

第四纪响蜥 (*Tinosaurus*) 化石的首次发现¹⁾

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摘要 在陕西洛南张坪洞穴的第四系中采得一些响蜥类 (*Tinosaurus*) 化石, 有保存相当完好的上下齿骨和齿列, 这是响蜥在第四纪的首次报道, 使该属化石的地史分布从早第三纪延伸到第四纪。新材料下颌骨较粗壮, 但个体很小, 有齿间沟, 同时兼具亚洲种及北美种的某些特征, 因此建立一新种 *Tinosaurus luonanensis* sp. nov.。

关键词 陕西洛南, 第四纪, 蜥蜴类, 响蜥

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1999年暑假, 西北大学地质系新生代地质与环境研究所对陕西洛南县张坪洞穴群进行了考察与标本样品采集, 获得了一些脊椎动物化石及石制品。本文仅对其中的部分爬行类标本进行初步记述。

有鳞目 Squamata

蜥蜴亚目 Lacertilia

避役科 Chameleontidae Gray, 1825

响蜥属 *Tinosaurus* Marsh, 1872

洛南响蜥 *Tinosaurus luonanensis* sp. nov.

(图 1, 2)

正型标本 同一个体的右上颌和左下颌。右上颌带 12 颗牙齿 (西北大学古脊椎动物化石编号 NWUV1134.1); 左下颌带 11 颗牙齿 (NWUV1134.2)。

归入材料 右上颌、右下颌各一块, 左下颌两块 (NWUV1135 ~ 1136, NWUV1137, NWUV1138)。

地点与层位 陕西洛南县张坪; 第四纪 (早更新世中晚期?)。

种名 Luonan, 洛南, 化石产地所在县名。

特征 异齿系, 前部牙齿端生, 锥状; 后部牙齿亚端生, 侧扁, 具三裂片的花瓣形, 中央主尖大, 两侧尖较小; 颊齿从后向前逐渐变小, 前端靠近前部锥状齿的部位牙齿发育最弱, 甚或缺失。上颌骨在鼻孔后壁向上突起最高, 后部较为平缓; 下颌骨较粗壮, 外侧视可见明显的齿间沟。

描述 正模的上颌骨 (图 1, a, b) 长 8.13mm, 最大高度 2.31mm。上颌骨前端增宽, 成为鼻腔的下壁, 其前边与前颌骨愈合, 在前部锥形齿的齿根部位略微向上突起。上颌骨上缘在与鼻骨和前颌骨夹角处达到最高, 然后垂直下降, 再向后平缓延伸。

上颌骨上共有 12 颗牙齿, 齿列长 7.0mm; 内侧视最后一颗牙齿最大宽 0.68mm, 最大

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高 0.87mm。前部两个锥形齿略向前内横排,合计长度 1.06mm。后部为 10 颗侧扁的三尖状齿,合计长度 5.87mm。三尖状齿的三个尖前后一字形排列,中央主尖高大,前后两个侧尖小。前部锥形齿与后部三尖状齿之间有齿缺存在,齿缺长 0.63mm,齿缺部位牙床明显上凹;外侧看齿缺的后上方有两个神经孔呈前后排列。

正模的下颌骨(图 1,c,d)长 8.17mm,高(最后一颗牙之下的颌骨高)1.5mm,齿骨后端残破,与其他骨片的关系不甚清楚,但齿骨的其他部分保存得比较完整。下颌骨前端小,略向前内弯翘;外侧有 5 个神经孔;齿骨后边的冠状骨、隅骨未见到,但似有隅骨的切迹存在,隅骨狭长;上隅骨似应有残存,但未见其结合线而无法分辨。下颌骨内侧麦氏沟裸露,前部细长,向后逐渐宽阔;夹板骨缺失;下颌骨下缘略为下拱。

下颌上共有 11 颗牙齿,齿列长 6.3mm;牙齿突出齿缘 0.3~0.5mm,内侧视下颌最后一颗牙齿最大宽 0.67mm,最大高 0.92mm。前部只有第 2 颗牙齿保存,锥形端生,第 1、3、4 颗牙齿缺失(在 NWUV1137 标本上,前部 4 颗牙齿保存完好,其形态与上颌(NWUV1134.1)的前部牙齿相似,呈锥形,端生;其中第 4 颗牙较前 3 颗略大,且延伸方向也不尽相同:它略向后斜伸,而前 3 颗则略向前斜伸)。后部的 10 颗颊齿总

长约 5.50mm,亚端生,侧扁,具三尖,三个尖呈三裂片的花瓣状,中央尖高大,前后两侧尖较小,侧小尖与大的中央尖之间有一小沟;牙齿由前向后逐渐增大,无齿缺;下颌外侧牙齿间存在由于与上牙咬合而磨损形成的垂直齿间沟,尤其是在中后部牙齿间特别明显。

比较与讨论 *Tinosaurus*(响蜥)属化石最初见于北美,后在我国内蒙古和其他地点有所发现,但材料均不完整。张坪的标本与 *Tinosaurus* 属的特征比较吻合,而与其他属种的特征相去甚远。

据 Gilmore(1928)所述,Marsh 于 1872 年建立了 *Tinosaurus* 属,其主要特征是:牙齿端生,小而侧扁,具有锐尖;后部牙齿三尖,前部牙齿的小尖退化,侧小尖有或无。下颌骨外侧,牙齿之间存在着由于上下牙齿咬合时相互磨损而形成的垂直的齿间沟,牙齿由后向前逐个变小。

本属已有 6 个种:*Tinosaurus stenodon*、*T. pristinus*、*T. asiaticus*、*T. lushihensis*、*T. doumuensis*

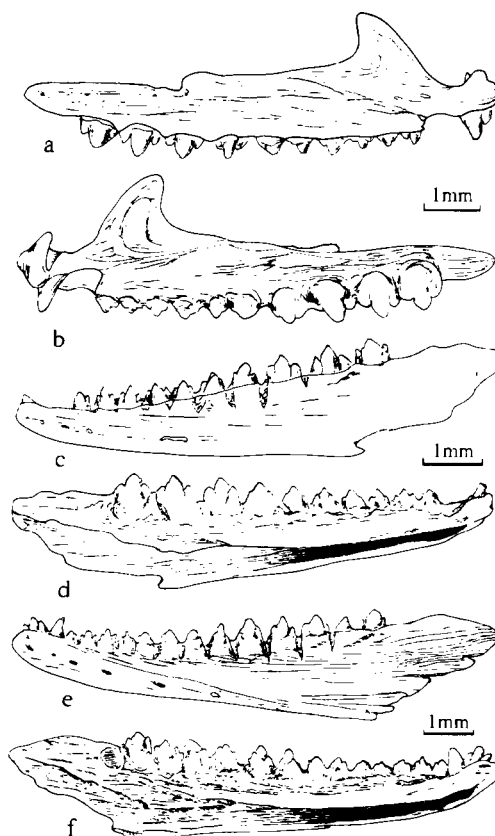


图 1 洛南响蜥

Fig.1 *Tinosaurus luonanensis* sp. nov.

a、b 右上颌外、内侧视(External and internal views of right maxilla, NWUV1134.1) c、d 左下颌内、外侧视(Internal and external views of left mandible, NWUV1134.2) e、f 左下颌内、外侧视(Internal and external views of left mandible, NWUV1137)

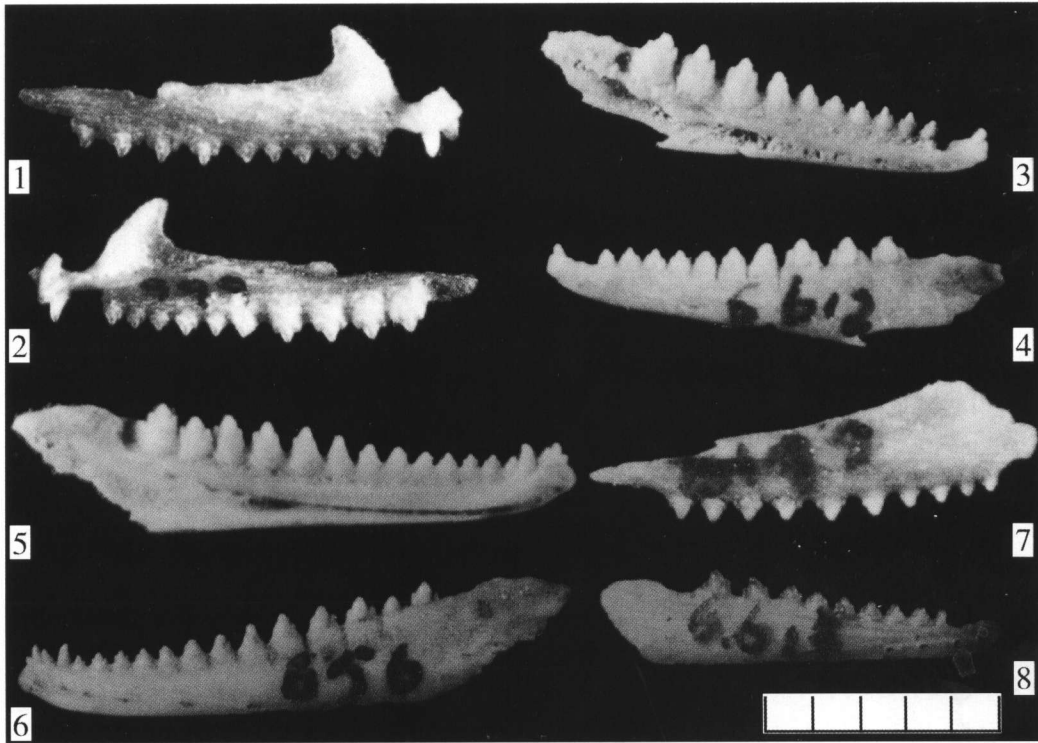


图2 洛南响蜥

Fig.2 *Tinosaurus luonanensis* sp. nov.

- 1~2, NWUV1134.1, 右上颌(right maxilla), holotype, 1. 外侧视(external view), 2. 内侧视(internal view);
 3~4, NWUV1134.2, 左下颌(left mandible), holotype, 3. 内侧视(internal view), 4. 外侧视(external view);
 5~6, NWUV1137, 左下颌(left mandible), 5. 内侧视(internal view), 6. 外侧视(external view);
 7. NWUV1135, 右上颌(right maxilla), 外侧视(external view);
 8. NWUV1136, 右下颌(right mandible), 外侧视(external view)

标尺(scale bar) = 5mm

和 *T. yuanquensis*。前两种发现于北美中始新世地层上部,后4种分别发现于内蒙古晚始新世地层下部、河南卢氏的晚始新世地层下部、安徽古新统痘姆组上部及山西垣曲晚始新世地层。在这些标本中,除后3种有上下颌骨外,其余的都是不完整的下颌骨。

Gilmore (1943)记述了产自内蒙古苏尼特右旗赛乌苏伊尔丁曼哈晚始新世地层中的 *Tinosaurus* 属化石,订名为 *T. asiaticus*。标本特征为“仅存在右下颌骨的后段,上有4个带尖的牙齿,牙齿侧扁,牙齿大小从后向前减小,牙齿排列紧密,但不重叠。”

董枝明(1965)记述了产自河南卢氏晚始新世早期地层中的 *Tinosaurus* 属化石,订名为 *T. lushihensis*。材料最初记为“同一个体的一块右上颌骨与右下颌骨的中段”。其种的特征为:“牙齿端生,小而侧扁,排列紧密。颊部牙齿具有三尖。后部牙齿为亚端生齿(subacrodont),其侧小尖彼此重叠。牙的大小由后向前递减,前部的牙齿趋于消失。”

侯连海(1974)记述了采自安徽潜山古新统痘姆组上部地层中的 *Tinosaurus* 属化石,研

究订名为 *T. doumuensis*。正型标本为左上、左下颌骨。其特征为:“异齿系,前部牙齿端生,细长圆锥体。后部亚端生齿,颊齿侧扁。上颌骨颊齿为等腰三角形,一个尖,大小相等;下颌骨颊齿三尖,中央主尖大,侧尖小,与中央主尖稍有分离,最后一个颊齿最小。上颌骨上缘圆,不为三角形。下颌骨前端纤弱,后部关节骨后突不明显,下缘弯曲成船形,麦氏沟裸露。”上颌骨 12 颗牙齿,下颌骨 13 颗牙齿,在第 4 颗牙齿之后有一大的齿缺。

李锦玲(1991a)记述了采自河南浙川的一段带有 3 个牙齿的颌骨,认为它与卢氏的 *T. lushihensis* 非常相似,订为 *Tinosaurus* cf. *T. lushihensis*,并提到卢氏的响蜥的正模应为两个上颌骨(一左一右),没有下颌骨。

李锦玲(1991b)还记述了另一采自山西垣曲河堤组寨里段晚始新世地层中的标本,定名为 *T. yuanquensis*。其特征为“下颌前部具 4 个侧生型锥状齿,第 4 齿硕大,为犬齿状齿。下颌外侧具齿间沟。上颌后部颊齿与下颌相对应,亦为三尖状齿。”

T. lushihensis 的上下颌骨前部的牙齿趋于退化,*T. doumuensis* 和 *T. yuanquensis* 的下颌骨甚至在该部位变成齿缺。但这种现象在 *T. stenodon* 中却没有发生;在 *T. pristinus* 和 *T. asiaticus* 标本上,由于没有保存该部位的牙齿而无从比较。当然,在 *T. doumuensis* 标本上,其上下颌的牙齿差异太大,除形态怪异外,颊齿也不是三尖状,而是等腰三角形齿,只有一个尖,大小相等,同一个体上、下颌骨牙齿这样明显的差异是少见的。侯连海(1974)认为,“其上颌骨不是 Chamaeleontidae 科的典型构造样式”(表 1)。

表 1 *Tinosaurus* 属各种的主要特征、时代及分布地点

Table 1 The characters, age and localities of *Tinosaurus*

(mm)

特征及分布 characters and distribution	保存齿数及其总长 number and length of remained teeth		下颌最后一 颊齿下高度 height of the lower jaw (under the last tooth)	齿间沟 vertical grooves between teeth	时代 age	地点 localities
	上颌 upper jaw	下颌 lower jaw				
<i>T. luonanensis</i>	12 7	17 7.5	1.9	有 with	Q ₁	陕西洛南 Luonan, Shaanxi
<i>T. yuanquensis</i>	8 15			有 with	E ₃	山西垣曲 Yuanqu, Shanxi
<i>T. stenodon</i>		3 4.5 4 4.0		有 with	E ₂	北美 North America
<i>T. pristinus</i>		8 9.4		有 with	E ₂	北美 North America
<i>T. asiaticus</i>				无 without	E ₂	内蒙古 Nei Mongol
<i>T. lushihensis</i>	10 10 13 12.5			无 without	E ₂	河南卢氏 Loushi, Henan
<i>T. cf. T. lushihensis</i>	2 1.31			无 without	E ₂	河南浙川 Xichuan, Henan
<i>T. doumuensis</i>	12 9.2	13 11.4	2.8	无 without	E ₁	安徽痘姆 Doumu, Anhui

Tinosaurus lushihensis、*T. doumuensis* 和 *T. asiaticus* 的下颌颊部牙齿的侧小尖与大的中央尖之间有浅沟相隔,它们的下颌骨外侧无齿间沟存在;而 *T. stenodon* 和 *T. pristinus* 的则相反,在颊齿的主尖与侧尖之间没有浅沟相隔,下颌骨外侧有齿间沟存在。侯连海(1974)据此曾将 *Tinosaurus* 属以齿间沟的有无分为两组:“下颌骨外侧,牙齿之间有垂直的齿间沟,北美的两种属之;牙齿之间不具备齿间沟,亚洲的三种属之”。但是 1991 年李锦玲记述的 *T. yuanquensis* 却发现齿间沟存在。

上述材料中,与本文记述的洛南标本特征最接近的当属 *T. yuanquensis*。两者的颊齿

形态相似,下颌外侧都有齿间沟。但它们的区别也是明显的(见表2):1)牙齿的着生特征不同。*T. yuanquensis* 的颊齿为端生型,而洛南的标本颊齿为亚端生型。这一点在洛南标本上下颌内侧非常清楚,它既不像侧生齿那样完全贴附于颌骨内侧,又可以看到齿基部的轮廓,可以说是典型的亚端生齿。2) *T. yuanquensis* 的上颌颊齿前部单尖,后部三尖,“自前向后逐渐加大,且三尖齿逐渐完善。上颌齿列的最后端为一小的三尖状齿,推测为新生齿。”洛南的上颌标本具有完整的齿列,除前部锥状齿外,后部颊齿无论大小均为三尖状齿,并且最后一颗牙齿几乎是齿列中最大的。3) *T. yuanquensis* 的下颌前部第4颗锥状齿硕大,为“犬齿状齿”,其后为一段齿缺,洛南的下颌标本前部第4颗锥状齿只略微增大,远未达到“犬齿状齿”的程度,其后也没有齿缺存在,紧接第4颗锥状齿的是一颗最小的三尖状齿。4) *T. yuanquensis* 的下颌较纤细,从素描图上测得第4锥状齿高度大于其下的齿骨高度,洛南标本上该齿的高度仅为其下齿骨高度的一半。5) 两者的大小也比较悬殊。*T. yuanquensis* 所保存的不完整的左上颌齿列(8个侧扁的颊齿)长约15mm(图上测量),而洛南标本的右上颌全部12颗牙齿齿列长只有7mm,10个侧扁的颊齿仅5.87mm,约为 *T. yuanquensis* 的1/3左右。

表2 *T. yuanquensis* 和 *T. luonanensis* 主要特征比较

Table 2 Comparisons of the main characters in *T. yuanquensis* and *T. luonanensis*

属种 species	<i>T. yuanquensis</i>	<i>T. luonanensis</i>
特征 characters		
齿型 tooth type	端生 acrodont	亚端生 subacrodont
上齿列长 length of tooth row in upper jaw	> 15mm	= 5.87mm
上齿列最后一齿 last tooth of upper jaw	较小 smaller	最大 biggest
下颌第4锥状齿 4th conical tooth of lower jaw	硕大,犬齿状,高度大于下方颌高 much larger, caniniform, higher than depth of dentary	稍大,高度仅为下方颌高之半 slightly bigger, only half the depth of dentary
下颌 lower jaw	纤细 slender	粗壮 sturdy

洛南的标本除尺寸小以外,具有 *Tinosaurus* 属的特征,如异形齿,前部端生,单尖;后部亚端生,侧扁,三尖;颊齿由后向前变小,趋于退化,甚至消失;有齿间沟等。其中,上、下颌骨前部牙齿由后向前逐渐变小,趋于退化的特征与上述 *T. lushihensis*、*T. doumuensis* 和 *T. yuanquensis* 的一致或相近,而与 *T. stenodon* 相区别;其颊部牙齿的侧小尖与大的中央尖之间有浅沟相隔,也与除 *T. yuanquensis* 外的其他中国种相一致,而与北美种有别;但张坪的标本有下齿间沟存在,这是除 *T. yuanquensis* 外的其他亚洲种所不具有,而北美种才有的。

中国现生的蜥蜴目(Lacertiformes)(四川省生物研究所,1977),从分科检索特征来看,8个科中只有鬣蜥科(Agamidae)的牙齿特征为端生齿,异型,与洛南的标本较为相似。其他几个科的牙齿特征各异,如壁虎科(Gekkonidae),侧生齿,圆锥形,小而数多;石龙子科(Scincidae),侧生齿,尖出或钩状,齿冠侧圆或圆形;蜥蜴科(Lacertidae),侧生齿;双足蜥科(Dibamidae),齿尖,钩曲;蛇蜥科(Anguinae),侧生齿,形状不一,或尖锐而微弯,或结节状;异蜥科(Xenosauridae),侧生齿,圆锥形,中等大小而数多;巨蜥科(Varanidae),侧生齿,齿较

大,基部较宽等,牙齿特征相去甚远。

鬣蜥科以现今广泛分布于秦岭及我国西北、西南其他地区的龙蜥属(*Japalura*)为例(原洪,1985;郑生武等,1999),其上下颌齿分化出单锥形齿与三尖齿,三尖齿由前向后逐渐增大,其特征与 *Tinosaurus* 属非常相像。但是张坪的标本与现生的 Agamidae 科的属种相比较还是有区别的。仍然以上述龙蜥属为例(江耀明等,1986),它的前部尖齿中有一枚特别粗大,在一些南方种类如云南龙蜥(*J. yunnanensis*)、台湾龙蜥(*J. swinhonis*)等,该齿与后部三尖齿约等大;在另一些北方种如草绿龙蜥(*J. flaviceps*)、丽纹龙蜥(*J. splendida*)等,该齿远大于后部三尖齿。张坪标本的前部锥形尖齿一般小于后部三尖齿,其中最大尖齿的宽度只有后部三尖齿宽度的 1/2 到 1/3,仅与前部趋于退化的最小的三尖齿宽度相当。另外,同安徽痘姆的标本一样,张坪的几件标本中,其下颌骨后方均未见到明显的关节骨后突,这一点似乎也支持将该属放在 Chameleontidae 科,而不是 Agamidae 科。

洛南的标本以其下颌牙齿的侧小尖与大的中央尖之间有浅沟相隔而区别于 *T. stendon* 和 *T. pristinus*;以其下颌骨外侧有齿间沟而区别于 *Tinosaurus lushihensis*、*T. doumuensis* 和 *T. asiaticus*;以其亚端生齿型、完善的三尖状齿、粗壮的下颌及较小的尺寸等特征而区别于 *T. yuanquensis*。它与该区目前现生的 Agamidae 科的某些种类既有相似之处也有明显的不同。因此把它订为一新种 *T. luonanensis* sp. nov.。

洛南的标本产自洞穴中,与之共生的有青羊类化石,因此可以肯定其时代不会早于第四纪,按其高程与阶地的关系及与附近龙牙洞的比较来看,其时代亦属第四纪无疑,很可能是早更新世中晚期。

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THE FIRST APPEARANCE OF *TINOSAURUS* FOSSIL IN THE QUATERNARY

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Key words Luonan, Shannxi, Quaternary, lizard, *Tinosaurus*

Summary

Some *Tinosaurus* fossils were collected from the Quaternary caves of Luonan County, Shaanxi Province, which are well-preserved row of teeth and dentary. The dentary is stronger and has the vertical grooves between teeth on external side of ramus caused by wear of opposing upper teeth. The teeth are reducing in size from back to front. It is the first report of *Tinosaurus* in the Quaternary

and made the record of this genus extended from early Tertiary to the Quaternary. The specimens from the area show the characters of *Tinosaurus* well, and compared with other species of the genera, they show some differences. So we record it as a new species: *T. luonanensis* sp. nov.

1 Systematic paleontology

Family Squamata

Subfamily Lacertilia

Tribe Chameleontidae Gray, 1825

Genus *Tinosaurus* Marsh, 1872

Tinosaurus luonanensis sp. nov.

(Fig. 1, 2)

Holotype NWUV 1134.1 ~ 2, a right maxilla with 12 teeth; a left mandible with 11 teeth.

Referred specimens A pair of right maxilla and mandible, two left mandibles (NWUV 1135 ~ 1136, NWUV 1137, NWUV 1138).

Etymology Named after "Luonan" County, Shaanxi Province, where the new species is discovered.

Locality and age Zhangping of Luonan County, Shaanxi Province; Quaternary (mid-late of Early Pleistocene?).

Diagnosis Teeth are small size, heterodonty, acrodont anteriorly, conical; subacrodont posteriorly, tricuspid; the center main cusp is stronger than those of both sides. Teeth are reducing in size from back to front. The anterior of the upper jaw is convex highly at back-wall of the nostril and the posterior is smooth. The lower jaw is stronger and arched down or not, and there are vertical grooves between teeth on external side of ramus caused by wear of opposing upper teeth.

2 Description

Upper jaw Length of upper jaw specimen is 8.13mm, highest is 2.31mm. Its widely anterior part is the bottom of the nostril, which united with the premaxilla. The highest of the upper side is between the nosalia and prefrontal, then smooth posterior after sharply down.

There are 12 teeth on the upper jaw with 7.0mm in length. The first 2 teeth are conical, 1.06mm long; the following 10 teeth are tricuspid, 5.87mm in length. The width of the last one on the upper tooth row is 0.68mm, 0.87mm in height. The three cusps of tricuspid are arranged along a line. There are two neuroforamens on anterior in external view.

Lower jaw Length of lower jaw specimens is 8.17mm, height (under the last tooth) is 1.5mm. The anterior of mandible is small, lightly bent to internal and with five neuroforamens on external. The supraangular is difficult to distinguish since its sutural line is hard to see. But there seems a sutural line of angular and which looks narrowly long. The mackelian canal is uncovered, which is narrow along its anterior half but slightly increases in depth posteriorly.

There are 11 teeth on the lower jaw, the total length of the teeth is 6.3mm. On the specimen 1137 (Fig. 1, e, f), the first four teeth are similar with those of upper jaw while the 4th tooth slightly larger than the first three teeth. The features of the posterior teeth are almost the same to those of the upper jaw.

3 Comparison and discussion

The genus *Tinosaurus* was established by Marsh in 1872. Its features was given by Gilmore (1928) as: "Teeth typically of small size, acrodont; "tricuspid posteriorly, denticles reducing anteriorly; "vertical grooves between teeth on external side of ramus caused by wear of opposing upper teeth. Teeth reducing in size from back to front".

After Marsh, 6 species have been reported from the northern hemisphere; two of which were from the northern America and the others from Asia.

The new species *T. luonanensis* is distinguished from all the other species (including the *Tinosaurus stenodon*, *T. pristinus*, Gilmore, 1928; *T. asiaticus*, Gilmore, 1943; *T. lushihensis*, Dong, 1965; *T. doumuensis*, Hou, 1974 and *T. yuanquensis*, Li, 1991) in genus *Tinosaurus* by following: 1) *T. luonanensis* is distinguished from *T. asiaticus*, *T. lushihensis* and *T. doumuensis* by its presence of vertical grooves between teeth on external surface of lower jaw; 2) *T. luonanensis* is distinguished from *T. stenodon* and *T. pristinus* by its better defined grooves that set off the denticles from the large median cusp; 3) *T. luonanensis* also differs from all others for it is the smallest one: its length of 10 cheek teeth is only one-third of the *T. yuanquensis*.

In some respects, such as the shape and arrangement of tooth, the new species *T. luonanensis* is closely related to *T. yuanquensis* from the Eocene Hedi Formation of Shanxi. And both of them have the presence of vertical grooves between teeth on external surface of lower jaw. Significant differences that can serve to distinguish the two taxa may be as follows: 1) the cheek teeth of *T. luonanensis* are subacrodont, while they are acrodont in *T. yuanquensis*; 2) all of the cheek teeth of *T. luonanensis* are tricuspid, and the last one is almost the biggest, while they "are tricuspid, perfected gradually and increased in size from the fore to the last", and the last one of the row is smaller in *T. yuanquensis*; 3) the 4th tooth in *T. luonanensis* is slightly bigger than other three teeth, far from the caniniform, while it "is caniniform, much larger than the first three teeth" in *T. yuanquensis*; 4) depth of the dentary in *T. luonanensis* is double of the 4th tooth on it, while it is only a half and rather shallow, slender in *T. yuanquensis*; 5) the difference of their size is obvious: the length of all 10 flat cheek teeth on the upper jaw in *T. luonanensis* is 5.87mm, while the length of uncomplete row (8 flat teeth) of *T. yuanquensis* is about 15mm, almost 3 times of the former.

The new species is preserved in caves of Luonan County. According to the relation between the caves and the terraces and comparison with the Long-ya-dong cave, we suggest that the age of the Zhang-ping caves should be Quaternary, and not earlier than this age.

References

- Amphibians and Reptile Laboratory in Living Things Institute of Sichuan Province(四川省生物研究所两栖爬行动物研究室), 1977. Index of the Reptile in China. Beijing: Science Press. 18 ~ 38(in Chinese)
- Dong Z M(董枝明), 1965. A new species of *Tinosaurus* from Lushih, Honan. Vert PalAsiat(古脊椎动物学报), 9(1): 79 ~ 83(in Chinese with English summary)
- Hou I. H(侯连海), 1974. Paleocene lizards from Anhui, China. Vert PalAsiat(古脊椎动物学报), 12(3): 193 ~ 200(in Chinese with English abstract)
- Gilmore C W, 1928. Fossil lizards of North America. Mem Nat Acad Sci, 22: 30 ~ 32
- Gilmore C W, 1943. Fossil lizards of Mongolia. Bull Am Mus Nat Hist, 81(4): 361 ~ 384
- Jiang Y M(江耀明), Hu Q X(胡其雄), 1986. Studies on Chinese *Japalura* and comparison of their skulls. Acta Herpetologica Sinica(两栖爬行动物学报), 5(1): 1 ~ 4(in Chinese)
- Li J L(李锦玲), 1991a. Fossil reptiles from Hetaoyuan Formation, Xichuan, Henan. Vert PalAsiat(古脊椎动物学报), 29(3): 190 ~ 203(in Chinese with English summary)
- Li J L(李锦玲), 1991b. Fossil reptiles from Zhaili Member, Hedi Formation, Yuanqu, Shanxi. Vert PalAsiat(古脊椎动物学报), 29(4): 276 ~ 285(in Chinese with English summary)
- Yuan H(原洪), 1985. Reptilian fauna of Shaanxi Province. Acta Herpetologica Sinica(两栖爬行动物学报), 4(2): 133 ~ 139(in Chinese)
- Zheng S W(郑生武), Li B G(李保国), 1999. Index and distribution of the vertebrate animal in Northwest Area of China. Xi'an: Northwest University Press. 88 ~ 94(in Chinese)