

# 贵州台江中寒武世凯里动物群<sup>\*</sup>

赵元龙<sup>1)</sup> 袁金良<sup>2)</sup> 黄友庄<sup>1)</sup> 毛家仁<sup>1)</sup>  
钱逸<sup>2)</sup> 张正华<sup>3)</sup> 龚显英<sup>1)</sup>

- 1) 贵州工学院地质系, 贵阳 550003  
2) 中国科学院南京地质古生物研究所, 南京 210008  
3) 贵州石油勘探开发指挥部地质研究所, 贵阳 550001

## 内 容 提 要

贵州中寒武世凯里动物群由10个以上门类化石组成, 包括棘皮动物、水母状化石、蠕虫、海绵、软舌螺、三叶虫、腕足类、单板类、菌藻类、疑源类、一些分类不明的化石及遗迹化石。这一动物群形成于浅海陆棚环境, 它是继我国已发现的、世界闻名的澄江动物群之后, 在我国寒武系发现的另一个布尔吉斯页岩型动物群。

**关键词** 凯里动物群 中寒武世 布尔吉斯页岩型 贵州台江

1982年11月, 赵元龙、黄友庄、龚显英等在贵州台江县革东镇八郎、屯州一带测制寒武系凯里组剖面时, 除采集到大量三叶虫及海绵、腕足类、单板类、菌藻类、软舌螺等化石外, 还在凯里组中部意外地发现了数块完整的棘皮动物化石。以后数年间, 赵元龙等利用学生毕业实习或其他机会多次去八郎剖面采集化石, 相继采集到水母状化石、蠕虫、双壳类等。1990年春, 笔者在申请科研基金时, 将其命名为凯里动物群, 年底获国家自然科学基金及贵州省科技基金的资助。1990年10月及1991年4月, 课题组在八郎剖面进行了两次较大规模的采集工作, 获得了很多棘皮动物及水母状化石。1993年4月, 尹磊明作了疑源类样品的分析, 发现了疑源类化石。至此, 凯里动物群已成为拥有10多个门类的化石群。

## 一、凯里动物群的组成

凯里动物群的产地是凯里地区台江县革东镇八郎村, 西距贵阳和凯里分别为270km和70多公里(插图1)。位于贵阳至湖南怀化主干公路北侧3km处, 交通方便。

严格地讲, 凯里动物群因含有较多的菌藻类化石, 应称作生物群或化石群。不过藻类化石数量有限, 不是动物群的核心成员, 况且菌藻类化石是在“凯里动物群”一名发表以后发现的, 为避免命名上的混乱, 故我们仍将其称作动物群。除了一些分类位置未定的化石和遗迹化石外, 凯里动物群含有10个门类化石: (1) 多孔动物门(Porifera) 海绵骨针; (2) 腔肠动物门(Coe-

\* 国家自然科学基金及贵州省科技基金资助项目。

lenterata)水螅纲;(3)蠕虫类(Vermes);(4)触手动物类(Lophophorates)水母状化石;(5)软体动物门(Mollusca)单板纲、软舌螺、双壳纲;(6)节肢动物门(Arthropoda)三叶虫纲、大型双壳节肢动物、大型节肢动物;(7)腕足动物门(Brachiopoda)无铰纲、有铰纲;(8)棘皮动物门(Echinodermata)海百合亚门始海百合纲、海扁果亚门海箭纲;(9)菌藻类,包括蓝细菌门(Cyanobacteria)、绿藻门(Chloophyta);(10)疑源类(Acritarcha)。初步统计,属和种的数量分别超过56个和85个(包括10未定种),其中8新属16新种。

在动物群中,无论是属、种或是标本数量,三叶虫均居首位,次为腕足动物,但动物群的核心成员则是棘皮动物和水母状化石。棘皮动物大部分属种均具有发育的茎、萼、腕,并有1块2个个体以根相连的罕见标本。保存如此完整、数量如此之多的棘皮动物,在我国尚属首次发现。其形态特征有别于北美、波希米亚中寒武统的始海百合类。水母状化石保存较好,数量较多,与云南澄江动物群中的 *Rotadiscus* Sun et Hou(孙卫国等,1987)非常相似,部分外环有一些大型双壳节肢动物,为很好的生态标本。动物群中的软舌螺化石保存比较好,有1块既有直肠痕又具口盖伸缩肌痕的标本(毛家仁等,1992)。加拿大的布尔吉斯页岩动物群和美国犹他州中寒武统 Spence 页岩均含有不少蓝菌、绿藻(Walcott, 1920; Whittington, 1985; Conway Morris and Robison, 1988)。凯里动物群中的蓝菌、绿藻

也比较多,两者的属种基本相同。动物群中常见的三叶虫有 *Kaotia*, *Xingrenaspis*, *Oryctocephalus*, *Olenoides*, *Peronopsis*, *Pagetia* 等,具有明显的扬子区与江南区的过渡色彩。

## 二、凯里动物群的时代

凯里动物群产于贵州台江寒武系凯里组中部。凯里组是扬子区与江南区之间的过渡区西部(凯里相区)跨早、中寒武世的岩石地层单元,主要由灰绿、灰色泥岩、粉砂质泥岩组成,上部及下部夹灰、深灰色中一薄层泥质灰岩、灰岩,厚250—300m。经周志毅、袁金良等研究,由下而上划分为4个三叶虫带:(1) *Kunmingaspis-Nangaops* 带;(2) *Wuxunaspis* 带;(3) *Oryctocephalus-Xingrenaspis* 带;(4) *Kootenia jialaoensis* 带(周志毅等,1980)。凯里动物群位于 *Oryctocephalus-Xingrenaspis* 带的中部(插图2),共生的三叶虫还有 *Kaotia*, *Olenoides*, *Peronopsis*, *Pagetia*, *Burlingia*, *Kütsingocephalus* 等,其时代为中寒武世。*Kunmingaspis-Nangaops* 带含有大量全球分布的 *Bathymotus*(赵元龙等,1990)、大区域性分布的 *Redlichia* 及常见于下寒武统的 *Protoryctocephalus* 等,与 *Chittidilla*, *Mufushania*, *Kunmingaspis* 等三叶虫共生,作者建议将该带改称为 *Bathymotus-Nangaops* 带,作为寒武

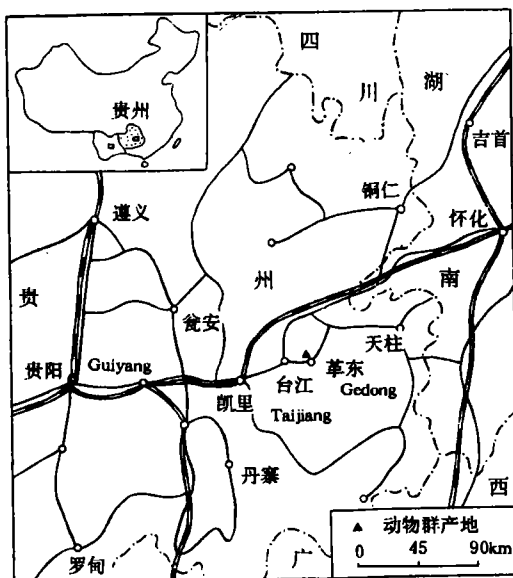


插图1 贵州凯里动物群剖面位置图  
Map showing the location of the main section  
yielding the Kaili Fauna

纪华南过渡区凯里组及同期地层的第一个三叶虫带(赵元龙等,1993),时代为早寒武世晚期。由于 *Wuxunaspis* 带所在层位厚度不大,有的作者甚至已取消这一三叶虫带(尹恭正,1987),这样 *Oryctocephalus-Xingrenaspis* 带实际上就是凯里地区中寒武统第一个三叶虫带,而位于该带中部的凯里动物群的确切时代是中寒武世早期,相当于我国徐庄期早期(表 1)。

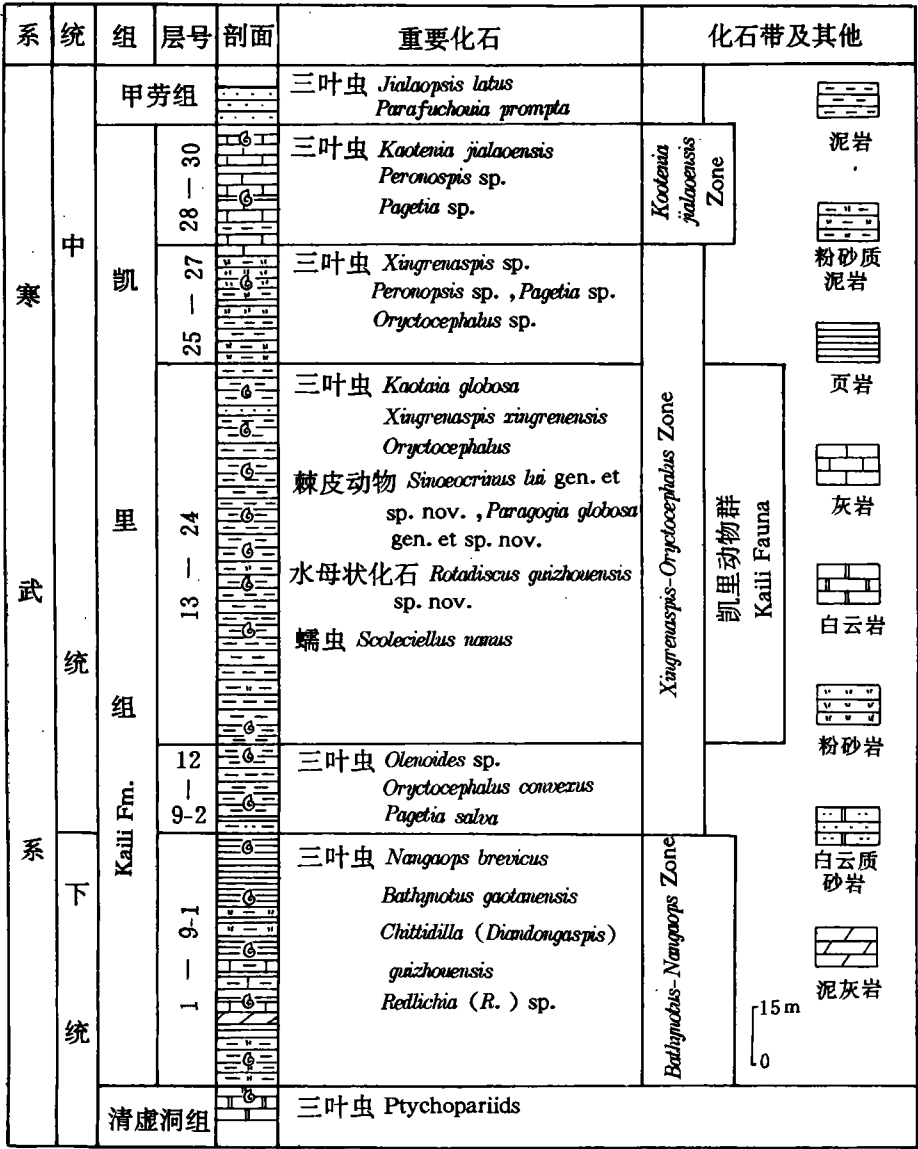


插图 2 贵州台江凯里组柱状剖面图

The columnar section of Lower—Middle Cambrian Kaili Formation at Taijiang, Guizhou

表 1 贵州台江中寒武统下部的划分及凯里动物群的层位  
Subdivisions of lower part of the Middle Cambrian in Taijiang, Guizhou,  
showing horizon of the Kaili Fauna

系	统	阶	岩石地层	生物地层
寒  武  系	中  统	张夏阶 Changhia Stage	娄山关群(下部) Loushanguan Group	
		徐庄阶 Hsuehuang Stage	甲劳组 Jialao Fm.	<i>Parafuchouia</i> Zone
			凯里组 Kaili Formation	<i>Kootenia jialaoensis</i> Zone <i>Oryctocephalus- Xingrenaspis</i> Zone <i>Wuzhuaspis</i> Zone
	下  统	毛庄阶 Maochuang Stage		<i>Bathynotus-Nangaops</i> Zone
		?	“清虚洞组” “Tsingsutung Fm.”	<i>Redlichia guizhouensis</i> Zone

三、凯里动物群的沉积环境

凯里动物群产于凯里组的中部。凯里组中部是由灰绿、黄绿色泥岩、粉砂质泥岩和少量薄层至微层综灰色含黄铁矿白云质泥质粉砂岩所组成,少见波痕和扰动构造。根据众多保存完好的三叶虫、棘皮动物、水母状化石、菌藻类的事实和遗迹化石研究的综合分析(杨式溥,1994),可以推断凯里动物群是生活在距岸有一定距离的地台浅海区,处于正常波基面之下、风暴波基面之上较安静的水域。此外,含化石的层位有丰富的有机质,说明当时海水表层中的氧和水中的含盐度正常,适合各种动植物的生存。但当台地浅水区受到风暴波浪扰动时,本区底质可以受到轻微的影响,向陆潮下带的一些较粗的物质会被扬起并搬运到这个地区,因而形成泥岩和粉砂岩的交替沉积,使得化石群的保存状况有好有坏,但都属于正常开阔海的沉积环境。

四、凯里动物群的性质及意义

凯里动物群是继我国澄江动物群(张文堂,1987;侯先光,1987;Chen *et al.* , 1991)之后被发现的又一个重要的寒武纪动物群。因含有水母状化石、蠕虫类等软躯体化石,应属于布尔吉斯

页岩型动物群。凯里动物群中的软躯体化石、非三叶虫节肢动物化石虽远不如澄江动物群中的保存完美,但却拥有我国首次发现的保存完整的寒武纪棘皮动物,以及大量的世界性分布的三叶虫,具有独特的生物组合特征。在凯里动物群与澄江动物群之间,同一门类中相似或相同的属种不多,这可能是时代差异所造成。凯里动物群的发现不仅填补了我国寒武纪化石宝库中某些门类的空白,也是澄江动物群的极好补充,对于深入研究澄江动物群、开展我国早期后生动物演化研究有着重要的作用。

加拿大西部不列颠哥伦比亚省中寒武统布尔吉斯页岩动物群也拥有大量的软躯体化石、非三叶虫节肢动物、脊索动物等(Conway Morris and Whittington, 1979, 1985; Conway Morris, 1989),相比之下,凯里动物群显得门类少、属种少,但这两个动物群之间仍有许多相同之处,如都具有棘皮动物、刺细胞动物、海绵动物、软舌螺类、三叶虫及菌藻类等,不少属种也完全相同。布尔吉斯页岩动物群有一个可能归入软体动物门的 *Wiwaxia* Walcott, 这一动物全身覆以鳞片(scales)(Conway Morris and Whittington, 1979, p. 131; Conway Morris, 1985, fig. 29),而凯里动物群中有 20 多块类似 *Wiwaxia* 鳞片的化石。这两动物群的时代都是中寒武世,通过三叶虫化石组合对比,布尔吉斯页岩动物群的时代相当于徐庄期晚期或张夏期早期。因此,布尔吉斯页岩动物群的确切时代要晚于凯里动物群。由于凯里动物群的时代介于澄江动物群和布尔吉斯页岩动物群之间,因此对生物的演化以及研究澄江动物群和布尔吉斯动物群都有帮助。

美国西部犹他州等地的中寒武统含有多门类化石(Sprinkle, 1976; Ubaghs and Robison, 1985; Conway Morris and Robison, 1988; Robison, 1991),与凯里动物群也有许多相似之处。

除非洲、南美洲、南极洲外,其他各洲均有布尔吉斯页岩型动物群的分布(Conway Morris, 1989),凯里动物群的发现,又增加了一个布尔吉斯页岩型动物群的产地,为深入研究布尔吉斯页岩型动物群、古生物地理、中寒武统洲际对比提供了重要资料。

## 五、凯里动物群的研究方向

澳大利亚晚前寒武纪埃迪卡拉动物群和加拿大中寒武统布尔吉斯页岩动物群,经过长期的研究现已成为生物组合面貌清楚、举世闻名的动物群。澄江动物群从发现软躯体化石算起,至今也有 20 多年,目前仍在深入研究之中。凯里动物群发现至今也有 10 余年,但真正进行研究才是近 3—4 年的事,因此凯里动物群的研究工作刚起步,有待今后采集更丰富的标本作深入细致的研究。其中,有两个方面要特别给予注意:

首先,要加强化石采集工作。过去的采集工作规模小,今后应进行大规模的采集。至 1986 年止,布尔吉斯页岩动物群采集的标本已达 730 000 多件(Conway Morris, 1989, p. 340)。澄江动物群的采集工作采用推土机挖掘,采集的标本数量也非常多,而凯里动物群的标本才采集到 4 000 件左右,相距甚远。加强采掘工作的目的是要采集到更多的软躯体和珍稀化石,丰富动物群的内容。除了在动物群产地继续大规模采集外,还应在华南过渡区凯里组同期地层中搜寻、采掘。目前,黔东南部分地区中寒武统相应地层中,已见到棘皮动物化石萼部碎片及蠕虫化石,这给扩大寻找凯里动物群产地提供了线索。其次必须组织专门研究人员有计划的进一步开展系统古生物学、古生态学、沉积、埋藏学和古地理、古气候学等方面的研究。

笔者在研究凯里动物群的过程中得到很多单位及个人的支持、关心,谨向他们致以衷心的感谢。戴新春、李信善、廖善友以及贵州工学院地质系 81—83 级、85—87 级的部分同学参加了野外工作;胡尚卿、任玉皋、杨荣庆、王长国、熊蕴芝、廖谨行等摄制化石照片、清绘图件,笔者也一并向他们表示感谢。

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## MIDDLE CAMBRIAN KAILI FAUNA IN TAIJIANG, GUIZHOU

Zhao Yuan-long<sup>1)</sup>, Yuan Jin-liang<sup>2)</sup>, Huang You-zhuang<sup>1)</sup>,  
Mao Jia-ren<sup>1)</sup>, Qian Yi<sup>2)</sup>, Zhang Zheng-hua<sup>3)</sup> and Gong Xian-ying<sup>1)</sup>

1) Department of Geology, Guizhou Institute of Technology, Guiyang 550003

2) Nanjing Institute of Geology and Palaeontology, Academia Sinica, Nanjing 210008

3) Geological Institute, Petroleum Exploration Headquarters of Guizhou, Guiyang 550001

**Key words** Taijiang, Guizhou, Middle Cambrian, Kaili Fauna, Burgess Shale-type

### Summary

A Burgess Shale-type fauna, including 10 phyla of echinoderms, medusiform fossils, vermes, trilobites, etc. has been discovered in the middle part of the Kaili Formation (Lower—Middle Cambrian) at Balang village, Taijiang County, Guizhou Province, and named the Kaili Fauna by the authors in 1990.

### COMPOSITION OF THE FAUNA

The Kaili Fauna is composed of 10 phyla, which are: (1) Porifera (sponges); (2) Coelenterata (Hydrozoa); (3) Vermes; (4) Lophophotes (Medusiform fossils); (5) Mollusca (Monoplacophora, Hyolitha, Bivalvia); (6) Arthropoda (Trilobita, large bivalved arthropods, large arthropods); (7) Brachiopoda (Inarticulata, Articulata); (8) Echinodermata (Eocrinoidea, Homoiostelea); (9) Algae (Cyanobacteria, Chlorophyta); and (10) Acritarcha, totally including over 56 genera and over 85

species, together with some undeterminable fossils which are not clear in classification and some trace fossils.

The core of the fauna is made up of Echinodermata and medusiform fossils. However, the trilobites are most numerous in genera and specimens, occupying more than 35% of the total fauna; some trilobite genera are widely distributed in the world. Among the more than 100 echinoderm specimens, many of them are still preserved with stem, calyx, and brachioles; there is also a very rare specimen of two individuals with their stems connected together. Such complete and numerous echinoderms are discovered for the first time in the Cambrian of China. The medusiform fossils are also better preserved; in certain specimens, some large bivalved arthropods are in the rank around individuals. Among the fauna, the fossils of Hyolitha are also better preserved in large quantities and numbers which are rarely seen in Middle Cambrian in China. There is one specimen with rectum trace and adductor and abductor muscle of the operculum (Mao *et al.*, 1992).

## I . AGE OF THE FAUNA

The fossils of the Kaili Fauna were collected from the middle part of the *Oryctocephalus-Xingrenaspis* zone in the middle part of the Kaili Formation (Lower—Middle Cambrian) at Balang, Taijiang; associated trilobites include *Olenoides*, *Kaotia*, *Pagetia*, *Pianaspis*, *Peronopsis*, *Burlingia*, *etc.* Exactly the age of the fauna is Middle Cambrian. Below the *Oryctocephalus-Xingrenaspis* zone, a large quantity of the Lower Cambrian trilobite *Bathymotus* elements are widely distributed; other Lower Cambrian trilobites such as *Redlichia*, *Protoryctocephalus* were also collected. Therefore, the Kaili Fauna further shows that its age belongs to the early stage of Middle Cambrian.

## III . SEDIMENTARY ENVIRONMENT OF THE FAUNA

The country rocks of the Kaili Fauna are granular and may be divided into mudstone, siltstone and calcareous rock, showing fine bedding structure with few ripple marks, but the wadding structure is unobservable. These grey-green and yellow-green country rocks with scattered pyrites indicate that the sedimentary environment was under a weak oxidizing condition. Boring-trace fossils have seldom been seen. There are a large number of fossils including many phyla in country rocks. The above-enumerated characteristics indicate that the Kaili Fauna lived in the shelf of shallow water representing a peaceful environment far from seacoast.

## IV . NATURE AND SIGNIFICANCE OF THE FAUNA

The Kaili Fauna belongs to the Burgess Shale-type Fauna, because it contains soft-bodied fossils such as medusiform fossils and Vermes. Its discovery has filled the gap of some Cambrian Palaeontological phyla and taxa in China and is of importance in studying the metazoan evolution of the early stage and palaeogeography of Cambrian in the world. The soft-bodied fossils and non-trilobite arthropods of



the Kaili Fauna are much less than those of the Chengjiang Fauna (Zhang, 1987; Hou, 1987; Chen *et al.*, 1991), but the Kaili Fauna has complete echinoderms, hyolithids with muscle trace, *Wuraxia* and a large number of trilobites; the genera and species of large bivalved arthropods, trilobites, *etc.* in the Kaili Fauna, have their own bioassemblage features and are younger in age. The Kaili Fauna is another important discovery following the Chengjiang Fauna of Cambrian in China. In comparison with the Burgess Shale-type Fauna (Conway Morris and Whittington, 1979, 1985), the Kaili Fauna also contains a lot of soft-bodied fossils and non-trilobite arthropods, but with many genera and species of trilobites, hyolithids, sponges, algae, *etc.* and its age is the same as the former. The discovery of the Kaili Fauna expands the field of the Middle Cambrian Burgess Shale-type Fauna in the world.

The authors would like to express their gratitude to Nanjiang Institute of Geology and Palaeontology, Academia Sinica and Taijiang County Government of Guizhou Province and some persons for giving much help in the study of the Kaili Fauna; they are Professors Li Xing-xue, Zhou Zhi-yi, Yang Zun-yi, Yang Shi-pu, H. B. Whittington, S. Morris Conway, C. P. Hughes, R. A. Robison, J. Bergstrom, Dr. P. Ahlberg, and especially, Professor Lu Yan-hao, who is always concerned about the study of the Kaili Fauna, even during his stay in hospital. This study is supported by the scientific funds from the National Science Foundation of China and the Science and Technical Foundation of Guizhou.