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Discovery of Middle Triassic radiolarian fauna from the Nan area along the Nan-Uttaradit suture zone, northern Thailand

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Abstract. A Middle Triassic radiolarian fauna is present in the siliceous rock section at the Nan area along the Nan-Uttaradit suture zone, northern Thailand. The radiolarian fauna is composed of *Triassocampe deweveri*, *T. nishimurai*, *Annulotriassocampe campanilis*, *Cenosphaera igoi*, and other species and corresponds to the Anisian (Middle Triassic) *Triassocampe deweveri* fauna reported from Japan, Hungary, Italy, Austria, Far East of Russia, and northern and eastern Thailand. More than fifteen radiolarian species belonging to eight genera are investigated. The radiolarian-bearing rocks were probably deposited in a pelagic environment within the Nan-Uttaradit back-arc basin between the Simao and Indochina blocks during Middle Triassic time. This suggests that the Nan-Uttaradit back-arc basin, the Palaeo-Tethys ocean and Panthalassa ocean were probably connected by seaways at this time and might have shared the same oceanic circulation system. Furthermore, the complete closure of the Nan-Uttaradit back-arc basin between the Simao and the Indochina blocks is thought to have occurred at least after the Middle Triassic.

Key words: Middle Triassic, Radiolaria, Nan-Uttaradit back-arc basin, Nan-Uttaradit suture zone, Simao, Thailand

Introduction

Detailed age determinations based on radiolarian biostratigraphy of pelagic, hemipelagic and continental margin sediments distributed in Southeast Asian countries have been used for terrane analysis and for understanding continental collisions and the opening and/ or closing of the Palaeo-Tethys ocean. The radiolarian ages provide constraints on the ages of opening of the Palaeo-Tethys and of the closure of its main and subsidiary branches (e.g., Sashida *et al.*, 1993, 1997; Sashida and Igo, 1999; Kamata *et al.*, 2002). However, the timing of these events is still debatable. The study of radiolarians is very important in elucidating the tectonic development of the Palaeozoic and Mesozoic in Thailand.

The mainland of Thailand is traditionally regarded as consisting of two principal continental blocks, the western Sibumasu (Shan-Thai) and eastern Indochina blocks (e.g., Bunopas, 1981, 1992; Metcalfe, 1999; Singharajwarapan and Berry, 2000; Wonganan and Caridroit, 2005; Ishida *et al.*, 2006). The Nan-Uttaradit suture was believed to be the suture zone, represented by remnants of palaeooceanic sediments, between the Sibumasu and Indochina continental blocks (e.g., Bunopas, 1981, 1992; Metcalfe, 1999). In contrast, the mainland of Thailand has recently been reinterpreted as representing three principal continental blocks: the western Sibumasu, central northern Simao and eastern Indochina blocks (Metcalfe, 2002, 2005, 2006; Feng *et al.*, 2005). The boundary between the Sibumasu and Simao blocks in northern Thailand is the Chiang Mai Suture (Metcalfe, 2005). 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 Simao block and South China/Indochina blocks (Ueno and Hisada, 1999; Wang *et al.*, 2000; Metcalfe, 2002, 2005).

In May 2005, we visited the Nan area along the Nan-Uttaradit suture zone, northern Thailand to collect radiolarian-bearing rocks (Figures 1, 2 and 3). These rocks yielded poorly to moderately preserved Middle Triassic radiolarians which have never been reported in this area. More than fifteen radiolarian species belonging to eight

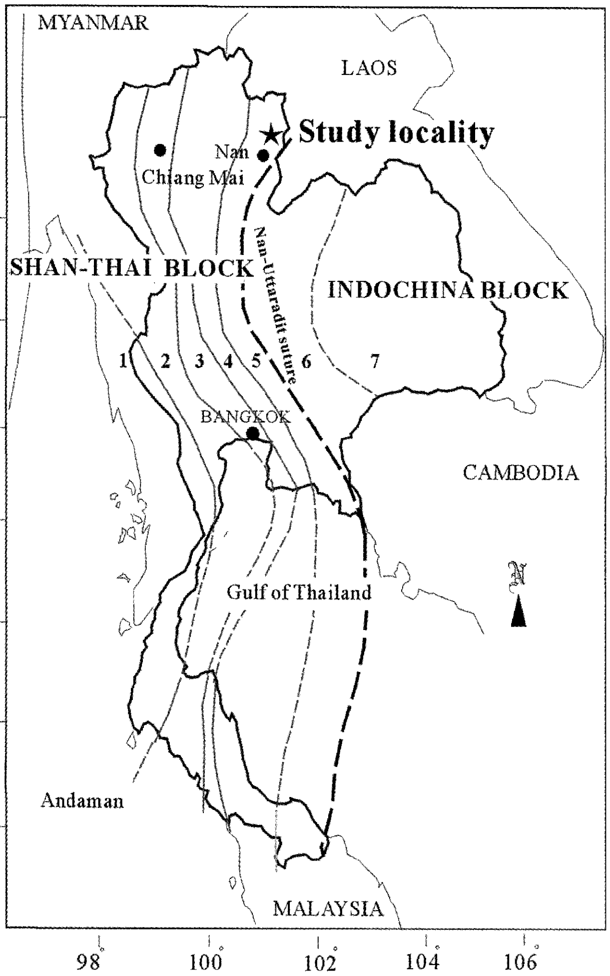


Figure 1. Index map showing the location of the study section in the Nan area along the Nan-Uttaradit suture zone. Basic map is from Bunopas (1992). Number 1 to 7 in Thailand represents the stratigraphic belts recognized by Bunopas (1992).

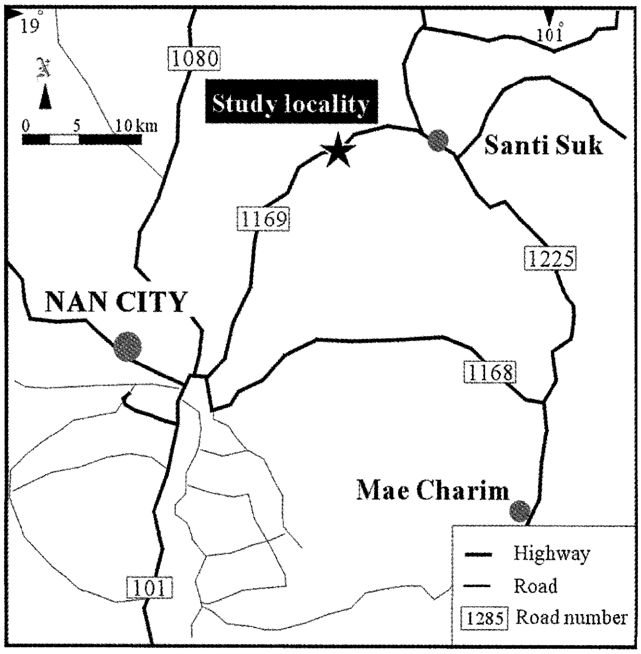


Figure 2. Map showing the locality of the study section along the highway number 1169 in the Nan area, northern Thailand.

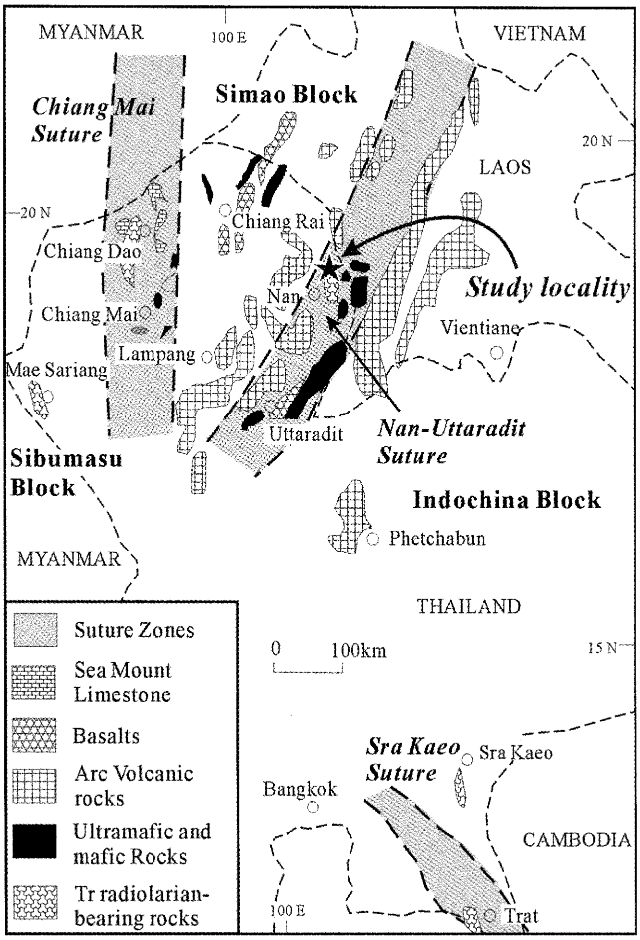


Figure 3. Geological sketch map showing the Chiang Mai, Nan-Uttaradit and Sra Kaeo suture zone of Thailand, the southern part of the Simao Terrane, and the distribution of volcanic arc rocks, basalts, ultramafic and mafic rocks, seamount carbonates in northern Thailand and Triassic radiolarian bearing-rocks in northern and eastern Thailand (from Metcalfe, 2002). The Triassic radiolarian-bearing rocks data are from Caridroit *et al.* (1992), Sashida *et al.* (1993, 1997, 1998, 2000a) and Kamata *et al.* (2002).

genera were discriminated and the palaeogeographic significance of this radiolarian fauna is discussed.

Geologic setting and tectonics of Thailand

It is widely believed that Thailand consists of two allochthonous terranes, namely, the eastern Indochina and western Sibumasu (Shan-Thai) blocks which were separated by the northern Nan-Uttaradit (Nan) and southern Sra (Sa) Kaeo-Chanthaburi suture zones (Bunopas, 1992; Metcalfe, 1999; Hada *et al.*, 1999; Mantajit, 1999, Agematsu *et al.*, 2006). The Sibumasu and Indochina blocks were thought to have formed the outer margin of northern Gondwanaland in the Early Palaeozoic around the palaeoequator. The Indochina block is composed mainly of Precambrian rocks with some Palaeozoic shallow marine faunas and floras probably deposited in a warm climate (Metcalfe, 1986). This block drifted away from Gondwanaland in the Devonian, during the opening of the Palaeo-Tethys ocean. The basement of Sibumasu block consists of high-grade metamorphic rocks, gneiss, and sedimentary rocks of Precambrian age with Late Carboniferous to Early Permian glacial-marine diamictite and Early Permian cool-water fauna (e.g., Bunopas, 1981). The Sibumasu block was removed from Gondwanaland after the Early Permian and collided with the Indochina block in the Late Triassic, after the closing of the Palaeo-Tethys ocean (e.g., Metcalfe, 1999). According to Bunopas (1992), the geological framework of Thailand consists of seven longitudinal stratigraphic belts, which are designated BS-1 to BS-5 (Sibumasu Block) and belts BI-6 to BI-7 (Indochina Block). The investigated area probably is within belt BS-5 along the Nan-Uttaradit suture zone, northern Thailand (Figure 1).

Recently, Metcalfe (2005) proposed the Nan-Uttaradit suture zone in northern Thailand which is representative of the collision between the Simao and Indochina blocks in the Middle to early Late Triassic (Figure 3). The Simao block was first proposed by Wu *et al.* (1995) from SW China. This block has variously been referred to the Lanpin-Simao, Qamdo-Simao blocks of Tibet and the Eastern Qiangtang block (Zhang *et al.*, 2002) or North Qiangtang block (e.g., Jin, 2002). Recently, several authors (e.g. Wang *et al.*, 2000; Ueno and Hisada, 1999; Metcalfe, 2002, 2006; Feng *et al.*, 2005) suggested that the Simao block was separated from the South China block by back-arc spreading in the Early Carboniferous which belongs to the Cathaysian domain. In northern Thailand, the Simao block is bounded to the west by the Chiang Mai suture zone and to the east by the Nan-Uttaradit suture zone (Metcalfe, 2002, 2006) (Figure 3). The basement rocks of the Simao block are buried beneath thick Palaeozoic-Mesozoic sequences (Metcalfe, 2006). In contrast, the collision between the Sibumasu and Indochina blocks is the cause of the Palaeo-Tethys closing in the Late Triassic that led to the development of the Chiang Mai suture (Metcalfe, 2002) or the Chiang Rai Tectonic Line (Ueno and Hisada, 2001) in central northern Thailand and the Sra Kaeo suture zone in eastern Thailand (Metcalfe, 2000, 2002, 2005).

Lithology and lithostratigraphy

The siliceous rock section crops out along Highway No. 1169 about 26 km north of Nan city (100°53′805″ E, 18°55′628″N) (Figure 2). The study section presents strong folding and several faults. Six rock samples were collected (samples number STS 1–6) for radiolarian analysis. This section (about 7 m thick) is composed of a bedded sequence of chert alternating with shale and reddish gray to black siliceous shale (about 3–10 cm thick) (Figures 4 and 5). The complete sequence can not be measured due to soil cover and faults. These rocks are slightly metamorphosed and yielded poorly to moderately preserved Middle Triassic radiolarians. Under microscopic observation, chert is mainly composed of microcrystalline quartz associated with clay minerals and radiolarian tests. These cherts exclude coarse-grained terrigenous materials (larger than clay size). The siliceous shale is composed mainly of clay-sized minerals with siliceous cement, and radiolarian tests. Angular detrital quartz grains are also commonly presented. Recrystallized and deformed radiolarian tests predominate (Figure 6).

Radiolarian fauna and age assignment

Radiolarians obtained from six samples are shown in Figure 5 and most of the identified species are shown in Figure 8. Six samples (STS 1–6) have been collected from the chert and reddish gray to black siliceous shale. They contain a Middle Triassic *Triassocampe deweveri* fauna, which has never been reported in this area. More than fifteen radiolarian species belonging to eight genera were identified, among which the important radiolarian species are *Triassocampe deweveri* (Nakaseko and Nishimura, 1979), *Triassocampe nishimurai* Kozur and Mostler, 1994, *Annulotriassocampe campanilis* Kozur and Mostler, 1994, *Cenosphaera igoi* Sashida, 2000a, and others. This radiolarian fauna resembles that of the *Triassocampe deweveri* Assemblage established by Yao (1982) from the Inuyama area, central Japan. A similar radiolarian fauna is also known to occur in the Trat area, eastern Thailand (Sashida *et al.*, 1997), Saba Yoi, southern Thailand (Sashida *et al.*, 2000b), Mae Sariang

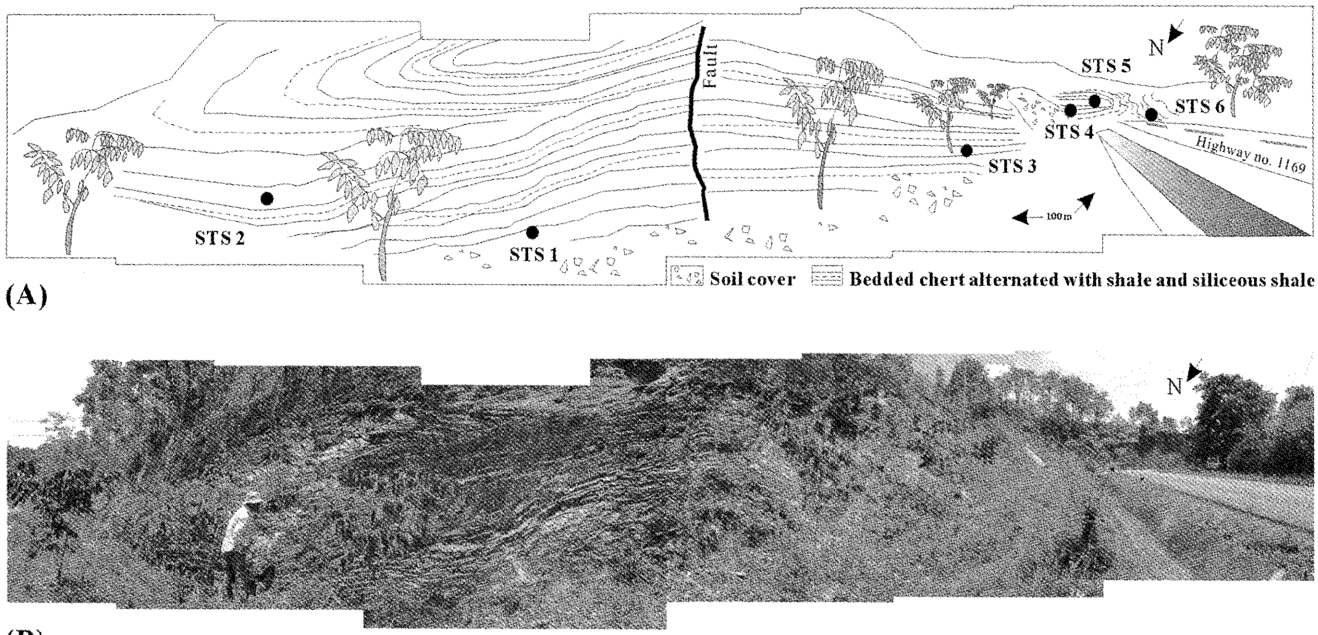


Figure 4. **A**. Sketch of the roadcut outcrop section along the highway 1169, Nan Province, northern Thailand, showing the occurrence of bedded chert alternated with shale and siliceous shale, and sampling points of rock sample STS 1–6. **B**. Outcrop photographs of the studied section.

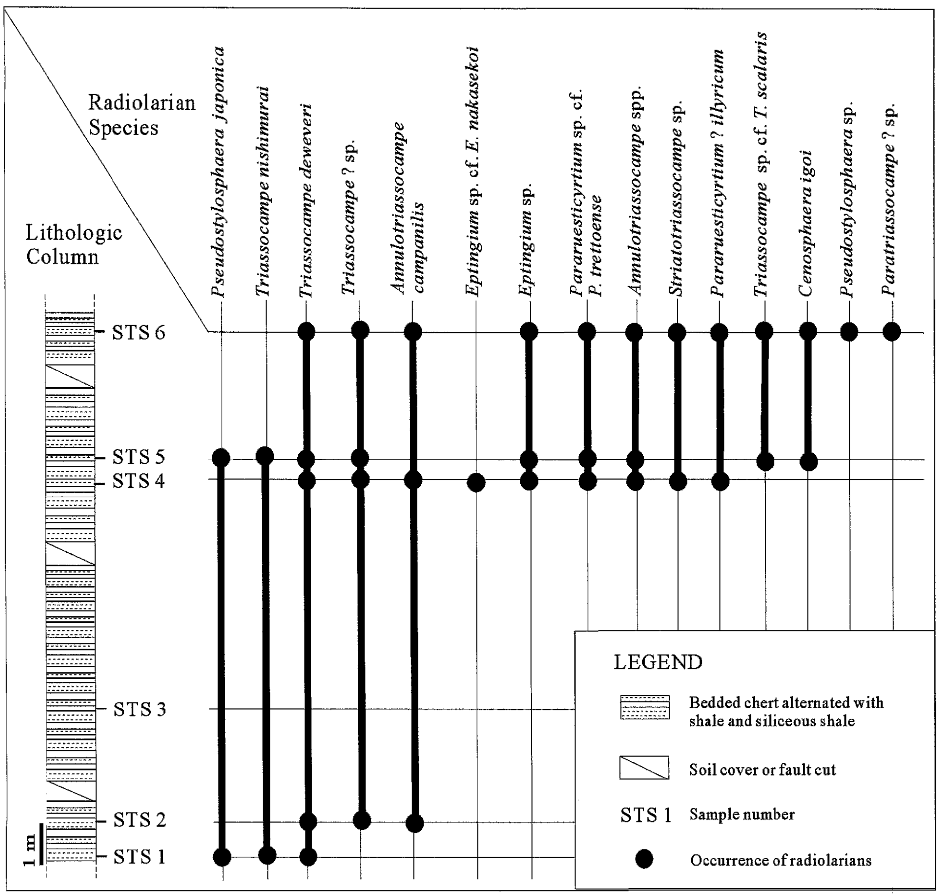


Figure 5. Lithologic column and stratigraphic distribution of radiolarian species of the study section in the Nan area.

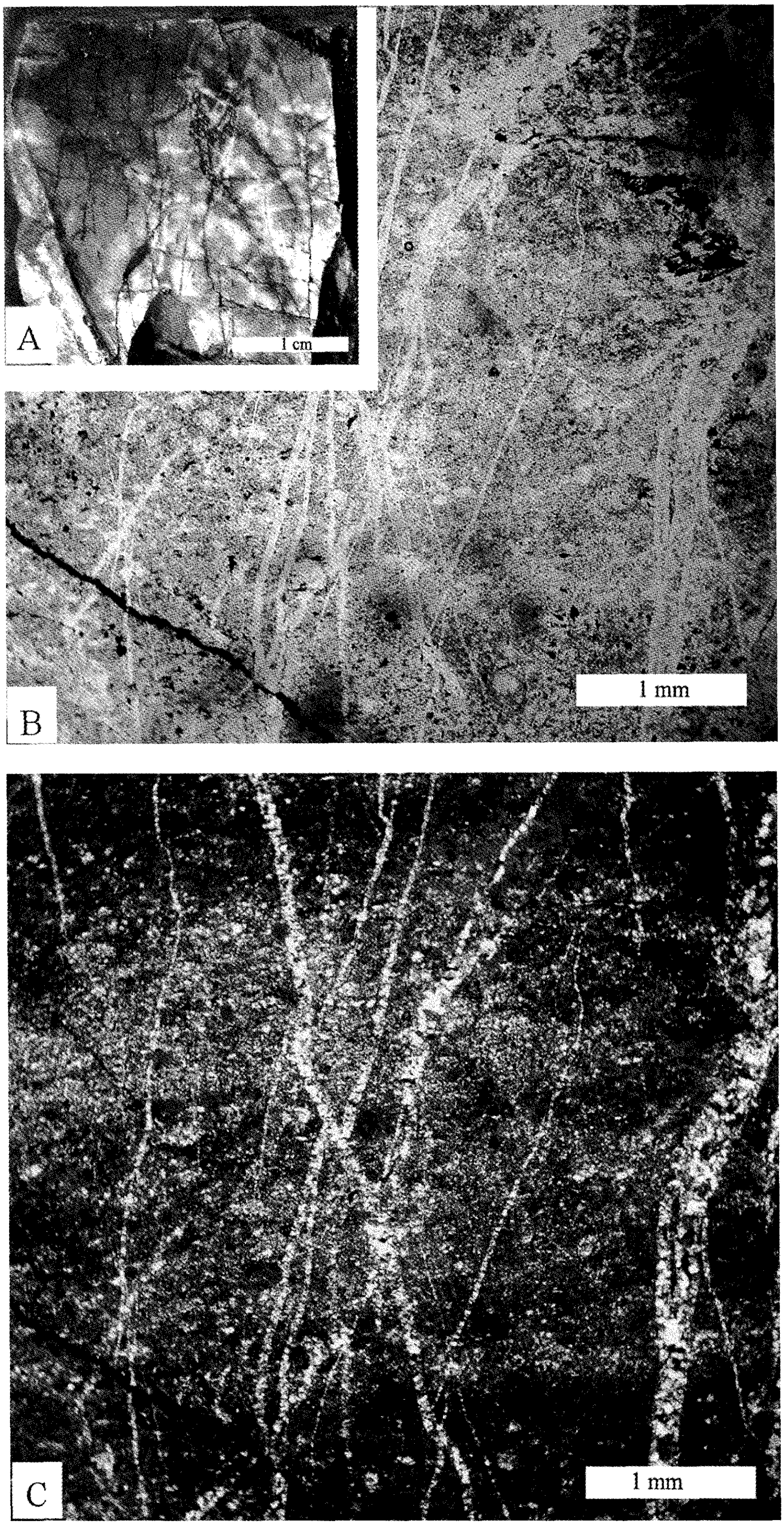


Figure 6. Cut surface **A** and microphotographs (**B** and **C**) of siliceous shale from sample STS 4 showing slightly metamorphosed radiolarians. This rock is composed mainly of clay-sized minerals with siliceous cement, and recrystallized and deformed radiolarian tests. Angular detrital quartz grains and several quartz veins are also commonly presented. **B**. open polars, **C**. crossed polars.

area, western Thailand (Kamata *et al.*, 2002), Mae Sot and Umphang areas, west of northern Thailand (Ishida *et al.* 2006), Fang and Chiang Dao areas, northern Thailand (Caridroit *et al.* 1992; Sashida *et al.*, 1993, 1998), Philippines (Cheng, 1989; Yeh, 1990, 1992), the Far East of Russia (Bragin, 1991), Slovenia (Ramovs and Gorican, 1995), Hungary, Italy and Austria (Kozur and Mostler, 1994). This fauna can be correlated to the TR 2C Zone (*Triassocampe deweveri* Lower-occurrence Zone) by Sugiyama (1997) in central Japan. The age of this radiolarian fauna is considered to be Middle Triassic (Anisian).

Palaeogeographic significance

The Nan area is located along the Nan-Uttaradit suture zone in northern Thailand. This suture zone represents the segment of the back-arc basin which opened in the Carboniferous between the Simao and Indochina blocks in northern Thailand (Ueno and Hisada, 1999; Wang *et al.*, 2000; Metcalfe, 2002, 2005, 2006). It consists of pre-Permian ophiolitic mafic and ultramafic rocks with associated blueschists. Mafic and ultramafic blocks in the mélange comprise ocean-island basalts, back-arc basin basalts and andesites, island-arc basalts and andesites and supra-subduction cumulates generated in Carboniferous to Permo-Triassic times. Permo-Triassic dacites and rhyolites are associated with a relatively unmetamorphosed Lower Triassic sandstone-shale turbidite sequence. Suture zone rocks are overlain unconformably by Jurassic redbeds and post-Triassic intraplate continental basalts (Metcalfe, 2005). However, the biogenic siliceous sediments and sedimentary rocks which are characteristic of a back-arc basin (Marsaglia, 1995) have never been reported from the Nan-Uttaradit suture zone in northern Thailand. Furthermore, the timing of the collision in the Nan-Uttaradit suture has been interpreted by a number of workers as Late Triassic (e.g., Gatinsky *et al.*, 1978; Bunopas, 1981; Hutchision, 1989; Hada *et al.*, 1999; Singharajwarapan and Berry, 2000), Late Permian-Early Triassic (Stauffer, 1974; Metcalfe, 1986), Middle Permian (Helmcke, 1986) and Middle to early Late Triassic (Metcalfe, 2005).

In the last decade, pelagic rocks have been reported from several areas in Thailand, and were regarded as deposited in the Palaeo-Tethys ocean (e.g., Caridroit *et al.*, 1992; Sashida *et al.*, 1993, 1997, 1998, 2000a, 2000b; Kamata *et al.*, 2002; Ishida *et al.*, 2006). In northern Thailand, the occurrence of Devonian to Middle Triassic bedded chert was reported from the "Fang Chert" distributed in the Fang and Chiang Dao areas, north of Chiang Mai province (Caridroit *et al.*, 1992; Sashida *et al.*, 1993, 1998, 2000a). These studies suggested that the well bedded Fang Chert, consisting of a series of chert beds several centimetres thick intercalated with a few millimetres thick siliceous claystone, has been deposited in a pelagic environment far from land areas. This Fang Chert excludes coarse-grained terrigenous material. In contrast, the Triassic chert of the Mae Sariang area, northwestern Thailand seems to differ from the pelagic chert (Fang Chert) in its lithology, namely, its containing numerous rhombus-shaped dolomite grains and calcareous red shale (Kamata *et al.*, 2002). They inferred that the chert of the Mae Sariang area seems to have accumulated on a continental margin and may be the eastern marginal facies of the Sibumasu block. Recently, Ishida *et al.* (2006) also reported a Middle to Late Triassic radiolarian fauna from the Triassic chert sequence and chert clasts in the base conglomerate of the Jurassic from the Mae Sot and Umphang areas, northwestern Thailand. The chert sequence and the siliceous clasts suggest the presence of an ocean before the end-Triassic orogeny along the Mae Sariang zone that amalgamated parts of the Sibumasu block (Ishida *et al.*, 2006). However, the Triassic sequence in easternmost North Thailand, especially along the Nan-Uttaradit suture zone, still lacked Triassic palaeobiogeographic evidence.

As mentioned before, the siliceous rocks from the Nan area along the Nan-Uttaradit suture zone in our study seem to be similar to the pelagic chert from the Fang and Chiang Dao areas (Caridroit *et al.*, 1992; Sashida *et al.*, 1993, 1998, 2000a). Lithologically they seem also to be similar to the pelagic sedimentary rocks from the Mae Sot and Umphang areas (Ishida *et al.*, 2006). Based on their lithostratigraphy, biostratigraphy and tectonic correlation, we consider that these radiolarian-bearing rocks have been deposited within the Nan-Uttaradit back-arc basin between the Siamo and Indochina blocks during the Middle "Triassic." Furthermore, Middle Triassic radiolarian faunas similar to those of the Nan area have also been reported from central Japan (Yao, 1982; Sugiyama, 1997), Philippines (Cheng, 1989; Yeh, 1990, 1992), the Far East of Russia (Bragin, 1991), Slovenia (Ramovs and Gorican, 1995), and Hungary, Italy and Austria (Kozur and Mostler, 1994), of which radiolarian-bearing rocks are thought to have been deposited in the Panthalassa and western Palaeo-Tethys ocean. This may indicate that the Nan-Uttaradit back-arc basin, the Palaeo-Tethys and Panthalassa ocean were probably connected by seaways at this time and shared the same oceanic circulation system (Figure 7). Considering these few data, we can conclude that the closure of the Nan-Uttaradit back-arc basin probably occurred at least after the Middle Triassic time.

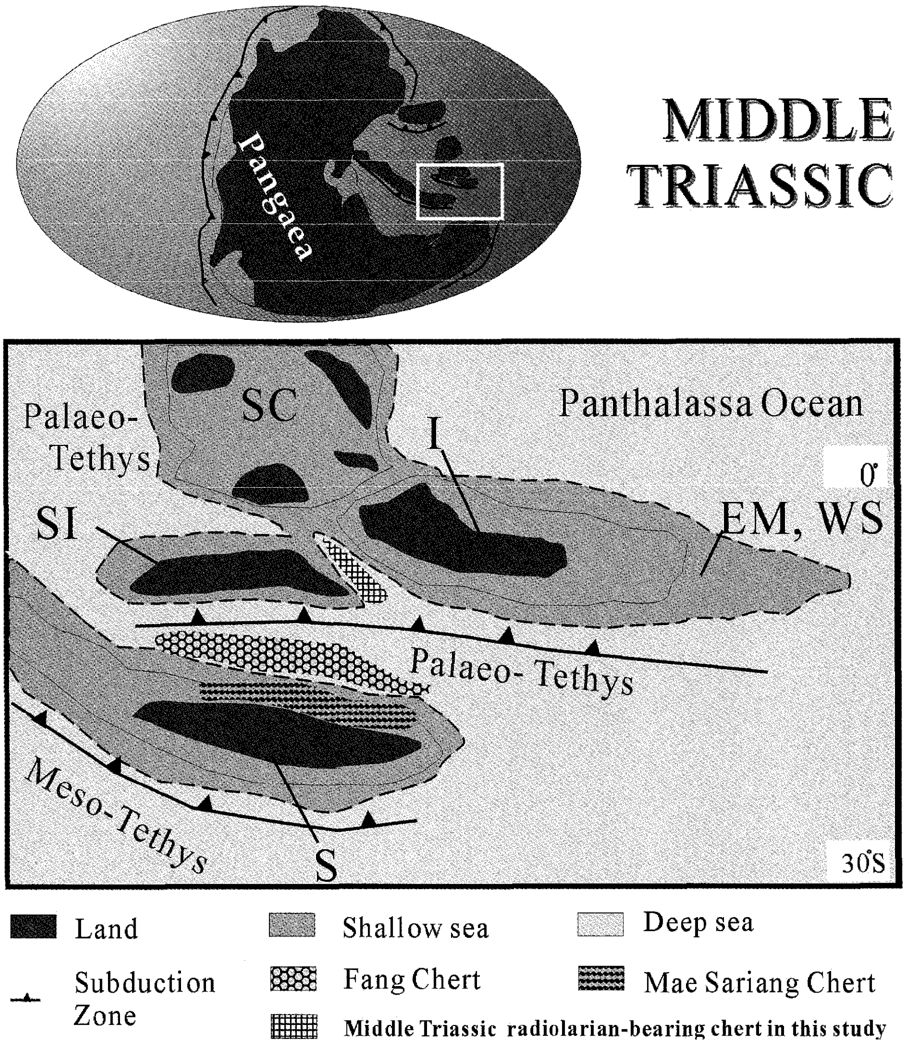


Figure 7. Palaeogeographic reconstruction of the Tethyan region for Middle Triassic showing the postulated positions of the East and South-East Asian terranes, and the distribution of land; the plot approximates the localities of the Fang Chert (Caridroit *et al.* 1992; Sashida *et al.*, 1993, 1998, 2000a), Mae Sariang Chert (Kamata *et al.*, 2002) in the main Palaeo-Tethys ocean and siliceous rock sequence from this study in the Nan-Uttaradit back-arc basin. SC, South China; I, Indochina; SI, Simao; EM, East Malaya; WS, West Sumatra; S, Sibumasu. (Modified from Metcalfe, 2005)

Systematic Palaeontology

Taxonomical framework basically follows De Wever *et al.* (2001). Palaeontological investigation was undertaken by D. Saesaengseerung. The species discussed and listed below are shown in Figure 8.

Class Actinopoda
Subclass Radiolaria Müller, 1858
Superorder Polycystina Ehrenberg, 1838, emend. Riedel, 1967
Order Spumellaria Ehrenberg, 1875, emend. De Wever *et al.*, 2001
Superfamily Actinommidae Haeckel, 1862, emend. Kozur and Mostler, 1979.

Family Pantanellidae Pessagno, 1977
Genus *Cenosphaera* Ehrenberg, 1854

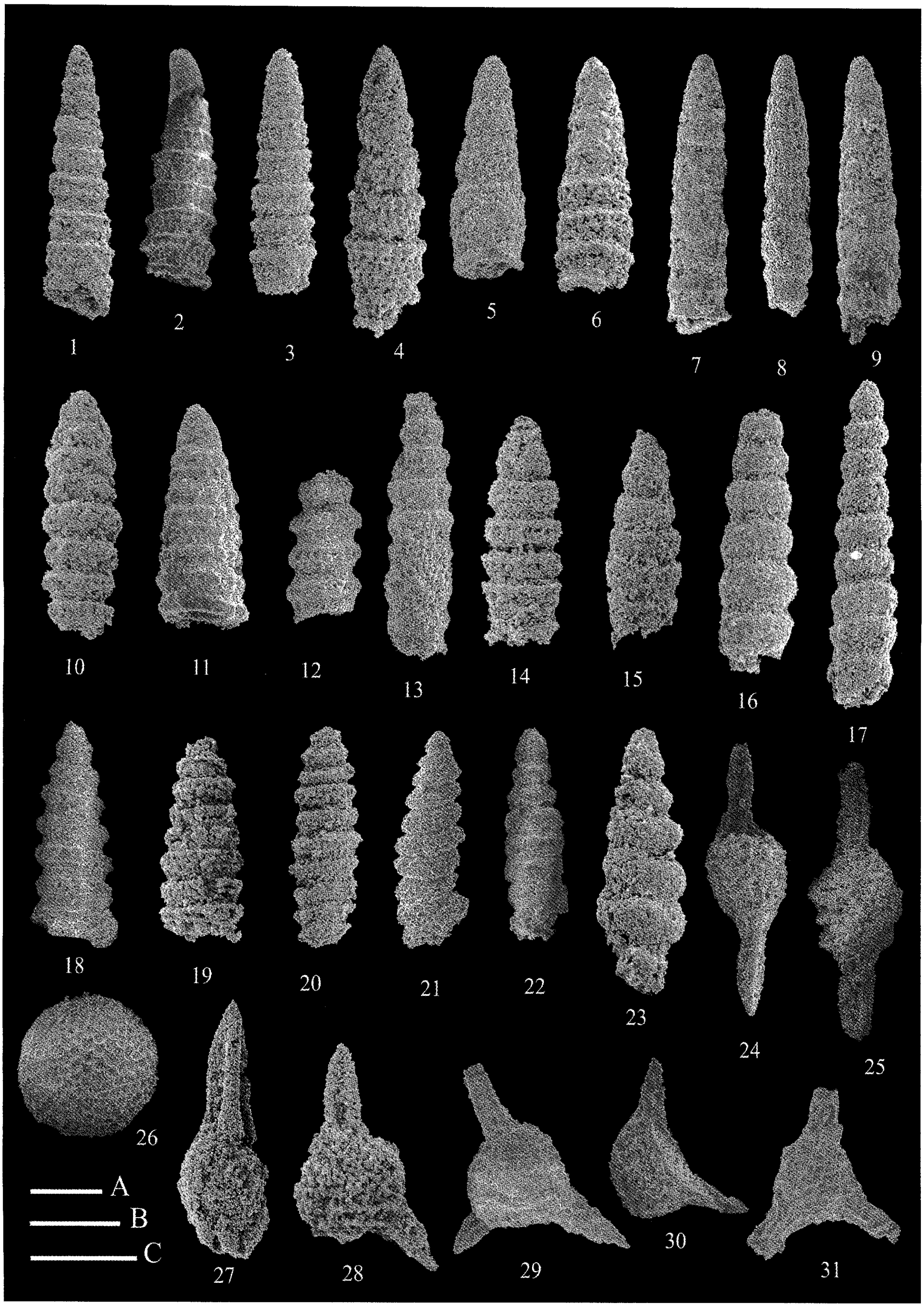
Cenosphaera igoi Sashida, 2000a

Figure 8.26

Cenosphaera igoi Sashida in Sashida *et al.*, 2000a, p. 804, figs. 10.7, 10.8.

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.

Occurrence.—Middle Triassic (Anisian). Northern Thailand.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Order Entactinaria Kozur and Mostler, 1982
Family Eptingiidae Dumitrica, 1978
Genus *Eptingium* Dumitrica, 1978

Eptingium sp. cf. *E. nakasekoi* Kozur and Mostler, 1994

Figures 8.30 and 8.31

cf. *Eptingium nakasekoi* Kozur and Mostler, 1994, p. 43, pl. 1, fig. 5; Ramovs and Grican, 1995, p. 185, pl. 5, figs. 9–10; Sugiyama, 1997, figs. 27.4, 27.5; Kamata *et al.*, 2002, fig. 7M.
Eptingium (?) sp. A, Cheng, 1989, p. 147, pl. 6, fig. 9.

Remarks.—From this species I found several poorly preserved specimens of *Eptingium*. Although their superficial ornamentation is not well visible, some of them seem to be morphologically close to *E. nakasekoi* Kozur and Mostler, having bladed, pointed spines of practically similar length.

Occurrence.—Middle Triassic (Anisian). Northern Thailand.

Eptingium sp.

Figures 8.28 and 8.29

Remarks.— I consider as *Eptingium* sp. several poorly preserved specimens with rounded shell and practically equal, straight, bladed, and pointed spines.

Occurrence.—Middle Triassic (Anisian). Northern Thailand.

Family Hindeosphaeridae Kozur and Mostler, 1981
Genus Psedostylosphaera Kozur and Mostler, 1981

Pseudostylosphaera japonica (Nakaseko and Nishimura, 1979)

Figures 8.24 and 8.25

Archeospongopreunum japonica Nakaseko and Nishimura, 1979, pl. 1, figs. 2, 4, 9.
Pseudostylosphaera japonica (Nakaseko and Nishimura, 1979). Blome *et al.*, 1986, pl. 8, figs. 1, 2; Chang, 1989, p. 143, pl. 6, fig. 1; Yeh, 1989, p. 63, pl. 1, fig. 4; Yeh, 1992, p. 61, pl. 7, figs. 8–10; Kozur *et al.*, 1996, p. 212-213, pl. 6, fig. 15; Kamata *et al.*, 2002, p. 500, fig. 5F.

Remarks.—Although the specimens illustrated are very poorly preserved they could be rather confidently assigned to *P. japonica*, based on having an ellipsoidal shell and spines with pointed ends, thick blades and proximal part slightly constricted.

Occurrence.—Middle Triassic (Anisian). Worldwide.

Pseudostylosphaera sp.

Figure 8.27

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. As for the other spine there is no information because it is completely broken off. This specimen resembles rather well *Pseudostylosphaera.*

Occurrence.—Middle Triassic (Anisian). Northern Thailand.

Suborder Nassellariina Ehrenberg, 1875
Family Ruesticyrtiidae Kozur and Mostler, 1979
(syn.: Triassocampidae Kozur and Mostler, 1981)
(syn.: Xiphothecidae Kozur and Mostler, 1981)
Genus *Annulotriassocampe* Kozur, 1994

Annulotriassocampe campanilis Kozur and Mostler, 1994

Figures 8.12 and 8.13

Annulotriassocampe campanilis Kozur and Mostler, 1994, p. 132, 133, pl. 41, figs. 1–4, 7, 13, 15–18.

Remarks.—The examined specimens are identified as *A. campanilis* Kozur and Mostler (1994) by having diagnostic outline features. Abdominal segments are hooplike, with roundish outer pore frames. The outer pore frames in these segments are vertically elongated. Last segment is subcylindrical, with a proximal ring of

← **Figure 8.** Middle Triassic radiolarians from the Nan area, northern Thailand. All figures are scanning electronic micrographs. **1–3.** *Triassocampe deweveri* (Nakaseko and Nishimura) (1, IGUT-DS6115; 2, IGUT-DS0204; 3, IGUT-DS6127 (scale bar C)). **4.** *Triassocampe* sp. cf. *T. scalaris* Dumitrica, Kozur and Mostler (IGUT-DS61149 (scale bar C)). **5–6.** *Triassocampe* ? sp. (5, IGUT-DS0411; 6, IGUT-DS6118 (scale bar C)). **7–9.** *Striatotriassocampe* sp. (7, IGUT-DS6111; 8, IGUT-DS0419; 8, IGUT-DS0671 (scale bar C)). **10.** *Paratriassocampe* ? sp. (IGUT-DS6120 (scale bar C)). **11.** *Triassocampe nishimurai* Kozur and Mostler (IGUT-DS0602 (scale bar C)). **12–13.** *Annulotriassocampe campanilis* Kozur and Mostler (12, IGUT-DS0414; 13, IGUT-DS0410 (scalc bar C)). **14–20.** *Annulotriassocampe* spp. (14, IGUT-DS0693; 15, IGUT-DS6101; 16, IGUT-DS0626; 17, IGUT-DS0684; 18, IGUT-DS0409; 19, IGUT-DS0669; 20, IGUT-DS0664 (scale bar C)). **21–22.** *Pararuesticyrtium* ? *illyricum* (Kozur and Mostler) (21, IGUT-DS0408; 22, IGUT-DS0618 (scale bar C)). **23.** *Pararuesticyrtium* sp. cf. *P. trettoense* Kozur and Mostler (IGUT-DS0662 (scale bar C)). **24–25.** *Pseudostylosphaera japonica* (Nakaseko and Nishimura) (24, IGUT-DS0111; 25, IGUT-DS0416 (scale bar B)). **26.** *Cenosphaera igoi* Sashida (IGUT-DS0423 (scale bar A)). **27.** *Pseudostylosphaera* sp. (IGUT-DS0645 (scale bar B)). **28–29.** *Eptingium* sp. (28, IGUT-DS0617; 29, IGUT-DS6100 (scale bar A)). **30–31.** *Eptingium* sp. cf. *E. nakasekoi* Kozur and Mostler (30, IGUT-DS0412; 31, IGUT-DS0422 (scale bar A)). Scale bars: A = 50 μm; B and C = 100 μm.

vertically elongated pores followed by pore of irregular shape and arrangement. Tiny apical horn was observed in some examined specimens.

Occurrence.—Middle Triassic (Anisian). Northern Thailand. This species has been reported from late Anisian (Illyrian) and early Ladinian (Fassanian) in the Eurasiatic Tethys.

Annulotriassocampe spp.

Figures 8.14–8.20

Remarks.—The illustrated specimens have hooplike abdominal segments. These unidentified forms rather resemble *Annulotriassocampe* Kozur, 1994, in its general features. However, a precise comparison cannot be made because of the poor preservation.

Occurrence.—Middle Triassic (Anisian). Northern Thailand.

Genus *Pararuesticyrtium* Kozur and Mostler, 1981

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

Figures 8.21 and 8.22

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

Pararuesticyrtium ? *illyricum* (Kozur and Mostler). Kozur and Mostler, 1994, pl. 43, figs. 11, 12, 15, 16.

Remarks.—Although the examined specimens are poorly preserved, they could be assigned to *Pararuesticyrtium* ? *illyricum*, in having the most complete segment display only 2 rings of pores and hooplike segments.

Occurrence.—Middle Triassic (Anisian). Northern Thailand. This species has been reported from late Anisian (Illyrian) and early Ladinian (Fassanian) in Eurasiatic Tethys, and also Carnian in east-central Oregon, U.S.A.

Pararuesticyrtium sp. cf. *P. trettoense* Kozur and Mostler, 1994

Figures 8.23

cf. *Pararuesticyrtium trettoense* Kozur and Mostler, 1994, pl. 43, fig. 14.

Remarks.— Test slender conical, distally subcylindrical and then becoming even narrower. Cephalothorax is dome-shaped, smooth and poreless. Cephalic part of cephalothorax is very small and hemiglobular. Thoracic part is larger and globular. Abdomen and hooplike postabdominal segments are separated by deep grooves which are moderately wide, smooth and poreless strictures. These features are slightly similar to those of *Pararuesticyrtium trettoense* Kozur and Mostler.

Occurrence.—Middle Triassic (Anisian). Northern Thailand.

Genus *Paratriassocampe* Kozur and Mostler, 1994

Paratriassocampe ? sp.

Figure 8.10

Remarks.—Illustrated specimen has a conical test without distal skirt with hooplike postabdominal segments. This species is questionably placed in *Paratriassocampe* by the number and shape of segments.

Occurrence.—Middle Triassic (Anisian). Northern Thailand.

Genus *Striatotriassocampe* Kozur and Mostler, 1994

Striatotriassocampe sp.

Figure 8.7–8.9

Remarks.—Although the striations are not visible because of the poor preservation, the long conical shell and the concave outline of segments support this generic assignation.

Occurrence.—Middle Triassic (Anisian). Northern Thailand.

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

Triassocampe deweveri (Nakaseko and Nishimura, 1979)

Figures 8.1–8.3

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

Triassocampe deweveri (Nakaseko and Nishimura, 1979). Yao, 1982, pl. 1, figs. 1–3; Kozur and 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 and Liu, 1993, p. 547, pl. 3, figs. 1–4; Kozur and Mostler, 1994, p. 140, pl. 42, fig. 1, pl. 44, fig. 14, pl. 45, fig 6; Ramovs and Gorican, 1995, p. 192, pl. 7, figs. 13–14; Sugiyama, 1997, figs. 27–8; Sashida *et al.*, 2000b, p. 91, 93, figs. 8-1–5, 7, 8, 11–13, 22–25, 27, 28; Xia and Zhang, 2000, p.78, pl. 2, figs. 1–5; Feng *et al.*, 2001, p. 182, pl. 3, figs. 1–6; Ishida *et al.*, 2006, fig. 8.17; Onoue and Sano, 2007, fig. 5.

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

Occurrence.—Middle Triassic (Anisian). Northern Thailand. This species has been reported from the Middle Triassic worldwide.

Triassocampe nishimurai Kozur and Mostler, 1994

Figure 8.11

Triassocampe nishimurai Kozur and Mostler, 1994, p. 144, pl. 44, fig. 7, pl. 45, figs. 4, 9–11.

Remarks.—Poorly preserved specimen has a slender and subcylindrical test with long, cylindrical, apically broadly rounded, and large cephalothorax. 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 close. This specimen is compared to *T. nishimurai* Kozur and Mostler, although the distal segments cannot be observed.

Occurrence.—Middle Triassic (Anisian). Northern Thailand. This species has been reported from the Middle Triassic (Anisian) in Hungary.

Triassocampe sp. cf. *T. scalaris* Dumitrica, Kozur and Mostler, 1980

Figure 8.4

cf. *Triassocampe scalaris* Dumitrica, Kozur and Mostler, 1980, pl. 9, figs. 5, 6, pl. 14, fig. 2; Sashida *et al.*, 2000b, p. 93, figs. 8.6, 8.9, 8.14–18, 8.29, 8.30.

Remarks.—Although the illustrated specimen is poorly preserved, it seems to be morphologically close to *T. scalaris* Dumitrica, Kozur and Mostler, having a distinct row of nodes which form a circumferential ridge.

Occurrence.—Middle Triassic (Anisian). Thailand.

Triassocampe ? sp.

Figures 8.5 and 8.6

Remarks.—Examined specimens are characterized by a slender and subcylindrical test without apical horn, with a proximal ring of nodes or a smooth ring. I tentatively include these specimens in the genus *Triassocampe* Dumitrica, Kozur and Mostler based on their diagnostic shell features.

Occurrence.—Middle Triassic (Anisian). Northern Thailand.

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