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Triassic radiolarian assemblages from the chert-clastic rock sequences in the Kanchanaburi area, western Thailand

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Abstract

Early to early Late Triassic radiolarian assemblages have been identified in the chert-clastic rock sequences in the Kanchanaburi area, western Thailand. These rock sequences consist of well-bedded chert a few centimeters thick alternating with thin-films of shale and interbedded with siliceous shale and sometimes quartz-rich sandstone. The radiolarian assemblages are; the *Parentactinia nakatsugawaensis*, *Eptingium nakasekoi*, *Triassocampe deweveri*, Spine A2 and *Muelleritirtis cocholeata* assemblages of Early-to-early Late Triassic, which are known from Japan, USA, Russian Far East, European Tethys, northwestern Peninsular Malaysia, Philippines, and several areas in Thailand. The occurrence of the Early to early Late Triassic radiolarians from bedded chert sequences in this area suggests that the Palaeo-Tethys Ocean and Panthalassa Ocean were probably connected by seaways at this time and might have shared the same oceanic circulation system. Forty-five species belonging to 23 genera and five unidentified radiolarians with type A to E of radiolarian spines are investigated. These radiolarian-bearing rocks seem to have been deposited in a hemipelagic environment at the continental slope of the eastern margin of the Sibumasu Terrane. The occurrence of early Late Triassic radiolarians from bedded chert sequences in the Kanchanaburi area indicates that the closure of the Palaeo-Tethys Ocean occurred at least after early Late Triassic time.

Keywords: Kanchanburi, Palaeo-Tethys, Radiolarian, Sibumasu, Thailand, Triassic

1. Introduction

It is now accepted that the tectonic subdivision of mainland Thailand consists of four principal continental blocks, from west to east, Sibumasu Terrane, Inthanon Zone, Sukhothai Terrane, and Indochina Terrane (e.g., Sone & Metcalfe, 2008; Metcalfe, 2011, 2017). The origin of the two continental blocks, Sibumasu and Indochina Terrane are believed to be the northern margin of Gondwanaland. Two continental blocks drifted away from Gondwanaland at different times. The development process of the Tethyan Ocean was divided into several stages created by the rift of continental blocks, and finally, these continental blocks amalgamated to form the mainland South East Asia (e.g. Metcalfe, 1999, 2013).

Detailed age determinations based on radiolarian biostratigraphy of pelagic, hemi-pelagic and continental margin sediments distributed in Thailand are very important to elucidate the tectonic development of the Palaeozoic and Mesozoic orogenic belts and the continental collision and or closing of the Palaeo-Tethys Ocean. In Thailand, Triassic radiolarians have been reported from several areas such as the Mae Sariang area (Kamata et al., 2002), the Mae Hong Son-Mae Sariang area (Feng et al., 2005) and the Mae Sot and Umphang areas (Ishida et al., 2006) in western Thailand, the Chiang Dao area (Sashida et al., 2000a) and the Nan area (Saesaengseerung et al., 2008) in northern Thailand, the Trat area (Sashida et al., 1997) in eastern Thailand, and the Saba Yoi (Sashida et al., 2000b) and Hat Yai (Kamata et al., 2014) areas in southern peninsular Thailand (Fig 1A). These studies suggest that the radiolarian bearing-rocks are thought to have been deposited in the Palaeo-Tethys Ocean, back-arc basin or hemipelagic marginal seas. This study aims to clarify the age and infer the depositional environment of the radiolarian-bearing fine-grained siliceous rocks distributed in the Kanchanaburi area, from where we do not have sufficient radiolarian data except for the provisional reports by Sashida et al. (1998, 2019). The study area is located within the eastern part of the Sibumasu Terrane (Fig.1 A). The geological investigations were carried out in the Nong Prue district, north of Kanchanaburi City, during 2006-2008 to collect radiolarian-bearing rocks (Fig. 1B and 1C). Well to moderately preserved radiolarian faunas of the Early to early Late Triassic age and some foraminifers and sponge spicules are discovered in siliceous-rock samples. Forty-five radiolarian species belong-ing to 24 genera with 6 unidentified radiolarians and A to E types of radiolarian spines are identified.

Radiolarian specimens discussed herein were extracted from siliceous sedimentary rock by following the method described by Passagno & Newport (1972). The rock samples such as chert and siliceous shale were prepared for hydrofluoric acid treatment. The radiolarian extraction method is divided into acid treatment, sieving, drying, picking, coating, and photo-graphy. Dried residues were observed for radiolarians under the binocular microscope. Radiolarians were picked up by fine blush and took photographs with a Scanning Electron Microscope (SEM) and coated with gold.

2. Tectonic framework of Thailand

The mainland of Thailand is traditionally regarded as consisting of two principal continental blocks, the western Sibumasu (Shan-Thai Terrane in part) and eastern Indochina blocks which were thought to have been positioned along the outer margin of northern Gondwanaland in the Early Palaeozoic around the palaeoequator (Bunopas, 1981, 1992; Metcalfe, 2005). The Sibumasu and Indochina terranes are separated by the remnants of the Palaeo-Tethys Ocean such as the northern Nan-Uttaradit (Nan) and southern Sra (Sa) Kaeo-Chanthaburi suture zones (Bunopas, 1981, 1992; Metcalfe, 1999; Hada et al., 1999; Mantajit, 1999, Agematsu et al., 2006; Wonganan & Caridroit, 2005; Ishida et al., 2006). Recently, several investigators have contributed to the study of the tectonic evolution in northern and western Thailand and various opinions regarding the boundary as a remnant of the Palaeo-Tethys Ocean have been proposed. They are the Mae Hong Son-Mae Sariang region (also called Mae Yuam Fault Zone) (Helmcke, 1985; Ueno & Igo, 1997; Ferrari et al., 2008), and the Chiang Mai Suture Zone (Metcalfe, 2002, 2011) or the Inthanon Suture Zone (Sone & Metcalfe, 2008). Furthermore, the Nan-Uttaradit suture in northern Thailand has been regarded as representing a segment of the back-arc basin which opened in Carboniferous time between the Sukhothai Terrane and Indochina Terrane (Ueno & Hisada, 1999; Wang et al., 2000; Metcalfe, 2011). They are interpreted as an extensive accretionary complex of the closed Palaeo-Tethys Ocean and consist of various types of rocks such as basaltic volcanics, limestones, radiolarian chert, S-type granitoids and mylonitic/gneisses (Sone & Metcalfe, 2008). The Indochina Block possibly drifted away from Gondwanaland in the Devonian. The Sibumasu Block lifted from Gond-wanaland after the Early Permian and collided with the Indochina Block in the Late Triassic, after the closing the Palaeo-Tethys Ocean (e.g., Bunopas, 1981; Metcalfe, 1999, 2011, 2017).

Concerning the previous works of Triassic radiolarian fauna and their palaeogeography in northwestern Thailand, Kamata et al., (2002) discovered Triassic radiolarian faunas from the Mae Sariang area and suggested that the chert of the Mae Sariang Group seems to have been deposited on an eastern continental margin of the Sibumasu Block. The occurrence of Late Triassic (early Carnian) radiolarians from the Mae Sariang area indicates that the closure of the Palaeo-Tethys Ocean occurred after the early Carnian. Feng et al. (2005) reported Permian and Triassic radiolarians from north-western Thailand along the highway from Mae Hong Son to Mae Sariang. They suggested that radiolarian-

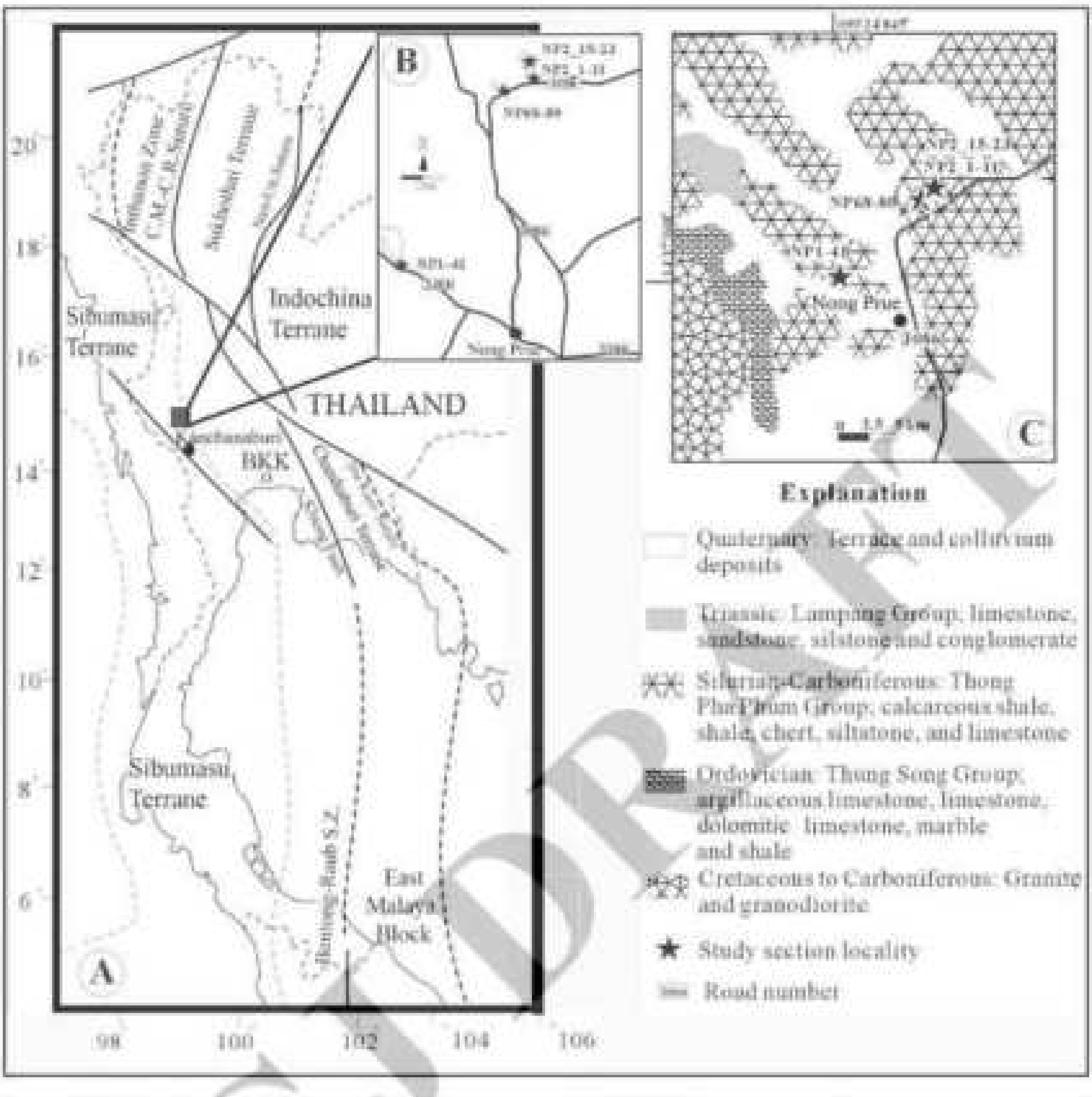

Fig. 1: (A) Index map showing the study area, faults, and sutures in Thailand. Basic Map is from Metcalfe (2017). (B) The locality map of the study sections in the Nong Prue area. (C) Simplified geological map of the Nong Prue district, Kanchanaburi Province, western Thailand. (After the Geological Map of Thailand by Department of Mineral Resources, Thailand, 1999).

-bearing rocks were accumulated at a pelagic basin during the Late Palaeozoic and Triassic and the Sibumasu Block was not a single block during this age span, but compose of the Palaeotethyan Ocean and two continental terranes that were affiliated with the Gondwana (Tengchong-Phuket terrane) and Cathaysian (Simao-Lampang terrane) domains. Furthermore, Ishida et al. (2006) studied the Middle to Late Triassic (Ladinian to Rhaetian) radiolarians in the Mae Sot and Umphang areas, the westernmost part of Thailand and showed new micropalaeontological evidence for a Late Triassic orogeny (late Indosisian).

3. Lithology and lithostratigraphy

Seven study sections of chert-clastic rock sequences were investigated for the litho-logical analysis (Fig. 1B). Sections NP 1-14, NP 15-21, and NP 22-41 (099°24'845"E, 14°37'968"N) are roadcut outcrops and small quarry along road no. 3480 about 5 km northwest of Nong Prue city. Section NP 57-67, NP 68-80, NP 2-1-11, and NP 2-15-23 are in quarry outcrops of a small hill, northern side of the road no. 3086 about 10 km north of the Nong Prue city. Based on the geological map of Thailand (1999), the localities of the study sections belong to the

Thong Pha Phum Group (Silurian-Carbo--niferous) which consists of calcareous shale, shale, chert, siltstone, and limestone (Fig. 1C). Folding and faulting are observed at all of the study sections. Well bedded chert (gray to black or green color), normally has a thickness of few centimeters alternated with thin-films of shale and interbedded with shale, siliceous shale, and sometimes quartz-rich sandstone layers. Section NP 1-14 is at a quarry about 20 m thick and consists of greenish bedded chert (bed about 2-20 cm thick) alternated with thin-films of shale and siliceous shale. Based on the radiolarian analysis, the sequence of chert in this outcrop is overturned completely. Section NP 15-21 is at a small quarry is about 7 m thick and is consisting of gray chert (bed about 3-20 cm thick) alternated with thin-films of shale and siliceous shale. Sandstone layers are presenting irregularly by fault cutting in the lower part of this section. Section NP 22-41 (about 18 m thick) is a roadside outcrop and consists of greenish bedded chert alternated with thin-films of shale and siliceous shale and interbedded with quartz-rich sandstone beds (Fig. 4A). Section NP 57-67 is at a quarry about 10 m thick, and is consisting of black siliceous shale in the lower part and is overlain by the gray-greenish bedded chert (bed about 2-20 cm thick) alternated with thin-films of shale and siliceous shale. Section NP 68-80 is also at a small quarry, about 12 m thick, and is consisting of gray to greenish bedded chert (bed about 3-20 cm thick) alternated with thin-films of shale and siliceous shale. Section NP 2-1-11 is a quarry outcrop in the Wat Wangwanaram (temple) (099°27'672"E, 14°41'822"N) and has about 20 m thickness consisting of sandstone bed in the top and is unconformably covered by gray to black shale (about 5 m thick). Greenish gray chert (bed about 5 cm thick) is alternated with thin-films of shale and siliceous shale. Section NP 2-15-23 is in the big quarry outcrop, about 0.5 km north of Sections NP 2-1-11. This section is about 6 m thick consisting of gray-black shale (about 1 m thick) in the lowermost and is overline by green-black bedded chert (bed about 2-20 cm thick) which is alternated with thin-films of shale and siliceous shale in the upper part. The lithologic column and stratigraphic distribution of radiolarian species of the study sections are showing in Figs 2 and 3. Under the microscope, the quartz-rich sandstone is coarse, poorly sorted and consists of subangular to subrounded quartz grains with a few feldspar and rock fragments (Figs 4B-4D). The chert has a matrix consisting of microcrystalline quartz that includes radiolarian tests, sponge spicules, and calcareous organisms such as foraminifers. This chert contains terrigenous quartz grains larger than silt-sized particles (Figs. 4E-4G).

The sedimentary structures of these rocks are shown in Fig. 5. The contact between the chert and sandstone beds is not strongly deformed (Figs 5A and 5B). Some cherts are shown the lateral change of the clay layer to the siliceous part (Fig. 5C). In the base of bedded chert, we can see load-casted structures (Figs 5F and 5G). Moreover, this chert has a small sandstone lens in which angular chert fragments are present (Fig. 5I). Convolute bedding structure (Fig. 5E) and plane lamination (Fig. 5D) were also present in shale, chert, and siliceous shale. Some mudrock-chert shows characteristics of soft-sediment which are folded and partially fluidized (Fig. 5H). Based on these lithological characteristics, these rocks seem to have been deposited at the rather high angle slope in a hemipelagic basin rather than at a flat plane of the continental shelf or deep ocean basin. Furthermore, the study sections are quite different from those of a sandstone-chert mélange which is a chaotic mixture derived mainly from the dismembered upper part of the Ocean Plate Stratigraphy (Wakita & Metcalfe, 2005).

4. Radiolarian fauna and age assignment

Radiolarians obtained from chert and siliceous shale successions in the study area are shown in Figs. 2 and 3 and the selected species are shown in Figs. 6-8. We establish the following five radiolarian assemblages in chert sections from Kanchanaburi, in ascending order; the *Parentactinia nakatsugawaensis*, *Eptingium nakasekoi*, *Triassocampe deweveri*, Spine A2, and *Muelleritortis cocholeata* assemblages.

Fig. 2: Lithostratigraphic column and stratigraphic distribution of radiolarians in Section NP1-14, NP 15-21 and NP 22-41

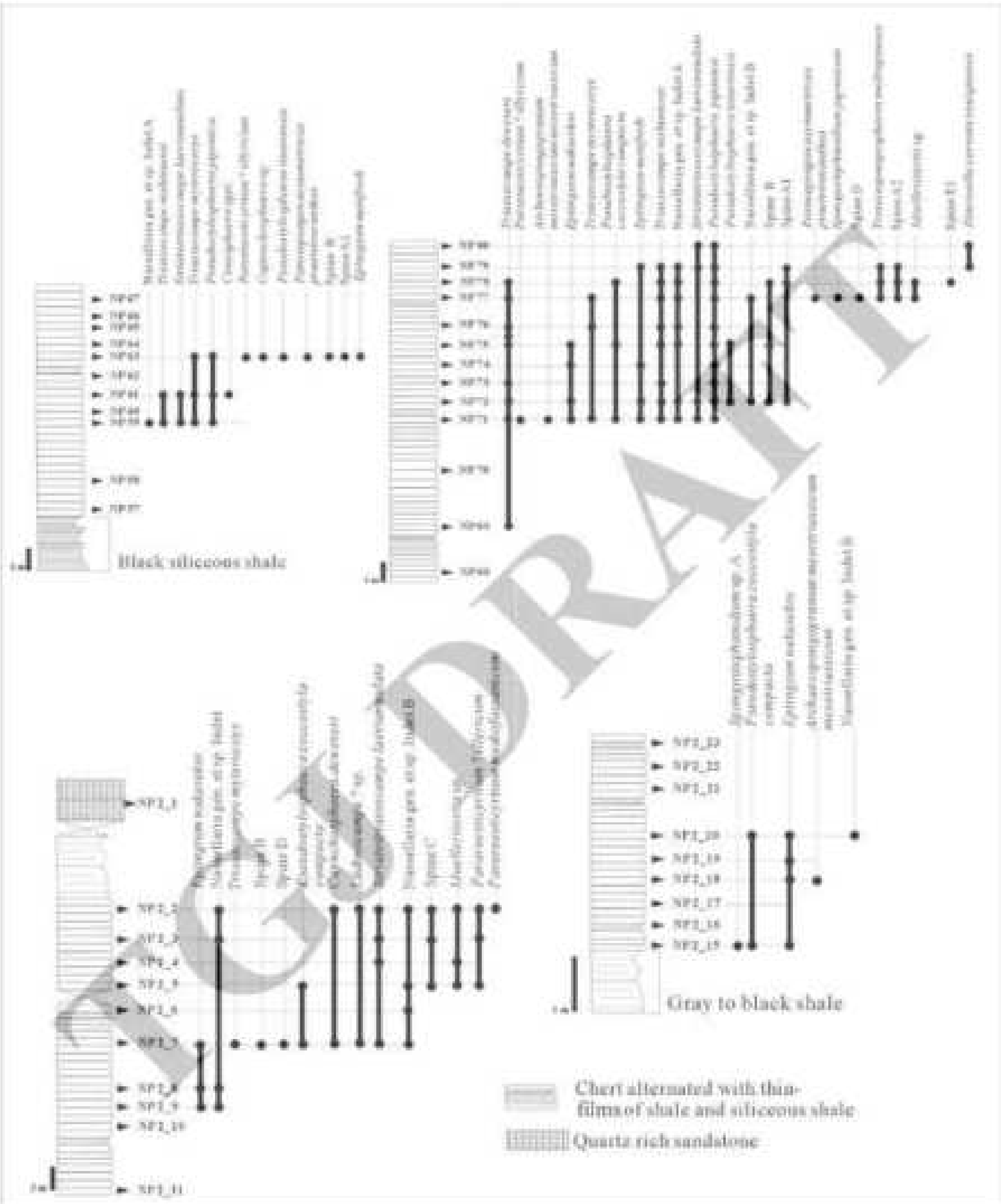

Fig. 3: Lithostratigraphic column and stratigraphic distribution of radiolarians in Section NP 57-67, NP 68-80, NP2_1-11 and NP2_15-23.

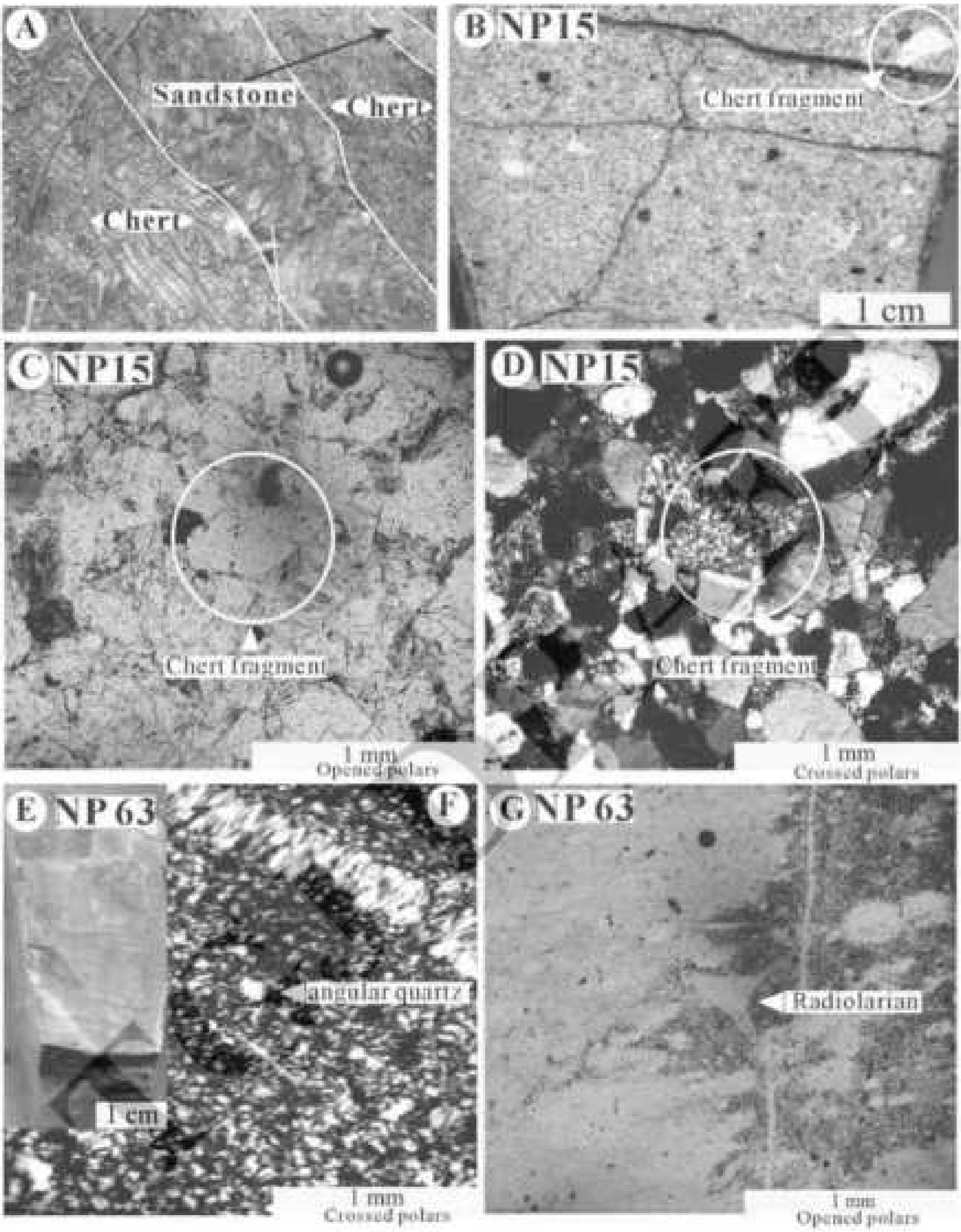

Fig. 4: (A) Photo of the chert-clastic rock sequence showing bedded chert intercalated with sandstone bed. (B) The polished surface of quartz-rich sandstone (sample number NP 15) (C and D) Microphotographs of the sample number NP 15 (E) Polished surface of chert (sample number NP 63) (F and G) Microphotographs of sample number NP 63

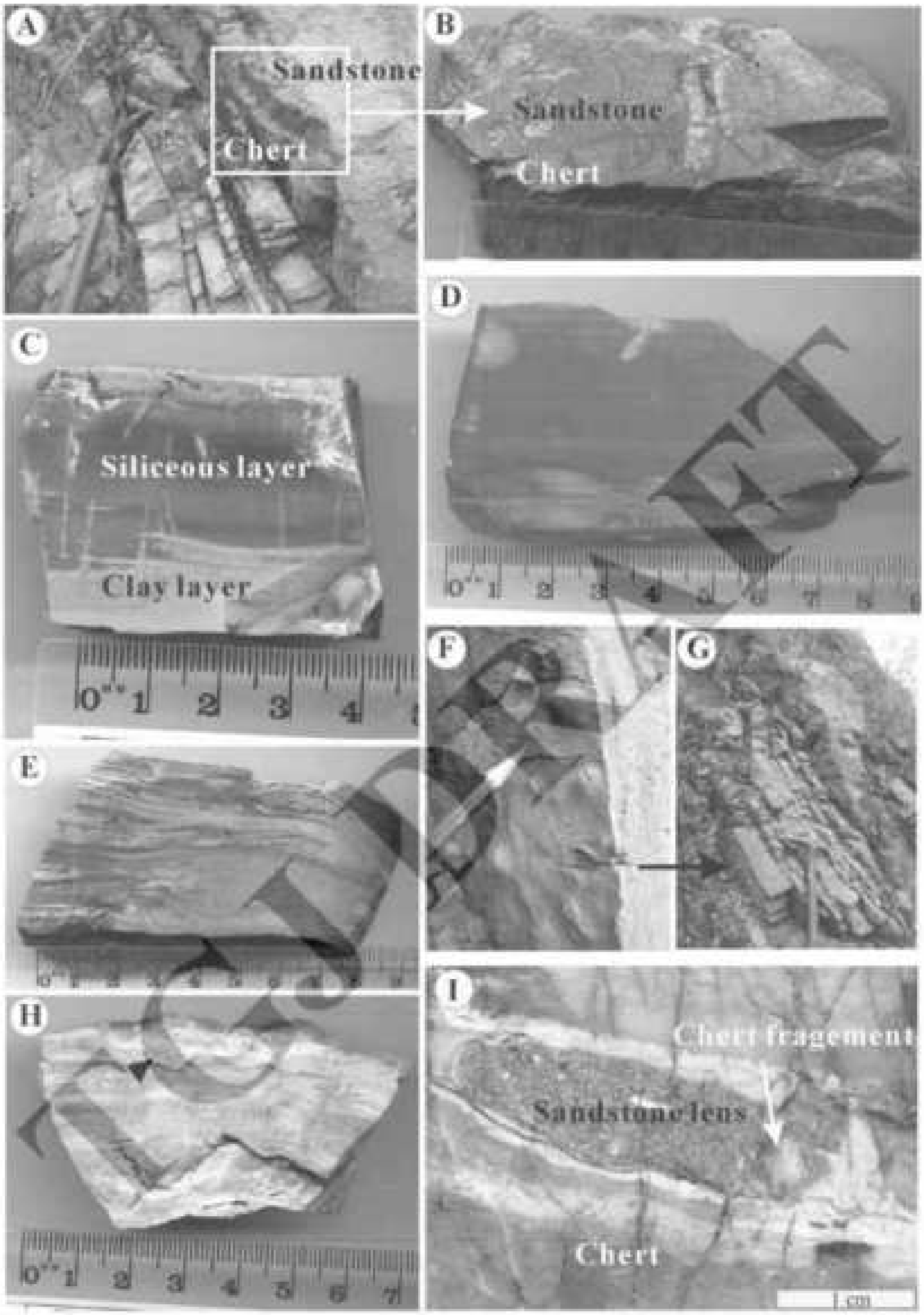

Fig. 5: (A) Photo of outcrop showing bedded chert associated with sandstone bed. (B) Polished surface photo showing the contract boundary of chert and sandstone samples. (C) Lateral change of clay layer and siliceous part (D) Plane lamination in black shale (E) Convolute bedding structure in shale (F and G) Load-casted structure in bedded chert (H) Soft- sediment folded and partially fluidized sets (I) Sandstone lens in chert sample

The *P. nakatsugawaensis* assemblage is identified only in the section NP 15-21. The following radiolarian species characterize this assemblage; *Praegomberellus* sp. cf. *P. pulcher* Kozur and Mostler, *Triassospongosphaera multispinosa* (Kozur and Mostler), *Spongostephanidium* sp. cf. *S. longispinosum* Sashida, *Spongostephanidium* sp. A and *Archaeosemantis* sp. cf. *A. venusta* Sashida. A similar radiolarian fauna has been reported from Ban Huai Tin Tang, north of Chiang Dao, northern Thailand (Sashida et. al, 2000a), the Mae Sariang area (Kamata et. al, 2002) and the Hat Yai area of southern Peninsular Thailand (Kamata et al., 2014). Although we do have "*Follicucullus*" which is a representative genus of the Middle to Late Permian and known from late Olenekian, this assemblage is roughly correlated to the late Olenekian TR0 or TR1 of Sugiyama (1997).

The *E. nakasekoi* assemblage was recognized in the Sections NP-2-1-11, and NP-2-15-23. This assemblage is characterized by the occurrence of *Pseudostylospahera coccostyla compacta*, *Spongostylus* sp. A and Nassellaria gen. et sp. indet. The first occurrence of *E. nakaekoi* defines the base of TR2A (Sugiyama, 1997), and this assemblage lacks the multisegmented Nasselarinas such as *Triassicampe*, this assemblage is correlated to TR2A by Sugiyama (1997). The age of this assemblage may be early Anisian. A similar radiolarian fauna has been described from the Hat Yai area of southern Peninsular Thailand (Kamata et al, 2014).

The *Triassocampe deweveri* assemblage was identified in the sections NP-4-14, NP-22-41, and NP-68-80. This assemblage is characterized by the occurrence of *Spongostephanidium japonicum* (Nakaseko and Nishimura), *Pseudostylosphaera coccostyla compacta* (Nakaseko and Nishimura), *P. japonica* (Nakase ko and Nishimura), *Cenosphaera igoi* Sashida, *T. nishimurai* Kozur and Mostler, *T. myterocorys* Sugiyama, *Yeharaia annulata* Nakaseko and Nishimura, *Y. transita* Kozur and Moslter, *Pararuesticyrtium mediofassanicum* Kozur and Mostler, *Eptingium manfredi* Dumitrica, and others. This fauna resembles TR2C (Sugiyama, 1997), of which the base is defined by the first occurrence of *T. deweveri*. The age of this assemblage is assigned to be Middle Triassic (middle to upper Anisian) based on the age of associated conodonts (Sugiyama, 1997). A similar radiolarian fauna is known from the Trat area of Eastern Thailand (Sashida et al., 1997) and the Hat Yai area of southern Peninsular Thailand (Kamata et al., 2014).

The Spine A2 assemblage is recognized in the sections NP-22-38 and NP-68-80. The species of this assemblage is almost the same as the *T. deweveri* assemblage but is distinguished by the occurrence of Spine A2. According to Sugiyama (1997), the first occurrence of Spine A2 defines the base of TR3A (Sugiyama, 1997). Based on the faunal similarity and the occurrence of Spine A2, this assemblage can be correlated with the latest Anisian TR3A of Sugiyama (1997). A similar radiolarian fauna has been reported from the Hat Yai area of southern peninsular Thailand by Kamata et al. (2014).

The *Muelleritortis cochleata* assemblage is recognized in the Sections NP-4-14 and NP-2-1-2.11. This assemblage is characterized by the occurrence of *Capnuchosphaera* sp., *Dumitricasphaera* sp., *Y. annulata*, *Y. transita*, *P. mediofassanicum*, Spine A to E, and others. The faunal composition of this assemblage except for the occurrence of *Capnuchoshaera* is similar to that of TR4A (Sugiyama, 1997). This assemblage may be correlated to the late Ladinian TR4A of Sugiyama. However, in the presence of the genus *Capnchospahera*, the age of this assemblage can range up into Late Triassic (early Carnian; TR5A by Sugiyama, 1997). A similar radiolarian fauna has been reported from the Mae Sariang area (Kamata et al., 2002).

In summary, five radiolarian assemblages from the bedded chert sequences in the Kan chanaburi area correspond to TR or TR1, TR2A, TR2B, TR3A, and TR4A or (TR5A) of Sugiyama (1997), respectively, which indicate Early to Middle Triassic (or early Late Triassic), late Olenekian (Late Spathian) to Ladinian (or early Carnian).

5. Systematic Palaeontology

The taxonomical framework is followed by De Wever et al. (2001) and O'Dogherty et al. (2009a, b). The palaeontological investigation was undertaken by D. Saesaengseerung. Synonym lists are limited only for selected ones that have descriptive works. Radiolarian species discussed in this paper are stored in the collection of the DMR and shown in Figs 6-8.

Class Actinopoda

Subclass Radiolaria Müller, 1858

Superorder Polycrystina Ehrenberg, 1838, emend. Riedel, 1967

Order Spumellaria Ehrenberg 1875, emend De Wever et al., 2001

Family Actinommidae Haeckel, 1862, emend. Reidel, 1967

Genus *Cenosphaera* Ehrenberg, 1854

Type species *Cenosphaera plutonis* Ehrenberg, 1854

***Cenosphaera igoi* Sashida, 2000a**

Figure 8.27

Cenosphaera igoi Sashida. Sashida et al., 2000a, p. 804, figs. 10.7, 10.8; Saesaengseerung et al., 2008, p. 403, fig. 8.26; Munasri & Putea, 2019, p. 6, 7, figs. 6a-6f.

Remarks: Our specimens resemble the holotype and paratypes of the species *Cenosphaera igoi*, having a rather thick-walled spherical shell with about 100 circular pores on a hemisphere. Pores are usually hexagonally framed and bear small spines at vertices. This species differs from *C. andoi* Sugiyama, 1992 described from Mino Terrane, central Japan by having circular pores.

Occurrence: Triassic from the Kanchanaburi area, western Thailand, northern Thailand, and Sumatra Island, Indonesia.

Superfamily Sponguracea Haeckel, 1862

Family Archaeospongoprunidae Pessagno, 1973

Type genus: *Archaeospongoprunum* Pessagno, 1973

Genus *Archaeospongoprunum* Pessagno, 1973

Type species: *Archaeospongoprunum venadoensis* Pessagno, 1973

***Archaeospongoprunum mesotriassicum mesotriassicum* Kozur & Mostler, 1981**

Figure 7.29

Archaeospongoprunum mesotriassicum mesotriassicum Kozur & Mostler, 1981, p. 41, pl. 42, fig. 4; Kozur & Mostler, 1994, p. 53, pl. 7, fig. 3.

Remarks: Several examined specimens are consisting of shell asymmetrically spindle-shaped with several layers of a fine-spongy meshwork. This species differs from *A. bispinosum* Kozur & Mostler (1981) by having two polar spines.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, and European Tethys.

***Archaeospongoprunum mesotriassicum asymmetricum* Kozur & Mostler, 1981**

Figures 7.26 and 7.30

Archaeospongoprunum mesotriassicum asymmetricum Kozur & Mostler, 1981, p. 41, pl. 42, fig. 3; Kozur & Mostler, 1994, p. 53, pl. 7, fig. 4

Remarks: Examined specimens differ from *A. mesotriassicum mesotriassicum* Kozur & Mostler by having asymmetrical spongy shell.

Occurrence: Middle Triassic from the Kanchanaburi areas, western Thailand, and Europea Tethys.

Family Gomberellidae Kozur & Mostler, 1981

Type genus: *Gomberellus* Dumitrica, Kozur & Mostler, 1981

Genus *Praegomberellus* Kozur & Mostler, 1994

***Praegomberellus* sp. cf. *P. pulcher* Kozur & Mostler, 1994**

Figure 8.25

Praegomberellus pulcher Kozur & Mostler, 1994, p. 58, pl. 9, figs. 6, 8

Remark: Poorly-preserved specimens were recovered, which slightly resemble *Praegomberellus pulcher* Kozur & Mostler by having diagnostic features. They are a sub-globular spongy shell with numerous spines. The spines have three-ridges and equal length of which three are closely spaced around one pole and other spines are irregularly distributed. However, spine poles of the examined speci-men are unclear.

Occurrence: Triassic from Kanchanaburi area, western Thailand, and European Tethys.

Family Pyramispongiidae Kozur & Mostler, 1978, emend. De Wever et al., 2001

Type genus: *Pyramispongia* Pessagno, 1973

Genus *Triassospongosphaera* (Kozur & Mostler, 1979)

Type species: *Triassospongosphaera triassicus* Kozur & Mostler, 1979

***Triassospongosphaera multispinosa* (Kozur & Mostler, 1979)**

Figure 8.26

Acanthospongosphara multispinosa Kozur & Mostler, 1979, p. 50, pl. 20, fig. 3

Triassospongosphaera multispinosa Kozur & Mostler, 1979. Kozur & Mostler, 1981, p. 67, pl. 58, fig. 3; Lahm, 1984, p. 66, 67, pl. 11 fig. 10; Sashida et al. 1999a, p. 772, figs 8.14, 8.15; Feng et al., 2009, p. 591, figs. 5.20-5.22.

Remarks: Examined specimens have a spongy shell with several straight and rod-like spines. Each specimen has equal spines. Although internal shell structure cannot be determined, outer shell features resemble those of the above-listed specimens of this species.

Occurrence: Triassic from the Kanchanaburi area, western Thailand, European Tethys, Timor Island, Indonesia, and northern Tibet.

Genus *Paurinella* Kozur & Mostler, 1981

Type species: *Paurinella curvata* Kozur & Moslter, 1981

***Paurinella trettoensis* Kozur & Mostler, 1994**

Figure 8.22

Paurinella trettoensis Kozur & Mostler, 1994, p. 74, pl. 15, fig. 15

Remarks: Shell is sub-spherical, spongy, with three needle-like spines, one of which is very long, the other 2 are short. Although one of the spines and internal layer cannot be determined, other features are identical to those of *P. trettoensis* Kozur & Mostler.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, and European Tethys.

***Paurinella curvata spinosa* Kozur & Mostler, 1994**

Figure 7.33

Paurinella curvata tenispinosa Kozur & Mostler, 1994, p. 71, pl. 15, figs. 1, 8

Remarks: Shell is characterized by having numerous layers of a spongy network around a microsphere with three main spines and no by-spines. The three main slender spines have round cross-sections and each are curved in a different direction from the plane. Two of the main spines are always curved against each other. Our poorly preserved specimens do not display the needle-like by-spines.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, and European Tethys.

***Paurinella curvata tenispinosa* Kozur & Mostler, 1994**

Figures 7.31 and 7.32

Paurinella curvata tenispinosa Kozur & Mostler, 1994, p. 71, pl. 15, figs. 2, 3

Remarks: This species differs from *P. curvata spinosa* Kozur & Mostler by having two main spines curved against each other and the absence of by-spines.

Occurrence: Middle Triassic from the Kanchanaburi area of western Thailand and European Tethys.

Paurinella? sp.
Figure 8.16

Remarks: Shell is characterized by having numerous layers of spongy network with four main spines and no by-spines. This form is questionably included in the genus *Paurinella* because of the presence of four main spines.

Occurrence: Middle to Late Triassic from the Kanchanaburi area of western Thailand.

Family Oertlispongidae Dumitrica, Kozur & Mostler, 1980

Type genus *Oertlispongus* Dumitrica, Kozur & Mostler, 1980

Genus *Paroertlispongus* Kozur & Mostler, 1981

Type species: *Paroetlispongus multispinosus* Kozur & Mostler, 1981

Spine A1

***Paroertlispongus multispinosus* Kozur & Mostler, 1981**

Figure 7.6

Paroertlispongus multispinosus Kozur & Mostler 1981, p. 48, pl. 1, fig. 3; Lahm, 1984, p. 45, pl. 7, figs. 5, 6; Kozur & Mostler, 1994, p. 69, pl. 12, fig. 10, pl. 13, fig. 4, 11; Kozur, 1996, p. 291, pl. 1, fig.1; Feng et al., 2001, p. 192, pl. 6, figs. 12, 14—18; Feng et al., 2009, p. 587, figs. 4-2, 4-3.

Remark: Spines are rod-like and straight consisting of a conical root and a long stem gradually tapering to an ended. Possible derivation of these spines is *Paroertlispongus multispinosus* Kozur & Mostler (1981) by having straight and thick spines. This spine is similar to that of *Oertlispongus diacanthus* Sugiyama, 1992, but the later spine is longer than the present spines.

Occurrence: Middle to Late Triassic from the Kanchanaburi area, western Thailand, northern Thailand, European Tethys, southern Turkey (Tekin et al., 2016), northern Tibet, southwest Yunnan, China.

Genus *Oertlispongus* Dumitrica, Kozur & Mostler, 1980

Type species: *Oertlispongus inaequispinosus* Dumtrica, Kozur & Mostler, 1980

Spine A2

***Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler, 1980**

Figures 7.8 and 7.9

Oertlispongus inaequispinosus Dumitrica, Kozur & Mostler, 1980, p. 5, pl.10, fig. 7; Kozur & Mostler, 1996, p. 108, 109, pl. 14, figs. 10, 11; Feng et al., 2009, p. 589, figs. 4. 18-4.22.

Oertlispongus inaequispinosus inaequispinosus Dumitrica, Kozur & Mostler, 1994, p. 61, pl. 10, figs. 1, 3.

Spine A2, Sugiyama, 1997, p. 137, 138, fig. 35.3

Remark: Spines are rod-like and curved. The curvature varies from a form with a slightly curved distal end to another strongly curved, sickle-like spine. The derivation of Spine A2 is *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler, 1980.

Occurrence: Middle to Late Triassic from the Kanchanaburi area, western Thailand, southern Peninsular Thailand (Kamata et al., 2014), northern Tibet, southern Turkey (Tekin et al., 2016), and European Tethys.

Genus *Pseudoertlispongus* Lahm, 1984

Type species: *Pseudoertispongus weddigi* Laham, 1984

Spine B

***Pseudoertlispongus angulatus* Kozur, 1996**
Figure 7.7
Pseudoertlingus angulatus Kozur, 1996, p. 291, 292, pl. 1, figs. 4, 5.

Remark: Spines are rod-like and curved in the end. The possible derivation of Spine A2 is *Pseudoertlispongus angulatus* Kozur.

Occurrence: Middle to Late Triassic from the Kanchanaburi area, western Thailand, and southern Turkey (Tekin et al., 2016).

Genus *Dumitricasphaera* Kozur & Mostler, 1979 emend Lahm 1984

Type species: *Dumitricasphaera goestlingensis* Kozur & Mostler, 1979

***Dumitricasphaera* sp.**

Figure 7.13

Remarks: The illustrated specimen has a spherical spongy shell and two polar spines. Polar spines are three-bladed and very stout. The spinule on the top of polar spines curved downwards following the outline of the spongy shell. This feature is similar to that of genus *Dumitricasphaera* Kozur and Mostler.

Occurrence: Triassic from Kanchanaburi area, western Thailand.

Spine C

***Dumitricasphaera planustyla* Lahm, 1984**

Figure 7.12

Dumitricasphaera planustyla Lahm, 1984, p. 71, pl. 12, fig. 9

Remark: Examined specimens are similar to the polar spines of *Dumitricasphaera planustyla* Lahm. However, they have the polar spines which have shorter branches and the branch of the slightly curved polar spine.

Occurrence: Middle to Late Triassic from the Kanchanaburi area, western Thailand, and European Tethys.

Genus *Falcispongus* Dumitrica, 1982

Type species: *Falcispongus falciformis* Dumitrica, 1982

Spine D

***Falcispongus falciformis* Dumitrica, 1982**

Figures 7.1-7.5

Falcispongus faciliforma Dumitrica, 1982, p. 66, pl.1, fig. 5, pl. 2, figs. 1, 3, 7, pl. 3, figs. 2, 3, 5, 6.; Feng et al., 2009, p. 589, fig. 4.13-4.16, 4.27-31.

Remark: Examined spines have the outer wing which widens proximally and gradually tapers distally. The wing portion of the main spine is quite similar to the spine shape of *Falcispongus falciformis* Dumitrica.

Occurrence: Middle to Late Triassic from the Kanchanaburi area, western Thailand, northern Tibet, and European Tethys.

Genus *Baumgartneria* Dumitrica, 1982

Type species: *Baumgartneria retrospina* Dumitrica, 1982

Spine E1

***Baumgartneria retrospina* Dumitrica, 1982**

Figure 7.10

Baumgartneria retrospina Dumitrica, 1982, p.70, pl. 9, figs. 2-8, pl. 10, figs. 1,2, pl. 12, fig. 3.

Remark: Several poorly-preserved specimens are examined. These spines have triangular and broad axial forms. The wing portion of the main spine is quite similar to the spine shape of *Baumgartneria retrospina* Dumitrica.

Occurrence: Middle to Late Triassic from the Kanchanaburi area, western Thailand, southern Turkey (Tekin et al., 2016), and European Tethys.

Spine E2

***Baumgartneria bifurcata* Dumitrica, 1982**

Figure 7.11

Baumgartneria bifurcate Dumitrica, 1982, p.71, pl. 10, figs. 3, 4; Kozur & Mostler, 1994, p. 64, pl. 13, figs. 3, 5, 6, 10.

Remark: Several poorly-preserved specimens are spines without a spongy shell. These spines have straight branches spine and perpendicular to the stem. The wing portion of the main spine is quite similar to the spine shape of morphotype II, *Baumgartneria bifurcata* Dumitrica.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, Japan (Sugiyama, 1997), southern Turkey (Tekin et al, 2016), and European Tethys.

Family Stylosphaeridae Haeckel, 1882

Genus *Spongostylus* Haeckel, 1882

Type species: *Spongostylus hastatus* Haeckel, 1882

Spongstylus koppi (Lahm, 1984)

Figure 7.25

Cromyostylus? kopi Lahm, 1984, p. 68, pl. 12, figs. 1, 2.

Spongopallium? koppi (Lahm). Gorican & Buser, 1990, p. 157, pl. 4, fig. 1

Spongstylus koppi (Lahm). Sashida et al., 1999a, p. 771, fig. 8.12

Remarks: This species has a spongy shell with two thin and slightly twisted polar spines which distinguish this species from other species in genus *Spongostylus* Haeckel. This form is identified to *Spongstylus kopi* (Lahm) by having diagnostic shell features.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand. This species has been reported from the Middle Triassic (Anisian to Ladinian) in European Tethys, southern Turkey (Tekin et al., 2016), and Timor Island.

Order Entactinaria Kozur and Mostler, 1982

Family Palaeoscenidiidae Riedel, 1967, emend. De Wever et al., 2001

Type genus: *Palaeoscenidium* Deflandre, 1953

Genus _Parentactinia_ Dumitrica, 1978b

Type species: *Parentactinia pugnax* Dumitrica, 1978b

Parentactinia nakatsugawaensis Sashida, 1983

Figure 8.3

Parentactinia nakatsugawaensis Sashida, 1983, p. 172-173, pl. 37, fig. 1-9; Sashida, 1991, p. 687-689, figs. 5-15, 16, 6.1, 6.3-6.6; Sugiyama, 1992, p. 1212-1213, figs. 14.7a-14.10; Blome & Reed, 1992, p. 376, figs. 13.7, 13.12; Sashida et al. 2000a, p. 801, fig. 8. 24; Sashida, et al., 2000b, p. 86, figs.7.1-7.7 Kamata et al. (2002), p. 491-506, figs. 5A; Takahashi & Miyake, 2014, p.286, figs. 204.1-204.3

Remarks: Most of the specimens have a loose latticed shell, which is a diagnostic character of this species. The specimen is incomplete but has the skeletal characters of *P. nakatsugawaensis* Sashida, 1983 such as a short median bar, short apical spines, and long basal spines.

Occurrence: Early to Middle Triassic from the Kanchanaburi area, western Thailand. This species has been reported from the Early to Middle Triassic (Olenekian to Anisian) in Japan, Vietnam, southern and northern Thailand, and North America.

Family Eptingiidae Dumitrica, 1978a

Type genus: *Eptingium* Dumitrica, 1978a

Range: Middle Triassic (Anisian) to Late Jurassic (Tithonian)

Genus _Eptingium_ Dumitrica, 1978a

Type species: *Eptingium manfredi* Dumitrica, 1978a

Eptingium nakasekoi Kozur & Mostler, 1994

Figure 8.8

Eptingium nakasekoi Kozur and Mostler, 1994, p. 43, pl. 1, fig. 5; Sugiyama, 1997, p. 176, figs. 27-4, -5; Spiller, 2002, p. 38, pl. 4, fig. q; Feng et al., 2009, p. 596, fig. 6.8.

Remarks: Three main spines of this species are characterized by the grooves and ridges, pointed in ends that are almost the same length.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, southern Peninsular Thailand (Kamata et al., 2014), Japan, European Tethys, northwestern Malaysia, northern Tibet, and southern Turkey (Tekin et al., 2016).

Eptingium manfredi Dumitrica, 1978a

Figure 8.7

Eptingium manfredi Dumitrica, 1978a, p. 7, 8, pl. 3, figs. 3, 4, pl. 4, figs. 1, 2, 5-7; Gorican & Buser, 1990, p. 144, pl. 8, figs. 7, 8; Yeh, 1990, p. 23, pl. 6, figs. 4, 5, 8, 9; Bragin, 1991, p. 109, pl. 2, figs. 12, 13; Sashida et al., 1993b, p. 82, 83, fig. 6.1, 6.2; Kellie & De Wever, 1995, p. 144, 145, pl. 1, figs. 11, 12; Kozur et al., 1996, p. 204, 205, pl. 10, figs. 1-4, 6, 10; Sashida et al.,1997, p. 13, figs. 6-12, 13; Sashida et al., 2000a, p. 806, figs. 9.13-9.16; Feng et al., 2009, p. 598, fig. 6.6.

Eptingium manfredi manfredi Dumitrica. Sashida et al., 1999a, p. 773, fig. 6.16, 6.17; Spiller, 2002, p. 37, pl.4, figs. n, o.

Remarks: As discussed by the previous authors, this species has a variable shape and torsion of the spine. Examined specimens have a shell with three equal, broad-bladed spines and do not have any spine torsion. The end of the spines is rounded.

Occurrence: Middle Triassic from the Kanchanaburi area, western and northern Thailand, southern Peninsular Thailand (Kama-ta et al., 2014), Russian Far East, European Tethys, Japan, northern Tibet, southern Turkey (Tekin et al., 2016) and northwestern Peninsular Malaysia (Basir, 1997).

Eptingium sp.

Figure 8.9

Remarks: Our examined specimens have a shell with grooves and ridges of three main spines. This form differs from other species of *Eptingium* by having a smaller shell.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand.

Genus _Cryptostephanidium_ Dumitrica, 1978a

Type species: *Cryptostephanidium cornigerum* Dumitrica, 1978a

Cryptostephanidium? megaspinosum Sashida & Kamata, 1999

Figure 8.11

Cryptostephanidium? megaspinosum Sashida & Kamata in Sashida et al, 1999a, p. 773, figs. 6.11-6.13.

Remarks: Shell has a sub-spherical to spherical outline with small pores. The pore frames are very high and small nodes are present. Three main spines are very broad and gradually pointed distally. The furrows between the blades are wide and deep. The internal spicular system cannot be observed. Although examined specimens have equal length of spines, they are safely identified to *Cryptostephanidium? Megaspinosum* Sashida & Kamata,1999.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, and Timor Island.

Genus _Spongostephanidium_ Dumitrica, 1978a

Type species: *Spongostephadium spongiosum* Dumitrica, 1978a

Spongostephanidium japonicum (Nakaseko and Nishimura, 1979)

Figure 8.10

Trilonche japonica Nakaseko and Nishimura, 1979, p. 72, pl. 4, figs. 8, 10.

Cryptostephanidium sp. E, Cheng, 1989, p. 148, pl. 7, fig.6.

Spumellaria gen. et sp., indet. A, Cheng, 1989, p. 147, pl. 6, fig. 8, pl. 7, figs. 1, 2.

Cryptostephanidium sp., Sashida et al., 1993b, p. 84, figs. 6- 6-9.

Cryptostephanidium japonicum (Nakaseko & Nishimura). Gorican & Buser, 1990, p. 142, pl. 8, fig.3; Yeh, 1990, p. 22, pl. 4, fig. 10, pl. 5, figs. 1, 2, 7, pl. 10, fig. 11, pl. 11, fig. 18; Ramovs & Gorican, 1995, p. 184, pl. 5, fig. 1; Kozur et al., 1996, p. 207-208, pl. 6, figs. 1-3

Spongostephanidium japonicum (Nakaseko & Nishimura, 1979), Sashida et al., 1999a, p. 775, figs. 6.1, 6.2, 6.6-6.8, 6.10

Remarks: Examined specimens are characterized by having a shell with rather thick three spines and strong and high nodes on the vertices of pore frames. This species is quite similar to *S. japonicum* (Nakaseko and Nishimura, 1979) by having diagnostic features.

Occurrence: Triassic from the Kanchanaburi area, western Thailand, Japan, Philippines, European Tethys, and Timor Island.

Spongostephanidium sp. cf. _S. longispinosum_ Sashida, 1991

Figure 8.13

Spongostephanidium longispinosum Sashida, 1991, p. 694, figure 7-1-3

Remarks: Examined specimens are slightly similar to *S. longispinosum* Sashida in having a spongy shell with rod-like three spines with pointed ends.

Occurrence: Triassic from the Kanchanaburi area, western Thailand.

***Spongostephanidium* sp. A**

Figure 8.14

Remarks: Examined specimens have high nodes on the pore frames of the shell with rather thick three rod-like spines. Three main spines are short and strong with pointed ends and three grooves in the base. We included this species in genus *Spongostephanidium* Dumitrica by having diagnostic shell features.

Occurrence: Triassic from the Kanchanaburi area, western Thailand.

Family Hindeosphaeridae, Kozur & Mostler, 1981

Type genus: *Hindeosphaera* Kozur & Mostler, 1979

Genus *Parasepsagon* Dumitrica, Kozur & Mostler, 1980

Type species: *Parasepsagon tetracanthus* Dumitrica, Kozur & Mostler, 1980

***Parasepsagon robustus* Kozur & Mostler, 1981**

Figure 8.23

Parasepsagon robustus Kozur & Mostler, 1981, p. 35, 36, pl. 5, fig. 1.

Remarks: Cortical shell globular. All four robust spines have the same size and are situated in one plane. Their axes show perpendicular. The spines become continuously narrower from their relatively broad basis toward the tips. They are tricarinate with broad ridges and deep furrows. Their terminal part is round and needle-like.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, and European Tethys.

***Parasepsagon asymmetricus praetetracanthus* Kozur & Mostler, 1994**

Figure 8.15

Parasepsagon asymmetricus praetetracanthus Kozur & Mostler, 1994, p. 49, 50, pl. 5, figs. 3

Remarks: Our examined specimens have a cortical shell of globular with maybe four spines. The spines have the same size and are situated in one plane. The spines became continuously narrower from their relatively broad basis toward the tips. They are three broad ridges and deep furrows. Their terminal part is round and needle-like. We included examined specimens in *P. asymmetricus praetetracanthus* Kozur and Mostler, although, inner structure and layer cannot be observed.

Occurrence: Middle Triassic in the Kanchanaburi area, western Thailand, and European Tethys.

***Parasepsagon* sp. A**

Figure 8.24

Remarks: This species differs from *P. robustus* Kozur and Mostler by having slender four main spines.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand.

***Parasepsagon* sp. B**

Figure 8.12

Remarks: This species differs from other species of genus *Parasepsagon* by having longer main spines

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand.

Family Muellertortiidae Kozur, 1988

Genus Muelleritortis Kozur, 1988

Type species: *Emiluvia* (?) *cochleata* Nakaseko & Nishimura, 1979

***Muelleritortis cochleata cochleata* (Nakaseko & Nishimura, 1979)**

Figure 8.19

Emiluvia? cochleate Nakaseko & Nishimra, 1979, p. 70, pl.3, figs. 2, 4, 6.

Muelleritortis cochleata cochleata (Nakaseko & Nishimura), Kozur, 1988, p. 53, pl. 1, figs. 1-8, pl. 2, figs. 1, 2, pl. 3, fig. 1; Kozur & Mostler, 1996, p. 86, pl. 2, figs. 1, 4, 8, 13, pl. 3, figs. 1, 3; Kamata et al., 2002, p. 501, fig. 6D.

Remarks: Examined specimens have a spherical to the subspherical shell and four main spines. Three main spines are twisted tightly and have grooves and ridges. An untwisted spine is slightly longer than the other spines. These characters are those of *M. cochleata cochleata* (Nakaseko & Nishimura).

Occurrence: Middle to Late Triassic from the Kanchanaburi area, western Thailand, northern Thailand, European Tethys, and Japan.

***Muelleritortis* sp.**

Figure 8.20

Remarks: Examined specimen has a spherical to the subspherical shell with grooves and ridges on four main spines. Three main spines are untwisted. One spine is slightly longer than the other spines.

Occurrence: Middle to Late Triassic from the Kanchanaburi area, western Thailand.

Genus *Pseudostylosphaera* Kozur & Mostler, 1981

Type species: *Pseudostylosphaera gracilis* Kozur & Mostler, 1981

***Pseudostylosphaera coccostyla compacta* (Nakaseko & Nishimura, 1979)**

Figures 7.19, 7.20, 7.22, 7.23.

Archaeospongoprunum compactum Nakaseko & Nishimura, 1979, pl. 1, figs. 3, 7; Spiller, 2002, p. 44, pl. 6, fig. k, l.

Pseudostylosphaera coccostyla compacta (Nakaseko & Nishimura, 1979), Kozur & Mostler, 1994, p. 44, pl. 1, fig. 8.

Stylosphaera compacta (Nakaseko & Nishimura, 1979), Bragin, 1991, p. 89, pl. 10, figs. 1, 2.

Pseudostylosphaera compacta (Nakaeko & Nishimura, 1979), Yeh, 1990, p. 15, pl. 4, figs. 3, 4, 20; Feng et al., 2009, p.593, figs. 5.5-5.7.

Remarks: Cortical shell is ellipsoidal with two equal polar spines. The broad ridges of the very big polar spine are subdivided by a central furrow. Examined specimens are quite similar to *P. compacta* (Nakaseko & Nishimura).

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand. This species has been reported from the Middle Triassic from Russian Far Eastin, Philippines, European Tethys, northwestern Peninsular Malaysia (Basir, 1997), and Japan.

***Pseudostylosphaera timorensis* Sashida & Kamata, 1999**

Figure 7.24

Pseudostylosphaera timorensis Sashida et.al., 1999a, p. 770, figs. 8.3-8.6.

Remarks: The globular shell is large for the genus and has many circular pores on its surface with two stout polar spines. The polar spines have three-bladed and needlelike distal ends. One polar spine is long, which is approximately the same length as that of the shell diameter, the other is half as long.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, southern Turkey (Tekin, 2016), and Timor Island.

***Pseudostylosphaera japonica* (Nakaseko & Nishimura, 1979)**

Figures 7.16-7.18

Archeospongoreunum japonica Nakaseko & Nishimura, 1979, p. 67, pl. 1, figs. 2, 4, 9

Pseudostylosphaera japonica (Nakaseko & Nishimura), Yeh, 1989, p. 63, pl. 1, fig. 4; Cheng, 1989, p. 143, pl. 6, fig. 1, pl. 7, fig. 7; Yeh, 1992, p. 61, pl. 7, figs. 8-10; Kozur et al., 1996, p. 212-213, pl. 6, fig. 15; Sugiyama, 1997, p. 186, fig. 48.15; Gorican & Buser, 1990, p. 155, 156, pl. 5, fig. 2; Kamata et al., 2002, p. 500, fig. 5F; Spiller, 2002, p. 44, 45, pl. 6, figs. m, n, o; Saesaengseerung et al., 2008, p. 405, figs. 8.24, 8. 25.

Stylosphaeara japonica (Nakaseko & Nishimura, 1979), Bragin, 1991, p. 91, pl.1, figs.11, 13, pl. 9, figs. 13, 14.

Remarks: An illustrated specimen is poorly preserved and has two straight and three-bladed polar spines which are equal in length of the main axis of the shell. These characters are the diagnosis of *P. Japonica*.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, northern Thailand, southern Peninsular Thailand (Kamata et al., 2014), European Tethys, northwestern Peninsular Malaysia (Basir, 1997), Rusian Eart East, southern Turkey (Tekin et al., 2016) and Japan.

Pseudostylosphaera longispinosa Kozur & Mostler, 1981

Figures 7.14 and 7.15

Pseudostylosphaera longispinosa Kozur & Mostler, 1981, pl. 1, fig. 6; Gorican & Buser, 1990, p. 155, pl. 5, figs.3-5.

Pseudostylosphaera longispinosa Kozur & Mostler, 1981, Sugiyama, 1997, p. 186, fig. 48.16; p. 15, pl. 4, fig. 2.

Remarks: Several examined specimens are characterized by having a spongy shell with two polar spines. The polar spines are long and three broad ridges. This species is identified to *P. longispinosa* Kozur & Mostler, 1981 by having its diagnostic shell features.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, Japan, and European Tethys.

Pseudostylosphaera sp. A

Figure 7.21

Remarks: This species is characterized by having a globular shell that is large for the genus and has many circular pores on its surface with two polar spines. These polar spines are stout, three-bladed, and have torsion. Examined specimen differs from *Pseudostylosphaera timorensis* Sashida & Kamata by having torsion spines.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand.

Pseudostylosphaera sp. B

Figure 7.27 and 7.28

Remarks: Our examined specimens differ from *Pseudostylosphaera* sp. A by having two main spines without torsion and they are always curved against each other.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand.

Family Capnuchosphaeridae De Wever, 1979, emend. Pessagno, 1979

Type genus: *Capnuchosphaera* De Wever, 1979

Genus *Capnuchosphaera* De Wever, 1979

Type species: *Capnuchosphaera triassica* De Wever *in* De Wever *et al.*, 1979

Capnuchosphaera deweveri Kozur & Mostler, 1979

Figure 8.21

Capnuchosphaera deweveri Kozur & Mostler, 1979, p. 75, pl. 10, figs. 4-7; pl. 12, fig. 1; De Wever, 1982, p. 153-154, pl. 3. figs. 10, 11; pl. 4, figs. 1, 2; Blome, 1984, p. 16, pl. 1, figs. 3, 8, 9, 16, 18; pl. 11, figs. 1, 2, 16; Lahm, 1984, p. 81, pl..14, fig.7; Yeh, 1990, p. 8, pl. 2, fig. 5, pl. 10, fig. 8; Sashida et al., 1996a, p. 229, 230, figs. 7-8, 11, 12.

Remarks: Although our examined specimens are poorly preserved, the size of the shell and outer shell shape are identical with those of the original specimens described by Kozur & Mostler (1979). This species is easily distinguished from other species of *Capnuchosphaera* by having slender arms, and longer twisted and terminal parts.

Occurrence: Late Triassic (early Carnian) from the Kanchanaburi area, western Thailand, European Tethys, Japan, Philippines, North America, and Timor Island.

Capnuchosphaera sp.

Figures 8.17 and 8.18

Remarks: Poorly-preserved specimens are characterized by a rather thin tube-like arm without any flared or distinctly twisted part. We assigned this species in genus *Capnuchosphaera* De Wever.

Occurrence: Late Triassic (early Carnian) from the Kanchanaburi area, western Thailand.

Order Nassellaria Ehrenberg, 1875

Family Achaeosementidae Kozur & Mostler, 1981, emend. De Wever et al., 2001
Type genus: *Archaeosemantis* Dumitrica, 1978b

Genus *Archaeosemantis* Dumitrica, 1978b
Type species: *Archaeosemantis pterostephanus* Dumitrica, 1978b

***Archaeosemantis* sp. cf. *A. venusta* Sashida, 1983**

Figures 8.1 and 8.2

Archaeosemantis venusta Sashida, 1983, p. 171, pl.36, figs. 1, 2, 4-9; Sashida, 1991, p. 681-696, figs. 5-4-8

Remarks: Examined specimens have spicules commonly with five to six spines arising from a very short median bar. Two basal spines are long and distal half of them are curved inward, which gradually tapered toward the end. The apical spines are three, long and straight. Examined specimens are similar to *A. venusta* Sashida, 1983.

Occurrence: Early to Middle Triassic from the Kanchanaburi area, western Thailand.

Family Poulpidae De Wever, 1981

Type genus: *Poulpus* De Wever, 1979

Genus *Poulpus* De Wever 1979

Type species: *Poulpus piabyx* De Wever *in* De Wever et al., 1979

***Poulpus illyricus* Kozur & Mostler, 1994**

Figures 8.4 and 8.5

Poulpus illyricus Kozur & Mostler, 1994, p. 117, pl. 29, figs. 8-10, pl. 32, figs. 1, 2, 4

Remarks: Examined specimens are characterized by having a monocytid shell. Cephalic is large and hemiglobular with a large spicular system. Three tricarinate feet are stout, large, in the basal part cylindrical with low continuation if the inner ridge.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, and European Tethys.

Genus *Hozmadia* Dumitrica, Kouzur & Mostler, 1980

Type species: *Hozmadia retriculata* Dumitrica, Kozur & Mostler, 1980

***Hozmadia* sp.**

Figure 8.6

Hozmadia sp. A, Sashida et al., 1999a, p. 779, figs. 10.15-10.18

Remarks: Shell consists of a sub-spherical to rather elongate cephalis with a stout horn and three feet. We included examined specimens in genus *Hozmadia* Dumitrica, Kozur & Mostler, although the internal spicular system and pores cannot be observed at all.

Occurrence: Triassic from the Kanchanaburi area, western Thailand. Species probably identified to the present species has been reported from the Middle Triassic in Timor Island.

Family Planispinocyrtiidae Kozur & Mostler, 1981

Type genus: *Planispinocyrtis* Kozur & Mostler, 1981

Genus *Ladinocampe* Kozur, 1984

Type species: *Ladinocampe multiperforata* Kozur, 1984

***Ladinocampe*? sp.**

Figures 6.14-6.16

Remarks: Examined specimens have elongated conical shell, smooth poreless cephalic, with large and tricarinate apical horn. Thorax and abdomen display distinctly broader, hoop-like segments until the end of the columella that contains numerous small pores. We tentatively included this species in genus *Ladinocampe* Kozur by having diagnostic shell features.

Occurrence: Triassic from the Kanchanaburi area, western Thailand.

Family Ruesticyrtiidae Kozur & Mostler, 1979

Type genus: *Ruesticyrtium* Kozur & Mostler, 1979

Genus *Striatotriassocampe* Kozur & Mostler, 1994

Type species: *Striatotriassocampe nodosoannulata* Kozur & Mostler, 1994

Striatotriassocampe laeviannulata Kozur & Mostler, 1994

Figures 6.8 and 6.9

Striatotriassocampe laeviannulata Kozur & Mostler, 1994, pl. 43, figs. 3, 7, 8

Remarks: Examined specimens resemble *Striatotriassocampe laeviannulata* Kozur & Mostler by having the slender subcylindrical and very long test. Cephalic is rounded conical and smooth or with few pores at the junction. Posthoracic segments are ring-like and become distal wards slightly higher. In the following segments, the pores are more numerous and more restricted to the lower part of the segment.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, southern Turkey (Tekin et al., 2016), and European Tethys.

Genus *Triassocampe* Dumitrica, Kozur & Mostler, 1980, emend. Blome, 1984

Type species: *Triassocampe scalaris* Dumitrica, Kozur & Mostler, 1980

Triassocampe deweveri (Nakaseko & Nishimura, 1979)

Figures 6.22-6.24

Dictyomitrella deweveri Nakaseko & Nishimura, 1979, p. 77, pl. 10, figs. 8? 9.

Triassocampe deweveri (Nakaseko & Nishimura, 1979), Kozur & Reti, 1986, p. 288, fig. 5-E; Cheng, 1989, p. 148, pl. 6, figs. 13-14, pl. 7, figs. 10-11; Yeh, 1990, p. 28, pl. 7, figs. 7, 18, 20, pl. 11, figs. 2-3, 7-8, 13-14; Feng & Liu, 1993, p. 547, pl. 3, figs. 1-4; Kozur & Mostler, 1994, p. 140, pl. 42, fig. 1, pl. 44, fig. 14, pl. 45, fig 6; Ramovs & Gorican, 1995, p. 192, pl. 7, figs. 13-14; Sashida et al, 2000b, p. 91, 93, figs. 8- 1-5, 7, 8, 11-13, 22-25, 27, 28; Xia & Zhang, 2000, p.78, pl. 2, figs. 1-5; Feng, et al., 2001, p. 182, pl. 3, figs. 1-6; Spiller, 2002, p. 39, pl.5, figs. , d, e, f, g, h; Saesaengseerung et al., 2008, p. 406, 407, figs. 8.1-8.3; Feng et al., 2009, p. 597, fig. 7.1-7.4.

Remarks: Examined specimens have a long conical test of which upper part of the cephalic conical, lower part cylindrical with the small and hoop-like thorax. Although all the following segments are inversely trapezoidal of the chamber, this feature is not very distinct. The proximal ring of nodes is in all post-thoracic segments distinctly separated from the segments. These shell features are quite similar to those of *Triassocampe deweveri* (Nakaseko & Nishimura, 1979).

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, northern Thailand, southwestern China, Philippines, European Tethys, northern Tibet, southern Turkey (Tekin et al, 2016), and Japan.

Triassocampe nishimurai Kozur & Mostler, 1994

Figure 6.1

Triassocampe nishimurai Kozur & Mostler, 1994, p. 144, pl. 44, fig. 7, pl. 45, figs. 4, 9-11; Saesaengseerung et al., 2008, p. 407, fig. 8. 11.

Remarks: Poorly-preserved specimen has a slender and sub-cylindrical test with long, cylindrical, apically broadly rounded, and large cephalothorax. The cephalic part is poreless and smooth. The thorax displays one ring of tiny, mostly closed pores. Abdomen and postabdominal segment display two rings of tiny pores that are mostly closed. This specimen is compared to *T. nishimurai* Kozur & Mostler, although the distal segments cannot be observed.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, and European Tethys.

Triassocampe myterocorys Sugiyama, 1992

Figures 6.19-6.21

Triassocampe myterocorys Sugiyama, 1992, p. 1198, figs. 11.1-11.3b; Sashida et al., 2000a, p. 807, figs. 9.2-9.5.; Feng et al., 2001, p. 180, pl. 2, figs. 16, 17.

Remarks: As suggested by Sugiyama (1992), this species has quite a wide variety in shell morphology. Illustrated specimens show the variation in the shape of the cephalic.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, southwestern China, and Japan.

***Triassocampe scalaris scalaris* Dumitrica, Kozur & Mostler, 1980**

Figure 6.25

Triassocampe scalaris scalaris Dumitrica, Kozur & Mostler, 1980, p. 26, pl. 9, figs. 5, 6, 11, pl. 14, figs. 2; Kozur & Mostler, 1994, p. 145, pl. 44, figs. 1-6, 10-12; pl. 45, figs. 1, 2, pl. 1, 2, pl. 47, figs. 2, 3.

Triassocampe scalaria Dumitrica, Kozur & Mostler, 1980, Feng et al., 2001, p. 182, pl. 3, figs. 14-16; Feng et al., 2009, p. 597, figs. 7.5-7.7.

Remarks: Examined specimen displays at least in the first 3 post thoracic segments 2 distinct rings of nodes separated by a slight incision. The segments are therefore short cylindrical with the slight median incision. These shell features are quite similar to those of *T. scalaris scalaris* Dumitrica, Kozur & Mostler.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, southwestern China, European Tethys, and northern Tibet.

Genus *Yeharaia* Nakaseko & Nishimura, 1979

Type species: *Yeharaia elegans* Nakaseko & Nishimura, 1979

***Yeharaia annulata* Nakaseko & Nishimura, 1979**

Figures 6.17 and 6.18

Yeharaia annulata Nakaseko & Nishimura, 1979, p. 10, figs. 1, 7, pl. 2, fig. 5; Kozur & Mostler, 1994, p. 147, pl. 46, figs. 6-11, pl. 47, figs. 4, 5.

Remarks: Several poorly-preserved specimens are characterized by having a conical shell with a long apical horn. Abdomen and post--abdominal chambers are hoop-like segments that display single rings of tiny pores. Features of examined specimens are quite similar to those of *Yeharaia annulata* Nakaseko & Nishimura.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, Japan, and European Tethys.

***Yeharaia transita* Kozur & Mostler, 1994**

Figures 6.10-6.12

Yeharaia transita Kozur & Mostler, 1994, p. 148, pl. 46, figs. 1-4, 12.

Remarks: *Y. transita* is distinguished from the other *Yeharaia* species by its very small apical horn.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, and European Tethys.

Genus *Pararuesticyrtium* Kozur & Mostler, 1981

Type species: *Pararuesticyrtium densiporatum* Kozur & Mostler, 1981

***Pararuesticyrtium? illyricum* (Kozur & Mostler, 1981)**

Figure 6.7

Triassocampe illyrica Kozur & Mostler, 1981, pl. 15, fig. 2; Yeh, 1989, p. 75, pl. 2, figs. 14, 23.

Pararuesticyrtium? illyricum (Kozur & Mostler), Kozur & Mostler, 1994, pl. 43, figs. 11, 12, 15, 16; Saesaengseerung et al., 2008, p. 406, figs. 8.12, 8. 13.

Remarks: Our examined specimen is poorly preserved and has the most complete segment display only two rings of pores and hooplike segments. Therefore, we questionably assigned this species to *P. illyricum*.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand, Philippines, and European Tethys.

***Pararuesticyrtium mediofassanicum* Kozur & Mostler, 1994**

Figure 6.13

Pararuesticyrtium mediofassanicum Kozur & Mostler, 1994, p. 109-101, pl. 28, figs. 1-4, 9,11.

Remarks: The test is conical and has a narrow distal skirt. The cephalothorax is dome-shape, smooth, and poreless. The cephalic part is rounded conical to subhemiglobular. The examined specimens are identical to *P. mediofassanicum* Kozur & Mostler by having a diagnostic shell outline.

Occurrence: Middle Triassic from Kanchanaburi area, western Thailand, and European Tethys.

Family Anisicyrtiidae Kozur & Mostler, 1981

Genus *Anisicyrtis* Kozur & Mostler, 1981

Type species: *Anisicyrica hungarica* Kozur & Mostler, 1981

***Anisicyrtis* sp.**

Figures 6.26-6.28

Remarks: Examined specimens have a subconical test and moderately large cephalic with tricarinate apical horn. Abdomen and postabdominal segment are low, separated by a very narrow and shallow constriction. Thorax, abdomen, and postabdominal segment are always covered by thick outer pore frames. We included this species in genus *Anisicyrtis* Kozur & Mostler by having diagnostic shell features.

Occurrence: Middle Triassic from the Kanchanaburi area, western Thailand.

Nassellaria gen. et sp. indet. A

Figures 6.2 and 6.3

Remarks: Test has a dome-shaped cephalic which lacks a horn. Obscure segments have numerous pores. This unidentified species differs from *Triassocampe deweveri* (Nakaseko & Nishimura) by lacking hoop-like thorax and abdomen.

Occurrence: Triassic from the Kanchanaburi area, western Thailand.

Nassellaria gen. et sp. indet. B

Figure 6.4

Remarks: Examined specimens have a conical test without horn and cephalic. Shell cover is smooth with horizontally arranged of several small pores. This unidentified species differs from Nassellaria gen. et sp. indet. A by having a smooth shell.

Occurrence: Triassic in the Kanchanaburi area, western Thailand.

Nassellaria gen. et sp. indet. C

Figures 6.5 and 6.6

Remarks: Several poorly preserved specimens were examined. The test has a conical shape with unclear segments which disarranged small pores. The caphalic is dome-shaped without horns.

Occurrence: Triassic in the Kanchanaburi area, western Thailand.

6. Correlation and palaeogeographic significance

In northern Thailand, the occurrence of long-duration radiolarian bearing-rocks (Devonian to Middle Triassic bedded chert) have been reported from the Fang area, north of Chiang Mai (e.g. Caridroit et al., 1990; Sashida et al., 1993a, 1998, 2000a; Wonganan & Caridroit, 2005). The Fang chert is well bedded, with beds of several centimeters intercalated with shale a few millimeters in thickness. Under microscopic observation, it is composed of abundant radiolarian tests and sponge spicules with clay minerals. This chert completely excludes coarse-grained terrigenous materials and thought to have been deposited in a pelagic environment far from land areas (Matsuda & Isozaki, 1991). These pelagic cherts are probably continuous toward northwestern Thailand e.g., along the highway from Mae Hong Son to Mae Sariang (Feng et al., 2005) and the Mae Sot and Umphang areas (Ishida et al., 2006) where radiolarian-bearing rocks are thought to have been deposited in the deep basin of Palaeo-Tethys Ocean. In contrast, the Triassic cherts in the Mae Sariang area of the Mae Sariang Group along the Thai--Myanmar border seem to differ from the pelagic bedded chert in its lithological charactersand intercalations of calcareous formations (Kamata et al., 2002). Kamata et al. (2002) suggested that chert successions distributed in the Mae Sariang area have been accumulated at the eastern continental margin of the Sibumasu Block within the western part of Palaeo-Tethys Ocean.

Based on the lithostratigraphy and radiolarian ages, the chert and clastic rock sequences in the Kanchanaburi area are correlated to the rock units distributed in the Mae Sariang area. The occurrence of early Late Triassic (early Carnian) radiolarians from the Mae Sariang (Kamata et al., 2002) and Kanchanaburi areas indicates that the depositional basins were present until the early Late Triassic time in the western part of the Palaeo-Tethys Ocean.
Kamata et al. (2014) described the litho- and biostratigraphy of fine-grained siliceous rock successions in the Hat Yai area of southern Peninsular Thailand. According to their study, fine-grained siliceous sedimentary rocks distributed in this area, are divided into two units of the lower shale unit and the upper chert unit. The lower shale unit yielded Late Middle to early Late Permian and the upper unit Early to Middle Triassic radiolarians, respectively. They suggested that the clastic-chert successions in the Hat Yai area are correlated with the Permo-Triassic Semanggol Formation (e.g., Teoh, 1992; Basir et al., 1995) of northwestern Peninsular Malaysia and Triassic chert in the Hat Yai area is not typical pelagic deep-water sediment deposited on an abyssal plain and instead, it is better to interpret as continental slope sediments overlying Permian fine-grained clastic rocks. The depositional environment of the chert in this area was likely restricted to the vicinity of a continental slope and rise, based on the lithological and biostratigraphical analyses. They also inferred that the continental margin of the Sibumasu Block along the of Palaeo-Tethys Ocean was represented by a stable passive margin without much tectonic activity and the closure of Palaeo-Tethys Ocean between the Sibumasu and Indochina terranes occurred at least after the Middle Triassic in southern Peninsular Thailand. In our provisional study in the Kanchanaburi area, Upper Permian chert and overlying siliceous shales that include uppermost Permian conodont-bearing limestone lens have been identified (Sashida et al., 2019). Jenjitpaiboon and Chonglakmani (2014) summarized the stratigraphy and fossils of the area about 10 km northwest of Nong Prue, western Kanchanaburi. They discriminated four stratigraphic units, Units A to D in ascending order in this area. Unit A consists of shale, calcareous shale, and limestone and Roadian–Wordian (Guadalupian, Middle Permian) ammonites were identified from the shale part of this unit. Unit B unconformably covers unit A and consists of limestone conglomerate, limestone, shale, and siliceous shale. The limestone conglomerate yielded Permian fusulinids, but they inferred the age of this unit to be Triassic. Unit C conformably overlies unit B and is composed of shale and siliceous shale. Unit D conformably covers unit C and consists of sandstone and shale. From the shale part of units C and D, Carnian–Norian (Late Triassic) bivalves, *Halobia* and others, have been identified. In the Nong Prue area, thick Permian–Triassic carbonate rocks correlated to the Chuping and Kodiang Limestone (e.g., Koike, 1982, Basir et al., 1995) in peninsular Malaysia and the Khlong Kon Limestone (e.g., Sashida et al, 1999b) and Chaiburi Formation (Ampornmaha, 1995) in southern peninsular Thailand are not found. In the Nong Prue area, western Kanchanaburi, there are two types of sedimentary rock sequence, one is that deposited in rather deep-sea continental slope to abyssal plain represented by the present Triassic radiolarian-bearing chert and the other is the continental shelf where clastic sediments were deposited yielding Upper Triassic *Daonella-Halobia* faunas. Based on these lithological and chronological features, our studied area correlated to the Semanggol Formation of northwestern peninsular Malaysia and Late Permian and Early–Middle Triassic siliceous rock sequence in the Hat Yai area, southern peninsular Thailand.

Based on the above mentioned several lines of evidence we can conclude that the closure of the Palaeo-Tethys Ocean probably occurred at least after the early Late Triassic (early Carnian) (Fig. 9B). In addition, Triassic radiolarian faunas from our studied area are similar to those of northwestern Peninsular Malaysia (e.g., Basir, 1997 Spiller, 2002), Philippines (e.g., Yeh, 1990), Japan (e.g., Sugiyama, 1997),

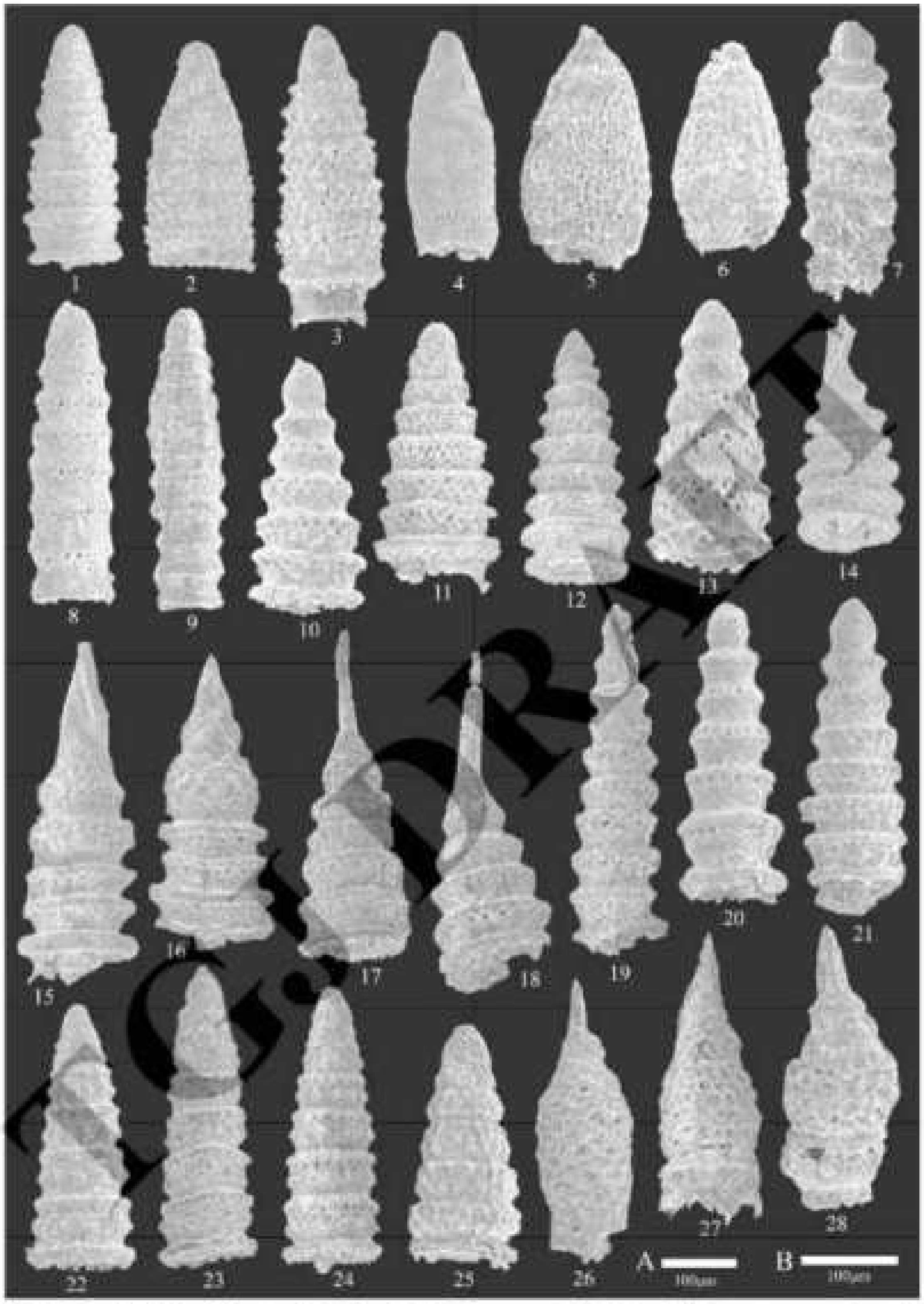

Fig. 6: Triassic radiolarians from the Kanchanaburi area, western Thailand. All figures are scanning electronic micrographs. 1. *Triassocampe nishimurai* Kozur & Mostler, 2, 3. Nassellaria gen. et sp. Indet. A, 4. Nassellaria gen. et sp. Indet. B, 5, 6. Nassellaria gen. et sp. Indet C, 7. *Pararuesticyrtium? illyricum* Kozur & Mostler, 8, 9. *Striatotriassocampe laeviannulata* Kozur & Mostler, 10-12. *Yeharaia transita* Kozur & Mostler, 13. *Pararuesticyrtium mediofassanicum* Kozur & Mostler, 14-16. *Ladinocampe?* sp., 17, 18. *Yeharaia annulata* Nakaseko & Nishimura, 19-21. *Triassocampe myterocorys* Sugiyama, 22-24. *Triassocampe deweveri* (Nakaseko & Nishimura), 25. *Triassocampe scalaris scalaris* Dumitrica, Kozur & Mostler, 26-28. *Anisicyrtis* sp. Scale bar A: figs. 8, 9, 19-21; Scale bar B: figs. 1-7, 10-18, 22-28.

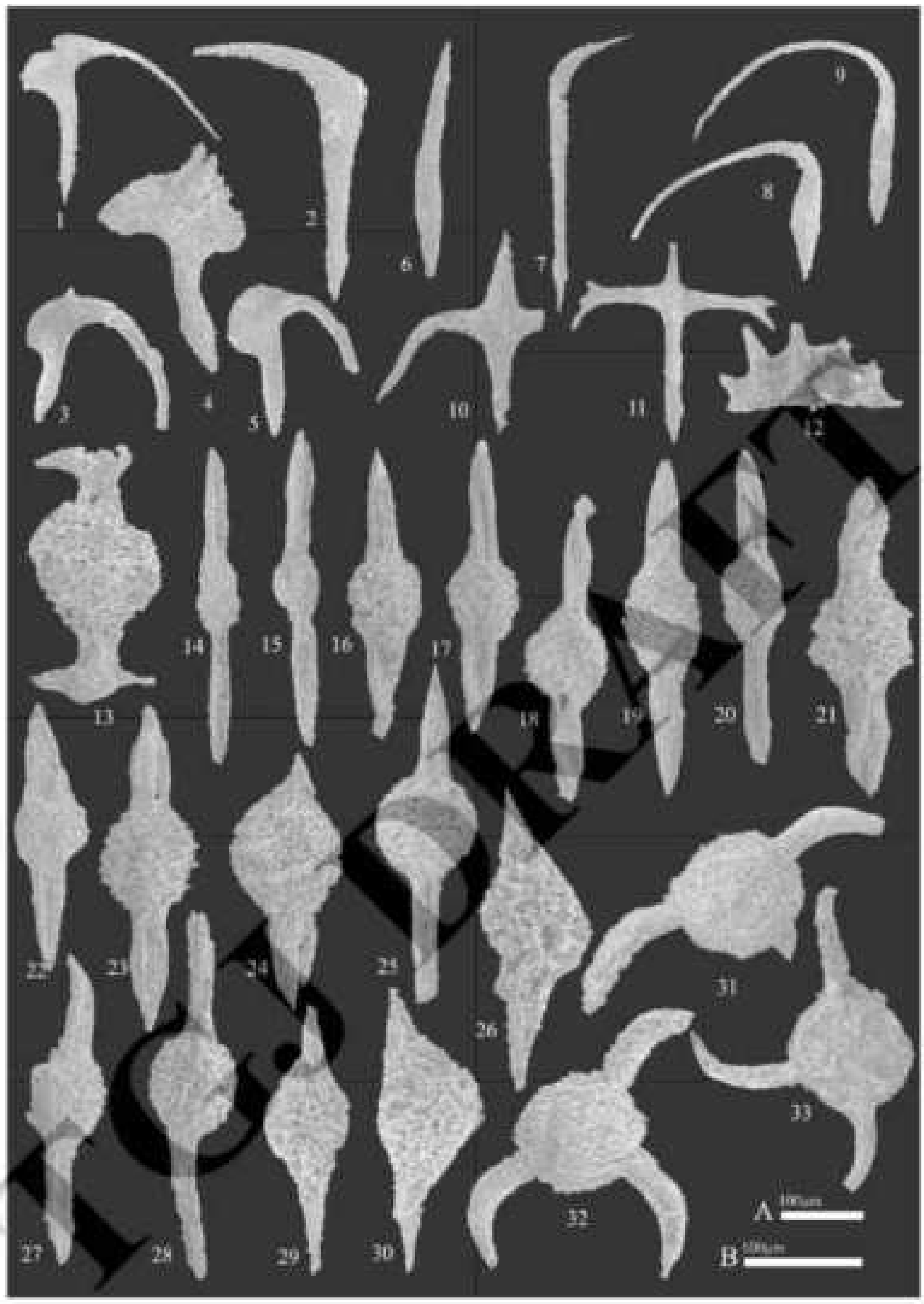

Fig. 7: Triassic radiolarians from the Kanchanaburi area, western Thailand. All figures are scanning electronic micrographs. 1-5. Spine D, *Falcispongus falciformis* Dumitrica, 6. Spine A1, *Paroertlispongus multispinosus* Kozur & Mostler, 7. Spine B, *Pseudoertlispongus angulatus* Kozur, 8, 9. Spine A2, *Oertlispongus inaequispinosus* Dumitica, Kozur & Mostler, 10. Spine E1, *Baumgarmeria retrospina* Dumitrica, 11. Spine E2, *Baumgarmeria bifurcate* Dumitrica, 12. Spine C, *Dumitricasphaera planustyla* Lahm, 13. *Dumitricasphaera* sp., 14, 15. *Pseudostylosphaera longispinosa* Kozur & Mostler, 16-18. *Pseudostylosphaera japonica* (Nakaseko & Nishimura), 19, 20, 22, 23. *Pseudostylosphaera coccostyla compacta* (Nakaseko & Nishimura), 21. *Pseudostylosphaera* sp. A, 24. *Pseudostylosphaera timorensis* Sashida & Kamata, 25. *Spongostylus koppi* (Lahm), 26, 30. *Archaeospongoprunum mesotriassicum asymmetricum* Kozur & Mostler, 27, 28, *Pseudostylosphaera* sp. B, 29. *Archaeospongoprunum mesotriassicum mesotriassicum* Kozur & Mostler, 31, 32. *Paurinella curvata tenispinosa* Kozur & Mostler, 33. *Paurinella curvata spinosa* Kozur & Mostler. Scale bar A: figs. 13-25, 27, 28, 31-33; Scale bar B: figs. 1-12, 26, 29, 30.

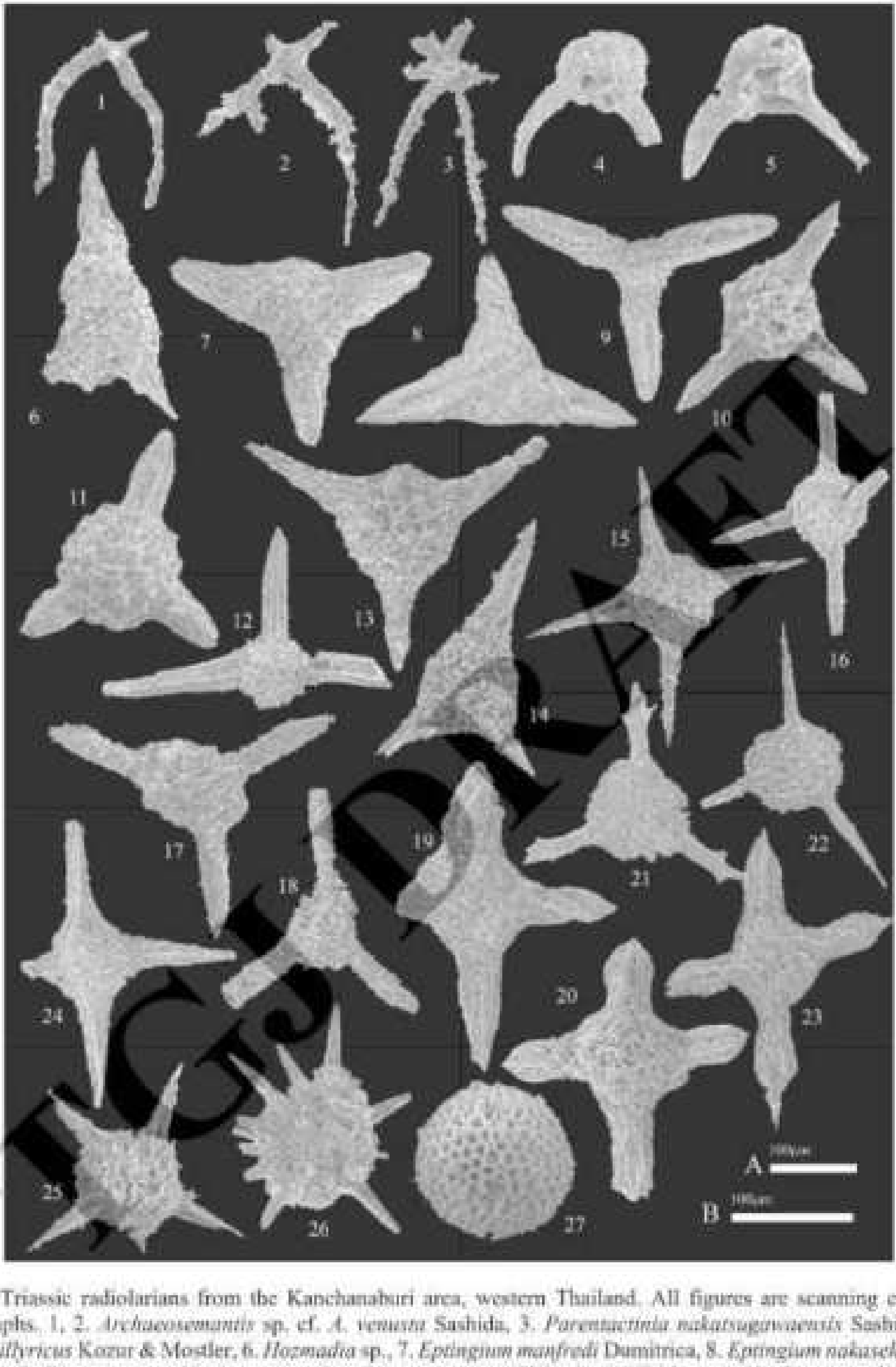

Fig. 8:. Triassic radiolarians from the Kanchanaburi area, western Thailand. All figures are scanning electronic micrographs. 1, 2. *Archaeosemantis* sp. cf. *A. venusta* Sashida, 3. *Parentactinia nakatsugawaensis* Sashida, 4, 5. *Poulpus illyricus* Kozur & Mostler, 6. *Hozmadia* sp., 7. *Eptingium manfredi* Dumitrica, 8. *Eptingium nakasekoi* Kozur & Moster, 9. *Eptingium* sp., 10. *Spongostephanidium japonicum* (Nakaseko & Nishimura), 11. *Cryptostephanidium ? megaspinosum* Sashida & Kamata, 12. *Parasepsagon* sp. B, 13. *Spongostephanidium* sp. cf. *S. longispinosum* Sashida, 14. *Spongostephanidium* sp. A, 15. *Parasepsagon asymmetricus praetetracanthus* Kozur & Mostler, 16. *Paurinella?* sp., 17-18. *Capnuchosphaera* sp., 19. *Muelleritortis cochleata cochleata* (Nakaseko & Nishimura), 20. *Muelleritortis* sp., 21. *Capnuchosphaera deweveri* Kozur & Mostler, 22. *Paurinella tretoensis* Kozur & Mostler, 23. *Parasepsagon robustus* Kozur & Mostler, 24. *Parasepsagon* sp. A, 25. *Praegomberellus* sp. cf. *P. pulche* Kozur & Mostler, 26. *Triassospongosphaera multispinosa* (Kozur & Mostler), 27. *Cenosphaera igoi* Sashida. Scale bar A: figs. 7-24, 26, 27; B: figs. 1-6, 25.

Oregon, USA (Blome & Reed, 1992), Rusian Far East (Bragin, 1991), European Tethys (e.g., Kozur & Mostler, 1994), of which radiolarian-bearing rocks are thought to have been deposited in the Panthalassa and western Palaeo-Tethys oceans. Although, the positions of Japan, Russian Far East, and western North USA are located in the middle to rather a high latitude in the northern hemisphere at present. Their radiolarian-bearing cherts are thought to have been deposited at low latitudes in the Panthalassa Ocean (Isozaki, 1997). This may indicate that the Palaeo-Tethys and Panthalassa oceans were connected by seaways at this time and shared the same oceanic circulation system.

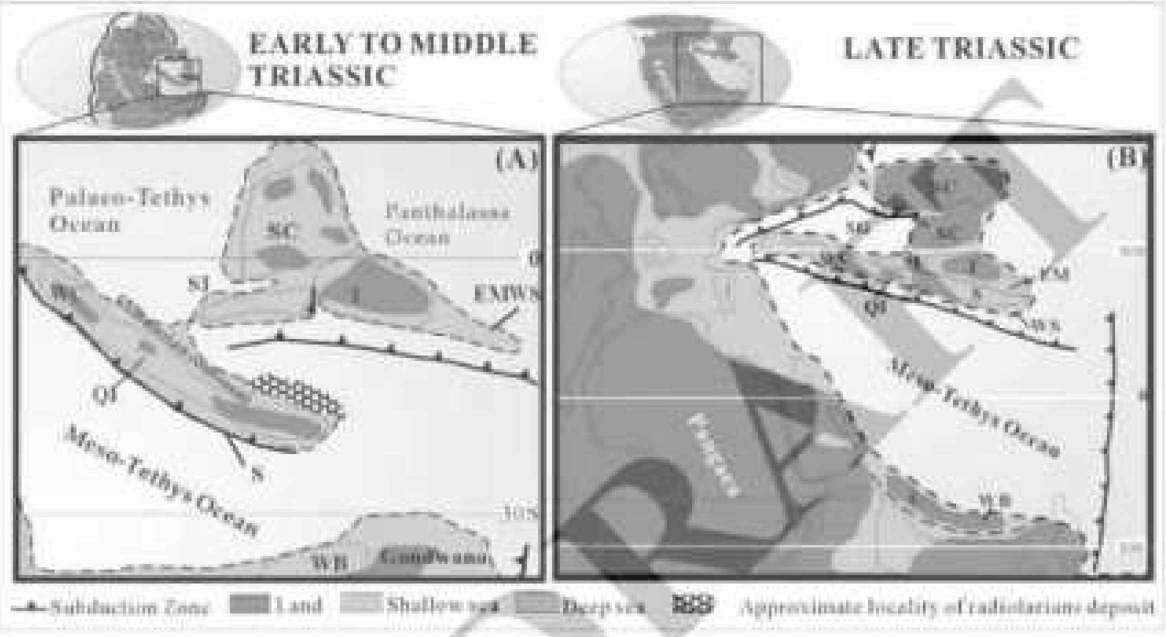

Fig. 9: (A) Palaeogeographic Reconstruction of the Tethyan region for Triassic showing the postulated positions of East and South-East Asian terranes, and the distribution of land; the plot approximates the locality of radiolarian-bearing rocks of the Kanchanaburi area, western Thailand. NC, North China; SC, South China; I, Indochina; EM, East Malaya; WS, West Sumatra; QI, Qiangtang; WC, Western Cimmerian Continent. The basic map is after Metcalfe (2011)

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