

贵州台江凯里组的双瓣壳节肢动物 *Tuzoia*^{*}

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提要 记述贵州台江凯里组中部青灰色泥岩内的无腹双瓣壳节肢动物 *Tuzoia* 两新种: *T. bispinosa* sp. nov., *T. magna* sp. nov.。扼要地讨论了 *Tuzoia* 的起源、演化趋向和分类位置。*Tuzoia* 浮游的生活方式和它营浮游生活的三叶虫一样,具有广泛的地理分布,不仅能在印度太平洋古动物地理区出现,也能在大西洋古动物地理区出现,不仅能在地台区出现,而且能在斜坡区出现。

关键词 双瓣壳节肢动物 *Tuzoia* 贵州

1 前言

在众多无腹双瓣壳节肢动物属之中,图士虾(*Tuzoia* Walcott, 1912)是一个较易辨认的属,此属的主要特征是有直的铰合线,具网纹的壳面装饰,中腹部有一个横脊,背缘有前后铰突起,腹缘通常具 1—15 根刺。到目前为止已有 19 个种,归于此属,它们是: *Tuzoia australis* Glaessner, 1979, *T. bispinosa* sp. nov., *T. burgessensis* Resser, 1929, *T. canadensis* Resser, 1929, *T. (?) dunbari* Resser, 1929, *T. getzi* Resser, 1929, *T. guntheri* Robison and Richards, 1981, *T. magna* sp. nov., *T. manchuriensis* Resser and Endo in Resser, 1929, *T. nitida* Resser and Howell, 1938, *T. nodosa* Resser, 1929, *T. (?) parva* (Walcott, 1912), *T. (?) peterseni* Robison and Richards, 1981, *T. polleni* Resser, 1929, *T. praemorsa* Resser, 1929, *T. retifera* Walcott, 1912, *T. sinensis* Pan, 1957, *T. spinosa* Resser, 1929, *T. vermontensis* Resser and Howell, 1938。据 Simonetta 和 Delle Cave (1975, p. 8) 以及 Robison 和 Richards (1981, p. 14) 的研究,其中 *Tuzoia burgessensis*, *T. canadensis* 两种是模式种 *T. retifera* 的晚出异名,笔者表示赞同。

Tuzoia 的这些种广泛分布于加拿大 (British Columbia), 美国 (Pennsylvania, Utah, Vermont), 南澳大利亚, 我国辽宁烟台当十岭—一本溪火连寨, 云南昆明筇竹寺以及贵州凯里台江一带。此外,最近在俄罗斯西伯利亚也有报道 (Ivantsov, 1998)。如此广泛的地理分布,这与营浮游的生活有关 (Conway Morris, 1985, p. 53)。本文所描述的 *Tuzoia* 与一些浮游的三叶虫 *Burlingia*, *Oryctocephalus*, *Microryctocara*, *Metabalangia*, *Olenoides*, *Peronopsis* 等

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共生,也证明了这一点。此外, *Tuzoia* 也有较明显的生态分异,在地台区发现的种(*Tuzoia sinensis* Pan, *T. nodosa* Resser)与在台地边缘及斜坡区发现的种(*T. bispinosa* sp. nov., *T. australis* Glaessner, *T. guntheri* Robison and Richards, *T. retifera* Walcott)相比,壳壁较厚,网眼壁较厚,边缘刺发育且较粗短,这可能是由于地台区的种在相对较浅的水体中生活,为适应较强的水动力环境出现的变化。在早寒武世晚期至中寒武世早期,浮游的三叶虫(如 *Burlingia*, *Olenoides*, *Arthricocephalus*, *Oryctocephalus*, *Microrhyctocara*, *Peronopsis*)和浮游的甲壳动物(如 *Tuzoia*, *Isoxys*)都有类似的地理分布,它们有没有明显的古生物地理区系,根据目前的资料,还很难作结论。

有关 *Tuzoia* 的系统分类位置,目前有关专家仍然意见不一,Simonetta 和 Delle Cave (1975),侯先光等(1997)将其置于 *Tuzoidea* 目 *Tuzoidea* 科;Robison 和 Richards(1981)则将其置于 *Protocarididae* 科,而陈均远等(1996),则统称为无腹双瓣壳节肢动物。笔者同样认为在软体、附肢还未发现或不十分了解的情况下(舒德干等,1995)将其指定到科及科级以上的分类单位,并没有任何实际意义,因此统称为甲壳类(Briggs *et al.*, 1994, p. 155—156)。

关于 *Tuzoia* 的起源和演化趋势目前尚无人作系统的研究,根据目前所采集到的标本以及所收集到的资料来看,笔者认为 *Tuzoia* 可能与 *Isoxys* 关系密切,因为较原始的,在早寒武世早期出现的一些种,如 *Isoxys auritus* (Jiang, 1982), *I. paradoxus* Hou, 1987 与 *Tuzoia* 的一些种一样,壳面都具有网状装饰,背部有前、后铰合刺或铰合突起,特别是像 *Tuzoia bispinosa* sp. nov. 的幼年壳的前、后铰合刺呈水平方向伸出(图版 I, 图 3),与 *Isoxys* 的特征完全相似,区别仅是 *Isoxys* 不具有边缘刺,和中腹部的横脊。*Tuzoia* 最早出现于早寒武世中期(*Palaeolenus* 带或 *Olenellus* 带中下部),繁盛于中寒武世早期(毛庄期和徐庄期),绝灭于中寒武世晚期(张夏期),其演化趋向为 1)壳体逐渐变长,由早寒武世的 35mm 增长到 125mm;2)网眼由小变大但数量上则由多变少;3)前、后铰突起由细长变粗短。

本文所描述的 *Tuzoia* 两新种 *T. bispinosa* sp. nov., *T. magna* sp. nov. 产于黔东南台江八郎剖面凯里组中部的青灰色泥岩内,与其共生的三叶虫有 *Oryctocephalus indicus* (Reed), *Burlingia*, *Microrhyctocara*, *Olenoides*, *Pagetia*, *Kailiella*, *Xingrenaspis*, *Danzhaiaspis*, *Kaotia*, *Kuetsingocephalus* 等,因此属 *Danzhaiaspis*-*Xingrenaspis* 带。*Tuzoia* 在黔东南地区的发现,为深入研究世界寒武纪地层对比,古生物地理分区以及早期后生生物的演化、扩散提供了十分有价值的资料。邓东兴同志为本文摄制化石照片,作者谨致谢忱。

2 化石描述

甲壳纲 Crustacea

图士虾属 Genus *Tuzoia* Walcott, 1912

模式种 *Tuzoia retifera* Walcott, 1912

双刺图士虾(新种) *Tuzoia bispinosa* sp. nov.

(图版 I, 图 1—8; 图版 II, 图 9—12)

描述 瓣壳椭圆形, 横向长度与纵向高度之比约 3:2。铰合线侧视几乎成直线。前背

铰突起细长,向前平伸或微向前上方伸出,后背铰突起较粗短,呈三角形,微向后上方斜伸,与铰合线约成 15° — 30° 交角。侧脊发育,几乎与背缘平行,两侧略向背缘弯曲,在中线位置侧脊至背缘距离略大于至腹缘距离。后侧缘具 2 根刺,其中靠上部的一根刺较细长,几乎与侧脊平行向后伸,另一根刺较短,向后略斜伸。壳面的网纹呈五边形,细而密。最大一块标本(图版 I,图 7)长 74mm,高 48mm。

比较 就壳的外形,侧脊的形态等特征来看,新种与布尔吉斯页岩中所产 *Tuzoia* 的模式种 *T. retifera* Walcott (Walcott, 1912, pl. 33, fig. 2; Resser, 1929, pl. 1, figs. 1—2; pl. 2, figs. 1—3; pl. 3, fig. 1; pl. 4, fig. 3) 十分相似,所不同的是新种个体小,前铰突起细长,仅有 2 个腹边缘刺,此外,网纹细密而多。从壳体外形、大小及壳面装饰来看,新种与南澳大利亚早寒武世 Emu Bay 页岩所产 *Tuzoia australis* Glaessner (Glaessner, 1979, Fig. 2) 也十分相似,但后者的前后背铰突起非常短小,侧脊不发育,腹缘仅有 1 个刺。

产地层位 贵州台江八郎;凯里组 *Danzhaiaspis*-*Xingrenaspis* 带。

大型图士虾(新种) *Tuzoia magna* sp. nov.

(图版 II, 图 13—16)

描述 壳呈横椭圆形,长与高之比约为 2:1。铰合线直,在前 $1/3$ 处有 2 个微斜向前伸的短小呈锯齿状的小刺。前后背铰突起呈短小的三角形,夹角约 70° — 80° 。中腹部的横脊不发育。后腹边缘具 3—4 根侧刺。壳面具六边形至椭圆形网纹状装饰。

比较 新种与本文描述的另一个新种的主要区别为背缘具 2 根略向前倾斜的锯齿状背刺,较短的前后背铰突起,不发育的横脊,腹后缘具 3—4 根刺,此外个体较大,壳体较长但较矮。就壳体的外形以及背腹缘刺的多少来看,新种与布尔吉斯页岩中所产 *Tuzoia burgessensis* Resser (Resser, 1929, pl. 2, fig. 1; pl. 3, fig. 1) 十分相似,虽然此种已归于 *Tuzoia retifera* (Robison and Richards, 1981, p. 14),它与 *Tuzoia retifera* 的主要区别是背刺向前斜伸,横脊不发育,网纹装饰细密,网孔小。

产地层位 贵州台江八郎;凯里组 *Danzhaiaspis*-*Xingrenaspis* 带。

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TUZOIA (BIVALVED ARTHROPODS) FROM THE LOWER—MIDDLE CAMBRIAN KAILI FORMATION OF TAIJIANG, GUIZHOU

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Summary

The material from the green-grey mudstone of middle part of the Kaili Formation (Lower—Middle Cambrian) of Balang Village, Taijiang, southeastern Guizhou represents two new species, *Tuzoia bispinosa* sp. nov. and *T. magna* sp. nov. The origin, general evolution and classification of the genus *Tuzoia* Walcott, 1912 are briefly discussed. It may be possible that *Tuzoia* is derived from the crustacean genus *Isoxys* Walcott, 1890, because of the common existence of antero-dorsal and postero-dorsal spines and very fine reticulae on the specimens both in the oldest species *Isoxys auritus* (Jiang, 1982) and juvenile valve of *Tuzoia bispinosa* sp. nov. (Pl. I, fig. 3). The general evolutionary trend of *Tuzoia* from the late Early Cambrian to late Middle Cambrian is the enlargement of the valve from length 35mm (*Tuzoia australis* Glaessner, 1979; *Tuzoia sinensis* Pan, 1957) to the maximum length 125mm (*T. guntheri* Robison and Richards, 1981), the decreasing in the number of the meshes but expanding the size of the meshes and the shortening the antero-dorsal and postero-dorsal process.

Tuzoia has been reported from Lower and Middle Cambrian formations both in Laurentia and Gondwana. The oldest species, *Tuzoia australis* Glaessner, has been described from Emu

Bay Shale of middle Lower Cambrian of South Australia (Pocock, 1964; Glaessner, 1979). In China 4 species have been found; one species *T. sinensis* Pan from the Wulongqing Member of the Canglangpu Formation (middle Lower Cambrian; *Palaeolenus* Biozone) in eastern Yunnan, South China; two species *Tuzoia bispinosa* sp. nov., *T. magna* sp. nov. from the middle part of the Kaili Formation (Lower-Middle Cambrian) and one species *Tuzoia manchuriensis* Resser and Endo in Resser, 1929, from the lower part of the Changhia Formation (late Middle Cambrian). Distribution elsewhere in western North America, includes three species *Tuzoia nodosa* Resser, *T. polleni* Resser and *T. spinosa* Resser from the Early Cambrian Eager Formation in British Columbia; three species *T. (?) dunbari* Resser, *T. getzi* Resser and *T. nitida* Resser and Howell from the Early Cambrian Kinners Formation in Appalachians, Pennsylvanian; one species *T. vermontensis* Resser and Howell from the latest Early Cambrian Parker shale in Appalachians, Pennsylvanian; three species *Tuzoia retifera* Walcott including *T. burgessensis* Resser and *T. canadensis* Resser, *T. (?) parva* (Walcott) and *T. praemorsa* Resser of early Middle Cambrian in British Columbia and Utah, one species *T. (?) peterseni* Robison and Richards, 1981, from the upper Wheeler Formation of late Middle Cambrian in House Range, Utah and the youngest species *Tuzoia guntheri* Robison and Richards from the Marjum Formation of late Middle Cambrian in House Range, Utah. The wide distribution of *Tuzoia* has their potential biostratigraphical significance in the Cambrian correlation between intercontinent.

DESCRIPTION OF THE FOSSILS

Crustacea

Genus *Tuzoia* Walcott, 1912

Type species: *Tuzoia retifera* Walcott, 1912

Tuzoia bispinosa sp. nov.

(Pl. I, figs. 1–6; pl. II, figs. 9–12)

Diagnosis: A medium sized species, valve elliptical in outline, about 1.5 times longer than high; antero-dorsal and postero-dorsal process moderate and spinous; lateral ridge extending almost full length of valve, slightly beneath midheight; the surface covered by reticulate pattern of fine ridges with many very small meshes; two marginal spines in postero-ventral position on each valve.

Comparison: In general outline of valve and lateral ridge the new species bears the closest resemblance to the type species *Tuzoia retifera* from Stephen Formation (Burgess Shale) in British Columbia and Utah (Walcott, 1912; pl. 33, fig. 2; Resser, 1929; pl. 1, figs. 1–2; pl. 2, figs. 1–3; pl. 3, fig. 1; pl. 4, fig. 3), however, it differs from the latter mainly in having relatively smaller size of valve, slender spinous antero-dorsal process, only two marginal spines in

postero-ventral position on each valve and reticula on the surface of valve with much smaller and much more meshes. In general configuration of valve and reticulate ornament of the surface of valve the new species is also quite similar to *Tuzoia australis* from Lower Cambrian Emu Bay Shale in South Australia (Glaessner, 1979, p. 23—25, fig. 2), but the latter has very small antero-dorsal and postero-dorsal process, vestigial lateral ridge and only one triangular marginal spine in postero-ventral position on each valve.

Locality and horizon: Balang village, Taijing, SE Guizhou; middle part of Kaili Formation; *Danzhaiaspis-Xingrenaspis* Zone.

Tuzoia magna sp. nov.

(Pl. II, figs. 13—16)

Diagnosis: Valve transverse elliptical in outline, about two times longer than high, with two short zigzag slightly slanting forwardly spines on dorsal margin, approximately one-third length from anterior dorsal end; antero-dorsal and postero-dorsal process short, triangular; lateral ridge vestigial; three or four marginal spines in postero-ventral position on each valve; reticulate ornament with hexagonal to elliptical meshes.

Comparison: *Tuzoia magna* sp. nov. can be distinguished from *T. bispinos* sp. nov. chiefly by its two short zigzag slightly slanting forwardly spines on dorsal margin, its shorter antero-dorsal and postero-dorsal process, its vestigial lateral ridge and three or four marginal spines in postero-ventral position instead of two spines in the latter. In general configuration of the valve and the presence of two short zigzag spines on antero-dorsal margin and three or four spines in postero-ventral position on each valve the new species is also quite like *Tuzoia burgessensis* (Resser, 1929, pl. 2, fig. 1; pl. 3, fig. 1) which has been considered as subjective junior synonym of *Tuzoia retifera* by Simonetta and Delle Cave (1975, p. 8) and Robison and Richards (1981, p. 14), however, it can be easily discriminated from the latter by its slightly slanting forwardly two short zigzag spines on antero-dorsal margin, its vestigial lateral ridge and its reticulate ornament with much more and much smaller meshes.

Locality and horizon: Balang village, Taijiang, SE Guizhou; middle part of Kaili Formation; *Danzhaiaspis-Xingrenaspis* Zone.

图 版 说 明

标本采自贵州省台江县革东镇八郎村下、中寒武统凯里组中上部;保存在贵州工业大学资源工程系。

图 版 I

1—8. *Tuzoia bispinosa* sp. nov.

1. 右壳侧视, 正模标本 (Holotype), $\times 2$, 野外号: GM9; 登记号: GK1540.

2. 左壳侧视, $\times 2$, 野外号: GM9; 登记号: GK1541.

3. 左壳侧视, $\times 2$, 野外号: GM9; 登记号: GK1542.

4. 部分损坏的闭合壳侧视, 其中左壳较完整, $\times 1.5$, 野外号: GM8-5-439; 登记号: GK1543.

5. 左壳侧视, $\times 1.5$, 野外号: GM9; 登记号: GK1544。
6. 右壳侧视, $\times 1$, 野外号: GM20-2-58; 登记号: GK1545。
7. 右壳侧视, $\times 1$, 野外号: GM21-3-105; 登记号: GK1546。
8. 右壳侧视, $\times 1.5$, 野外号: GM9; 登记号: GK1547。

图版 II

9—12. *Tuzoia bispinosa* sp. nov.

9. 左壳侧视, $\times 2$, 野外号: GM9; 登记号: GK1548。
10. 右壳侧视, $\times 2$, 野外号: GM9; 登记号: GK1549。
11. 部分左壳侧视, $\times 1.5$, 野外号: GM9-3-216; 登记号: GK1550。
12. 部分左壳侧视, $\times 1.5$, 野外号: GM9; 登记号: GK1551。

13—16. *Tuzoia magna* sp. nov.

13. 右壳侧视, 正模标本 (Holotype), $\times 1$, 野外号: GM9; 登记号: GK1552。
14. 左壳侧视, $\times 1$, 野外号: GM9; 登记号: GK1553。
15. 部分右壳, $\times 1$, 野外号: GM9; 登记号: GK1554。
16. 不完整左壳, $\times 1$, 野外号: GM9-1-497; 登记号: GK1555。



1



2



3



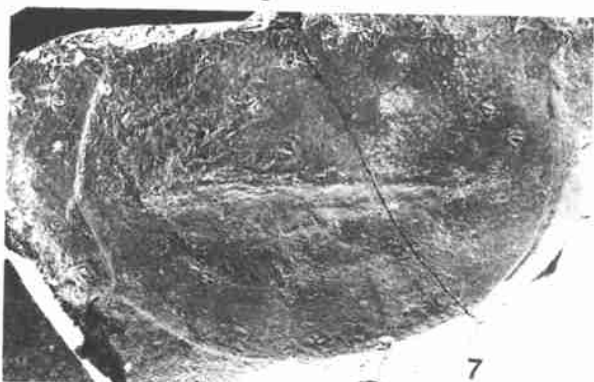
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8



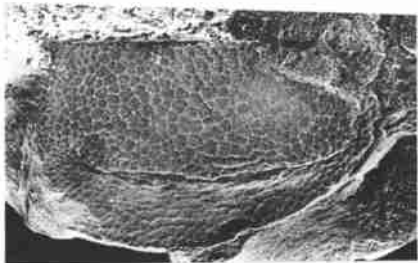
13



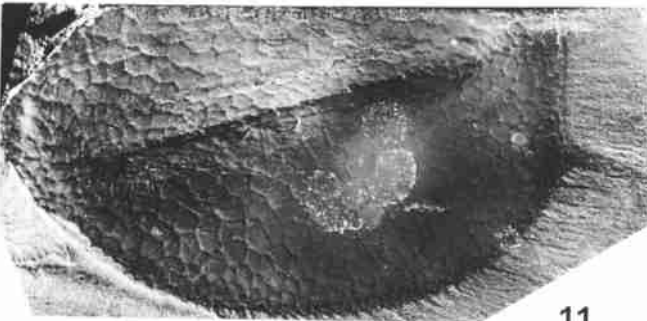
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16



12