

Some Permian radiolarians from Bukit Yoi, Pokok Sena, Kedah

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Abstract— A two metre thick chert sequence exposed at an excavation site at the northern slope of Bukit Yoi, south of Pokok Sena town. The chert sequence comprises chert layers interbedded with siliceous and tuffaceous mudstone. The chert samples yielded some fairly well-preserved radiolarians. Three radiolarian assemblage zones were identified i.e. *Pseudoalbaillella scalprata* m. *rhombothoracata*, *Pseudoalbaillella longtanensis* and *Pseudoalbaillella globosa* Zones. The *Pseudoalbaillella scalprata* m. *rhombothoracata* Zone is indicative of late Sakmarian, Early Permian, *Pseudoalbaillella longtanensis* Zone represents the Kungurian and the *Pseudoalbaillella globosa* Zone represents the Roadian, Middle Permian.

Keywords: Permian, radiolarians, Semanggol Formation, chert, assemblage zone

Abstrak— Satu jujukan rijang berketebalan 2 meter telah tersingkap di suatu tapak potongan cerun utara Bukit Yoi, di selatan pekan Pokok Sena. Jujukan rijang terdiri daripada lapisan rijang yang berselang lapis dengan batu lumpur bersilika dan batu lumpur bertuf. Sampel rijang menghasilkan beberapa radiolaria yang terawet dengan baik. Tiga zon himpunan radiolaria telah dikenal pasti iaitu Zon *Pseudoalbaillella scalprata* m. *rhombothoracata*, *Pseudoalbaillella longtanensis* dan *Pseudoalbaillella globosa*. Zon *Pseudoalbaillella scalprata* m. *rhombothoracata* menunjukkan usia Sakmarian akhir, Perm Awal, Zon *Pseudoalbaillella longtanensis* mewakili usia Kungurian dan Zon *Pseudoalbaillella globosa* mewakili Roadian, Perm Tengah.

INTRODUCTION

The Semanggol Formation was divided into three informal members namely the chert member, the rhythmite member and the conglomerate member (Burton, 1973), which were later called units by Teoh (1992). It is well known that the siliceous rocks of the Semanggol Formation contain Permo-Triassic radiolarians (Sashida *et al.*, 1992, 1993, 1995; Basir Jasin, 1994, 1996, 1997; Spiller & Metcalfe, 1995a, 1995b; Spiller, 2002; Basir Jasin *et al.*, 2005a, 2005b).

Sashida *et al.* (1995) identified three biozones from the chert unit of the Semanggol Formation namely *Follicucullus monacanthus*, *Neobaillella ornithoformis* and *Neobaillella opima* Zones. Spiller (2002) recognized five radiolarian zones namely *Pseudoalbaillella longtanensis*?, *Follicucullus porrectus*, *Neobaillella ornithoformis*, *Triassocampe coronata* and *Triassocampe deweveri* Zones. The zones were recognized from ten different localities in north and south Kedah. Basir Jasin *et al.* (2005a, 2005b) recorded nine biozones from one locality at Bukit Kukus in the vicinity of Kuala Ketil, south Kedah namely *Pseudoalbaillella scalprata* m. *rhombothoracata*, *Follicucullus monacanthus*, *Follicucullus porrectus*, *Neobaillella ornithoformis*, *Neobaillella opima*, *Entactinosphaera chiakensis*, *Triassocampe coronata*, *Triassocampe deweri* and *Oertlispongus inaequispinosus* Zones.

Basir Jasin (1997) first identified the *Pseudoalbaillella scalprata* m. *rhombothoracata* Zone from Bukit Yoi, Pokok Sena, Kedah. Recently, more radiolarian chert samples were collected from a new outcrop at the same locality. More species of radiolarians were identified.

GEOLOGICAL SETTING

The chert unit of the Semanggol Formation is widely exposed in Padang Terap area, north Kedah and in the Kulim-Baling area, south Kedah. In Padang Terap area, the chert unit is exposed at several localities namely Bukit Yoi, Bukit Larek, Bukit Tembaga, Bukit Nyan, Bukit Barak, Kampung Lanjut Malau and Kampung Kolam (Figure 1). The chert unit in Padang Terap area can be divided into six facies based on the outcrop exposed at Bukit Larek (Basir Jasin & Zaiton Harun, 2007). The sequence consists of the following facies (in ascending order):

- Black laminated mudstone
- Interbedded sandstone and mudstone
- Siliceous shale and mudstone
- Interbedded siliceous mudstone and chert
- Tuffaceous mudstone
- Interbedded chert and siliceous shale.

Paraconglomerate is also observed at Kampung Lanjut Malau but its stratigraphic position cannot properly be located due to the complex structure of the outcrop. The chert unit was deposited in a deep-sea basin (Basir Jasin & Zaiton Harun, 2007).

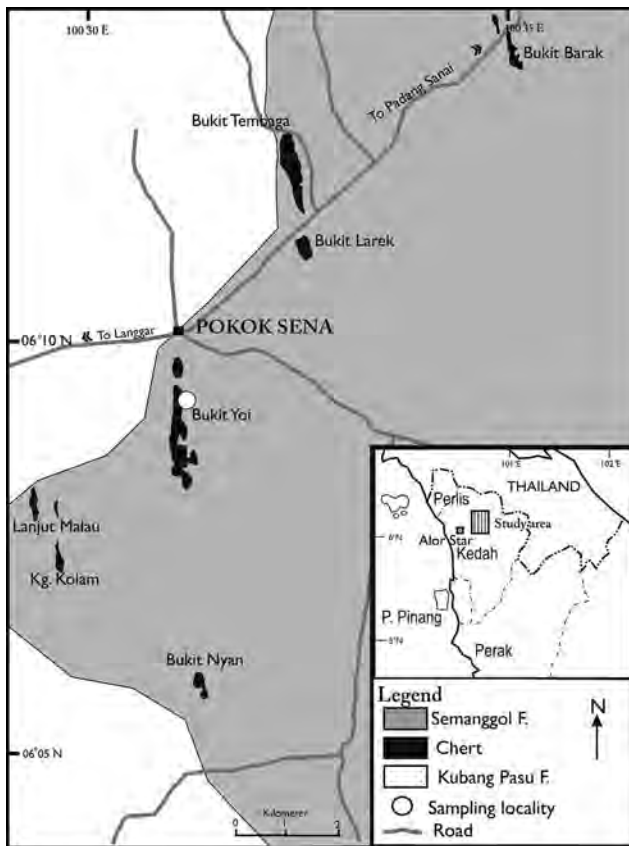


Figure 1: Geological map of the study area showing sample locality.

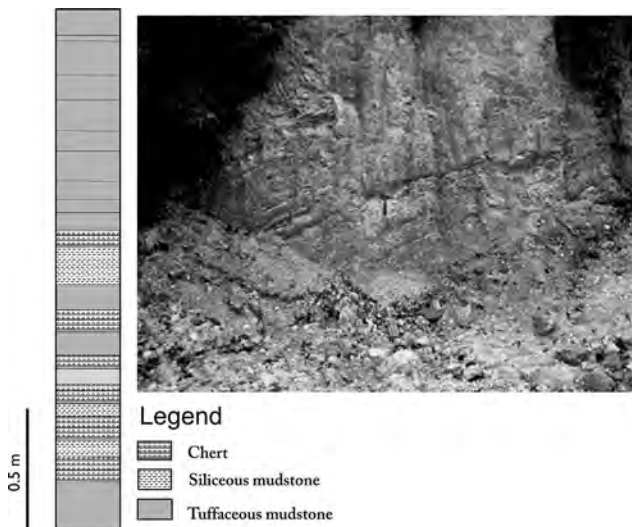


Figure 2: Outcrop of the chert sequence and lithologic log.

DESCRIPTION OF THE OUTCROP

A 2 m chert sequence is exposed at a new excavation site of Bukit Yoi (N 06° 09.3', E100° 31.2') about 2km south of Pokok Sena town. The sequence represents facies 4, *i.e.* interbedded siliceous mudstone and chert facies, which consists of interbedded chert, siliceous mudstone and tuffaceous mudstone (Figure 2). The top part of the

sequence is highly weathered and the beddings are obscured. The bottom part is moderately weathered and the layers are clearly visible. The thickness of the chert beds ranges from 2-5 cm.

RESULTS AND DISCUSSION

A total of ten chert and siliceous mudstone samples were collected from the chert unit at Bukit Yoi and only four chert samples yielded quite well-preserved specimens. The samples are labelled as BY101, BY102, BY103 and BY104. A total of 15 taxa are identified namely,

Pseudoalbaillella scalprata m. scalprata Ishiga (Plate 1, fig 1)

Pseudoalbaillella scalprata m. postscalprata Ishiga (Plate 1, fig. 2)

Pseudoalbaillella scalprata m. rhombothoracata Ishiga (Plate 1, fig 3)

Pseudoalbaillella elongata Ishiga and Imoto (Plate 1, fig. 4)

Albaillella asymmetrica Ishiga and Imoto (Plate 1, fig 5)

Pseudoalbaillella longtanensis Sheng and Wang (Plate 1, figs. 6, 7)

Pseudoalbaillella aidensis Nishimura and Ishiga (Plate 1, figs 8, 9)

Pseudoalbaillella fusiformis (Holdsworth and Jones) (Plate 1, figs. 10-12)

Pseudoalbaillella yanaharensis Nishimura and Ishiga (Plate 2, figs 1, 2)

Pseudoalbaillella globosa Ishiga, Kito and Imoto (Plate 2, figs. 3-5)

Pseudoalbaillella cf. longicornis Ishiga and Imoto (Plate 2, figs. 6, 7)

Pseudoalbaillella sp. (Plate 2, figs. 8, 9)

Latentifistula texana Nazarov and Ormiston (Plate 2, fig. 10)

Raciditor inflata (Sashida and Tonishi) (Plate 2, fig. 11) and

Ishigaum sp. (Plate 2, fig. 12)

The stratigraphic occurrences of the species are shown in Figure 3.

Base on the stratigraphic distribution of some selected taxa (Figure 4) by Nishimura & Ishiga (1987) and Ishiga (1990), the radiolarians can be assigned to three assemblage zones:

Pseudoalbaillella scalprata m. rhombothoracata assemblage Zone; The zone is characterized by the occurrence of zonal marker *Pseudoalbaillella scalprata m. rhombothoracata* together with *Pseudoalbaillella scalprata m. scalprata*, *Pseudoalbaillella scalprata m. postscalprata*, *Pseudoalbaillella elongata*, *Albaillella asymmetrica* and *Pseudoalbaillella elongata*. All the taxa are retrieved from sample BY101 at the base of the section. The *Pseudoalbaillella scalprata m. rhombothoracata* Zone is indicative of late Sakmarian, Early Permian. This is the oldest radiolarian zone discovered from the Semanggol

Formation. The zone was first reported from Bukit Larek and Bukit Yoi, north Kedah (Basir Jasin, 1996, 1997) and subsequently was also recorded from Bukit Kukus, south Kedah (Basir Jasin *et al.*, 2005a). The assemblage exhibits very low specific diversity. The stratigraphically important species in the zone is *Pseudoalbaillella elongata*, which has a very short range and is restricted to *Pseudoalbaillella scalprata m rhombothoracata* Zone (Ishiga, 1990)

Pseudoalbaillella longtanensis assemblage Zone; the assemblage consists of *Pseudoalbaillella longtanensis*, *Pseudoalbaillella aidensis*, *Pseudoalbaillella fusiformis*, *Pseudoalbaillella cf. longicornis* and *Pseudoalbaillella* sp. The assemblage was found in sample BY102. The zone represents Kungurian, Middle Permian (Yao *et al.* 2004). The *Pseudoalbaillella longtanensis* Zone was first recorded from the Semanggol Formation based on poorly preserved specimens recovered from a locality near Pokok Sena by Spiller & Metcalfe (1995b). The occurrence of *Pseudoalbaillella aidensis* in the present material is also indicative of the zone. Nishimura & Ishiga (1987) reported the occurrence of short ranging species of *Pseudoalbaillella aidensis* corresponds to the *Pseudoalbaillella longtanensis* Zone.

Pseudoalbaillella globosa assemblage Zone: the zone is characterized by the abundance of the zonal marker, *Pseudoalbaillella globosa* together with *Pseudoalbaillella yanaharensis*, *Pseudoalbaillella fusiformis*, *Pseudoalbaillella cf. longicornis*, *Latentifistula texana*, *Racidor inflata*, *Pseudoalbaillella* sp. and *Ishigaum* sp. The assemblage is found in samples BY103 and BY104. The zone represents Roadian, Middle Permian. *Pseudoalbaillella globosa* has a slightly longer stratigraphic range. It occurs from the late *Pseudoalbaillella longtanensis* Zone to the *Follicucullus monacantha* Zone. *Pseudoalbaillella yanaharensis* is a good indicator for the zone. Wang *et al.* (1994) recorded that the stratigraphic distribution of the species is restricted to the *Pseudoalbaillella globosa* Zone. This is a new zone recorded from the Semanggol Formation.

Spiller (2002) and Basir Jasin *et al.* (2005a) identified a total of six radiolarian zones from the Permian chert of the Semanggol Formation namely (in ascending order) *Pseudoalbaillella scalprata m. rhombothoracata* Zone, *Pseudoalbaillella scalprata m. rhombothoracata* Zone, *Follicucullus monacanthus* Zone, *Follicucullus porrectus* Zone, *Neoalbaillella ornithoformis* Zone and *Neoalbaillella opima* Zone. The newly discovered *Pseudoalbaillella globosa* Zone from the chert unit of the Semanggol Formation improves the radiolarian biostratigraphy. The radiolarian biozonation from the late Early Permian to the Late Permian is almost complete except the *Pseudoalbaillella sinuata* Zone. The *Pseudoalbaillella sinuata* Zone, which occurred between the *Pseudoalbaillella scalprata m. rhombothoracata* Zone and *Pseudoalbaillella longtanensis* Zone, is not yet discovered from the Semanggol Formation.

It seems that the occurrence of radiolarian chert was determined by the supply of tuffaceous material. A higher supply of tuffaceous material diluted the deposition of

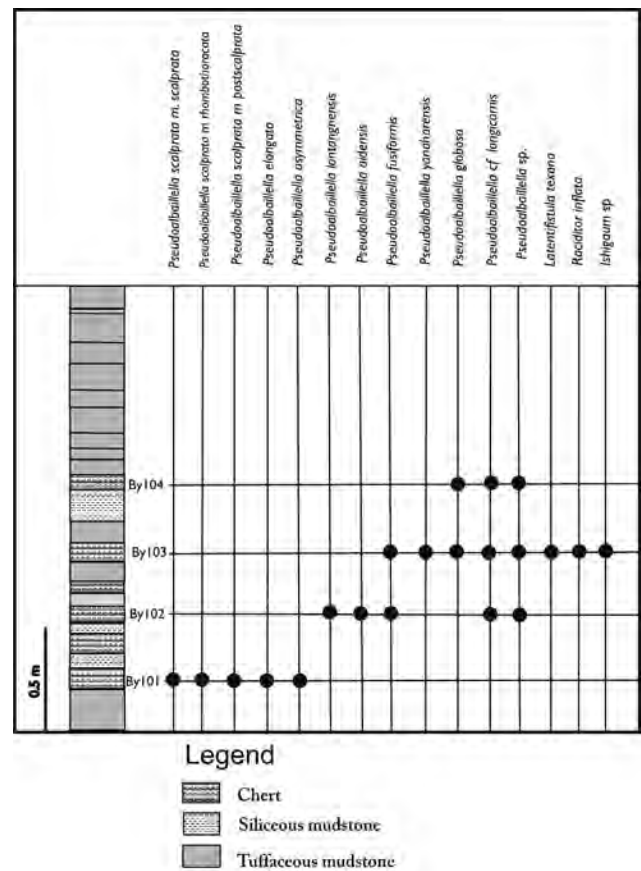


Figure 3: Stratigraphic distribution of radiolarians in the chert sequence at Bukit Yoi.

radiolarian chert. As a result, less bedded chert was formed. The tuffaceous material in the Semanggol Formation was deposited since Early Permian and continued to Triassic. This indicates the presence of volcanic activities in the vicinity of the Semanggol basin.

CONCLUSION

The chert unit of the Semanggol Formation comprises interbedded chert with siliceous mudstone and tuffaceous mudstone. Most of radiolarians were retrieved from the radiolarian chert. Three biozones were recognized based on the assemblage of radiolarians. The oldest chert belongs to the *Pseudoalbaillella scalprata m. rhombothoracata* Zone, late Sakmarian, late Early Permian. The *Pseudoalbaillella longtanensis* Zone and the *Pseudoalbaillella globosa* Zone indicate an age of Kungurian and Roadian, Middle Permian respectively. The *Pseudoalbaillella globosa* Zone is a new radiolarian zone discovered in the Semanggol Formation.

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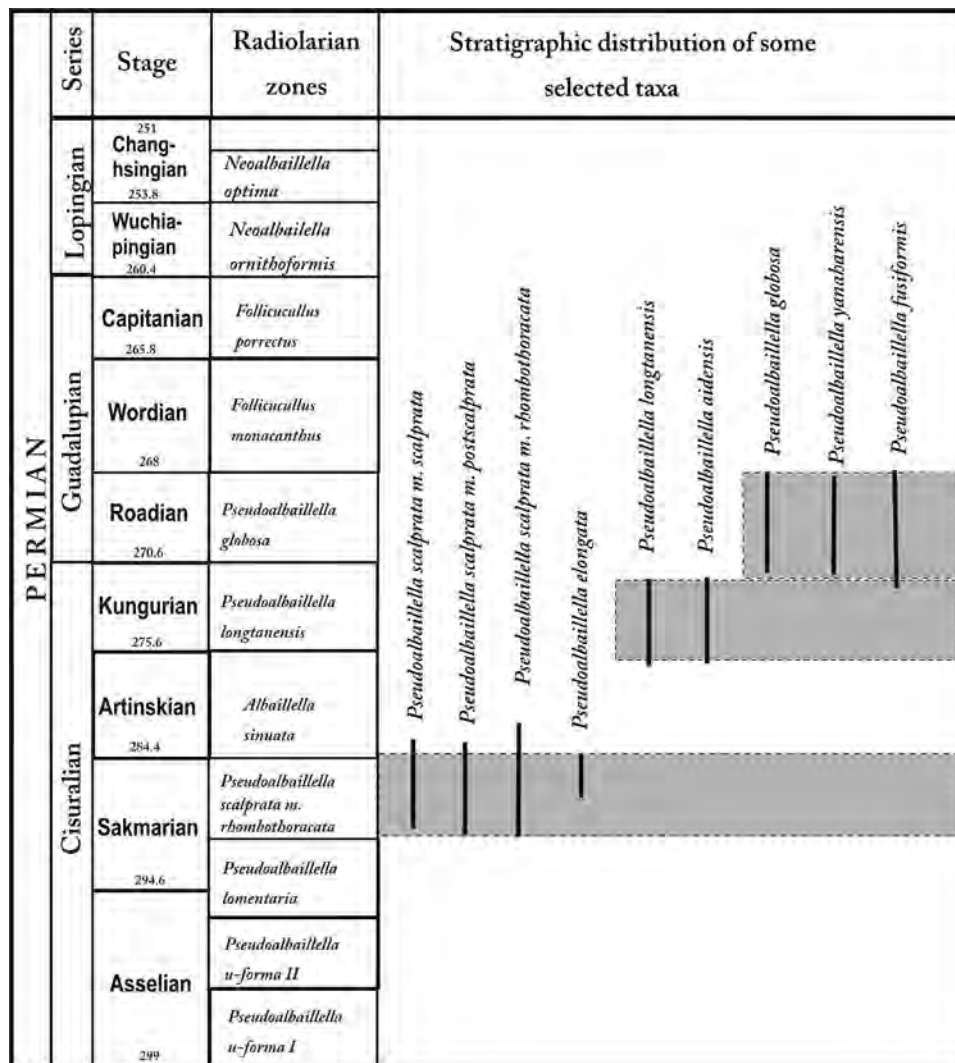


Figure 4: Stratigraphic distribution of some selected taxa.

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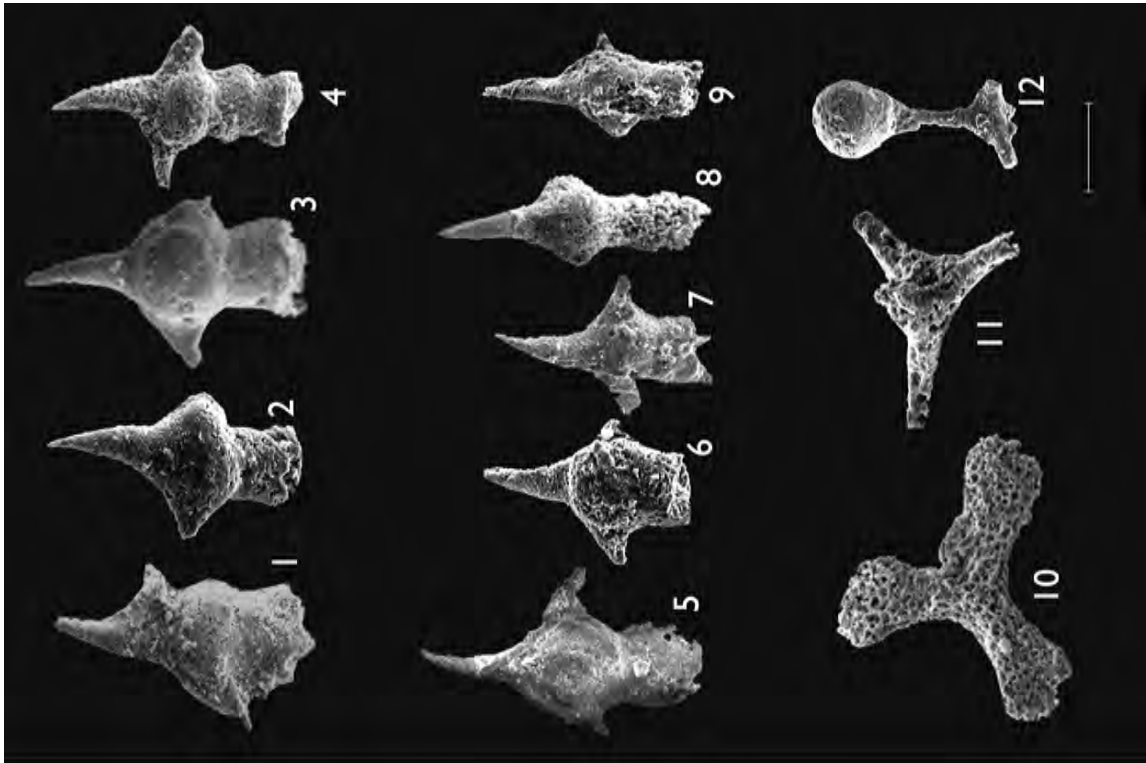


Plate 2: (Scale bar = 100 µm) 1 & 2 *Pseudoalbailletta yanaharensis* Nishimura and Ishiga; 3, 4 & 5 *Pseudoalbailletta globosa* Ishiga, Kito and Imoto; 6 & 7 *Pseudoalbailletta* cf. *longicornis* Ishiga and Imoto; 8 & 9 *Pseudoalbailletta* sp.; 10 *Latentifistula texana* Nazarov and Ormiston; 11 *Racditator inflata* (Sashida and Tonishi); 12 *Ishigaum* sp.

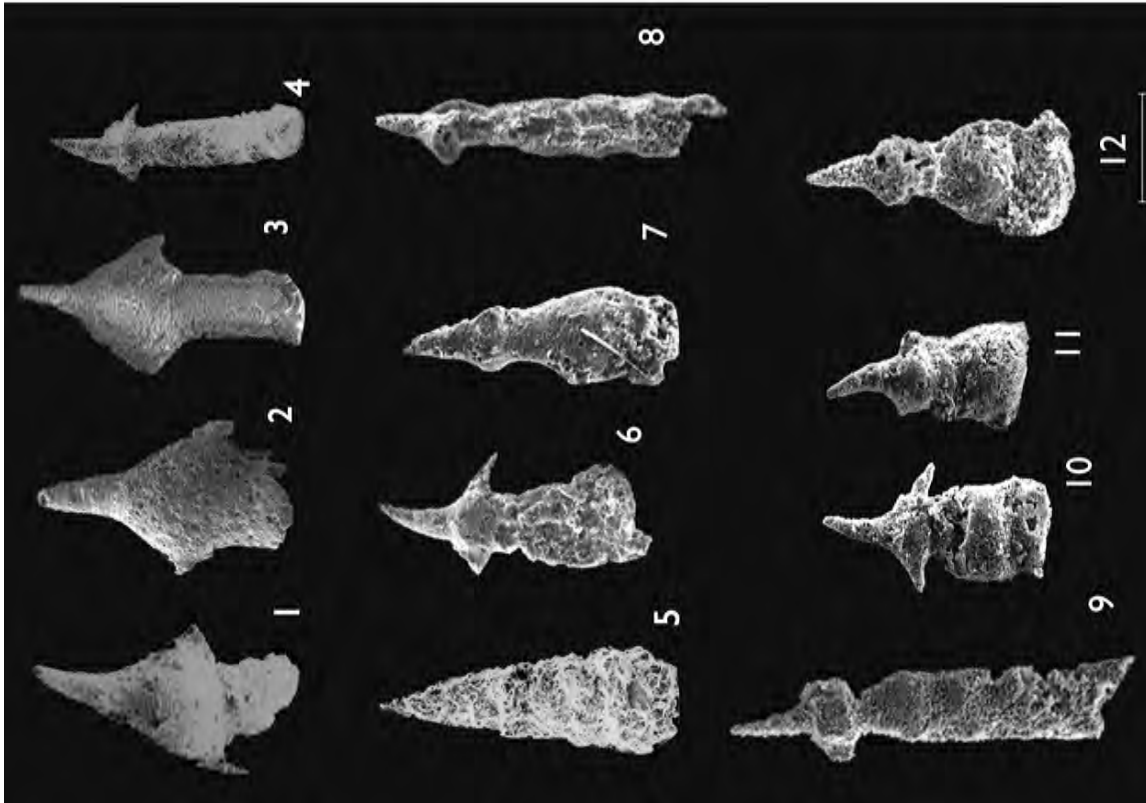


Plate 1: (Scale bar = 100 µm) 1 *Pseudoalbailletta scalprata* m. *scalprata* Ishiga; 2 *Pseudoalbailletta scalprata* m. *postscalprata* Ishiga; 3 *Pseudoalbailletta scalprata* m. *rhombothoracata* Ishiga; 4 *Pseudoalbailletta elongata* Ishiga and Imoto; 5 *Albailletta asymmetrica* Ishiga and Imoto; 6 & 7 *Pseudoalbailletta longtanensis* Sheng and Wang; 8 & 9 *Pseudoalbailletta aidensis* Nishimura and Ishiga; 10 & 12 *Pseudoalbailletta fusiformis* (Holdsworth and Jones).

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