

地层古生物论文集

第二十三辑

中国地质科学院地层古生物论文集编委会

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陕南川北奥陶系再研究

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一、前 言

陕南川北的奥陶系分布于扬子地台北缘边界断裂带(即平关—勉县、饶峰、青峰断裂线)的南沿,其西以龙门山深断裂带为界,向东延至城口附近,构造上属扬子准地台中的龙门—大巴台缘褶皱带(任纪舜等1980)的一部分,地层区划上归于米仓山—龙门山分区(赖才根等1982)。该区的奥陶系在赵亚曾、黄汲清、杨敬之、谷德振、侯德封、王现存等人的各类报告中,均已涉及,至今已有50余年的研究历史了。卢衍豪(1943, 1959, 1975)在该区确立的奥陶系层序,虽经多人、多次研究,对某些地点或某类问题提出过不少修改意见,但有关深入的生物地层研究资料和详细的实测剖面资料的报导,所见不多;有些问题,如该区的有无五峰期沉积、奥陶系与志留系间是否连续、庙坡期属何种沉积相、以及对西梁寺组的含义等问题的争论仍然存在,尚待解决。为此,我们在大致沿汉南杂岩北缘的几个地点,于1985年和1986年,两度实测和观察了四川广元谭家沟、陕西宁强赵家坝、宁强大竹坝、南郑元坝、南郑下梁山、南郑中梁寺和西乡、三郎铺等地的奥陶系剖面,采集了大量化石和部分岩石样品。经室内研究并结合前人资料分析,我们发现:米仓山—龙门山分区的奥陶系呈环带状分布于汉南杂岩周边,奥陶系下部和寒武系上部均有不同程度的缺失,奥陶系底部均发育有一层砾岩或砂岩,成为奥陶系总的发育特点;以镇巴—司上断裂为东界的米仓山地层小区内,据其地层发育差异还可划分为广元—宁强地区(位西北侧)和南江—西乡地区。前一地区在奥陶系与志留系交界处有不同程度的缺失;后一地区在奥陶系与志留系间是连续的,志留系底部的笔石带齐全,五峰期可划分出三个笔石带,南郑页岩应归入奥陶系。文内公布的四川广元谭家沟和陕西宁强赵家坝奥陶系剖面资料,就其所含各门类化石之齐全、丰富、层位之多、岩石及生物地层单元划分之细,是前所未有的,为今后各方面的研究工作提供了素材。广元谭家沟的谭家沟组的时代更改为牯牛潭期,宝塔组属牯牛潭晚期至庙坡期,宝塔期以后均已缺失的结论;宁强赵家坝宝塔组的大部分应属庙坡期的结论;西梁寺组顶界不超过 *Glyptograptus austrodentatus* 带的结论,与该区沉积和地质历史的阐述是吻合的。笔者对生物群特征与沉积环境的叙述属粗浅看法,发表于此,供讨论。

本文作者自始至终参加了野外和室内分析、鉴定各门类化石工作。在完成本项目研究过程中,姬再良参加了1985年野外工作,金若谷代为鉴定岩石薄片,野外交通和实验室使用上得到西安地质矿产研究所、陕西地矿局区调队和西安地院的帮助和支持,谨致谢意。

陕南川北奥陶系区划露头分布及剖面位置图

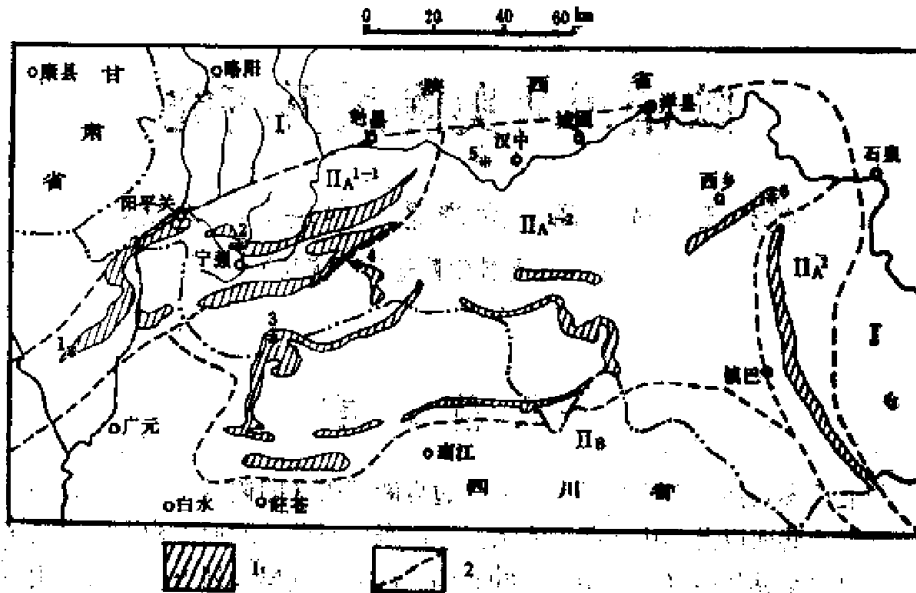


图 1

I—昆仑秦岭地层区；II—扬子地层区；II_A—米仓山—龙门山地层分区；II_A¹⁻¹—广元—宁强地区；II_A¹⁻²—南郑—西乡地区；II_A¹⁻³—堵河地层小区；II_B—四川盆地地层分区
 ●—实测剖面位置及编号；●1—四川广元谭家沟；●2—陕西宁强赵家坝；●3—陕西宁强大竹坝；●4—南郑元坝大佛堡；●5—南郑下梁山及中梁寺；●6—西乡三郎铺杨家沟
 1—奥陶系露头；2—地层区划界线

二、地层剖面描述

陕西宁强赵家坝剖面 (图2)

剖面位于宁强县城北5km的赵家坝双河口以东约800m的山脊和沟内，距卢衍豪(1959, 1975)的剖面约500m。层序如下：

上覆地层 下志留统崔家沟组：灰绿色、质纯、性脆泥岩，含笔石：*Streptograptus* sp.，微古植物(A-41)；*Vergachium rhomboides* Downie, *V. sabcaum* Stockmans

———平行不整合———

上奥陶统

宝塔组 (13.85 m)

- 16. 青灰色薄层含生物碎屑微晶灰岩，由密集的泥质条带和网纹分隔呈小瘤状体，含三叶虫(86NS-18-T)，*Cahovia detoides* Lu, *Cyclopyge recurva* Lu, *Pandora orbiculata* Ji, 距顶1.5m处含牙形石(85NS-14-C₁)，*Hamarodus europaeus* (Serpagli), *Dapsilodus similis* (Rhodes), *Pseudoonotodus mitratus* (Moskalenko) 1.86 m
- 18. 暗紫红色薄层至中层含生物碎屑微晶灰岩，含三叶虫(86NS-18-T)，*Cyclopyge* sp., *Trinoides* sp. 1.4 m
- 17. 暗紫红色钙质、粉砂质泥岩，含三叶虫类丰富的分形虫化石，三叶虫(86NS-

- 17-T) 有; *Pliomerina* sp., *Trinodus* sp., *Trinuclidia*, *Hammatocnemis* sp., *Cyclopyge* sp., *Hanxiongaspis elongatus* Chen 0.88 m
18. 紫红色薄层网纹灰岩, 含青灰色灰岩眼球体 1.12 m
15. 暗紫红色厚层生物碎屑微晶灰岩及含生物碎屑微晶灰岩。夹泥质条带(厚2—3cm), 各条带相隔10—15cm, 层面上具龟裂纹构造。距底2.19m处采得头足类(86NS-15-1), *Lituites ningbianensis* Lai, 及三叶虫; *Nileus armadilloformis* Lu, *Trinuclidia*, *Geragnostus* sp., *Hadronevus* sp., *Cyclopyge recurva* Lu; (86NS-15-T); *Cyclopyge* sp., *Pseudopeltigurus granulatus* Chen; *Cakovia elevata* Lu, 距底1.5m含牙形石(85NS-14-C₁), *Baltoniodus prevariabilis* (Fähræus), *Complexodus pugionifer* (Drygant), *Protopanderodus rectus* (Lindström), *Drepanodus sculponea* (Lindström); 距底3m含牙形石(85NS-14-C₂), *Baltoniodus prevariabilis* (Fähræus), *Complexodus pugionifer* (Drygant), *Rhodrognaethus elegans* (Rhodes), *Drepanodus arcuatus* Pander, *Walliserodus ethingtoni* (Fähræus) 4.66 m
- 在宁强滴水铺赵家坝村(原卢衍豪, 1959年所测剖面)的宝塔组中下部(相当本剖面18层)获得牙形石(85NS-M-T), *Pygodus anserinus* Lamont & Lindström, *Baltoniodus variabilis* Bergström, *Dapsilodus proceus* (Ethington), *Complexodus pugionifer* (Drygant), *Eoplacognathus fanyuensis* An & Ding, *E. miaopoensis* An & et al., *Baltoniodus prevariabilis* (Fähræus), *Panderodus gracilis* (Branson & Mehl), *Amorphognathus melcensis* Dzirk, *Rhodesognathus elegans* (Rhodes), *Paroistodus parallelus* (Pander), *Protopanderodus rectus* (Lindström), *Splindodus ramosus* (Hadding), *Paroistodus originalis* (Sergeeva), *Protopanderodus parathesis* Löfgren 等; 在宝塔组顶部(相当本剖面16层)采得头足类 *Estuiffes* sp.
14. 青灰色含泥质条带微晶砂、砾屑灰岩及生物碎屑微晶灰岩。底部含三叶虫(86NS-14-T); *Cyclopyge* sp. 和牙形石(85NS-13-C₁); *Eoplacognathus elegans* (Bergström), *Polyplacognathus suecici* Bergström, *Kelstognathus* sp., *Dapsilodus similis* (Rhodes), 距底3.06m处采得三叶虫(86NS-14-T₁); *Pseudopeltigurus granulatus* Chen, *Cyclopyge* sp.; (86NS-14-T₂); *Cyclopyge chinensis* Chen, *C. recurva* Lu, *C. subcylindrica* Chen, *Sphaerastochus* sp., *Pancleria orbiculata* Ji, *Hadronevus* sp., *Iliaenus nianhsiensis* Lu, *Nileus armadilloformis* Lu; 头足类(86NS-14-2); *Michelinoceras elongatum* (Yü), *Bactraceras angustisiphonatum* (Rüdiger) 和牙形石(85NS-13-C₂); *Drepanodus sculponea* (Lindström), *Oistodus longiramis* Lindström 3.33 m
13. 上部紫红色粉砂质页岩, 下部姜黄色粉砂质页岩 0.6 m
- 下奥陶统
牯牛潭组
12. 青灰色(风化后呈黄灰色)中层状含灰岩团块粉砂质泥灰岩及泥灰岩。灰岩团块呈灰色、与基质边界不清, 基质具波状层理、团块局部重结晶, 并含大量生物碎片。岩石层面呈豹皮状, 断面呈条带状, 距底9.44m处夹一层8cm厚的暗紫红色泥灰岩。距底3.18m处夹一薄层生物碎屑微晶灰岩, 在本层中部1/3厚度范围内采得头足类(86NS-12-Ce); *Richardsonoceras* spp., *Ancistroceras* sp. 13.6 m

西梁寺组

11. 深灰色粉砂质页岩夹灰色粉砂质泥岩及致密灰岩透镜体或灰岩条带。灰岩条带单层厚10—20cm, 每一条带相隔20—50cm。在中上部灰岩条带相对集中, 呈瘤状, 与页岩呈互层状。自上而下采得6层笔石, 距底21.36m(86NS-11-G₆)含 *Aulograptus leezhuangi* (Hsü), *Phyllograptus* cf. *anna* Hall, *Cryptograptus uniformis* Chen, *Cryptograptus uniformis* (subsp. nov.), *Glyptograptus austrodentatus* Harris et Keble, *G. austrodentatus major* Mu, *G. cf. robustus* Mu, *G. cf. tongziensis* Mu, *G. spp.*, *Amplexograptus* spp.; 三叶虫: (A-32); *Ninghianolithus welleri* (Endo), *Megalaspides* sp., 距底20.15m(86NS-11-G₅); *Didymograptus* cf. *hirundo* Salter, *Janograptus* sp., *Didymograptus* sp., *Aulograptus leezhuangi* (Hsü), *Cryptograptus uniformis* Chen, cf. *uniformis* Chen, *Climacograptus* sp., 三叶虫(86NS-11-T₂); *Ninghianites ninghanensis* Lu, *Iliaenus* sp., *Asaphus expansus* (Wahlenberg), 距底18.78m(86NS-11-G₄); *Didymograptus* sp., *Cryptograptus* sp., 距底16.02m(86NS-11-G₃); *Didymograptus* sp., *Cryptograptus* sp., *Glyptograptus austrodentatus* Harris et Keble, *Pseudoclimacograptus* sp., 距底10.53m(86NS-11-G₂); *Didymograptus* cf. *hirundo* Salter, 三叶虫(86NS-11-T₁); *Iliaenus sinensis* Yabe, *Isotoloides hangshanensis* Lu, *Hanchungolithus multiserialatus* (Endo), *Hanchungolithus* sp., *Ninghianites ninghanensis* Lu, *Ninghianolithus* sp., 距底2.8m(86NS-11-G₁); *Didymograptus* cf. *hirundo* Salter, *D. nexus* Wang, *D. patulus* Hall, *D. spp.*。近底部采得三叶虫(86NS-11-T₁); *Nessectes shensiensis* (Lu), *Ninghianites ninghanensis* Lu, *Trinucleid*。在本层近顶部还采得头足类: *Protocycloperas deprati* Reed, *Michelinoceras paraelongatum subcentrale* Lai, 海林螭, 三虫叶; *Nilens armodilloformis* Lu, *Nilens hangshanensis* Lu, *Asaphus expansus* (Wahlenberg)。微古植物(A-36)为: *Cymatogalea modesta* Gorka, *Cymatogalea timofeevi* (Martin), *Lophosphaeridium orbiculatum* Xing, *Baltisphaeridium simplex* (Duniff), *Microstridium bacilliferum* Deflandre。底部的微体古植物(A-36)为: *Baltisphaeridium hirsutoides* (Eisonack), *B. blabavense* (Vavrdova), *B. crinitum* Martin, *Goniosphaeridium dentatum* (Timofeev), *Dasydiacrodium* sp., *Acanthodiacyrodium* sp., *Clavachitina decipiens*, *Microstridium shintonensis* Downie, *M. imitatum* Deflandre; 在小沟对岸, 采得三层化石。距底1.6m处含笔石(85NS-11-G₂); *Tetragraptus quadribrachiatatus* (Hall), *T. cf. rigidus* Geh, *T. spp.*, *Didymograptus hirundo* Salter, *D. cf. hirundo* Salter, *D. cf. extensus linearis* Monson, *D. mundus* T. S. Hall, *D. spp.*, 三叶虫(85NS-11-T₁); *Isotoloides hangshanensis* Lu, *Taihungshanina* sp., *Ninghianites ninghanensis* Lu, *Trinucleid*。近底部采得笔石(85NS-11-G₁); *Didymograptus hirundo* Salter, *D. cf. hirundo* Salter, *D. cf. extensus* Monson, *D. cf. shensiensis*, *D. nexus* Wang, *D. spp.* 11.97m

赵家坝组

10. 暗灰色、灰黑色页岩, 风化后呈纸片状。下部夹一层土黄色细砂岩和数层薄层粉砂岩; 顶部为黑色页岩夹深灰色、黄绿色薄层粉砂质泥岩, 含三叶虫和丰富的笔石。顶部笔石(85NS-10-G₂)为: *Didymograptus hirundo* Salter, *D. cf. hirundo* Salter, *D. shensiensis* Ni, *D. mundus* T. S. Hall, *D. cf. shensiensis*

陝西寧強趙家壩雙河口異陶系尖測制面圖

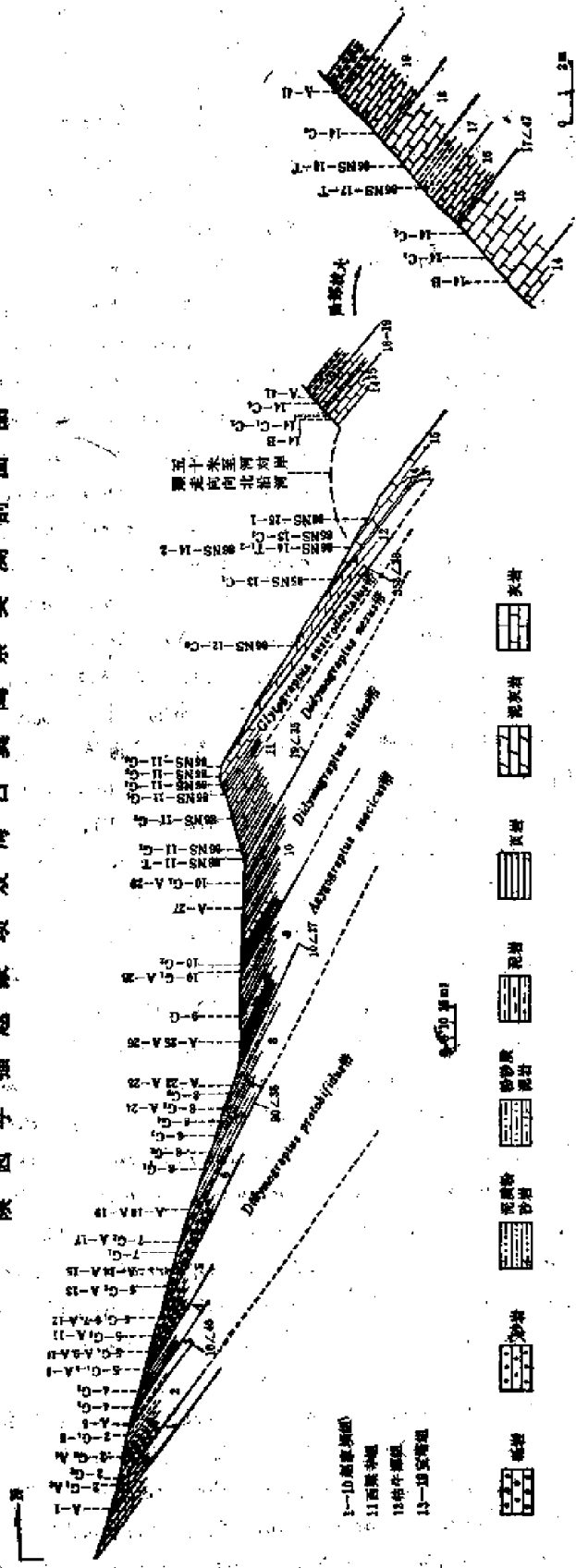


圖 2

Ni, *D. cf. uniformis* Elles et Wood, *D. nitidus* (Hall), *D. scalenus* Lin, *D. spp.*; 微体古植物(A-29)有: *Lophosphaeridium granulosum* (Staplin), *L. pilosum* Downie, *Micrhystridium ciliiforme* Fu, *M. imitatum* Deflandre, *Baltisphaeridium simplex* (Deunff), *B. acer* (Timofeev), *Cymatogalea cuvillieri* (Deunff); 本层上部含微体古植物(A-27), *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Baltisphaeridium simplex* (Deunff), *Micrhystridium spachorosuesti* Stockmans et Williere; 距底部1.65m处含笔石(85NS-10-G₁); *Didymograptus hirundo* Salter, *D. cf. hirundo* Salter, *D. extensus linearis* Monson, *D. cf. nitidus* (Hall); 距底0.41m处含(85NS-10-G₁); *Didymograptus hirundo* Salter, *D. cf. hirundo* Salter, *D. extensus linearis* Monson, *D. nitidus* (Hall), *D. cf. patulus* (Hall), *D. spp.*, *Azygograptus succicus* Moberg; 微体古植物(A-28), *Lophosphaeridium orbiculatum* Xing, *L. citrinum* Downie, *L. granulosum* (Staplin), *Helosphaeridium sp.*, *Baltisphaeridium simplex* (Deunff), *B. clavicornutum* Wetzel, *Goniosphaeridium dentatum* (Timofeev), *Cymatogalea margaritata* Deunff, *C. cuvillieri* (Deunff), *C. muricata* (Deunff), *Micrhystridium shenlonensis* Downie; 该层内采得三叶虫(85NS-10-T) (85NS-10-TD, 85NS-10-T₂); *Ptychopyge sp.*, *Taihungshania intermedia* Lu, *Megalaspides sp.*, *Nesouretus sp.*, *Ninghianolithus sp.*

18.58m

9. 暗灰绿色与黄绿色页岩互层, 中夹薄层黄灰绿色泥质粉砂岩和粉砂质条带; 页岩质纯、致密、性脆。在所夹泥质粉砂岩中含较丰富的三叶虫、腕足类和双壳类。在泥质粉砂岩与页岩过渡层中含较丰富的笔石, 以断笔石类为主, 少量对笔石, 计有(85NS-9-G); *Didymograptus hirundo* Salter, *D. cf. hirundo* Salter, *D. cf. extensus linearis* Monson, *D. cf. nitidus* Hall), *D. cf. patulus* (Hall), *Azygograptus fluitans* Ge, *A. cf. fluitans* Ge, *A. undulatus* Chen et Xia, *A. cf. undulatus* Chen et Xia, *A. lapworthi* Nicholson, *A. cf. lapworthi* Nicholson, *A. cf. succicus* Moberg; 三叶虫为(85NS-9-T₁), *Nesouretus sp.*, (86NS-原9-T₁); *Megalaspides sp.*, (85NS-9-T₂, 86NS-9-T₂); *Ptychopyge sp.*, *Taihungshania shui* Lu, (86NS-原9-T₁), *Nileus sp.*, *Ichangolithus sp.*, *Ninghianolithus sp.*, *Psilococephalina sp.*, (86NS-原9-T₂); *Isoisloides liangshanensis* Lu, (86NS-原9-T₂补含); *Nesouretus shensiensis* Lu, *Taihungshania intermedia* Lu; 在本层下部含微古植物(A-25, A-26); *Baltisphaeridium impalpabile* (Timofeev), *B. multiens* (Rud), *B. simplex* (Deunff), *Lophosphaeridium citrinum* Downie, *L. granulosum* (Staplin), *L. orbiculatum* Xing, *L. pilosum* Downie, *Goniosphaeridium dentatum* (Timofeev), *Coryphidium milada* Cramer et Diez, *Buedingisphaeridium tremadocum* Rasul, *Helosphaeridium sp.*, *Multiplicisphaeridium multipugimculatum* Cramer & Diez, *Peryhactium sp.*, *Micrhystridium acuminosum* Cramer & Diez

12.36m

8. 下部为深灰色、暗绿色含粉砂质泥岩, 风化后呈薄板状, 层面上富含绢云母碎片, 化石稀少; 中上部过渡为浅黄绿色及暗黄绿色含粉砂质泥岩, 风化后呈页片状, 含头足类, 腕足类, 三叶虫及笔石。三叶虫(85NS-8-T)为, *Taihungshania multisegmenta*, *Megalaspides sp.*; 笔石自上而下采得8层(85NS-8-G₁); *Azygograptus cf. lapworthi* Nicholson, (85NS-8-G₂); *Azygograptus*

flexilis Chen et Xia, (85NS-8-G₄); *A. lapworthi* Nicholson, *A. cf. lapworthi* Nicholson, *A. cf. undulatus* Chen et Xia, (85NS-8-G₃); *Didymograptus cf. hirundo* Salter, *Azygograptus flexilis* Chen et Xia, *A. lapworthi* Nicholson, *A. cf. lapworthi* Nicholson, *A. suecicus* Moberg, *A. cf. suecicus* Moberg, *A. cf. undulatus* Chen et Xia, *Azygograptus* spp., 三叶虫 (85NS-8-T); *Megalaspides* sp., (85NS-8-G₂); *Azygograptus fluitans* Ge, *A. cf. flexilis* Chen et Xia, *A. suecicus* Moberg, *A. undulatus* Chen et Xia, *A. cf. undulatus* Chen et Xia, *Azygograptus* spp., (85NS-8-G₁); *Azygograptus undulatus* Chen et Xia, *A. spp.*; 本层顶部含微古植物 (A-23), *Microhystridium acuminosum* Cramer et Diez, *Coryphidium milada* Cramer & Diez, *C. tadla* Cramer et Diez, *Veryhachium* sp., *Baltisphaeridium simplex* (Deunff), *B. duplicatum* (Timofeev), *Multiplicisphaeridium hydraferum* (Stockmans et al.), *Lophosphaeridium granulosum* (Staplin), *L. orbiculatum* Xing, *Goniosphaeridium nalikini* (Timofeev), *G. uncinatum* (Downie), *Cymatigalea cuvillieri* (Deunff), *Leiovalia oblonga* (Eisenack), *Acanthodiacrodiium tasselli* Martin, *Striathotheca variegulata* Cramer & Diez, 稍低为 (A-22), *Lophosphaeridium granulosum* (Staplin), *L. citrinum* Downie, *Coryphidium almohadilla* Cramer et Diez, *Multiplicisphaeridium furcatum* (Deunff), *Baltisphaeridium simplex* (Deunff), *B. duplicatum* (Timofeev), *Buedingisphaeridium tremadocum* Rasul, *Synsphaeridium conglutinatum* (Timofeev); 其下相当笔石层 (8-G₅) 的微古植物 (A-24) 为: *Baltisphaeridium simplex* (Deunff), *B. duplicatum* (Timofeev), *B. microspinosum* (Eisenack), *Cymatigalea cuvillieri* (Deunff), *C. timofeevi* (Martin), *Lophosphaeridium pilosum* Downie, *Microhystridium acuminosum* Cramer et Diez, *M. stellapilosum* Martin, *Protosphaeridium fuscipectiolatum* Cramer et Diez, *Coryphidium milada* Cramer et Diez, *Conochitina* sp., *Striathotheca variegulata* Cramer et Diez, *Veryhachium schmidtii* (Timofeev), *Veryhachium* sp.; 距A-22之下3m处产微古植物 (A-21): *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *L. granulosum* (Staplin), *Microhystridium imitatum* Deflandre, *M. pellitum* Martin, *Synsphaeridium conglutinatum* (Timofeev), *Acanthodiacrodiium tasselli* Martin, *Coryphidium australe* Cramer et Diez, *Cymatigalea timofeevi* (Martin), *Buedingisphaeridium tremadocum* Rasul, *Goniosphaeridium nalikini* (Timofeev), *Multiplicisphaeridium* sp., *Baltisphaeridium microspinosum* (Eisenack); 本层中部产微古植物 (A-20): *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Cymatigalea* Rasul, *Microhystridium acuminosum* Cramer et Diez, *M. nanacanthum* Deflandre, *Coryphidium milada* Cramer et Diez, *Buedingisphaeridium tremadocum* Rasul, *Baltisphaeridium simplex* (Deunff), *Multiplicisphaeridium consolator* Cramer et Diez, *Goniosphaeridium adlingans* (Timofeev), *Leioarachnium vittatum* Andreeva, *Lophodiacrodiium primum* (Timofeev); 本层底部产微古植物 (A-19, A-18), *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Goniosphaeridium adlingans* (Timofeev), *G. striatum* Lu, *Leiovalia oblonga* Eisenack, *Baltisphaeridium massium* Martin, *B. simplex* (Deunff), *B. zaleskyi* (Timofeev), *Buedingisphaeridium tremadocum*

Rasul, *B. fuscipetiolatum* (Cramer et Diez), *Coryphidium milada* Cramer et Diez, *Micrhystridium nanacanthum* Deflandre

10.28m

7. 黄绿色致密质纯性脆泥岩, 风化后呈页片状, 其中夹数层褐黄色薄层泥质粉砂岩。在由泥岩过渡为粉砂岩的粉砂质泥岩和泥质粉砂岩中, 含少量三叶虫、头足类、腕足类及丰富的笔石。自上而下采二层笔石及微古植物; 笔石 (85NS-7-G); *Azygograptus flavilis* Chen et Xia, *A. fluitans* Ge, *A. suecicus* Moberg, *A. undulatus* Chen et Xia, *Azygograptus* sp.; 三叶虫 (85NS-7-F); *Psilcephalina* sp.; 微古植物 (A-17); *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Baltisphaeridium simplex* (Deunff), *Micrhystridium imitatum* Deflandre; 笔石 (85NS-7-G); *Azygograptus fluitans* Ge, *A. lapworthi* Nicholson, *A. suecicus* Moberg, *A. cf. suecicus* Moberg, *A. undulatus* Chen et Xia, *Azygograptus* spp.; 三叶虫 (85NS-7-T); *Taihungshania intermedia* Lu, *T. shui* Lu

0.68m

6. 深灰色致密质纯性脆泥岩, 风化后呈页片状, 夹灰绿色粉砂质泥岩和薄层粉砂岩。含少量头足类、腕足类、三叶虫及分散式保存的笔石碎片。顶部含微古植物 (A-15); *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Cymatogalea cuvillieri* (Deunff), *Coryphidium baraka* Cramer et Diez, *Baltisphaeridium simplex* (Deunff), *Goniosphaeridium dentatum* (Timofeev), *Micrhystridium imitatum* Deflandre, *Verysachium saccatum* Stockmans et Williere, *Protosphaeridium fuscipetiolatum* Cramer et Diez, *Leiofusa* sp., (A-14); *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie; *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Buedingisphaeridium fuscipetiolatum* (Cramer et Diez), *Cymatogalea cuvillieri* (Deunff), *C. margaritata* Deunff, *Micrhystridium acuminatum* Cramer et Diez, *Goniosphaeridium septangulum* (Timofeev), *Coryphidium almohadilla* Cramer et Diez, *Baltisphaeridium microspinosum* (Eisenack), *B. simplex* (Deunff), *Striatotheca varirugulata* Cramer et al., *Pirea ornatissima* Cramer et Diez; 中上部含笔石 (85NS-6-G); *Azygograptus suecicus* Moberg, *A. sp.*, 微古植物 (A-13); *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Dactylifusa* aff. *cucurbita* Jardine et al., *Buedingisphaeridium fuscipetiolatum* (Cramer & Diez), *Dietyolidium stenodictyum* Eisenack, *Scaphospinosa ischorica* Ti, *Cymatogalea cuvillieri* (Deunff); 近底部含笔石 (85NS-6-G₁); *Didymograptus deflexus* E. et W., *D. acuabilis* Chen et Xia, *D. inflexus* Chen et Xia, *D. hurchi* Törnquist, *D. parvus* Chen et Xia, *D. saubros* Ni, *D. scalenus* Lin, *D. scanicus* Tjervik, *D. subconustus* Chen et Xia; 三叶虫 (85NS-6-T); *Taihungshania* sp., *T. brevicca* Lu; 微古植物 (A-12); *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Zomosphaeridium hiliferum* Xing, *Pirea ornata* (Burmann)

5.44m

5. 灰绿色泥岩, 风化后为深灰、黄绿色纸片状页岩, 夹粉砂质页岩, 顶部一层黄绿色页岩含笔石 (85NS-5-G₂); *Didymograptus hurchi* Törnquist, *D. scanicus* Tjervik; 及微古植物 (A-11); *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Baltisphaeridium simplex* (Deunff), *Cymatogalea cuvillieri* (Deunff); 中部所夹褐黄色粉砂质页岩含笔石 (85NS-5-G₁); *Didymograptus*

- aequabilis* Chen et Xia, *D. deflexus* Elles et Wood, *D. cf. deflexus* E. et W., *D. scanicus* Toerwijk; 及微古植物(A-9-10), (A-10), *Lophosphaeridium pilosum* Downie, *Microhystridium acuminatum* Cramer et Diaz, *Baltisphaeridium simplex* (Deunff), *Polemosphaeridium macropyllum* (Eisenack), *Cymatogalea timofeevi* (Martin), *Verzhachium* sp., (A-9), *Lophosphaeridium pilosum* Downie, *Leiosphaeridia wentlockia* Downie, *Leionalia oblonga* (Eisenack), 下部含微体古植物 (A-8), *Lophosphaeridium pilosum* Downie, *L. citrinum* Downie, *Leionalia oblonga* Eisenack, *Cymatogalea suecica* (Eisenack), *Baltisphaeridium simplex* (Deunff), *Microhystridium* sp., *Goniosphaeridium septangulum* (Timofeeva), *Microhystridium nannacanthum* Deflandre, 下部含笔石, 自上而下分为三层, (85NS-5-G₁), *Didymograptus deflexus* E. et W., *D. cf. deflexus* E. et W., *D. scanicus* Tjervik, *D. saubros* Ni, *D. sacillans* Tullberg, *D. sp.*, (85NS-5-G₂), *Didymograptus aequabilis* Chen et Xia, *D. filiformis* Tullberg, *D. kurchi* Tornquist, *D. saubros* Ni, (85NS-5-G₁), *Didymograptus cf. sinensis* Lee et Chen *D. spp.* 8.03 m
4. 褐黄色粉砂质页岩及灰绿色页岩, 间夹薄层泥质粉砂岩, 含三叶虫及笔石。上部含笔石 (85NS-4-G₁), *Didymograptus cf. cognatus* Harris et Thomas, *D. diapason* Chen et Xia, *D. diapason* subsp. nov., 三叶虫, *Taihungshania shui* Lu; 下部含笔石 (85NS-4-G₁), *Didymograptus diapason* Chen et Xia, *D. cf. diapason* Chen et Xia, *D. minutus* Tornquist, *D. protobifidus* Elles, *D. sp.* *D. spp.* 4.13 m
3. 褐黄色、灰绿色泥岩, 风化后呈纸片状, 偶夹铁质粉砂岩, 含三叶虫 (85NS-3-T), *Taihungshania intermedia* Lu, 等 2.59 m
2. 灰绿色、黄绿色泥岩, 风化后呈纸片状, 间夹褐黄色薄层粉砂质泥岩, 含三叶虫、腕足、头足及丰富的笔石。自上而下有下列化石: 顶部含笔石 (85NS-2-S), *Didymograptus minutus* Tornquist, *D. protobifidus* Elles, *D. spp.*; 三叶虫 (85NS-2-T₁), *Taihungshania* sp., *Magalaspides* sp.; 微古植物 (A-6), *Lophosphaeridium pilosum* Downie, *Leiosphaeridia minutissima* (Tim), *Cymatogalea multisepta* (Deunff), *Dictyotidium stenodictyum* Eisenack, 距底8.63 m处, 含笔石 (85NS-2-G₁), *Didymograptus minutus* Tornquist, *D. cf. minutus* Tornquist, *D. protobifidus* Elles, *D. cf. protobifidus* Elles, *D. cf. subtilis* Chen, *D. sp.*, *D. spp.*; 距底4.74 m处含笔石, (85NS-2-G₂) *Dictyonema* sp., *Schizograptus* sp., *Didymograptus parallelus* Chen et Xia, *D. cf. parallelus* Chen et Xia, *D. spp.*; 微古植物 (A-4), *Leiosphaeridium orbiculata* (Staplin), *Leiosphaeridia hyporboica* (Ti), *Cymatiosphaera multisepta* (Deunff), *Trachysphaeridium delium* King, *Baltisphaeridium simplex* (Deunff), *Buedingisphaeridium fuscipetiolatum* (Cramer et Diaz); 距底1.72 m笔石 (85NS-2-G₂) 有: *Didymograptus diapason* Chen et Xia, *D. protobifidus* Elles, *D. spp.*, *Dictyonema* sp.; 距底0.64 m笔石 (85NS-2-G₁) 有: *Didymograptus condensis* Ruedemann, *D. eobifidus* Chen et Xia, *D. cf. mammosus* Chen et Xia, *D. minutus* Tornquist, *D. nobilis* Chen et Xia, *D. parallelus* Chen et Xia, *D. spp.*; 三叶虫 (85NS-2-T₁), *Magalaspides* sp.; 微古植物 (A-2), *Leiosphaeridia orbiculata* (Staplin), *L. eisenack* (Timofeev), *Lophosphaeridium pilosum*

Downie, *L. citrinum* Downie, *L. ruidum* Andreeva; *Nierhystriidium pollitum* Martin, *Zonosphaeridium fuscum* var. *nigrum* King (MS), *Z. limbatum* Ti, *Z. aff. annularium* Xing; *Gymatogalea cuillieri* (Deunff), *Gonosphaeridium septangulum* (Timofeev), *Buedingisphaeridium fuscipetiolatum* (Cramer et Diez); 距底0.42m笔石 (86NS-2-G_{1a}) 有: *Didymograptus diapason* Chen et Xia, *D. cf. cobifidus* Chen et Xia, *D. protoartus* Decker, *D. protobifidus* Elles, *D. subtilis* Chen, *D. wudangensis* Chen, *D. sp.*, *Dictyonema sp.*; 底部含笔石 (86NS-2-G_{1a}); *Didymograptus diapason* Chen et Xia; *D. cobifidus* Chen et Xia, *D. nobilis* Chen et Xia, *D. protobifidus* Elles, *D. subtilis* Chen, *D. sp.*, *D. sp.*, *Dictyonema sp.* 8.68 m

1. 褐灰、灰黑色厚层砾岩。砾石成分主要为黑色燧石，分选和磨圆度较好。下部含微古植物 (A-1), *Lophosphaeridium filotum* Downie 3.85 m

-----平行不整合-----

下伏地层 下寒武统阎王庙组褐黄色厚层含砾粗砂岩

四川广元七里乡谭家沟剖面 (图3, 图4)

(西梁寺组以下剖面于谭家沟沟内测绘, 谭家沟组以上剖面测于谭家沟沟口河对岸公路旁)

上覆地层 下志留统崔家沟组黄绿色页岩

-----平行不整合-----

上奥陶统至下奥陶统

宝塔组

21. 青灰色中一厚层生物屑微晶灰岩, 具似龟裂状构造, 在山梁上厚度增至6.7m。含三叶虫 (86GS-宝-T) *Cyclopyge sp.*; 顶部含牙形石 (85-GT-C-1-C₂): *Baltanodus variabilis* (Bergström), *B. praevariabilis* (Fähraeus), *Eoplacognathus cf. Hudebnoki* (Hämar), *Amecephagnathus Malcomi* Dzik, *Sagittodontus robustus* Rhodes, *Eoplacognathus foliaceus* (Fähraeus) E. jianyensis An et Ding, *Protopanderodus varicosatus* (Sweet et Bergström), *P. rectus* (Lindström), *P. parvobasis* Lötgen, *Drepanodus arcuatus* Pandory; 距底2m含牙形石 (85GT-C-1-C₂): *Drepanostodus suberectus* (Branson et Mehl), *Daptidodus similis* (Rhodes); 距底0.5m处含牙形石 (85GT-C-1-C₂): *Eoplacognathus foliaceus* (Fähraeus), *E. misoponensis* An et al., *E. jianyensis* An et Ding, *Baltanodus praevariabilis* (Fähraeus), *Pygodus terrus* (Hadding), *Complanodus pugionifer* (Dryant), *Protopanderodus rectus* (Lindström), *Panderodus gracilis* (Branson et Mehl), *Walliserodus stingtoni* (Fähraeus) 2.3m

下奥陶统

谭家沟组

20. 深灰色厚至中层中-粗粒致密坚硬石英砂岩、钙质粗粉砂岩及钙质粉砂岩。距底2.3m处含少量笔石 (86GS-3-G) *Didymograptus sp.*, *Dictyonema sp.*, 近顶部含微古植物 (86GS-A-2): *Baltisphaeridium brevifilicum* Kjellström, *B. hirsutoides* (Eisenack), *Comasphaeridium campese* (Stockmans et Willie-ra), *Cymatogalea cf. stelligera* Görka, *Nierhystriidium henryi* Paris et Deunff, *Stelliferidium tortensia* Deunff et al. 27.86 m

四川广元谭家沟河口河对岸奥陶系实测剖面图

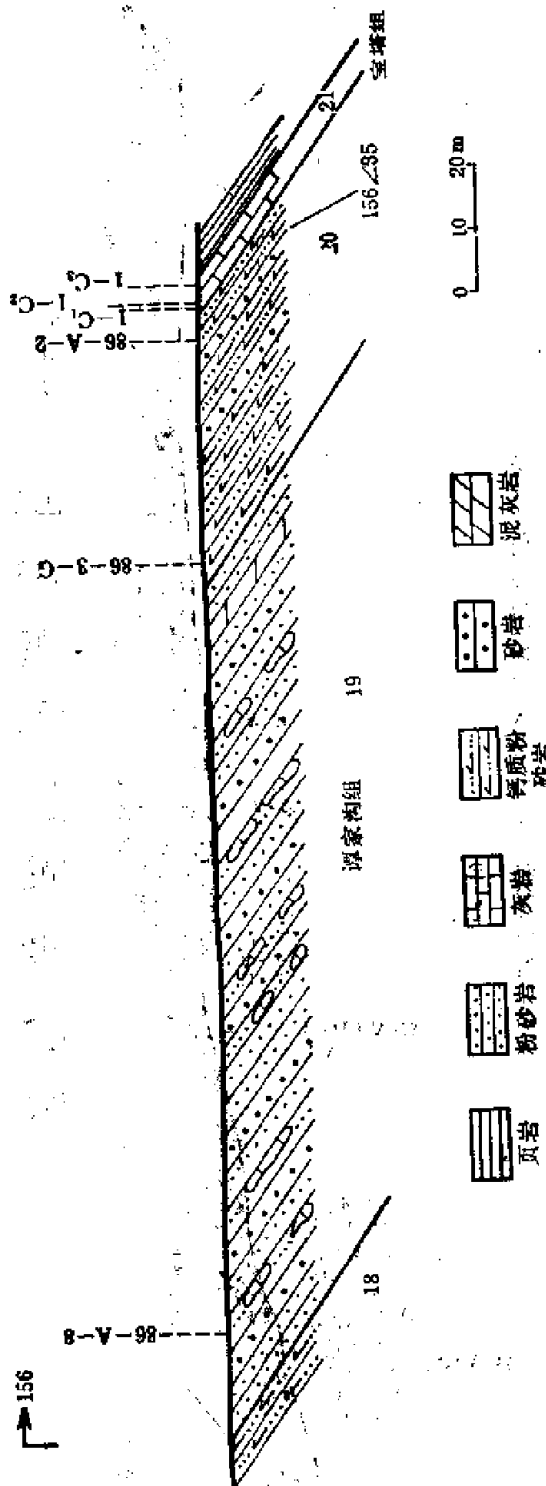


图 4