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 on a new road cut along the Bentong-Raub road. The assemblage is composed of Trilochne minax (Hinde), Trilochne davidi (Hinde), Trilochne vetusta Hinde, Trilochne cf. echinata (Hinde), Trilochne cf. parapalimbola Wang, Trilochne tretactinia (Foreman), Trilochne sp., Stigmosphaerostylus herculea (Foreman), Stigmosphaerostylus sp., and Helioentactinia sp. This assemblage represents an age of Famennian, Late Devonian.

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 melange. This suture separates the central domain of Peninsular Malaysia (Tjia, 1989) and represents the main Palaeo-Tethys Ocean, which separates the Sibumasu and Indochina continental terranes (Metcalfe, 1987).

The aim of this paper is to report a new discovery of some radiolarian fauna from chert blocks exposed in the melange 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 phyllite), chert, limestone, pyroclastics and serpentiniised mafic-ultramafic rocks.

Haile et al. (1977) tried to set up a standard stratigraphic scheme for the Palaeozoic rocks in the Bentong area. The oldest rocks are the Schist Series followed by the Chert-Ar gillite 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-Ar gillite 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 un sheared 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 diamicite 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 melange, 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 melange, 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 section 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 mélange 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 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:

- *Trilochne davidi* (Hinde)
- *Trilochne minax* (Hinde)
- *Trilochne vetusta* Hinde
- *Trilochne cf. echinata* (Hinde)
- *Trilochne cf. parapalimhola* Wang
- *Trilochne tretactinia* (Foreman)
- *Trilochne 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 *Trilochne*, which has not been reported in Peninsular Malaysia. Zonal markers are absent in the present material. The occurrence of *Trilochne 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 *Trilochne*. The most probable age of the chert is Famennian, based on the occurrence of *Trilochne tretactinia* and *Stigmosphaerostylus herculea*.

Figure 1. Map of the study area showing sample localities.
### Taxonomic Notes

<table>
<thead>
<tr>
<th>Class</th>
<th>Actinopoda</th>
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<tbody>
<tr>
<td>Subclass</td>
<td>Radiolaria</td>
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<tr>
<td>Soborder</td>
<td>Spumellaria</td>
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<tr>
<td>Family</td>
<td>Entactinidae</td>
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**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.

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

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

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

**Stratigraphic range:** Givetian, Middle Devonian to 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, 3-1, 3-2.

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

**Entactiniosphaera 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.

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*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 tretactinia* (Foreman) (Pl. 1, fig. 10)

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


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.


*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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