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Neoarchaeocrinus 在我国的发现

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内容提要

根据贵州石阡雷家屯志留系剖面的1块海百合化石标本建立了一新种:*Neoarchaeocrinus shiqianensis* sp. nov.。该种以较长大的初级间腕板及辐板脊与腕板脊围成菱形等特征区别于属内其他种。

关键词 海百合 *Neoarchaeocrinus* 志留纪 雷家屯组 石阡

Neoarchaeocrinus 属是 Camerata 亚纲中比较原始的一类,最早的地层记录为北美奥陶纪 Trenton 灰岩,相当于 Caradocian 期。在分类上它属 Diplobathra 目的 Rhodocrinitacea 超科 Archaeocrinidae 科。该属一般保存比较完整,萼杯较大,梨形或圆锥形,体板较多。下底板和底板各5块,分别组成下底板环和底板环。辐板5块,皆为与底板直接相连的初级间腕板分隔。辐板、初级间腕板之上还有许多排的腕板、间腕板,这些板都固定在萼杯上。

Strimple 和 Watkins (1955)建立本属时,只有 *Neoarchaeocrinus pyriformis* Billings, 1857 和 *N. obconicus* Slocom et Foerste,1924 两个种。前者被指定为模式种,产于加拿大安大略省的 Trenton 灰岩,最初 Billings (1857)认为该种应归 *Thysanocrinus* 属,后经 Wachsmuth 和 Springer (1897)重新研究,划归 *Archaeocrinus* 属。Moore 和 Laudon (1943)讨论 Diplobathra 的演化时,误将该种当作 *Archaeocrinus* 属的典型代表,实际上,该种的下底板较大,侧视可见,而 *Archaeocrinus* 属内绝大部分的种都不具备此特征,相反,它们的下底板皆很小且被海百合茎所掩盖。与 *N. pyriformis* 相似,*N. obconicus* 也有较大的下底板,侧视可见这一特征,在 *Neoarchaeocrinus* 属建立之前同样地被划入 *Archaeocrinus* 属。该种模式标本来自美国爱荷华州的 Maquoketa 页岩,其时代相当于欧洲的 Ashgillian 期。考虑到这两种都具有特殊的下底板形态,Strimple 和 Watkins (1955)把它们从 *Archaeocrinus* 属移出并建立 *Neoarchaeocrinus* 属。

1961年,Ramsbottom 发表的英国奥陶纪海百合化石名单中,*Archaeocrinus elevatus* Ramsbottom,1961 值得重新研究。根据原作者的描述及照片,其下底板也是较大且侧视可见,因此把它定为 *Archaeocrinus* 属的分子是不正确的。值得注意的是,在同一名单中,Ramsbottom (1961)还建立了 *Balacrinus* 属,该属与 *Neoarchaeo crinus* 都有下底板较大且侧视可见这一特征,然而 Ramsbottom 没有在 *Balacrinus* 属征讨论中与 *Neoarchaeocrinus* 属的定义进行比较,由此可见,他显然不了解 Strimple 和 Watkins 已做的工作。根据笔者重新厘定的 *Neoarchaeocrinus* 属的定义,*A. elevatus* 应归为 *N. elevatus* (Ramsbottom),产出

层位是 Stinchar 灰岩(Caradocian 期)。

H. L. Strimple (1963)研究 Hunton 群产出的海百合化石时,发现了 *N. necopinus*,该种有较发育的脊,在底板的中部形成瘤突。它的具体产地是美国俄克拉何马州的 Pontotoc 县,地层是 Henryhouse 组,时代为志留纪。

Neoarchaeocrinus 属出现的最高层位是法国 Sarthe 的 Saint-Cenere 组(泥盆纪 Siegerian),这是 Jean Le Menn (1985)重新研究 *Raphanocrinus* ? *wachsmuthi* Oehlert,1886 的模式标本后得出的。E. Kirk (1945)曾认为这块标本是可曲海百合类(flexible crinoids)的 *Griphocrinus* 属的分子。该种有非常发育的棱脊。

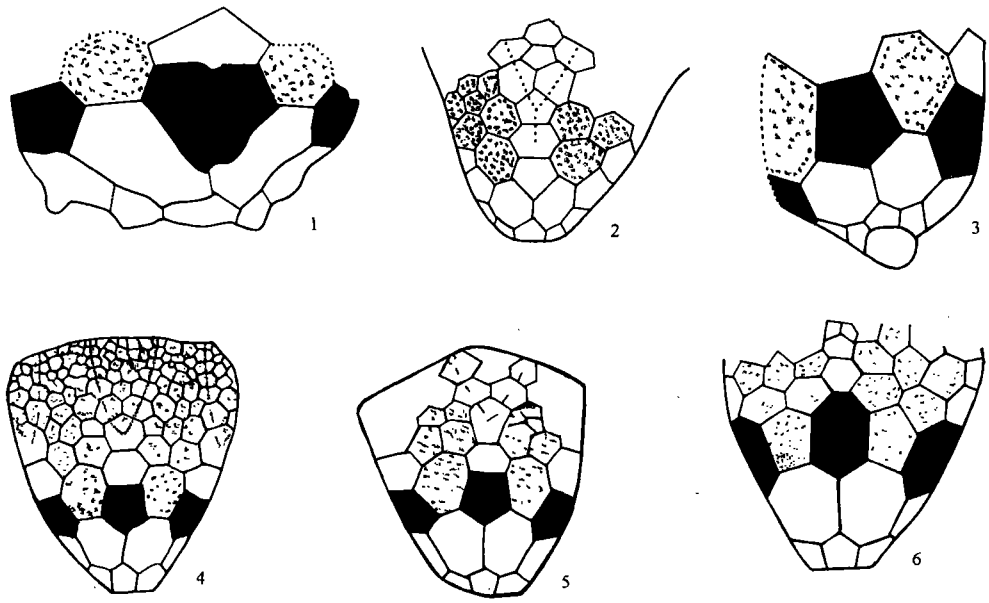

插图 1 *Neoarchaeocrinus* 各种的萼板侧视图

Showing latteral view of each species belonging to *Neoarchaeocrinus*

1. *N. necopinus* (Adapt from Strimple,1963,text-fig. 20b);2. *N. wachsmuthi* (According to the description of Le Menn,1985,p. 37—39);3. *N. shiqianensis* sp. nov.;4. *N. pyriformis* (After Moore and Laudon,1943,fig. 13);5. *N. obconicus* (According to the description given by Slocom and Foerste,1924,p. 328—330);6. *N. elevatus* (After Ramsbottom,1961,fig. 11)

1992 年,笔者在贵州石阡雷家屯志留系剖面发现 1 块海百合化石,经研究认为应是 *Neoarchaeocrinus* 属的一新种,命名为 *N. shiqianensis* sp. nov.。根据上述关于该属的记载,该属仅出现在北美地台,苏格兰及法国,因此贵州雷家屯志留系产出的这块标本不仅具有重要的分类意义,同时还具有古地理分布上的意义。

Neoarchaeocrinus shiqianensis sp. nov. 的正模标本产自石阡城北的马脚冲村附近,地层为雷家屯组。除回星哨组与二叠系为不整合接触外,从观音桥组到回星哨组之间皆为整合接触,只是在雷家屯组内部存在一小断层,造成小部分岩层缺失。本文所描述的的标本就产于这一断层之下的泥灰岩中,与之伴生的生物化石有腕足类 *Nalivkinia*(戎嘉余等,1984)。雷

家屯组之顶部灰岩中还有 *Petalocrinus*（穆恩之等，1987）。该组的时代相当于笔石带 Sedgwickii 带（戎嘉余等，1990）。

加上本文新命名的 *Neoarchaeocrinus shiqianensis* sp. nov.，本属就有 6 个种。根据它们在辐板（radials）、初级间腕板（first interprimbrachials）形状上的差异，该属可以很自然地分成两种类型（插图 1）。类型一（Type 1）由 *N. pyriformis*，*N. obconicus*，*N. necopinus*，*N. wachsmuthi*，*N. shiqianensis* 组成，其特点是辐板为五边形、初级间腕板为七边形。类型二（Type 2）只含 *N. elevatus* 一个种，它的辐板是七边形，而初级间腕板则是五边形。这两种类型通过骨板之间的融合（fusion），可能存在 Type 2 到 Type 1 的演化关系（插图 2）。

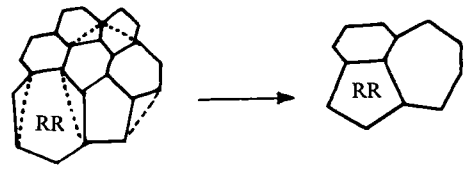

插图 2　类型一与类型二之间可能的演化关系示意图
Showing a possible relationship between Type 1 and Type 2

属种描述

原海百合科　Archaeocrinidae Moore et Laudon，1943

新原海百合属　Genus *Neoarchaeocrinus* Strimple et Watkins，1955

模式种　*Neoarchaeocrinus pyriformis* Billings，1857；加拿大，中奥陶世 Caradocian 期。

特征　萼杯圆锥形或梨形，下底板较大，侧视可见，向上扩展成喇叭状；间辐向第二排有 2 块间腕板（CD 间辐除外）。

讨论　Ramsbottom（1961）建立的 *Balacrinus* 属与 *Neoarchaeocrinus* 同归 Archaeocrinidae 科，都具有侧视可见且较大的下底板，它们的区别在于前者所有的一、二级间腕板的安排为 1＋3 块，CD 间辐向（即肛板所在位置）不能分辨出来。后者的一、二级间腕板为 1＋2 块，CD 方向为 1＋3 块。因此，为便于同 *Balacrinus* 区别，特将 *Neoarchaeocrinus* 属原有的定义扩展成本文所厘定的特征。

时代分布　中奥陶世—中泥盆世；北美，苏格兰，法国，中国。

石阡新原海百合　*Neoarchaeocrinus shiqianensis* sp. nov.

（图版 I，图 6）

唯一的标本仅见部分萼杯，围岩为泥质灰岩，由于风化，化石表面略有损坏，标本在成岩时受压，但其轮廓大致为圆锥形。能分辨的萼板有：下底板 5 块，底板 3 块，辐板 2 块，初级间腕板 2 块及腕板 1 块，一些测量数据如下：萼杯高（保存部分）26mm，萼杯宽（保存部分）28mm，底板高 9mm，初级间腕板高 13mm 初级间腕板宽 10mm。

下底板较大，侧视可见，五边形，宽略大于高，与茎相连处呈玫瑰花瓣形。底板七角形，上部为初级间腕板截切，中脊微弱，与辐板脊相连；底板间缝合线深。辐板大于底板，五角形，中脊微弱，上接腕板中脊成菱形，所围区域微凹。腕板六边形，比辐板小。初级间腕板在所有板中最大、最长，七边形，顶部与 2 块次级间腕板相接。萼杯其他板未保存，萼盖、腕及茎均不见。

比较 如插图1所示，*Neoarchaeocrinus* 根据辐板和初级间腕板的外形可分为两种类型，新种与类型二的 *N. elevatus* 有较大区别。在类型一之中，*N. pyriformis* 的底板、辐板、初级间腕板从面积上来看皆差不多大小；*N. obconicus* 所有的萼板当中，底板是最大的，辐板和初级间腕板相对要小一些，而新种的萼板以初级间腕板为最大且最长。如果把这3种的初级间腕板放在一起进行比较，新种无疑是最大的，它高达13mm，最宽处达10mm。

在 *Neoarchaeocrinus* 属所有的6个种之中，新种的萼板结构与 *N. wachsmuthi* 最接近，都有较长且大的初级间腕板，但这两个种的外观却相去甚远，新种萼杯上的脊不很明显，而 *N. wachsmuthi* 的脊异常发达，高突于萼杯之上，犹如镂刻。

新种与 *N. necopinus* 之间的区别在于新种辐板脊与腕板脊相围成菱形，而后者为"一"字形，*N. necopinus* 的脊比 *N. shiqianensis* 的发育，容易识别。

产地层位 贵州石阡，早志留世 Aeronian 阶雷家屯组。

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ON DISCOVERY OF *NEOARCHAEOCRINUS* IN CHINA

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Key words crinoid, *Neoarchaeocrinus*, Silurian, Guizhou

Summary

In China, the Lower Paleozoic crinoid faunas have been studied for nearly 40 years since 1954. Noticeably, these studies all deal with the Lower Silurian crinoids occurring in the Yangtze Platform. Considering this situation, the author collected fossil crinoids in Southwest China (including Guizhou, Sichuan, and Shanxi) twice during the years of 1992 and 1993 from the fossiliferous rocks of the Llandovery age.

The specimen described in this paper is collected from Shiqian, Guizhou. Along a narrow highway some 8 kilometres north of the town, there is a small hill opposite to a water pool, with the site of the sample located at the foot of the hill. There the rocks are referred to the Leijiatun Formation in which *Petalocrinus* also occurs (Mu and Lin, 1987; Holland, 1990). Previous studies have shown that this mudstone correlates with the *sedgwichii* Biozone (Upper part of Aeronian). The new species *Neoarchaeocrinus* was previously known as a genus of Cameratad distributed in North America and West Europe. It is accordingly considered as of significance to report this new species from China.

Two aspects concerning the genus *Neoarchaeocrinus* are worth discussing. One aspect is the taxonomic position of *Archaeocrinus elevatus* Ramsbottom, 1961. According to the descriptions and figures given by Ramsbottom (1961), this species possesses large infrabasals which can be seen from a side view, and the two rows of interray plates directly above the basals are arranged as 1+2. Obviously, instead of to *Archaeocrinus*, the species should be assigned to the genus *Neoarchaeocrinus*. This case has been noticed by J. Le Menn (1985, 1987), but he has not given any comments. Stephen K. Donovan (1986) and Harrell L. Strimple (1972) also included *A. elevatus* Ramsbottom, 1961, in *Neoarchaeocrinus*.

The other aspect is related to the division within the, genus *Neoarchaeocrinus*. Including the new species proposed in this paper, the genus *Neoarchaeocrinus* comprises 6 species, namely, *N. pyriformis* Billings, 1857 (Trenton Limestone of Caradoc age, Ontario, Canada), *N. obconicus* Slocom et Foerste, 1924 (Maquoketa Shale of Ashgill age, Iowa, USA), *N. elevatus* Ramsbottom, 1961 (Caradoc, Stinchar Limestone groups, Girvan of Scotland), *N. necopinus* Strimple, 1963 (Henryhouse Fm., Silurian, Oklahoma, USA), *N.*

wachsmuthi Oehlert, 1886 (Saint-Céneré Fm., Devonian, Sarthe, France), and *N. shiqianensis* sp. nov.; *N. pyriformis* was designated as the type species of the genus by Strimple and Watkins (1955). From the illustration of Fig-1, the genus is naturally divided into two different types from each other in the shape of radials and lowermost interprimibrachials. Type 1 has pentagonal-edged radials and heptagonal-edged lowermost interprimibrachials, in which *N. pyriformis*, *N. obconicus*, *N. necopinus*, *N. wachsmuthi* and *N. shiqianensis* sp. nov. are involved. Contrarily, Type 2 has heptagonal radials and pentagonal lowermost interprimibrachials and this model is shown only in *N. elevatus*. Fig-2 provides a possible evolutionary relationship between Type 1 and Type 2.

Family Archaeocrinidae Moore et Laudon, 1943

Genus *Neoarchaeocrinus* Strimple et Watking, 1955

Diagnosis Calyx conical or pyriform and relatively large, with upflaring infrabasals clearly visible in side view. All but CD interradial areas with 2 plates in the second row.

Discussion When the genus *Neoarchaeocrinus* was erected by Strimple and Watkins in 1955, it was composed of only two species, namely, *N. pyriformis* and *N. obconicus*. Both of them are characterized by large infrabasals which can be seen from a side view, and this feature is enough to distinguish the genus from others subordinate to Archaeocrinidae. In 1961, Ramsbotton published a list of crinoids discovered from the British Ordovician; in this contribution he proposed a genus *Balacrinus* which was also placed in the family Archaeocrinidae. Obviously, the diagnosis of *Neoarchaeocrinus* needs emending, because *Balacrinus* has the characters which were originally given to *Neoarchaeocrinus*. As a matter of fact, the two genera can be readily distinguished by the arrangement of the interradial area. In the first two rows of interradials, *Balacrinus* performs 1+3 in all directions of interrays, whereas *Neoarchaeocrinus* 1+2 in all but CD interrays.

Neoarchaeocrinus shiqianensis sp. nov.

(Pl. I, fig. 6)

Diagnosis A species of *Neoarchaeocrinus* with larger and longer lowermost interprimibrachials; ridges of radials and first brachials enclosing the rhombic-shaped area.

Description The only material was exposed above its enclosing rock composed of mudstone. Due to weathering, nearly 1/3 part of the surface has been damaged. However, a careful observation would provide all the characters possessed by the genus. The plates that can be determined include: 5 infrabasals, 3 basals, 2 radials, 2 lowermost interprimibrachials and 1 lowest branchial, with their arrangements illustrated in Text-fig. 1.

Although the cup has been compressed, its conical shape is still conceivable. Infrabasals resemble each other in size and shape, pentagonal, wider than high; its suture connected with proximal columnals looks like a rossette. Basals heptagonal; median ridge

faint, connecting with ridge of radials; between a pair of basals, common edge deep, with upper part truncated by the first interprimibrachials. Radials large, pentagonal; median ridge faint, forming an X-shape, extending to ridge of branchials, with enclosed areas depressed. Lowest brachials imagined to be hexagonal. Lowermost interprimibrachials heptagonal, directly resting on basals, separating radials all around, larger than wide, being the largest plate on the cup. Other plates have not been preserved.

Measurements Height (preserved part): 26mm, Width of ring of radials: 28mm, Height of basals: 9mm, Height of first interprimibrachials: 13mm, Length of first interprimibrachials: 10mm.

Discussion As a representative of Type 2, *N. elevatus* has a marked difference in the shape of radials and lowermost interprimibrachials as compared with the new species (Type 1), by which they can be readily distinguished. Within the members of Type 1, as mentioned above, *N. pyriformis* has a subequal size of basals, radials and lowermost interbrachials, whereas *N. obconicus* has the largest basals among the cup plates, In contrast to them, the new species is characterized by its relatively large and long lowermost interprimibrachials and small basals.

Viewing from the arrangement of ossicles on the proximal cup, the new species is most similar to *N. wachsmuthi*. But in the shape of the cup, they have a great difference; the new species has weakly developed ridges, while *N. wachsmuthi* has strongly developed ridges looking like a bamboo basket.

The differences between *N. shiqianensis* and *N. necopinus* are mainly in the form of the area where median ridges of radials and the first brachials meet together. The form of the former is rhombic in shape and its enclosing area is depressed , while the latter is simply in 1-shape.

Locality and horizon Shiqian County, Guizhou; Leijiatun Formation, Upper part of Aeronian.

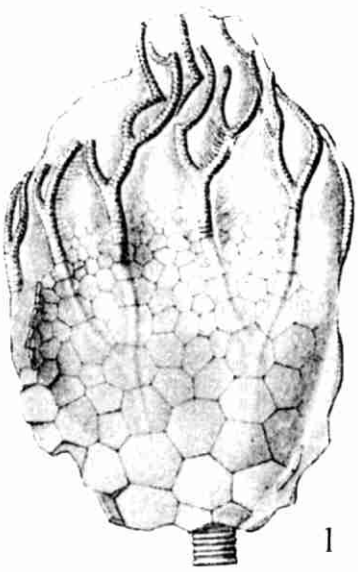
图 版 说 明

新种模式标本保存于中国科学院南京地质古生物研究所。除新种模式标本照片外(图版 I，图 6)，其它照片均用作比较，翻拍自不同作者。(The only specimen of *Neoarchaeocrinus shiqianensis* sp. nov. is housed in the NIGPAS. Figs. 1—5 are all re-photoed from various sources so as to correlate with Fig. 6).

图 版 I

1. *Neoarchaeocrinus pyriformis* Billings, 1857; holotype, ×1, lat. view. Trenton Limestone, Ontario, Can.
2. *Neoarchaeocrinus obconicus* Slocom et Foerste, 1924; holotype, ×2, lat. view, Maquoketa Shall, Iowa, U. S. A.
3. *Neoarchaeocrinus elevatus* Ramsbottom, 1961; holotype, ×3, lat. view, Stinchar Limestone, Girvan, Scotland.
4. *Neoarchaeocrinus wachsmuthi* Oehlert, 1886; holotype, ×1. 5, lat. view, The Saint-cenere Fm. , Sarthe, France.
5. *Neoarchaeocrinus necopinus* Strimple, 1963; holotype, ×1. 3, lat, view, Henryhouse Fm. , Oklahoma, U. S. A.
6. *Neoarchaeocrinus shiqianensis* sp. nov.

NIGP 121557, holotype, ×2, 6a. lat. view; 6b. basal view. Leijiatun Fm. , Shiqian County, Guizhou.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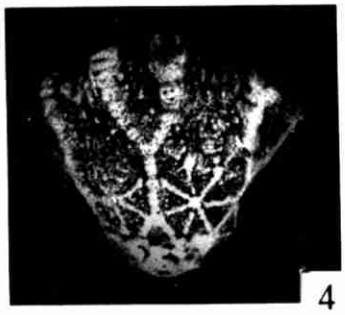
2


3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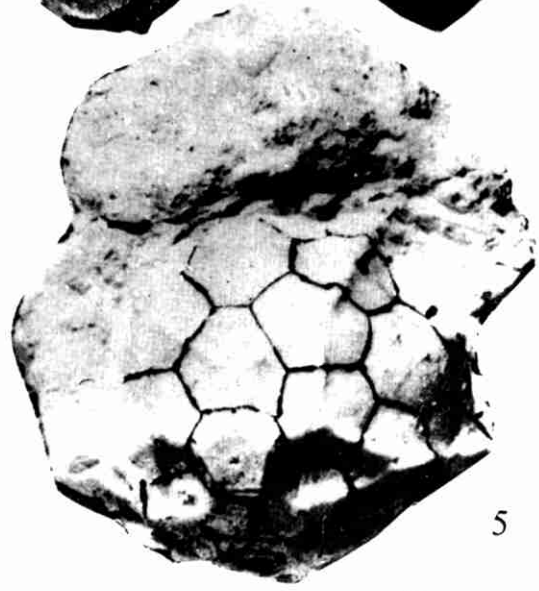
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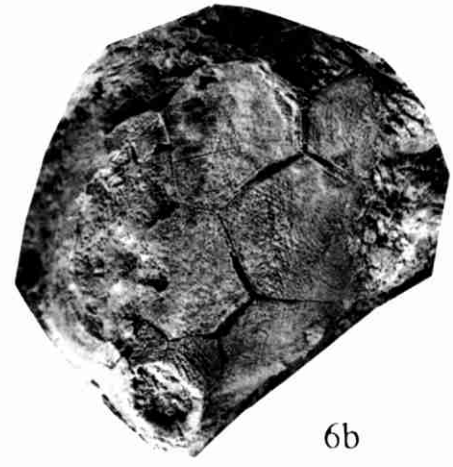
6a


6b