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贵州凯里地区下、中寒武统凯里组下部 *Redlichia* 的再研究*

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提要 重新描述了黔东南下、中寒武统凯里组下部 *Redlichia* 属的 *Redlichia* (*Redlichia*) *coniformis taijiangensis*, *Redlichia* (*Redlichia*) *takooensis longispinus* 和 1 未定种 *Redlichia* (*Redlichia*)sp.。并对其生物学、生物地层学及其在下、中寒武统界线划分与对比的作用及意义进行讨论。

关键词 *Redlichia* 下、中寒武统凯里组 界线划分

赵元龙等在研究贵州中寒武统凯里生物群及下、中寒武统界线的过程中,于界线之下的下、中寒武统凯里组下部地层中发现了一些 *Redlichia*,笔者曾作了初步报道(郭庆军等,1998)。但其生物学、生物地层学的探讨尚未进行。本文就这两方面作补充及讨论。

***Redlichia* 的特征** 莱得利基虫(*Redlichia* Cossmann,1902)不仅是莱得利基虫科最重要的三叶虫,也是三叶虫纲中重要的属之一。该属以具有 3 对头鞍沟的锥形头鞍、长而弯曲的眼叶及其末端靠近头鞍、面线前支与头盖中轴夹角 α 在 50°—90°之间、尾小为特征。它包括 4 个亚属。至 1980 年,已达 90 多个种(张文堂等,1980)。近期至少又增加了十几个种(仇洪安,1980;郭鸿俊等,1982;孙振华等,1982;许保桐等,1987;郭鸿俊等,1996),达到 100 多个种。当然这些种需要进一步清理及归并。

***Redlichia* 的时代** *Redlichia* 在我国是公认的早寒武世中、晚期的重要三叶虫(卢衍豪等,1965;张文堂等,1980)。但是随着陡坡寺期下部地层中 *Redlichia*, *Bathynotus* 与 *Kunmingaspis*, *Chittidilla* 共生的情况下不断被发现(孙振华,1982;张全忠等,1984;赵元龙等,1993;袁金良等,1997;郭庆军等,1998)以来,也有人认为它的时代可延伸至中寒武世早期,并称这些与 *Kunmingaspis*, *Chittidilla* 共生的 *Redlichia* 为孑遗分子(见项礼文等,1981,151 页;尹恭正,1987,82 页)。

与 *Chittidilla*, *Kunmingaspis* 共生的 *Redlichia* 有 2 个种群,一是 *Redlichia*(*Redlichia*) *guizhouensis coniformis* 种群,包括湖北大洪山地区的 *Redlichia*(*Redlichia*) *guizhouensis coniformis* Sun,1982(孙振华,1982)及贵州凯里地区的 *Redlichia*(*Redlichia*) *coniformis taijiangensis* Guo et Zhao,1998(郭庆军等,1998),这些三叶虫均和产于贵州北部下寒武统清虚洞组上部的 *Redlichia*(*Redlichia*) *guizhouensis* Zhou,1978(尹恭正,1978,图版 147,图 1)相

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似;另一个种群为 *Redlichia*(*Redlichia*) *takooensis longispina* Guo et Zhao,1998,其最相似的三叶虫 *Redlichia*(*Redlichia*) *takooensis* Lu,1950(卢衍豪等,1965,65页,图版9,图1;张文堂等,1980,130页,图版23,图1—14;插图64,65)也产于下寒武统上部。

关于 *Kunmingaspis*, *Chittidilla* 的时代,需要进行探讨。*Kunmingaspis* Chang,1964与 *Chittidilla* King,1941过去一直被认为是中寒武世的标准化石(罗惠麟,1974;张文堂等,1980;项礼文等,1981;尹恭正,1978,1987;罗惠麟等,1994)。随着与 *Redlichia* 共生的化石不断被发现,对其时代归属产生了疑问,并认为它的时代应随着共生的地区型属 *Redlichia*、全球型 *Bathynotus* 的时代而变为早寒武世(赵元龙等,1993)。其实 *Kunmingaspis* 的时代不局限于早寒武世,在贵州台江八郎,它还可以上延至中寒武世凯里生物群中(袁金良等,Ms)。在喜马拉雅山地区Parahi山谷(Valley),它也出现在中寒武统,与 *Oryctocephalus indicus* 共生(Jell et Hughes,1997),而 *O. indicus* 已被部分学者作为中寒武世开始的重要化石(袁金良等,1997;Sundberg *et al*.,1997;Sundberg *et al*.,1999)。因此,*Kunmingaspis* 的时代为早至中寒武世。*Redlichia* 的出现完全不受 *Kunmingaspis* 原有中寒武世时代限制的影响。

至于 *Chittidilla* 其时代应根据共生的 *Redlichia*, *Bathynotus* 的时代而确定其时代为早寒武世晚期。张文堂教授近期告诉笔者之一的袁金良:滇东陡坡寺组下部早已发现了 *Bathynotus*,如果情况无误,则陡坡寺组下部属早寒武世时代的结论更为可靠了。

分布特征及层位 *Redlichia* 不仅是寒武纪亚太生物区的重要分子,广泛分布于中国、澳大利亚、印度、巴基斯坦、伊朗,而且还分布在南极洲、西班牙、西伯利亚南部的下寒武统(张文堂等,1980)。*Redlichia* 是下寒武统中、上部的重要化石。

在中国华南地区,*Redlichia* 主要分布于早寒武世地台区,但至早寒武世末期,*Redlichia* 除在地台区内(习水)有产出外,但大量的是在地台区的边缘区(恩施、京山、钟祥)及过渡地区(丹寨、台江、崇阳),这一现象值得注意。

***Redlichia* 在下、中寒武统界线划分中的作用** 由于 *Redlichia* 的时代是早寒武世中、晚期,它一直被作为下、中寒武统界线划分的重要化石(张文堂,1964;孙振华等,1982;卢衍豪等,1988;郭鸿俊等,1991;赵元龙等,1993;赵元龙等,1996;袁金良等,1997)。赵元龙、袁金良并据 oryctocephalids 三叶虫的重要作用,提出以 *Redlichia*, *Bathynotus* 的灭绝,掘头虫 *Orycotcephalus*(赵元龙等,1996)或 *O. indicus*(袁金良等,1997)的出现作为下寒武统的结束、中寒武统的开始。这一见解和美国部分学者的观点不谋而合(袁金良等,1997;Sundberg *et al*.,1997)。在台江八郎剖面,*Redlichia* 产出层位距 *Orycotcephalus indicus* 的层位仅80多厘米,说明 *Redlichia* 在划分中、下寒武统界线有重要的作用,特别是有全球分布的 *Bathynotus* 与 *Redlichia* 共生,进一步说明 *Redlichia* 在下、中寒武统界线划分作用的重要性及可靠性。

属种描述

莱得利基虫属 *Redlichia*(Redlichia)Cossmann,1902

打鼓莱得利基虫 *Redlichia*(Redlichia)takooensis Lu,1950

长刺打鼓莱得利基虫 ***Redlichia***(Redlichia) takooensis longispina **Guo and Zhao,1998**

(图版Ⅰ,图 1_a,1_b,2_a,2_b;图版Ⅱ,图 3,5—7)

1998 *Redlichia*(*Redlichia*) *takooensis longispina*,郭庆军等,贵州工业大学学报,52 页,图版Ⅰ,图 3_a,3_b。

材料　背壳两块,背甲印模两块,头盖 3 块(其中未成年体 2 块),头及部分胸部及其印模各 1 块。

描述　背壳长椭圆形。头鞍锥形,前端尖圆。三对头鞍沟。颈沟两侧深,中部浅。颈环向后拱曲。面线前支与中轴呈 65°—75°交角。眼前翼呈三角形。眼叶细长,末端达颈环相对水平位置。眼沟深。固定颊较窄、低凸。缺失内边缘。活动颊宽大,颊刺特长,末端已估计达第 10 个胸轴节的相对水平位置。胸部 15 节。尾小。

比较　新亚种和 *Redlichia*(*Redlichia*) *takooensis* Lu(卢衍豪,1950,166 页,图版Ⅰ,图 1—4;卢衍豪等,1965,65 页,图版 9,图 1;张文堂等,1980,130 页,图版 23,图 1—14;插图 64—65)相似,但新亚种头盖无内边缘或极窄,不具颈刺,颊刺特长,尾轴第 10 节不具轴刺,区别明显。

产地层位　贵州丹寨县兴仁岩英、台江八郎,中、下寒武统凯里组下部(下寒武统)。

台江莱得利基虫 ***Redlichia***(Redlichia) taijiangensis **Guo et Zhao,1998**

(图版Ⅱ,图 2,4)

1998 *Redlichia*(*Redlichia*) *coniformis taijiangensis*,郭庆军等,贵州工业大学学报,52 页,图版Ⅰ,图 1,4。

描述　头盖狭长。头鞍长锥形,向前收缩缓慢,前缘平圆。具有 3 对明显的头鞍沟,第 1 对短而不明显,后 2 对深并微向后弯曲。颈沟微向后弯曲。颈环宽度均匀。眼叶呈新月形,较短,前端始于头鞍中、上部位置,末端达颈环相对位置。眼内侧沟深。面线前支和中轴呈 80°左右交角。内边缘极窄或缺失。外边缘宽度均匀,且微向前拱曲。前边缘沟明显。

比较　*Redlichia taijiangensis* 与产于湖北大洪山南部早寒武世末期的 *Redlichia*(*Redlichia*) *guizhouensis coniformis* (Sun)相比(孙振华等,1982,303 页,图版Ⅰ,图 1—11)后者头盖长、宽近于相等,头鞍较宽,前端圆润,具有极窄的内边缘,外边缘较窄,面线前支与中轴交角较小。此种和 *Redlichia*(*Redlichia*) *guizhouensis* Zhou(卢衍豪等,1974,85 页,图版 31,图 10)也很相似,但后者头鞍近于柱形,眼叶呈新月形,外边缘(纵向)较窄,前边缘沟深,面线前支与中轴的交角(75°)稍小,区别也明显。从头盖、头鞍形态、眼叶大小、形态、内边缘的发育特征等方面观察,*Redlichia*(*Redlichia*) *guizhouensis coniformis* 介于 *Redlichia*(*Redlichia*) *taijiangensis* 与 *Redlichia*(*Redlichia*) *guizhouensis* 之间。

产地层位　贵州台江八郎,下、中寒武统凯里组下部(下寒武统)。

莱得利基虫(未定种) Redlichia(Redlichia)**sp.**

(图版Ⅱ,图 1)

描述　头盖正方形。头鞍锥形,前端圆润。具 3 对明显的头鞍沟,第一对较浅,第 2、3 对较深且横越整个头鞍。颈环宽度均匀。眼叶呈新月形。眼内侧沟较深,面线前支与中轴呈 60°—75°交角。内边缘窄。外边缘较宽,纵向宽度均匀,向前拱曲。前边缘沟浅较明显。

比较　未定种与锥形莱得利基虫 *Redlichia*(*Redlichia*) *coniformis* 比较相似(图版Ⅰ,图 1,4)。但前者头鞍锥形,后两对头鞍沟深,面线前支与中轴交角较小,外边缘(纵向)较

宽，区别明显。

产地层位 贵州丹寨兴仁岩英，下、中寒武统凯里组下部(下寒武统)。

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THE RESTUDY OF *REDLICHIA* FROM THE LOWER PART OF THE KAILI FORMATION IN KAILI AREA, GUIZHOU PROVINCE

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Key words: *Redlichia*, the Lower-Middle Cambrian, Kaili Formation, the division of boundary

Summary

During the study of the Middle Cambrian Kaili biota by Zhao Yuan-long *et al*., they have found some specimens of *Redlichia* in the lower part of Kaili Formation of the Lower-Middle Cambrian, authors initiatively reported it (Guo and Zhao, 1998). But the biology and biostratigraphy are still not studied in detail; the paper will discuss the two aspects of *Redlichia*.

The Characters of *Redlichia*: *Redlichia* Cossmann, 1902 is not only the most important trilobite of Redlichiidae Poulsen, 1927, but also one of the important genera of trilobita. The *Redlichia* with conical glabella and three pairs of glabellar furrows, long and curved palpebral lobe, crescent in shape, anterior branch of facial suture and sagittal axis diverges at an angle about 50° to 90°, small pygidium. It includes four subgenera. There have been over 90 species until 1980 (Zhang *et al*., 1980). Nowadays, there are more than 100 species (Guo et Zhao, 1982; Sun *et al*., 1982; Xu *et al*., 1987; Guo *et al*., 1996). Of course, these species need be farther studied.

The age of *Redlichia*: *Redlichia* is an important trilobite of the later and middle peroid of Lower Cambrian (Lu *et al*., 1965; Zhang *et al*., 1980). Since association of *Redlichia* with *Kunmingaspis*, *Chittidilla* has been continuously found (Sun *et al*., 1982; Zhang *et al*., 1984; Zhao *et al*., 1993; Yuan *et al*., 1997; Guo *et al*., 1998), some authors considered that the age of *Redlichia* is ranging up to the early Middle Cambrian, and that *Redlichia* associated with *Kunmingaspis* and *Chittidilla* is relic species (Xiang *et al*., 1981, p. 151; Yin, 1978, p. 82).

There are two groups of species of *Redlichia* associated with *Chittidilla* and *Kunmingaspis*. One is *Redlichia* (*Redlichia*) *guizhouensis coniformis* Sun, 1982, from Dahongshan area in Hubei Province and *Redlichia* (*Redlichia*) *coniformis taijiangensis* (Guo et Zhao), 1998 from Kaili area in Guizhou Province. This species group is similar to *Redlichia* (*Redlichia*) *guizhouensis* Zhou, 1974 (Yin Gong-zheng, 1978, p. 400, pl. 147, fig. 1), of the upper Qing-

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xudong Formation of the Lower Cambrian in north of Guizhou. The other is *Redlichia* (*Redlichia*) *takooensis longispina* Guo et Zhao, 1998, which is similar to *Redlichia* (*Redlichia*) *takooensis* Lu, 1950 (Lu *et al*., 1965, p. 65, plate 9, fig. 1; Zhang Wen-tang *et al*., 1980, p130, plate 23, figs. 1—14, text-figs. 64, 65); it is also from the upper part of the Lower Cambrian.

Kunmingaspis Chang, 1964 and *Chittidilla* King, 1941 were regarded as index fossils of the Middle Cambrian (Xiang *et al*., 1981; Zhou *et al*., 1982; Luo, 1974; Luo *et al*., 1994), and were conventional fossils of Douposi Formation of the Middle Cambrian. However, because *Kunmingaspis* Chang, 1964 and *Chittidilla* King, 1941 were associated with *Redlichia*, and there is a question about their age. Some authors think that they belong to the Lower Cambrian (Zhao *et al*., 1993). Actually, in Balang section of Taijiang, Guizhou, *Kunmingaspis* could extend to the Kaili biota of Middle Cambrian (Yuan *et al*., Ms); *Kunmingaspis* is associated with *Oryctocephalus indicus* of the Middle Cambrian at Parahi Valley of Himalayan in India (Jell and Hughes, 1997, p. 11, Text-fig. 3). Therefore, the age of *Kunmingaspis* is from the later peroid of Lower Cambrian to Middle Cambrian; *Kunmingaspis* could not affect to the age of *Redlichia*. It is surely age of *Chittidilla* is later peroid of Early Cambrian.

As for the age of *Kunmingaspis* and *Chittidilla* in the lower part of Douposi Formation, their age should be in the end of the Lower Cambrian according to the division of the strata. Recently Zhang Wen-tang who told Yuan Jin-liang, one of the authors that *Bathynotus* was previously found in the lower part of Douposi Formation in east of Yunnan, if it is sure, the conclusion of the above is correct.

Distribution Character And Strata: *Redlichia* is not only an important fossil of Asia-Pacific Realm of the Lower Cambrian and distributive in China, Australia, india, Pakistan, Iran; but also wide distributed in Antarctica, Spain, south of Siberian and so on.

In south China, *Redlichia* mainly distributed in the Yangtze platform of the Early Cambrian, but Xishui of inner stable area in the end of the Early Cambrian. However, most of *Redlichia* distributed in the edge of Yangtze platform (Enshi, Jingshan, Zhongxiang) and transitional area (Danzhai, Taijiang, Chongyang), so the phenomenon should be noticed.

The Importance of *Redlichia* for the Division of the Lower-Middle Cambrian Boundary: *Redlichia* is important to divide the Lower-Middle Cambrian boundary of Asia-Pacific Realm (Zhang 1964; Sun *et al*., 1982; Lu *et al*., 1988; Guo *et al*., 1991; Zhao *et al*., 1993; Zhao *et al*., 1996; Yuan *et al*., 1997). According to the importance of oryctocephalids, Yuan Jin-liang introduced that the extinction of *Redlichia* and the first appearance of *Oryctocephalus indicus* were regarded as the basal Middle Cambrian, and American scholors had similar opinion of the division (Sundberg *et al*., 1997, 1999). Because there is only a little more than 50cm between *Redlichia* and *Oryctocephalus indicus* in Balang section, Taijiang, Guizhou province of China, which shows that *Redlichia* is important for the division of the Lower-Middle Cambrian boundary, especially, *Bathynotus* and *Redlichia* were associated, which indicated *Redlichia* is

reliable for the division of the boundary.

Family Redlichiidae Poulsen, 1927

Subfamily Redlichiinae Poulsen, 1927

Genus *Redlichia* (*Redlichia*) Cossmann, 1902

***Redlichia* (*Redlichia*) takooensis Lu, 1950**

***Redlichia* (*Redlichia*) takooensis longispina Guo et Zhao, 1998**

(P1. Ⅰ, fig. 1; P1. Ⅱ, figs. 3, 5—7)

1998 *Redlichia* (*Redlichia*) *takooensis longispna* (subsp. nov.), Guo Qing-jun and Zhao Yuan-long, Journal of Guizhou University of Technology, p. 52, pl. Ⅰ, figs. 3a, 3b.

Material: Two dorsal exoskeletons and internal mold of dorsal exoskeleton; one cephalon and part thorax and its internal mold, two cranidia.

Description: Dorsal exoskeleton long-elliptical; glabella conical in shape, sharp in frontal part, with 3 pairs of glabellar furrows, second and third pairs transverse glabellar furrows; occipital furrow deep in both sides. Occipital ring arched backwards, broader in the middle part. Palpebral lobe long in length, terminal end reaching level of occipital ring and almost connect with occipital ring. Palpebral furrow shallow, α angle 60°—75°. Brim very narrow or almost absent. Anterior border midium in width, convex. Librigena wide (tr.) and large, librigenal spine long in length, terminal end reaching the level of tenth axial segment.

Thorax axis convex, with long spine in fourth axial ring.

Pygidium small.

Comparison: The subspecies differs from *Redlichia* (*Redlichia*) *takooensis* Lu, 1950 (Lu, 1950, p. 166, p1. Ⅰ, figs. 1—4; Lu *et al*., 1965, p. 65, pl. 9, fig. 1; Zhang *et al*., 1980, p. 130, pl. 23, figs 1—14, Text-figs. 64—65) in having very narrow or absent brim; without occipital spine; very long librigenal spine.

Occurrence: Balang from Taijiang and Yanying from Danzhai of Guizhou Province, Lower part of Lower-Middle Cambrian Kaili Formation.

***Redlichia* (*Redlichia*) taijiangensis Guo et Zhao, 1998**

(P1. Ⅱ, figs. 2, 4)

1998 *Redlichia* (*Redlichia*) *coniformis taijiangensis*, Guo Qin-jun and Zhao Yuan-long, Journal of Guizhou University of Technology, p. 52, pl. Ⅰ, figs. 1, 4.

Material: two cranidia.

Description: Cranidium medium in size; glabella long conical, tapering forword slowly, wide-rounded in front, with 3 pairs of glabellar furrows, first pair shallow, second and third pairs deeper and transverse. Occipital furrow deeper. Occipital ring even in width (sag.). Palpebral lobe crescent in shape, shorter, frontal end connecting with mid-upper part of glabella, terminal end reaching level of upper part of occipital ring and almost close to occipital ring; anterior branches of facial sutures connect with glabella in front of palpebral lobe, α angle 78°—80°; brim

very narrow or absent; anterior border even (sag.).

Comparison and discussion: *Redlichia* (*Redlichia*) *taijiangensis* is similar to *Redlichia* (*Redlichia*) *guizhouensis coniformis*, Sun 1982 (Sun, 1982, p. 303, pl. Ⅰ, figs. 1—14), but the latter has wider cranidium, rounded frontal part of glabella, narrowest brim, narrower anterior border, α angle less thatn 65°—70°. *Redlichia* (*Redlichia*) *taijiangensis* also differs from *Redlichia* (*Redlichia*) *guizhouensis* Zhou (Lu *et al*., 1974, p. 85, pl. 31, fig. 10), but the latter has conical glabella, crescent palpebral lobe, narrower anterior border, α angle less than 70° *Redlichia* (*Redlichia*) *guizhouensis coniformis* is located between *Redlichia* (*Redlichia*) *guizhouensis* and *Redlichia* (*Redlichia*) *taijiangensis* in the shape of glabella, palpebral lobe, brim and measurement of α angle.

Occurrence: Balang from Taijiang and Yanying from Dznzhai of Guizhou Province, lower part of Lower-Middle Cambrian Kaili Formation.

图 版 说 明

标本产自贵州凯里地区下、中寒武统凯里组下部。现保存在贵州工业大学资源工程系古生物及生物成矿研究所实验室。

图版Ⅰ

1,2. *Redlichia* (*Redlichia*) *takooensis longispina* Guo et Zhao, 1998

1a. 分开的背甲,正模标本,×3;采集号:A6-1-30a。登记号:GK4401;

1b. 分开的背甲印模,×3;采集号:A6-1-30b。登记号:GK4402;

2a. 头盖及部分胸节,×8;采集号:GTB-8-1-1a。登记号:GK4408;

2b. 头盖及部分胸节印模,×8;采集号:GTB-8-1-1b。登记号:GK4409。

贵州丹寨岩英、台江八郎,下、中寒武统凯里组下部(下寒武统)。

图版Ⅱ

1. *Redlichia* sp.

1a. 头盖,×5;采集号:A6-2-50a。登记号:GK4403;

1b. 头盖印模,×5;采集号:A6-2-50b。登记号:GK4404。

贵州丹寨岩英,下、中寒武统凯里组下部(下寒武统)。

2,4. *Redlichia* (*Redlichia*) *taijiangensis* Guo et Zhao, 1998

2. 头盖,×4;采集号:GTB-8-2-66。登记号:GK4411;

4. 头盖,模式标本,×5;采集号:GTB-8-2-2。登记号:GK4414。

贵州台江八郎,下、中寒武统凯里组下部(下寒武统最顶部)。

3,5—7. *Redlichia* (*Redlichia*) *takooensis longispina* Guo et Zhao, 1998

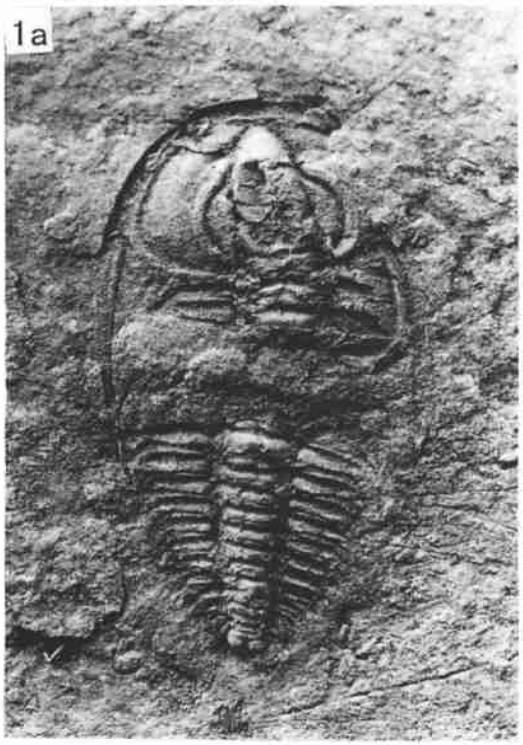
3. 头盖,×4;采集号:GTB9-1-140。登记号:GK4410;

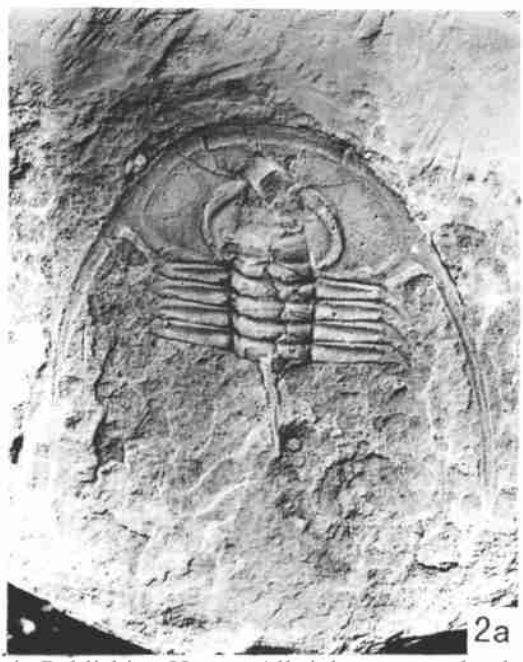
5. 幼虫头盖,×6;采集号:GTB-9-2-176。登记号:GK4406;

6. 幼虫头盖,×6;采集号:GTB-9-0-61。登记号:GK4405;

7. 未成年背壳印模,×5;采集号:GTB-9-1-2。登记号:GK4413。

贵州台江八郎,下、中寒武统凯里组下部(下寒武统最顶部)。






1a


1b

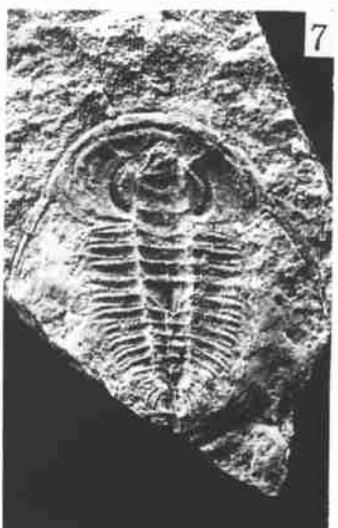

2


3


4


5


6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