
Report

Chinese fusulinaceans kept in the Museum of Nature and Human Activities, Hyogo, Japan

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Abstract

The eastern Tethyan fusulinacean faunas are best represented by Chinese examples. They are taxonomically much more diverse than those reported from outside China, particularly those of the Middle and Late Permian. Some fusulinaceans characteristic of China are kept in the Museum of Nature and Human Activities, Hyogo, Japan. They are available for comparative fusulinacean studies between China and sources outside China. Fusulinaceans contained in 130 pieces of limestone thin sections, prepared in China, range from Bashkirian (lowest Upper Carboniferous) to Changhsingian (uppermost Permian). Some photomicrographs of their limestone petrologies and well-oriented fusulinaceans are included herewith, to illustrate aspects of the present materials, in addition to brief notes on their geographic and biogeographic distributions. Limestone petrology and foraminiferal faunal composition of each are shown in appendix.

Key words: Chinese fusulinaceans, registration, geographic and biostratigraphic distributions, foraminiferal fauna

Introduction

A great number of reports in the literature illustrating fusulinaceans, describing their morphologic characters, and discussing their phylogeny and biostratigraphic distribution, have been published in many places in China. It seems to be generally difficult for foreign paleontologists outside China to understand these works in the case of those written exclusively in Chinese.

Chinese fusulinaceans, on the other hand, are very important on account of their taxonomically diverse faunas in particular Middle and Late Permian examples representing those of the East Tethyan Province (Kobayashi, 1997; 1999) covering East and Southeast Asia. Details on fusulinacean morphologic characters, their morphologic variation, and the relationship between limestone petrology and faunal composition are closely recognizable through the microscopic observation of limestone thin sections in addition to the original description and illustration.

One hundred and thirty specimens of limestone thin sections, prepared in China, are registered and kept in the Museum of Nature and Human Activities, Hyogo (MNHAH). Many fusulinaceans contained in these sections are available for comparative fusulinacean studies between China and outside China, on account of their excellent preservation and their various ages ranging from early Late Carboniferous (Bashkirian) to latest Permian (Changhsingian). Almost all of these thin sections are less than 1 cm², and locality name, and one representative genus name are denoted exclusively to each of them. They contain many fusulinaceans characteristic in China but rare or absent in Japan, such as *Leella*, *Pisolina*, *Wutuella*, *Gallowaiina*, and *Ziguiella*, and others. The MNHAH provides paleontologists with these thin sections for reference and comparison purposes.

This paper shows the result of the examination of faunal constituent of Chinese fusulinaceans kept in the collection of the MNHAH. Geographic and

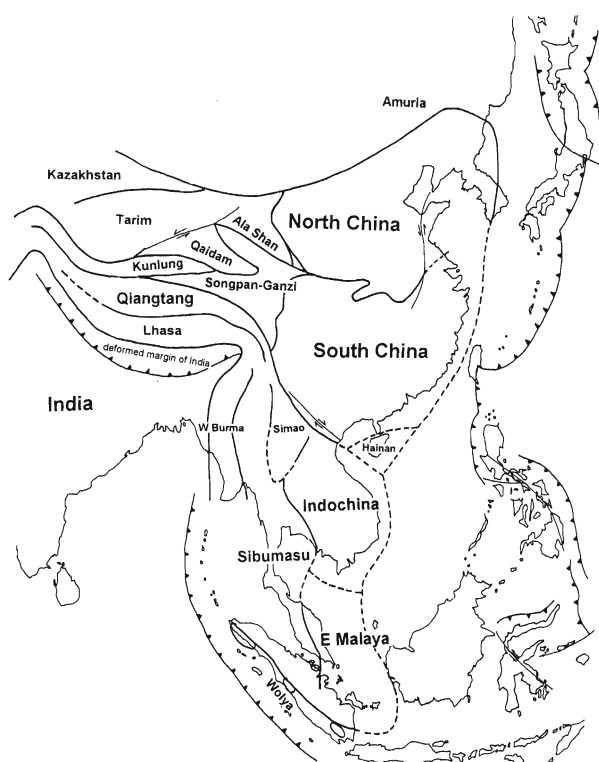


Fig. 1. Tectonic map of East and Southeast Asia (Kobayashi, 1999).

biostratigraphic distributions of the present materials are shown with brief notes on the Upper Paleozoic tectonic and paleontologic implications of China on account of their bearing on East and Southeast Asia including Japan. Limestone petrology and foraminiferal faunal composition in each thin section are presented as an appendix of this paper. Photomicrographs of some of these fusulinaceans and limestone petrologies are included herewith to illustrate aspects of the present materials.

Geographic Distribution

China and its surrounding areas are divisible into several tectonic units, such as North China, South China, Tarim, Kunlun, Lhasa, and others, by differences in their geologic development (Fig. 1). They lay far away in each other before their amalgamation since the Late Paleozoic Era (Fig. 2).

Distribution, stratigraphy, depositional facies, and lithologic composition of the Chinese Upper Paleozoic

are variable in places and ages (e. g., Yang et al., 1985). They are deeply concerned with the tectonic history of China and global sea-level fluctuation. For example, in North China, which began to collide with South China in the Early Permian, the Upper Paleozoic consists of shallow marine deposits intercalating coal measures and weathered residual soils in the Carboniferous and lower part of the Permian, and terrestrial deposits in the rests of Permian. Global climatic warming change and rifting in the northern margin of Gondwanaland started at the beginning of late Early Permian time and controlled the Upper Paleozoic carbonate deposition in the Lhasa block where the Upper Carboniferous and Lower Permian are represented by cool biota and glacial deposits.

Among these continental blocks, the Carboniferous and Permian of South China, which had lain under the tropical Paleo-Tethys throughout that time (Fig. 2), are composed of nearly continuous carbonate successions, and yield abundant marine faunas. Fusulinaceans are rich in species diversity as well as other faunas and consist of many taxa distinctive to South China especially in the Middle and Upper Permian.

Localities of limestone thin sections kept in the MNHAH extend to ten states and three autonomous political regions of (the People's Republic of) China (Fig. 3). Their rather wide distribution through the Upper Carboniferous and Lower Permian may be related to widespread marine deposits at that time throughout China, except for South Tibet (Lhasa Block). Furthermore, concentration of their distribution in South China seems to be due to limestone deposition throughout the Upper Paleozoic in South China. North Chinese, Kunlun and Tibetan examples are rare or absent in our materials.

Fusulinacean data of China are exceedingly voluminous and internationally very important. Some of them should be examined from the viewpoint of paleobiogeography and tectonic development, such as the late Middle Permian *Lepidolina-Sumatrina* fauna from the easternmost part of Jilin (Han, 1980). Interpretation of its occurrence from North China is uneasy, but very interesting and significant. This fauna from Jilin is closely related to that of South China as well as Akiyoshi, belonging paleobiogeographically to the Eastern Tethyan Province (Kobayashi, 1997; 1999). Fusulinacean faunas and their distribution in China are indispensable for various kinds of Japanese paleontologic studies and related sciences because of their degree of faunal similarities between China and

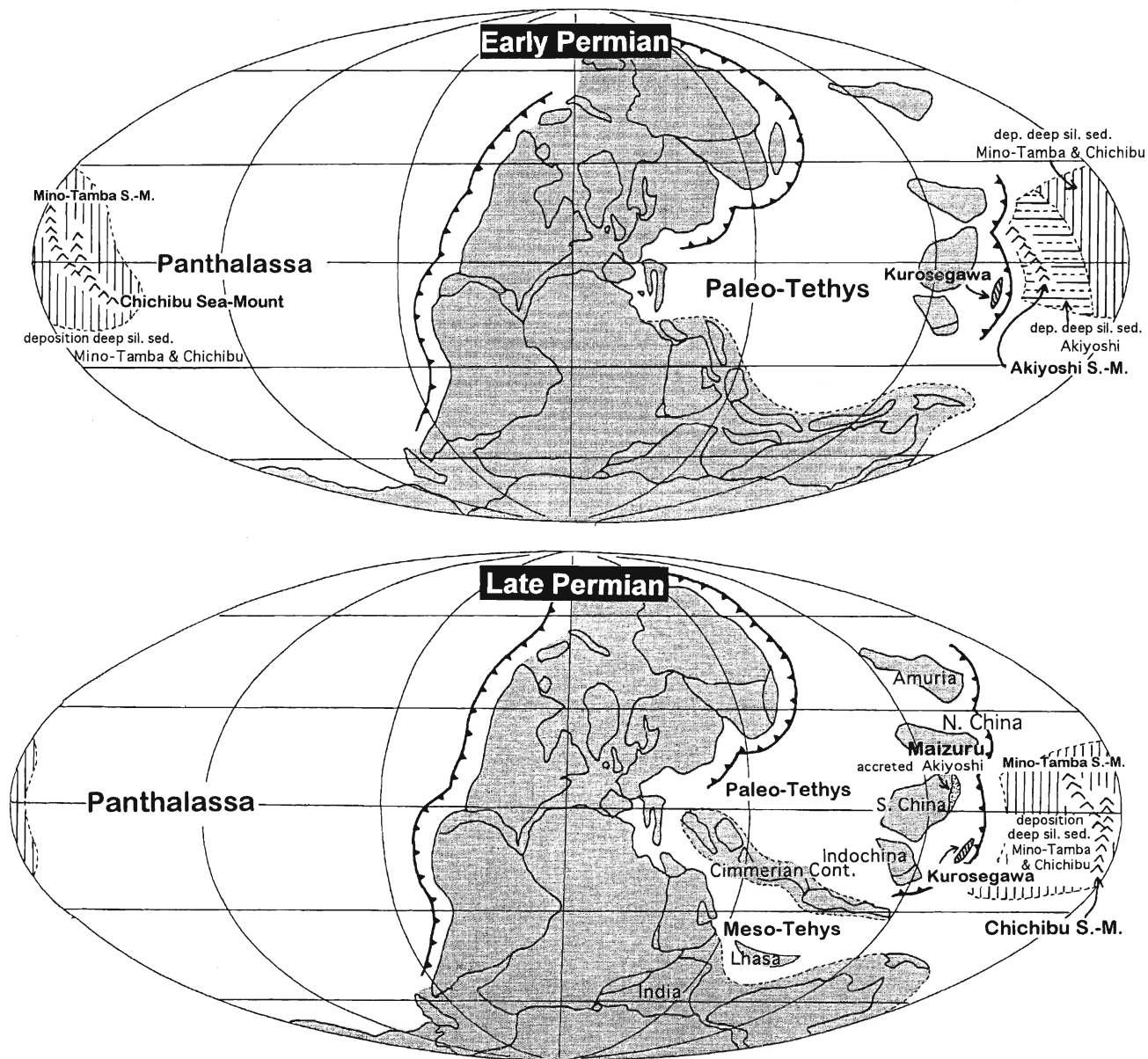


Fig. 2. Paleogeographic reconstruction in Early and Late Permian time (Kobayashi, 1999).

outside China in space and time.

Biostratigraphic Distribution

Fusulinaceans are highly reliable and available for biostratigraphic zonation and international correlation of the Upper Paleozoic. Emphasized herein, in particular, are remarkable differences of disappearance ages of fusulinaceans, taxonomic diversity, generic composition, and stratigraphic range of Permian fusulinaceans among Southwestern North America,

Ural regions and Russian Platform, and Tethyan regions (Fig. 4). These differences are considered to be resulted from those of the Permian tectonic history, sea-level fluctuations, and paleogeographic position in these three regions. Much more varied generic composition of the Tethyan regions than that of the other two regions and distinctive occurrences of neoschwagerinids and verbeekinids are thought to be probably caused largely by tropical to subtropical environmental settings of the Tethyan regions in Permian time (Ross, 1995; Ross and Ross, 1995). Fusulinacean faunas of the eastern part

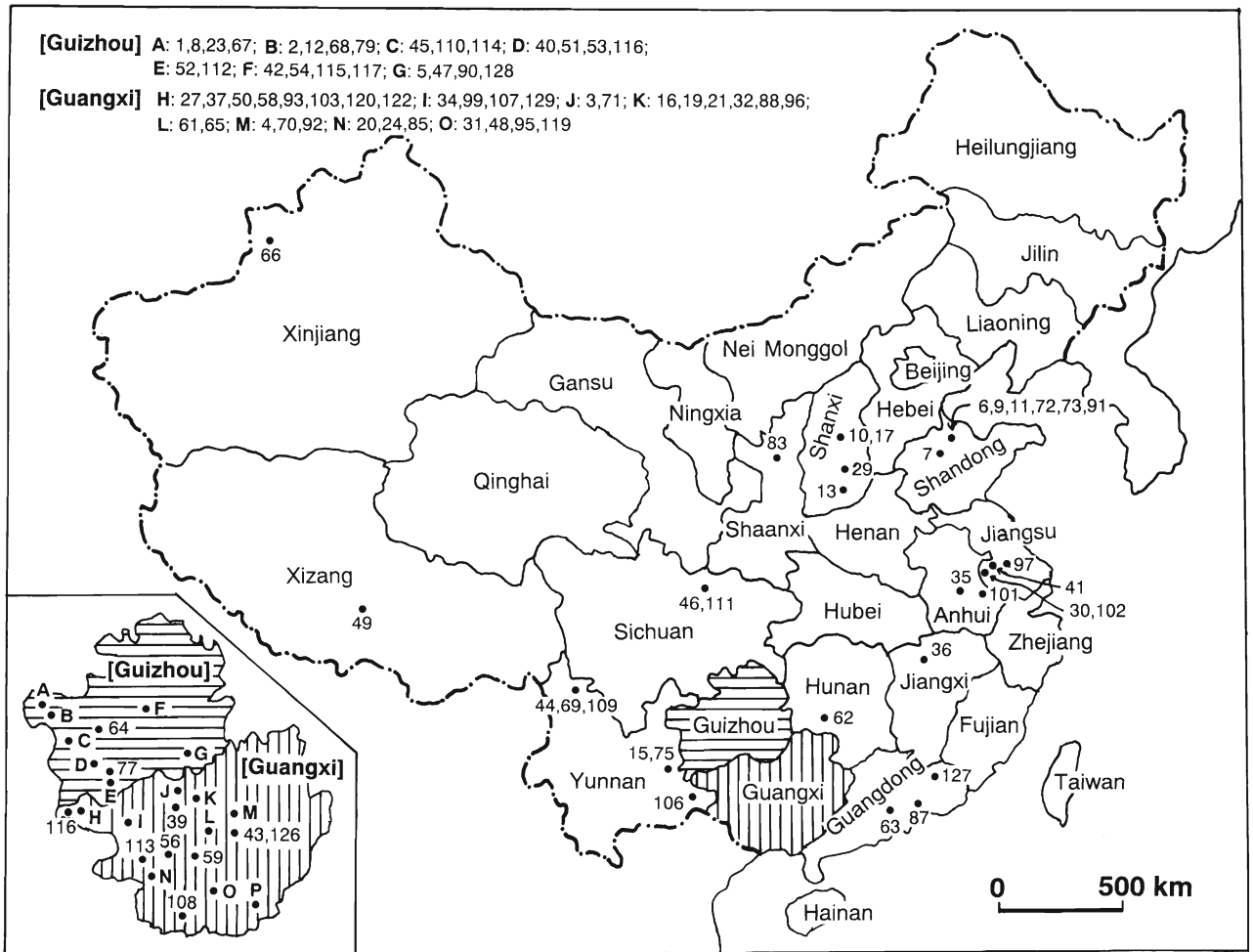


Fig. 3. Geographic distribution of limestone thin sections, numbered 1 to 130, kept in the Museum of Nature and Human Activities, Hyogo. Locality name is not shown in the thin section Nos. 98 and 104. Among the 128 specimens, 105 are shown, so far as we can confirm them on the map. The number used in this figure is the same as that shown at the left side of the appendix table.

of the Tethyan regions are represented by those of South China.

Nearly continuous Upper Paleozoic carbonate sequences are widely distributed in South China, particularly in Guizhou and Guangxi where they are subdivided biostratigraphically into 13 fusulinacean zones in generic level according to Sheng (1992). Much more detailed subdivisions are possible. Biostratigraphic distribution of 130 specimens kept in the MNHAH is roughly shown on the basis of the fusulinacean zonation by Sheng (1992) with slight modification (Fig. 5). They are assignable to the *Pseudostaffella* Zone (the *Pseudostaffella antiqua* Zone), to the *Palaeofusulina* Zone (the *Palaeofusulina sinensis* Zone), chronostratigraphically equivalent to the Bashkirian (lowest Upper Carboniferous) to Changhsingian (uppermost Permian)(Fig. 5).

Post-Sakmarian (Middle and Upper Permian) fusulinaceans have not been found in North China. The Carboniferous, Lower and Middle Permian fusulinaceans with close affinities to South Chinese examples are known from Songpan-Ganzi and Kunlun. The Upper Permian (Wuchiapingian and Changhsingian) fusulinaceans, however, are lacking in these regions except for those reported from Shaanxi and Tewo, southern end of Gansu (Sun, 1979) referable to Songpan-Ganzi.

Many fusulinacean and other foraminiferal species and genera ranging from Bashkirian to Changhsingian are included in our present materials (See appendix table). In particular, most of them are from South China, representing the Eastern Tethyan Faunal Province. Our present materials, though only consisting of 130 pieces of thin sections, contain characteristic fusulinaceans of

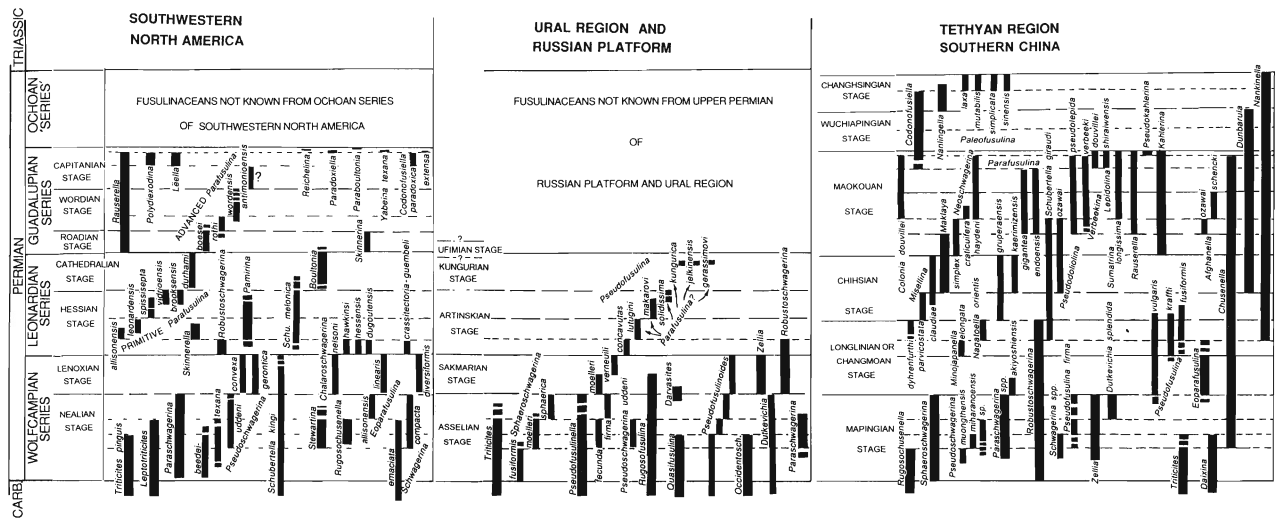


Fig. 4. Stratigraphic ranges of some common fusulinacean species or genera in the Southwestern North America, Ural regions and Russian Platform, and Tethyan regions (Ross and Ross, 1995).

		Tethys, Russian P.	Southwest China	Fusulinacean zone (SW China)	Thin section number (MNHAH)	
Permian	Upper	Dorashamian	Upper	Changhsingian	<i>Palaeofusulina</i> Zone 60, 63, 64, 65, 124, 127, 128, 129	
		Dzhulfian	Upper	Wuchiapingian	<i>Codonofusiella</i> Zone 62, 126	
	Middle	Midian	Middle	Maokouan	<i>Lepidolina</i> Zone 53(?), 61(?), 122, 125(?)	
		Murgabian			<i>Neoschwagerina</i> Zone 45, 49(?), 50, 51, 52(?), 55, 56, 57, 58, 59, 97, 100(?), 104(?), 110, 111, 113, 114, 115, 116, 118, 119, 120, 121, 123	
		Kubergandian			<i>Cancellina</i> Zone 33(?), 42, 46(?), 48, 107(?), 108(?), 112	
	Lower	Bolorian	Lower	Chihhsian	<i>Misellina</i> Zone 29, 39, 44, 105, 109	
		Yakhtashian			Changmoan	<i>Pamirina</i> Zone 27, 37(?), 38, 40(?), 93
		Sakmarian			Mappingian	<i>Pseudoschwagerina</i> Z. 20(?), 21, 86(?), 87, 103
	Carboniferous	Upper	Asselian	Upper	Xiaodushanian	<i>Triticites</i> Zone 25, 26, 28, 91, 92, 94, 95
						Weiningian
Bashkirian			<i>Profusulinella</i> Zone 12, 15, 17(?), 77			
			<i>Pseudostaffella</i> Zone 2, 3, 7, 8, 9, 10, 11, 13, 14, 67, 68(?), 69, 70(?), 72, 73, 74, 75, 76, 78, 83			
Lower		Serpukhovian	Lower	Datangian	<i>Eostaffella</i> Zone 4, 5, 6, 7, 1	
					<i>Eostaffella</i> Zone 1, 6, 6	

Fig. 5. Biostratigraphic distribution of fusulinaceans contained in 130 thin sections. The number in this figure is the same as that shown at the left side of the appendix table. The fusulinacean zonation and chronostratigraphic subdivision of the Carboniferous and Permian of China are based on those of Southwest China by Sheng (1992) with slight modification. The zonal assignment is impossible in fusulinaceans contained in thin section Nos. 22, 24, 30-32, 34-36, 41, 43, 47, 54, 79, 80, 88, 89, 96, 98, 99, 101, 102, 106, 117, and 130. (See also appendix table)

China, and are available for fusulinacean comparative studies between China and outside China.

Acknowledgements

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Plate 1. Thin-section photomicrographs showing various kinds of limestone petrology. All are x 6.3. Plane light.

1. Crinoidal algal packstone, Middle Permian, Kongshan (Nanjing), D1-001772.
2. Algal foraminiferal packstone, Middle Permian, Yangchang (Guizhou), D1-001851.
3. Bioclastic fusulinine packstone, Middle Permian, Dantu (Jiangsu), D1-001764.
4. Algal packstone, Middle Permian, Chongzou(Guangxi), D1-001775.
5. Fusulinine grainstone, Lower Permian, Yishan(Guangxi), D1-001816.
6. Poriferal algal grainstone, Middle Permian, Dongping (Guangxi), D1-001767.
7. Calcarenite, Middle Permian, Taiping(Guangxi), D1-001786.
8. Foraminiferal crinoidal grainstone, Middle Permian, Ziyun (Guizhou), D1-001837.
9. Lime-wackestone, Upper Permian, Dushan(Guizhou), D1-001795.
10. Foraminiferal crinoidal grainstone/packstone, Upper Carboniferous, Dulan(Guangxi), D1-001749.

Plate 2.

1. *Eostaffella subsolana* Sheng, x 30, Xianning(Guizhou), D1-001798.
2. *Ozawainella mosquensis* Rauser-Chernousova, x 30, Liuzhou(Guizhou), D1-001801.
3. *Ozawainella* sp., x 30, Yishan(Guangxi), D1-001813.
4. *Staffella* sp., x 15, Longdeng(Guangxi), D1-001819.
5. *Chenella* sp., x 30, Tianlin(Guangxi), D1-001831.
6. *Chenella kueichihensis* (Chen), x 30, Xishan(Jiansu), D1-001797.
- 7-9. *Pseudoendothyra* spp., x 30, 7: Yishan(Guangxi); D1-001763, 8: Tiandeng(Guangxi); D1-001821, 9: Dushan(Guizhou); D1-001844.
10. *Nankinella quasihunanensis* Sheng, x 10, Dantu(Jiangsu), D1-001764.
11. *Eoverbeekina intermedia* Lee, x 10, Yangchang(Guizhou), D1-001851. (See also Plate 6-6)
- 12-14. *Pisolina excessa* Lee, 12, 13: x 10; D1-001766; 14: x 20, D1-001828, all from Tianlin(Guangxi).
- 15, 16. *Sphaerulina crassispira* Lee, 15: x 10, locality unknown, D1-001765, 16: x 20, Qixiashan, D1-001827.

17. *Leella* sp., x 20, Laibin(Guangxi), D1-001840.
18. *Fusiella typica* Lee and Chen, x 30, Nandan(Guangxi), D1-001800.
19. *Boultonia* sp., x 30, Xuzhou(Jiangxi), D1-001747.
20. *Fusiella* (?) sp., x 30, Shuicheng(Guizhou), D1-001735.
- 21, 22. *Schubertella giraudi* (Deprat), 21: x 20; Taiping(Guangxi); D1-001845, 22: x 30; Hushan(Jiangsu); D1-001756.
23. *Neofusulinella* sp., x 30, Chongzuo(Guangxi), D1-001775.
- 24, 25. *Wutuella wutuensis* (Kuo), 24: x 15; Ziyun(Guizhou); D1-001837, 25: x 20; Tianlin(Guangxi); D1-001774.
- 26, 27. *Lantschichites* sp., 26: x 30; 27: x 20, Laodongkou (Sichuan), both D1-001792.
- 28, 29. *Dunbarula nana* Kochansky-Devidé and Ramovš, both x 30, Dushan(Guizhou), D1-001844.
30. *Codonofusiella* sp., x 30, Shaoyang(Hunan), D1-001859.
- 31, 32. *Gallowaiina meitiensis* Chen, x 20, 31: Meixian(Guangdong); D1-001794, 32: Jiahe(Guangdong); D1-001860.
- 33, 34. *Ziguiella quasicylindrica* (Ding), 33: x 20; Shangsi(Sichuan); D1-001791, 34: x 30; Qiaozishan(Guizhou); D1-001857.

Plate 3.

- 1, 2. *Palaeofusulina jiaozishaniva* Rui, x 30, 1: Anshun(Guizhou); D1-001861, 2: Dushan(Guizhou); D1-001795.
3. *Palaeofusulina sinensis* Sheng, x 30, Tianlin(Guangxi), D1-001976
4. *Nanlingella minima* (Sheng and Chang), x 30, Laibin(Guangxi), D1-001793.
- 5-7. *Pseudostaffella antiqua* (Dutkevich), x 30, 5: Yining(Xinjiang); D1-001733, 6, 7: Xianning(Guizhou); D1-001798.
8. *Pseudostaffella gorskyi* (Dutkevich), x 30, Nandan(Guangxi), D1-001738.
9. *Pseudostaffella sphaeroidea* (Ehrenberg), x 20, Zibo(Shandong), D1-001739.
10. *Pseudostaffella cuboides* Rauser-Chernousova, x 20, Boshan(Shandong), D1-001804.
11. *Yangchienia iniqua* Lee, x 20, Guangyuan (Sichuan), D1-001778.
12. *Profusulinella* sp., x 30, Zibo(Shandong), D1-001803.
- 13, 14, 16, 17. *Fusulinella bocki* Moller, 13: x 20; Fucheng(Shanxi); D1-001810, 14: x 10; Xianning(Guizhou); D1-001805, 16: x 20; Jinsigang(Nanjing); D1-001741, 17: x 15; Xiaodushan(Yunnan); D1-001736.
15. *Profusulinella paratimanic* Rauser-Chernousova, x 30, Dushan(Guizhou), D1-001802.
18. *Eofusulina rasdorica* (Putrya), x 10, Shuicheng(Guizhou), D1-001799.
19. *Beedeina lanceolata* (Lee and Chen), x 10, Taiyuan(Shanxi), D1-001807.
20. *Fusulina cylindrica* Fischer de Waldheim, x 10, Yanan?(Shanxi), D1-001750.
21. *Fusulina quasicylindrica* Lee, x 10, Zibo(Shandong), D1-001806.
- 22, 29, 30. *Protriticites* spp., 22: x 10; Shuicheng(Guizhou); D1-001809, 29, 30: x 20; Yangchang(Guizhou); D1-001744.
23. *Montiparus paramontiparus* Rozovskaya, x 10, Guangan(Yunnan), D1-001812.
24. *Quasifusulina longissima* (Moller), x 10, Taiyuan(Shanxi), D1-001814.
- 25, 26. *Putrella* spp., x 10, 25: Changmo(Guangxi); D1-001811, 26: Dannan(Guangxi); D1-001745.
27. *Pseudowedekindellina* (?) sp., x 30, Shuicheng(Guizhou), D1-001746.
- 28, 31, 32. *Rauserites* spp., x 10, 28: Xianning(Guizhou); D1-001820, 31: Dushan(Guizhou); D1-001757, 32: Dongping(Guangxi); D1-001748.

Plate 4.

- 1, 2. *Sphaeroschwagerina pavlovi* (Rauser-Chernousova), x 10, 1: Nanping(Guizhou); D1-001823, 2: Zibo(Shandong); D1-001758.
3. *Pseudoschwagerina muongthensis* (Deprat), x 10, Xikou(Shanxi), D1-001822.
4. *Zellia* sp., x 10, Changmo(Guangxi), D1-001761.
- 5, 6. *Triticites* sp., 5: x 10; 6: x 30, Yishan(Guangxi), D1-001813.
7. *Triticites acutus* (Schellwien), x 10, Dulan(Guangxi), D1-001749.
8. *Macclouidia* (?) sp., x 10, Dongping(Guangxi), D1-001753.
- 9, 10. *Eoparafusulina laudoni* (Skinner and Wilde), x 10, 9: Lianhuashan(Guangdong); D1-001754, 10: Yishan(Guangxi), D1-001818.
- 11, 12. *Triticites ferganensis* Mikluho-Maklay, x 10, 11: Tiandong(Guangxi); D1-001752, 12: Yishan(Guangxi); D1-001816.
13. *Darvasites contractus* (Schellwien and Dyhrenfurth), x 10, Tiandeng(Guangxi), D1-001817.
14. *Biwaella omiensis* Morikawa and Isomi, x 20, Bunuo?(Guangxi), D1-001835.
- 15, 16. *Robustoschwagerina changmeensis* Xia and Li, x 10, Longlin(Guangxi), 15: D1-001824; 16: D1-001760.

Plate 5.

- 1, 2. *Occidentoschwagerina fusulinoides* (Schellwien), x 10, 1: Dongping(Guangxi); D1-001825, 2: Taiping(Guangxi); D1-001762.
3. "*Schwagerina*" *sinensis* Chen, x 10, Yishan(Guangxi), D1-001829.

4. *Cuniculinella vulgariformis* (Morikawa), x 10, Longlin(Guangxi), D1-001834.
5. *Chalarioschwagerina inflata* Skinner and Wilde, x 7, Longlin(Guangxi), D1-001770.
6. *Rugososchwagerina* sp., x 7, Ziyun(Guizhou), D1-001783.
7. *Orientoschwagerina liangshanensis* (Sheng), x 10, locality unknown, D1-001771.
8. *Schwagerina chihsiaensis* (Lee), x 10, Qixiashan(Nanjing), D1-001769.
9. *Chusenella ishanensis* Hsu, x 10, Xilin(Guangxi), D1-001785.
10. *Chusenella globularis* (Gubler), x 10, Xainza(Xizhang), D1-001846.
11. *Chusenella sinensis* Sheng, x 10, Chonguo(Guangxi), D1-001775.
- 12, 14. *Parafusulina* (?) sp., x 10, 12: Gaoan(Jiangxi); D1-001833, 14: Guangde(Anhui); D1-001768.
13. *Parafusulina* (?) *constricta* Chen, x 7, Dongping(Guangxi), D1-001767.
15. *Parafusulina* sp., x 10, Longtan(Jiangsu), D1-001838.
16. "*Pseudofusulina*" *houae* Sheng, x 10, Dongping(Guangxi), D1-001830.

Plate 6.

1. *Misellina ovalis* Deprat, x 20, Kongshan(Nanjing), D1-001772.
- 2, 3. *Maklaya* sp., x 20, Xiaodushan(Yunnan), 2: D1-001776, 3: D1-001841.
4. *Praesumatrina neoschwagerinoides* (Deprat), x 20, Houchang(Guizhou), D1-001779.
5. *Neoschwagerina margaritae* Deprat, x 10, Jiuzhi(Guizhou), D1-001781.
- 6, 16. *Pseudodoliolina pseudolepida* (Deprat), x 10, 6: Longlin(Guangxi); D1-001847, 16: Longsang(Guangxi), D1-001780.
- 7, 8, 15. *Sumatrina annae* Volz, x 10, 7: Datieguan(Guizhou); D1-001854, 8: Houchang(Guizhou); D1-001852, 15: Ziyun(Guizhou); D1-001790.
9. *Metadoliolina lepida* (Schwager), x 10, Pingguo(Guangxi), D1-001853. (See also Fig. 8-7)
10. *Verbeekina verbeeki* (Geinitz), x 10, Yangchang(Guizhou), D1-001782.
11. *Afghanella sumatrinaeformis* (Gubler), x 10, Longlin(Guangxi), D1-001787.
- 12a, 12b. *Colania kwangsiana* Lee, 12a: x 10; 12b: x 20, Wuming(Guangxi), D1-001856.
- 13a, 13b. *Lepidolina multiseptata* (Deprat), 13a: x 8; 13b: x 20, Longlin(Guangxi), D1-001789.
14. *Paraverveekina* (?) sp., x 7, Ziyun(Guizhou), D1-001850.

Plate 7.

- 1-5, 8, 10, 11. Enlarged photomicrographs of inner volutions of Plate 4-1, Plate 4-15, Plate 4-3, Plate 5-7, Plate 6-5, Plate 6-11, Plate 6-15, and Plate 6-8, respectively. All x 20.
6. *Eoverbeekina intermedia* Lee, x 20, Yangchang(Guizhou), D1-001784.
- 7a, 7b. *Metadoliolina lepida* (Schwager), 7a: x 20; 7b: x 10, Taiping(Guangxi), D1-001786.
9. *Afghanella schencki* Thompson, x 20, Longlin(Guangxi), D1-001855.

Plate 1

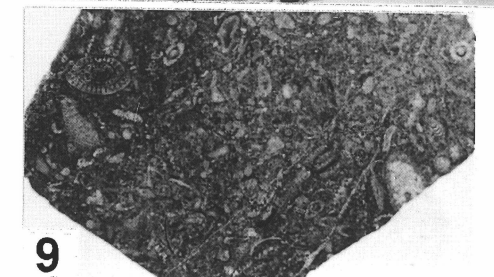
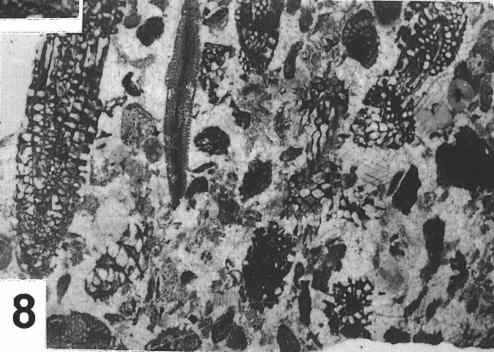
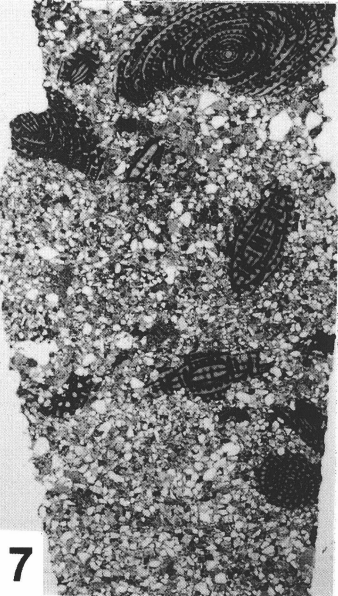
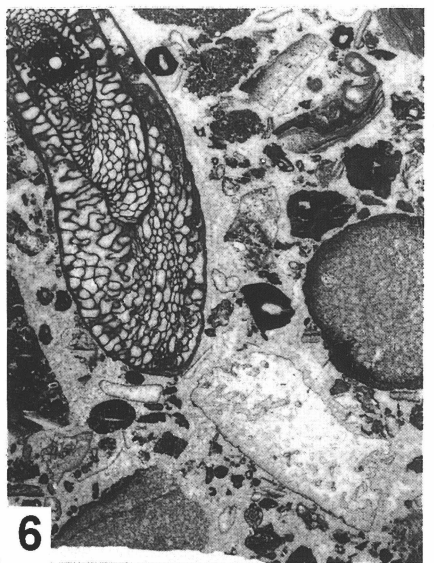
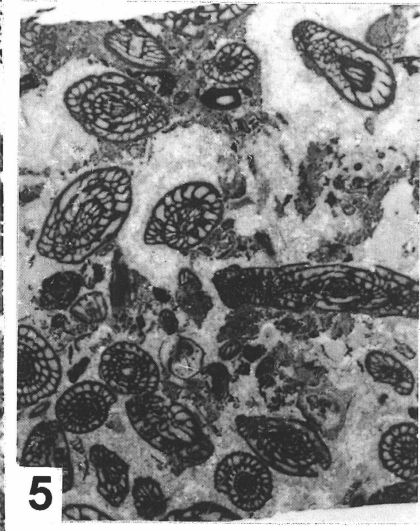
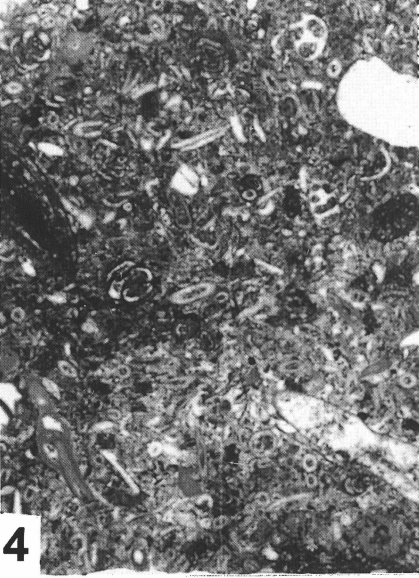
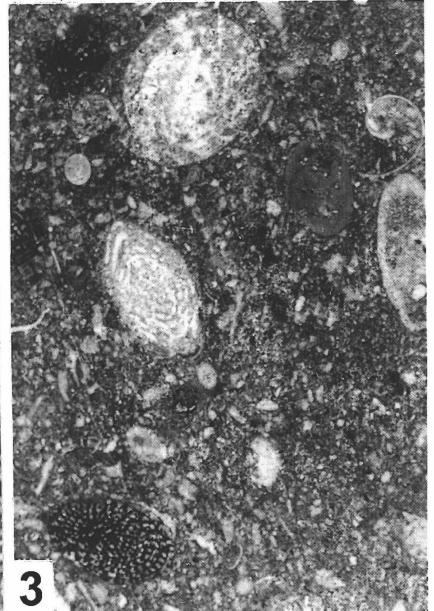
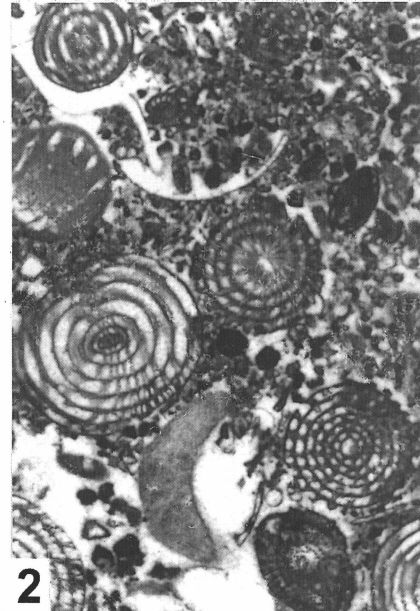
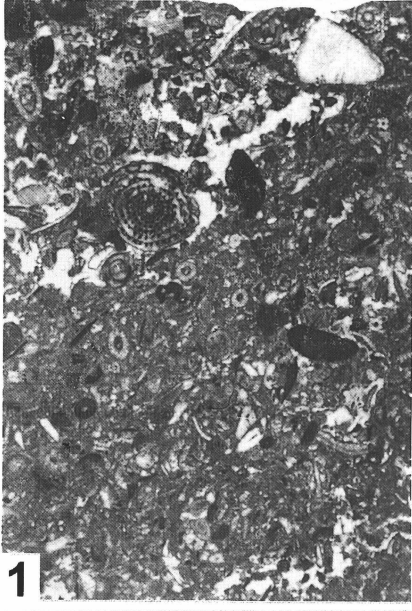


Plate 2

