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广西隆林石炭系与二叠系界线专号

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内 容 简 介

本号收编了有关广西隆林地区石炭系与二叠系界线方面的六篇论文。这批论文系统、全面地介绍了本区卜糯、龙桑两条石炭-二叠系剖面的地层层序；并依据笔、珊瑚、腕足、双壳、头足、腹足、苔藓、牙形石及三叶虫等9个门类大量化石的研究成果，对本区晚石炭世至早二叠世早期的生物群特征作了较为深入的讨论，相应建立了笔、珊瑚、腕足和双壳类等组合带或化石带；进而，深入讨论并确定了本区石炭系和二叠系的界线。

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广西隆林地区石炭系与二叠系的界线

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〔内容提要〕 本文详尽地介绍了广西隆林地区卜糯和龙桑二条剖面。据9个门类化石的综合研究,本文对晚石炭世和早二叠世早期的古生物特征、地层划分与对比作了较全面阐述;建立了筳类、珊瑚、腕足类和双壳类等化石带或组合带;进而着重讨论了石炭系和二叠系的界线,提出了以筳类*Mcclouidia*带作为本区二叠系底界的意见。

一、引 言

研究地区位于广西壮族自治区西北部隆林各族自治县境内(图1),属于江南(或华南)地层区右江分区隆林百色小区^{〔1〕}。区内石炭、二叠纪地层均为浅海相碳酸盐岩,其分布广泛、发育完全、化石丰富、门类繁多、保存完好,因此是研究石炭系和二叠系,特别是研究两系界线的不可多得地区之一。

本区石炭、二叠系及其古生物以往的研究程度较低(表1)。50—60年代,广西石油队和651地质队等在该区进行过区域地质普查和找矿工作。在此基础上编制了“中南地区区域地层表”。贵州省地质矿产局区调队于1977年在本区开展1:200000区域地质调查。董文兰据此区调资料^{〔2〕}描述了常么下二叠统的筳类三个属种;龙家荣^{〔3〕}从马平群(组)分立出常么组,以代表早二叠世早期的地层,其底界略高于本文内的珊瑚Sb-Wb带之底。1979年,云南石油队和成都地质学院在隆林一带进行过石炭二叠系研究。黄志勋等^{〔4〕}以祥播乡龙桑剖面为标准创立隆林阶,做为特提斯海区早二叠世早期的一个年代地层单位,代表中国*Misellina*带和*Pseudoschwagerina*带之间的地层。嗣后,时言^{〔5〕}和黄志勋等^{〔6〕}分别描述了该区珊瑚2属种和筳类13属、4亚属、27种。

本文研究的范围限于自筳类*Triticites*带至*Misellina*带或*M. claudiae*带的地层;于

表 1 广西隆林地区石炭-二叠系划分沿革

Table 1 The successive changes of the Carboniferous - Permian division in Longlin region of Guangxi

丁文江 V.K.Ting 1928	中南地区 *1 1974	贵州地质区调队 *2 1980	龙家荣 Long Jiarong 1982	黄志勋、时言等 Huang Zhixun et al. 1982	本 文 Present paper		
					笔类带 Fusulinids Zone	珊瑚带 Corals Zone	腕足组合带 Brach. A. Zone
石 炭 — 二 叠 系 Carboniferous - permian System	L. Permian S. 下二叠统	下 二 叠 统	柄 霞 组 常 么 组 Changme Fm.	栖霞阶 Qixia St. 隆林阶 Longlin St. Pamirina-Nagatoella (Darvasites) z. (带)	Mi Zone (带)	C-W Zone	Rc-Al A. Z.
					B Zone(带)	带	F-A" A.Z.
					PC Z. Pa Z. (带)	Sb-Wb Z. (带)	Om-Co A. Z.
					Mc Z. (带)	Am-N Z. (带)	C-L A. Z.
马 平 石 灰 岩 Mapping Limestone	上 石 炭 统	上 石 炭 统	马 平 组	Pseudoschwagerina (s.l.) z. (带)	Ps Zone (带)	Ap-Pm Z. (带)	Ae-B-Li A.Sz. Ag-Du A.Sz.
					TP Z. (带)		As-Mpm A.Z.
下 二 叠 统 L. Permian Ser.	Qixia Fm. 栖霞组	下 二 叠 统	下 二 叠 统	栖霞阶 Qixia St.	Misellina claudiae Z.	Pseudoschwagerina (s.l.) Z.	Triticites z.
U. Carboniferous Ser. 上 石 炭 统	Mapping Group 马 平 群	上 石 炭 统	上 石 炭 统	马平阶 Mapping St.			

*1 — The Regional Stratigraphic Scale of Central-South China

*2 — Regional Geological Surveying Party Guizhou

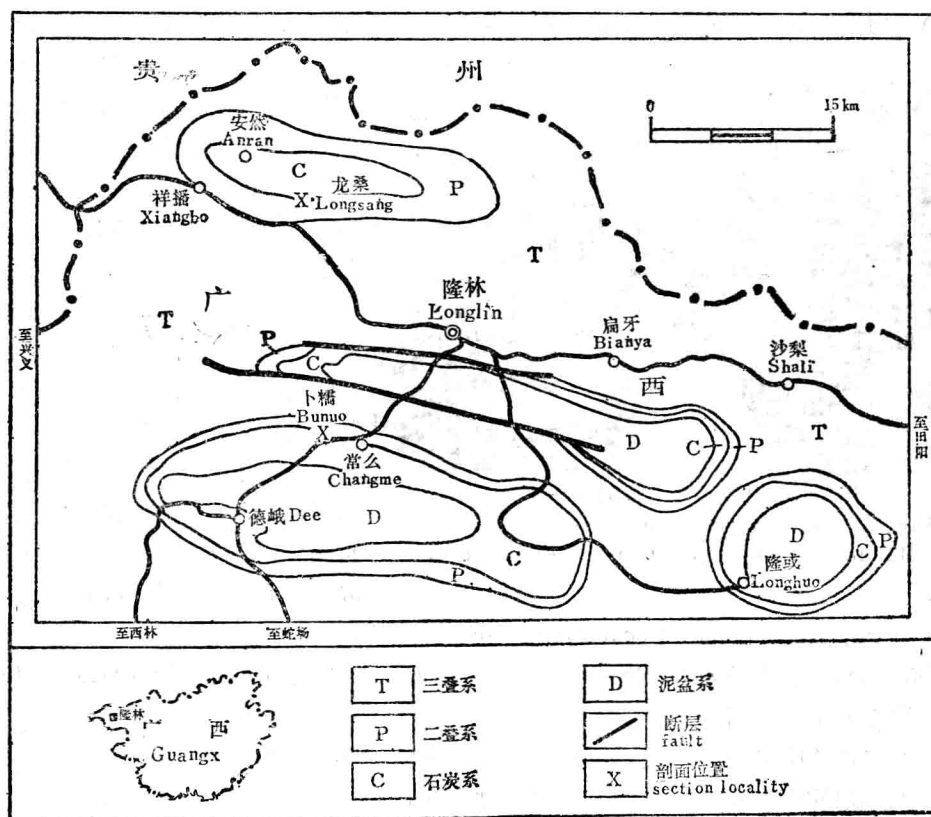


图 1 广西隆林地区地层分布和剖面位置

据广西区测地质调查队1975年：广西壮族自治区地质图（1:50万）简化

Fig. 1 Stratigraphic distributions and section localities in Longlin, Guangxi

After Regional Geological Surveying Party of Guangxi (1975) ;
Geological map (1:500000) of Guangxi Zhuang Autonomous Region

1982年10月至1985年3月在隆林地区开展研究工作，观察了祥播乡安然、隆或乡隆或和常么乡新寨等剖面；重新详测了常么乡卜糯剖面（即常么组建组剖面）和龙桑剖面（即隆林阶的建阶剖面）；采集11个门类（包括瓣类、珊瑚、腕足类、双壳类、腹足类、头足类、苔藓虫、三叶虫、牙形石、喙壳类和藻类）的大量标本，共获254属（亚属）、498种（包括变、亚种），其中藻类和喙壳类未研究；菊石和牙形石为我们首次发现。这就大大地丰富了本区的古生物内容，较确切地反映了生物群的全貌，从而为地层划分和对比提供了充分的化石依据。在我们工作过的剖面中，尤以位于德峨背斜北翼的卜糯剖面为最佳，系在人工开凿的山路旁（图2），岩层出露完整、连续，见有上述11个门类化石、其中瓣类和腕足类极为丰富，珊瑚和藻类比较繁盛，且交通方便，是研究石炭系与二叠系界线颇为理想的剖面之一，但该剖面底部可能有小断层存在。龙桑剖面位于安然背斜的南翼，不仅交通不便，而且剖面上有不少地段被残坡积物掩盖，化石较单调，除有孔虫类（多结晶、受挤压）外，其它化石很少或没有，在剖面中尚夹一层0.17m厚的水云母粘土岩（被黄志勋等

遗漏)。以此作为建阶的标准剖面似不可取。从卜糯和龙桑剖面的碳酸盐岩石类型和化石来看,代表两种不同的沉积类型。前者为水动力较强的近岸浅海相沉积;后者是水动力较弱的浅海相沉积。

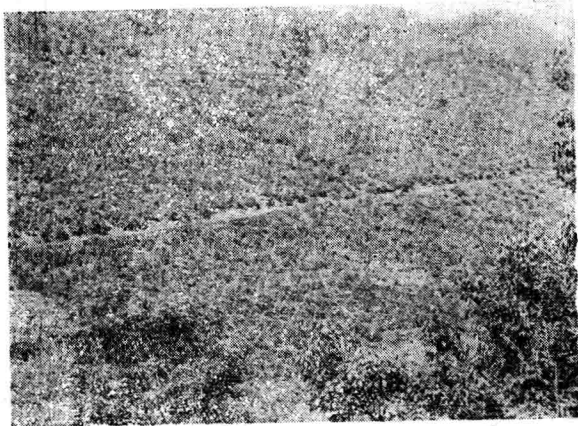


图 2 隆林常么乡卜糯剖面全景
Fig. 2 Showing general view of section of Bunuo village, near Changme of Longlin Guangxi

本文系统地描述了卜糯和龙桑两剖面。据 9 门类生物群的综合研究,对本区晚石炭世晚期和早二叠世早期的古生物群特征、地层划分与对比作了较全面的阐述,同时创建了筴类、珊瑚、腕足类和双壳类等化石带或组合带,并以筴类为主要依据,结合其它化石的佐证,着重讨论了石炭系与二叠系的界线,提出以 *Mccloudia* 带之底做为本区二叠系的底界。此界线既不同于我国传统的 *Misellina* 带或 *M. claudiae* 带的底界,

也有别于苏、美、日等国以 *Pseudoschwagerina* 带做为二叠系的下限;与近年国内有人提出的 *Pamirina* 带、*Schwagerina cushmani* 带或 *Pamirina-Nagatoella (Darvasites)* 带为界线的划分也不尽相同。

本文系“中国石炭二叠系界线研究”专题的地区性阶段成果,也是一项集体研究成果。天津地质矿产研究所夏国英,宜昌地质矿产研究所许寿永、杨德骊,广西地质研究所李家骧、黄勇强,沈阳地质矿产研究所梁仲发、刘效良,中国地质科学院 562 地质队李莉、地质研究所张毓秀,南京地质矿产研究所陈华成、王云慧等先后参加了该专题的野外研究工作并分别研究了筴类、珊瑚、腕足类、双壳类、头足类、腹足类和苔藓虫。此外,参加该专题野外研究的还有:江苏省、贵州省、广西壮族自治区等省(区)地质矿产局区域地质调查队的俞学光、康沛泉和黄保平等;贵州省地质矿产局区域地质调查队的王洪第、董文兰、冯儒林,天津地质矿产研究所赵松银,广西地质研究所苏一保,宜昌地质矿产研究所周天梅等分别研究了珊瑚、筴类、腕足类、牙形石和三叶虫。本文由许寿永、杨德骊执笔完成。

在研究过程中,我们得到各协作单位,特别是广西地质矿产局钟铿总工程师,广西地质研究所和贵州省地质矿产局区调队等多方的帮助。宜昌地质矿产研究所谌建国、黎汉明工程师协助鉴定岩石标本;谌建国工程师还考察了卜糯剖面,对本区的沉积环境的研究给予一定的帮助;张仁杰工程师协助将全文译成英文,在此一并谨致谢忱。

二 剖 面 描 述

(一) 卜糯剖面 (图3)

剖面位于常么乡卜糯村西侧新开山间小路上,露头良好,化石丰富,门类繁多^①,

①化石新种属的描述参见本刊相应专文。

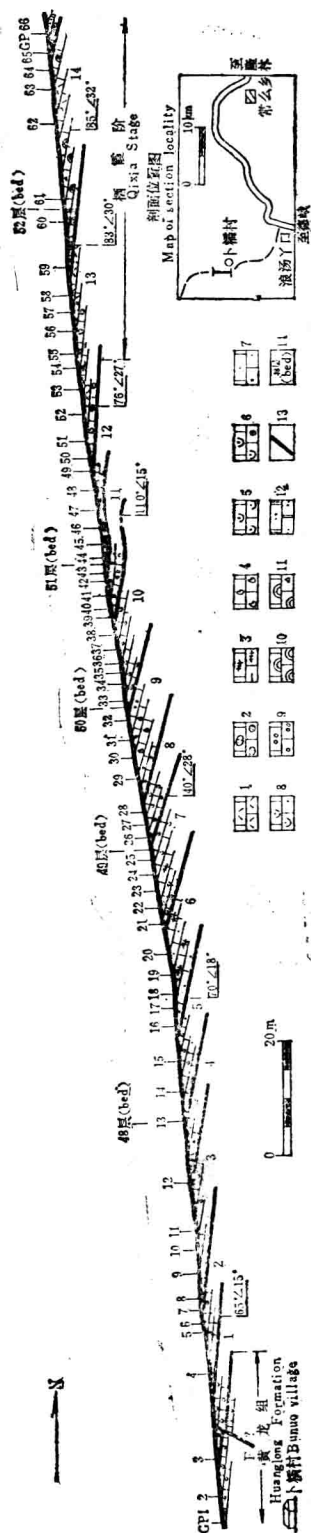


图 3 广西隆林常么乡卜糯村石炭系与二叠系剖面图

1—spar-allochem limestone; 2—spar-micropellet limestone; 3—spar-algal-micrite;
4—biosparite; 5—spar-bioclastic limestone; 6—spar-bioclastic-oncolites limestone;
7—calcarene with sparite; 8—biospar-calcarenite; 9—sparrudstone; 10—spar-reef
limestone; 11—spar reef-sparrudite; 12—microspar-dolomite with calcite; 13—fault;
14—stratigraphic number of RGSP, Guizhou

Fig. 3 The Carboniferous-Permian Section of Banuo village, near Changme township, Longlin, Guangxi

1—spar-allochem limestone; 2—spar-micropellet limestone; 3—spar-algal-micrite;
4—biosparite; 5—spar-bioclastic limestone; 6—spar-bioclastic-oncolites limestone;
7—calcarene with sparite; 8—biospar-calcarenite; 9—sparrudstone; 10—spar-reef
limestone; 11—spar reef-sparrudite; 12—microspar-dolomite with calcite; 13—fault;
14—stratigraphic number of RGSP, Guizhou

是本区的代表性剖面。自上而下为:

上覆: 下二叠统 栖霞阶 (上部略)

14. 灰色、深灰色厚层亮晶粒屑灰岩、云化亮晶礁角砾灰岩、亮晶藻水螅礁灰岩, 亮晶藻海绵礁灰岩, 夹薄层含钙质粉晶白云岩, 厚度大于13m, 富含化石 (采集号: GP59—66)。筳类有 *Misellina claudiae* (Deprat), *M. spp.*, *Robustoschwagerina tumida* (Licharew), *R. changmeensis* Xia & Li (sp. n.), *Toriyamaia ellipsoidalis* Sheng & Sun, *T. laxiseptata* Kanmera, *Chenella rhomboides* Wang Y. H., *Parafusulina shaksgamenensis* Reichel, *Pamirina* ? sp., *Nankinella* sp., *Schubertella* sp., *Pseudofusulina krafftii* (Schellwien), *P. hawkinsi* (Dunbar & Skinner), *P. subellipsoides* Chen J. R., *P. (Laxifusulina) neimonggolensis latiucula* Xia, *P. (Laxifusulina) sp.*, *Schwagerina turgida* Skinner & Wilde, *S. tschernyschewi* (Schellwien), *S. bunuoensis* Xia & Li (sp. n.); 珊瑚 *Duplophyllum tenueseptatum* Schouppé & Stacul, *D. longiseptatum* Xu & Chen (sp. n.), *Paraduplophyllum fornicatum* Xu & Chen (sp. n.), *Adamanophyllum* ? sp., *Lophocarinophyllum* sp., *Tachylasma magnum* Grabau, *Plerophyllum falconophylloidea* Xu & Chen (sp. n.), *P. sp.*, *Amygdalophylloides longlinensis* Xu & Chen (sp. n.); 腕足类: *Enteleutes* spp., *Orthotetes* sp., *Schizophoria* sp., *Rhipidomella cordialis* Grant, *Fluctuaria* aff. *undata* (DeFrance), *Thamnusia* cf. *parvispinosa* (Stehli), *Haydenella* sp., *Neospirifer* sp., *Martinia* sp., *Stenosisma* sp., *Dielasma indentum* Grabau, *D. sp.*; 头足类: *Rhiphaeonautilus* ? minor Liang (sp. n.); 腹足类: *Meekospira* sp., *Bellerophon exquisitum* Liang (sp. n.); 牙形石: *Diplognathodus* sp., *Ozarkodina* sp.

13. 浅灰色厚层亮晶—泥晶团粒灰岩, 亮晶粒屑灰岩, 含藻泥晶灰岩, 厚4m, 含化石 (采集号: GP49—58)。筳类有 *Brevaxina* sp., *Pseudofusulina (Laxifusulina) guangxiensis* Xia & Li (sp. n.), *P. (L.) neimonggolensis* (Han), *P. (L.) spp.*, *P. krafftii* (Schellwien), *P. krafftii magna* Toriyama, *P. globosa* (Deprat), *P. hexagonaria* Igo, *Parafusulina tianyangensis* Lin, *P. cincta* Reichel, *P. splendens* Dunbar & Skinner, *P. longissima* Xia & Li (sp. n.), *Schwagerina turgida* Skinner & Wilde, *S. amoena* Skinner & Wilde, *S. spp.*, *Paraschwagerina magna* Skinner & Wilde, *P. sp.*, *Misellina longlinensis* Dong, *M. sp.*, *Robustoschwagerina guangnanica* Sheng, Wang & Zhong, *R. longlinensis* Dong, *Schubertella* sp.; 珊瑚: *Lonsdaleiastrea* sp., *Amplexocarinia ireginae* Soshkina, *Yatsengia guangxiensis* H. D. Wang (sp. n.), *Y. sp.*, *Pavastehphyllum* cf. *crassithecum* Wu, *Wentzellophyllum persicum* (Douglas), *Wentzeloides longlinensis* H. D. Wang (sp. n.), *Szechuanophyllum parvum* H. D. Wang (sp. n.), *Laophyllum* sp., *Plerophyllum falconophylloidea* Xu & Chen (sp. n.), *P. sp.*, *Paracarinia* sp., *Cyathocarinia* sp., *Stereostylus* sp., *Protomichelina* camara Wu & Zhao; 腕足类: *Enteleutes* sp., *Dictyoclostus manchuricus* (Chao), *D. nantanensis* (Grabau), *Buxtonia* sp., *Avonia echidniformis* Grabau em-

end. Chao, *A. lopingensiformis* Ustriski, *Linoproductus simensis* (Tschernyschew), *L. pseudocorrugatus* Park., *L. sp.*, *Cancrinella cancriniformis* (Tschernyschew), *C. sp.*, *Fluctuaria specialis* Li (sp. n.), *F. aff. undata* (Defrance), *Haydenella tersa* Li (sp. n.), *Stepanoviella sp.*, *Compressoproductus corniformis* (Chao), *Plicatifera sp.*, *Plicatiferina ? sp.*, *Marginifera costalliformis* Li (sp. n.), *Incisus longlinensis* Yang (sp. n.), *Uncinunellina wangenheimi* (Pander), *U. sp.*, *Wellerella sp.*, *Psilocamera tschernyschewi* (Volgiu), *Paranorella longlinensis* Yang (sp. n.), *Eliva mignon* Grabau, *Ella sp.*, *Brachythyridina sp.*, *Choristites sp.*, *Neospirifer fasciger* Keyserling, *Punctospirifer ornata* Waagen, *Martinia aff. manchuriensis* Chao, *M. changchiakouensis* Chao, *Ambocoelia sp.*, "*Attenuatella*" *changmeensis* Li (sp. n.), *Squamularia sp.*, *Cryptospirifer ? sp.*, *Cleiothyridina subexpansa* (Waagen), *Notothyris nucleolus* (Kutorga), *Dielasma sp.*; 头足类: *Metapronorites elegans* Liang (sp. n.), *Neoglyphyrites distortus* Liang (sp. n.), *Marathonites guangxiensis* Liang, (sp. n.), *Gaetanoceras regulare* Liang (sp. n.), *Agathiceras longlinensis* Liang (sp. n.); 双壳类: ? *Euchondria smithwickensis* Newell, *Streblocondria sp.*; 腹足类: *Bellerophon sp.*, *Naticopsis longlinensis* Liang (sp. n.), *Phymatifer longlinensis* (Pan), *Strobeus longlinensis* Liang (sp. n.), *Flemingella sp.*; 三叶虫: *Anisopyge ? sp.*; 牙形石: *Diplognathodus sp.*, *Neogondolella bisselli* (Clark & Behnken); 苔藓虫: *Fistulipora lunatifera* Bassler, *F. sinensis* Yoh.

— 整 合 —

马平组: 厚54m

12. 浅灰色厚层亮晶礁角砾灰岩, 含极少量白云质团块, 厚3.7m, 含化石(采集号: GP44—48)。瓣类: *Pseudofusulina arataniensis* Kawano, *P. hawkinsi* (Dunbar & Skinner), *P. hexagonaria* Igo, *P. krafftii* (Schellwien), *P. sp.*, *Schwagerina turgida* Skinner & Wilde, *S. gruperaensis* Thompson & Miller, *Paraschwagerina mira* Rauser; 珊瑚: *Calophyllum lanceolatum* Xu & Chen (sp. n.), *Duplophyllum longiseptatum* Xu & Chen (sp. n.) 腕足类: *Choristites sp.*, *Krotovia sp.*, *Dictyoclostoides spp.*; 牙形石: *Neogondolella bisselli* (Clark & Behnken), *Neostreptognathodus sulcopicatus* (Yongquist, Hawley & Miller)。

11. 浅灰色厚层亮晶砾屑灰岩, 厚2.9m, 含化石(采集号GP39—43)。瓣类: *Pseudofusulina cf. fecunda* Shamov & Scherbovich, *P. krafftii* (Schellwien), *P. changmeensis* Xia & Li (sp. n.) *P. (Laxifusulina) neimonggolensis* (Han), *P. (L.) sp.*, *Staffella akagoensis* Toriyama, *Schwagerina gruperaensis* Thompson & Miller, *S. tschernyschewi* (Schellwien), *S. tschernyschewi magna* Xia & Li (subsp. n.), *S. tschernyschewi longa* Xia & Li (subsp. n.), *Parafusulina nanjingensis* Wang Y. H., *Minojapanella sp.*, *Pseudendothyra powwowensis* (Thompson), *Toriyamaia sp.*; 珊瑚: *Calophyllum changmeense* Xu & Chen (sp. n.), *Lophocarinophyllum barbatum* Wu &

Zhou, *L. sp.*, *Lonsdaleiastraea floralis* Xu & Chen (sp. n.), *Leonardophyllum* ? sp., *Xianzaporaspinulosus* Xu & Chen (sp. n.); 腕足类: *Rhipidomella* ? sp., *Schizophora* sp., *Juresania* sp., *Linoproductus* sp., *Compressoproductus* sp., *Neochonetes* sp., *Choristites* sp., *Eliva* sp., *Martinia* sp., *Squamularia* sp., *Phricodothyris* sp., *Beecheria* cf. *sublaevis* (Waagen); 腹足类: *Bellerophon* sp.; 三叶虫: *Ditomopyge* sp.; 牙形石: *Neostreptognathodus sulcopicatus* (Yongquist, Hawley & Miller)。

10. 浅灰色厚层亮晶砾屑灰岩、亮晶生物屑灰岩, 厚8.5m, 含化石 (采集号: GP33—38)。瓣类: *Pseudofusulina* (*Laxifusulina*) sp., *P. krafftii* (Schellwien), *P. sp.*, *Schwagerina turgida* Skinner & Wilde, *S. amoena* Skinner & Wilde, *S. guembeli* Dunbar & Skinner, *Schubertella giraudi* (Deprat), *Pamirina* ? sp.; 珊瑚: *Amplexocarinia curvatum* Xu & Chen (sp. n.), *Kabakovitchiella arcuata* (Schouppé & Stacul), *K. sp.*, *Paracania* sp., *Pentaphyllum* sp., *Lophophylidium* spp., *Verbeekiella* sp., *Wentzelellites bunuoensis* Xu & Chen (sp. n.), *W. macrocolumna* Xu & Chen (sp. n.), *W. spp.*, *Pterophyllum* cf. *clavatum* Iljina, *Prosmilia irregulare* Xu & Chen (sp. n.), *Cyathocarinia crassata* Guo, *Prowentzelellites polyedricus* Xu & Chen (sp. n.), *Michelinia bunuoensis* Xu & Chen (sp. n.), *M. pecteniformis* Haung, *Xianzaporaspinulosus* Xu & Chen (sp. n.), *Protomichelinia crassa* Xu & Chen (sp. n.); 腕足类: *Orthotichia magnifica* Grabau, *Enteletes nucleola* Grabau, *Schuchertella* sp., *Schizophoria* sp., *Neochonetes* sp., *Juresania juresanensis* (Tschernyschew), *Marginifera* sp., *Dictyoclostus rimalis* Lee & Duan, *Cancrinella truncata* (Chao), *C. cancriniformis* (Tschernyschew), *Compressoproductus multicorugatus* Li (sp. n.), *Echinoconchus* sp., *Martinia timanica* Tschernyschew, *M. nucula* Rothpletz, *M. spp.*, *Martiniopsis* sp., *Choristites pavlovi* (Stuckenberg), *C. spp.*, *Athyris mongoliensis* (Grabau), *A. sp.*, *Fluctuaria* sp., *Vediproductus* cf. *punctatiformis* (Chao), *Linoproductus cora* (d'Orbigny); 双壳类: *Leptodesma* sp.; 腹足类 *Bellerophon bunuoensis* Liang (sp. n.), *B. sp.*, *Leptozygia* sp., *Retispira longlinensis* Liang (sp. n.), *Anomphalus longlinensis* Liang (sp. n.), *Paromphalus* sp., *Phymatopleura polycosta* Liang (sp. n.), *Knightella bunuoensis* Liang (sp. n.), *Spiroraphella* sp.; 三叶虫: *Paraphillipsia sinensis* Zhou (sp. n.)。

9. 浅灰、灰白色中厚层亮晶砾屑灰岩, 亮晶生物灰岩, 层理清楚, 厚8m, 含化石 (采集号: GP29—32)。瓣类: *Chalaroschwagerina inflata* Skinner & Wilde, *Paraschwagerina longa* Xia & Li (sp. n.), *Pseudofusulina* (*Laxifusulina*) *guangxiensis* Xia & Li (sp. n.), *P. (L.) primigena* Xia, Dong & Li (sp. n.), *Schwagerina tschernyschewi* (Schellwien); 珊瑚: *Zeliaphyllum* sp., *Paracania* sp., *Aethephyllum sinense* Xu & Chen (gen. & sp. n.), *Protomichelinia crassa* Xu & Chen (sp. n.); 腕足类: *Linoproductus* sp., *Stepanoviella* sp., *Choristites poulovi* (Stuckenberg); 腹足类: *Bellerophon* sp..

8. 浅灰色厚层亮晶生物屑灰岩和亮晶生物屑核形石灰岩, 厚3.8m, 含化石 (采集号: GP26—28)。瓣类: *Pseudofusulina gallowayi* Chen, *P. hawkinsi* (Dunbar & Skin-

ner), *P. ventricosa* (Skinner & Wilde), *P. globosa* (Deprat), *Schubertella magna* Lee & Chen, *Schwagerina cushmani* (Chen), *S. viriosa* Lin, *Darvasites* cf. *sinensis* (Chen); 珊瑚: *Verbeekiella* sp.; 腕足类: *Chasidella* sp.; 双壳类: *Streblochondria longiauriculata* Zhang; 腹足类: *Bellerophon* sp.

7. 浅灰色厚层亮晶生物屑灰岩, 夹亮晶—泥晶藻屑灰岩, 厚6.4m, 富含化石 (采集号: GP21—25)。瓣类: *Pseudofusulina horadaniensis* Igo, *P. uralica* (Krotow), *P. corpulenta* (Skinner & Wilde), *P. hessensis* (Dunbar & Skinner), *P. vulgaris* (Schellwien), *P. ventricosa* (Skinner & Wilde), *P. subellipsoides* Chen J. R., *Schwagerina tschernyschewi magna* Xia & Li (subsp. n.), *Schubertella paramelonica* Suleimanov, *S. kingi exilis* Suleimanov, *S. phairayensis* (Colani), *S. giraudi compacta* Sheng, *Paraschwagerina inflata* Chang, *Nankinella quasihunanensis* Sheng; 珊瑚: *Bunophyllum braidiformis* Xu & Chen (gen. & sp. n.), *Wentzelella crassa* Xu & Chen (sp. n.), *Lophophylidium* sp.; 腕足类: *Leptodus* sp., *Martinia* sp., *Avonia* sp., *Lissochonetes?* sp., *Cancrinella cancriniformis* Tschernyschew, *Choristites* sp.; 双壳类: *Streblochondria longiauriculata* Zhang, *Pernopecten ohioensis* Newell, *Aviculopecten eaglensis* (Price), *Euchondria* sp.; 腹足类: *Phymatifer guangxiensis* Liang (sp. n.), *P. bunuoensis* Liang (sp. n.); 三叶虫: *Nipponaspis guangxiensis* Zhou (sp. n.)。

6. 灰白色厚层亮晶砂屑灰岩, 藻屑灰岩, 厚7.6m, 富含化石 (采集号: GP16—20)。瓣类: *McCloudia ovatoides* (Liu, Xiao & Dong), *Pseudofusulina kracffti* (Schellwien), *P. cf. wangmoensis* Sheng, *P. verneuili* var. *infesta* Vissarionova, *P. karagasensis ventricosa* Rauser, *P. laxissima* (Dunbar & Skinner), *P. gallowayi* Chen, *P. longlinensis* Xia & Li (sp. n.), *P. changmeensis* Xia & Li (sp. n.), *P. proplicatissima* Rauser, *Kwantoella longissima* Xia & Li (sp. n.), *Sphaerulina zisongzhengensis* Sheng, *Rugosofusulina latioralis belajensis* Suleimanov, *Schubertella giraudi* (Deprat), *S. parva* Stewart, *S. sp.*, *Robustoschwagerina nana* Sheng, Wang & Zhong, *Pseudoreichelina tumita* Xia & Li (sp. n.), *Chenella huayingensis* Chang & Wang, *Schwagerina cushmani longa* Zhou, *S. tschernyschewi* (Schellwien), *S. tschernyschewi brevicula* Xia & Li (subsp. n.), *S. quasisubnathorsti* Xia & Li (sp. n.), *Pseudofusulinella* cf. *dunbarinaeformis* Da, *Sphaeroschwagerina changmeensis* Xia & Li (sp. n.), *S. sp.*, *Novella lanceolata* Qian, *Quasifusulina* sp.; 珊瑚: *Szechuanophyllum szechuanense simplex* (Yü & Lin), *S. bunuoense* Xu & Chen (sp. n.), *S. denticulatum* (Huang), *S. solidum* H. D. Wang (sp. n.), *Multimurinus szechuanophylloides* Xu & Chen (sp. n.), *Iranophyllum crassiseptatum* H. D. Wang (sp. n.); 腕足类: *Enteleles hemiplicatus* (Hall), *Meekella timanica* Tschernyschew, *M. sp.*, *Mapingticha longlinensis* Li (gen. & sp. n.), *Schellwienella senilis* (Phillips), *Streptorhynchus longlinensis* Li (sp. n.), *Rhipidomella* sp., *Leptodus tenuis* (Waagen), *L. nobilis* (Waagen), *L. sp.*, *L. ? sp.*, *Chonetes latesinuata* Schellwien, *C. uralicus* Moeller, *Neochonetes carbonifera* (Keyserling), *Lissochonetes?*

spp., *Chonostegoidella longlinensis* Li & Yang (gen. & sp. n.), *Echinoconchus mapingensis* Grabau, *Pustula gyrolfexa* Li (sp. n.), *Krotovia pustulata* (Keyserling), *K. nasuta* Li (sp. n.), *Alexenia gratiodentalis* (Grabau), *A. mucronata* Liao, *Spyridiophora distincta* Cooper & Stehli, *Linoproductus cora* (d'Orbigny), *L. simensis* (Tschernyschew), *L. decorus* Li (sp. n.), *L. sp.*, *Tuberella typica* Li (gen. & sp. n.), *T. altiformis* Li (gen. & sp. n.), *Compressoproductus mongolicus* (Diener), *C. corniformis* Chao, *Marginifera pusilla* Schellwien, *M. typica* Waagen, *M. sp.*, *Dictyoclostus yohi* (Chao), *D. sp.*, *Rugivestis kutorgae* (Tschernyschew), *Cancrinella cancriniformis* (Tschernyschew), *C. sp.*, *Fluctuaria specialis* Li (sp. n.), *Plicatifera latisulcata* Li (sp. n.), *Costispinifera conspicua* Ching & Ye, *Thamnosia longlinensis* Yang (sp. n.), *T. capitansensis* (Girty), *T. mutabilis* Li (sp. n.), *Incisus spiralis* Yang (sp. n.), *I. longlinensis* Yang (sp. n.), *Teleoproductus typicus* Li (gen. & sp. n.), *T. deminutus* Li (gen. & sp. n.), *Stenosisma biplicata* (Stuckenber), *S. purdoni* (Davidson), *S. purdoni* var. *gigantea* (Diener), *Pugnax swallowiana* (Shumard), *Choristites pavlovi* (Stuckenber), *C. brachythyrisiformis* Li (sp. n.), *C. cf. nikitini* (Tschernyschew), *C. wangchuchueini* Chao, *C. trautscholdi* (Stuckenber), *C. loczyi* var. *acutiauriculata* Fredericks, *C. sp.*, *Elivina lyra* Kutorga, *Eliva mignon* Grabau, *Brachythyris ufensis* Tschernyschew, *Brachythyris* sp., *Neospirifer tegulatus* (Trautschold), *N. striatus* (Sowerby), *Semibrachthyris anshunensis* Liao, *S. subpentagona* Zheng, *Spiriferella saranae* (Verneuil), *S. rajah* (Salter), *Punctospirifer ornata* Waagen, *Martiniopsis* aff. *lutugini* Tschernyschew, *M. convexa* Tschernyschew, *Squamularia* cf. *extensa* Grabau, *S. sp.*, "*Phricodothyris*" *longlinensis* Li (sp. n.), *P. sp.*, *Martinia* cf. *latisulcata* Liao, *M. corculum* (Kutorga), *M. uralica* var. *longa* Tschernyschew, *M. manchuriensis* Chao, *Cleiothyridina* sp., *Beecheria* cf. *sublaevis* (Waagen), *B. sp.*, *Dielasma giganteum* Tschernyschew, *D. mapingensis* Grabau, *D. millepunctatum* var. *mongolicum* Grabau, *Pseudodielasma orientale* Yang (sp. n.), *Skeletonia* cf. *crassa* Cooper & Grant; 双壳类: *Pernopecten obtusus* (Grabau); 三叶虫: *Nipponaspis guangxiensis* Zhou (sp. n.)。

5. 浅灰、灰白色亮晶生物屑砂屑灰岩, 厚2.8m, 含化石(采集号: GP13—15)。筳类: *McCloudia brevis* (Skinner & Wilde), *Schwagerina viriosa* Lin, *Sphaerulina zisongzhengensis* Sheng, *Schubertella magna* Lee & Chen, *Pseudofusulina* cf. *pulchella* (Skinner & Wilde), *P. sp.*, *Pseudoschwagerina longlinensis* Xia & Li (sp. n.); 珊瑚: *Nephelophyllum transitorium* Xu & Chen (sp. n.), *Caninia* sp.; 腕足类: *Dielasma* sp., *Beecheria minima*? (Merla), *Phricodothyris* sp., *Martinia* sp., *Chaoiella* sp., *Krotovia mapingensis* Grabau, *Avonia sub-tuberculatus* (Grabau), *Marginifera pusilla* var. *mapingensis* Grabau, *Linoproductus* cf. *simensis* (Tschernyschew); 双壳类: *Pernopecten ohioensis* Newell,

4. 浅灰色厚层亮晶砾屑灰岩, 厚1.6m, 含化石(采集号: GP12)。珊瑚: *Bayhaia virginiae* Wilson; 腕足类: *Marginifera* sp.

3. 深灰色亮晶生物屑灰岩, 厚4m, 富含化石(采集号GP7—11)。瓣类: *Triticites pectschoricus brevis* Rauser & Beljaev, *T. mediocris* Dunbar & Henbest, *T. kawensis* Thompson, *Pseudofusulinella proba* Skinner & Wilde, *P. compressa* Xia & Li (sp. n.), *Schubertella kingi* Dunbar & Skinner, *S. simplex* Lange, *Ozawainella guizhouensis* Chang, *O. guangxiensis* Chen & Wang, *Quasifusulina* sp., *Schwagerina* sp., *Rugosofusulina laxa* (Skinner & Wilde), *R. paraconcessa* (Rauser); 珊瑚: *Pseudozaphrentoides annulata* (Dobrolyubova & Kabakovich), *P. mapingensis* (Lee & Yü), *P. lingwuensis* (Lee & Yü), *P. verticillatus* (Barbour), *P. amplexoides* (Stuckenberga), *P. popovi* (Fomichev), *Bothrophyllum?* sp., *Fomichevella kiaeri* var. *major* (Heritsch), *Protoneoticophyllum crassum* Xu & Chen (gen. & sp. n.), *Amplexocarinia subtilis* Schouppé & Stacul, *A. pseudosubtilis* Xu & Chen (sp. n.), *A.* sp., *Timania damauensis* X. Yu, *T. guangxiensis* Xu & Chen (sp. n.), *T.* sp., *Lophophyllidium* cf. *plummeri* Jeffords, *Smerinthophyllum typicum* Xu & Chen (gen. & sp. n.), *Ivanovia crassa* Xu & Chen (sp. n.), *Pseudocarniaphyllum crassicolumnum* Xu & Chen (sp. n.), *Huananophyllum* cf. *lithostrotionelloidea* Xu, *Petalaxis antheroides* Xu & Chen (sp. n.), *P.* sp., *Antheria minor* H. D. Wang (sp. n.), *Sestrophyllum* sp., *Koninkocarinia* sp.; 腕足类: *Enteletina mirabilis* (Mansuy), *Enteleles lamarki* Fischer de Waldheim, *E.* sp., *Meekella* sp., *Rhipidomella* sp., *Schizophoria* sp., *Krotovia pustulata* (Keyserling), *Juresania juresanensis* (Tschernyschew), *Buxtonia magna* Yang (sp. n.), *B.* cf. *scabriculoides* (Paesckelmann), *B.* sp., *Avonia subtuberculatus* (Grabau), *Linoproductus simensis* (Tschernyschew), *L.* sp., *Cancrinella* sp., *Anidanthus enaagardi* Li (sp. n.), *Chaoiella grunewaldti* (Krotow), *Chonostegoidella minor* Li & Yang (gen. & sp. n.), *Marginifera pusilla* var. *mapingensis* Grabau, *M. magniplicata* Huang, *M. gobiensis* Chao, *Dictyoclostus semireticulatus* (Martin), *D.* cf. *multicostatus* Tong, *D.* sp., *Teguliferina geniculata* (Ozaki), *Alexenia* sp., *Costachonetes pygmaea* (Loczy), *Neochonetes granulifera* var. *asiatica* (Chao), *N.* sp., *Uncinunellina* sp., *Phricodothyris* sp., *Squamularia rostrata* (Kutorga), *S.* spp., *Martinia* spp., *Elivina* cf. *tibetana* (Diener), *Ncospirifer* sp., *Brachythyris rectangula* (Kutorga), *Choristites* sp., *Athyris acutirostris* Grabau, *Dielasma* sp., *Plicatifera* sp., *Echinoconchus mapingensis* Grabau, *E.* sp.; 头足类: *Metapronorites deformatus* Liang (sp. n.); 双壳类: *Leptodesma* (*Leiopteria*) *lunulata* (Phillips), *Pterinopectinella welleri* Newell, *Palaeolima retifera* (Shumard), *Annuliconcha magnini* (Mansuy), *Streblochondria* cf. *sculptilis* (Miller), *Streblopteria changmeensis* Zhang (sp. n.), *Pernopecten ohioensis* Newell, *Parallelodon sangmonensis* (Worthen), *Acanthopecten mapingensis* (Grabau); 三叶虫: *Nipponaspis guangxiensis* Zhou (sp. n.), *Ditomopyge* sp.; 牙形石: *Neostreptognathodus pequopensis?* Behnken, *Streptognathodus elongatus?* Gunnell.

2. 灰至深灰色厚层亮晶砂屑生物屑灰岩, 厚2.6m, 富含化石(采集号: GP4—6)。瓣类:

Pseudofusulinella fusulinellaeformis Da, *Schwagerina plicatissima* (Rauser), *Montiparus montiparus* (Ehrenberg), sensu Moeller, *Schubertella transitoria* Staff & Wedekind, *S. rara* Sheng, *Quasifusulina eleganta* Schlykova, *Ozawainella guangxiensis* Chen & Wang,, *Triticites mediocris* Dunbar & Henbest; 珊瑚: *Pseudozaphrentoides janshuiensis* (Sun), *Ccninia lipoensis chuanshanensis* X. Yu, *Lophophyllidium* sp., *Adetopora* sp.; 腕足类: *Enteleles lamarki* Fischer de Waldheim, *Schizophoria resupinata* (Martin), *Krotovia* sp., *Buxtonia* sp., *Avonia cylindrica* Ustriski, *Echinoconchus mapingensis* Grabau, *Plicatiferina crenulata* (Grabau), *Chonostegoidella minor* Li & Yang (gen. & sp. n.), *Linoproductus* sp., *Alexenia gratiodentalis* (Grabau), *Neoplicatifera costata* Ni, *Marginitifera pusilla* var. *mapingensis* Grabau, *Neochonetes carbonifera* (Keyserling), *Choristites* sp., *Brachythyris* sp.; 腹足类: *Orthonychia* sp.; 牙形石: *Neogondolella bisselli* (Clark), *Neostreptognathodus sulcopicatus* (Yongquist, Hawley & Miller), *Hindeodella* sp..

1. 灰色厚层亮晶生物屑灰岩, 厚2.1m, 含大量化石(采集号: GP3)。瓣类: *Pseudofusulinella proba* Skinner & Wilde, *Eoparafusulina conferta* Chen & Wang; 珊瑚: *Amplexocarinia geyeri* Heritsch, *A. pseudosubtilis* Xu & Chen (sp. n.), *Pseudozaphrentoides diphyphylloides* X. Yu, *P. amplexoides* (Stuckenberg), *P. trinkleri* (Schindewolf), *P. nevadensis* (Meek), *P. cf. spatiosus* (Moore & Jeffords), *P. spp.*, *Pseudocarniaphyllum* sp., *Caninia* sp., *Caninophyllum stenium* Xu & Chen (sp. n.), *C. sp.*, *Arctophyllum laterincrescens* Xu & Chen. (sp. n.), *Bothroclisia clisiophyloides* Fomichev, *Protonaoticophyllum guangxiense* Xu & Chen (gen. & sp. n.), *P. sp.* (gen. n.), *Lophocarinophyllum* ? sp., *Tetralasma irregulare* Xu & Chen (sp. n.), *Lomaphyllum* sp., *Michelinia bunuoensis* Xu & Chen (sp. n.), *Xianzapora tabulata* Xu & Chen (sp. n.); 腕足类: *Orthotichia derbyi* (Waagen), *Meekella striatocosta* (Cox), *M. sp.*, *Streptorhynchus* aff. *conicus* Lee & Gu, *Acosarina indica* (Waagen), *A. monocosta* Li (sp. n.), *Enteleles lamarki* Fischer de Waldheim, *E. andrewsi* Grabau, *Limbella wolfcampensis* (King), *Chonostegoidella minor* Li & Yang (gen. & sp. n.), *C. longlinensis* Li & Yang (gen. & sp. n.), *Richthofenia elegans* Li (sp. n.), *Avonia echidniformis* Grabau & Chao, *A. cylindrica* Ustriski, *A. subtuberculata* (Grabau), *A. wallacei* Derby, *A. adaucta* Li (sp. n.), *A. aspereta* Li (sp. n.), *A. gaominensis* (Grabau & Yoh), *A. orbiculata* Li (sp. n.), *A. longitubercula* Li (sp. n.), *A. phanera* Li (sp. n.), *Buxtonia longispina* Lee & Gu, *B. mosquensis* Ivanov, *Juresania juresanensis* (Tschernyschew), *J. grandispinosa* Li (sp. n.), *Waagenoconcha humboldti* (d'Orbigny), *Echinoconchus punctatus* (Martia), *E. multirugosus* Lee & Duan, *E. mapingensis* Grabau, *Vediproductus formos* Li (sp. n.), *Kochiproductus carboniferous* Li (sp. n.), *K. longlinensis* Li (sp. n.), *Krotovia pustulata* (Keyserling), *K. mapingensis* (Grabau), *K. latisulcata* Li (sp. n.), *K. longlinensis* Li (sp. n.), *K. elegans* Li (sp. n.), *K. nasuta* Li (sp. n.), *Alexenia gratiodentalis* (Grabau), *Dictyoclostus nantanensis* (Grabau), *D. boliviensis* (d'Orbigny), *D. doneizianus* (Licharew), *D. aff. qiliensis* Lee & Duan,