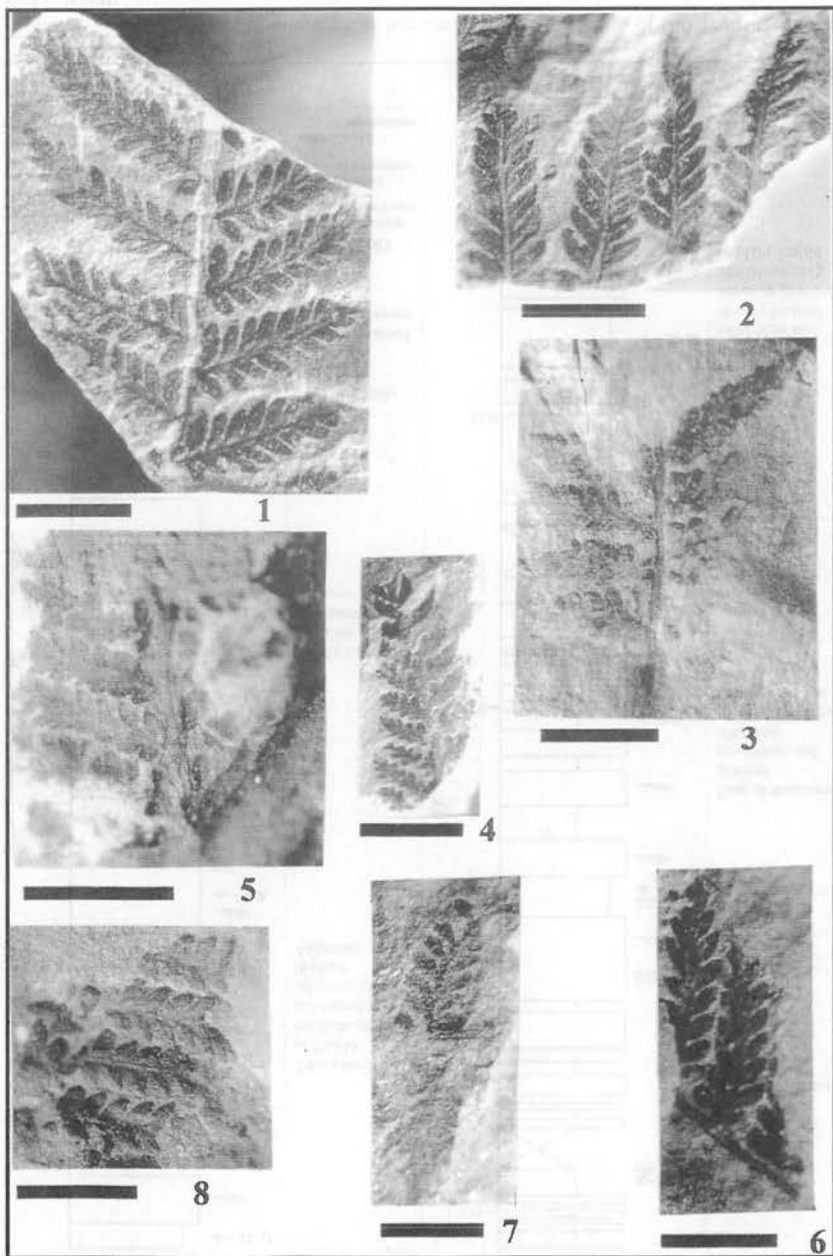


Plate 1. 1-8: *Gleichenites (Gleichenoides) pantiensis* Kon'no 1967 (Sample 15-E<sub>1</sub>&P<sub>2</sub>; Sample 17-A, F, G, N, K<sub>2</sub> & K<sub>1</sub>) (Scale bar = 5 mm).

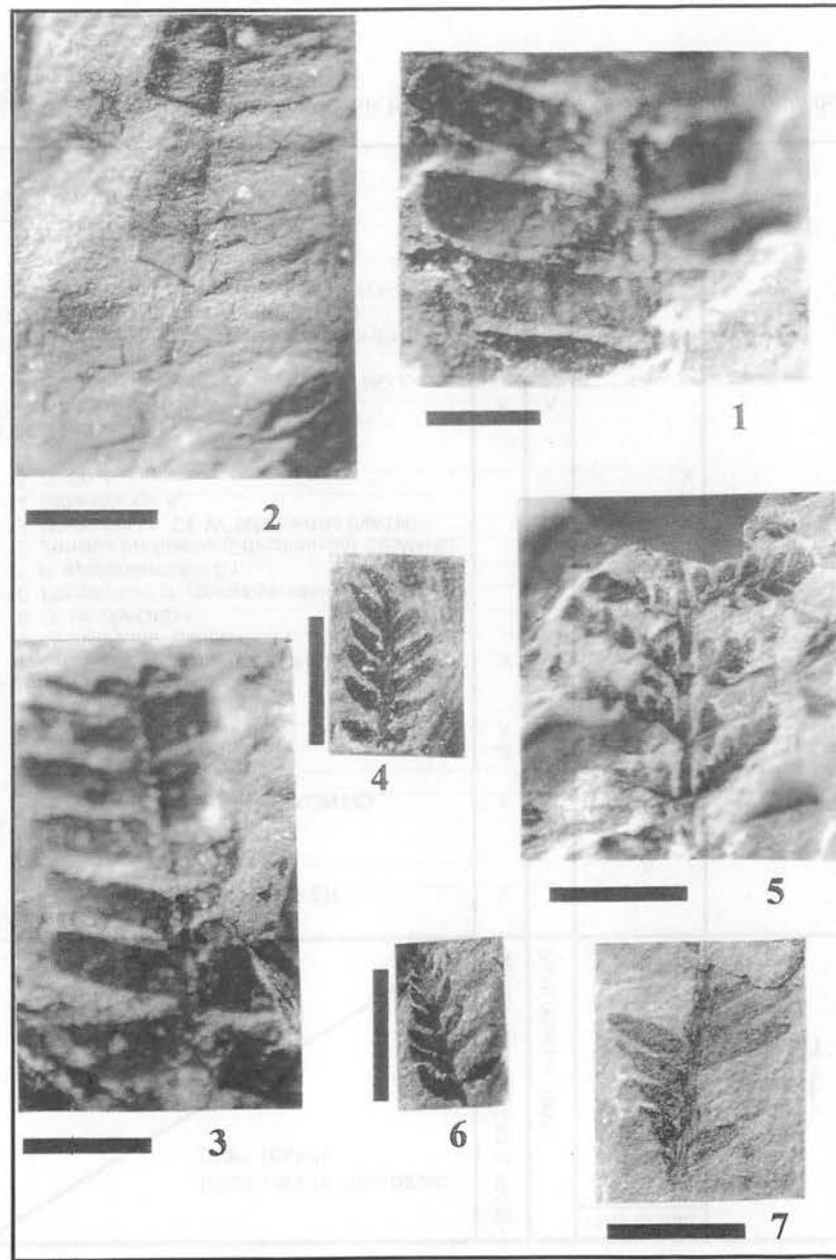


Plate 2. 1-3: *Ptilophyllum cf. pterophylloides* (Yokohama) (Sample 19-B, C & D); 4-6: *Gleichenites (Gleichenoides) gagauensis* Kon'no 1967 (Sample 15-L, O&P<sub>1</sub>); 7: *Otozamites gagauensis* Kon'no 1968 (Sample 20-I) (Scale bar = 5 mm).

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