第三十一卷 第二期 地 球 学 报 Vol.31 No.2
二〇一〇年四月: 263-266 Acta Geoscientica Sinica Apr. 2010: 263-266
www.cagsbulletin.com www.地球学报.com

中国辽西中侏罗世地层发现船颌翼龙新属新种

吕君昌[1)], 富察晓蕙[2)], 陈金梅[3)]

1)中国地质科学院地质研究所, 北京 100037;
2)热河古生物化石博物馆, 河北承德 067000; 3)辽西博物馆, 辽宁朝阳 122000

摘 要: 根据不完整的化石骨架, 建立船颌翼龙一新属新种: 李氏凤凰翼龙。它产自辽西中侏罗世的髫髻山组。具有以下特征: 上颌有 11 对以上牙齿, 最后一枚牙齿位置靠后, 位于眶前孔后下角的下方。翼掌骨长度大约为肱骨的 55%。凤凰翼龙的发现不但增加了船颌翼龙的新成员, 而且对船颌翼龙的古地理分布提供了重要信息。它代表目前为止最早的船颌翼龙类。为我们了解船颌翼龙的起源和演化具有重要意义。

关键词: 凤凰翼龙; 船颌翼龙类; 中侏罗世; 髫髻山组; 辽西
中图分类号: Q915.23; P915.86 文献标志码: A 文章编号: 1006-3021(2010)02-263-04

A New Scaphognathine Pterosaur from the Middle Jurassic of Western Liaoning, China

LÜ Jun-chang[1)], FUCHA Xiao-hui[2)], CHEN Jin-mei[3)]

1) *Institute of Geology, Chinese Academy of Geological Sciences, Beijing* 100037;
2) *Jehol Paleontological Museum, Chengde, Hebei* 067000;
3) *Western Liaoning Museum, Chaoyang, Liaoning* 122000

Abstract: A new scaphognathine pterosaur: *Fenghuangopterus lii* gen. et sp. nov. is erected based on an incomplete skeleton. It comes from the Middle Jurassic Tiaojishan Formation of the western Liaoning. It is characterized by more than 11 pairs of the upper jaw teeth, and the last tooth is located far posteriorly in the jaw, under the postoventral corner of the antorbital opening, metacarpal IV length is about 55% that of the humerus. The discovery of *Fenghuangopterus* not only adds a new member of scaphognathine pterosaurs, but also provides much more information on the paleogeographical distribution. It represents the earliest scaphognathine pterosaur known. It plays a key role in understanding the origin and evolution of scaphognathine pterosaurs.

Key words: *Fenghuangopterus*; scaphognathinae; Middle Jurassic; Tiaojishan Formation; western Liaoning

Compared with other pterosaurs, the scaphognathine pterosaurs are very rare. At present, only three genera of this subfamily are reported, they are: *Scaphognathus* (Goldfuss, 1831; Wagner, 1861), *Sordes* (Sharov, 1971), and *Harpactognathus* (Carpenter et al., 2003). Scaphognathinae was proposed by Holley (Hooley, 1913) to include *Scaphognathus* and *Parapsicephalus*. However, *Parapsicephalus*, which is remarkably similar to *Dorygnathus*, and quite possibly congeneric with it, does not share the diagnosis of Scapognathinae, thus it was excluded from the subfamily (Carpenter et al., 2003). Later, Wellnhofer added *Sordes* to the subfamily (Wellnhofer, 1978). Carpenter et al.(2003) erected a new genus of the Scaphognathinae-*Harpactognathus*, based on the general shape and propotions of the rostrum and distribution, position and orientation of the dental alveoli.

The first *Scaphognathus* specimen, which was discovered from the Solnhofen strata near Eichstätt, is one of the earliest pterosaur finds of all and was described by Goldfuss (Goldfuss, 1831). Because the

本文由自然基金项目(编号: 90914003)、973 项目(编号: 2006CB701405)和中国地质科学院地质研究所所长基金(编号: J0703)联合资助。
收稿日期: 2010-04-13; 改回日期: 2010-04-15。
第一作者简介: 吕君昌, 男, 1965 年生。副研究员。主要从事中生代爬行动物(尤其是恐龙类和翼龙类)及其地层的研究。通讯地址: 100037, 北京市西城区百万庄大街 26 号。电话: 010-68999707。E-mail: Lujc2008@126.com。

tail region is not preserved, Goldfuss mistook the specimen as a new *Pterodactylus* species: *P. crassirostris* (Wellnhofer, 1991). Following discovery of a specimen with a tail in Mühlheim,Wagner recognized the true relationships of "*P.*" *crassirostris* and named a distinct genus: *Scaphognathus* (Wagner, 1861).

All the reported pterosaurs of scaphognathinae were found from the Late Jurassic (Wellnhofer, 1991; Carpenter et al., 2003). Here we describe a new genus of Scaphognathinae from the Middle Jurassic Tiaojishan Formation of Jianchang County, western Liaoning Province (fig.1). It not only represents the second *Scaphognathus*-like pterosaur outside of Europe, but also extends its geological range from Upper Jurassic to the Middle Jurassic.

1 Systematic Paleontology

Pterosauria Kaup, 1834
Rhamphorhynchidae Seeley, 1870
Subfamily Scaphognathinae Hooley 1913
Fenghuangopterus gen. nov. (Fig. 2)

Etymology: Fenghuang refers to the Fenghuang Mountain, which is the famous buddha scenic spot in western Liaoning.

Diagnosis: As for the only species

Fenghuangopterus lii gen. et sp. nov.

Etymology: The specific name is honor of Li Xiumei, who offers the specimen for scientific study.

Holotype: An incomplete skeleton with a partial skull and lower jaws, housed at the Chaoyang Geopark (CYGB-0037), Chaoyang City of Liaoning Province.

Holotype locality and horizon: Linglengta, Jianchang of Liaoning Province; Middle Jurassic Tiaojishan Formation (Bureau of Geology and Mineral Resources of Liaoning Province, 1990).

Diagnosis: A scaphognathine pterosaur that differs from others in last tooth located more posteriorly, 11 pairs of upper teeth, and metacarpal IV length about 55% that of the humerus.

2 Description

The skeleton with an incomplete skull and lower is preserved (Fig.2, table 1). The skull is preserved in ventrolateral view. The vertebral column is exposed on its ventral surface.

The skull is not well-preserved. The braincase and most of the skull roof were damaged before burial. More than five broken teeth are preserved anterior to the rostral end of the skull. The quadrate is steeply oriented. The posterior process (jugal process) of the maxilla is deep, forming a part of the lower margin of the antorbital opening. Compared with the skull length, the lower margin of the antorbital opening is long, indicating a large antorbital fenestra. The teeth are peg–like and slightly curved with sharp tips, about 9mm long. The preserved teeth and tooth sockets indicate that there are about 11 teeth in each side of the upper jaw (Fig. 2B). The teeth are oriented vertically rather than horizontally. The teeth are widely spaced, similar to the case in other members of Scaphognathinae, but the distances between the fourth tooth to the seventh are less than these between other teeth. The last tooth is located far posteriorly, at the level of the posteroventral corner of the antorbital opening.

The mandibular symphysis is short. The dentary is deep and with an expanded distal end. The retroarticular is short. The number of dentary teeth is not clear due to the poor preservation.

There are 7 cervical vertebrae preserved. The cervical vertebrae are relatively short and they are nearly the same in size. The cervical vertebra bears a slender, long rib.

There are 13 dorsal vertebrae. They are smaller than cervical vertebrae. The anterior dorsal ribs are slender. The anterior three dorsal vertebrae are covered by the sternum. Three sacral vertebrae are preserved. The anterior portion of the caudal series is preserved. The caudal vertebrae are wrapped by a sheath of bony filaments composed of highly elongated ossified extensions of the zygapophyses and hypapophyses, as in *Rhamphorhynchus* (Wellnhofer, 1975; Wellnhofer, 1978).

The sternum is fan-shaped with convex distal margin. Two openings are present in the sternum, which is similar to that of *Scaphognsthus* (Wellnhofer, 1978).

The scapula and coracoid are fused. The coracoid is longer than the scapula. The scapula is elongate. The shaft of the coracoid is straight, whilst that of the scapula is curved. The coracoid bears a distinct process near its proximal end.

Humerus is well-preserved. The shaft of the humerus is straight. The deltopectoral crest is developed with an elongate rectangular profile. There is no distinct neck, unlike the case in *Rhamphorhynchus* (Wellnhofer, 1975). There is no pneumatic opening in the proximal portion of the humerus.

Most of the front limbs were strongly damaged before burial. They are weathered and preserved as fragments. The wing phalanges are especially poorly preserved. The distal ends of the ulna and radius are preserved. The preserved portions indicate that the diameters of both ulna and radius are the same. The carpals are not well preserved, and no detailed information can be obtained. Metacarpal IV is short, about 55% length of the humerus. Wing phalanx 1 is longer than wing phalanx 2.

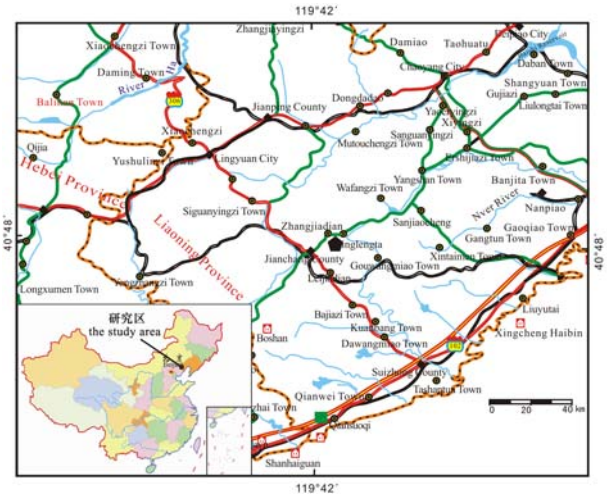

图 1　研究区及化石产地示意图。实心五角形代表化石产地

Fig. 1　The map of the research area and fossil locality. The solid pentagon represents the fossil site.

The pelvic girdle is not well-preserved. Although the femur and tibia are damaged, their lengths can be correctly measured. The length ratio of femur to tibia is 0.57. No information can be observed from the rest of the hindlimb.

3　Discussion and conclusion:

Fenghuangopterus gen. nov. is assigned to the subfamily Scaphognathinae based on the following characters: proportionately short skull with a blunter tip and a larger antorbital fenestra, wider spaced and vertically rather than horizontally oriented teeth (Wellnhofer, 1991; Carpenter et al., 2003; Unwin 2003).

Fenghuangopterus differs from *Scaphognathus* in its larger number of teeth, and the last tooth is located more distally than in *Scaphognathus* (Wellnhofer 1991).

图 2　正型标本李氏凤凰翼龙的照片**(A)**及头骨部分放大**(B)**。箭头所指为牙齿或齿槽。

简字缩写：cer. 颈椎椎体；co. 乌喙骨；h.，肱骨；sc. 肩胛骨；sk.头骨；ti.，胫骨。

Fig. 2　The photograph of the holotype *Fenghuangopterus lii* gen. et sp. nov. (CYGB-0037) (A) and the close up of the skull of *Fenghuangopterus lii* gen. et sp. nov. Arrows point to teeth or tooth sockets. Abbreviations: cer. Cervical vertebrae; co. coracoid; h., humerus; sc. scapula; sk. skull; ti., tibia.

表 1 李氏凤凰翼龙新属新种的数据测量

Table 1 Measurements (mm) of *Fenghuangopterus lii* gen. et sp. nov.

	Length	width
Skull	76.3	-
Ventral margin of the antorbital opening	12.3	-
Lower jaw	76	-
Cervicals (3-7)	85	-
Cervical 4	11	8
Dorsal-sacral	100	4 (single)
Coracoid	50	4
Scapula	40	4
Humerus	63	5
Ulna/radius	85	5/5
Metacarpal IV	35	5
Wing Phalanx 1/2/3	125/75/-	7/-
Femur	57	7
Tibia	100	5

Fenghuangopterus is difficult to compare with *Harpactognathus*, except for the tooth arrangements. The largest spacing among the teeth is between the 7th tooth and 8th tooth in *Fenghuangopterus*, whilst it is between the fourth and the fifth in *Scaphognathus* (Carpenter et al., 2003).

Fenghuangopterus is the second *Scaphognathus*-like pterosaur found outside of Europe. Although the specimen is not well-preserved, the tooth morphology and arrangements are similar to those of *Scaphognathus*. It is unequivocally assigned to the subfamily Scaphognathinae. The discovery of *Fenghuangopterus* from the Middle Jurassic of China indicates that scaphognathine pterosaurs are widely distributed, and it represents the oldest scaphognathine found to date. The higher tooth count of *Fenghuangopterus* versus other scaphognathines suggests that it represents a primitive form.

Many kinds of pterosaurs found from the same horizon as *Fenghuangopterus*, such as *Changchengopterus* (Lü, 2009) or from the same locality, such as large numbers of *Darwinopterus* (Lü et al., 2010), which is represented by more than 20 individuals, indicates that great potential diversity and abundance of pterosaurs exists in the Middle Jurassic of western Liaoning and its surrounding areas.

Acknowledgements: The first author thanks to Dr. Dale Winkler (Southern Methodist University, Dallas, TX, USA) for reviewing the first draft of the manuscript and made constructive suggestions. The specimen was prepared by Zhang Y-Q of Institute of Geology, CAGS. This research was supported by grants from the Natural Science Foundation of China (90914003), the 973 Project (2006CB701405) and the Basic Outlay of Scientific Research Work from the Ministry of Science and Technology (J0703).

References:

BUREAU of Geology and Mineral Resources of Liaoning Province. 1990. Regional Geology of Liaoning Province[M]. Beijing: Geological Publishing House.

CARPENTER K, UNWIN D, CLOWARD K, MILES C, and MILES C. 2003. A new scaphognathine pterosaur from the Upper Jurassic Morrison Formation of Wyoming, USA[J]. In BUFFETAUT, E., and MAZIN, J.-M.(eds.), Evolution and Palaeobiology of Pterosaurs, Geological Society Special Publication, 217: 45-54.

GOLDFUSS G A. 1831. Beiträge zur Kenntnis verschiedener Reptilien der Vorwelt. I. Reptilien aus dem lithographischen Schiefer[J]. Nova Acta Phys. Med. k. Leopold.-Carol. Inst. Akad. Naturf, 15 (1): 61-128.

HOOLEY R W. 1913. On the skeleton of Ornithodesmus latidens: an Ornithosaur from the Wealden shale of Atherfield (Isle of Wight)[J]. The Quarterly Journal of the Geological Society, 69: 372-422.

KAUP J J. 1834. Versuch einer Eintheilung der Saugethiere in 6 Stämme und der Amphibien in 6 Ordnungen [J]. *Isis*, 3: 311-315.

LÜ J. 2009. A new non-pterodactyloid pterosaur from Qinglong County, Hebei Province of China[J]. Acta Geologica Sinica, 83(2): 189-199.

LÜ J, UNWIN D M, JIN X, LIU Y and JI Q. 2010. Evidence for modular evolution in a long-tailed pterosaur with a pterodactyloid skull[J]. Proceedings of the Royal Society B, 227: 383-389.

SEELEY H G. 1870. The Ornithosauria: an elementary study of the bones of pterodactyls [J]. Proceedings of the Cambridge Philosophical Society, 2: 186.

SHAROV A G. 1971. New flying reptiles from the Mesozoic of Kazakhstan and Kirghizia[J]. Akademia Nauk, Paleontological Institute Trudy, 130: 104-113 (in Russia).

UNWIN D M. 2003. On the phylogeny and evolutionary history of pterosaurs [J]. In BUFFETAUT E. and MAZIN J.-M.(eds.). Evolution and Palaeobiology of Pterosaurs[M]. Geological Society Special Publication, 217: 139-190.

WAGNER J A. 1861. Neue Beiträge zur Kenntnis der urweltlichen Fauna des lithographischen Schiefers. 2. Abt. Schildkröten und Saurier[J]. Abh. k. bayer. Akad. Wiss. math.-phys, 9: 67-124.

WELLNHOFER P.1975. Die Rhamphorhynchoidea (Pterosauria) der Oberjura-Plattenkalke Süddeutschlands. Teil I. Allgemeine Skelletmorphologie[J]. Paläontographica Abt. A, 148: 1-33.

WELLNHOFER P. 1978. Handbuch der Paläoherpetologie. Pterosauria, 19: 1-87.

WELLNHOFER P. 1991. The Illustrated Encyclopedia of Pterosaurs [M]. Salamander, 1-192.