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NEW LATEST PERMIAN FORAMINIFERS FROM LAREN (GUANGXI PROVINCE, SOUTH CHINA): PALAEOBIOGEOGRAPHIC IMPLICATIONS

NOUVEAUX FORAMINIFERES DU PERMIEN TERMINAL DE LAREN (PROVINCE DE GUANGXI, CHINE DU SUD) : IMPLICATIONS PALEOBIOGEOGRAPHIQUES

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Abstract

Microfacies analyses performed on the latest Permian Wujiaping Formation at Laren (Guangxi Province, South China) show that the bioclastic-rich limestones of Late Permian age contains a rich and well-diversified foraminiferal fauna. This fauna is here revised in order to be compared with time-equivalent levels of southern Iran and southern Turkey. Some new and unexpected phylogenetic trends are highlighted among the biseriamminoids. The new or poorly known genera *Retroseptellina*, *Septoglobivalvulina*, *Paraglobivalvulinoides*, *Dagmarita*?, *Bidagmarita* nov. gen., *Louisettita*, *Paradagmaritopsis* nov. gen. and *Paradagmarita*? are concerned. Nevertheless, these newly appeared biseriamminoids are subordinate to abundant *Tetrataxis* and *Climacammina*, ultimate survivors of the families Palaeotextulariidae and Tetrataxidae, appeared as old as the Early Carboniferous ("Mississippian"). Algae, miliolids, and nodosarioids are poorly represented. Two genera and four species are here newly described: *Globivalvulina curiosa* nov. sp., *Louisettita ultima* nov.

sp., *Bidagmarita* nov. gen., *Bidagmarita sinica* nov. gen. nov. sp., *Paradagmaritopsis* nov. gen., *Paradagmaritopsis kobayashii* nov. gen. nov. sp. The palaeogeographic distribution of these foraminifers is interpreted to be typically of Neo-Tethyan regions, ranging from southern Turkey (Hazro) to South China (Laren) and up to Japan for some species (i.e., *Paradagmaritopsis*).

At Laren, Late Permian strata are generally characterized by *Reichelina* ex gr. *simplex* Sheng, 1956. Isolated samples of packstones, collected in Tsoteng region (Guangxi Province, South China), contain *Sphaerulina* sp. together with various smaller foraminifers and numerous representatives of the new species *Globivalvulina curiosa* nov. sp. In this study we demonstrate that the regions of Zagros (Iran), Taurus (Turkey), South China and even Japan shared similar foraminiferal assemblages and represented intermittently connected palaeobiogeographic provinces during Late Permian times.

Résumé

Dans la région de Laren (Province du Guangxi, Chine du Sud), des microfaciès calcaires bioclastiques renferment jusqu'à la limite Permo-triasique (PTB), de riches faunes de foraminifères. Elles sont révisées taxonomiquement afin d'être comparées aux éléments des associations du Sud de l'Iran et du Sud de la Turquie. Des tendances évolutives insoupçonnées se révèlent, surtout parmi les bisériamminoïdes, avec des genres nouveaux ou peu connus : *Retroseptellina*, *Septoglobivalvulina*, *Paraglobivalvulinoides*, *Bidagmarita* nov. gen., *Louisettita*, *Paradagmaritopsis* nov. gen. et *Paradagmarita*? Ces taxons inhabituels sont cependant subordonnés à d'abondants survivants d'autres superfamilles (Palaeotextularioidea and Tetrataxoidea) apparues dès le Carbonifère inférieur ("Mississippien"), tels que *Tetrataxis* et *Climacammina*. Algues, miliolides, et nodosarioïdes sont peu représentés. Six taxons sont décrits: *Globivalvulina curiosa* nov. sp., *Louisettita ultima* nov. sp., *Bidagmarita* nov. gen., *Bidagmarita sinica* nov. gen. nov. sp., *Paradagmaritopsis* nov. gen., *Paradagmaritopsis kobayashii* nov. gen. nov. sp. La répartition paléogéographique de ces foraminifères est typiquement néo-thysienne, du Sud de la Turquie (Hazro) au Sud de la Chine, voire jusqu'au Japon avec *Paradagmaritopsis*. Des échantillons isolés de packstones collectés dans une autre région (Tsoteng, Province du Guangxi, Chine du Sud) contiennent *Sphaerulina* sp. ainsi que de petits foraminifères variés et de nombreux spécimens d'une espèce nouvelle *Globivalvulina curiosa* nov. sp.

Dans cette étude il est démontré qu'au cours du Permien supérieur, le Zagros (Iran), le Taurus (Turquie), la Chine du Sud (bassin de Nanpanjiang) et même le Japon partagent des associations de foraminifères similaires et que ces diverses provinces paléobiogéographiques étaient périodiquement interconnectées.

Keywords: Foraminifers; Biseriamminoids; Systematics; New taxa; Late Changhsingian; Upper Permian; South China

Mots clés : Foraminifères ; Bisériamminoïdes ; Systématique ; Nouveaux taxons ; Changhsingien supérieur ; Permien supérieur ; Chine du Sud

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1. Introduction

Traditionally, Late Permian (Lopingian) microfossils are considered as tenacious survivors, between two severe biotic crises: end-Middle Permian and, then, the worst, end-Permian crisis, where the life has almost disappered from the earth. According to Loeblich and Tappan (1987), only 15 fusuline genera in the super-families Schubertelloidea and Staffelloidea persisted within Lopingian times, between the two crises. Additional 23 to 25 non-fusuline genera (i.e., Biseriamminoidea, Endothyroidea, Tetrataxidoidea, Palaeotextulariioidea, and Lasiodiscoidea) are known from Wuchiapingian to Changhsingian rocks, respectively. In this time interval, at least 35 genera of lagenids are also recognised. Among them, e.g., *Geinitzina*, *Pachyphloia*, *Nodosinelloides*, *Protonodosaria* and *Robuloides* are especially widespread. Dasycladals are very few, less than 10 genera (see compilation in Granier and Grgasovic, 2000). Only bioaccumulations of *Permocalculus* or *Gymnocodium* can be emphasized (e.g., Théry et al., 2007).

Recently, the knowledge of the Late Permian foraminifers and calcareous algae was improved by different works concerning the Khuff Formation (Late Middle Permian to Early Triassic) in the Middle East (Vaslet et al., 2005; Vachard et al., 2005; Insalaco et al., 2006; Gaillot, 2006; Vachard et al., 2006; Gaillot and Vachard, submitted). Many new taxa are illustrated and/or described within these contributions.

The Permian-Triassic Khuff Formation, our initial reference, has been defined by Steineke et al. (1958) near the town of Khuff in central Saudi Arabia. This formation, about 190 m thick, is essentially made of carbonates and evaporites, and less of clastics. It rests over the massive sandstones of the Saq Formation upon a major unconformity (the Pre-Khuff Unconformity) and is conformably overlay by the clayely and evaporitic lower Triassic (“Scythian”) Sudair Shale Formation. The Khuff Formation represents a complete Lopingian (Late Permian) succession (Vaslet et al. 2005; Vachard et al. 2005; Gaillot, 2006).

The Khuff depositional system developed on the margin of the Neo-Tethyan Ocean, separating the Gondwana supercontinent from the Gondwanan terranes (Cimmerian megablock). The general palaeogeographic context of this system was a marginal marine shelf setting with an inner platform that was very flat, ramp-like, but with local depressions (Sharland et al. 2001; Insalaco et al. 2006).

Comprehensive investigations recently undertaken in the Nanpanjiang Basin (South China) revealed a rich and new Late Permian foraminiferal-algal association. The discovery, description and revision of some new and/or stratigraphically and palaeogeographically significant taxa are related, identifying the main markers for the latest Permian in South China. Among the foraminifers, the group of Biseriamminoidea was the most important and highly diversified, because the disappearance of the neoschwagerinid, verbeekinid and schwagerinid fusulines at the end-Capitanian,

In South China as well as elsewhere in the Tethys, and especially in western Neo-Tethys, the shallow depositional settings of the Lopingian (including Wuchiapingian and Changhsingian) are generally characterized by abundant Globivalvulinidae (family including Paradagmaritininae and Globivalvulininae). The representatives of this family are considered as available proxies to identify semi-restricted environments.

During the Lopingian times, the representatives of the order Lagenida, also present in our associations, have been regarded as indicative of inner to middle neritic environments throughout the Tethyan domain and northern higher latitudes (Gaillot, 2006). The robust biostratigraphic framework based on the detailed description of foraminifers and algae as well as on the distribution of key-taxa allows us to propose new palaeobiogeographic implications for the Late Permian.

The first aim of this work is to describe the microfacies and the microfossil content of the latest Permian calcisponges-bearing reef limestones of the Wujiaping Formation from Laren (Guangxi Province, South China). The second topic aims to compare the biotic content from this section, with the “Khuff Formation” *sensu lato* time equivalents in the Middle East. This aspect, together with the terrestrial Cathaysian flora from Iran, suggest direct connections between Zagros (southern Iran) and south China during several epochs, and westward movement of the South China Block.

2. **The Nanpanjiang Basin and section location**

The Yangtze carbonate platform of South China constituted a stable palaeogeographic component from Late Proterozoic to the end of Middle Triassic with deposition of shallow-water carbonates during most of this time (Enos et al., 1998). Middle and Late Permian reef limestones are widely distributed and well preserved in eastern Yunnan, southwestern Guizhou and northwestern Guangxi (Sheng et al., 1985; Rigby et al., 1989 a, b; Fan et al., 1990).

The southern margin of the Yangtze platform was embayed by the Nanpanjiang Basin (see Lehrmann et al., 1998 for a description of this basin) which was widely opened and extended into central Guizhou and northwestern Guangxi. Dominant deep-water deposits surrounded various carbonate platforms dispersed within the basin (Fig. 1). The Laren section (NW Guangxi, Fengshan District), the main locality on which this study focuses, lies on the margin of one of these isolated platforms.

The Laren profile illustrates an excellent outcrop straddling the Permo-Triassic boundary (Galfetti et al., 2007). The Upper Permian beds, mainly characterized by shallow-water reef limestones, are of about 20 m-thick in the measured section. They are drastically overlain by a ~7.5 m-thick unit of calcimicrobial limestones of earliest Triassic age (Griesbachian) (Fig. 2).

The very rich and biostratigraphically significant foraminiferal assemblage found within the beds just before the Permian-Triassic boundary allows attributing a late Changhsingian age, while the precise age of the microbial limestone immediately above the boundary is indeterminable because of nearly total absence of index fossils.

In order to compare the foraminiferal associations of Laren with those of coeval limestones, we also collected two samples in the Tsoteng area, located ~80 km south of Laren (Fig. 1). At this locality the uppermost Permian Heshan Formation is mainly composed of massive and thick-bedded bioclastic-rich limestones deposited in shallow-water settings.

3. Facies and microfacies

Late Permian rocks are generally very massive, dark-coloured and frequently accompanied by centimetric to decimetric black chert concretions. At Laren these beds display an extraordinary, well preserved faunal assemblage (e.g., brachiopods, gastropods, rugose corals, very large calcareous algae and calcareous porifera) (Fig. 3). Geometrical orientation of fossils has not been observed excepting for a sphinctozoan colony which illustrates a planar setting (Fig. 3a).

Microfacies analysis on thin sections (Fig. 4) revealed that these skeletal, peloidal grainstones are mainly associated with: rare gastropods, rare incertae sedis *Tubiphytes* (non *Shamovella*) *obscurus* Maslov, 1956, *Ramovsia*? sp., *Donezella* sp., *Radiosphaerina*? sp., *Asterosphaera* cf. *pulchra* Reitlinger 1957 and *Asterosphaera* sp., rare fusulinids *Nankinella* cf. *inflata* (Colani, 1924) emend. Sheng, 1963 and *Reichelina simplex* Sheng, 1956, in addition to abundant and diversified smaller foraminifers, especially biseriamminids. The following taxa are recognized: *Eotuberitina spinosa* (Lys in Lys et al., 1980); *Postendothyra micula* (Sosnina in Sosnina and Nikitina, 1977); *Globivalvulina curiosa* Gaillot and Vachard nov. sp.; *G. kantharensis* Reichel, 1946; *G. vonderschmitti* Reichel, 1946; *G. bulloides* (Brady, 1876); *Septoglobivalvulina distensa* (Wang in Zhao et al., 1981); *S.* cf. *guangxiensis* Lin, 1978; *S.* sp. 1; *Dagmarita chanakchiensis* Reitlinger 1965; *D. altilis* Wang in Zhao et al., 1981; *D.?* cf. *sharezaensis* Mohtat-Aghai and Vachard, 2003; *D. simplex* Wang in Zhao et al., 1981; *Bidagmarita sinica* nov. gen. nov. sp. (with pseudo-fibrous inner layer); *Siphodagmarita vasleti* Gaillot and Vachard in Gaillot et al. (submitted); *Louisettita ultima* Gaillot and Vachard in Gaillot et al. (submitted); *Retroseptellina decrouezae* (Köylüoglu and Altiner, 1989); *Retroseptellina nitida* (Lin, Li and Sun, 1990); *Paraglobivalvulinoides septulifer* (Zaninetti and Altiner, 1981); *Paradagmaritopsis kobayashii* nov. gen. nov. sp. Gaillot and Vachard; *Paradagmaritopsis* sp. and *Paradagmarita* sp. They are associated with relatively rare nodosarioids, such as *Rectostipulina* sp., *Nodosinelloides* sp., *Geinitzina* sp., *Pseudotristix* cf. *solida* Reitlinger, 1965, *Pachyphloia pedicula* Lange, 1925, *P.* ex gr. *ovata* Lange, 1925, and *Ichthyofrondina palmata* (Wang, 1974). Miliolids are very rare as well as *Pseudovermiporella nipponica* (Endo in Endo and Kanuma, 1954). Phylogenetically older forms (first appeared as old as early to late Mississippian), such as *Climacammina* (*C. tenuis* Lin, 1978) and *Tetrataxis* (*T. lata* Spandel, 1901), are relatively common (Fig. 4). This fact seems to be common in the late Changhsingian (Gaillot, 2006).

Isolated sample T0 (Tsoteng area) is a peloidal, sandy and finely bioclastic, neosparitized wackestone with *Reichelina simplex*, *Pachyphloia* sp., *Dagmarita* sp. and *Asterosphaera* sp. A relatively large lithoclast of bioclastic rudstone with *Sphaerulina*, *Nankinella*, *Neodiscus*, *Permocalculus, Mizzia, Rectostipulina quadrata, Pachyphloia, Nodosinelloides* is also present in this microfacies.

A second isolated sample T1 (Tsoteng area) is represented by dolomitized, pyritized wackestone displaying clotted structures in microfacies and yielding rare ostracodes, very rare *Frondina* and relatively abundant *Globivalvulina curiosa* nov. sp.

4. Discussion

Middle and Late Permian reefs are widely distributed in north-western Guangxi Province, where they are part of a carbonate platform-margin reef belt (Rigby et al. 1989 a, b). According to these authors, Inozoans (unsegmented calcareous sponges with skeletons) and other sponges (sphinctozoans) are major frame-builders in the Permian reefs of South China.

Although the biodiversity of the sphinctozoans is generally poor, smaller foraminifers are highly variable taxonomically in these reefs. Biseriamminids are especially diversified with the genera and subgenera *Globivalvulina*, *Dagmarita*, *Septoglobivavulina*, *Louisettita*, *Siphodagmarita*, *Paradagmarita*?, *Paraglobivalvulinoides* and *Paradagmaritopsis* nov. gen. This diversity was already underlined within the Chinese literature (e.g., Lin et al., 1990).

The late Changhsinghian age is demonstrated by the following association: *Retroseptellina decrouezae*, *R. nitida*, *Siphodagmarita*, *Paradagmaritopsis*, *Paradagmarita*, *Louisettita* and *Paraglobivalvulinoides*. Even though no marker fossils of the latest Changhsingian (e.g., *Gallowainella*, advanced *Colaniella*, *Geinitzinita*, *Robustopachyphloia*, *Glomomidiellopsis*, *Paradagmarita monody*) were distinguished, bloom of *Robuloides* (see Gaillot, 2006) was encountered in this fauna.

The abrupt transition from latest Permian foraminifer-rich grainstones with sophisticated endoskeletons, to earliest Triassic calcimicrobial limestones yielding very simple and undivided foraminifers, is known from Turkey to South China (see review in Groves and Altiner, 2005). Nevertheless, late Permian reefs, including the Late Changhsingian ones, are very rare in these Neo- and Palaeo-Tethyan Provinces. Exceptional examples were reported from Greece, South China (Flügel and Reinhardt, 1989; Weidlich, 2002; Weidlich et al., 2003; this study), and NW Caucasus (Théry et al., 2007) where the sphinctozoan and inozoan bioconstructions are especially well-known (Rigby et al., 1989 a, b; Fan et al., 1990).

5. Taxonomy

Key of lecture: p. = pars; ? = questionable; v. = *video* or *vidimus* (from Latin, means that the material was in person see by the authors).

Class ?FORAMINIFEREA

Family TUBERITINIDAE Miklukho-Maklay, 1958

Remarks: The Tuberitinidae have two stages of a cycle of life, diplospherine, free, and eotuberitine, attached) (Conil et al., 1977); unknown among the truly characterized Foraminifera, associated with the absence of true foraminiferal apertures, can indicate another group of Protozoa or Protophyta. A relationship might exist with some calcispherids (see Vachard, 1994).

Genus ***Eotuberitina*** Miklukho-Maklay, 1958

Type species: *Eotuberitina reitlingerae* Miklukho-Maklay, 1958

Diagnosis: Small Tuberitinidae with a flat to convex basal disc and a thin microgranular wall. Groups of 2-3 specimens exist but are rare.

Occurrence: Silurian-Latest Permian (Vdovenko et al., 1993), cosmopolite. The presence of *Eotuberitina reitlingerae* up to the Changhsingian was previously indicated (Lin et al., 1990).

Eotuberitina spinosa (Lys in Lys et al., 1980)

Fig. 5(7)

1977 *Tuberitina collosa* Reitlinger forma *spinosa* - Lys in Montenat et al., p. 244, pl. 1, fig. 1 (nomen invalidum).

1980 *Tuberitina collosa spinosa* n. subsp. Lys in Lys et al., p. 81, pl. 1, fig. 11.

v. p. 1980 *Diplosphaerina* ex gr. *inaequalis* (Derville) - Vachard, p. 411-412, pl. 25, fig. 13.

1986 *Eotuberitina reitlingerae* Miklukho-Maklay - Fontaine et al., pl. 22, fig. 10.

1989 *Altjussella grandis* nov. sp. Pronina in Kotlyar et al., p. 93, pl. 3, fig. 19.

v. 1990 *Diplosphaerina spinosa* (Lys in Lys et al.) - Vachard and Miconnet, p. 302, pl. 2, fig. 3.

1995 *Tuberitina collosa spinosa* Reit. (sic) - Partoazar, pl. 12, figs 5-6.

1996 *Altjussella grandis* Pronina - Pronina, pl. 1, fig. 2; pl. 2, fig. 1.

1999 *Altjussella grandis* Pronina - Kotlyar et al. p. 311 (no illustration).

2004 *Altjussella grandis* Pronina - Dronov, p. 792 (no illustration).

v. 2006 *Eotuberitina spinosa* (Lys in Lys et al.) - Gaillot, p. 36, pl. I.4, fig. 4, pl. I.10, fig. 2, pl. I.15, fig. 13, pl. I.17, fig. 14, pl. I.18, fig. 10, pl. III.3, figs 8-9, pl. III.5, fig. 7, pl. VII.1, fig. 7.

Description: Test ampulliform with numerous small radial spines all around the periphery of the hemispherical chamber. Attachment face as in the other tuberitinids. The eotuberine type is common but diplospherine stages exist (e.g., Vachard, 1980, pl. 25, fig. 13; this study). Wall dark, microganular, finely porous. The chamber is regularly hemispherical. The attachment disk is limited to the base of the chamber. Spines are short, radial and regularly spaced.

Discussion: This species was successively attributed to *Tuberitina*, *Diplosphaerina* and *Altjussella*. It differs from *Tuberitina* by the spinose thin wall and the growth limited to a single chamber, from *Eotuberitina reitlingerae* by the spinosity, and from *Altjussella* by another type of wall (see the comparative illustrations of the quoted genera in Vachard, 1994, fig. 8, p. 15). Based on our observations, the wall is microstructurally similar to this of *Eotuberitina*.

Dimensions: Over-all diameter = 0.140-0.460 mm (0.075-0.175 mm), inner diameter = 0.120-0.445 mm (0.065-0.140 mm), wall thickness = 0.005-0.015 mm, height of spines = 0.004-0.030 mm (0.003-0.035 mm).

Occurrence: Midian-Lopingian. Southern Italy (Monte Facito; Vachard and Miconnet, 1990); Crimea (Kotlyar et al., 1999); Transcaucasia (Kotlyar et al., 1989; Pronina, 1996); NW Caucasus (Pronina-Nestell and Nestell, 2001); Oman (Jebel Akhdar; Lys in Montenat et al., 1977); Zagros (Lys et al., 1980; this study); Alborz (Partoazar, 1995); Afghanistan (Vachard, 1980); Central Pamir (Dronov, 2004), and Lamayuru Block of Ladakh Himalaya (Lys et al., 1980); discovered in South China (this work). Therefore, *E. spinosa* is relatively characteristic of a western to central Tethyan province, but is present in both Palaeo-Tethys and Neo-Tethys.

Class FORAMINIFEREA d'Orbigny, 1826

orth. mut. d'Eichwald, 1830 nomen translat. Lee, 1990

Order FUSULINIDA Fursenko, 1958

Suborder FUSULININA Fursenko, 1958 nomen translat. Bogush, 1985

Superfamily BRADYINOIDEA Reitlinger, 1950

nomen translat. Rauzer-Chernousova et al., 1996 (ex family)

Family BRADYINIDAE Reitlinger, 1950 nomen translat. Reitlinger, 1958 (ex subfamily)

Subfamily BRADYININAE Reitlinger, 1950

Genus ***Postendothyra*** Lin, 1984

Type species: *Postendothyra scabra* Lin, 1984.

Synonyms: *Endothyranopsis* Cummings, 1955 (pars), *Bradyina* von Möller, 1878 (pars).

Diagnosis: Small test organized as a *Bradyina* (planispiral, involute, nautiloid), but with very finely alveolar wall and pre and post- septal lamellae faint to absent. Wall microgranular. Aperture terminal simple.

Composition: Numerous species (but with probably many synonyms).

Occurrence: Midian-Changhsingian. South China (Hubei; Lin, 1984), Italy (Vachard and Miconnet, 1990), Greece (Vachard et al., 1993b), Slovenia (Flügel et al., 1984), Crimea (Pronina and Nestell, 1997), Cyprus (Nestell and Pronina, 1997), Turkey (Zaninetti et al., 1981), Afghanistan (Vachard, unpublished data), Primorye (Sosnina and Nikitina, 1977), Malaysia (Fontaine et al., 1994), NW Thailand (Fontaine et al., 1993), East Thailand (Fontaine et al., 1997), Cambodia (Nguyen Duc Tien, 1986b), Transcaucasia (Pronina, 1988), Japan (Kobayashi, 1986 ; 1997c), Oman (Vachard et al., 2002), and Himalaya (Lys et al., 1980).

Postendothyra micula (Sosnina in Sosnina and Nikitina, 1977)

Fig. 5(3-5)

1977 *Bradyina micula* nov. sp. Sosnina in Sosnina and Nikitina, p. 46-47, pl. 1, fig. 17-18.

1978 *Endothyranopsis guangxiensis* nov. sp. Lin, p. 34, pl. 7, figs 1-3.

1981 *Bradyina guangxiensis* (Lin) - Zhao et al., pl. 1, figs 13-15.

p. 1986b *Globivalvulina cyprica* Reichel - Nguyen Duc Tien, pl. 13, figs 16?, 17-18 (non figs 14-15 = Globivalvulinidae).

1987 *Paraglobivalvulina recristallisée*? - Panzanelli-Fratoni, pl. 6, fig. 9.

1988 *Bradyina guangxiensis* (Lin) - Pronina, pl. 2, figs 2-3.

1989 *Bradyina guangxiensis* (Lin) - Pronina, pl. 1, figs 2-3.

1989 *Bradyina micula* Sosnina - Kotlyar et al., pl. 1, fig. 9.

1990 *Postendothyra guangxiensis* (Lin) - Lin et al., p. 191, pl. 18, figs 21-26.

v. 1990 *Bradyina micula* Sosnina - Vachard and Miconnet, p. 303, pl. 2, fig. 6.

v. 1993a *Bradyina micula* Sosnina - Vachard et al., pl. 4, fig. 1.

p. v. 1994 *Bradyina* sp. - Fontaine et al., pl. 18, fig. 6 (no fig. 4 = *Neoendothyra*, nor fig. 5 = *Endoteba*).

1996 *Bradyina*? sp. - Leven and Okay, pl. 8, fig. 24; pl. 9, fig. 36.

1997 *Postendothyra micula* (Sosnina) - Pronina and Nestell, pl. 1, fig. 7.

2001 *Postendothyra guangxiensis* (Lin) - Pronina-Nestell and Nestell, pl. 4, fig. 15.

v. 2006 *Postendothyra micula* (Sosnina in Sosnina and Nikitina) - Gaillot, p. 41-42, pl. VII.1, figs 3-5.

Description: We synonymize *Postendothyra micula* with *P. guangxiensis*. Our Fig. 5(3) is typical of the former species, and the Fig. 5(4) from the second one. The parameters of both species are similar (diameter of *P. micula* = 0.330-0.350 mm, diameter of *P. guangxiensis* = 0.250-0.450 mm). Measurements of our material are: Diameter = 0.360-0.440 mm, width = 0.260-0.280 mm, w/D = 0.59-0.76, number of whorls: 2-2.5, number of chambers at the last whorl: 5, proloculus diameter = 0.020 mm, height of last chamber = 0.120-0.160 mm, wall thickness = 0.006 mm.

Occurrence: As for the genus.

Superfamily PALAEOTEXTULARIOIDEA Galloway, 1933

nomen translat. Habeeb, 1979 (ex family)

Family PALAEOTEXTULARIIDAE Galloway, 1933

nomen translat. Wedekind, 1937 (ex subfamily)

Subfamily PALAEOTEXTULARIINAE Galloway, 1933

Genus ***Climacammina*** Brady in Etheridge, 1873 emend. Cummings, 1956

Type species: *Textularia antiqua* Brady in Young and Armstrong, 1871.

Diagnosis: Palaeotextulariinae (i.e., Palaeotextulariidae with bilayered wall) with biseriate initial chambers with basal and single apertures, followed by several uniseriate and cribrate chambers.

Occurrence: Late Brigantian-Late Changhsingian, cosmopolite since the Pennsylvanian (Mamet, 1970, p. 33).

Climacammina tenuis Lin, 1978

Fig. 5(2)

1978 *Climacammina tenuis* nov. sp. Lin, p. 20, pl. 23, fig. 9.

1984 *Climacammina tenuis* Lin - Lin, p. 122, pl. 2, fig. 29.

1990 *Climacammina tenuis* Lin, Li and Sun, p. 144, pl. 7, figs 11-13.

1992 *Climacammina tenuis* Lin - Ueno, fig. 10: 16-17.

non 1995 *Climacammina tenuis* Lin - Ueno et al., fig. 3: 6 (other species, maybe *C. sphaerica* Potievskaya).

v. 2006 *Climacammina tenuis* Lin - Gaillot, p. 55, pl. VII.1, fig. 2.

Description: The species is characterized by few biseriate chambers and numerous uniseriate chambers, relatively wide and low with many cribrate apertures. It differs from *C. valvulinoides* Lange, which is the species generally cited in the Changhsingian, by a smaller test and from *C. major* Morozova sensu Bozorgnia, 1973, by more uniseriate chambers, and a more tapering test.

Dimensions: The figured specimen of South China measures: Height = 2.200 mm, width = 1.000 mm, w/H ratio = 0.55, proloculus diameter = 0.160 mm, number of biseriate chambers: 3 pairs, number of uniseriate chambers: 8, height of last chamber = 0.240 mm, wall thickness = 0.020 mm.

Occurrence: Early-Middle Permian of South China; Murgabian (= Wordian) of NE Japan (Ueno, 1992).

Superfamily TETRATAXOIDEA Galloway, 1933

nomen translat. Haynes, 1981 (ex subfamily)

Family TETRATAXIDAE Galloway, 1933

nomen translat. Pokorny, 1958 (ex subfamily)

Synonyms: Pseudotaxidae Mamet, 1974, Valvulinellidae Loeblich and Tappan, 1984, Abadehellidae Loeblich and Tappan, 1984, Endotaxidae Bogush and Brazhnikova in Rauzer-Chernoussova et al., 1996.

Diagnosis: Unique family of trochospiral Fusulinida. Conical shape, with eventual diversely shaped terminal appendices. Four or five chambers per whorl. Undivided chambers or more or less complex partitions. Wall unilayered dark, or bilayered with a brown inner layer and a yellow outer layer. Aperture terminal umbilical.

Remarks: These families are synonyms, because all include rare specimens with a particular type of attachments (the "microaquariums" of Vachard and Krainer, 2001). Therefore, only one family of Fusulinida exhibits a trochospiral coiling during the Carboniferous-Permian.

Occurrence: Late Tournaisian-Late Changhsingian; cosmopolite.

Genus ***Tetrataxis*** Ehrenberg, 1854

Type species: *Tetrataxis conica* Ehrenberg, 1854.

Diagnosis: Test medium to large, trochospirally coiled, with four chambers per whorl. Wall bilayered, granular and pseudofibrous.

Remarks: An important problem is the life position of *Tetrataxis*: i.e., attached, not attached, periodically free or attached, with or without interposition of a microaquarium between the test and the substrate (Kochansky-Devidé, 1970, pl. 2, fig. 8; Toomey et al., 1977, fig. 8P; Poncet, 1982; Cossey and Mundy, 1990; Ueno and Igo, 1993, fig. 3. 23; Mundy, 1994, text-fig. 12 p. 722; Gallagher, 1998; Vachard and Krainer 2001; Krainer et al., 2003a, pl. 3, fig. 38, pl. 4, fig. 17; Saïd, 2005, fig. XII.5), and the significance of the terminal appendices of "*Globotetrataxis*" Brazhnikova in Aizenberg et al., 1983 and species like *Tetrataxis mira* Conil and Lys, 1964 or *T. fortis* Bogush and Yuferev, 1976 [compare with Adachi, 1985, pl. 13, figs 9-11; or *Globotetrataxis* sp. E (Matsusue, 1992, fig. 3. 27); *Tetrataxis* sp. of Ueno and Igo (1993, fig. 3. 22) and Ueno et al. (1994, fig. 4. 12)].

Occurrence: Late Ivorian (MFZ6) to latest Permian (Gaillot, 2006); cosmopolite.

Tetrataxis lata Spandel, 1901

Fig. 5(8)

1901 *Tetrataxis conica* Ehrenberg var. *lata* n. var. Spandel, p. 186, fig. 6 a, b.

1949 *Tetrataxis lata* Spandel - Morozova, p. 261-262, pl. 2, figs 20, 23, 28.

non 1961 *Pseudotetrataxis conica* var. *lata* - Deleau and Marie, p. 93, pl. 11, figs 5, 8 (another species).

1982 Tetraxis conica lata Spandel - Hao and Lin, pl. 2, fig. 7.

1986 *Tetrataxis lata* Spandel Zolotova et al. in Gorskii and Kalmykova, pl. 22, figs 10 a, b.

1990 *Tetrataxis lata* Spandel - Lin et al., p. 156, pl. 9, figs 4-5.

1999 *Tetrataxis lata* Spandel - Groves and Boardman, pl. 1, figs 7-9.

v. 2006 *Tetrataxis* ex gr. *conica* Ehrenberg - Insalaco et al., pl. 2, fig. 4.

2006c *Tetrataxis* sp. - Kobayashi, pl. 3, figs 15-16.

2006c *Tetrataxis* sp. - Kobayashi, pl. 1, fig. 42.

v. 2006 *Tetrataxis lata* Spandel - Gaillot, p. 57, pl. I.4, fig. 3, pl. I.5, figs 2, 14, pl. II.3, fig. 6, pl. III.22, fig. 4, pl. VII.1, fig. 8.

Discussion: The average dimensions of our specimens are: Height = 0.640 mm, diameter = 1.070 mm, ratio height/diameter = 0.60, number of chambers: 5, apical angle = 90, last thickness = 0.70 mm. Consequently, it belongs to a great species with few whorls of the group *T. conica* Ehrenberg, 1854 (angle of 90°, ratio of 0.50-0.60), but true *T. conica* is very smaller for the same number of whorls; more precisely, according to its parameters, the specimens are rather attributed to *Tetrataxis lata* Spandel, 1901.

Remarks: This species has two senior homonyms: *Tetrataxis lata* Potievskaya, 1958 (not yet re-named) and *T. lata* Bogush and Juferev, 1962 (re-named *T. bogushi* Ueno and Nakazawa, 1993).

Occurrence: Early Permian of Kansas, Urals, North China. Kazanian of Russia. Common in the Late Changhsingian strata of South China (this work). In the Zagros (Iran), Tetrataxis lata is one of the diagnostic fossil of the Wuchiapingian transgression (Gaillot, 2006).

Superfamily BISERIAMMINOIDEA Chernysheva, 1941

nomen translat. Marfenkova, 1991 (ex family)

Diagnosis: A superfamily of Fusulinida Endothyrina characterized by a sligthly trochospiral to planispiral biseriate coiling, eventually uncoiled. Wall very variable, but without clearly established generic criteria. Aperture single terminal basal.

Composition: 2 families: Biseriamminidae Chernysheva, 1941 (including Koktjubinidae Marfenkova, 1991); Globivalvulinidae Reitlinger, 1950 nomen translat. herein.

Remarks: The limits of the genera and families and generally poorly established. *Biseriammina* is especially poorly illustrated.

Occurrence: Tournaisian-latest Permian; cosmopolite.

Family GLOBIVALVULINIDAE Reitlinger, 1950 nomen translat. herein

(pro subfamily)

Subfamily GLOBIVALVULININAE Reitlinger, 1950 (sic Globivalvulinae)

Genus ***Globivalvulina*** Schubert, 1921

Type species: *Valvulina bulloides* Brady, 1876.

Diagnosis: Small, medium or large globivalvulinid test, entirely biseriate and planispiral. Subglobular with lobate periphery. Valvular projection well developed. Wall black, micrognanular to differentiated: with a yellow pseudo-fibrous inner layer (see *G. mosquensis* Reitlinger, 1950), *Omphalotis*-like (Vachard and Beckary, 1991), granular with agglutinate particules: *G. granulosa* Reitlinger, 1950, with intermediary clear layer (“diaphanotheca” of authors): *G. bulloides* (“Brady” of the authors). Aperture simple protected by the valvular projection.

Remarks: *Globivalvulina* is composed of several groups of species according to generally admitted foraminiferal criteria: wall structure, size, development of the valvulae, characters of the chambers, and shape of the apertural face. Unfortunately, these characters appear very variable among the specimens of the same population (Vachard et al., 2006).

Occurrence. Serpukhovian to latest Permian; cosmopolite.

Globivalvulina bulloides (Brady, 1876)

Fig. 6(1)

1876 *Valvulina bulloides* nov. sp. Brady, p. 89-90, pl. 4, figs 12-15.

1981 *Globivalvulina bulloides* (Brady) - Zhao et al., pl. 2, figs 4-5.

1990 *Globivalvulina bulloides* (Brady) - Lin et al., p. 86, p. 162, pl. 11, figs 3-1 (with 5 references in synonymy).

1998 *Globivalvulina bulloides* (Brady) - Pinard and Mamet, p. 118-119, pl. 27, figs 16-20; pl. 28, figs 1-4, 5?, 6-11 (with 30 references in synonymy).

2005 *Globivalvulina bulloides* (Brady) - Brenckle, p. 47, pl. 7, fig. 18-22 (lectotype designated).

p. 2006b *Globivalvulina* sp. A - Kobayashi, fig. 3.28, 30, 32-34 (non fig. 3.29, another species, nor fig. 3.31, 35-36 = *Retroseptellina decrouezae*, see below).

v. 2006 *Globivalvulina bulloides* (Brady) - Gaillot, p. 59-60, pl. I.3, figs 1, 5, 7-8; pl. I.37, figs 2-3; pl. I.43, fig. 12; pl. III.23, fig. 5; pl. IV.2, fig. 13; pl. V.3, fig. 1; pl. VI.4, figs 3, 7, 15.

v. 2006 *Globivalvulina bulloides* (Brady) - Vachard et al., p. 472, fig. 5. 17, fig. 6. 18-20, fig. 7. 9?, 13?

Discussion: The type-species of the genus is proportionally medium-sized. The growth is regular and the valvular projection moderate. The wall is suggested as “diaphanothecal” by many authors (e.g., Pinard and Mamet, 1998; Brenckle, 2005), but according to our observations, from the Bashkirian to Changhsingian times, this clear intermediary layer is not always present in all the specimens of a same population. Although admitted by almost all the authors, this unique criterion chosen to separate “*Biseriella*” and *Globivalvulina* must be seriously re-examined. Diameter = 0.400 mm, number of whorl: 1.5, number total of chambers: 5, proloculus diameter = 0.025 mm, height of last chamber = 0.115 mm, wall thickness = 0.015 mm.

Occurrence: Early Pennsylvanian to latest Permian; cosmopolite.

Globivalvulina curiosa Gaillot and Vachard nov. sp.

Fig. 7(16-20)

v. 2006 *Globivalvulina curiosa* Gaillot and Vachard nov. sp. Gaillot, p. 63-64, pl. VII.3, figs 16-20 (nomen nudum because introduced in a Ph.D.).

Etymology: From Latin *curiosus* = curious, because of the puzzling shapes of tests.

Type locality: Tsoteng (Guangxi, South China).

Type level: Late Changhsingian. Base of thrombolites, lithostratigraphically assigned to the basis of Triassic (investigation of conodonts in progress).

Diagnosis: A *Globivalvulina* without any regularity neither in the coiling nor type of chambers.

Description: (1) Proloculus: ovoid, regular in shape and location, measuring 0.011-0.033 mm of small axis and 0.033-0.055 mm of large axis. (2) Coiling planispiral, relatively regular (Fig. 7 (16)) or with a tendency to uncoiling (Fig. 7(21)). (3) Shape of chambers: very irregular (Fig. 7(16-17)), hemispherical to semi-ovoid, as in the tests affected today by marine pollutions (e.g., Debenay et al., 1996; Armynot du Châtelet et al., 2004). Sutures are generally deep with a lobate profile (Fig. 7(17)) or not (Fig. 7(21)). The shape of chambers is never regular; abnormal chambers are located at the end of the coiling (Fig. 7(21)), at the beginning of the terminal whorl (Fig. 7(16)), or in the entire terminal whorl (Fig. 7(17)). (4) Height of last chamber: relatively constant although the variations in shape: 0.155 mm (Fig. 7(16)), 0.244 mm (Fig. 7(17)), 0.166 mm (Fig. 7(20)) (5) Axial section (Fig. 7(20)) and oblique sections (Fig. 7(18-19)) are relatively similar to that of the other *Globivalvulina*; nevertheless, the tapering and the sutures of these sections are noticeable. (6) Endoskeleton composed of an oral tongue relatively developed and incurved with a “modern style” profile (Fig. 7(20)). Septa are (locally?) prolonged by small expansions thinner and more undulate (Fig. 7(17-18)). Some septa are curvated backwards (Fig. 7(16, 21)). Rare calcified globules or loops are visible in the last chamber of the most deformed specimen (Fig. 7(17)). (7) The wall is microgranular, dark unilayered, medium-thick (0.006-0.013 mm) (theoretically these specimens could be attributed to *Biseriella*). (8) Aperture terminal at the base of the last chamber, wide and depressed (Fig. 7(20)).

Holotype: Fig. 7(16) (sample T1).

Type material: Twenty specimens in one thin-section.

Repository of the type: Natural History Museum, Geneva (Switzerland), holotype number MHNG 07-001.

Comparison: According to C. Jenny-Deshusses (pers. comm. to D. Vachard. and in press) “crazy globivalvulines” exist in the Lopingian of Iran (Alborz). They migth be related to this species. All the “normal” globivalvulines of the literature are different, as well as the *Biseriella*.

Remarks: Due to the Permian-Triassic transition, these forms could be related with the different observed geochemical shifts (hypothesis shared with C. Jenny-Deshusses and S. Richoz).

Occurrence: late Changhsingian? (South China, this work).

Genus ***Septoglobivalvulina*** Lin, 1978 emend. Gaillot and Vachard in Gaillot et al. (submitted)

Type species: *Septoglobivalvulina guangxiensis* Lin, 1978.

Diagnosis: Test similar to *Globivalvulina* but differing by an ovoid to subspherical shape and a voluminous last chamber covering entirely the preceeding whorls. Endoskeleton as in *Globivalvulina*, i.e., reduced to an oral tongue. Wall thin dark microgranular unilayered.

Composition: *Septoglobivalvulina guangxiensis* Lin, 1978 (D = 0.820-0.920 mm), *S. similis* Lin, Li and Sun, 1990 (D = 0.740-0.870 mm), *Globivalvulina distensa* Wang in Zhao et al., 1981 (D = 0.500-0.700 mm); *Septoglobivalvulina* cf. *globosa* sensu Vachard et al., 2002 (pl. 1, figs 13-14) non Wang in Zhao et al. 1981 (D = 0.660-0.800 mm). *S.* sp. 1 of this study (D = 0.555 mm); ?*Globivalvulina cyprica* sensu Nguyen Duc Tien, 1986b, pl. 6, fig. 14 only (non Reichel, 1946).

Comparison: Differs from *Globivalvulina* by the increasing in height and width of the last chamber becoming enveloping of the preceding coiled chambers, from *Paraglobivalvulina* by the shape not completely spherical, the thin wall and the more rudimentary endoskeleton, and from *Retroseptellina* Gaillot and Vachard in Gaillot et al. (submitted; nomen nudum) by the shape of the septa plane and not curvated backward, and the more marked increasing in height of the last chamber whereas the last chambers of *Retroseptellina* are wider than the preceeding ones. Unlike Ünal et al. (2003, pl. 1, figs 9-11), which re-assigned *Paraglobivalvulina gracilis* Zaninetti and Altiner, 1981 to *Septoglobivalvulina*, we prefer maintain this species in *Paraglobivalvulina* (Gaillot, 2006; Gaillot et al., submitted).

Occurrence: Early?-late Midian to Changhsingian: Oman, South China (this work), Transcaucasia, Turkey (Hazro), Iran (Fars, Zagros) and Abu Dhabi.

Septoglobivalvulina cf. *guangxiensis* Lin, 1978

Fig. 7(14)

v. 2006 *Septoglobivalvulina* cf. *guangxiensis* Lin - Gaillot, p. 70-71, pl. I.4, fig. 14, pl. VII.3, fig. 14.

v. 2006 *Septoglobivalvulina* cf. *guangxiensis* Lin - Vachard et al., fig. 9. 7.

Compare with:

1978 *Septoglobivalvulina guangxiensis* nov. gen. nov. sp. Lin, p. 28, pl. 5, figs 4-7.

1981 *Septoglobivalvulina guangxiensis* Lin - Zhao et al., pl. 2, fig. 10.

1984 *Paraglobivalvulina gracilis* Zaninetti and Altiner - Altiner, pl. 1, fig. 15 (the chamberlets of *S. gracilis* are not visible).

1987 *Paraglobivalvulina guangxiensis* Lin - Loeblich and Tappan, pl. 230, figs 7-8.

1990 *Septoglobivalvulina guangxiensis* Lin - Lin et al., p. 164-165, pl. 12, figs 11-12, 13? (13 might belong to *Siphoglobivalvulina*).

? 1992 *Paraglobivalvulina mira* Reitlinger - Berczi-Makk, pl. 4, fig. 7.

? p. 2005 *Paraglobivalvulina globulosa* (sic, probably: *globosa* Wang) - Hughes, pl. 2, fig. 21 (non figs 22-23 = ?*S. distensa*).

Comparison: Our material differs from the type material by the smaller size (Diameter = 0.820-0.900 mm) and thicker wall, but the chamber shape and the big proloculus are identical. Diameter = 0.670 mm, width = 0.680 mm, number of whorl: 1, number of chambers: 2, proloculus diameter = 0.233 mm, height of last chamber = 0.130 to 0.330 mm, wall thickness = 0.020 to 0.056 mm.

Occurrence: Wuchiapingian-Changhsingian of South China (Lin et al., 1990, p. 95). Wuchiapingian of Kuh-e Surmeh, Zagros, Iran (Gaillot, 2006).

Septoglobivalvulina distensa (Wang in Zhao et al., 1981)

Fig. 6(2)

1981 *Globivalvulina distensa* nov. sp. Wang in Zhao et al., p. 48 (in Chinese), 75 (in English), pl. 2, figs 1-3.

1985 *Globivalvulina* sp. of *G. vonderschmitti* group - Okimura et al., pl. 1, fig. 10.

? 1988 *Paraglobivalvulina*? sp. - Pronina, pl. 2, figs 8-9.

p. 1990 *Globivalvulina laxa* nov. sp. Lin, Li and Sun, p. 163-164, pl. 11, fig. 36 only (non figs 35, 37-38 = globivalvulinid indet.).

? p. 2005 *Paraglobivalvulina globulosa* (sic, probably: *globosa* Wang) - Hughes, pl. 2, figs 22-23 (non fig. 21 = ?*S. guangxiensis*).

v. 2006 *Septoglobivalvulina distensa* (Wang in Zhao et al.) - Gaillot, p. 71, pl. I.4, fig. 5; pl. I.5, fig. 15; pl. I.7, fig. 12; pl. I.17, fig. 12; pl. I.37, fig. 9; pl. I.43, fig. 15; pl. II.8, fig. 1, 5; pl. II.9, fig. 1; pl. II.31, fig. 4; pl. III.6, fig. 5; pl. III.15, fig. 14?; pl. III.16, fig. 5; pl. VI. 4, figs 10-11; 16, pl. VI.5, fig. 18; pl. VI.6, fig. 21; pl. VII.2, fig. 2.

Description: Our specimen corresponds to the minimal dimension of the type material. Diameter = 0.500 mm, number of volution: 1, number of chambers: 3 or 4, proloculus diameter = 0.070 mm, height of last chamber = 0.235 mm (i.e., almost the middle of the total diameter), wall thickness = 0.015 mm.

Occurrence: Early?-late Midian to Changhsingian: Oman, South China (this work), Turkey (Hazro), Iran (Fars, Zagros), UAE. Late Changhsingian of South China (this work), and ?Transcaucasia.

Septoglobivalvulina sp. 1

Fig. 6(3)

v. 2006 *Septoglobivalvulina* sp. 1 - Gaillot, p. 71-72, pl. I.11, fig. 9; pl. I.12, figs 1-2; pl. VII.2, fig. 3.

Description: This unique specimen has the same size than *S. distensa* but more whorls and more chambers. Diameter = 0.555 mm, number of volutions: 2, number of chambers: 5 or 6, proloculus diameter = 0.060 mm, height of last chamber = 0.360 mm (i.e., more than the middle of the total diameter), wall thickness = 0.015 mm.

Occurrence: Early Changhsingian of Zagros (Kuh-e Surmeh) (Gaillot, 2006). Late Changhsingian of South China (this work).

Genus ***Retroseptellina*** Gaillot and Vachard in Gaillot et al., submitted

Type species: *Globivalvulina decrouezae* Köylüoglu and Altiner, 1989.

Diagnosis: Coiling similar to *Globivavulina*, with few whorls and few chambers, with a tendency of the increasing of the width of the chambers during the growth. Septa strongly curvated backward. Wall single microgranular.

Composition: *Globivalvulina globosa* Wang in Zhao et al., 1981; *G. decrouzae* Köylüoglu and Altiner, 1989; *Paraglobivalvulina nitida* Lin, Li and Sun, 1990.

Comparison: Differs from *Globivalvulina* by the shape of the septa and the chambers; from *Septoglobivalvulina* by an increasing in width more than in height, and the strongly backward curvated septa.

Occurrence: Questionable in “early Murgabian” of Thailand (Ueno and Sakagami, 1993; and more probably Midian in age). Murgabian-Dzhulfian-Dorashamian of southern Turkey (e.g., Canuti et al., 1970 up-dated by Gaillot et al., submitted; Koylüoglu and Altiner, 1989; Ünal et al., 2003), Thailand and Malaysia (Yanagida et al., 1988; Fontaine et al., 1993; 1994). Midian of Batain Plain, Oman (Vachard et al., 2002). Latest Midian-earliest Dzhulfian of Transcaucasia (Kotlyar et al., 1989). Midian of New Zealand (Vachard and Ferrière, 1991). Late Midian of central Japan (Kobayashi, 2006b). Dorashamian of Greece (Altiner and Özkan-Altiner, 1998; Baud et al., 1991; Grant et al., 1991). Wuchiapingian-Changhsingian of South China (Lin et al., 1990; (this work). Wuchiapingian of northern Italy and Iran (Mohtat-Aghai and Vachard, 2005). Duhaysan Member (late Dzhulfian) of Saudi Arabia (Vachard et al., 2005). Changhsingian of Hungary (Théry et al., 2007).

Retroseptellina decrouezae (Köylüoglu and Altiner, 1989)

Fig. 6(5)

p. 1970 *Globivalvulina graeca* Reichel - Canuti et al., fig. 14.1 (non fig. 14. 3, 4, 6 correctly interpreted).

p. 1970 *Globivalvulina* sp. - Canuti et al., fig. 14. 2, 5.

1989 *Globivalvulina* sp. Kotlyar et al., pl. 3, fig. 21.

1989 *Globivalvulina decrouezae* nov. sp. Köylüoglu and Altiner, p. 479-481, text-fig. 8 A-H, J-K, pl. 7, fig. 14.

p. 1990 *Globivalvulina globosa* Wang - Lin et al., p. 162, pl. 11, figs 26-27 (non figs 28-29 = *Globivalvulina bulloides*).

v. 1991 *Paraglobivalvulina*? sp. - Vachard and Ferrière, p. 2, fig. 2.

v. 1993 *Globivalvulina* or *Paraglobivalvulina*? - Fontaine et al., fig. 5E.

v. 1993 *Paraglobivalvulina mira* Reitlinger - Fontaine et al., fig. 6F.

v. 1994 *Paraglobivalvulinoides*? - Fontaine et al., pl. 47, fig. 7.

p. 1995 *Paraglobivalvulina mira* Reytlinger - Berczi-Makk et al., pl. 6, figs 1-3 (non pl. 7, figs 1-2 = *R. nitida*).

1998 *Globivalvulina decrouezae* Köylüoglu and Altiner - Altiner and Özkan-Altiner, pl. 3, fig. 23.

2001 *Paraglobivalvulina globosa* (Wang) - Pronina-Nestell and Nestell, pl. 5, figs 2-3.

v. p. 2002 *Septaglobivalvulina* (sic) *globosa* (Wang) - Vachard et al., pl. 1, fig. 13 (non fig. 14 = *Septoglobivalvulina distensa* or *gracilis*).

2004 *Globivalvulina globosa* Wang - Zhang and Hong, p. 70, pl. 1, figs 24-26.

v. 2005 *Septoglobivalvulina decrouezae* (Köylüoglu and Altiner) - Mohtat-Aghai and Vachard, pl. 2, fig. 17.

v. 2005 *Septoglobivalvulina*? *decrouezae* (Köylüoglu and Altiner) - Vachard et al., p. 154-155, pl. 3. 5-6.

v. 2006 *Septoglobivalvulina*? *decrouezae* (Köylüoglu and Altiner) - Insalaco et al., pl. 1, fig. 20.

p. 2006b *Globivalvulina* sp. - Kobayashi, figs 3. 31, 35-36 (non figs 3. 28-30, 32-34 = truly *Globivalvulina* spp.).

2006c *Septoglobivalvulina*? sp. - Kobayashi, pl. 2, figs 9-12.

v. 2006 *Retroseptellina decrouezae* (Köylüoglu and Altiner) - Gaillot, p. 68-69, pl. I.13, figs 12-14; pl. I.14, figs 1-2; pl. I.15, fig. 15; pl. I.18, figs 3-5, 9; pl. I.37, fig. 12; pl. II.8, fig. 3; pl.III.2, fig. 5; pl. III.3, fig. 13; pl. III.4, fig. 13; pl. III.6, fig. 6; pl. III.7, fig. 2; pl. III.16, figs 16-17; pl. III.22, fig. 14; pl. VI.5, fig. 26; pl. VII.2, fig. 5.

v. 2006 *Retroseptellina decrouezae* (Köylüoglu and Altiner) - Vachard et al., fig. 9. 5.

Discussion: The outline is subrectangular, the number of whorls is 2 or 3. *R. globosa* has fewer whorls, and *R. nitida* is more evolute. In fact, the transition from *R. decrouezae* to *R. nitida* is progressive. *R. decrouezae* is characterized by more than 1 whorl, no increasing of the last whorl, and a much larger size (> 0.500 mm). Its chambers are spacious, and the backward curvature of the septa takes the form of a hook.

Dimensions: Diameter = 0.440 mm, width = 0.450 mm, w/D = 1.03, number of whorls: 1.5. The diameter of the type material of Köylüoglu and Altiner (1989) is a little larger with 0.520-0.640 mm.

Occurrence: Late Midian-Lopingian of Italy, Turkey, Thailand and Malaysia, Transcaucasia, New Zealand, Greece, South China, central Iran, Saudi Arabia (see compilation in Vachard et al., 2005, p. 155). Midian of Central Japan (Kobayashi, 2006b). Changhsingian of Japan (Kobayashi, 2006c). Lopingian of Zagros-Fars-Abu Dhabi area. Early Wuchiapingian of Hambast region (Central Iran) (Mohtat-Aghai and Vachard, 2005). Hazro: Late Wuchiapingian-Early Changhsingian.

Retroseptellina nitida (Lin, Li and Sun, 1990)

Fig. 6(4)

1990 *Paraglobivalvulina nitida* nov. sp. Lin, Li and Sun, p. 166, pl. 12, figs 20-21.

p. 1995 *Paraglobivalvulina mira* Reitlinger - Berczi-Makk et al., pl. 7, figs 1-2 (non pl. 6, figs 1-3 =).

v. 2006 *Retroseptellina nitida* (Lin, Li and Sun) - Gaillot, p. 84-85, pl. I.19, fig. 18; pl. II.8, fig. 7; pl. VII.2, fig. 4.

v. 2006 *Retroseptellina nitida* (Lin, Li and Sun) - Vachard et al., fig. 9. 6.

Description: The last chambers of *R. nitida* are evolute. The curvature of septa is diversely developed, from weak to hook-shaped. Dimensions: H = 0.500-0.580 mm, w = 0.450-0.780 mm, number of whorls: 2.5. The type material of Lin et al. (1990) is larger with 0.960-1.120 mm but for 3-4 whorls.

Occurrence: Lopingian of South China (Lin, Li and Sun, 1990), Hungary (Berczi-Makk et al., 1995), and Zagros, Kuh-e Surmeh (Gaillot, 2006).

Genus ***Paraglobivalvulinoides*** Zaninetti and Jenny-Deshusses, 1985

Type species. *Paraglobivalvulina*? *septulifera* Zaninetti and Altiner, 1981.

Diagnosis: Test large, spherical, biserially coiled, involute, chambers wide and strongly embracing. Oral chamberlets with very complex tongues. Wall microgranular, proportionally thin.

Composition: *Paraglobivalvulina*? *septulifera* Zaninetti and Altiner, 1981, *Paraglobivalvulina piyasini* Sakagami and Hatta, 1982, *Paraglobivalvulinoides spumida* Lin, Li and Sun, 1990.

Occurrence: Latest Changhsingian, Alborz, northern Iran (Bozorgnia, 1973), Zagros, southern Iran (Gaillot, 2006), ?Italy (Pasini, 1985), Greece (Vachard et al., 1993b), Himalaya (Lys et al., 1980), South China (Lin et al., 1990; this work), Thailand (Sakagami and Hatta, 1982; Yanagida, 1988), Transcaucasia (Pronina-Nestell and Nestell, 2001), Japan (Kobayashi, 1997; 1999), and Malaysia (Fontaine et al., 1994).

Paraglobivalvulinoides septulifer (Zaninetti and Altiner, 1981)

Fig. 5(1)

1973 *Paraglobivalvulina mira* Reitlinger - Bozorgnia, p. 145, pl. 39, figs 9-11 pl. 40, figs 1-2.

1980 *Paraglobivalvulina mira* Reitlinger - Lys et al., pl. 3, figs 7-10.

1981 *Paraglobivalvulina*? *septulifera* nov. sp. Zaninetti and Altiner, p. 40-41, pl. 1, figs 15-19.

1981 *Paraglobivalvulina* sp. - Altiner, pl. 36, fig. 3.

1982 *Chrysanthemina* - Jiang, Yang and Zang, pl. 2, fig. 10 (nomen nudum, no description).

1982 *Paraglobivalvulina piyasini* nov. sp. Sakagami and Hatta, p. 10, pl. 5, fig. 1.

1983 *Paraglobivalvulina septulifera* Zaninetti and Altiner - Jenny-Deshusses, pl. 23, fig. 5.

1985 *Paraglobivalvulina septulifera* Zaninetti and Altiner - Pasini, pl. 61, fig. 11.

? 1987 *Paraglobivalvulina septulifera* Zaninetti and Altiner - Noé, p. 108, pl. 30, fig. 10.

? 1988 *Paraglobivalvulina piyasini* Sakagami and Hatta - Yanagida, pl. 2, figs 28-29.

1990 *Paraglobivalvulina*? *septulifera* Zaninetti and Altiner - Lin et al., p. 166, pl. 12, figs 22-24.

? 1990 *Paraglobivalvulina spumida* nov. sp. Lin et al., p. 166-167, pl. 12, figs 25-30.

1993b *Paraglobivalvulinoides septulifera* Zaninetti and Altiner (sic without brackets) - Vachard et al., pl. 8, fig. 1.

1993 *Paraglobivalvulina* sp. - Baghbani, pl. 6, fig. 5.

1994 *Paraglobivalvulina septulifer* Zaninetti and Altiner - Fontaine et al., pl. 47, fig. 6.

1996 *Paraglobivalvulinoides septulifera* (Zaninetti and Altiner) - Rauzer-Chernousova et al., pl. 18, fig. 10.

? 1997 *Paraglobivalvulina piyasini* Sakagami and Hatta - Kobayashi, fig. 2. 3, pl. 4, figs 1-5.

? 1999 *Paraglobivalvulina piyasini* Sakagami and Hatta - Kobayashi, text-fig. 1. 11 p. 281.

2001 *Paraglobivalvulinoides* sp. - Pronina-Nestell and Nestell, pl. 5, figs 6-7.

? 2001 *Paraglobivalvulina piyasini* Sakagami and Hatta - Pronina-Nestell and Nestell, pl. 5, fig. 8.

v. 2006 *Paraglobivalvulinoides* sp. - Insalaco et al., pl. 2, fig. 24.

2006c *Paraglobivalvulina* sp. - Kobayashi, pl. 2, fig. 13.

2006c *Paraglobivalvulina mira* (Reitlinger) - Kobayashi, pl. 2, fig. 14.

v. 2006 *Paraglobivalvulinoides septulifer* (Zaninetti and Altiner, 1981) - Gaillot, p. 73, pl. I.19, fig. 19.

v. 2006 *Paraglobivalvulinoides septulifera* (Zaninetti and Altiner, 1981) - Vachard et al., fig. 9. 10.

Dimensions: Height = 2.300-2.860 mm, width = 2.300-2.800 mm, number of pairs of chambers: 4, wall thickness = 0.050 mm.

Occurrence: As for the genus.

Subfamily DAGMARITINAE Bozorgnia 1973 emend. herein

Synonyms: Biseriamminidae Chernysheva, 1941 (pars); Globivalvulinidae Reitlinger, 1950 (pars); Louisettitinae Loeblich and Tappan, 1984; Louisettitidae nomen translat. Rauzer-

Chernousova et al., 1996; dagmaritin-type biseriamminids sensu Altiner (1997, text-fig. 1 p. 3).

Remarks: This subfamily corresponds to the *Dagmarita*-lineage and its possible ancestors. The subfamily is morphologically poorly known (and/or poorly represented morphological variations). The creation of Louisettininae appears, in this case, devoid of significance.

Composition: *Sengoerina* Altiner, 1999; *Crescentia* Ciarapica, Cirilli, Martini and Zaninetti, 1986; *Dagmarita* Reitlinger, 1965; *Siphodagmarita* Gaillot and Vachard (nomen nudum). *Bidagmarita* gen. nov.; *Louisettita* Altiner and Brönnimann, 1980.

Occurrence: Early Murgabian/Wordian to latest Changhsingian; Palaeo-Tethyan, Ne-Tethyan.

Genus ***Dagmarita*** Reitlinger, 1965

Type species: *Dagmarita chanakchiensis* Reitlinger, 1965.

Diagnosis: Test rectilinear, tapering, biseriate. Chambers hemispherical to semi-ellipsoidal. Wall thin, with development of lateral horn-like expansions. Wall microgranular, uni- to three layered (granular or finely perforated in anatypical forms, see below: *Dagmarita*?).

Composition: Many species are described in the literature, often with excessive synonymies. Two groups can nevertheless be distinguished: *D. chanakchiensis* and *D. altilis*.

The following species were described: *D. chanakchiensis* Reitlinger, 1965; *D. elegans* Sosnina in Sosnina and Nikitina, 1977; *D. cuneata* Sosnina in Sosnina and Nikitina, 1977; *D. exilis* Sosnina in Sosnina and Nikitina, 1977; *D. oblonga* Sosnina in Sosnina and Nikitina, 1977; *D. altilis* Wang in Zhao et al., 1981; *D. elongata* Wang in Zhao et al., 1981; *D. minuscula* Wang in Zhao et al., 1981; *D. simplex* Wang in Zhao et al., 1981; *D. liantanensis* Hao and Lin, 1982; *D. caucasica* Vuks in Kotlyar et al., 1984; *D. minima* Lin, 1984; *D. shahrezaensis* Mohtat Aghai and Vachard, 2003. *D. shahrezaensis* do not display lateral expansions and might belong to another genus to be described.

Occurrence: Early Murgabian (Vachard, 1980) and/or early Maokouan (Lin et al., 1990) to latest Changhsingian (Zhao et al., 1981; Lin et al., 1990) of Palaeo-Tethys and Neo-Tethys. with the following detailed distribution from West to East: Middle Permian of Appennines (Panzanelli-Fratoni et al., 1987; Vachard and Miconnet, 1990); Middle Permian of Montenegro (Pantic, 1970); Late Permian of the Carnic Alps (Noé, 1987); Late Permian of Hungary (Berczi-Makk, 1992); Late Permian of western Turkey (Argyriadis et al. 1976; Lys and Marcoux, 1978); Late Permian of eastern Taurus (Zaninetti et al., 1981; Altiner, 1981, 1984; Koyluöglu and Altiner, 1989); Midian-Changhsingian of Hazro (Canuti et al. 1970 as *Palaeotextularia* sp.; updated in this study); Midian-Dzhulfian of Transcaucasia (Reitlinger, 1965; Kotlyar et al., 1984, 1989); Late Permian of central Alborz (Bozorgnia, 1973; Jenny-Deshusses, 1983); Late Wuchiapingian of central Iran (Mohtat-Aghai and Vachard, 2003); Lopingian of Zagros and Fars (this study); Middle Permian of central Afghanistan (Vachard and Montenat, 1981); Middle Permian of Salt Range (Pakistan, Okimura, 1988); Late Changhsingian of Ladakh (Himalaya, Lys et al., 1980); Maokouan- Changhsingian of South China (Zhao et al., 1981; Lin et al., 1990); Middle Permian of West Thailand (Fontaine et al., 1988a) and Philippines (Fontaine et al., 1986); Midian-Dzhulfian of northwestern Thailand (Caridroit et al., 1990, p. 342, 348); Middle Permian of Malaysia (Fontaine et al., 1988b); Midian-Dzhulfian of northwestern Thailand (Caridroit et al., 1990, p. 342, 348); Middle-Late Permian of Cambodia (Nguyen Duc Tien, 1979, 1986a); Late-Middle Permian of Primorye (Sosnina in Sosnina and Nikitina, 1977); Late Midian-Changhsingian of Japan (Kobayashi, 2006c).

Dagmarita altilis Wang in Zhao et al., 1981

Fig. 6(19)

1981 *Dagmarita altilis* nov. sp. Wang in Zhao et al., p. 74, pl. 1, fig. 24.

1984 *Dagmarita minima* Lin, p. 112, pl. 1, figs 18-19.

1988 *Dagmarita altilis* Wang - Pronina, pl. 2, figs 10-11.

1989 *Dagmarita altilis* Wang - Pronina, pl. 1, figs 10-11.

1990 *Dagmarita altilis* Wang - Lin et al., p. 84 (no illustration).

v. 2006 *Dagmarita altilis* Wang - Insalaco et al., pl. 2, fig. 2.

v. 2006 *Dagmarita altilis* Wang in Zhao et al. - Gaillot, p. 77, pl. I.7, fig. 15 pl. I.8, figs 1-3, 11, 21-22, pl. I.14, figs 5-6, 11, 13¸pl. I.16, fig. 1; pl. I.9, fig. 14?, pl. II.14, figs 12-13, pl. II.31, figs 5, 9, pl. III.6, figs 10-11, pl. III.15, figs 3, 8, 17, pl. III.16, figs 1, 8, pl. III.22, fig. 10; pl. III.24, figs 1-7; pl. III.25, figs 5-9, 15-18; pl. VI.6, fig. 2; pl. VII.2, fig. 19.

Description: This species differs from *D. chanakchiensis* by a wider test, a truncate base, and wider chambers. Some specimens of *D. altilis* appear more or less similar to *D. simplex* Wang in Zhao et al. by the simple wall thin dark microgranular, the basal often truncated and the shape of chamber. They probably correspond to juveniles and/or deformed specimens of *D. altilis*.

Occurrence: Early Maoukouan-Latest Changhsingian of southern China (Wang in Zhao et al. 1981; Lin et al., 1990), Changhsingian of Transcaucasia (Pronina 1988; 1989), Lopingian of Zagros. Lopingian of Hazro (Turkey).

Dagmarita? cf. *sharezaensis* Mohtat-Aghai and Vachard, 2003

Fig. 6(18)

Compare with:

? 1986 *Dagmarita* sp. - Vuks and Chediya, pl. 9, fig. 10.

v. 2003 *Dagmarita shahrezaensis* nov. sp. Mohtat-Aghai and Vachard, p. 38, 40, 42, pl. 1, figs 1-14 (with 4 references in synonymy).

v. 2005 *Dagmarita shahrezaensis* Mohtat-Aghaï and Vachard - Mohtat-Aghai and Vachard, p. 211, pl. 2, figs 21-22; pl. 3, fig. 5.

? 2005 *Dagmarita chanakchiensis* Reitlinger - Hughes, pl. 4, fig. 9.

v. ? 2005 *Dagmarita*? *shahrezaensis* Mohtat-Aghai and Vachard - Vachard et al., p. 155, pl. 3, figs 9-10, 15?

v. 2006 *Dagmarita? sharezaensis* Mohtat-Aghai and Vachard - Gaillot, p. 77-78, pl. I.8, fig. 6; pl. I.37, fig. 16; pl. V.3, fig. 9; pl. VI. 5, figs 1?, 19; pl. VII.2, fig. 18.

Comparison: This species differs from *D. chanackchiensis* and *D. altilis* by the absence of hornlike expansions, but the wall and septal curvature are characteristic of *Dagmarita* genus. This specimen is especially long and thick-walled (hence the open nomenclature).

Occurrence: Questionable in early Changsinghian of Saudi Arabia and Late Changhsingian of Primorye. Late Wuchiapingian-?Changhsingian of central Iran, Himalaya, Transcaucasia, South China and Malaysia. Late Wuchiapingian of central Iran. Late Midian-Changhsingian of Zagros and Hazro (Gaillot, 2006).

Genus ***Bidagmarita*** Gaillot and Vachard gen. nov.

Type species: *Bidagmarita sinica* Gaillot and Vachard nov. gen. nov. sp.

Etymology: From Latin *bis* = two times, doubly, and *Dagmarita* similar genus; because of the double size in comparison to this latter genus and the bilayered wall.

Diagnosis: *Dagmaritin* genus characterized by a great size and a bilayered wall: microgranular outer layer, pseudofibrous inner layer, and a faint curvature backward of the septa.

Composition: *Bidagmarita sinica* nov. sp. ; ?*Dagmarita chanakchiensis* sensu Lys in Lys et al., 1980 and sensu Fontaine et al., 1994, pl. 3, fig. 6; ?*D. caucasica* Vuks in Kotlyar et al., 1984; ?*D*. spp. of *D. chanakchiensis* group sensu Okimura et al. (1985, pl. 1, figs 7-8); *D*. sp. sensu Fontaine et al., 1994, pl. 45, fig. 9.

Comparison: The new genus differs from *Dagmarita* by the great size and the wall, from *Louisettita* by the wall and the absence of endoskeleton.

Occurrence: ?Kalabagh Member, Salt Range, Pakistan; ?Abadeh Formation, central Iran. ?Nikitin Suite (Late Changhsingian) of NW Caucasus. ?Late Changhsingian of Lamayuru Block (Ladakh Himalaya). ?Late Changhsingian of Malaysia. Late Changhsingian of South China (this work).

Bidagmarita sinica Gaillot and Vachard nov. gen. nov. sp.

Fig. 7(4-5)

v. 2006 *Bidagmarita sinica* Gaillot and Vachard nov. gen. nov. sp. Gaillot, p. 78-79, pl. VII.3, figs 4-5 (nomen nudum in a Ph.D.).

v. 2006 *Bidagmarita sinica* Gaillot and Vachard - Vachard et al., fig. 9. 14-15 (nomen nudum, no description).

Etymology: From Latin *Sinicus* = from China.

Type locality: Laren (Guangxi, South China).

Type level: Late Changhsingian.

Diagnosis: As for the genus.

Description: Test large for a Dagmaritin, obviously tapering. Proloculus spherical moderately large. Sagittal axial section (Fig. 7(4)) showing a regular increasing in width and height of the chambers. The pairs of septa which have the typical form of the *Dagmarita* at the beginning: i.e., their end situated in the symmetry plane (which coincides with the axis of development), are progressively distant from each other and the space without septa in the center increases. Horny expansions are proportionally weak in comparison with the size of the test, and a rapid examination can permit to conclude to a palaeotextulariid representative. Nevertheless, the wall and the curvature of septa differ completely. Chamber subtrapezoidal in shape. Septa gently curvated. A small oral tongue terminates the septa and re-inforces the aperture (as in *Dagmarita*). Other endoskeletal elements are absent. Within the wall, the microgranular layer is very thin and the pseudofibrous inner layer has three or four times ticker. In frontal axial section (Fig. 7(5)), excepted the generic differences, the differences with *Dagmarita* or *Louisettita ultima* are rather incipient. No transverse sections were observed.

Dimensions: Height = 0.835-1.025 mm, width = 0.690 mm, test thickness = 0.465 mm, proloculus diameter = 0.020 mm, number of chambers: 8 pairs, height of last chamber = 0.167-0.222 mm, wall thickness = 0.015 mm.

Comparison: No illustration in the literature is comparable.

Holotype: Fig. 7(4) (sample L3).

Type material: Rare form: 4 specimens in 3 thin-sections.

Repository of the type: Natural History Museum, Geneva (Switzerland), holotype number MHNG 07-002.

Occurrence: Late Changhsingian of Laren section (South China, this work).

Genus ***Louisettita*** Altiner and Brönnimann, 1980 emend. herein

Type species: *Louisettita elegantissima* Altiner and Brönnimann, 1980.

Emended diagnosis: The shape is identical to *Dagmarita*, but some endoskeletal elements appear (the “radial partitions” of the original diagnosis) that, in advanced species, form small loops or equivalents to the phrenothecae of some schwagerinoid fusulinids (and not always radial and perpendicular partitions as indicated in the original diagnosis), or backward oriented septa. Wall microgranular, monolayered. Aperture basal simple.

Composition: *L. elegantissima*, *L. ultima* nov. sp., *L. extraordinaria* nov. sp., ?*Paradagmarita dubreuilli* Vachard, 1980 (nomen nudum) (= ?*Paradagmarita* sp. Pronina, 1988a, pl. 2, fig. 14 = Pronina, 1988, pl. 1 fig. 14).

Occurrence: Late Changhsingian. Turkey, Zagros, ?Afghanistan, ?Transcaucasia and ?South China (this work).

Louisettita ultima Gaillot and Vachard nov. sp.

Fig. 6(20-25)

1981 *Dagmarita* sp. - Wang in Zhao et al., pl. 1, fig. 26.

v. 2006 *Louisettita ultima* Gaillot and Vachard in Gaillot, p. 81, pl. I.14, figs 7-10; pl. I.15, figs 8, 16-17; pl. I.19, fig. 14; pl. III.5, fig. 8?; pl. III.6, fig. 12; pl. VI.6, figs 9-14; pl. VI.7, fig. 18; pl. VII.2, figs 20-25.

Etymology: From Latin *ultimus* = ultimate, because this species persists in the latest Permian sequence prior the end Permian mass extinction.

Type locality: Laren (Guangxi, South China).

Type level: Late Changhsingian.

Diagnosis: Test medium sized for the genus, wall thick unilayered, loops few visible, backward curvated septa present.

Description: The species, medium sized for the genus, is a little larger than the type-species *L. elegantissima*, and exhibits a thicker wall. The radial partitions are visible in convenient sections. The main criteria of this species is the development of a backward curvature of the septa (e.g., as in *Retroseptellina*). Large and robust test with thick wall but thin septa. No specimens were observed with regular vertical partitions. Endoskeletal elements very irregularly arranged as small chamberlets: at the base of septa or laterally (Fig. 6 (23)), or loops (Fig. 6(20)) or curvature of septa (Fig. 6(25)). The wall of the last chambers of the specimen 6(21) is finely perforated; this particularity exists also in Turkey (Altiner, unpublished data).

Dimensions: Height (H) = 0.315-0.550 mm, width (w) = 0.145-0.220 mm, w/H = 0.40-0.46, proloculus diameter = 0.025 mm, number of pairs of chambers: 5-6, wall thickness = 0.012-0.020 mm, loop thickness = 0.002mm.

Holotype: Fig. 6(20) (sample L10).

Type material: 28 specimens.

Repository of type: Natural History Museum, Geneva (Switzerland), holotype number MHNG 07-003.

Occurrence: Changhsingian of Eastern Taurus (Hazro), Zagros (Gaillot, 2006) and South China (this work).

Subfamily PARADAGMARITINAE Gaillot and Vachard (submitted)

2006 Paradagmaritinae Gaillot, p. 82 (nomen nudum).

Description: A subfamily of Globivalvulinidae (i.e., with a biserially coiled growth and a microgranular wall, occasionally differenciated) characterised by an uncoiling more or less developed after an initial coiling generally slightly trochospiral.

Composition: *Paradagmarita* Lys in Lys and Marcoux, 1978; *Paradagmarita*? (this study); *Paradagmaritopsis* gen. nov.; *Paradagmaritella* nov. gen. Gaillot and Vachard (nomen nudum, submitted); *Paradagmacrusta* nov. gen. Gaillot and Vachard (nomen nudum, submitted); *Paremiratella* nov. gen. Gaillot and Vachard (nomen nudum, submitted).

Discussion: Differ from Globivalvulininae in the uncoiled part of the test; differ from Dagmaritininae (= Louisettitinae) in the coiled part. No evidence of the phylogenetic filiation from *Dagmarita* to *Paradagmarita* (as proposed by Altiner, 1997) has been observed. A filiation from *Globivalvulina* seems to be more likely (see the specimens of Okimura et al., 1985, pl. 1, fig. 16, and Berczki-Makk et al., 1995, pl. 6, fig. 4).

Occurrence: Lopingian, frequent on both sides of western Neo-Tethys (but quoted from southern Italy to Thailand), and confirmed here in Japan with *Paradagmaritopsis*) and mentioned for the first time in South China (with *Paradagmarita*? sp. and *Paradagmaritopsis*, this work).

Genus ***Paradagmarita*** Lys in Lys and Marcoux, 1978 emend.

Type species: *Paradagmarita monodi* Lys in Lys and Marcoux, 1978.

Emended diagnosis: Small to medium-sized globivalvulinid paradagmaritin characterized by an early stage enrolled, biserial, involute, slightly trochospiral, and a later uncoiled, biserial stage, relatively long. Wall dark, microgranular, relatively thin, uni- or multilayered. Chambers inflated. Aperture simple, terminal, interio-marginal with a valvula.

Occurrence: According to Kotlyar et al. (1989, tabl. 1 n° 24), *Paradagmarita* appears in the latest Khachikian (top of Midian), but the illustrated specimen (pl. 4, fig. 10) looks like *Spireitlina* Vachard in Vachard and Beckary, 1991. Middle Wuchiapingian-Changhsingian. Paleo-Tethyan and Neo-Tethyan (Gaillot, 2006), principally known in Turkey (Taurus), Iran (Zagros), Saudi Arabia (Vachard et al., 2005) and Transcaucasia (Pronina-Nestell and Nestell, 2001), but mentioned from Italy to Japan. The *Paradagmarita* from Afghanistan described by Vachard (1980) rather belong to the genus *Louisettita*. Forms from Thailand and Pakistan are very different. The *Paradagmarita* of Japan (Kobayashi, 1997; 2004) belong to *Paradagmaritopsis*, also observed in South China (this study). Rare *Paradagmarita*, briefly described below, are present in South China.

Paradagmarita sp.

Fig. 6(11, 17)

v. 2006 *Paradagmarita* spp. Gaillot, p. 85-86, pl. I.6, fig. 4, pl. III.2, fig. 7, pl. VII.2, figs 11, 17.

Description: Two cross sections displaying an arcuate beginning of coiling, trocho- or planispiral, followed by a plansipiral coiling with chambers enveloping the apertural face. These characters evoke the genus Paradagmarita or a more peneropliform new genus.

Diameter = 0.300-0.355 mm, number of volution: 1-1.5, number of chambers of last whorl: 6-10.

Occurrence: Changhsingian of Laren (South China, this work).

Genus ***Paradagmaritopsis*** Gaillot and Vachard gen. nov.

Type species: *Paradagmaritopsis kobayashii* Gaillot and Vachard nov. gen. nov. sp.

Etymology: Ending *opsis* = similar to.

Diagnosis: Coiled part very short reduced to the two first chambers, or to the curvature of the axis. Long uncoiled biseriate part. Chambers subelliptical in shape, with oblique long axis.

Comparison: It differs from *Paradagmarita* by the very short coiled part; from *Dagmarita* by the absence of lateral cameral protuberances; from the *Palaeotextularioidea* by the type of wall and the minute size; from *Globispiroplectammina* Vachard, 1977 by the type of wall, and from *Robustulina* Gaillot and Vachard in Gaillot, 2006 by the importance of the uncoiled part.

Occurrence: Late Wuchiapingian-Changhsingian of Zagros (Gaillot, 2006). Changhsingian of Japan and South China (this work).

Paradagmaritopsis kobayashii Gaillot and Vachard

Fig. 6(6-8, 12-14, 15?, 16?)

1997 *Paradagmarita* sp. - Kobayashi, pl. 4, fig. 19.

2004 *Paradagmarita* sp. - Kobayashi, p. 67, fig. 6.47-6.50.

v. 2006 *Paradagmarita* sp. 2 - Insalaco et al., pl. 2, fig. 1.

v. 2006 *Paradagmaritopsis kobayashii* Gaillot and Vachard nov. gen. nov. sp. - Gaillot, p. 87-88; pl. I.9, figs 1-9; pl. I.12, fig. 23; pl. II.15, figs 6-8, 15; pl. II.16, figs 1-2, 6-14; pl. III.15, figs 11-12; pl. III.22, fig. 13; pl. VII.2, figs 6-8, 12-15, 16? (nomen nudum; submitted).

v. 2006 *Paradagmaritopsis kobayashii* Gaillot and Vachard - Vachard et al., figs 10. 8-10.

Etymology: Dedicated to Prof. Fumio Kobayashi, for his work in Permian micropaleontology.

Type locality: Laren (Guangxi, South China).

Type level: Late Changhsingian.

Diagnosis: As for the genus.

Description: The initial deviated part is very short composed of 2-3 pairs of chambers, small, hemispherical suceeding to the proloculus. The uncoiled biserate part is proportionally large formed of asymmetrical ogival chambers often terminated by a mamilla (holotype: Fig. 6(6)). The wall is dark, thin to relatively thick (due to planes of section or local thickennings?). Height = 0.280-0.700 mm, width = 0-160-0.460 mm, proloculus diameter = 0.040-0.050 mm, number of pairs of coiled chambers: 2-3, number of pairs of uncoiled chambers: 3-4. The specimen Fig. 6(15) is exceptionally large with H = 1.500 mm for 8 pairs of chambers, it is unique. The specimen Fig. 6(16) differs by a relatively long coitled stage of one complete whorl, nevertheless as the last chamber is similar to the chambers of the holotype (Fig. 6(6)), it is provisionally considered as forming part of the species.

Holotype: Fig. 6(6) (sample L10).

Repository of the type: Natural History Museum, Geneva (Switzerland) , holotype number MHNG 07-004.

Occurrence: As for the genus.

Paradagmaritopsis sp.

Fig. 6(9-10)

v. 2006 *Paradagmaritopsis* sp. - Gaillot, p. 88, pl. VII.2, figs 9-10.

Description: Two oblique sections in the Chinese material exhibit a coiling apparently diffrent of *P. kobayashii*. Height = 0.425-0.465 mm, width = 0.190 mm, test thickness = 0.130 mm, proloculus diameter = 0.030 mm, number of chambers: 5 pairs, height of last chamber = 0.110-0.130 mm, wall thickness = 0.010 mm.

Occurrence: Late Changhsingian of South China (this work).

Suborder FUSULININA Fursenko, 1958

Superfamily OZAWAINELLOIDEA Thompson and Foster, 1937 nomen translat. Solovieva, 1978 (pro family)

Family REICHELINIDAE Miklukho-Maklay, 1959 nomen translat. Vachard et al., 1993a (pro Reichelininae)

Genus: ***Reichelina*** Erk, 1942

Type species: *Reichelina cribroseptata* Erk, 1942.

Reichelina simplex Sheng, 1956

Fig. 5(6), Fig. 7(12)

1956 *Reichelina simplex* nov. sp. Sheng, p. 290, 299, pl. 1, figs 5-6.

1963 *Reichelina simplex* Sheng - Sheng, p. 149, pl. 1, figs 10-12.

1977 *Reichelina simplex* Sheng - Lin et al., p. 13, pl. 2, fig. 5.

1979 *Reichelina simplex* Sheng - Sun, pl. 1, figs 3-4.

1984 *Reichelina simplex* Sheng - Sheng and Rui, p. 34, pl. 1, fig. 8.

1989 *Reichelina* sp. - Pronina, pl. 2, fig. 5.

1991 *Reichelina simplex* Sheng - Flügel et al., pl. 37, fig. 3.

v. 2006 *Reichelina simplex* Sheng - Insalaco et al., pl. 2, fig. 3.

v. 2006 *Reichelina simplex* Sheng - Gaillot, p. 44-45, pl. I.4, fig. 1, pl. I.5, fig. 12, pl. I.17, figs 2, 18; pl. I.18, fig. 2, pl. I.36, figs 1-2, 8, pl. II.3, fig. 8, pl. II.33, figs 1, 4, 15, 18; pl. III.6, fig. 13; pl. III.7, fig. 1; pl. VI.4, figs 4-5, 17-19; pl. VI.5, fig. 2; pl. VII.1, fig. 6; pl. VII.3, fig. 12.

Description: Our specimens correspond exactly to the smallest dimensions of the populations described by Sheng (1963), with, for the illustrated specimen of Fig. 5(6): Diameter = 0.600 mm, width = 0.150 mm, w/D = 0.25, number of whorls: probably 3, height of the last part = 0.080 mm; and for the other one (Fig. 7(12)): Diameter = 0.410 mm (only the coiled part is cut), width = 0.125 mm, w/D = 0.30, number of whorls: 3.5, proloculus diameter = 0.022 mm.

Discussion: This species described in the Wuchiapingian and Changhsinghian of South China is the smallest of the adult *Reichelina* (we consider *R. minuta* Erk as a juvenile of *R. cribroseptata*). The latest *Reichelina* cited in South China is *Reichelina pulchra* Miklukho-Maklay, 1954 (Sheng et al., 1984, text-fig. 6 p. 143).

Occurrence: Late Midian of Sicily (Flügel et al., 1991), Hazro (Turkey) and Kuh-e Dena (Zagros). Late Changhsingian of Transcaucasia (Pronina, 1989). Lopingian of Kuh-e Surmeh and Fars. Not found in Abu Dhabi wells probably due to restricted environments.

Superfamily STAFFELLOIDEA Miklukho-Maklay, 1949 nomen translat. Solovieva, 1978

Family STAFFELLIDAE Miklukho-Maklay, 1949 nomen traslat. Rauzer-Chernousova et al., 1996 pro subfamily (sic Staffellininae)

Genus ***Nankinella*** Lee, 1933

Type species: *Staffella discoides* Lee, 1931.

Nankinella cf. *inflata* (Colani, 1924)

Fig. 5(12)

Compare with:

1924 *Fusulinella inflata* nov. sp. Colani, p. 77-78, pl. 15, figs 3-5, 7-10, 13, 15; pl. 29, fig. 25.

1963 *Nankinella inflata* (Colani) - Sheng, p. 31-32, 155, pl. 3, figs 1-5 (with 2 references in synonymy).

1977 *Nankinella inflata* (Colani) - Lin et al., p. 14-15, pl. 2, fig. 14.

1998 *Nankinella* cf. *inflata* Colani (sic) - Zhang and Hong, p. 209, pl. 2, fig. 19 (with 5 references in synonymy).

v. 2006 *Nankinella* cf. *inflata* (Colani) - Gaillot, p. 47, pl. VII.1, fig. 12.

Description: Our material contains several oblique sections of a large species with relatively few whorls. They migth belong to N. inflata (Colani, 1924) sensu Sheng, 1963. Diameter = 3.000 mm, width = 2.160 mm, w/D = 0.72 for 10 whorls. Unfortunately, no axial section was found.

Occurrence: Middle to Late Permian of Viet-Nam, South China, Xizang, Thailand, Cambodia, Malaysia, Greece (Chios Island).

Order LAGENIDA Lankester, 1885

Superfamily NODOSARIOIDEA Ehrenberg, 1838

Genus ***Pachyphloia*** Lange, 1925

Type species: *Pachyphloia ovata* Lange, 1925 (see Loeblich and Tappan 1987 and not Sellier de Civrieux and Dessauvagie, 1965).

Occurrence: FAD in the Sakmarian. Acme and specific diversification: Midian-Lopingian (this study in Hazro, Turkey, and Zagros, Iran). LAD Latest Permian.

Pachyphloia pedicula Lange, 1925

Fig. 5(9)

1925 *Pachyphloia pediculus* nov. sp. Lange, p. 232, pl. 1, fig. 23.

1960 *Pachyphloia pediculus* Lange - Sosnina, pl. 1, fig. 6.

1965 *Pachyphloia “pediculus”* Lange – Sellier de Civrieux and Dessauvagie, p. 114-115 (no illustration).

1970 *Pachyphloia pedicula* Lange - Pantic, pl. 10, fig. 9.

1973 *Pachyphloia pedicula* Lange - Bozorgnia, p. 154-155, pl. 36, figs 1-2, 4.

1978 *Pachyphloia pedicula* Lange - Lys and Marcoux, pl. 8, fig. 3

1981 *Pachyphloia pedicula* Lange - Altiner, pl. 40, figs 19-24.

1983 *Pachyphloia pedicula* Lange - Jenny-Deshusses, p. 106, pl. 4, fig. 1 (with 4 references in synonymy.

1986a *Pachyphloia* sp. - Nguyen Duc Tien, pl. 1, figs 19-20.

1990 *Pachyphloia pediculus* Lange - Lin et al., p. 243, pl. 32, figs 7-8.

1992 *Pachyphloia pedicula* Lange - Berczi-Makk, pl. 1, fig. 2.

1995 *Pachyphloia pedicula* - Berczi-Makk et al., pl. 2, figs 6-8; pl. 9, figs 6?, 7?

2004 *Pachyphloia pediculus* Lange - Zhang and Hong, p. 76, pl. 3, fig. 25 (with 2 references in synonymy).

v. 2006 *Pachyphloia pedicula* Lange - Gaillot, p. 167, pl. I.26, fig. 7; pl. I.27, fig. 9; pl. III.27, fig. 8; pl. VI.11, fig. 2; pl. VI.12, fig. 3; pl. VI.13, fig. 3; pl. VII.1, fig. 9.

Description: Test medium sized with relatively few chambers. Height = 0.750 m, width = 0.560 mm, w/H = 0.75, number of chambers: 8 or 9, proloculus diameter = 0.025 mm, height of last chamber = 0.120 mm, wall thickness = 0.020 mm.

Occurrence: Late Midian of Sumatra. Late Midian, Wuchiapingian and Changhsingian of Hazro (eastern Taurus, Turkey). Late Changhsingian of NW Caucasus, Hungary, Alborz, Turkey, Transcaucasia and South China.

Family FRONDINIDAE Gaillot and Vachard in Gaillot et al. (submitted)

2006 Frondiniidae fam. nov. - Gaillot, p. 195 (nomen nudum in a Ph.D.).

2006 Frondinidae fam. nov. Gaillot and Vachard in Gaillot et al., p. 158-159 (nomen nudum; submitted).

Diagnosis: A family of Nodosarioidea relatively common during the Midian/Capitanian and the Late Permian. This family is characterized by its dark (microgranular?) wall and the embracing shape of the chambers. Apertures are smooth or with an internal neck.

Composition: *Frondina* Sellier de Civrieux and Dessauvagie, 1965; *Ichthyofrondina* Vachard in Vachard and Ferrière, 1991 emend.

Comparison: The family differs from all the other groups of Nodosarioidea by the return to a dark wall (this of the distant ancestor *Earlandia*; Vachard, 1994), whereas the members of the family are rigorously homeomorph of some typical Nodosarioidea such as *Ichtyolaria* Wedekind, 1937. The link between ancestral *Nodosinelloides* and Frondinidae can be represented by an unknown genus which would present the partial disappearance of the yellow external layer of the wall.

Occurrence: Capitanian-Changhsingian. Palaeo-Tethys and Neo-Tethys.

Genus ***Ichthyofrondina*** Vachard in Vachard and Ferrière, 1991 emend.

Type species: *Ichthyolaria latilimbata* Sellier de Civrieux and Dessauvagie, 1965.

Synonyms: *Frondina* Sellier de Civrieux and Dessauvagie, 1965 (pars); *Lingulina* (pars); *Pseudoglandulina* sp.; *Ichthyolaria* (pars); *Frondicularia* Defrance, 1824 (pars).

Emended diagnosis: Test uniseriate. Chambers palmate, strongly embracing, rarely evolute. Wall hyaline but apparently dark. Aperture simple, terminal, central, with or without two inner oral tongues.

Composition: *Ichthyolaria latilimbata* Sellier de Civrieux and Dessauvagie, 1965; *I. nessenensis* Bozorgnia, 1973; *I. primitiva* Sellier de Civrieux and Dessauvagie, 1965; *Frondicularia*? *arpaensis* Pronina in Kotlyar et al., 1989; *F. guangxiensis* Lin, 1978?; *F. simplex* Lin, 1978; *F. palmata* Wang, 1974; *Frondina parvula* Pronina in Kotlyar et al., 1989; *Frondina* sp. 1 sensu Pronina, 1988 (pl. 2, figs 47-48), and 1989 (pl. 1, figs 23-24).

Occurrence: Late Midian-Changhsinghian, Palaeo-Tethys and Neo-Tethys. (Turkey, Iran, Transcaucasia, South China, Thailand, New Zealand. Changhsingian South China, North Caucasus and Transcaucasia).

Ichthyofrondina palmata (Wang, 1974)

Fig. 5(11)

1974 *Frondicularia palmata* nov. sp. Wang, p. 287, pl. 149, fig. 11.

1978 *Frondicularia palmata* Wang - Lin, p. 43, pl. 8, fig. 30.

1981 *Frondicularia palmata* Wang - Zhao et al., pl. 3, figs 17-18.

1988 *Frondina palmata* (Wang) - Pronina, pl. 2, figs 49-50.

1989 *Frondina palmata* (Wang) - Pronina, pl. 2, figs 21-22.

p. 1990 *Frondicularia palmata* Wang - Lin et al., p. 232, pl. 29, figs 12-14 (non figs 15-16 = *I. latilimbata*).

non 1997 *Lunucammina palmata* (Wang) - Kobayashi, pl. 3, figs 13-14 (= *Nodosinelloides*? sp.).

non 2001 *Frondina palmata* (Wang) - Pronina-Nestell and Nestell, pl. 2, fig. 19 (another species of *Ichtyofrondina*).

non 2001 *Lunucammina palmata* (Wang) - Kobayashi, pl. 1, figs 23-24 (= *Nodosinelloides*? sp., as in 1997).

non 2002 *Lunucammina* cf. *palmata* (Wang) - Kobayashi, pl. 3, figs 13-14 (= *Frondina* or another species of *Ichthyofrondina*).

2005 *Ichthyofrondina palmata* (Wang) - Groves et al., p. 25, figs 22.1-5.

v. 2006 *Ichthyofrondina palmata* (Wang) - Gaillot, p. 160-161, pl. I.27, fig. 6, pl. VII.1, fig. 11.

Description: Test minute. Palmate chambers, completely enveloping the preceeding ones, but with the proloculus remaining prominent. Sutures absent. *I. latilimbata* (Sellier de Civrieux and Dessauvagie, 1965) and its probable synonym *Ichthyofrondina guangxiensis* (Lin, 1978) is larger, with less enveloping chambers. Our specimens are strictly similar to the *I. palmata* described by Lin et al. (1990). Height = 0.300 mm, width = 0.180 mm, w/H = 0.60, number of chambers: 6, proloculus diameter = 0.020 mm, height of last chamber = 0.060 mm, wall thickness = 0.005 mm.

Occurrence: Lopingian of South-China, Turkey, Zagros and Transcaucasia (Gaillot, 2006).

6. Palaeobiogeographic implications

The palaeogeographic distribution of the biseriamminoids described herein is interpreted to be typically Neo-Tethyan, ranging from southern Turkey (Hazro) to South China (Laren), and even reaching Japan for some genus (i.e., *Paradagmaritopsis*).

Kobayashi (2004) indicated the presence of *Paradagmaritopsis* in Japan, under the name of *Paradagmarita* sp., together with two important biogeographical markers: *Globivalvulina* sp. and *Partisania* sp., respectively. The recent discovery of these taxa in the Late Permian strata of the Arabian Plate (Gaillot, 2006) suggests that many taxa, which are supposed to be limited to the western Neo-Tethys, may in fact migrate towards Panthalassa *(*i.e., Japan).

Those taxa appear to be apparently absent in other well-known Tethyan areas such as Oman, Afghanistan or Pakistan, as well as South China or Thailand. The possibilities which may explain the lack of these taxa in several regions are: (a) gaps in the geological record; (b) fossil preservation (taphonomy); (c) unfavourable depositional environments and/or substrates and (d) disappearance of the original area by subduction. The lack of data is evidently very important because it could completely avoid the palaeobiogeographical reconstructions.

As put forward by various authors however, some Upper Permian biogeographic markers are useful to constrain palaeobiogeography; they are *Shanita* (e.g., Sengör et al., 1988; Ueno, 2003), *Palaeofusulina* and *Colaniella* (e.g., Kobayashi, 1999). In addition, the distribution of Globivalvulinidae, and especially of *Paradagmarita* (Sengör et al., 1988; Gaillot and Vachard, 2004), re-inforces the palaeobiogeographic provinces previously proposed. They indicate that the BaoShan Block (Yunnan) and Lhassa Block (Xizang) are related to the Peri-Gondwan border and/or to another ancient plate, more or less directly linked to Gondwana. According to the data provided by literature, microfaunal comparisons with foraminifers of

Padang (Sumatra) and Salt Range, as well as of Lamayuru (close to the Indus Suture) are difficult to establish because of the differences on ages and assemblages. The North Chinese Tarim Basin and Kun-Lun Mountains are related to the Peri-Hercynian Block based on the palaeobiogeographic distribution of Viséan foraminifers and calcareous algae, as well as on the presence of *Eopolydiexodina* (e.g., Vachard and Bouyx, 2002).

South China and Indochina Blocks are in Extra-Gondwanan (or Cimmerian: Sengör, 1979, or Extra-Hercynian new name) location. Well constrained in latitude (Ziegler et al., 1997), these two blocks are conversely not constrained in longitude and could be located more westward and almost in connection with Iran (see also the palaeomagnetic data of Besse et al., 1998). A more western location of these blocks may well also explain the striking similarities between Vietnam and Greece, both studied at the beginning of the twentieth century by Deprat (1912) (see also Théry et al., 2007).

Considering that the blocks of North China and Mongolia have undergone similar westward displacement, we obtain a Pangea scheme, applicable to the Carboniferous and Permian distribution of foraminifers and calcareous algae (Gaillot, 2006).
In this configuration, the oceans precluding the collisional belts have been narrow oceans or sea ways, comparable to recent Red Sea. Fossils distribution emphasizes that during the Late Permian, the Zagros (Iran), Taurus (Turkey), South China and even Japan shared similar foraminiferal assemblages and represented intermittently connected palaeobiogeographic provinces. However, it is to be noted that neither *Shanita* nor *Monodiexodina* have been found in the Laren material.

A second possible hypothesis could take into account the model of an ever-green-Pangea, also characterised by narrow oceans. This palaeogeographic configuration had existed from Cambrian to Early Jurassic explaining the different palaeogeographic reconstructions that followed each other all over this interval of time. The lack of oceanic bottom remnants is easily explained by the evolution through time of different Tethyan basins, which continuously originate, or vanish, from refitting and remodelling of land masses.
The foraminiferal migration ways and the direction of migration are poorly understood due to the gaps indicated above and particularly due to the paucity of data in Himalaya. More likely, the two palaeo-provinces: Taurus-Zagros-Oman-Saudi Arabia-south and central Afghanistan, and western Myanmar-western Thailand-Bao Shan, could directly be connected with South China as well as with Indochina (Fig. 8). Hence, the Middle-Late Permian distribution of foraminifers and calcareous algae suggests that no major Pangea break-up, without any far

migration of tectonic plates, occured since the end of the Early Permian, after the formation of collisional suture of Urals.

7. Conclusions

The exhaustive study and inventory of the foraminiferal assemblage enclosed within the beds preceding the Permian-Triassic boundary in the Laren section (Guangxi Province, South China) allow us to highlight the following features:

1. The Laren section illustrates an excellent outcrop straddling the Permo-Triassic boundary (Galfetti et al., 2007).

2. The latest Permian is mainly characterized by shallow-water calcisponge reef limestones. The bioclastic carbonate microfacies contain a rich and well diversified foraminiferal and algae microfauna.

3. The existence of new phylogenetic lineages among the biseriamminoids foraminifera is evidenced. They concern the genera *Retroseptellina*, *Septoglobivalvulina*, *Paraglobivalvulinoides*, *Louisettita*, *Paradagmaritopsis* nov. gen. and *Paradagmarita*. For South China, the main implication is that the phylogeny of the new herein described subfamily Paradagmaritinae represents the main framework for the latest Permian (Lopingian) biozonation.

4. The Persian Gulf possibly acted as a radiative pole for the Paradagmaritinae. From there, a pool of initially endemic species intermittently spread towards relatively closed palaeobiogeographic domains. In South China, up to Japan, the main correlable event is represented by the lineage *Globivalvulina/Paradagmarita* transitional forms to *Paradagmaritopsis kobayashii* nov. gen. nov. sp.

5. Survivors of superfamilies Palaeotextularioidea and Tetrataxoidea, have appeared since the Early Carboniferous, such as *Tetrataxis* and *Climacammina*, are relatively common up to the PTB.

6. Algae, miliolids and nodosarioids are poorly represented.

7. Six taxa are newly described: *Globivalvulina curiosa* nov. sp., *Louisettita ultima* nov. sp., *Bidagmarita* nov. gen., *Bidagmarita sinica* nov. gen. nov. sp., *Paradagmaritopsis* nov. gen., and *Paradagmaritopsis kobayashii* nov. gen. nov. sp.

8. *Paradagmarita*, *Paradagmaritopsis* and *Paradagmarita*? constitute the subfamily Paradagmaritinae, which parallel evolves with the globivalvulinid families: Globivalvulininae, Dagmaritinae and Paraglobivalvulinae.

9. The palaeogeographic distribution of the biseriamminoids is typically Neo-Tethyan, spanning from southern Turkey (Hazro) to South China (Laren); *Paradagmaritopsis* even attains Japan. Consequently, during the Late Permian, Zagros (Iran), Taurus (Turkey), South China and even Japan shared similar foraminiferal assemblages and represented intermittently connected palaeobiogeographic provinces.

10. The migration ways and the direction of migrations are poorly understood essentially due to the paucity of data in Himalaya. Nevertheless, some key-areas such as Thailand, Burma, South China, Afghanistan, Pamir, Salt Range and Oman, should provide further data to figure out.

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Figure captions

Fig. 1. Geographic map of the Western Guangxi Province with location of the studied areas and distribution of Late Permian platforms (modified after Rigby et al. 1989b).

Fig. 2. Outcrop photograph of the detailed Permo-Triassic boundary at Laren section. Note the contrasting lithologies between the Late Permian calcisponge reefs of Wujiaping Fm. and the Early Triassic calcimicrobial limestones of Luolou Fm.; scale = 6 m.

Fig. 3. Field photographs showing latest Permian (late Changhsingian) reef limestones associated with the calcisponges bioconstruction of Laren. **(a)** Calcisponges in life position; scale = 5 cm. **(b)** Longitudinal section of the calcisponges; scale = 5 cm. **(c)** Transverse sections of the same calcisponges; scale = 2,5 cm. **(d)** Sponges of the genus *Discosiphonella* and silicified brachiopods; scale = 1,25 cm.

Fig. 4. Thin-section photomicrographs of the bioclastic wacke/packstones associated with the calcisponge reefs. **(a)** Neosparitized bioclastic limestone showing *Neodiscus* sp.,

Climacammina sp. (several sections) and *Tetrataxis* sp. Thin section L10b (coll. T. Galfetti); scale 500 µm. **(b)** Similar microfacies showing *Paraglobivalvulinoides* sp., *Climacammina* sp. and *Neodiscus* sp. Thin section L10b (coll. T. Galfetti); scale = 500 µm. **(c)** Neosparitized, slightly silicified, bioclastic and peloidal wackestone showing *Climacammina* sp. and *Nankinella* sp. Thin section L6 (collection T. Galfetti); scale = 500 µm.

Fig. 5. (1). *Paraglobivalvulinoides septulifer* (Zaninetti and Altiner, 1981). Subaxial section. Sample L6. **(2).** *Climacammina tenuis* Lin, 1978. Sagittal axial section. Sample L6. **(3-5).** *Postendothyra micula* (Sosnina in Sosnina and Nikitina, 1977). **3.** Axial section. Sample L3. **4.** Axial section. Sample L6. **5.** Transverse section. Sample L6. **(6).** *Reichelina simplex* Sheng, 1956. Subaxial section. Sample L3. **(7).** *Eotuberitina spinosa* (Lys in Lys et al., 1980), Transverse section. Sample L10. **(8).** *Tetrataxis lata* Spandel, 1901. Subaxial section. Sample L3. **(9).** *Pachyphloia pedicula* Lange, 1925. Axial section. Sample L3. **(10).** *Pseudotristix* sp. Subaxial section difficult to separate from a *Geinitzina* but here associated in Fig. 7(3), and differing from the other true *Geinitzina* of the same thin section by the sises of the test and the chamber. Sample L10. **(11).** *Ichtyofrondina palmata* (Wang, 1974). Axial section. Sample L6. **(12).** *Nankinella* cf. *inflata* (Colani, 1924) emend. Sheng, 1963. Recrystallised axial section. Sample L10.

Fig. 6. (1). *Globivalvulina bulloides* (Brady, 1876). Transverse section. Sample L3. **(2).** *Septoglobivalvulina distensa* (Wang in Zhao et al., 1981). Transverse section. Sample L3. **(3).** *Septoglobivalvulina* sp. 1. Transverse section. Sample L10. **(4).** *Retroseptellina nitida* (Lin, Li and Sun, 1990). Subtransverse section. Sample L10. **(5).** *Retroseptellina decrouezae* (Köylüoglu and Altiner, 1989). Subtransverse section. Sample L3. **(6-8, 12-14, 15?, 16?).** *Paradagmaritopsis kobayashii* Gaillot and Vachard nov. gen. nov. sp. **6.** Holotype. Transverse section. Sample L10. **7.** Paratype. Axial section. Sample L3. **8.** Paratype. Subaxial section. Sample L6. **12.** Paratype. Axial section. Sample L10. **13.** Paratype. Transverse section. Sample L3. **14.** Paratype. Oblique section. Sample L10. **15.** Paratype? Anatypical large subaxial section. Sample L6. **16.** Paratype? Anatypical long coiled initial part. Sample L6. **(9-10).** *Paradagmaritopsis* sp. **9.** Subaxial frontal section. Sample L6. **10.** Sagittal axial section. Sample L6. **(11, 17).** *Paradagmarita* sp. Two subtransverse sections. Sample L10. **(18).** *Dagmarita*? cf. *sharezaensis* Mohtat-Aghai and Vachard, 2003. Oblique section. Sample L10. **(19).** *Dagmarita altilis* Wang in Zhao et al., 1981. Axial section. Sample L3. **(20-25).** *Louisettita ultima* Gaillot and Vachard nov. sp. **20.** Holotype. Oblique section showing the

endoskeleton. Sample L10. **21.** Paratype. Oblique sagittal section; the wall of the last chamber is finely perforated; this particularity exists also in dagmaritins of Turkey (Altiner, unpublished data). Sample L10. **22.** Paratype. Oblique section. Sample L6. **23.** Paratype. Oblique section showing small lateral chamberlets. Sample L10. **24.** Paratype. Oblique section. Sample L6. **25.** Paratype. Oblique section showing the curvature of the septa and the lateral chamberlets. Sample L10.

Fig. 7. (1-2). *Ramovsia?* sp. **1.** Recrystallized longitudinal section attached on a gastropod (right). Sample L3. **2.** Longitudinal section with more typical wall, differing from *Earlandia/Aeolisaccus* by the size and the asymmetry. Sample L3. **(3).** *Pseudotristix* cf. *solida* Reitlinger, 1965. Transverse section. Sample L3. **(4-5).** *Bidagmarita* sinica nov. gen. nov. sp. **4.** Holotype. Sagittal axial section. Sample L3. **5.** Paratype.Frontal axial section. Sample L3. **(6, 8).** *Asterosphaera* sp. Two sections showing the type of wall and the crenulata inner periphery characteristic of the genus according to Vachard and Clément, 1994. Sample L6. **(7).** *Radiosphaerina*? sp. The outer periphery is more irregular and the inner periphery not circular, two differences with a transverse section of a costulate nodosarioid. Sample L3. **(9-10).** *Asterosphaera* cf. *pulchra* Reitlinger, 1957. **9.** A typical tangential section. Sample L6. **10.** Very rare type of section showing two connected specimens. Sample L3. **(11).** *Rectostipulina* cf. *quadrata* Jenny-Deshusses, 1985. A very rare octogonal transverse section. Sample T0. **(12).** *Reichelina simplex* Sheng, 1956. Axial section in the coiled part. Sample T0. **(13).** *Donezella* sp. A probably new species with a large thallus without visible bifurcation, but exhibiting the typical wall. Sample L6. **(14).** *Septoglobivalvulina* cf. *guangxiensis* Lin, 1978. Axial section. Reworked Wuchiapingian. Sample T0. **(15).** *Sphaerulina* sp. Transverse section. Sample T0. **(16-21).** *Globivalvulina curiosa* nov. sp. **16.** Holotype. Transverse section. **17.** Paratype. Subtransverse section. **18.** Paratype. Oblique section. **19.** Paratype. Oblique section. **20.** Paratype. Subaxial section. **21.** Paratype. Transverse section. Sample T1.

Fig. 8. Palaeogeographic reconstruction and location of *Paradagmarita* Subprovince (light grey). 1: Italy; 2: Tunisia; 3: Ex-Yugoslavia; 4: Albania; 5: Hungary; 6: Greece; 7: Cyprus; 8: Crimea; 9: Caucasus; 10: Anatolia; 11: Taurus; 12: Oman-Saudi Arabia; 13: Zagros; 14: Alborz; 15: Afghanistan; 16: Salt Range; 17: SE Pamir; 18: Himalaya; 19: Kashmir; 20: Tibet; 21: South China; 22: Thailand-Burma; 23: Malaysia; 24: Indosinia; 25: Primorye-Koryak; 26: Japan; 27: “Kobayashi block” (according to Kobayashi, 2004). After Gaillot, 2006, modified.