This volume will draw the attention of everyone interested in the fascinating diversity of ancient ecosystems such as reefs and shell accumulations in the Palaeozoic, whose difficulty of study rests primarily on its multidisciplinary position crossing numerous geological disciplines. Their facies characterization is, like many other biosedimentary structures, a process that requires the acquisition and integration of a wide and multi-scale diversity of observations, which include field (global geometries), sample (fabrics), and thin-section (textures) scales.

One of the messages of this collection of papers is the wide diversity of sedimentary geometries and facies displayed by Palaeozoic reefs, shell accumulations, and transitional composite deposits. We have touched on some of the major issues at this stage of development in the field: the major climatic, environmental and evolutionary factors that controlled the Palaeozoic development of shell accumulations and reefs.

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Illustration page 277: Tubiphytes-Archaolitoporella-bryozoan boundstone, Asselian, Urals (Russia).
LATEST PERMIAN CALCISPONGES OF LAREN, GUANGXI PROVINCE, SOUTH CHINA

LOCALITY. — 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. 1995). 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. 1989a, b).

The southern margin of the Yangtze platform was embayed by the Nanpanjiang Basin (sensu Lehrmann et al. 1998) which was widely opened southward and extended into central Guizhou. Dominant deep-water deposits surrounded various carbonate platforms dispersed within the basin. The Laren area lies on the margin of one of these isolated platforms (Fig. 85) and is located in the Fengshan District of the northwestern Guangxi Province.

STRATIGRAPHY. — In South China, largely because of post-sedimentary faulting, complete Late Permian-Early Triassic sections are often very rare. The Laren profile is a particular exception. In fact, it illustrates an excellent outcrop straddling the Permo-Triassic Boundary apparently devoid of hiatuses (Galfetti et al. 2007). The latest Permian Wujiaping Formation is characterized by shallow-water reef limestones. These rocks are drastically overlain by a ~7.5 m-thick unit of calcimicrobial limestones of earliest Triassic age (Griesbachian) (Fig. 86).

The foraminifer assemblage (see below) within the beds preceding the Permain-Triassic boundary allows to attribute a late Changhsingian age, while the nearly total absence of index fossils immediately after the boundary does not consent to precisely date the base of the calcimicrobial unit. However the base of these beds is bed-parallel and the bottom surface does not show any evidence of erosion processes. The occurrence of foraminiferal “disaster forms” such as Earlandia sp., Rectocornuspira kalhori, Spirorbis phylactaena, Cornuspira mahajeri as well as rare nodosarioids, two and seven meters above the latest Permian beds, leads to suggest a Griesbachian (earliest Triassic) age for the calcimicrobial unit.

FIG. 85. Geographic map of the West Guangxi Province, location of the studied area (black star) and distribution of the Permian platform (modified after Rigby et al. 1989b).
FIGS 86-93. 86, The Permian-Triassic boundary at Laren (South-China), with the studied calcisponge reefs capped by calcimicrobial limestones of earliest Triassic age; scale = 5 m. 87-90: Field photographs showing latest Permian (late Changhsingian) reef limestones associated with the calcisponge bioconstruction of Laren. 87, Calcisponges in life position; scale = 5 cm. 88, Longitudinal section of the calcisponges; scale = 5 cm. 89, Transverse sections of the same calcisponges; scale = 2,5 cm. 90, Rugose corals and silicified brachiopods; scale = 1,25 cm. 91-93: Microfacies of the bioclastic wacke/packstones associated with the calcisponge reefs. 91, Neosparitized, slightly silicified, bioclastic and peloidal wackestone showing Climacammina sp. and Nankinella sp. Thin section L6 (collection T. Galfetti); scale = 500 μm. 92. Neosparitized bioclastic limestone showing Paraglobivalvulinoides sp., Climacammina sp. and Neodiscus sp. Thin section L10b (coll. T. Galfetti); scale = 500 μm. 93, Similar microfacies showing Neodiscus sp., Climacammina sp. (several sections) and Tetrataxis sp. Thin section L10b (coll. T. Galfetti); scale 500 μm.
FACIES AND MICROFACIES (Figs 86-93). — Permian strata are easily recognizable in South China because of their typical, spectacular karst morphology. Macroscopically, Late Permian rocks are generally very massive, dark-colored and frequently accompanied by centimetric to decimetric black chalk concretions. At Laren these beds display an extraordinarily, well preserved faunal assemblage (e.g., brachiopods, gastropods, rugose corals, very large calcareous algae and calcareous porifera) (Figs 87-90). Geometrical fossils orientation has not been observed excepting for a sphinctozoan colony which illustrates a planar setting (Fig. 87). Microfacies analysis on thin sections (Figs 91-93) revealed that these skeletal, peloidal pack/grainstones are mainly associated with: rare gastropods, rare incertae sedis Tubiphytes (non Shamovella) obscurus Maslov, rare fusulinids Nankinella cf. inflata (Colani) emend. Sheng, and Reichelina simplex Sheng, as well as abundant and diversified small foraminifers, especially biseriamminids. Among foraminifers, the following taxa have been recognized: Eotubertina spinosa (Lys in Lys et al.); Postendothyra micula (Sosnina in Sosnina & Nikitina); Globovalvulina curiosa Gaillot & Vachard in Gaillot et al.; G. kantharensis Reichel; G. vonderschmitti Reichel; G. bulloides (Brady); Septoglobivalvulina distensa (Wang in Zhao et al.); S. cf. guangxiensis Lin; S. sp. 1; Dagmarita chanakchiensis Reitlinger; D. altillis Wang in Zhao et al.; D.? cf. sharezaensis Mohtat-Aghai & Vachard; D. simplex Wang in Zhao et al.; Bidagmarita sinica Gaillot & Vachard in Gaillot et al. (with pseudo-fibrous inner layer); Siphodagmarita vasleti Gaillot & Vachard in Gaillot et al.; Louisettitina ultima Gaillot & Vachard in Gaillot et al.; Retroseptellina decrouzeae (Koyluoglu & Altiner); Retroseptellina nitida (Lin et al.); Paraglobivalvulinoidea septulifer (Zaninetti & Altiner); Paradagmaritopsis kobyayashii Gaillot & Vachard in Gaillot et al.; Paradagmaritopsis sp. and Paradagmaritopsis sp. They are associated with relatively rare nodosarioids, such as Rectostipulina sp., Nodosinelloides sp., Geinitzina sp., Pseudotristix cf. solida Reitlinger, Pachyphloia pedicula Lange, P. ex gr. ovata Lange, and Ichthyofrondina palmata (Wang). Miliolids are very rare with some tubes of Pseudovermiporella nipponica (Endo in Endo & Kanuma). Phylogenetically older forms (early to late Mississippian), such as Climacammina (C. tenuis Lin) and Tetrataxis (T. lata Spandel) are relatively frequent (Figs 91-93). The latter aspect seems to be common in the late Changhsingian (Gaillot 2006).

BIODIVERSITY AND TAPHONOMY. — As indicated by Rigby et al. (1989a, b), the biodiversity of the sphinctozoans is generally poor in these reefs, whereas the smaller foraminifers belong to diverse families. Here the biseriamminids are especially diversified with the genera and subgenera Globovalvulina, Dagmarita, Septoglobivalvulina?, Louisettitina?, Paradagmaritopsis, Paraglobivalvulinoidea and Paradagmaritopsis n. gen. This diversity has been already pointed out in the Chinese literature (e.g., Lin et al. 1990).

DISCUSSION. — The abrupt transition at the Permian-Triassic boundary, from bioclastic pack/grainstones containing foraminifers with sophisticated endoskeletons, to calcimicrobial limestones showing a total lack or extreme rarity of very simple, undivided foraminifers is known from Turkey to South China (e.g. Groves & Altiner, 2005). Nevertheless, the last Permian reefs in the late Changhsingian are very rare in this Neo- and Palaeo-Tethyan Provinces. Exceptions were described in Greece and South China (Flügel & Reinhardt 1989; Weidlich 2002; Weidlich et al. 2003; this study), and NW Caucasus (Théry et al. this volume); the sphinctozoan and inozoan bioconstructions (Rigby et al. 1989a, b) are especially famous.

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