第46卷 第2期
2008年4月

古脊椎动物学报
VERTEBRATA PALASIATICA

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简报

中国西部准噶尔盆地侏罗纪石树沟组的巨型兽脚类恐龙[1)]

徐 星[1] 詹姆斯·克拉克[2]

（1 中国科学院古脊椎动物与古人类研究所 北京 100044）

（2 美国乔治·华盛顿大学生物科学系 华盛顿特区 20052）

摘要：中国西部准噶尔盆地东北缘中侏罗世晚期到晚侏罗世早期沉积的石树沟组（Eberth et al., 2001）产出过巨型的蜥脚类恐龙化石（Russell and Zheng, 1993），但产出的兽脚类恐龙个体则相对较小（Currie and Zhao, 1993）。我们近年来在石树沟组中采集到大量脊椎动物化石（Clark et al., 2006），其中包括许多零散的骨骼和牙齿标本。本文报道一个产自石树沟组上部的兽脚类牙齿化石（IVPP V 15310），对于全面了解石树沟脊椎动物群具有一定意义。

V 15310保存了一个近乎完整的上颌齿或下颌齿的齿冠。它具有典型兽脚类恐龙牙齿的特征：强烈侧扁，向后弯曲，前后缘有锯齿。齿冠有几种不同的磨蚀面：齿尖磨蚀成近圆形，靠近齿尖的齿冠前缘有一较大的平的磨蚀面，锯齿也受到不同程度的磨蚀。V 15310很大，相关的测量数据和一些白垩纪的巨型兽脚类恐龙牙齿的测量数据相近。依据我们定义的一个定量评估锯齿大小的指标（锯齿大小指数），得出V 15310的锯齿大小指数非常小，与霸王龙相似，这与锯齿和齿冠大小具有反比关系的结论是一致的（Farlow et al, 1991）。V 15310的另外一些形态特征对于推断它在兽脚类中的系统位置也提供了帮助。这些特征包括后缘锯齿明显高于前缘锯齿以及齿冠的唇侧和舌侧都有微弱的釉质褶皱。根据牙齿大小、釉质褶皱的发育程度以及锯齿的形态（Sereno et al., 1996; Chure et al., 1999; Holtz, 2004），V 15310被归入中国盗龙类。其中，后缘锯齿和前缘锯齿的基部长度近似，但前者明显高于后者这一特征组合可能是中国盗龙类的一个鉴定特征。这一特征组合也见于四川的中国盗龙类。相比而言，V 15310在已报道的侏罗纪兽脚类恐龙牙齿中尺寸最大（Smith, 2005; Smith et al., 2005），大小接近白垩纪的一些巨型兽脚类恐龙牙齿。新材料的发现表明兽脚类至少在晚侏罗世早期就已演化出了这种巨型体型。

关键词：准噶尔盆地，中晚侏罗世，石树沟组，兽脚类恐龙，牙齿

中图法分类号：Q915.864 **文献标识码**：A **文章编号**：1000－3118（2008）02－0157－04

1）中国科学院百人计划及院长基金项目，国家自然科学基金项目（编号：40310178、40125006）和美国国家科学基金项目资助。

收稿日期：2008－01－15

THE PRESENCE OF A GIGANTIC THEROPOD IN THE JURASSIC SHISHUGOU FORMATION, JUNGGAR BASIN, WESTERN CHINA

XU Xing[1] James M. CLARK[2]
(1 *Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences* Beijing 100044 xuxing@ivpp.ac.cn)
(2 *Department of Biological Sciences, George Washington University* Washington, DC 20052, USA)

Key words Junggar Basin, Mid-Late Jurassic, Shishugou Formation, theropod, tooth

The Shishugou Formation of the northeastern Junggar Basin, Xinjiang Uygur Autonomous Region, China was deposited during the late Middle Jurassic through early Late Jurassic (Eberth et al., 2001). The giant sauropod *Mamenchisaurus sinocanadorum* (Russell and Zheng, 1993) is known from the formation, but the largest theropod known is the relatively small *Sinraptor dongi* (Currie and Zhao, 1993), with an estimated body length of 7.2 meters. Our expeditions from 2001 through 2007 in this formation resulted in the discoveries of many articulated skeletons and many isolated elements as well (Clark et al., 2006). Here we report an isolated large theropod tooth collected from the upper part of the formation at the Wucaiwan locality in the Junggar Basin. This isolated tooth was preserved within a partial sauropod skeleton, which might have been a prey of the bearer of the tooth. The dental description terms follow Smith et al. (2005).

V 15310 is possibly a shed crown of a lateral tooth as a root is absent and a depression appears to be present at the base of the crown which might indicate the presence of a resorption pit. Like a typical theropod tooth crown, it is strongly compressed mediolaterally, curved posteriorly, and finely denticulated along the mesial and distal carinae (Fig. 1A)

V 15310 is large in size. The apical length (AL) and crown height (CH) of the preserved tooth crown are 102 mm and 92 mm, respectively; the crown base length (CBL) and crown base width (CBW) are 35 and 18 mm, respectively; the crown base ratio (CBR) and crown height ratio (CHR) are 0.51 and 2.63, respectively. The tooth crown is much thicker labiolingually close to the mesial margin than to the distal margin and basally than apically; the lingual surface is much more convex mesiodistally than the labial surface.

Both the mesial and distal carinae are well developed (Fig. 1B, C). The mesial carina is slightly displaced onto the lingual surface apically. Small denticles are present along both carinae. The denticulated carina is 83 mm long along the distal margin and appears to be slightly shorter (80 mm long) along the mesial margin. The denticles are variable in size both between and along the carinae. The denticles are robust, with the labiolingual width of their basal sections much greater than either their length or height. The middle denticles are slightly longer than the apical ones (0.57 and 0.49 mm in basal length, respectively, along the distal carina), and the latter longer than the basal ones (0.44 mm). An individual denticle is small relative to the tooth size. DSI (Denticle Size Index; defined as a ratio of denticle basal length against CH times 1000) is used to describe the relative size of denticles. DSI for the middle denticles along the distal carina of V 15310 is about 6, comparable to that in a similar-sized *Tyrannosaurus* tooth (about 7). It is about 20 in a *Sinraptor* tooth of 35 mm in CH. Denticle size is negatively correlated with the dental crown size among theropods and larger teeth normally bear smaller denticles (Farlow et al., 1991). The denticles along the distal carina are slender in labial or lingual view, being much higher than long (the basal ones are nearly twice as high as long, the middle ones about one-fourth higher than long, and the apical ones intermediate in proportions). They are slightly curved toward the crown tip, the apical ones more so than the basal ones. The apical ones are, however, more symmetrical than the basal ones in having a bluntly rounded tip whereas in the latter the more pointed tips curve slightly toward the crown

tip. The inter-denticle notch (or slit) is shallow between the apical denticles but deep between the basal denticles (one-third the denticle height). Blood grooves are restricted between the adjacent denticles, with little extension onto the crown surface. The denticles along the mesial carina are similar in most features to the ones along the distal carina; a few differences exist, however. They are proportionally shorter (about as high as long) and thus look more robust than the denticles along the distal carina. Also unlike the latter, which are chisel-like with the base smoothly continuing onto the crown surface, the mesial denticles are somewhat bulbous basally.

Weak enamel wrinkles are present on both the labial and lingual surfaces. The wrinkle rows are close and parallel to the denticles, and they are more developed close to the mesial carina than the distal carina. The wrinkles are arcuate, each about 4 mm long, and sweep slightly down and away from the carinae.

Wear is present in several forms. The enamel is worn away around the tip, producing a slightly round tip. The wear facet along the mesial carina is large, extends from the tip a length of about 10 mm, and is relatively flat basally. Some denticles along both mesial and distal carinae are abraded. The apical denticles are more heavily abraded than the more basal ones and the denticles along the mesial carina are abraded more than along the distal carina.

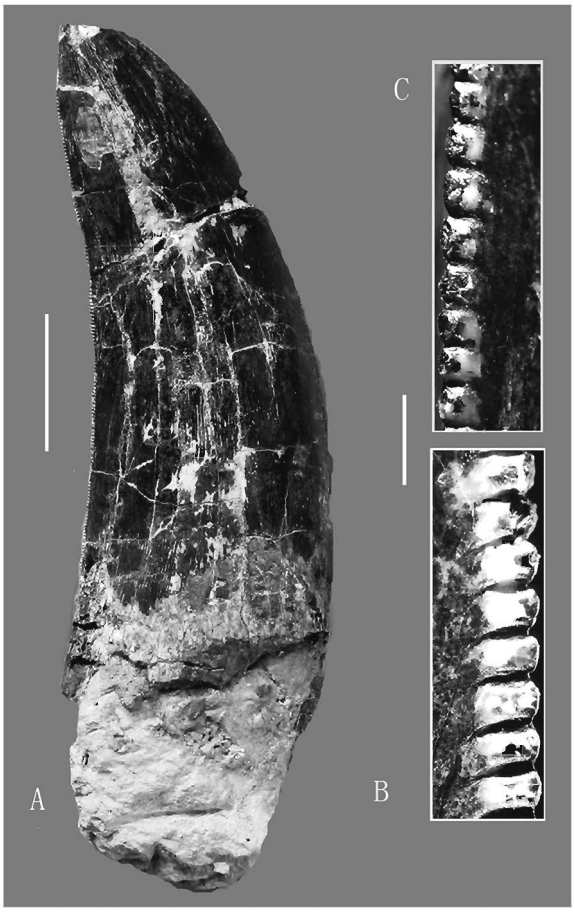

图 1　准噶尔盆地石树沟组的巨型兽脚类恐龙牙齿(IVPP V 15310)

Fig. 1　A gigantic theropod tooth from the Shishugou Formation of Junggar Basin (IVPP V 15310)

A. 唇侧视 labial view; B. 齿冠中部后缘舌侧近视 close-up of middle section of distal carina in lingual view; C. 齿冠中部前缘舌侧近视 close-up of middle section of mesial carina in lingual view; 比例尺 scale bar: A = 20 mm, B and C = 1 mm.

Several dental features are useful for inferring the affinities of V 15310. Enamel wrinkles have been reported in *Carcharodontosaurus* (Sereno et al., 1996), *Giganotosaurus*, some large tyrannosauroid teeth (Holtz, 2004), and isolated teeth from the Late Cretaceous of Japan and Brazil, respectively (Chure et al., 1999). They are also present in *Sinraptor*, though extremely weakly developed. In *Carcharodontosaurus*, *Gigantosaurus* and *Sinraptor* enamel wrinkles are across the crown surface; in tyrannosauroids and the isolated teeth from Japan and Brazil, enamel wrinkles are restricted to the mesial and/or distal margins. V 15310 is similar to the latter group, though more weakly developed. The distal denticles are significantly higher than the mesial denticles in V 15310, a feature known in some dromaeosaurids, basal tyrannosauroids, *Sinraptor*, and *Yangchuanosaurus*, but V 15310 is more similar to *Sinraptor* and *Yangchuanosaurus* in that the mesial denticles are about as long as the distal ones. It is likely that V 15310 is a gigantic sinraptorid, either a

taxon assignable or closely related to *Yangchuanosaurus magnus*, the longest tooth of which is 75 mm long in AL (Dong et al., 1983) or an old individual of *Sinraptor*. If the latter is true, *Sinraptor* might have an indeterminate growth strategy because the much smaller *Sinraptor* holotype is an adult individual (Currie and Zhao, 1993).

The most conspicuous feature is the large size of V 15310. Among the known theropod taxa (Smith, 2005; Smith et al., 2005), only *Tyrannosaurus*, *Carcharodontosaurus*, *Acrocanthosaurus* and probably *Giganotosaurus* have a maximum CBL subequal to or larger than that of V 15310; *Tyrannosaurus*, *Acrocanthosaurus*, *Suchomimus*, *Gorgosaurus and Daspletosaurus* have a maximum CBW subequal to or larger than that of V 15310; *Tyrannosaurus*, *Carcharodontosaurus* and probably *Gigantosaurus* have a maximum CH subequal to or larger than that of V 15310; and only *Tyrannosaurus* has a maximum AL subequal to or larger than that of V 15310. V 15310 is the largest known theropod tooth reported to date from Jurassic sediments. The discovery of V 15310 from the Shishugou Formation suggests that theropods evolved gigantic size as early as the early Late Jurassic, possibly co-evolving with large herbivorous dinosaurs such as mamenchisaurs that are common in this formation.

Acknowledgements The authors thank G. B. Wei for providing information on Sichuan theropods, X. Y. Zhang for photographing, L. S. Xiang and X. Q. Ding for preparing the specimen, and members of the Sino-American expedition team for collecting the fossil. This study is supported by the National Natural Science Foundation of China, the National Science Foundation Division of Earth Sciences, George Washington University, and the Chinese Academy of Sciences.

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