

Some Devonian radiolarians from chert blocks in the Bentong-Raub Suture Zone, Pahang

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Abstract: Ten radiolarian taxa were identified from chert blocks of the Bentong-Raub Suture Zone, exposed at a new road cut along the Bentong-Raub road. The assemblage is composed of *Trilonche minax* (Hinde), *Trilonche davidi* (Hinde), *Trilonche vetusta* Hinde, *Trilonche cf. echinata* (Hinde), *Trilonche cf. parapalimbola* Wang, *Trilonche tretactinia* (Foreman), *Trilonche sp.*, *Stigmosphaerostylus herculea* (Foreman), *Stigmosphaerostylus sp.*, and *Helioentactinia sp.* This assemblage represents an age of Famennian, Late Devonian.

Abstrak: Sepuluh taksa radiolaria telah dikenal pasti daripada bongkah batuan rijang yang tersingkap di potongan jalan baru Bentong-Raub. Himpunan radiolaria terdiri daripada *Trilonche minax* (Hinde), *Trilonche davidi* (Hinde), *Trilonche vetusta* Hinde, *Trilonche cf. echinata* (Hinde), *Trilonche cf. parapalimbola* Wang, *Trilonche tretactinia* (Foreman), *Trilonche sp.*, *Stigmosphaerostylus herculea* (Foreman), *Stigmosphaerostylus sp.*, dan *Helioentactinia sp.* Himpunan ini menunjukkan usia Famennian, Devon Akhir.

INTRODUCTION

The Bentong–Raub Suture Zone is a narrow north-south trending zone extending from Tomo in southern Thailand through Bentong and Raub and to the east of Malacca town. The suture continues across the Strait of Malacca to the Bengkalis Depression in Central Sumatra (Tjia, 1987; 1989). The suture zone reaches a maximum width of 13 km and contains serpentinite, pre-Devonian quartz-mica schists and mélangé. This suture separates the west from the central domain of Peninsular Malaysia (Tjia, 1989) and represents the main Palaeo-Tethys Ocean, which separates the Sibumasu and Indochina continental terranes (Metcalf, 2000).

The aim of this paper is to report a new discovery of some radiolarian fauna from chert blocks exposed in the mélangé of the Bentong- Raub Suture Zone.

GEOLOGICAL SETTING

The Bentong-Raub Suture Zone is epitomized by the Schist Series and the Lower Arenaceous Series (Alexander, 1968). The former is in the west and the latter is in the east forming the Bentong Group. Jaafar Ahmad (1976) grouped both formations into the Karak Formation. He recognized six associated lithologic units i.e. rudite-arenite, argillite (including schist and phillite), chert, limestone, pyroclastics and serpentinitised mafic-ultramafic rocks.

Haile *et al.* (1977) tried to set up a standard stratigraphic scheme for the Paleozoic rocks in the Bentong area. The oldest rocks are the Schist Series followed by the Chert-Argillite and the youngest are the Red Beds. Tjia (1987) did not agree with the scheme because clasts of the Red Beds occur within the Chert-Argillite unit. Tjia (1987, 1989) suggested that the rocks found along the suture

comprise mainly pre-Silurian Schist and a Clastic-Chert unit. In addition, serpentinite and olistostrome are present. The serpentinite occur mainly as elongated bodies of schistose mafic-ultramafic rocks within quartz mica schist that strike northward. The serpentinite bodies have been interpreted as fragments of oceanic crust (Jones, 1973; Hutchison, 1975; Tjia 1987). The Clastic-Chert unit is equivalent to the Karak Formation of Jaafar Ahmad (1976) but excludes the quartz schist and amphibolite schist. The unit was previously known as the Foothills Formation and Older Arenaceous Series. Tjia (1987) interpreted the Clastic-Chert unit as comprising a sub-unit of clastic, sheared and unsheared olistostrome and a sub-unit of chert. The olistostrome was described as conglomerate or conglomeratic rocks by previous authors and Chakraborty and Metcalfe (1987) used the term diamictite to describe the mixture of limestone clasts in a pelitic matrix.

OUTCROP DESCRIPTION

A new road cut between Bentong and Raub exposed outcrops of rocks in the Bentong-Raub Suture Zone. The rocks consist of olistostrome or mélangé, with clasts ranging from granule to block sizes embedded in a foliated fine grained matrix. The clasts and megaclasts comprise several types of sandstones, folded ribbon chert, pelagic limestone, slate and siliceous shale.

Three localities BR1, BR3 and BR4 were identified for collecting chert samples along the road (Figure 1). BR1 is located at latitude 3° 35'N and longitude 101° 54'E. The section exhibits mélangé, containing blocks of folded ribbon chert, massive dark gray sandstone, and dark and red weathered mudstone. The width of the block of ribbon chert is about 30 m. The boundaries of the block strike south-southeast and dip moderately steeply to the west.

The attitude of the blocks is parallel to the general trend of the suture.

BR3 is located at latitude 3° 36.5'N and longitude 101° 54.2'E. The total width of the outcrop is about 500 m. This sections consists of matrix-supported conglomerate containing dominant clasts of sandstone and minor clasts of chert set in a matrix of sandstone. The angular to rounded clasts range from pebble to block sizes. Samples were collected from a block of thinly bedded dark gray to yellowish gray chert. The width of the block is 4.5 m and total thickness is about 4 m. The individual thicknesses of chert beds range from 3 to 10 cm. This section is interpreted to represent a submarine debris flow.

BR4 is located at latitude 3° 35.6'N and longitude 101° 54'E. This section represents a fault zone or mylonite zone of sheared mélangé containing augen-shaped dark gray sandstone, laminated sandstone, massive sandstone and siliceous mudstone. The augen-shaped clasts range from pebble to cobble sizes. The block consists of thinly bedded dark gray chert, massive sandstone, siliceous shale and slate. The actual shape of the block could not be seen

because parts of the block have been cut during the road construction. Generally, the mylonitic foliation strikes north-northwest and are steeply dipping to vertical. The whole section is about 400 m wide.

RADIOLARIAN AND AGE

Biostratigraphic study of radiolaria from the Bentong-Raub Suture Zone was carried out by Spiller (1996, 2002). She reported the occurrences of three Late Devonian radiolarian taxa consisting of fragmentary specimens of *Holoeciscus foremanae* Cheng, *Popofskyellum* sp. and *Archocyrtium* sp. from a chert locality north of Bentong town.

The spectacular outcrops in this study were exposed along the new Bentong-Raub road. Several chert blocks were observed at the outcrops. A total of 24 samples were collected from three chert localities; 14 samples from locality BR1, 5 samples from BR3 and 5 samples from BR4 (Figure 1). Only two samples produced moderately well preserved radiolarians (samples BR3-4 and BR4-3). Both samples yielded a similar radiolarian assemblage. Ten taxa were identified as follows:

- Trilonche davidi* (Hinde)
- Trilonche minax* (Hinde)
- Trilonche vetusta* Hinde
- Trilonche cf. echinata* (Hinde)
- Trilonche cf. parapalimbola* Wang
- Trilonche tretactinia* (Foreman)
- Trilonche* sp.
- Stigmosphaerostylus herculea* (Foreman)
- Stigmosphaerostylus* sp.
- Helioentactinia* sp.

This assemblage is different from that reported by Spiller (1996, 2002). The assemblage is dominated by the genus *Trilonche*, which has not been reported in Peninsular Malaysia. Zonal markers are absent in the present material. The occurrence of *Trilonche tretactinia* (Foreman) and *Stigmosphaerostylus herculea* suggests a Famennian (Late Devonian) age similar to the one reported by Spiller (1996, 2002). In Peninsular Malaysia, the oldest radiolarians are Famennian. This suggests that there was a period of high radiolarian productivity during this time. Famennian radiolarians were also reported in China (Wang *et al.*, 2003) and eastern Australia (Aitchison *et al.*, 1999).

CONCLUSION

New outcrops were exposed along the new road from Bentong to Raub, which contain several blocks of tightly folded chert sequence. Ten species of Late Devonian radiolaria were identified. The radiolarian assemblage is different from those previously reported from the area. The most dominant form is *Trilonche*. The most probable age of the chert is Famennian, based on the occurrence of *Trilonche tretactinia* and *Stigmosphaerostylus herculea*.

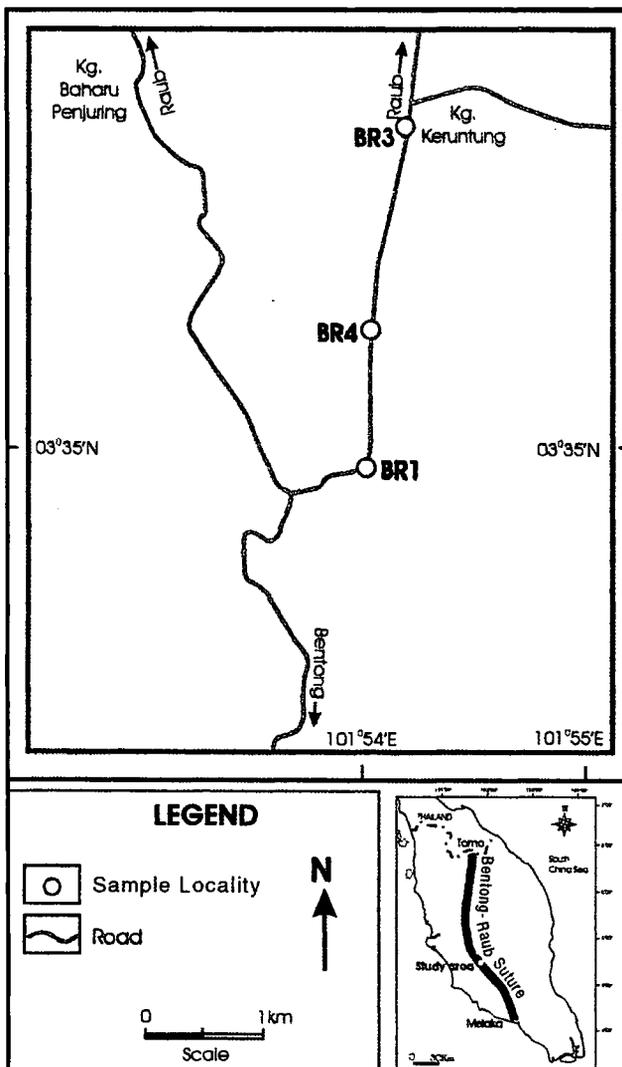


Figure 1. Map of the study area showing sample localities.

TAXONOMIC NOTES

Class Actinopoda
 Subclass Radiolaria
 Soborder Spumellaria
 Family Entactiniidae

Genus *Trilonche* Hinde 1899; emend. Foreman 1963; emend Aitchison and Stratford 1997.

Trilonche davidi (Hinde) (Pl. 1; fig. 1)

Staurolonche davidi Hinde 1899, p. 46, pl. 8. fig.13.

Trilonche davidi (Hinde) Aitchison and Stratford 1997, p.380, figs.2-8,3-4.

Stratigraphic range: Givetian, Middle Devonian to Late Devonian (Wang *et al.* 2003)

Trilonche minax (Hinde) (Pl.1, figs. 2,3,4)

Xiphosphaera minax Hinde 1899, p. 45, fig 8.

Staurodruppa? prolata Foreman 1963, p. 281, pl. 8, figs. 1a-b; pl. 9, fig 12.

Entactinosphaera egindyensis Nazarov 1975, p. 61;pl.5, figs. 2-4;pl.6, figs.1-5.

Trilonche minax Aitchison and Stratford 1997, p. 377, figs. 2-3, 2-4; figs. 3-3, 3-5.

Remarks: The species is the most common form found in the present material. They are very well preserved.

Stratigraphic range: Givetian, Middle Devonian to Famennian, Late Devonian (Wang *et al.* 2003)

Trilonche vetusta Hinde 1899; emend. Aitchison and Stratford 1997. (Pl.1, figs. 5, 6, 7)

Trilonche vetusta Hinde 1899, p. 48, pl.8. figs. 18,19.

Trilonche vetusta Hinde, Aitchison and Stratford 1997,p.374-376, figs.2-1,2-2,figs. 3-1,3-2.

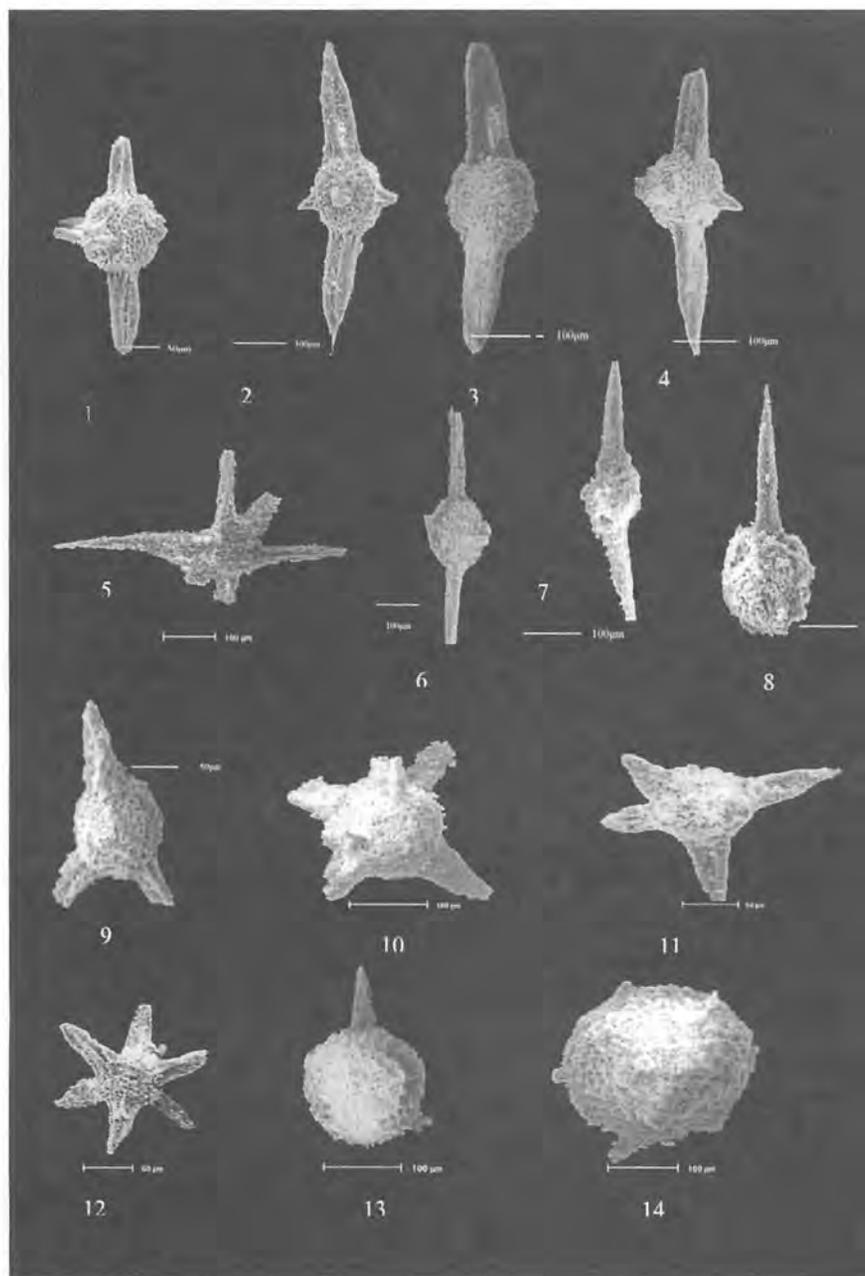


Plate 1. 1. *Trilonche davidi* (Hinde); 2, 3, 4. *Trilonche minax* (Hinde); 5, 6, 7. *Trilonche vetusta* Hinde; 8. *Trilonche cf. echinata* (Hinde); 9. *Trilonche cf. parapalimbola* Wang; 10. *Trilonche tretactinia* (Foreman); 11. *Trilonche* sp.; 12. *Stigmosphaerostylus herculea* (Foreman); 13. *Stigmosphaerostylus* sp.; 14. *Helioentactinia* sp.

Stratigraphic range: Givetian, Middle Devonian to Famennian, Late Devonian (Wang *et al.* 2003)

Trilonche cf. echinata (Hinde) (Pl. 1, fig. 8)

Remarks: The specimens are not well preserved and are partly crystalized. It has one prominent main spine similar to *Trilonche echinata* (Hinde). Other smaller spines are not preserved.

Trilonche cf. parapalimbola Wang (Pl. 1, fig. 9)

Remarks: The specimens are not well preserved. They show some external spines similar to *Trilonche parapalimbola* Wang.

Trilonche trectactinia (Foreman) (Pl. 1, fig. 10)

Entactinosphaera trectactinia Foreman 1963, p. 276, pl.2, figs. 6a-b; pl. 6, figs. 2a-b.

Trilonche tetractinia (Foreman) Wang *et al.* 2003, p. 134, pl. 1, figs 25-30.

Stratigraphic range: Famennian, Late Devonian (Wang *et al.* 2003).

Trilonche sp. (Pl. 1, fig. 11)

Remarks: Specimens are poorly preserved and cannot be identified to species level.

Genus: *Stigmosphaerostylus* Rüst 1892; emend. Foreman 1963.

Stigmosphaerostylus herculea (Foreman) (Pl. 1, fig. 12)

Entactinia herculea Foreman 1963, p. 271, pl.1, figs. 3a-d.

Stigmosphaerostylus herculea (Foreman) Wang *et al.*, 2003, p.132, pl. 5, fig. 14.

Stratigraphic Distribution: Famennian, Late Devonian (Wang *et al.*, 2003).

Stigmosphaerostylus sp. (Pl. 1 fig. 13)

Remarks: The specimens are poorly preserved.

Genus: *Helioentactinia*

Helioentactinia sp. (Pl. 1. fig. 14)

Remarks: The specimens are poorly preserved and species cannot be identified.

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