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On the taxonomy of *Xinpusaurus* (Reptilia: Thalattosauria)

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Abstract After examining the holotypes and the referred specimens of three species of *Xinpusaurus*, I conclude that the snout and the shape of the dentary cannot be used to differentiate the known species of *Xinpusaurus* and that the postcranial diagnostic characters of *X. kohi* cannot be confirmed because of the poor preservation; so both *X. bamaolinensis* and *X. kohi* should be junior synonyms of *X. suni*. The anatomy of the braincase of this taxon is further clarified.

Key words Guanling, Guizhou; Triassic; Thalattosauria

1 Introduction

Xinpusaurus is one of the most common reptiles of Guanling Biota. The genotype species is *Xinpusaurus suni* Yin, 2000, originally based on four specimens of Yin, in Yin et al. (2000:pls. VII, VIII). An isolated skull, referred to *Xinpusaurus* cf. *X. suni*, was described by Liu and Rieppel (2001). The second species, *Xinpusaurus bamaolinensis* Cheng, 2003, was named based on a well-preserved skull with the mandible. The most striking difference between the two species is the extensive overbite of the premaxillary rostrum in *X. bamaolinensis*, i.e., the rostrum is longer than the rest of the skull, with the premaxilla extending anteriorly far beyond the dentary. Jiang et al. (2004) described another species, *Xinpusaurus kohi*, based on a skeleton, which was regarded as a subjective junior synonym of *X. bamaolinensis* (Rieppel and Liu, 2006). Here, further examination of the relevant specimens clearly indicates that both *Xinpusaurus bamaolinensis* and *X. kohi* are the junior synonyms of *X. suni*.

Institutional abbreviations GMPKU, Geological Museum of Peking University, Beijing, China; Gmr, GGSr, collections at the Geological Survey of Guizhou, Guiyang, China; IVPP V, Vertebrate fossil specimen of the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China; SPCV, Yichang Institute of Geology and Mineral Resources, now Wuhan Institute of Geology and Mineral Resources, Wuhan, Hubei, China.

Examined specimens Gmr 010 (holotype of *Xinpusaurus suni*), an almost complete

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Fig. 1 The holotype of *Xinpusaurus suni*, Gmr 010, in left lateral view

skeleton with laterally exposed skull and lower jaw (Fig. 1); GGSr 001, a well-preserved skull with partially postcranial skeleton, now housed at Guizhou Palaeontological fossil Museum (Luo and Yu, 2002); GMPKU 2000/005 (holotype of *Xinpusaurus kohi*), an incomplete skeleton; IVPP V 11860, an isolated skull (Liu and Rieppel, 2001); IVPP V 12673, partially skeleton (Liu, 2001); IVPP V 14372, an isolated skull (Rieppel and Liu, 2006); SPCV 30015 (holotype of *Xinpusaurus bamaolinensis*), a partial skeleton with well-preserved skull and lower jaws.

The holotype and the original referred specimens of *Xinpusaurus suni* are Gmr 010, 011, 012 and 013. All these specimens have not been accessible to other researchers, the description was based on Gmr 010 that did not receive a proper preparation.

2 Comments on some osteological features of *Xinpusaurus*

2.1 Snout

Xinpusaurus bamaolinensis and *X. kohi* were differentiated from *X. suni* mainly by the long snout that overhangs the lower jaw. However, the overbite of the premaxillary rostrum could be a common feature of all specimens of *Xinpusaurus*. The tip of the snout is not completely preserved in most specimens except SPCV 30015, Gmr 010, Gmr 011, and GGSr 001. The snout relative to the skull is the largest in SPCV 30015 among the available specimens (Table 1), but it is only slightly larger than that of GGSr 001, the latter missing its anterior tip. It seems that the snout is relatively longer in smaller specimens and varies in length in specimens. Therefore, the relative size of the snout cannot be used as a good diagnostic character.

Table 1 Measurements of some skulls of *Xinpusaurus* (mm)

Specimen number	Skull length	Snout length	Ratio (%)
Gmr 011	>170	>96	>56
GMPKU 2000/005	196	116	59
GGSr 001	250	>138	>55
SPCV 30015	252	156	62
Gmr 010	340	185	54

Note: skull length: distance from tip of snout to posterior tip of supratemporal; snout length: distance from tip of snout to anterior margin of orbit; ratio: snout length/skull length.

2.2 Quadrate

The quadrate is a massive element in *Xinpusaurus*. It was figured and described in IVPP V 11860 and V 14372 (Liu and Rieppel, 2001; Rieppel and Liu, 2006). The epipterygoid was misidentified in V 14372 (Rieppel and Liu, 2006: fig. 2B); this element is broad and rod-like as in most tetrapods. It is actually the left quadrate in posteromedial view, with a lateral flange from the shaft. A bone with same shape is preserved in the similar position of the left side in V 11860 (Fig. 2A), which should be the left quadrate but was originally misidentified as a part of the prootic (Liu and Rieppel, 2001).

2.3 Braincase

The braincase is poorly known in thalattosaurs except some specimens of *Xinpusaurus*, the latter provides a chance to detail the structure. Although the braincase of *Xinpusaurus* was described previously (Liu and Rieppel, 2001; Rieppel and Liu, 2006), some new anatomical information can be added. The prootic is poorly exposed in most specimens, and the description is mostly based on IVPP V 11860 and V 14372. The anterodorsally projecting alar process of the prootic and the trigeminal recess were identified by Rieppel and Liu (2006). However, the position of the trigeminal recess should be the notch on the dorsal side (Fig. 2B) rather than the one in their figure 2A, in which the position was identified based on the braincase of *Anshunsaurus wushaensis* (Rieppel et al., 2006). The anterior portion of the prootic is partially defiladed by the quadrate in V 11860, but the posterior portion is well exposed. The crista prootica runs anteroventrally from the point near the distal end of the paroccipital process, possibly covers the middle portion of the quadrate in this specimen. Running ventrally to the crest is a deep groove for head-vein. Posterior to the groove and at the

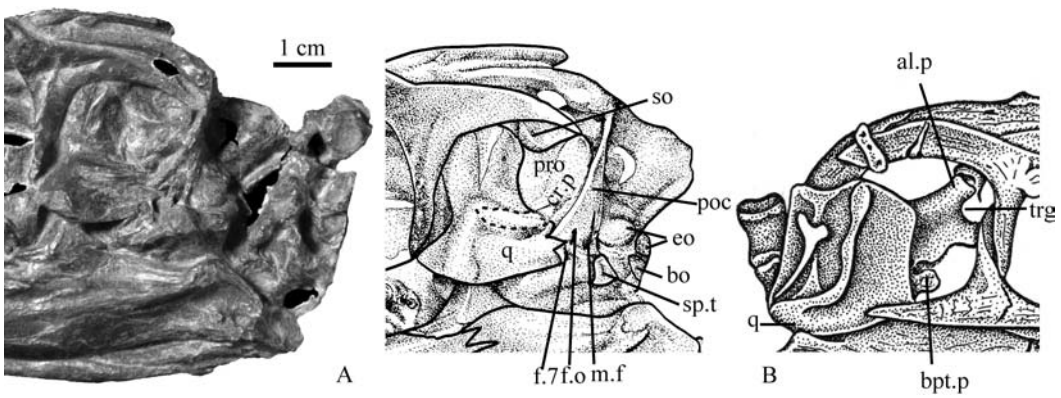

Fig. 2 The posterior part of the skull of *Xinpusaurus suni*, showing the braincase
A. IVPP V 11860; B. V 14372 in right lateral view
Abbreviations: al.p. alar process of prootic前耳骨翼突; bo. basioccipital基枕骨; bpt.p. basipterygoid process 基翼骨突; cr.p. crista prootica前耳骨脊; eo. exoccipital外枕骨; f.7. foramen for facial nerve面神经孔; f.o. fenestra ovalis椭圆孔; m.f. metotic fissure; poc. paroccipital process副枕骨突; pro. prootic前耳骨; q. quadrate方骨; so. supraoccipital上枕骨; sp.t. sphenoccipital tubercle (=basal tubercle)蝶枕骨结节; trg. trigeminal recess三叉神经窝

proximal end of the paroccipital process lie two foramina, the anterior one being the fenestra ovalis and the posterior (large) one being metotic fissure. Anteroventrally lies an opening on the prootic, possibly for the facial nerve. The paroccipital process derived from the opisthotic is fused with the exoccipital. The posterior side of the braincase is well exposed in V 14372 and was fully documented by Rieppel and Liu (2006).

2.4 Dentary

The dentary is explained as a long bone extending to the coronoid process on lateral surface in the first description of the skull morphology of *Xinpusaurs* based on V 11860 (Liu and Rieppel, 2001) and this explanation was held in Rieppel and Liu (2006: fig. 3). In contrast, the dentary extends posteriorly close to level opposite to the anterior margin of the orbit in Gmr 010 and GGSr 001 (Luo and Yu, 2002), V 14372, and the holotypes of *X. kohi* and *X. bamaolinensis*. Our reexamining specimen V 11860 shows that the suture between the dentary and the surangular was misidentified in the previous study; it actually reaches dorsally to level opposite to the anterior margin of the orbit as in the aformetioned specimens and then extends anteroventrally.

In the know specimens of *Xinpusaurus*, two types of the dentary-surangular suture pattern were documented: Type I, the V-shaped pattern, with the posterodorsal and posteroventral processes of the dentary bracketing the anterior tip of the surangular; Type II, the oblique pattern with the anterior portion of the surangular extending anteroventrally to underlie the dentary. Type I was seen in Gmr 010 (Luo and Yu, 2002: fig. 1) and GMPKU 2000/005 (Jiang et al., 2004: fig. 3), Type II was seen in V 14372 (Rieppel and Liu, 2006: fig. 2) and SPCV 30015 (Cheng, 2003: fig. 1). These two types of the sutural pattern are also present in the clade Thalattosauridea, for example: Type I in *Clarazia schinzi* (Rieppel, 1987), Type II in *Thlattosaurus alexandrae* (Nicholls, 1999). However, Type I in known specimens of *Xinpusaurus* could be resulted from the preservation bias or misidentification. In well-preserved specimens, only Type II is observed, which include V 11860, V 14372, and GGSr 001. In some specimens with Type II, such as V 11860, and V 12673, the dentary is thickened anteriorly to the suture, and that part is of the similar shape to Type I and could be, at the matter of fact, the place of the dentary-surangular suture. Moreover, GMPKU 2000/005 is poorly preserved for this part and the original description of the dentary morphology is equivocal.

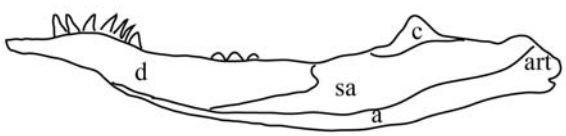

Fig. 3 Reconstruction of the left lower jaw of *Xinpusaurus suni* in lateral view, showing the shape of the dentary
Abbreviations: a. angular隅骨; art. articular关节骨; c. coronoid冠状骨; d. dentary齿骨; sa. surangular上隅骨

In conclusion, the dentary is similar in shape for all the known specimens of *Xinpusaurus* where the bone is well-preserved. Its posterior portion with a rather curved posterior margin is ventrally narrowed and underlain by the anterior process of the surangular as shown in the reconstruction (Fig. 3).

2.5 Postcranial skeleton

The holotype of *Xinpusaurus suni* (Gmr 010) has a nearly complete skeleton although it has not been formally described (Fig. 1). The partial skeleton of V 12673 is the only well prepared and described specimen of *X. suni* (Liu, 2001). The postcranial anatomy of *X. suni* is mainly known from V 12673.

The holotype (SPVC 30015) is the only specimen of *X. bamaolinensis*, including a nearly complete postcranial skeleton which consists of two parts. The posterior part of the slab is not naturally connected with the anterior part of the slab and will not be used here because it may not belong to the same individual. This specimen shows that the vertebrae are exposed in lateral view; the scapula, clavicle, humerus and radius on the left side are also exposed. They show no difference with corresponding bones of V 12673, such as short neck, proximal end of humerus being wider than distal end, and kidney-shaped radius.

Jiang et al. (2004) proposed the following postcranial diagnosis for *X. kohi*: "neural spines of cervical vertebrae wider and more closely spaced; only 35 presacral vertebrae at maximum; scapula much larger than humerus; radius with distinct anteroproximal notch; carpus well ossified; femur with narrow proximal end; fibula slightly wider than long; tarsus completely ossified with two proximal and at least four distal tarsals; metatarsals two to five of similar length; stylo- and zeugopodial portion of hindlimb only about 10% larger than forefin."

The holotype and only specimen of *X. kohi*, GMPKU 2000/005, includes the postcranial skeleton. However, the postcranial skeleton is not completely articulated as alleged in the original paper. It is obvious that the posterior portion (behind the calcite "vein") does not match the anterior portion and cannot be safely referred to the same individual as the skull. Even if all parts belong to same individual, some bones including those vertebrae just anterior to the pelvis are missing. When the author examined the specimen, a piece of the specimen had lost, and the scapula was incomplete. Some alleged diagnoses were based on the poorly preserved bones and their conclusion cannot be verified. The radius and the femur are incomplete in proximal end. The tibia and fibula are incomplete and hard to recover their original shapes. They described and drew the pes (Jiang et al., 2004:fig. 3C) but I did not see those bones.

X. suni has at least 40 presacrals, including a short neck, and around 100 caudals (Yin et al., 2000). These numbers are unknown in SPCV 30015 and GMPKU 2000/005. The neural spines of cervical vertebrae are relatively slightly wider in GMPKU 2000/005. This can be explained by ontogenetic change. The closely spaced status is doubtful for poor preservation. Even it was true, this difference could be caused by the different ways of preservation.

The scapula is slender, with a distinctly constricting middle portion, and shorter than the humerus in *X. suni*. The alleged scapula in GMPKU 2000/005 is actually the scapula plus coracoid based on the shape of the bone from their photo and drawing. Two carpals and many tarsals were described, but the identification of the carpals is not convincing because of the poor condition of this area. Even if the ossified capals were really present in GMPKU

2000/005, the absence of these bones in *X. suni* needs to be confirmed by more specimens.

The hind limb is poorly preserved, none of the femur, the tibia, and the fibula is complete, and only impression is available for most distal elements. If their identification on the tarsus is correct, the distinct difference between known specimens may indicate that the posterior part of the slab of GMPKU 2000/005 may not belong to *Xinpusaurus*. The relative size of the stylo- and zeugopodial portion of the hindlimb to those of the forelimb cannot be compared in GMPKU 2000/005 because the posterior part of the slab likely represents an additional individual.

3 Conclusion

As the aforementioned comparison, *X. bamaolinensis* and *X. kohi* cannot be differentiated from *X. suni* based on the known specimens, and currently only the type species of *Xinpusaurus* is valid. The relative length of the snout varies with growth, and possibly decreases ontogenetically.

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新铺龙(爬行纲: 海龙目)的分类

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摘要：比较了已经描述的新铺龙(*Xinpusaurus*)的三个种，确定以往确立的种间鉴别特征是无效的。吻部比例以及齿骨形态都不能用来区分它们，戈氏种(*X. kohi*)的头后骨骼鉴别特征基础不牢，大多因标本保存欠佳不能明确其有效性。因此，建议废除巴毛林种(*X. bamaolinensis*)以及戈氏种，新铺龙属仅保留属型种——孙氏新铺龙(*X. suni*)——为有效种。文中还进一步阐明了本属种脑颅的形态。

关键词：贵州关岭，三叠纪，海龙

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References

Cheng L(程龙), 2003. A new species of Triassic Thalattosauria from Guanling, Guizhou. Geol Bull China(地质学报), **22**: 274–277(in Chinese)

Jiang D Y, Maisch M W, Sun Y L et al., 2004. A new species of *Xinpusaurus* (Thalattosauria) from the Upper Triassic of

China. J Vert Paleont, **24**: 80–88

Liu J, 2001. Postcranial skeletou of *Xinpusaurus*. In: Deng T, Wang Y eds. Proceedings of the Eighth Aunllal Meeting of the Chinese Society of Vertebrate Palaeoutology. Beijing: China Ocean Press. 1–7

Liu J(刘俊), Rieppel O, 2001. The second thalattosaur from the Triassic of Guizhou, China. Vert PalAsiat(古脊椎动物学报), **39**(2): 77–87

Luo Y M(罗永明), Yu Y Y(喻羌义), 2002. The restudy of the skull and mandible of *Xinpusaurus suni*. Guizhou Geol(贵州地质), **19**: 71–76(in Chinese)

Nicholls E L, 1999. A reexamination of *Thalattosaurus* and *Nectosaurus* and the relationships of the Thalattosauria (Reptilia: Diapsida). PaleoBios, **19**: 1–29

Rieppel O, 1987. *Clarazia* and *Hescheleria*, a re-investigation of two problematical reptiles from the Middle Triassic of Monte San Giorgio, Switzerland. Palaeontogr Abt A, **195**: 101–129

Rieppel O, Liu J, 2006. On *Xinpusaurus* (Reptilia: Thalattosauria). J Vert Paleont, **26**: 200–204

Rieppel O, Liu J, Li C, 2006. A new species of the thalattosaur genus *Anshunsaurus* (Reptilia: Thalattosauria) from the Middle Triassic of Guizhou Province, southwestern China. Vert PalAsiat(古脊椎动物学报), **44**(4): 285–296

Yin G Z(尹恭正), Zhou X G(周修高), Cao Z T(曹泽田), 2000. A preliminary study on the early Late Triassic marine reptiles from Guanlig, Guizhou. Geol Geochem(地质地球化学), **28**: 1–23(in Chinese)