

Permian ammonoids from Kuala Betis area, Kelantan and their paleogeographic significance

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Abstract: Two new Permian ammonoid bearing localities were recently discovered from Kuala Betis area, Kelantan. At Sungai Peralong, ammonoid cephalopods and some brachiopods were found in thin to moderately bedded tuffaceous siltstone and mudstone. The ammonoid fauna consists of *Agathiceras* cf. *suessi* Gemmellaro, *Adrianites* cf. *elegans* Gemmellaro, *Popanoceras* sp., *Propinacoceras* sp., ?*Imitoceras* sp. and some small orthoconic ammonoids. At another locality near Sungai Berok, ammonoid fauna was preserved in thin tuffaceous shale interbedded with chert and cherty mudstone. This locality yields *Agathiceras* cf. *suessi* Gemmellaro, *Adrianites* cf. *elegans* Gemmellaro, *Popanoceras* sp., *Propinacoceras* sp. and *Hoffmannia* cf. *hoffmanni* (Gemmellaro). The cephalopod assemblages from these localities partly resembles that of the middle Permian Sungai Cheroh cephalopod fauna (Lee, 1978). The Sungai Peralong, Sungai Berok and Sungai Cheroh fauna are all associated with deep water sediment within the Bentung Suture zone. Similarities between these fauna and the Italian Socio fauna and the Basleo fauna of Timor (Lee, 1978) and many other ammonoid occurrences in Europe, North Africa and West Asia (Blendinger *et al.*, 1992) indicated that an oceanic link has been established between these pelagic fauna, perhaps as early as Lower Permian or even earlier.

INTRODUCTION

Jones *et al.* (1966) recorded for the first time the occurrence of Permian ammonoid in Malaysia area from the H.S. Lee Beds, west of Kampar and regarded these ammonoids which include *Stacheoceras* sp., *Crimites* sp. and *Adrianites* sp. as middle Permian in age. Later, Suntharalingam (1968) added and illustrated another genus *Agathiceras* sp. to the list of ammonoid genera found from the same bed. Lee (1978) reidentified and described these cephalopods as *Prostacheoceras skinneri* (Miller), *Neocrimites* cf. *guangxiensis* Chao and Liang and *Adrianites* cf. *insignis* Gemmellaro. Based on the occurrences of *Prostacheoceras skinneri* (Miller), Lee (1978) suggested a late lower Permian age for the H.S. Lee ammonoid fauna. However Fontaine (1986) and Fontaine and Ibrahim Amnan (1994) considered that the fauna from H.S. Lee Bed are of middle Permian age.

Lee (1978) described some middle Permian cephalopod including *Agathiceras suessi* Gemmellaro, *Adrianites elegans* Gemmellaro and *Popanoceras* cf. *scrobiculatum* Gemmellaro from Sungai Cheroh, Pahang. The Cheroh fauna is the only known Permian cephalopod fauna from the Central Belt of Peninsular Malaysia prior to the present study. Whereas, from the Western Belt, another Permian (middle Permian) cephalopod occurrences was reported by Abdullah Sani Hashim (1985) from the Kenny Hill Formation in Sepang area.

Mohamad Radi Jaafar (1991) and Ng (1991) have found one cephalopod-bearing locality each from their final year geological mapping project in Sungai Peralong and Belau area, respectively. Recently, a paleontological study has been carried out by the author from the same area. A bigger collection of cephalopods were made from this study, but no new Permian cephalopod locality was discovered.

GEOLOGICAL SETTING

Kuala Betis village is situated in southwest Kelantan, about 40 km west of Gua Musang Town. The geology of Kuala Betis is mainly made of the Permo-Triassic metasedimentary-pyroclastic sequence (Aw, 1974) which was later considered as the Gua Musang Formation by Kamal Roslan Mohamed *et al.* (1993). This formation unconformably overlies an olistostrom unit which was considered as part of the Bentung Suture Zone by Tjia and Syed Sheikh AlMashoor (1993). Many fossiliferous localities were discovered from the Kuala Betis area. Some of them bear Permian flora and fauna including some ammonoids, while others contain Triassic fauna (see Fig. 1).

Permian ammonoid faunas came from two separate localities, i.e. from Sungai Peralong and Sungai Berok. Both localities fall within the olistostrome unit which marked the eastern margin of the Bentung Suture Zone of Tjia and Syed Sheikh AlMashoor (1993).

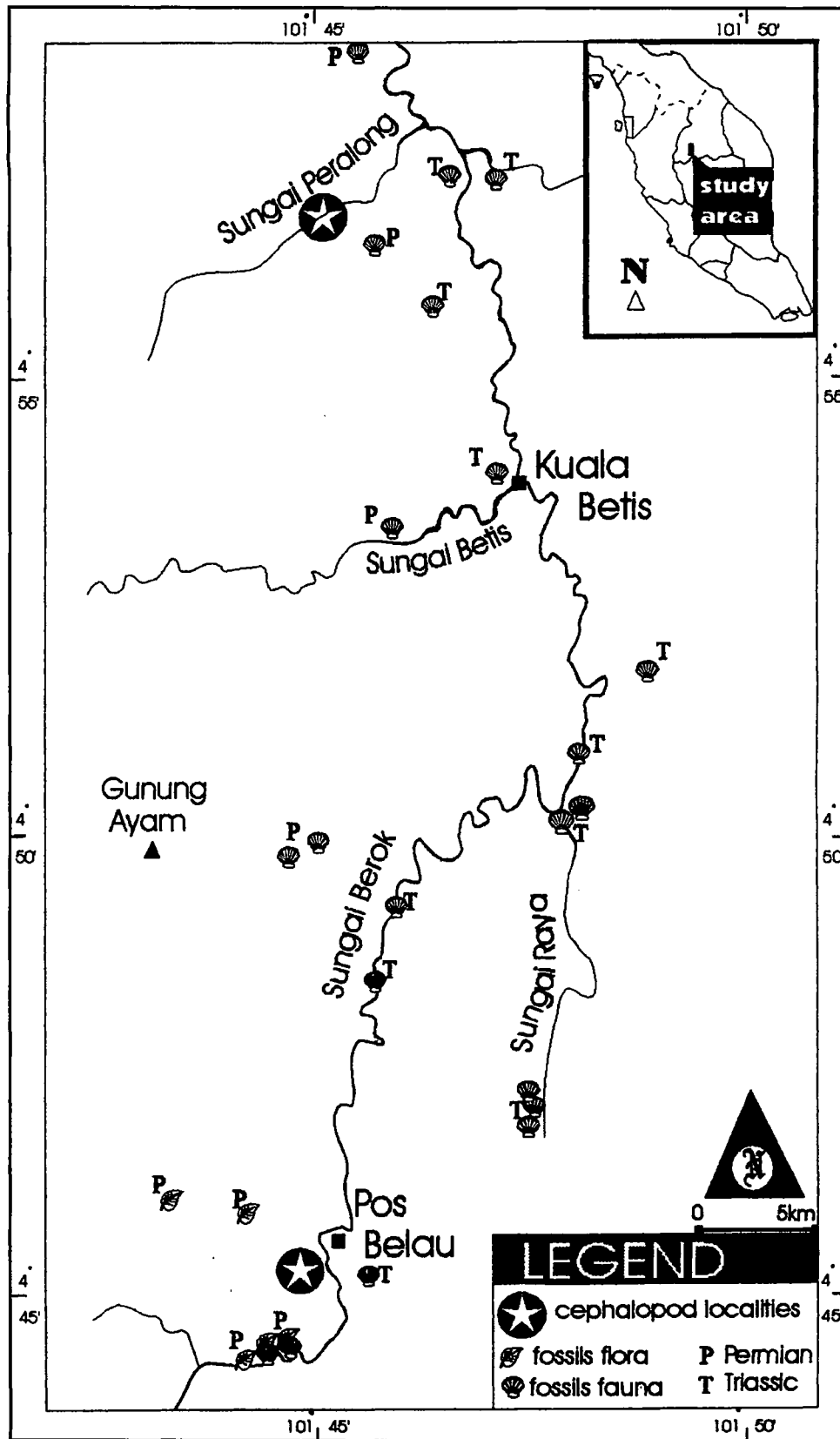


Figure 1. Permian cephalopod localities in the Kuala Betis area, Kelantan.

Along the timber track at Sungai Peralong crop out several exposures of steeply dipping to vertical sedimentary rocks. These sedimentary rocks consist of thin to thickly bedded tuffaceous mudstone, siltstone and sandstone. Some of the thin to moderately bedded tuffaceous siltstone and mudstone within 50 m distance from the log bridge, both on the northwest and southeastern sectors of the track yield some cephalopod remains. Samples from the Geological Survey collections examined in this study apparently came from the nearby river exposure. Some very rare productidid and athyrid brachiopods were also found from this locality.

The Sungai Berok cephalopod fauna came from a road cut (i.e. the proposed Pulai-Cameron Highlands road) exposure about 200 m southwest of Belau bridge. This road cut exposed some thinly bedded chert and cherty mudstone interbedded with very thin layers or laminae of tuffaceous shale. The fauna is commonly preserved in this thin layer of tuffaceous shale.

THE FAUNA

The Sungai Peralong fauna is dominated by goniatitic ammonoids including *Agathiceras* cf. *suessi* Gemmellaro (Fig. 2l), *Adrianites* cf. *elegans* Gemmellaro, *Popanoceras* sp., *Propinacoceras* sp. (Fig. 2e), *?Imitoceras* sp. (Fig. 2g) and some small orthoconic cephalopods (Fig. 2h). The brachiopods include *Linoproductus* sp. and *Neophricadothyris* sp. Most of the fauna are preserved forms of mould, occasionally with preserved ceratitic or goniatitic sutures. Sometimes remaining pulverised shells are still preserved. The presence of some fragmentary shell remains in this locality suggested that some of the faunal elements might have been reworked from a shallower depth.

The Sungai Berok fauna is almost entirely made of goniatitic ammonoids. They consist of *Agathiceras* cf. *suessi* Gemmellaro (Fig. 2c, d), *Adrianites* cf. *elegans* Gemmellaro (Fig. 2a, b), *Popanoceras* sp. (Fig. 2k), *Propinacoceras* sp. (Fig. 2f, m) and *Hoffmannia* cf. *hoffmanni* (Gemmellaro) (Fig. 2i, j). The fauna is preserved in the form of moulds with occasional chalky pulverised shell remains. Basir Jasin (1994) has recorded the occurrences of some lower Permian radiolarians from the same chert unit, but from a different locality, perhaps from a lower horizon. Unlike that of the Sungai Peralong, the Sungai Berok cephalopod shells are usually unbroken, implying that they have not been transported by any bottom current.

AGE

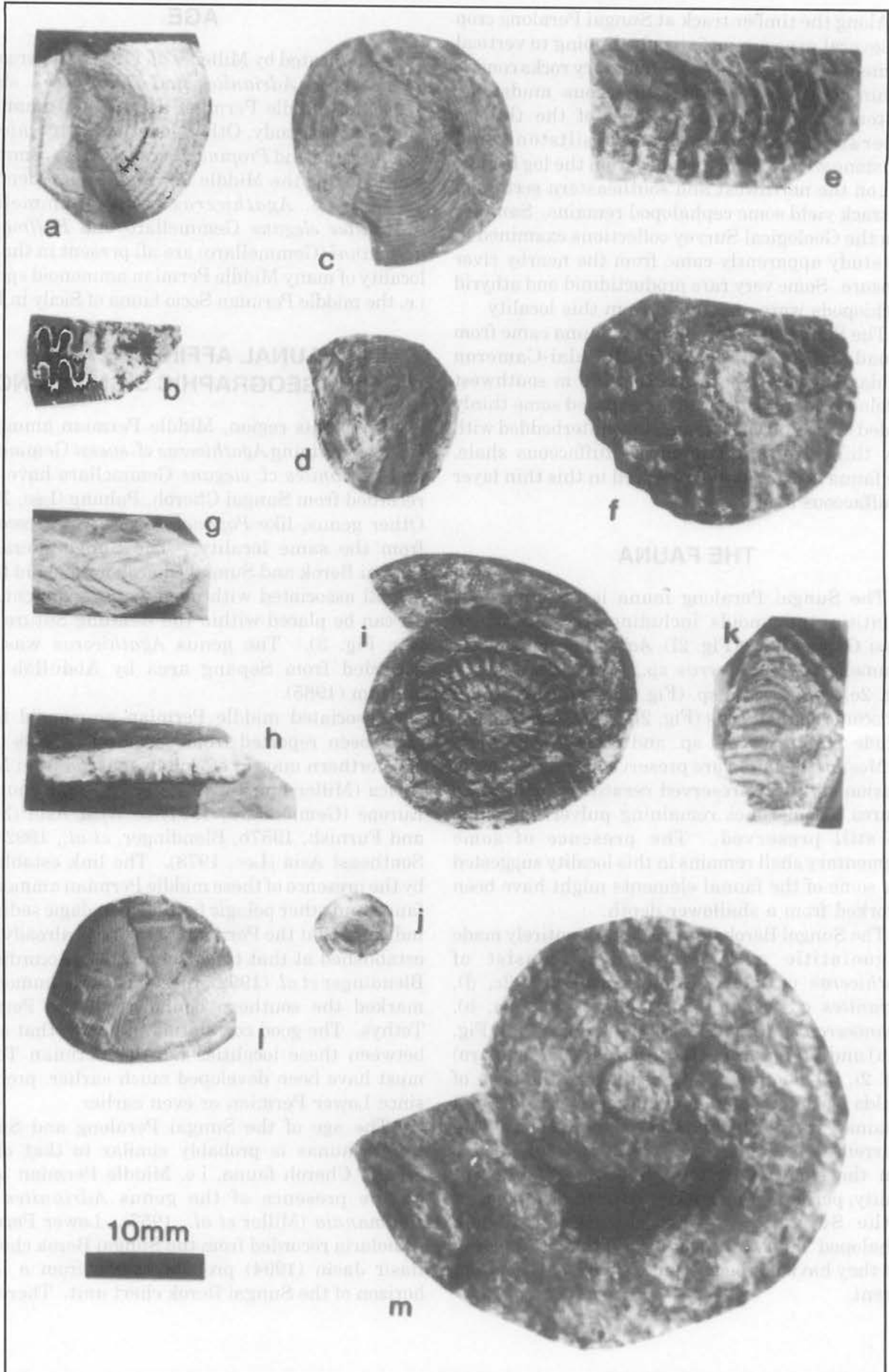
As indicated by Miller *et al.* (1957), the presence of the genus *Adrianites* and *Hoffmannia* should mark a middle Permian age to both ammonoid fauna in this study. Other genera like *Agathiceras*, *Popanoceras* and *Propinacoceras* are also commonly found during the Middle Permian time. Identified species, i.e. *Agathiceras suessi* Gemmellaro, *Adrianites elegans* Gemmellaro and *Hoffmannia hoffmanni* (Gemmellaro) are all present in the type locality of many Middle Permian ammonoid species, i.e. the middle Permian Socio fauna of Sicily in Italy.

FAUNAL AFFINITIES AND PALEOGEOGRAPHIC SIGNIFICANCE

From this region, Middle Permian ammonoid fauna containing *Agathiceras* cf. *suessi* Gemmellaro and *Adrianites* cf. *elegans* Gemmellaro have been recorded from Sungai Cheroh, Pahang (Lee, 1978). Other genus, like *Popanoceras* was also recorded from the same locality. The Sungai Peralong, Sungai Berok and Sungai Cheroh ammonoid fauna are all associated with deep water sediment, and all can be placed within the Bentung Suture zone (see Fig. 3). The genus *Agathiceras* was also recorded from Sepang area by Abdullah Sani Hashim (1985).

Associated middle Permian ammonoid fauna have been reported from various localities along the northern margin of Gondwanaland from North Africa (Miller and Furnish, 1957a) and Southern Europe (Gemmellaro, 1887) to West Asia (Miller and Furnish, 1957b, Blendinger, *et al.*, 1992) and Southeast Asia (Lee, 1978). The link established by the presence of these middle Permian ammonoids fauna and other pelagic fauna and pelagic sediment indicates that the Permian Tethys has already been established at that time (see Fig. 4). According to Blendinger *et al.* (1992), these Permian ammonoids marked the southern boundary of the Permian Tethys. The good correlation indicates that a link between these localities i.e. the Permian Tethys must have been developed much earlier, probably since Lower Permian or even earlier.

The age of the Sungai Peralong and Sungai Berok faunas is probably similar to that of the Sungai Cheroh fauna, i.e. Middle Permian based on the presence of the genus *Adrianites* and *Hoffmannia* (Miller *et al.*, 1957). Lower Permian radiolaria recorded from the Sungai Berok chert by Basir Jasin (1994) probably came from a lower horizon of the Sungai Berok chert unit. Therefore,



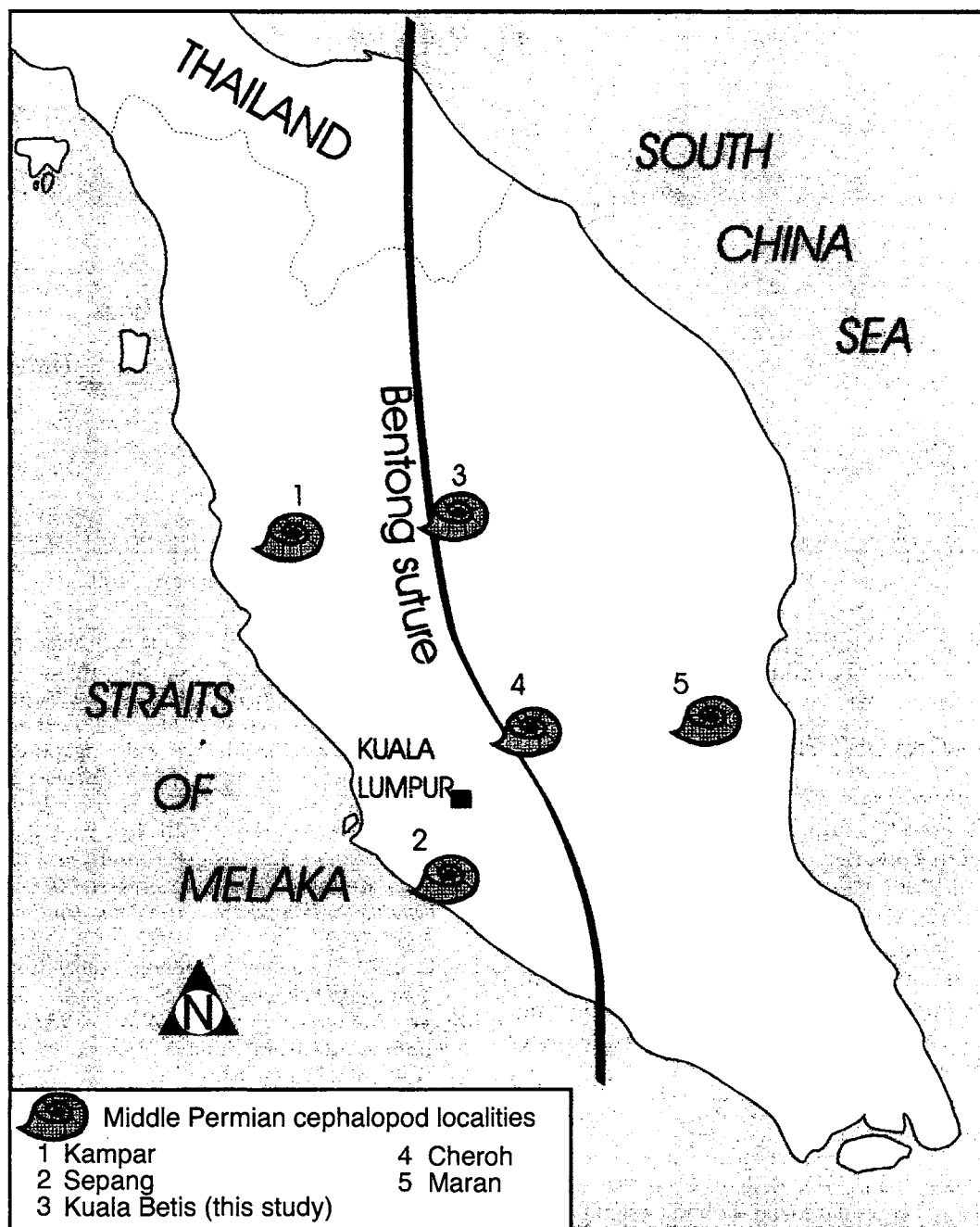


Figure 3. The distribution of Middle Permian cephalopods in Peninsular Malaysia.

Figure 2. 2a, b — *Adrianites cf. elegans* Gemmellaro (2a — side view, 2b — ceratitic suture); 2c, d, l — *Agathiceras cf. suessi* Gemmellaro (2c, d — side view, 2l — ventral view); 2e, f, m — *Propinacoceras* sp., (2e — ventral view, 2f, m — side view); 2g — ?*Imitoceras* sp. (side view); 2h — orthoconic cephalopod (side view); 2i, j — *Hoffmannia cf. hoffmanni* (Gemmellaro) (side view, 2j — ?juvenile specimen); 2k — *Popanoceras* sp. (ventrolateral view). (Specimens in figures 2a, b, c, d, f, i, j, k, m came from loc. Sungai Berok; specimens in figures 2e, g, h, l came from loc. Sungai Peralong)

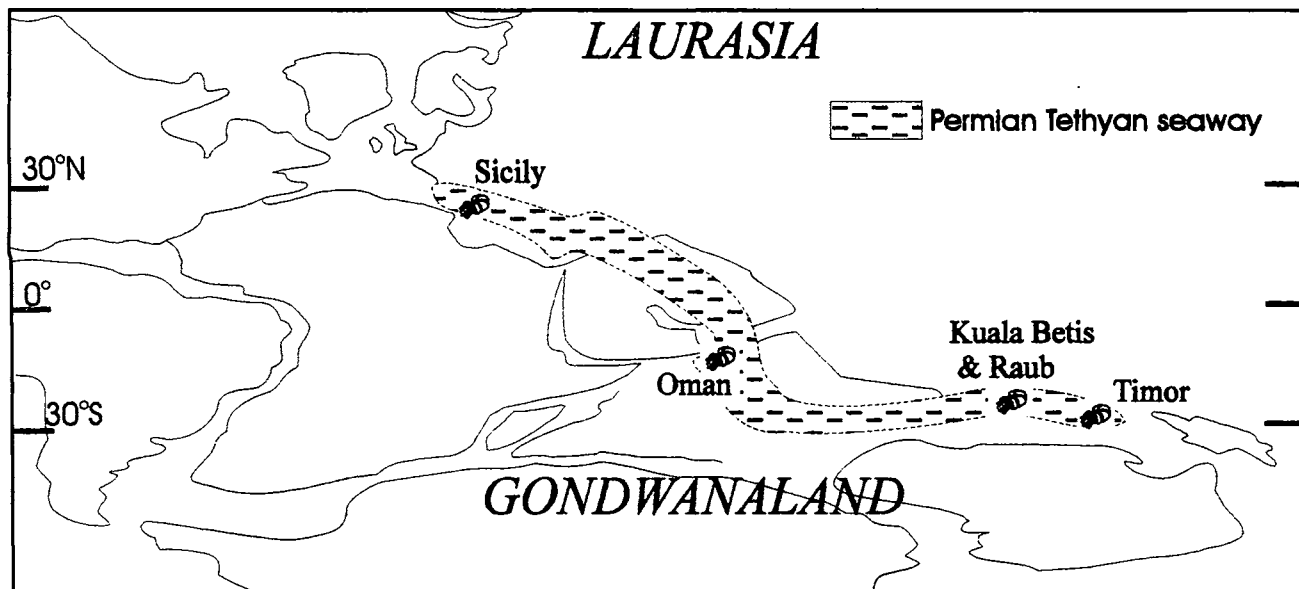


Figure 4. Middle Permian Tethyan seaway (modified after Blendinger *et al.*, 1992).

the age range of the Sungai Berok chert can be postulated as Lower Permian to Middle Permian.

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