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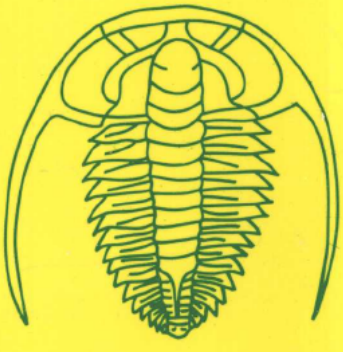

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STRATOTYPE SECTION FOR LOWER CAMBRIAN STAGES IN CHINA

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前　言

当前，国际地科联地层委员会寒武系分会正酝酿着全球寒武系的分统、建阶和对比，讨论确定寒武系阶的名称、层型剖面地点和化石分带，以作为国际地层划分、对比的标准。全球早寒武世分为东方动物群（太平洋动物群）区系和西方动物群（大西洋动物群）区系两大生物地理区系。前者以莱得利基虫类（RedIichids）动物群为代表，后者以小油栉虫类（Olenellids）动物群为代表。东方动物群广布于亚洲大部分地区及大洋洲和南极洲。中国是东方动物群区系的典型代表。由于早寒世全球分为两大动物地理区系，因此全球下寒武统必须建立两类分阶、分带的标准。中国下寒武统的建阶、分带将成为亚、澳地区早寒武世地层划分对比的标准。

中国下寒武统划分为梅树村阶、筇竹寺阶、沧浪铺阶和龙王庙阶4个年代地层单位。云南东部昆明、晋宁、马龙地区是中国下寒武统建阶层型剖面所在地。该区早寒武世地层出露完整，各阶上下界线清楚，生物化石极其丰富。对这一地区层型剖面的研究，不仅对中国下寒武统建阶分带有重要意义，而且对力争全球下寒武统建阶层型选在中国亦有极大的潜在作用。

80年代以来，随着中国震旦系——寒武系界线层型剖面的研究，对梅树村阶的顶底界线、化石分带和生物组合、同位素年龄及磁性地层特征等方面均有较深入的研究，达到较高的研究水平。但筇竹寺阶、沧浪铺阶及龙王庙阶则停留在60—70年代的研究程度，对层型剖面的生物演化分布规律、岩石岩相特征、同位素年龄及古地磁特征等均未作系统研究，因而所建立的阶名、层型剖面和化石分带要得到国际公认尚有一定差距。根据目前发展趋势，有必要对这些剖面加深研究，以期尽快提出较高水平的科研成果。

为此，云南省地质矿产局地质科技发展基金委员会，于1989年1月正式批准《中国下寒武统建阶层型剖面研究》（89—J_1）项目（1989年1月—1991年12月）。专题组全面开展了滇东昆明、晋宁、马龙、宜良地区下寒武统建阶层型剖面的野外和室内研究工作（图1）。通过三年多的艰苦努力，进一步加深了梅树村剖面的研究，重新审定和补充了梅树村阶的化石带和生物组合内容，系统测定了梅树村剖面的碳氧同位素，并获得较好的结果。首次测得筇竹寺阶下界的锶锶同位素年龄值为556.8±10.7Ma。发现和实测了晋宁老高山和宜良龙肇寺剖面，重新测制了昆明筇竹寺、龙王庙，马龙矿山、红军哨，乌龙箐和小罗贵等10条剖面，系统采集、分析、鉴定岩石和光谱样品910件，古生物化石标本2146件，为室内综合研究提供了丰富扎实的基础资料。

本书详细讨论了中国下寒武统建阶层型剖面的岩石地层、生物地层及年代地层特征，对下寒武统各阶有时间意义的化石带和化石组合、各阶上下界线及识别标志进行了详细论述。并建议按地层规范要求重新给予新的组名，用黑林铺组、红井哨组、乌龙箐组及山邑村组分别取代筇竹寺组、沧浪铺组和龙王庙组。根据滇东地区早寒武世建阶层型剖面的生物带和化石组合与国内的扬子区、华北区及东北南部区和国外的巴基斯坦、摩洛哥、澳大利亚及西伯利亚的相关地层进行了对比，并与西方动物群区系的北美和北欧作了比较。根据时间分布将中国早寒武世生物群划分为梅树村动物群、最古老三叶虫动物群、澄江动物群和马龙动物群4个主要类型。以小江古断裂为

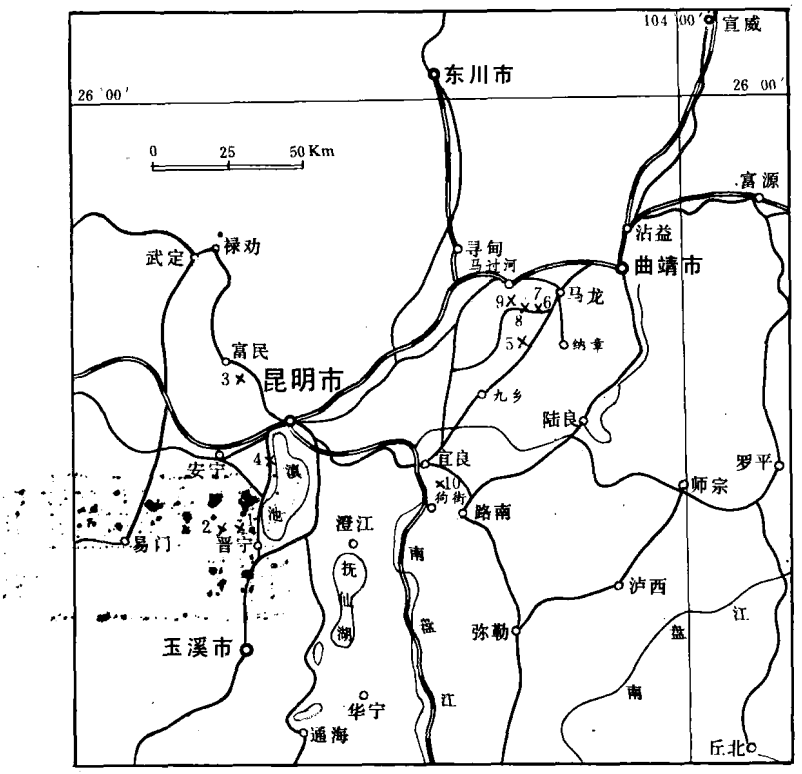

图 1 昆明、马龙地区下、中寒武统剖面位置图

1．晋宁梅树村 2．晋宁老高山 3．昆明笋竹寺 4．昆明西山龙王庙 5．马龙矿山 6．马龙红军哨象头山 7．马龙红军哨砍斧箐 8．马龙乌龙箐 9．马龙小罗贵 10．宜良陡坡寺

界。将滇东地区早、中寒武世三叶虫动物群分为昆明—武定区和马龙—宜良区两个生物地理区。

本书全面系统地总结了滇东早寒武世各类生物化石的纵横向分布规律，重点对三叶虫、软舌螺、腕足类、遗迹化石及类水母进行了系统描述，共计 61 属 129 种(其中 8 个新属 37 个新种)，附有 40 个化石图版。文内还讨论了滇东地区早寒武世的古构造环境及各时期的沉积相，编制了 6 个时期的岩相古地理图。对进一步了解沉积盆地演化及区域古地理格局都有重要意义。

1993 年 2 月，《中国下寒武统建阶层型剖面研究》报告完成后，由云南省地质矿产局组织，送请中国科学院卢衍豪、王鸿桢、刘宝珺院士，中国地质科学院项礼文研究员和昆明工学院易定蓉副教授评审，他们对该成果均给予较高的评价，认为本研究成果“工作基础扎实，资料丰富，内容完整，分析合理，观点明确，立论严谨，测试数据可靠，各种结论可信度高，有的资料为首次发表，有不少新见，特别是作者采用了学科交叉渗透的研究方法，使生物地层研究更为深化，构成该项目的特色之一。该成果在我国各纪建阶工作中，起到示范作用，是目前全球早寒武世地层古生物、区域古地理、同位素年龄等方面综合研究最为详细的成果，已达国际水平和国内先进水平”(云南省地质矿产局科学技术成果鉴定征书)。

在本项目研究过程中，得到中国地质科学院地质研究所项礼文教授的大力支持，资助我们测

定了筇竹寺阶下界的年龄值。我所武希彻、宋学良、欧阳麟参加了前期部分工作；昆阳磷矿张世山、陶永和给予很好的的合作和支持；云南省地矿局区调所张定辉、兰朝华提供部分资料；中国科学院南京地质古生物研究所王化羽提供部分腕足类化石名单；我所杨勤生高级工程师给予指导和帮助，古生物室宋学良、李代芸、方润森协助鉴定珊瑚、古植物及部分腕足类化石，武希彻鉴定全部岩石薄片，所内磨片、光谱、绘图、照相、复印等部门给予大力协助和支持，李希勣教授翻译外文摘要，在此一并致谢。文中不当之处和错误的地方，敬请读者批评指正。

著者

1994 年 7 月

ABSTRACT

Current thoughts of the Subcommission on Cambrian Stratigraphy, Commission on Stratigraphy, International Union of Geological Sciences is intending on dividing Series of global Cambrian, establishing stages and correlations, discussing to confirm names of Cambrian Stages as well as type locality of stratotype section and fossil zones to be standard of international stratigraphic divissions and correlation.

In Early Cambrian, owing to differences of global biofacies and faunal provinces, it can be divided into two major faunal realms: the Oriental Fauna (Pacific Fauna) and the Occidental Fauna (Atlantic Fauna). The former is represented by Redlichids Fauna, while the latter is represented by Olenellids Fauna. The Oriental Fauna distribute widely in most part of Asia, Oceania and Antarctica. China is the typical representative of the Oriental Fauna realm. Because of dividing into two fauna realms for Early Cambrian of the whole globe, it is nececreary to establish two kinds of stage and zone divisions standard in the whole globe. Establishment of stages and zones divisions of Lower Cambrian Series in China would be standard for stratigraphic divisions and correlation of Early Cambrian in Asia and Autralia regions.

Lower Cambrian in China is divided into four chronostratigraphic units: the Meishucunian Stage, the Qiongzhusian Stage, the Canlangpuian Stage and the Longwangmiaoian Stage. Kunming, Jinming and Malong areas in Eastern Yunnan are the type locality for the Lower Cambrian stratotype section of stages in China. In these areas, stratum of Early Cambrian expose perfectly with clear boundaries at top and bottom of each stage and extremely abundant fossils. Research of the stratotype section of this region is not only significant in stage establishment and zoning of Lower Cambrian in China, but also there would have potential function in trying to select the global Lower Cambrian stratotype section of stages in China.

From bottom to top, the Meishucunian Stage is divided into three small shelly fossil zones: (1) *Anabarites—Protohertzina* zone, (2) *Paragloborilus—Siphogonuchites* zone, (3) *Sinosachites—Lapworthella* zone. In the earlist time, begining of the Meishucunian Stage was located at exposure of the *Anabarites—Protohertzina* zone (Point A), but later on, owing to the stratotype point of Precambrian—Cambrian boundary was selected at point B between (1) and (2) fossil zones, bassal boundary of the Meishucunian Stage is changed to bottom of *Paragloborilus—Siphogonuchites* zone, (1) zone is divided into the Dengyingxiaian Stage of the Upper Sinian. There are abundant small shelly fossils of many varities in the Meishucunian Stage: Hyolithids, Hyolithelmithes, Tubelichitids, Conodontomorphs, Conularids, Monoplacopho-

rans, Gastropods, Brachiopods, Vermes, Trace fossils, Microfossils and Acritarchs etc. Age of Lower boundary of the Meishucunian Stage is 597 Ma.

The Qiongzhusian Stage may be divided into two trilobite fossil zones: (1) *Parabdiella* zone, (2) *Eoredlichia* zone. Boundary between the Qiongzhusian Stage and Meishucunian Stage is located at the exposure of the oldest trilobite *Parabadiella*, with disappearance of *Eoredlichia* and *Wutingaspis* as the boundary of the Qiongzhusian and Canglangpuian Stage. In the Qiongzhusian Stage, chief fossils are Trilobites and Archaeostracods accompanied with Brachiopods, Hyolithids, Arthropods, Vermes, Medusae and Sponges etc. Age of Lower boundary of the Qiongzhusian Stage is 556.8 Ma.

For the Canglangpuian Stage, there should only establish four fossil zones: (1) *Yiliangella* zone, (2) *Drepanuroides* zone, (3) *Palaeolenus* zone, (4) *Megapalaeolenus* zone. *Malungia* was a cross — stage trilobite with its age extend across late Qiongzhusian Age to Early Canglangpuian Age. Life span of *Yunnanaspis* was extremely short, it coexisted with *Yiliangella*, so it should not be used as zone fossil. Disappearance of *Megapalaeolenus* is used to be division boundary of the Canglangpuian and Longwangmiaoian Stages. Trilobite is the main fossil in the Canglangpuian Stage with a few Brachiopods, Hyolithids and Trace fossils accompanied in it.

Only one fossil zone of *Hoffetella — Redlichia* (*Pteroredlichia*) *murakamii* is established for the Longwangmiaoian stage. Its upper boundary is put at the horizon with disappearance of Redlichids and abundant shows of Ptychoparids, this is the Lower—Middle Cambrian boundary in China. Trilobite is predominant in the Longwangmiaoian Stage with a few Brachiopods, Hyolithids and Trace fossils accompanied in it.

Most of the current terms established for chronostratigraphic units in China were originated from Formation names. Owing to boundaries of chronostratigraphic units are divided by fossil zones, they are not always unanimous with the division boundaries based on lithostratigraphic units with sudden changes of lithological character. For instance, the Qiongzhusian Stage contains only upper part of the Qiongzhusi Formation (Yuanshan Member), lower boundaries for both are not the same. Thus two stratigraphic units of different kinds are being using the same geographic name, it is easy to get confuse and misundderstood. We suggest using the Heilinpu Formation, Honjingshao Formation, Wulongqing Formation and Shanyicun Formation to replace the Qiongzhusi Formation, Canglangpu Formation and Longwangmiao Formation respectively.

Taking biozones and fossil assemblages from the Lower Cambrian stratotype section in stages of the Meishucunian Stage, Qiongzhusian Stage, Canglangpuian Stage and Longwangmiaoian Stage in China, they are correlated with correspondent stratum in the Yangtze Region,

North China Region and Southern part of the North—East China Region at home, as well as with those in Pakistan, Morocco, Australia and Siberia. They are also correlated with North America and North Europe which belong to Occidental Fauna realm.

Sedimentation of Early Cambrian in Eastern Yunnan was based on carbonate platform of the Late Sinian Dengyingxiaian Age developed in litteral and shallow sea environment. Sediment rocks are chiefly of terrigenous clastic and chemical—biochemical in charactor and of mixed sedimentation type with equal development in muddy and clear water. Based on rocks assemblage and evolution of sedimental facies, The Early Cambrian in Eastern Yunnan is divided into six ages as the Early and Late Meishucunian Age, the Qiongzhusian Age, the Early and Late Canglangpuian Age and the Longwangmiaoian Age,and also correspondent lithofacies and paleogeographic map is made. During the Early Meishucunian Age, the East Yunnan sea basin evolved from subtidal zone to intertidal zone forming sedimentation characteriged mainly of phosphorite, silicolite and dolomite. Based on differences of rock kinds and sedimental environments, they can be classified to be six facies type as dolomite tidal flat facies, mudston—dolomite tidal flat facies, phosphorit—dolomite tidal flat facies, dolomite—phosphorite tidal flat facies, phosphorite—sandstone tidal flat facies and inter—platform basin facies. During the Late Meishucunian Age, sedimental condition of East Yunnan sea basin changed evidently to be muddy water of shallow sea environment with its sedimente chiefly of terrigenous fine clastic rocks. It can be divided into two facies zones as nearshore facies and offshore plain facies. In the Qiongzhusian Age, the basin margin lightly uplifted, main sediments shale and siltstone with a few fine grained qualtzose sandstone can be classified to be three zones. as foreshore facies,nearshore facies and offshore plain facies zone. In the Early Canglangpuian Age, most part of East Yunnan sea basin evolved to be littoral environment with its central part uplifted and thickness of rock beds thinner more obviously. Mainly with sediments of debris arkose, quartzose sandstone and siltstone, they can be classified to be three facies zones as foreshore facies, nearshore facies and offshore plain facies. In the Late Canglangpuian Age, sedimental differentiation is still rather obvious, sediments of clear waters type appear at western part of the Basin. Predorminant with shale, siltstone and a few fine sandstone and argillaceous limestone, they can be classified to be four facies zones as limestone tidal flat facies, foreshore facies, nearshore facies and offshore plain facies. In the Longwangmiaoian Age, sedimentation was mainly in clear waters with dolomite as the main rock and limestone extensively distributed. There also appears gypsum—salt lagoon sediments. They can be classified into five facies zones as dolomite tidal plat facies, mudstone—dolomite tidal flat facies, stagnant sea limestone microfacies, stagnant sea limestone and fine—grained terrigenous rock microfacies.

This paper describes kinds of fossils in the Early and Middle Cambrian including Trilo-

bites, Hyolithids, Brachiopods, Trace fossils and Medusoid. There are 61 genera and 129 species in total, in wich there are 8 new genera and 37 new species as followa: Trilobites: *Redlichia* (*Redlichia*) *xunquensis* Luo (sp. nov.), *R.* (*R.*) *puzhaocunensis* Luo (sp. nov.), *R.* (*Pteroredlichia*) *malongensis* Luo (sp. nov.), *R.* (*P.*) *wulongqingensis* Luo (sp. nov.), *Wutingaspis hongjunshaoensis* Luo (sp. nov.), *Paramalungia angustilimbata* Luo (sp. nov.), *Yinites malongensis* Luo (sp. nov.), *Y. distinctus* Luo (sp. nov.), *Yiliangellina* ? *magna* Luo (sp. nov.), *Parayiliangella* Luo (gen. nov.), *Mayiella quadrata* Luo (sp. nov.), *Megapalaeolenus luquanensis* Luo (sp. nov.), *Yunnanocephalus latilimbatus* Luo (sp. nov.), *Hongjunshaonia kanfuqingensis* Luo (gen. et sp. nov.), *Eoptychoparia dahaiensis* Luo (sp. nov.), *Yiliangaspis latus* Luo (gen. et sp. nov.), *Y. malongensis* Luo (gen. et sp. nov.), *Sinoptychoparia xundianensis* Luo (sp. nov.), *S. zhanyiensis* Luo (sp. nov.), *Douposiella zhanyiensis* Luo (sp. nov.), *Xundiania quadrata* Luo (gen. et sp. nov.), *Chittidilla sheshanensis* Luo (sp. nov.); Hyolithids: *Allatheca yiliangensis* Jiang (sp. nov.), *A. xiaoluoguiensis* Jiang (sp. nov.), *Malongtheca malongensis* Jiang (gen. et sp. nov.), *M. normala* Jiang (gen. et sp. nov.), *Aristitheca cannoides* Jiang (gen. et sp. nov.), *Ambrolinevitus meishucunensis* Jiang (sp. nov.), *A. ventricosus euries* Jiang (subsp. nov.); Trace fossils: *Archaeichnium kunmingensis* Luo (ichnosp. nov.), *Arthrophycus qiongzhusiensis* Luo (ichnosp. nov.), *Bifungites kunyangensis* Luo (ichnosp. nov.), *Climactichnites laogaoshanensis* Luo (ichnosp. nov.), *Cruziana beifengwanensis* Luo et Gao (ichnosp. nov.), *Palaeophycus beifongwanensis* Luo (ichnosp. nov.), *Qipanshanichnus gyrus* Luo et Tao (ichnogen. et ichnosp. nov.), *Thalassinoides xiaoluoguiensis* Luo (ichnosp. nov.); Medusoid: *Malongmedusa orbiculata* Luo (gen. et sp. nov.).

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第一章　中国早寒武世地层划分

第一节　云南东部早、中寒武世岩石地层单位

一、研究简史

丁文江、王曰伦(1937)报道马龙地区发现早寒武世地层，并将其命名为沧浪铺页岩(Tsanglangpu Shale)。卢衍豪(1941)详细研究了昆明附近早寒武世地层和三叶虫动物群，划分下寒武统为3个岩石地层单位。将沧浪铺组含义缩小，限于下寒武统中部，同时创建筇竹寺组和龙王庙组，分别代表早寒武世早期和晚期地层。1939年卢衍豪、王鸿桢(见谢家荣，1941)将宜良陡坡寺附近含"*Ptychoparia*"三叶虫的页岩和灰岩命名为陡坡寺组，并怀疑其时代为中寒武世。

江能人等(1964)系统研究了滇东地区的寒武纪地层，将早寒武世最早期的一段含磷地层命名为梅树村组。同时肯定了滇东地区有中寒武世 地层存在，并创名云山村组和双龙潭组。张文堂等(1966，1979)再次研究了云南东部寒武纪地层，将沧浪铺组进一步划分为红井哨段和乌龙箐段，并作了化石分带。

罗惠麟等(1982，1984)在研究云南东部震旦系—寒武系界线地层时，将渔户村组进一步划分为旧城段、白岩哨段、小歪头山段、中谊村段和大海段；筇竹寺组分为八道湾段和玉案山段。同时厘 定了梅树村阶的顶底界线，并建立了化石带(表1)。

二、各组段特征

(一)渔户村组

刘鸿允、刘钰(1963)将何春荪(1942)的"上层紫色页岩系"与"渔户村含燧石石英岩系"合并称为渔户村组，时代属寒武纪最早期。罗惠麟等(1982)将渔 户村组由下至上进一步划分为旧城段、白岩哨段、小歪头山段、中谊村段和大海段5个岩性段。渔户村组主要为一套含磷硅质 白云岩、磷块岩夹硅质条带的地层。西部昆明—华宁一线厚度在200—300米之间，向东明显变薄，马龙矿山厚仅56.31米。该组是一个跨时代的岩石地层单位，除上部含丰富小壳化石和遗迹化石的部分归入下寒武统梅树村阶外，其余大部属上震旦统 (图2)。

(二) 筇竹寺组

筇竹寺组为卢衍豪 (1941) 建立，层型剖面在昆明筇竹寺南后龙洞沟。它是位于渔户村组白云岩之上及沧浪铺组厚层块状砂岩之下的一段地层。主要由黑色、灰黑色页岩、粉砂岩组成，上部夹薄层石英粉砂质白云岩。筇竹寺剖面厚193.67米。向东至宜良、马龙地区，页岩增多，粒

表 1　滇东下、中寒武统岩石地层划分沿革简表

作者	卢衍豪 1941		卢衍豪 1962		江能人等 1964		张文堂等 1973,1979		罗惠麟 1976		罗惠麟等 1982,1984		本　文			
地层划分	中寒武统	陡坡寺组	下寒武统	龙王庙组	中寒武统	双龙潭组	中寒武统	双龙潭组	中寒武统	双龙潭组	中寒武统	双龙潭组	中寒武统	双龙潭组		
						云山村组		陡坡寺组		陡坡寺组		陡坡寺组		陡坡寺组		
	下寒武统	龙王庙组			下寒武统	龙王庙阶	下寒武统	龙王庙组	下寒武统	龙王庙组	下寒武统	龙王庙组	下寒武统	龙王庙组		
		沧浪铺组		沧浪铺组		沧浪铺阶		乌龙箐段		乌龙箐段		乌龙箐段		沧浪铺组	乌龙箐段	
								沧浪铺组		沧浪铺组		沧浪铺组			关山段	红井哨段
								红井哨段		红井哨段		红井哨段				
		筇竹寺组		筇竹寺组（Hyolithes层）		筇竹寺阶		筇竹寺组		筇竹寺组		玉案山段		筇竹寺组	玉案山段	
						梅树村组		梅树村组	渔户村组	梅树村段		八道湾段			石岩头段	
										中谊村段	渔户村组	大海段		渔户村组	大海段	
	震旦系	石灰岩		灯影组	上震旦统	灯影灰岩	上震旦统	灯影组		白岩哨段		中谊村段	上震旦统		中谊村段	
			上震旦统									小歪头山段			小歪头山段	

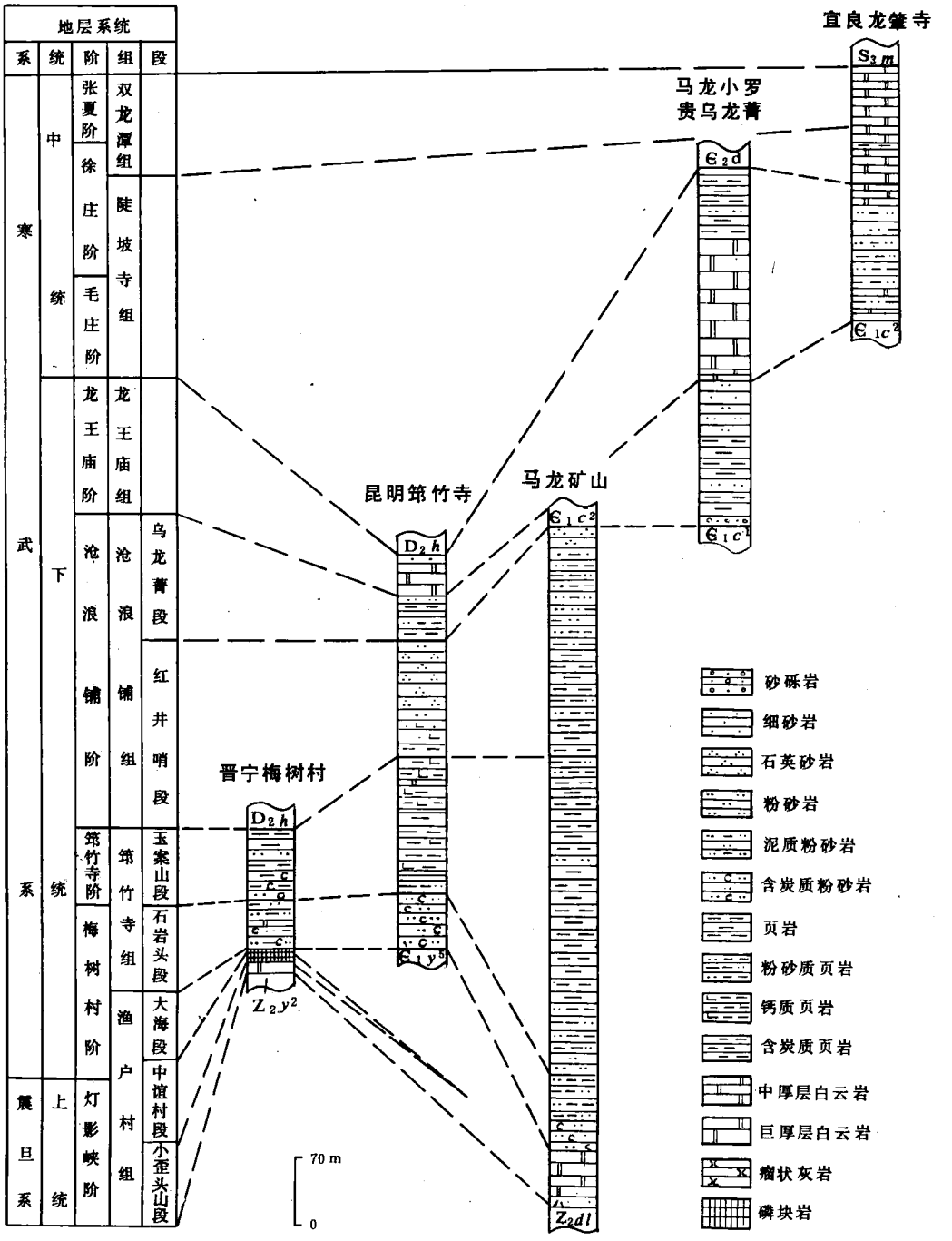

图 2　滇东下、中寒武统地层柱状对比图