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# Occurrence of Late Permian radiolarians from the Chituao section, Laibin, Guangxi, China

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**Abstract**

Late Permian (Wujiapingian - early Changxingian) radiolarians were detected from the Chituao section, Laibin, Guangxi, China. The radiolarian assemblages have several species similar to those from Southwest Japan. The radiolarian assemblages are compared to the assemblages of the *Follicucullus charveti* - *Albaillella yamakitai* Zone and the *Neoalbaillella ornithoformis* Zone of Southwest Japan. Correlation of the Upper Permian strata between the Yangzi Platform of South China and the Mino Terrane of Southwest Japan is made by conodont and radiolarian zones. The occurrence of *Follicucullus* aff. *whangaroaensis* from the Chituao section suggests a paleogeographical similarity between the Yangzi Platform of South China and the Waipapa Terrane of New Zealand.

**Key-words** : Late Permian, Wujiapingian, radiolaria, conodont.

## 1. INTRODUCTION

In the last several years, Upper Permian radiolarian and conodont biostratigraphy has progressed in the pelagic sediments of Japan. Kuwahara et al. (1998) confirmed the Upper Permian radiolarian zones in bedded cherts of the Gujo-hachiman section, Mino Terrane, Southwest Japan. Subsequently, Kuwahara (1999) described several species of Late Permian *Albaillella* and proposed their phylogenic lineages in the same section as Kuwahara et al. (1998). Moreover, Yao et al. (2001) recognized six conodont interval zones in the same section and correlated them with both the radiolarian zones and the conodont zones of South China.

On the other hand, Late Permian radiolarians from the Yangzi Platform were reported from many localities as follows: Zhang et al. (1992) from the Dalong Formation, Hushan, Nanjing; Wang (1993) from the Kufeng Formation, Hushan, Nanjing; Yao et al. (1993) from the Dalong and Changxing formations, Guizhou and Guangxi; Yu (1996) from the Wujiaping and Dalong formations, Lekang, Guizhou; Yang et al. (1997) from the Changxing Formation, Changxing, Zhejiang; Yao and Kuwahara (1999a) from the Wujiaping and Dalong formations, Shangsi, Sichuan; Yao and Kuwahara (1999b, 2000) from the Shaiwa Group and Dalong Formation, Ziyun and Luodian, Guizhou; Gao et al. (2001) and Wang and Sheng (2001) from the Shaiwa Group, Ziyun, Guizhou; Sheng et al. (2001) from the Changxing Formation, Liuqiao, Guangxi. As a result of these reports, the radiolarian faunal characters of the platform region have been shown. However, the radiolarian assemblages were almost all reported from the upper Upper Permian (Changxingian). Scarcity of Wujiapingian radiolarian occurrences may be due to the lithological characteristics of the Wujiapingian of South China.

In this study, we report radiolarian fossils from the lower Upper Permian (Wujiapingian) of the Chituao sec-

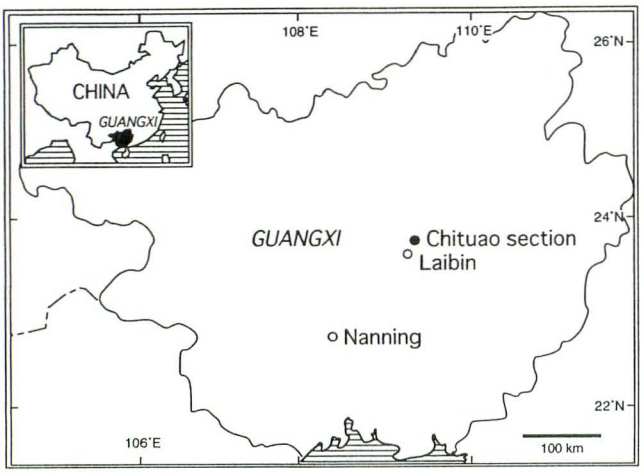


Fig. 1 Index map of the Laibin area.

tion, Laibin area, Guangxi, China (Fig. 1). We correlate the radiolarian assemblages with those of Southwest Japan. Additionally we discuss the paleobiogeographical significance of the radiolarian assemblages.

We use in this paper the spelling for Chinese stage names and platform name, as Wujiapingian, Changxingian and Yangzi, according to the Chinese Pinyin system.

## 2. GEOLOGIC SETTINGS

### 2.1 Geologic settings

The studied area is located in Laibin City, Guangxi Zhuang's Autonomous Region (Figs. 1, 2), belonging tectonically to the southwestern Yangzi Platform. The Upper Paleozoic near Laibin is dominated by marine carbonates with minor cherty and terrigenous clastic intervals. The Middle to Upper Permian comprise the Maokou and the Gufeng formations and the Heshan and the Dalong formations, respectively. In the Laibin area, there is the Penglaitan section, which is a stratotype section for the Lopingian, as mentioned in the later chapter.

### 2.2 Explanation of studied section

The studied section, named as the Chituao section, is located westward of Chituao hamlet, east of Fenghuang Village (Fig. 2). The section crops out along road-cuts with an east-west direction (Fig. 3). The strata consist mainly of gray to black bedded chert and siliceous mudstone, with manganese mudstone layers in the middle part of the section (Fig. 4). It strikes from NS to N20E, and dips about 60-70 degrees to east. The thickness of the section is 158 m. This section was previously considered to the Gufeng Formation. The radiolarians indicate that the section is correlated to the Upper Permian Dalong Formation, as discussed later.

## 3. MATERIALS AND METHODS

Rock samples were collected for radiolarians from 55 horizons at the section, numbered from R1910 (lowermost) to R1964 (uppermost). The interval of each horizon is from 90 cm to 5 m (average 2.4 m), except in the middle part of the section, which includes the manganese layers. The weight of each rock sample is several hundred grams.

Rock samples were immersed in a 5% HF solution for 24 hours. Residues were collected using 35 and 200 mesh sieves. In some samples, only a few radiolarian fossils were obtained by one time HF treatment. To get enough fossils, the same treatment was conducted repeatedly from several times to ten times at the maximum.

Microfossils, including radiolarians, foraminifera, sponge spicules, and ostracoda(?), were obtained from the Chituao section. However, conodonts were not detected. Some foraminifera and sponge spicules occurred sporadically in the lower part of the section (R1910-R1922). In middle part of the section (R1923-

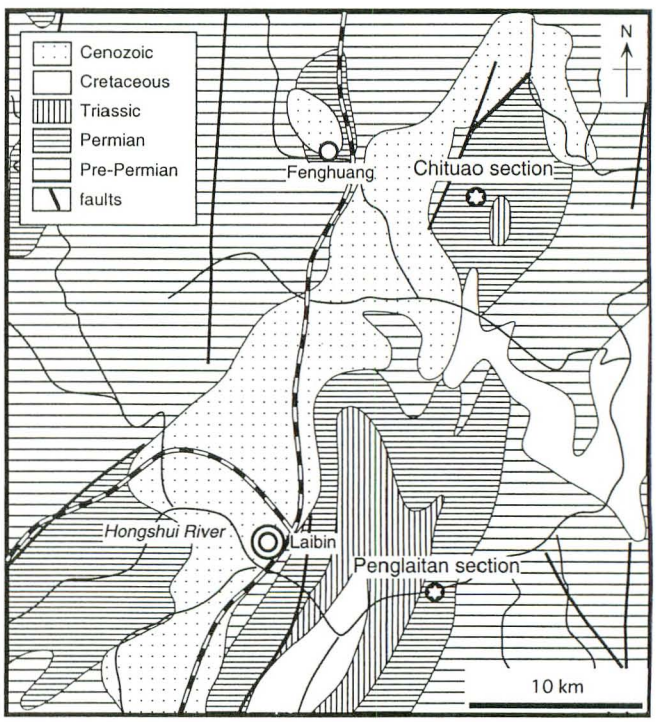


Fig. 2 Geological sketch map of the Laibin area (based on the geologic map by Bureau of Geology and Mineral Resources of Guangxi Zhuang Autonomous Region, 1985) showing the location of the Chituao section.

R1947), radiolarians, foraminifera, sponge spicules, and ostracoda(?) appeared commonly. Especially, moderately preserved radiolarians occurred abundantly from R1935 to R1943. In the upper part of the section (R1948-R1964), sponge spicules increase markedly with small amounts of spherical radiolarian ghosts.

## 4. RADIOLARIAN ASSEMBLAGES

Radiolarian fossils, which can be taxonomically identified, are obtained from 14 samples (Fig. 5, Plates 1-2). Total 47 species are recognized through the section. Up to 28 species are recognized in one sample. The radiolarian assemblage is composed of Albaillellaria, Entactinaria, Latentifistularia and Spumellaria, although the classification of spherical radiolarians is debatable. The stratigraphic distribution of albaillellarians is shown in Fig. 4. *Follicucullus* cf. *bipartitus, Follicucullus* cf. *charveti, Albaillella* cf. *yamakitai, Albaillella* cf. *protolevis* and *Albaillella* sp. G are important species for age determination.

The characteristics of representative samples are described below.

R1923: Sample R1923 includes *Follicucullus* cf. *charveti* and *Follicucullus* cf. *bipartitus*. In spite of ten times HF treatment, we could obtain only one specimen for each species. The specimen, identified as *Follicucullus* cf. *charveti* (Plate 1, fig. 6), shows the bulbous pseudothorax, which is characteristics of *Follicucullus charveti* in a broad sense, although the ventral spine is not preserved. The specimen of *Follicucullus* cf. *bipartitus* (Plate 1, fig.5) is rather poorly preserved, but shows a curved apical cone.

R1924: Though poor in preservation, it includes a few specimens of *Follicucullus* aff. *whangaroaensis*. The form of the shell is similar to *Follicucullus*

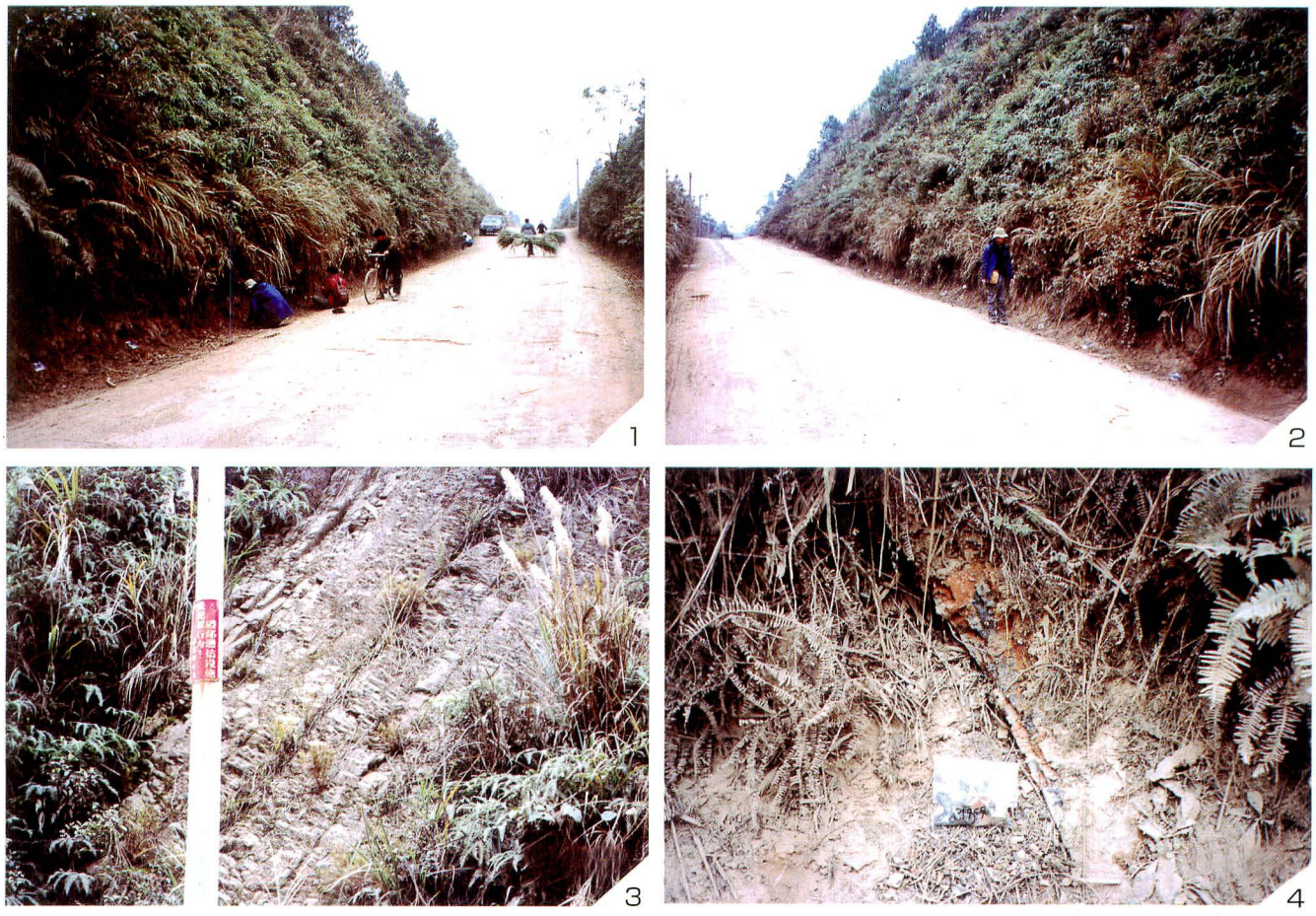


Fig. 3 Photographs of the Chituao section, Laibin, Guangxi, China.
1. Photograph of the lower part of the Chituao section. 2. Photograph of the upper part of the Chituao section. 3. Photograph of the outcrop showing the chert layers of the middle part of the Chituao section. 4. Close-up view of the outcrop showing black chert layer at sample R1959.

*whangaroaensis* but is different as mentioned below. *Follicucullus whangaroaensis* is originally described from a Late Permian limestone lens at Arrow Rocks in the Whangaroa Area within Waipapa Terrane, New Zealand (Takemura et al., 1999). The type specimens have 240-330 μm in length of shell, and have two distinct inflated rings in the lower part. Present specimen from the Chituao section (Plate 1, fig.7), has 430 μm length of shell with no rings in the lower part.

R1937: Moderately preserved radiolarians occurred in R1937. *Follicucullus* spp. are common, but they are often broken. *Albaillella* cf. *yamakitai* is characteristic of this horizon. In the figured specimen of *Albaillella* cf. *yamakitai* (Plate 1, fig. 2), the ventral wing protrudes in the middle part of the shell that resemble *Albaillella yamakitai*. The abundant species are *Foremanhelena triangula, Raciditor scalae*, and Entactinaria? gen. et sp. indet. A with four radial spines.

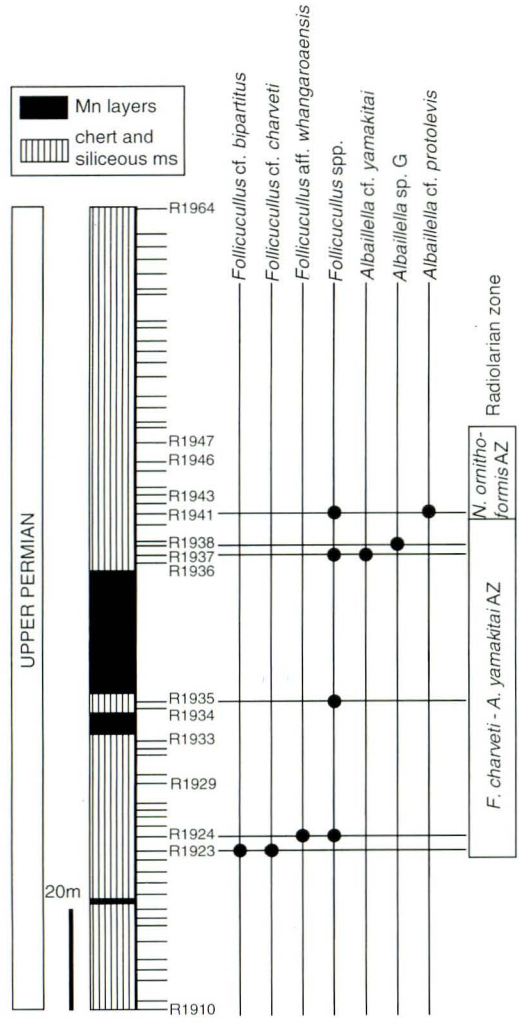


Fig. 4 Column of the Chituao section with sampling horizons and selected radiolarian occurrences.

R1938: The preservation and the abundance of radiolarians are rather good in sample R1938. A lot of *Albaillella* sp. G occur in this horizon. Other common species are *Foremanhelena triangula, Ruzhencevispongus*? sp. A, *Entactinia itsukaichiensis, Hegleria* sp. A, and *Orbiculiforma*? sp. A.

**R1941: One specimen of *Albaillella* cf. *protolevis* occurred in the sample R1941. It shows a smooth shell surface, which is a diagnostic character distinguishing it from *Albaillella yamakitai, Albaillella* sp. G etc. *Latentifistula similicutis*, Latentifistularia gen. et sp. indet. A2, and *Hegleria mammilla* are commonly observed from this sample.**

R1943: The representative of sample R1943 includes *Ishigaum trifustis, Raciditor* cf. *scalae, Copicyntra*? sp. A, *Hegleria* sp. B, *Spongotripus*? sp. A etc. Albaillellarians are not detected from this sample.

Based on these composition, the radiolarian assemblage from R1923 to R1938 is compared to the *Follicucullus charveti-Albaillella yamakitai* Assemblage, and the assemblage of R1941 may be compared to the *Neoalbaillella ornithoformis* Assemblage of SW Japan (Kuwahara et al., 1998), respectively.

## 5. DISCUSSION

### 5.1 Age and correlation

From the middle part of the Chituao section, some Permian radiolarians are extracted. Based on their radiolarian assemblages, middle part of this section is correlated to the *Follicucullus charveti - Albaillella yamakitai* Assemblage Zone, and the *Neoalbaillella ornithoformis* Assemblage Zone (Kuwahara et al., 1998) of Southwest Japan (Fig. 4). Because *Albaillella protolevis* occurs abundantly in the lower part of the *Neoalbaillella ornithoformis* Assemblage Zone (Kuwahara, 1999), the specimen of *Albaillella* cf. *protolevis* herein observed may indicate the lower part of the *Neoalbaillella ornithoformis* Assemblage Zone.

Ishiga and Miyamoto (1986) reported the *Follicucullus bipartitus-Follicucullus charveti* Assemblage from the fusulinacean *Lepidolina kumaensis* Zone of the Kuma Formation, Southwest Japan. The *Lepidolina kumaensis* Zone was settled to the lower part of Wujiapingian (Ishii, 1990). The *Follicucullus bipartitus-Follicucullus charveti* Assemblage Zone of Ishiga (1990) is equivalent to the *Follicucullus charveti - Albaillella yamakitai* Assemblage Zone of Kuwahara et al. (1998), which is considered to correspond to the

| | Plate-Fig. | R1923 | R1924 | R1929 | R1935 | R1936 | R1937 | R1938 | R1939 | R1940 | R1941 | R1942 | R1943 | R1946 | R1947 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALBAILLELLARIA | | | | | | | | | | | | | | | |
| *Albaillella* cf. *protolevis* Kuwahara | 1-1 | | | | | | | | | | X | | | | |
| *Albaillella* cf. *yamakitai* Kuwahara | 1-2 | | | | | | X | | | | | | | | |
| *Albaillella* sp. G of Kuwahara (1999) | 1-3, 4 | | | | | | | X | | | | | | | |
| *Follicucullus* cf. *bipartitus* Caridroit & DeWever | 1-5 | X | | | | | | | | | | | | | |
| *Follicucullus* cf. *charveti* Caridroit & DeWever | 1-6 | X | | | | | | | | | | | | | |
| *Follicucullus* aff. *whangaroaensis* Takemura | 1-7 | | X | | | | | | | | | | | | |
| *Follicucullus* spp. | 1-8, 9, 10 | | X | | X | | X | | | | X | | | | |
| ENTACTINARIA | | | | | | | | | | | | | | | |
| *Copicyntra* ? sp. A | 1-11 | | | | | | X | X | | | | | X | | |
| *Copicyntra* ? sp. A2 | 1-12 | | | | | | | | | | | | X | | |
| *Copicyntra* ? sp. B | 1-13 | | | | | | | X | | | | | | | |
| *Copicyntroides* sp. A | 1-14 | | | | | | X | | | | | | | | |
| *Copiellintra* ? sp. A | 1-15 | | | | | | X | X | | X | | | X | | |
| *Copiellintra* ? sp. B | 1-16 | | | | | | | X | | | | | | | |
| *Entactinia itsukaichiensis* Sashida & Tonishi | 1-17 | | | | | | | X | | X | | | | | |
| *Entactinia* cf. *itsukaichiensis* Sashida & Tonishi | | | | | | | | | | | | | X | | |
| *Entactinosphaera* ? *crassispinosa* Sashida & Tonishi | 1-18 | | | | | | | X | | X | | | | | |
| *Hegleria mammilla* (Sheng & Wang) | 1-19 | | | | | X | | X | | X | X | X | X | | |
| *Hegleria* sp. A | 1-20 | | | X | | | X | X | | | | | | | |
| *Hegleria* sp. B | 1-21 | | | | | | | | | X | | | X | | |
| *Meschedea permica* Sashida & Tonishi | 1-22 | | | | | | | | | | | | X | | |
| *Meschedea* ? sp. A | 1-23 | | | | | | | X | | | | | | | |
| *Triaenosphaera minutus* Sashida & Tonishi | 1-24 | | | | | | | X | | | | | | | |
| Entactinaria? gen. et sp. indet. A | 1-25 | | | | | | X | X | | | | | X | | |
| Entactinaria? gen. et sp. indet. B | 1-26 | | | | | | | X | | | | | | | |
| Entactinaria gen. et sp. indet. C | 1-27 | | | | | | | | | | X | | | | |
| Entactinaria? gen. et sp. indet. D | 1-28 | | | | | | | | | | X | | | | |
| Entactinaria? gen. et sp. indet. E | 1-29 | | | | | | | | | | X | | | | |
| LATENTIFISTULARIA | | | | | | | | | | | | | | | |
| *Foremanhelena triangula* DeWever & Caridroit | 2-1 | | | | | | X | X | | | | | | | |
| *Gustefana obliqueannulata* Kozur | 2-2 | | | | | | | | | | X | | X | | |
| *Gustefana* sp. | 2-3 | | | | | | | | | | X | | | | |
| *Ishigaum trifustis* DeWever & Caridroit | 2-4 | | | | | | X | | | | | | X | | |
| *Latentifistula similicutis* Caridroit & DeWever | 2-5 | | | | | | X | X | | | X | | | | |
| *Latentifistula* ? sp. A | 2-6 | | | | | | X | X | | | | | X | | |
| *Latentifistula* sp. B | 2-7 | | | | | | | X | | | | | X | | |
| *Latentifistula* sp. C | 2-8 | | | | | | | X | | | | | | | |
| *Latentifistula* sp. D | 2-9 | | | | | | | X | | | | | | | |
| *Ormistonella robusta* DeWever & Caridroit | 2-10 | | | | | | | X | | | | | | | |
| *Raciditor gracilis* (DeWever & Caridroit) | 2-11 | | | | | | | X | | X | X | | X | | |
| *Raciditor inflata* (Sashida & Tonishi) | 2-12 | | | | | | | | | X | X | | | | |
| *Raciditor* cf. *inflata* (Sashida & Tonishi) | | | | | | | | X | | | | | | | |
| *Raciditor* cf. *scalae* (Caridroit & DeWever) | 2-13 | | | | | X | X | X | X | X | | | X | X | X |
| *Ruzhencevispongus* ? sp. A | 2-14 | | | | | | | X | | | | | | | |
| *Tormentum* sp. A | 2-15 | | | | | | X | | | | | | | | |
| Latentifistularia? gen. et sp. indet. A | 2-16 | | | | | | X | | | | X | | | | |
| Latentifistularia? gen. et sp. indet. A2 | 2-17 | | | | | | | | | | X | | | | |
| Latentifistularia? gen. et sp. indet. B | 2-18 | | | | | | | X | | | | | | | |
| Latentifistularia? gen. et sp. indet. C | 2-19 | | | | | | | X | | | | | | | |
| SPUMELLARIA | | | | | | | | | | | | | | | |
| *Grandetortura* ? sp. A | 2-20 | | | | | | | X | | | | | | | |
| *Orbiculiforma* ? sp. A | 2-21 | | | | | | | X | | | | | | | |
| *Spongotripus* ? sp. A | 2-22 | | | | | | | | X | | | | X | | |
| Spumellaria gen. et sp. indet. A | 2-23 | | | | | | X | | | | | | | | |
| Total number of species | | 2 | 2 | 1 | 1 | 2 | 15 | 28 | 2 | 8 | 13 | 1 | 15 | 1 | 1 |

Fig. 5 Occurrences of radiolarians in the Chituao section.

| | | South China Conodont zone (Mei and Shi, 1999) | SW Japan Conodont zone (Yao et al., 2001) | SW Japan Radiolarian zone (Kuwahara et al., 1998) | This study |
|---|---|---|---|---|---|
| UPPER PERMIAN | Lower-Middle Changxingian | *Clarkina changxingensis* | *Clarkina parasubcarinata* | *Neoalbaillella optima* | |
| | | *C. subcarinata -C. wangi* | *C. subcarinata* | *Neoalbaillella ornithoformis* | *Neoalbaillella ornithoformis* |
| | Middle-Upper Wujiapingian | *C. inflecta* | *C. orientalis* | *Follicuculls charveti -Albaillella yamakitai* | *Follicuculls charveti -Albaillella yamakitai* |
| | | *C. orientalis* | | | |
| | | *C. transcaucasia* | *C. liangshanensis* | *Follicuculls scholasticus -F. ventricosus* | |

Fig. 6 Correlation of radiolarian and conodont zones in the Upper Permian.

Wujiapingian.

The correlation between radiolarian zones and conodont zones was made by Yao et al. (2001) in the Gujo-hachiman section, Mino Terrane, Southwest Japan. The *Follicucullus charveti - Albaillella yamakitai* Assemblage Zone is correlated to the *Clarkina liangshanensis* and *Clarkina orientalis* conodont zones. The *Neoalbaillella ornithoformis* Assemblage Zone roughly corresponds to the *Clarkina subcarinata* Zone. These conodont zones were correlated to those of South China also. Therefore, Chinese conodont zones and Japanese radiolarian zones can be correlatable (Fig. 6).

On the basis of the above-mentioned correlation between the radiolarian and conodont zones, the age of the *Follicucullus charveti - Albaillella yamakitai* Assemblage Zone is late Wujiapingian. The age of the *Neoalbaillella ornithoformis* Assemblage Zone is latest Wujiapingian? to early Changxingian.

The Chituao section was previously considered to the Gufeng Formation of Middle Permian age. This study indicates that the Chituao section is the Upper Permian. Based on their geologic age, the Chituao section could be correlated to the Dalong Formation, apart from the Gufeng Formation.

According to Jin et al. (1998), the Maokou and the Heshan formations crop out at the Penglaitan section near Laibin (Fig. 2). These strata have been well investigated as the stratotype section for the Lopingian. The Upper Permian Heshan Formation, 150 m in thickness, is composed of limestone, chert and mudstone. The Chituao section should not be assigned to the Heshan Formation lithologically irrespective of the same age.

### 5.2 Paleogeographic view and further problems

The radiolarian assemblage from the Chituao section includes *Follicucullus* aff. *whangaroaensis*. *Follicucullus whangaroaensis* occurs abundantly from a limestone lens at the Arrow Rocks in the Waipapa Terrane, New Zealand, but it has not yet been found from Japan. However, the specimen of *Follicucullus* aff. *whangaroaensis* from the Chituao section shows some morphologic difference compared with the type specimen of *Follicucullus whangaroaensis* as mentioned before, although the similar shell form may give paleogeographic implications.

In the paleogeographic reconstruction during late Permian time, the Yangzi Platform was located at the low latitude area between Paleo-Tethys and Panthalassa (e.g., Wu, 1999). The Permian in the Waipapa Terrane, New Zealand, containing *Follicucullus whangaroaensis*, is considered to originate in a low-latitude area (Takemura et al., 1999). On the other hand, *Follicucullus whangaroaensis* has not been found from the Upper Permian chert facies of the Mino Terrane of Southwest Japan. It is considered that these Japanese Permian of the Mino Terrane was originally deposited in the low-latitude area in the Panthalassa. So this *Follicucullus whangaroaensis* could be a key to suggest paleogeographical differences between Paleo-Tethys and Panthalassa within the same low-latitude area.

It is remarked that the studied radiolarian assemblages are generally compared to the Japanese Late Permian radiolarian assemblages as illustrated by Kuwahara and Yao (2001). However, the studied radiolarian assemblages comprise only of several to 28 species at the maximum per one sample. This specific number is rather small, compared with those from the chert sample of Southwest Japan, which ordinarily includes about 100 species. The difference in specific number could be merely due to the difference in fossil

preservation, but there is some possibility that it reflects the original faunal difference between the Yangzi Platform and Southwest Japan.

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Plate 1. Scanning photomicrographs of Late Permian radiolarians from the Chituao section, Laibin, Guangxi, China.

Fig. 1. *Albaillella* cf. *protolevis* Kuwahara, from R1941
Fig. 2. *Albaillella* cf. *yamakitai* Kuwahara, from R1937
Fig. 3. *Albaillella* sp. G of Kuwahara (1999), from R1938
Fig. 4. *Albaillella* sp. G of Kuwahara (1999), from R1938
Fig. 5. *Follicucullus* cf. *bipartitus* Caridroit & DeWever, from R1923
Fig. 6. *Follicucullus* cf. *charveti* Caridroit & DeWever, from R1923
Fig. 7. *Follicucullus* aff. *whangaroaensis* Takemura, from R1924
Fig. 8. *Follicucullus* sp., from R1937
Fig. 9. *Follicucullus* sp., from R1937
Fig. 10. *Follicucullus* sp., from R1941
Fig. 11. *Copicyntra*? sp. A, from R1938
Fig. 12. *Copicyntra*? sp. A2, from R1943
Fig. 13. *Copicyntra*? sp. B, from R1938
Fig. 14. *Copicyntroides* sp. A, from R1937
Fig. 15. *Copiellintra*? sp. A, from R1943
Fig. 16. *Copiellintra*? sp. B, from R1938
Fig. 17. *Entactinia itsukaichiensis* Sashida & Tonishi, from R1938
Fig. 18. *Entactinosphaera*? *crassispinosa* Sashida & Tonishi, from R1938
Fig. 19. *Hegleria mammilla* (Sheng & Wang), from R1943
Fig. 20. *Hegleria* sp. A, from R1938
Fig. 21. *Hegleria* sp. B, from R1943
Fig. 22. *Meschedea permica* Sashida & Tonishi, from R1943
Fig. 23. *Meschedea*? sp. A, from R1938
Fig. 24. *Triaenosphaera minutus* Sashida & Tonishi, from R1938
Fig. 25. Entactinaria? gen. et sp. indet. A, from R1943
Fig. 26. Entactinaria? gen. et sp. indet. B, from R1938
Fig. 27. Entactinaria gen. et sp. indet. C, from R1941
Fig. 28. Entactinaria? gen. et sp. indet. D, from R1941
Fig. 29. Entactinaria? gen. et sp. indet. E, from R1941

Plate 1

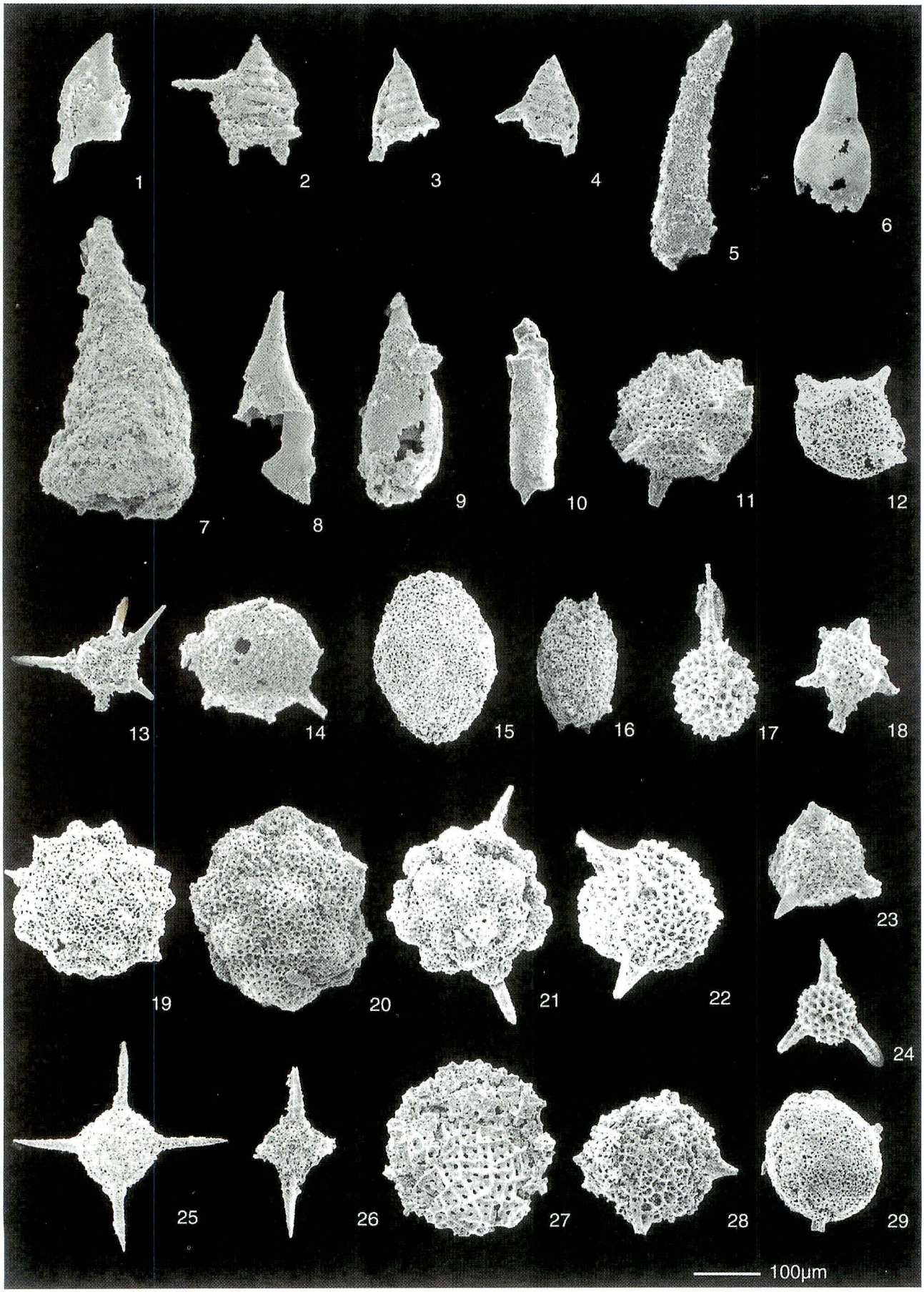
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Plate 2. Scanning photomicrographs of Late Permian radiolarians from the Chituao section, Laibin, Guangxi, China.

Fig. 1. *Foremanhelena triangula* DeWever & Caridroit, from R1937
Fig. 2. *Gustefana obliqueannulata* Kozur, from R1941
Fig. 3. *Gustefana* sp., from R1941
Fig. 4. *Ishigaum trifustis* DeWever & Caridroit, from R1943
Fig. 5. *Latentifistula similicutis* Caridroit & DeWever, from R1941
Fig. 6. *Latentifistula*? sp. A, from R1937
Fig. 7. *Latentifistula* sp. B, from R1943
Fig. 8. *Latentifistula* sp. C, from R1938
Fig. 9. *Latentifistula* sp. D, from R1938
Fig. 10. *Ormistonella robusta* DeWever & Caridroit, from R1938
Fig. 11. *Raciditor gracilis* (DeWever & Caridroit), from R1943
Fig. 12. *Raciditor inflata* (Sashida & Tonishi), from R1941
Fig. 13. *Raciditor* cf. *scalae* (Caridroit & DeWever), from R1938
Fig. 14. *Ruzhencevispongus*? sp. A, from R1938
Fig. 15. *Tormentum* sp. A, from R1937
Fig. 16. Latentifistularia? gen. et sp. indet. A, from R1937
Fig. 17. Latentifistularia? gen. et sp. indet. A2, from R1941
Fig. 18. Latentifistularia? gen. et sp. indet. B, from R1938
Fig. 19. Latentifistularia? gen. et sp. indet. C, from R1938
Fig. 20. *Grandetortura*? sp. A, from R1938
Fig. 21. *Orbiculiforma*? sp. A, from R1938
Fig. 22. *Spongotripus*? sp. A, from R1943
Fig. 23. Spumellaria gen. et sp. indet. A, from R1937

Plate 2