

Implications of new biostratigraphic data for stratigraphic correlation of the Permian and Triassic in Peninsular Malaysia

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Abstract: Recent biostratigraphic work necessitates revision of the ages of several Permo-Triassic formations and units within Peninsular Malaysia. The Chuping Limestone in Perlis is now known to extend up to the Late Triassic. Cherts which have been assigned to the Semanggol Formation in Kedah have various ages ranging from Lower Permian to Upper Triassic. This extended age range for these cherts has implications for regional Permian palaeogeography and tectonics. Newly determined Permian ages of clasts in mélange and Lower and Upper Permian ages of bedded cherts along the Raub-Bentong suture zone suggest a latest Permian or Triassic closure of the Palaeo-Tethys in this region. The presence of previously unknown tracts of Lower Triassic limestones in the Central Belt (Jerus Limestone) and subsurface Triassic limestones in the basement of the Malay basin, offshore Terengganu also have regional stratigraphic and tectonic implications. A correlation chart for sedimentary rock units in Peninsular Malaysia, incorporating the new biostratigraphic data is presented.

INTRODUCTION

Much new information has recently come to light concerning the age and correlation of Permian and Triassic sedimentary rocks in Peninsular Malaysia. These new data necessitate a modification of previous correlations for the Permian and Triassic of Peninsular Malaysia. This paper presents a brief overview of recent and new Permo-Triassic biostratigraphic findings and presents a new correlation chart for the Permian and Triassic of Peninsular Malaysia. The biostratigraphy will be discussed within the framework of the now well known Western, Central and Eastern Belts of the Malay Peninsula.

WESTERN BELT

Kodiang and Chuping Limestones of Kedah and Perlis

The Chuping Limestone of northwest Peninsular Malaysia, until recently considered entirely of Permian age, has yielded Middle/Late Triassic (Ladinian or Carnian) foraminifera and algae (Fontaine *et al.*, 1988) and Late Triassic (early Norian) conodonts (Metcalf, 1990a). This limestone unit therefore spans the time interval late Early Permian-Late Triassic and is in part equivalent to the Kodiang Limestone which ranges in age from

Late Permian to Late Triassic (Ishii and Nogami, 1966; Koike, 1973, 1982; Metcalfe, 1981, 1984, 1992a). The Kodiang Limestone has recently been shown to extend up to the Norian at Bukit Kepelu near Kodiang (Metcalf, 1992a).

Semanggol Formation, Perak and Kedah

Until very recently, the Semanggol Formation was considered to be entirely of Triassic age (Khoo, 1983). Metcalfe (1990b) reported early Carnian conodonts from pelagic limestones occurring in the upper part of the chert member of the Semanggol Formation and suggested that the chert member represented the Early, Middle and early Late Triassic. The possibility of the cherts extending down into the Permian was also recognised. Sashida *et al.* (1992) and Sashida *et al.* (1993) reported Upper Permian (Guadalupian) radiolarians representative of the *Neobailiella ornithiformis* and *Follicucullus monacanthus* Zones from cherts exposed at Bukit Nyan and Bukit Barak near Kuala Nerang, Kedah. These cherts were considered to form part of the Semanggol Formation thus extending the known age-range of the Formation down to the Middle Permian. Subsequent work (Spiller and Metcalfe, 1993; in press) has shown the presence of Lower to Upper Permian radiolarians in a single 50 m thick section of bedded cherts and mudstones near Kuala Nerang. The Lower Permian is indicated by the presence of

radiolarians indicative of the Wolfcampian *Pseudoalbaillella lomentaria* Zone and the Upper Permian (Guadalupian) by morphotypes I and II of *Follicucullus scholasticus* Ormiston and Babcock which are diagnostic of the *Follicucullus scholasticus* Zone (Spiller and Metcalfe, in press). Cherts which have been assigned to the Semanggol Formation therefore range in age from at least Lower Permian to early Upper Triassic. This extended age range has important implications for Permo-Triassic palaeogeography and tectonics of Peninsular Malaysia. Azhar (1993), on lithostratigraphic and sedimentological grounds, suggested the possibility of stratigraphic breaks within the sequence mapped as Semanggol Formation in the Gunong Semanggol area and proposed that the conglomerate (with predominantly chert clasts) at the Pechah Batu quarry, Gunong Semanggol is an older pre-Semanggol sequence. Acceptance of this proposal would call into question the stratigraphic position and relationship of the Permian cherts recognised in Kedah to the Semanggol Formation.

RAUB-BENTONG SUTURE ZONE

Biostratigraphic and geochemical studies of mélange and bedded chert sequences along the Raub-Bentong suture zone are currently being carried out at the University of New England. Micropalaeontological studies of mélange clasts and matrix, and bedded cherts are being undertaken to provide constraints on the age of opening and closure of the branch of Palaeo-Tethys represented by the Raub-Bentong suture.

Mélange

Initial results provide Permian ages from limestone olistoliths in mélange near Raub (Taman Indapura and Krau Satu Road) indicating a Late Permian or Triassic age for the suture. Late Permian ages for some clasts are indicated by the presence of the conodonts *Neogondolella rosenkrantzi* (Bender and Stoppel), *Neostreptognathodus* sp. and *Sweetognathus?* sp. and a Lower Permian (Sakmarian) age for other clasts is indicated by the presence of the fusulinid foraminifera *Paraschwagerina* sp., *Pseudofusulina* sp. and *Schwagerina* sp. (Metcalfe, unpublished).

Bedded cherts

Bedded cherts within the suture zone have yielded radiolarian faunas that indicate Upper Devonian and Lower Carboniferous ages from Selangor, Pahang and Negeri Sembilan (Spiller and Metcalfe, in press) but very recently, three localities have yielded Lower and Upper Permian ages from

exposures of the suture in Pahang and Kelantan (Spiller and Metcalfe, unpublished).

CENTRAL BELT

Permian-Triassic limestones, Western Central Belt

Extensive tracts of limestone occur along the western part of the Central Belt of Peninsular Malaysia and have been interpreted as a carbonate platform developed as algal boundstones, fusulinid banks and oolitic and peloidal grainstone sand sheets on marine volcanic highs (Azhar, 1990a). These limestones were originally thought to be entirely of Carboniferous age, typified by Gua Sei and Gua Bama. Recent conodont and foraminiferal biostratigraphic work has shown these limestones to be of Permian and Early Triassic age.

Gua Sei, Kampong Gua

Limestones exposed in this limestone hill were previously regarded as Carboniferous in age based on a restricted macrofauna (Jones *et al.*, 1966). Metcalfe (unpublished work) has recovered Lower Triassic conodont faunas from the limestones exposed at Gua Sei and nearby Kampong Gua. The faunas include *Hindeodus parvus* (Kozur) and *Isarcicella isarcica* (Huckriede) and indicate a Griesbachian age.

Kuala Lipis-Gua Musang road, north of Bukit Tujoh

Large limestone blocks, enveloped by shales and siltstones, exposed in a road cutting on the Kuala Lipis-Gua Musang road immediately southwest of where the road crosses Sungei Jeleteh have yielded rich Lower Triassic (late Scythian-Smithian) conodonts including *Neospathodus triangulus* (Bender), *Platyvillosus costatus* (Staesch), *Neospathodus dieneri* Sweet and *Platyvillosus hamadai* Koike (Metcalfe, 1992b). The sediments at this locality have been interpreted by Metcalfe (1992) as a possible submarine slump or olistostrome.

Gua Panjang, Pahang

Limestones at the abandoned Modal Quarry at Gua Panjang, Pahang represent a lower sequence of wackestones with interbedded tuffs, overlain by algal boundstones and the boundary between these units has been interpreted as a probable disconformity (Azhar, 1990b; Nuraiteng, 1993). The presence of Palaeofusulina, Reichelina and Colaniella in the lower unit indicate an Upper Permian age (Nuraiteng, 1993). This unit has also yielded conodonts (Metcalfe, unpublished) which

include *Neogondolella rosenkrantzi* (Bender and Stoppel) indicating an Upper Permian (Tatarian — either Guadalupian or Dzhulfian) age, consistent with the age indicated by the foraminifera.

Gunung Sinyum, Kota Jin, Pahang

Middle and Upper Triassic algae have recently been reported from limestones exposed at Gunung Sinyum and Kota Jin in the Jengka triangle, Pahang (Fontaine *et al.*, 1988). In addition, Upper Permian (Capitanian) conodonts, including *Neogondolella rosenkrantzi* (Bender and Stoppel) and *Neogondolella serrata serrata* (Clark and Ethington) have also been reported from Gunung Sinyum (Idris and Hashim, 1988) indicating that the Permian-Triassic boundary occurs in this limestone hill.

Jerus Limestone, Cheroh, Pahang

The Jerus Limestone, cropping out around Cheroh north of Raub, Pahang was until recently, in the absence of any age indicative fossils, regarded as of probable Palaeozoic (Carboniferous or Permian) age (Richardson, 1939, 1947; Alexander, 1968). Metcalfe (1990a), however, reported Lower and Middle Triassic conodonts from this limestone. The Lower Triassic (Dienerian) conodonts include *Neospathodus conservativus* (Muller), *Neospathodus cristagali* (Huckriede), *Neospathodus dieneri* Sweet and *Neospathodus pakistanensis* (Sweet). The presence of Middle Triassic strata is indicated by the occurrence of *Neogondolella excelsa* (Mosher).

Raub Gold Mine

Interbedded siltstones, mudstones and limestones of the Raub Group exposed at the Raub Gold Mine, Bukit Koman, near Raub have yielded the conodont *Neogondolella rosenkrantzi* (Bender and Stoppel) indicating a Late Permian (Tatarian — either Guadalupian or Dzhulfian) age (Metcalfe, 1993).

Early Triassic limestone conglomerates and limestones near Raub

Channel-filling limestone conglomerates (fault talus?) and interbedded limestones exposed in a road cutting at 4.3 km along the Krau Satu road near Raub (Metcalfe, 1989), have yielded Lower Triassic conodonts, including various species of *Neospathodus* (Metcalfe, unpublished). Associated bedded limestones exposed in the Krau satu road cut at 4.8 km yield typical Spathian (Lower Triassic-late Scythian) conodonts including *Neospathodus triangulatus* (Bender), *Neospathodus collinsoni* Solien and *Platyvillosus costatus* (Staesche), together with reworked Scythian conodonts including *Isarcicella isarcica* (Huckriede) and

reworked Permian conodonts including *Diplognathus* (Metcalfe, unpublished).

EASTERN BELT

Triassic Sotong limestones, offshore Terengganu

Previously reported occurrences of marine Triassic sedimentary rocks in the eastern belt of Peninsular Malaysia, included on the Geological Survey of Malaysia's Geological Map of Peninsular Malaysia, have now been removed from the latest edition of this map as they cannot be substantiated. There is therefore no record of marine Triassic rocks in the eastern belt of the Peninsular. However, studies of limestones forming the basement of the Sotong B-1 Well in the Malay Basin, offshore Terengganu have shown the presence of a varied microfauna and flora which indicate a middle Upper Triassic age (Fontaine *et al.*, 1990).

CONCLUSIONS

A revision of the correlation of Permian and Triassic sedimentary rocks in Peninsular Malaysia is necessitated by a number of significant changes in the age assignments for several formations in the Peninsular and for rocks within the Raub-Bentong suture. A new correlation chart for the Permian and Triassic of Peninsular Malaysia is given in Figure 1. The Chuping Limestone is now known to range up to the Late Triassic and to be in part equivalent to the Kodiang Limestone. The Kanthan Limestone of Perak has also yielded Lower Permian conodonts (Metcalfe, 1981) and ranges in age from Silurian to Permian. Discoveries of Lower and Upper Permian radiolarians from the bedded cherts which have been assigned to the Semanggol Formation in Kedah suggests the presence of a deep marine basin of this age in northwest Peninsular Malaysia which has important implications for the Permian palaeogeography and tectonic models for the region. Mélange along the Raub-Bentong suture zone contains clasts of Lower and Upper Permian ages and is interpreted to be of Permian to Lower Triassic in age (Fig. 1). Associated bedded cherts have also yielded Lower and Upper Permian radiolarians, indicating that the Palaeo-Tethys only closed in this area in the latest Permian or Triassic. Other significant recent findings are the presence of previously unrecognised tracts of Triassic limestones in the Central and Eastern Belts of the Peninsular including the Lower to Middle Triassic Jerus limestone and the Upper Triassic Sotong limestones.

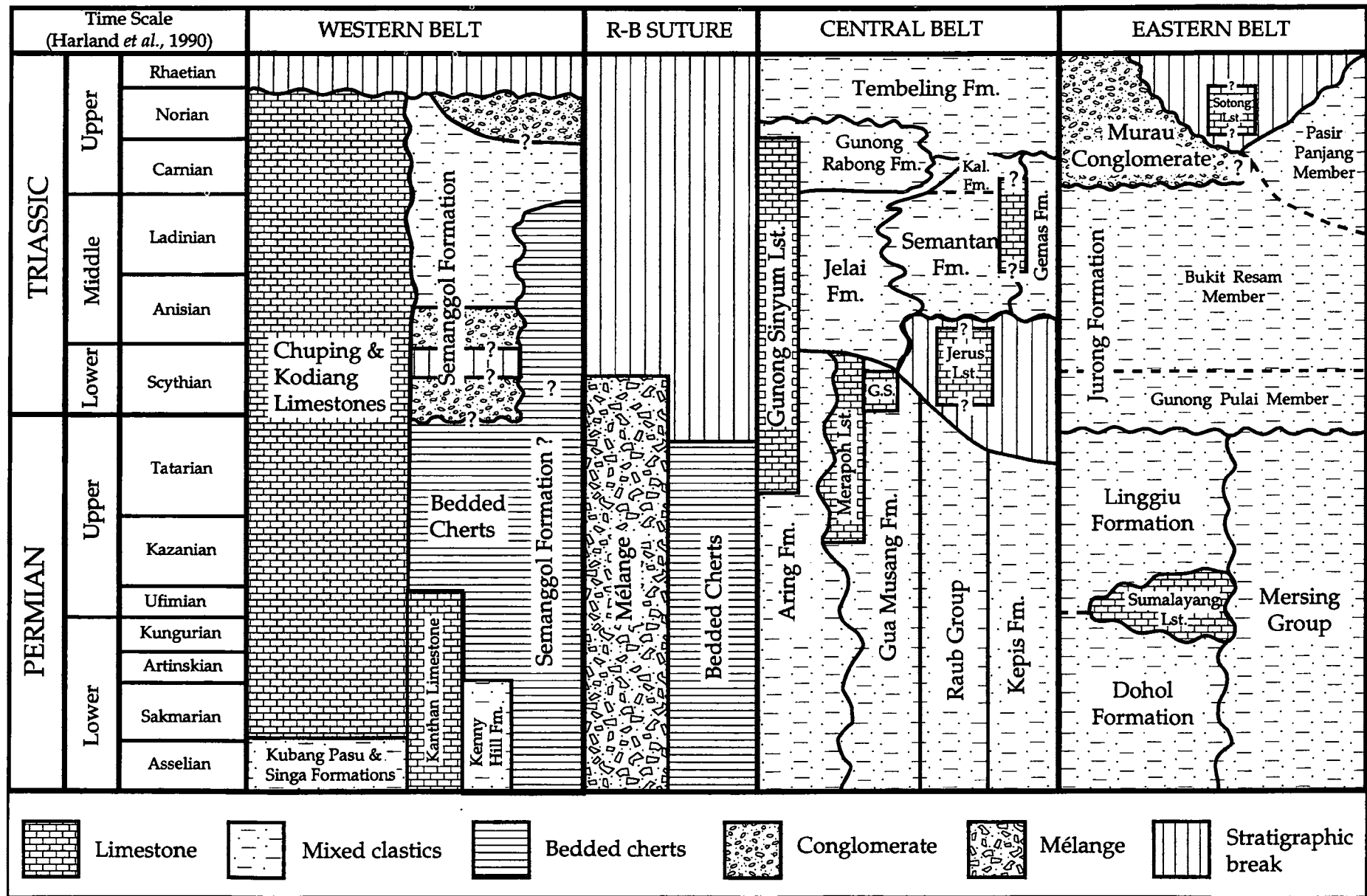


Figure 1. Stratigraphic correlation chart for the Permian and Triassic of Peninsular Malaysia. Units shown are not to scale. Kal. Fm. = Kaling Formation; G.S. = Gua Sei Limestones.

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