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记宁夏同心中中新世 *Alloptox*（兔形目，鼠兔科）

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关键词 宁夏同心 中中新世 跳兔 牙齿形态

内 容 提 要

从牙齿形态方面记述了同心中中新世的 *Alloptox gobiensis*（Young, 1932）和 *Alloptox* sp.，并尝试探讨了 P_3 和 P^2 的各主要性状在该属内种的划分和系统进化方面的意义。

在1985年底和1986年夏季两次野外工作中，作者在宁夏回族自治区同心县踏勘和实测中中新世地层剖面时，按层位采集了一批小哺乳动物化石[1]。其中以兔形目材料较为丰富，包括头骨、上、下颌和数量较多的单个牙齿。这些标本来自分属9个层位的18个化石地点（该处所指的层位是野外实测剖面中的顺序编号，后面所列的层号也是原始编号）（图I）。从下至上剖面厚约200米。除套子梁的材料暂定为 *Alloptox* sp. 外，所有材料都归属于 *A. gobiensis*。

自杨钟键1932年研究了采自内蒙通古尔的材料（包括一受挤压的头骨、一上颌、两下颌及一些肢骨）并建立该种之后，直至1981年 Erbajeva, M.A. 才又描述了蒙古人民共和国 Улан-Тологой（乌兰一托洛戈伊）地区的定为该种的丰富材料。宁夏同心的材料，除有较多 P^2 外，还有 DP^2, DP^4, DP_3, DP_4, I^3 和一些磨蚀程度很轻的 P_3 和 P_4。它们不仅提供了过去不曾有的牙齿形态方面的信息，而且可能有助于了解 *Alloptox* 属的进化历史。

本文着重于对同心地区的 *Alloptox gobiensis* 的牙齿形态特征的研究，该种共327件标本。为了解它们在不同层位（时间）和地点（空间）可能有的变化，我们按地点和层位观察测量了所有材料，并从各层位和地点选择具代表性的标本绘图以便全面客观地表现同心地区 *A. gobiensis* 的牙齿形态特征。插图都是在 M7A 双目立体显微镜下绘制的，并都表现为左侧齿，凡原标本为右侧者，都在图下方标以“inv”字样。描述侧重于 P^2, P_3 以

1）参加野外工作的还有宁夏回族自治区地质矿产局区域地质调查队的陈景智、周浩和张寿银同志。

及过去未曾描述过的 I^3, DP^2, DP^4, DP_3 和 DP_4。此外，对套子梁的 *Alloptox* sp. 的27件标本也作了描述和讨论。

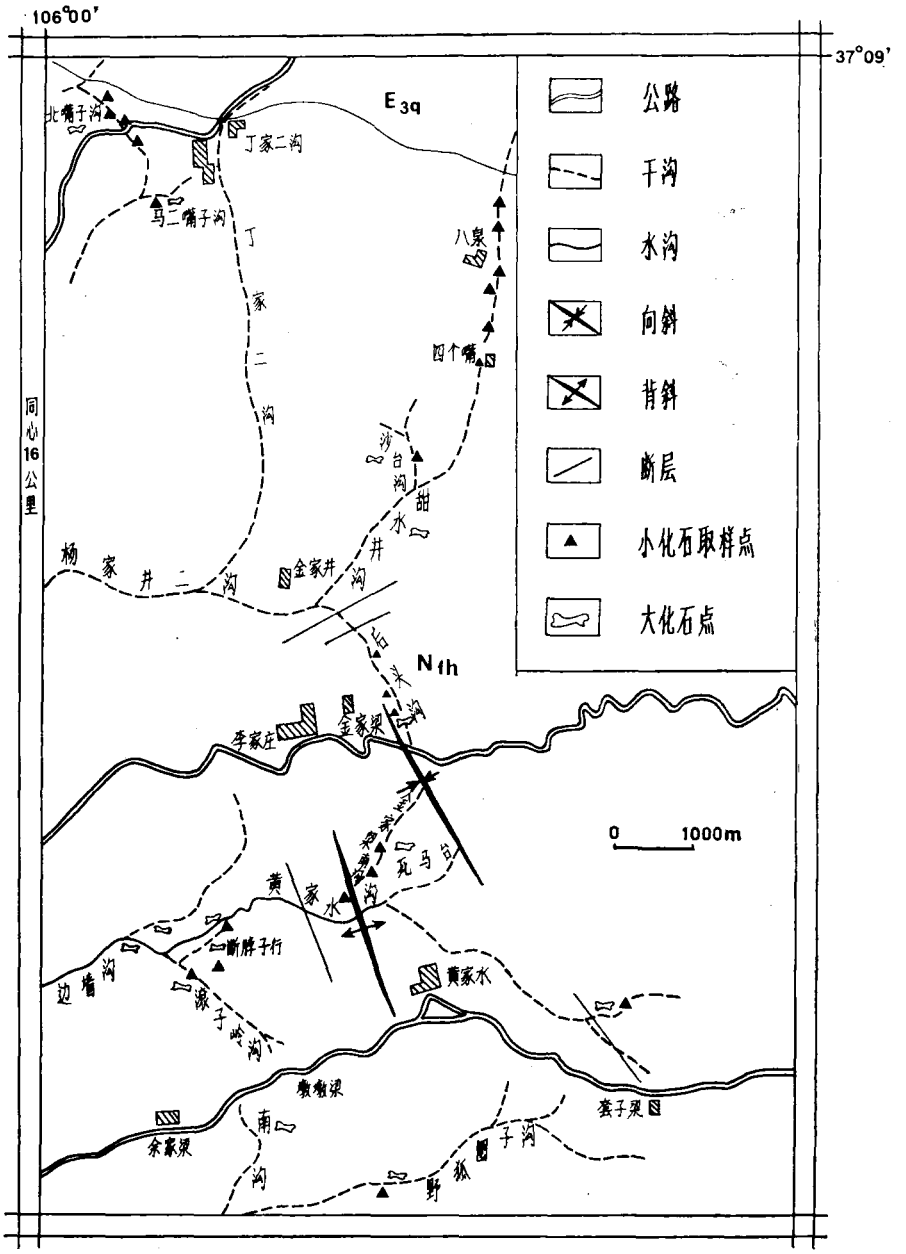

图 1　宁夏同心中中新世哺乳动物化石地点分布图

Fig.1　Sketch map showing localities of middle Miocene mammals in Tongxin area of Ningxia

一、标 本 记 述

兔形目 Lagomorpha Brandt, 1885

鼠兔科 Ochotonidae Thomas, 1897

跳兔鼠 *Alloptox* Dawson, 1961

戈壁跳兔 *Alloptox gobiensis* (Young, 1932)

(图 II—V)

种型 属于同一个体的带 P_3-M_3 的左、右下颌及带 P^3-M^1 的右上颌。编号 RV32130.1—3。

模式地点 内蒙古自治区通古尔盆地，Sum 喇嘛寺院南约 7.5 公里。

模式层位与时代 白色软质泥灰岩层，夹于底部红色粘土和上部含铲齿象白色砂层和砂岩层中。通古尔期，中中新世。

归入标本 (按地点和野外实测剖面层号)

(1) 北嘴子沟 4 层 (V8822.1—23): $6P_3$, $1P_4$, $1M_{1/2}$; $2I^2$, $1P^2$, $5P^3$, $2P^4/M^1$, $5M^2$。

(2) 北嘴子沟 7 层 (V8823.1—30): $10P_3$, $1P_4$, $2M_{1/2}$; $5I^2$, $1DP^2$, $3P^2$, $4P^3$, $1P^4/M^1$, $3M^2$。

(3) 北嘴子沟 11 层 (V8824. 1—30): $3DP_3$, $4P_3$, $2P_4$; $3I^2$, $2I^3$, $3P^2$, $4P^3$, $4P^4/M^1$, $5M^2$。

(4) 八泉 7 — 11 层 (V8825.1—50): 8 下颌带不同数目颊齿或门齿；2 上颌带门齿或颊齿。单个牙齿为: $6I_2$, $1DP_3$, $9P_3$, $1P_4$, $6I^2$, $1I^3$, $4P^2$, $7P^3$, $4P^4/M^1$, $1M^2$。

(5) 八泉 14 层 (V8826.1—11): $1I_2$, $1P_3$; $4I^2$, $2P^3$, $3P^4/M^1$。

(6) 八泉 15 层 (V8827.1—19): $1I_2$, $2P_3$, $1DP_4$, $1M_{1/2}$; $5I^2$, $1P^2$, $3P^3$, $2P^4/M^1$, $2M^3$, 1 右上颌带 P^3-M^2。

(7) 黄家水沟 26 层 (V8833.1—50): 18 下颌，带不同数目的颊齿，有时带门齿；11 上颌带不同数目的颊齿(V 8833. 19—29): $2I_2$, $3P_3$, $2M_3$; $3I^2$ $1I^3$, $3P^2$, $3P^3$, $1P^4/M^1$, $3M^2$。

(8) 西黄家水沟 26 层 (V8832.1—20): $2I_2$, $1P_3$ 的齿座部分, $2P_4$, $3M_1/M_2$; $1I^2$, $4P^3$, 1 残破 DP^4, $6P^4/M^1$。

(9) 黄家水沟 28 层 (V8834.1—6): $1I_2$, $1DP_3$, $1M_{1/2}$; $1I^2$, $1P^4/M^1$, $1M^2$。

(10) 断脖子行沟 (28 层?) (V8835.1—10): $1I_2$, $2P_3$; $1I^2$, $1P^2$, $2P^3$, $1P^4/M^1$, $2M^2$。

(11) 死马台 26 层 (V8837.1—14): $1I_2$; $2I^2$, $3P^3$, $6P^4/M^1$, $1M^2$; —左上颌带 P^3 — M^1。

(12) 野狐狸圈子沟下砂层(=26 层) (V8828.1—19): $1I_2$, $7P_3$, $1P_4$, $1M_1$; $2I^2$, $1I^3$, $4P^3$, $1M^2$, 1 左上颌带 P^3-M^1。

(13) 野狐狸圈子沟上砂层(=28 层) (V8829.1—17): 右下颌带 P_3-M_1; $1I_2$, $5P_3$, $1P_4$; $2I^2$, $1I^3$, $3P^3$, $3P^4/M^1$。

（14）金家梁南沟 26 层（V8830.1—19）：$1I_2$，$5P_3$，$1M_1/M_2$；$3P^2$，$2P^3$，$4P^4/M^1$，$3M^2$。

（15）后头沟 28 层（V8831）：$1DP_3$。

（16）滚子岭沟 26 层？（V8838.1—9）：4 下颌带不同数目颊齿，有时带门齿；5 上颌带 P^3-M^2。

（17）滚子岭沟 28 层？（V8839）：1 左 P^4/M^1。

描述　I^2：齿杆强烈弯曲。齿前方为一内陡外缓的宽 V 形槽。珐琅质层仅覆于齿杆前方，稍向外侧包卷（图 III-12）。

I^3：为一稍向后弯曲的、横切面呈钝圆三角形的齿柱（图 III-13）。近中侧平，珐琅质层薄；外侧前、后珐琅质层较厚，连成弧形。

P^2：总共 17 枚。为一短宽、略向后弯的齿柱。齿柱上下宽度近等或由上至下稍变宽。齿柱前方一般有两个被白垩质充填的前褶。内侧的褶较深，可达嚼面长度的二分之一左右，一般伸向后外方；外侧的褶较浅；两褶将 P^2 分为明显的外、中、内三叶。内叶最大，前方一般呈钩状（V8825.37、38，图 III-6，III-3），个别标本钩状不明显（如 V8825.36，图 III-4），其前内侧常有一浅褶；中叶和外叶大致相等。嚼面形态在少数 P^2 中略有变化：V8824.14 的中叶较大，内、中、外三叶大致相等，内叶前方不呈钩状，中叶上有一浅褶（图 II-29）。V8825.35-36 两枚 P^2 的外叶前面另有一浅褶，内叶上无褶或有浅褶。这些褶无论深浅，都贯穿于整个齿柱，齿柱都为丰富的白垩质包裹（图 III-10）。

P^3：具有一般鼠兔类的 P^3 的形态，但其前叶唇侧端膨大，呈棒锤状，后叶唇端尖锐或圆钝（V8823.25，图 II-14）。次沟及 U 形褶都被白垩质所充填，珐琅质在齿内缘及 U 形褶的内外壁厚。V8823.23（图 II-13），嚼面略经磨蚀，齿柱较低，高仅 3.62 mm；齿咀嚼面由外、中、内三叶组成，被两个向后外方斜伸的前褶分开，内侧前褶略呈新月形，大于外侧前褶。次沟发育，将内叶分为前后两叶（但其前叶已破损）；中叶内侧也具一褶。褶和次沟都为白垩质所充填（图 II-13）。

P^4-M^2：形态也与一般鼠兔类同，但 M^2 后方无突起。这里仅描述一枚磨蚀较浅的 P^4 和一枚 M^2。右 P^4（V8833.27，图 IV-8），与 M^1、M^2 同在一右上颌内。该齿已稍经磨蚀。次沟向齿内伸向前外方，达齿冠宽度的三分之一。齿的外半部在前后叶（齿座与跟座）之间，有一向外开口的近椭圆形的窝，窝内明显可见两稍经磨蚀并已相连的小齿柱，该两小齿柱之一位于窝的前外侧，另一位于窝的后内方。后叶外端原来也应有一珐琅质小齿柱，现经磨蚀后也已与后叶相连，但仍可见齿柱的痕迹（图 IV-8）。一年轻个体的左 M^2（V8828.18，图 V-2），尺寸很小，上窄下宽。下端开口，无齿根。前叶宽、后叶窄。次沟长度为齿宽的三分之二。齿外侧与次沟相对有一开阔的浅沟，沟内有一尚未经磨蚀、高 0.7 mm 的齿柱，该齿柱向下即融合到齿外壁内（图 V-2）。

I_2：形态与一般鼠兔者同，齿杆沿下颌骨舌侧腹缘后伸，终止于 M_1 跟座或齿座。

P_3：共 57 枚。形态变异较大，大多数标本嚼面三角形，下后尖前端（即牙齿或三角座前端）角状，并向两侧伸展呈角状，致使下后尖呈横宽的菱形。具两个前外沟，前前外沟，较后前外沟浅。前内沟先伸向后外方，然后折向后内方；其外侧壁多数具一明显的突向外侧的折角，其前壁与后壁多平行，且与跟座后壁的夹角小。跟座的内柱（下内尖）长，内侧有一深（占 30.5%）浅（占 47.7%）程度不同的侧沟或无沟（占 22%）。牙齿珐琅质在前内

沟的前壁与后端、后外沟后壁及齿的后内角明显变薄。齿的后内角呈圆角状。齿柱外包有丰富的白垩质(图 V-5、6)。

少数标本 (V8824.5, 图 II-26 和 V8822.1, 图 II-6) 前内沟先伸向后外方，然后向后方直伸；V8823.2 的前内沟伸向后外方；在少数标本中(10%)，如北嘴子沟 7 层的 V8823.6 (图 II-17)，八泉 7—11 层的三枚牙齿，下后尖前端略圆钝(图 III-1)。

有三枚磨蚀很浅或较浅的 P_3。V8830.2 (图 V-3)，唇侧珐琅质已破损，嚼面刚受磨蚀，下内柱前部还未经磨蚀。其下后尖前端角状，且向两侧伸展呈角状；具两前外沟，前前外沟甚浅，后前外沟较深。前内沟向后直伸，至齿基部形态不变。下内柱内侧有一深沟，向基部渐变浅。V8828.1 (图 V-1)，磨蚀程度与 V8830.2 大致相同。下后尖较宽，前端圆钝，向基部变为角状。前内沟向后伸；但至齿基部，先伸向后外方，然后向后直伸，稍向内折。在齿上部仅有一前外沟，至下部为两个。下内柱很长，内侧有一伸至齿基部的深沟，向下下内柱占齿长的比例变小。V8829.2 (图 V-4)，为一稍经磨蚀的年轻个体。下后尖前端角状，两侧也伸展呈角状；两前外沟均较发育，但后前外沟较深。前内沟向后内弯。下内柱长，内侧沟深，齿柱上小下大。

P_4-M_2: 同鼠兔类下颊齿形态。齿座后边有一指向后方的 V 形突。此 V 形突由 P_4 至 M_2 渐变弱。P_4 齿柱直，M_1 稍向后弯，M_2 向后弯度最大。

M_3: 共 5 枚 (V8833.4, .18, .48, .49, 黄家水沟 26 层；V8825.2, 八泉 7—11 层)。形态变化较大，卵圆形至肾形。齿柱外侧窄，无棱角。齿柱下端向后弯，后面有一深浅程度不一的沟。齿柱下端较上端宽(图 IV-3、6、7；图 III-1)。

乳齿: 左 DP^2 仅一枚 (V8823.19, 北嘴子沟 7 层)。齿小 (0.64 × 1.22)，低冠。由一向后外斜伸的前褶将齿分为内外两叶，前褶向齿基部延伸仅达齿高的三分之二。具内外两齿根：舌侧齿根较长而粗；唇侧齿根位高，较细且极短(图 II-12)。

右 DP^4 (V8832.14, 西黄家水沟 26 层): 齿小(1.17 × 1.46)，冠极低(1.46 mm)，稍经磨蚀，齿根已损。冠面由大致等宽的前后两叶组成，后叶内半部已破损，未见次沟。齿外侧前后叶之间有一近椭圆形珐琅质齿柱，长度与前后叶相当，以 U 形褶与前后叶分开，前内方由一珐琅质"桥"与前叶后壁相连，在外侧，齿柱基部消失在后叶内(图 IV-12)。

DP_3 (V8824.1—3, 北嘴子沟 11 层；V8834.2, 黄家水沟 28 层；V8831.1, 后头沟 28 层。图 II-20、21、22；图 V-10、11): 与 *Ochotona lagreli* 的 DP_3 很相似，由前、中、后三叶组成，三叶之间沿齿纵轴以狭窄的珐琅质"桥"连接；第三叶舌侧通常长于唇侧。齿根已破损。

右 DP_4 (V8827.4, 八泉 15 层)与 *Ochotona lagreli* 的 DP_4 很相似。由前后两叶(三角座及跟座)组成。在前叶前部上端有一附加的横宽的齿叶，尚未经磨蚀，至齿柱上部四分之一处即消失。齿冠上窄下宽，齿根已掉落，前叶后部中央，如同 P_4，有一指向后方的钝角，齿座高于跟座(图 III-14)。

跳兔(未定种) *Alloptox* sp.

(图 VI)

标本 V8836.1—27。一左上颌带 P^3-M^2 (V8836.7)；属于同一下颌的 I_2、P_3-M_1

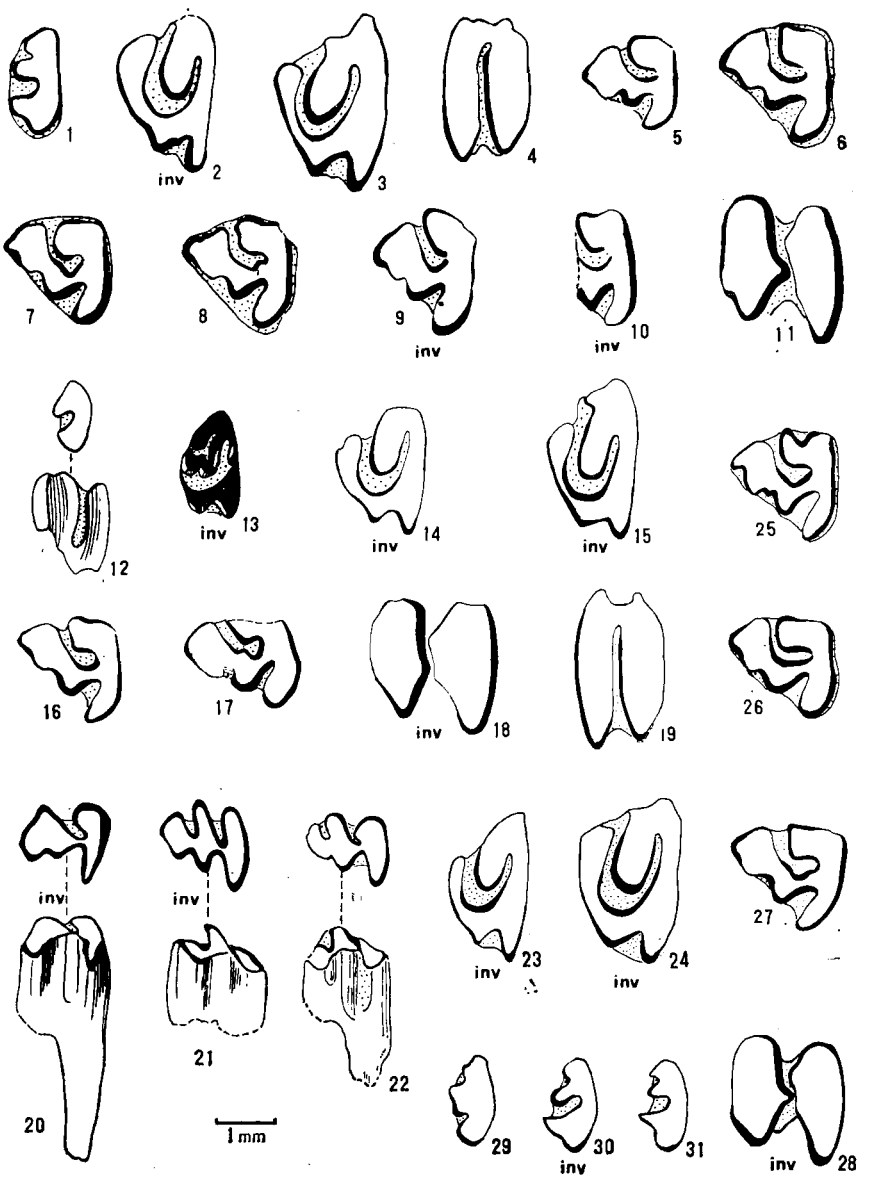

图 II 北嘴子沟 4、7、11 层的 *Alloptox gobiensis*

Fig.II *Alloptox gobiensis* from Beizuizigou levels 4, 7 and 11

北嘴子沟 4 层 (level 4) V8822: 1.左 P^2 (P^2sin) V8822.11; 2.右 P^3 (P^3dex) V8822.16; 3.左 P^3 (P^3sin) V8822.12; 4.左 M^2 (M^2sin) V8822.18; 5. 左 P_3 (P_3sin) V8822.4; 6. 左 P_4 (P_4sin) V8822.1; 7.左 P_3 (P_3sin) V8822.3; 8.左 P_3(P_3sin) V8822.2; 9.右 P_3 (P_3dex) V8822.5; 10. 右 P_3 残块 (fragment of P_3dex) V8822.6; 11.左 P_4 (P_4sin) V8822.7

北嘴子沟 7 层 (level 7) V8823: 12. 左 DP^2 (DP^2sin) V8823.19 嚼面视及前面视 (occlusal and anterior views); 13. 右 P^3 (P^3dex) V8823.23 仅受极轻微磨蚀 (slightly worn); 14. 右 P^3 (P^3dex) V8823.25; 15.右 P^3 (P^3dex) V8823.24; 16. 左 P_3 (P_3sin) V8823.5; 17. 残破左 P_3 (fragment of P_3sin) V8823.6; 18.右 M_1/M_2 (M_1/M_2dex) V8823.13; 19.左 M^2(M^2sin、V8823.28

北嘴子沟 11 层 (level 11) V8824: 20.右 DP_3 (DP_3dex) V8824.2 嚼面视及唇面视 (occlusal and labial views); 21.右 DP_3 (DP_3dex) V8824.3 嚼面视及唇面视 (occlusal and labial views); 22.左 DP_3 (DP_3sin) V8824.1 嚼面视及唇面视 (occlusal and labial views); 23.右 P^3 (P^3dex)V8824.19; 24.右 P^3 (P^3dex) V8824.18; 25.左 P_3 (P_3sin) V8824.4; 26. 左 P_3 (P_3sin) V8824.5; 27. 左 P_3 (P_3sin) V8824.6; 28.右 P_4 (P_4dex) V8824.8; 29.左 P^2 (P^2sin) V8824.14; 30.右 P^2 (P^2dex) V8824.15; 31.左 P^2 (P^2sin) V8824.13

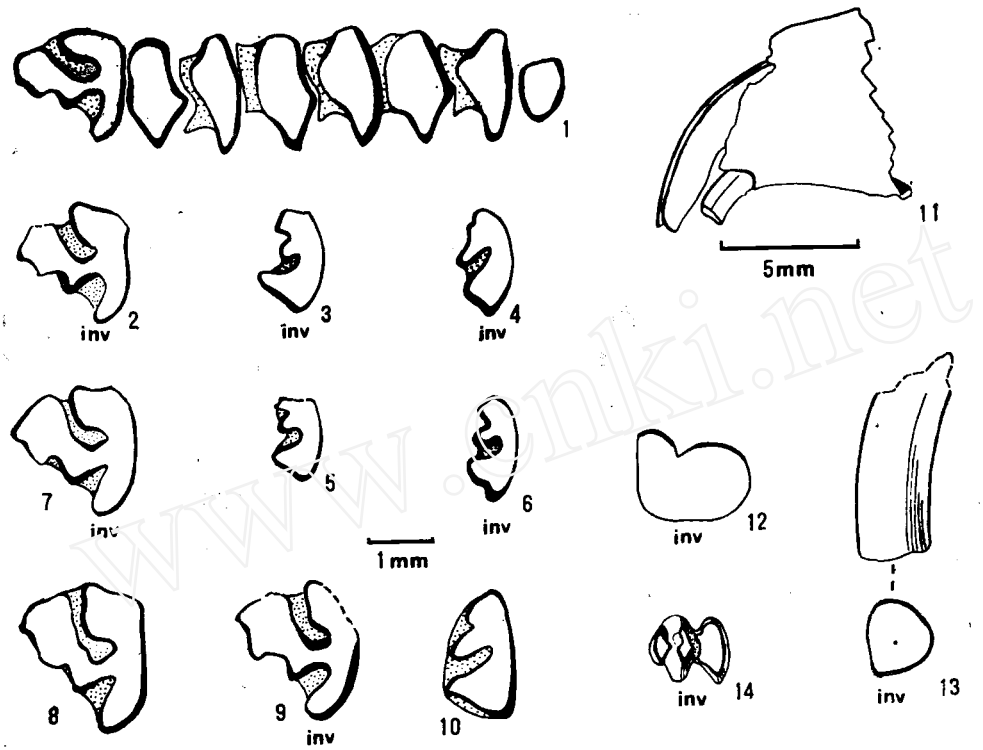

图 III 八泉 7—11 层、14 层及 15 层的 *Alloptox gobiensis*

Fig.III *Alloptox gobiensis* from Baquan levels 7—11, 14 and 15

八泉 7—11 层 (level 7—11) V8825: 1.左 P_3—M_3 (P_3—M_3sin) V8825.2; 2.右 P_3 (P_3dex) V8825.14; 3.右 P^2 (P^2dex) V8825.38; 4.右 P^2 (P^2dex) V8825.36; 5.左 P^2 (P^2sin) V8825.35; 6.右 P^2 (P^2dex) V8825.37; 11.左侧前颌骨带 I^2 及 I^3 (left maxilla with I^2—I^3) V8825.33 唇面视 (labial view); 12.右 I^2 (I^2dex) V8825.31; 13. 右 I^3 (I^3dex) V8825.32 唇面及嚼面视 (labial and occlusal views)

八泉 14 层 (level 14) V8826: 7.右 P_3 (P_3dex) V8826.2

八泉 15 层 (level 15) V8827: 8.左 P_3 (P_3sin) V8827.2; 9.右 P_3 (P_3dex) V8827.3; 10.左 P^2 (P^2sin) V8827.11; 14.右 DP_4 (DP_4dex) V8827.4 嚼面视 (occlusal view)

(V8836.9); 一对具 I_2 的下颌前端 (V8836.1); $1I_2$, $4P_3$, 一带 M_1 及 M_2 的左下颌 (V8836.14), $3M_3$ $3I^2$, $2I^3$, $4P^2$, $2P^4$, $2P^4/M^1$, $2M^2$。

地点与层位 套子梁。可能高于 28 层。

描述 P^2 宽。四枚中有两枚在形态上同其它层位的标本，另外两枚(V8836.5—6)的内叶前内侧具两个相当深的褶(图 VI-10、11)。

P^4: 两枚 P^4。左 P^4 (V8836.20, 图 VI-13), 上窄下宽，下端开口，无齿根。内半部分刚受磨蚀，外半部尚未经磨蚀。次沟向齿内伸向前外方，仅达齿冠宽度的四分之一，向下变深。齿的外半部前后叶之间有一向外开口的椭圆形的窝，窝内有两珐琅质小齿柱，都未经磨蚀，一位于前外侧，另一位于后内方，前者在齿外壁明显可见，但仅向下延伸 0.63 mm，就消失在外壁内。在后叶外端也可见到一明显的珐琅质小乳突，该乳突经磨蚀后很快会融合到后叶中(图 VI-13)。右 P^4(V8836.21), 较 V8836.20 磨蚀深，前后叶之间的椭圆形窝已消失。珐琅质小齿柱已被磨蚀成两长形珐琅质圈，位于后叶的外半部:

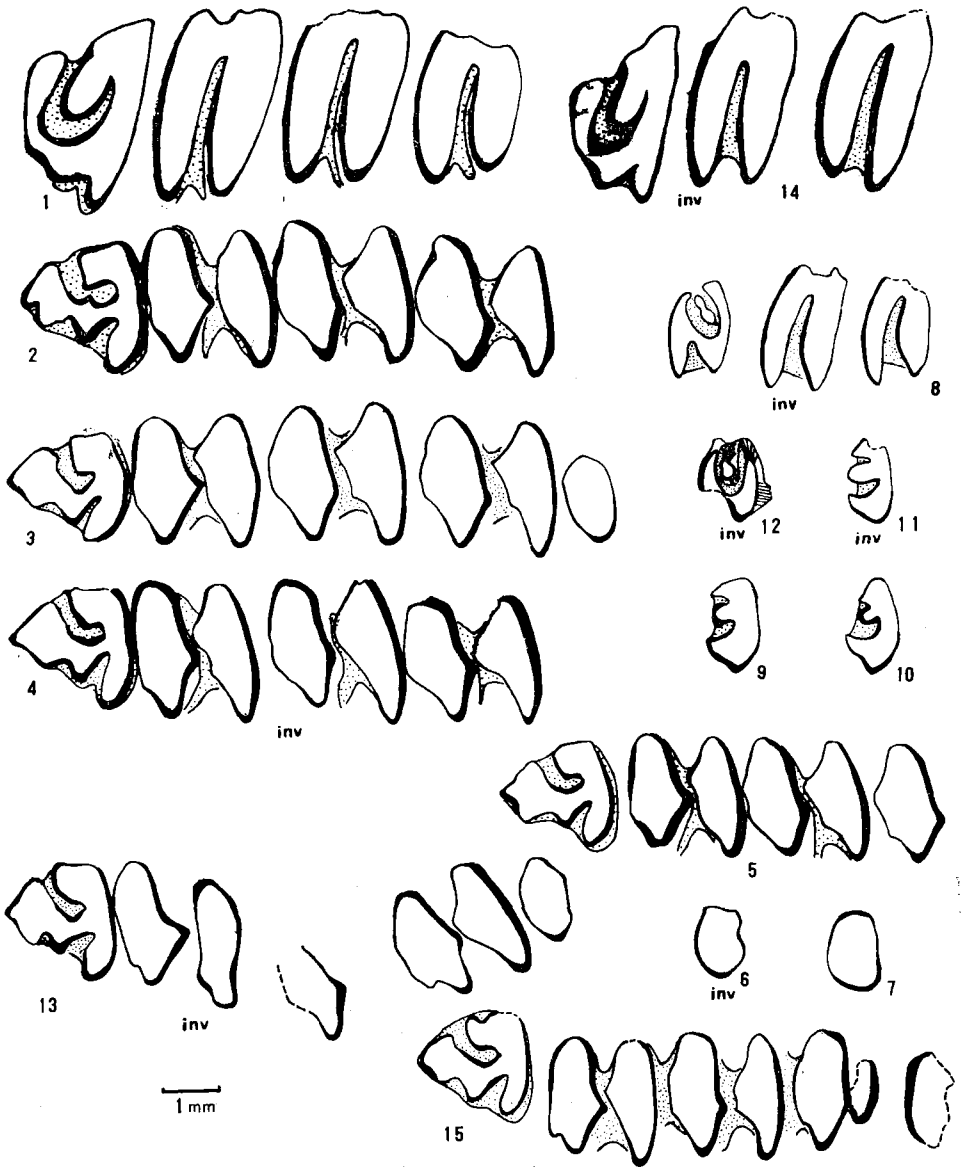

图 IV　黄家水沟 26 层及西黄家水沟 26 层的 *Alloptox gobiensis*，与通古尔的种型及宁夏灵武水洞沟的 *Alloptox* sp. 比较

Fig. IV　*Alloptox gobiensis* from level 26 of Huangjiashuigou and Xihuangjiashuigou compared with holotype from Tunggur and *Alloptox* sp. from Shuidonggou of Ningxia

黄家水沟 26 层 (Huangjiashuigou level 26) V8833：1.左 P^3-M^2 (P^3-M^2sin) V8833.22；2. 左P_3-M_2 (P_3-M_2sin) V8833.1；3.左 P_3-M_3 (P_3-M_3sin) V8833.4；4.右 P_3-M_2 (P_3-M_2dex) V8833.7；5.左 P_3-M_2 (P_3-M_2sin) V8833.3；6.右 M_3 (M_3dex) V8833.49；7. 左 M_3 (M_3sin) V8833.48；8.右 P^4-M^2 (P^4-M^2dex) V8833.27；9.左 P^2 (P^2sin) V8833.35；10.左 P^2 (P^2sin) V8833.34；11.右 P^2 (P^2dex) V8833.36

西黄家水沟 26 层 (Xihuangjiashuigou level 26) V8832：12.右 DP^4(DP^4dex) V8832.14

***Alloptox gobiensis* 内蒙通古尔 (Tunggur, Nei Mongol)**：13. 种型 (holotype) 右 P_3-M_3 (P_3-M_3 dex)，RV32130.1；14.右 P^3-M^1 (P^3-M^1dex)，RV32130.2

***Alloptox* sp. 宁夏灵武水洞沟 (Shuidonggou, Ningxia)**：15. 左 P_3-M_3 (P_3-M_3sin)，RV28007

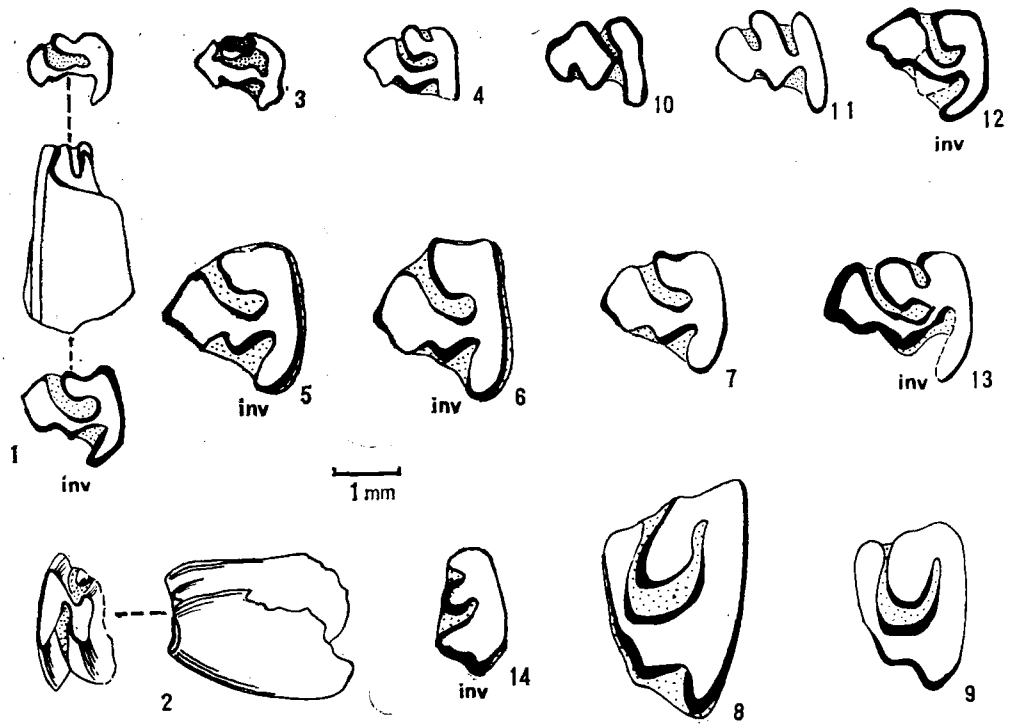

图 V 野狐狸圈子沟 26 层 (V8828)、28 层 (V8829)，金家梁南沟 26 层 (V8830)、后头沟 28 层 (V8831)，黄家水沟 28 层 (V8834) 及断脖子行沟 (V8835) 的 *Alloptox gobiensis*

Fig.V *Alloptox gobiensis* from Yehulijuanzigou level 26 (V8828), level 28(V8829); Jinjialiangnangou level 26 (V8830); Houtougou level 28(V8831); Huangjiashuigou level 28 (V8834) and Duanbozixinggou (? level 28, V8835)

野狐狸圈子沟 26 层 (Yehulijuanzigou level 26) V8828: 1.右 P_3 (P_3dex)V8828.1 嚼面、底面及后面视 (Occlusal, bottom and posterior views); 2.左 M^2 (M^2sin) V8828.18 轻微磨蚀，嚼面及后面视 (slightly worn, occlusal and posterior views)

金家梁南沟 26 层 (Jinjialiangnangou level 26): 3. 左 P_3 (P_3sin) V8830.2 轻微磨蚀 (slightly worn)

野狐狸圈子沟 28 层 (Yehulijuanzigou level 28) V8829: 4.左 P_3 (P_3sin) V8829.2; 5.右 P_3(P_3 dex) V8829.4; 6.右 P_3 (P_3dex) V8829.5; 7.左 P_3(P_3sin) V8829.3, 8.左 P^3 (P^3sin)V8829.12; 9.左 P^3 (P^3sin) V8829.13

后头沟 28 层 (Houtougou level 28) V8831: 10.左 DP_3 (DP_3sin) V8831.1

黄家水沟 28 层 (Huangjiashuigou level 28) V8834: 11.左 DP_3 (DP_3sin) V8834.2

断脖子行沟(28 层?) (Duanbozixinggou ?level 28) V8835: 12.右 P_3 (P_3dex) V8835.2; 13. 右 P_3 (P_3dex) V8835.3 底面视 (bottom view); 14.右 P^2 (P^2dex) V8835.5

一位于后外侧，另一位于前内侧(图 VI-12)。

P_3: 在总的形态特征方面，与其它地点和层位的标本一致。其中一枚磨蚀程度很浅的 P_3 (V8836.11, 图 VI-4) 的特征与全家梁南沟的 V8830.2 大致相同: 齿柱上小下大，下内柱前部还未经磨蚀;下后尖前端角状，且向两端延伸呈角状，但无前前外沟。前内沟向后直伸，然后偏向外侧，在齿基部稍向内弯。齿外尚未被白垩质包裹。其它成年个体的齿柱外，白垩质包裹多。

M_3: 大小和形态变化较大。V8836.25 近似于矩形，内侧呈直边;外侧边为圆弧状，珐

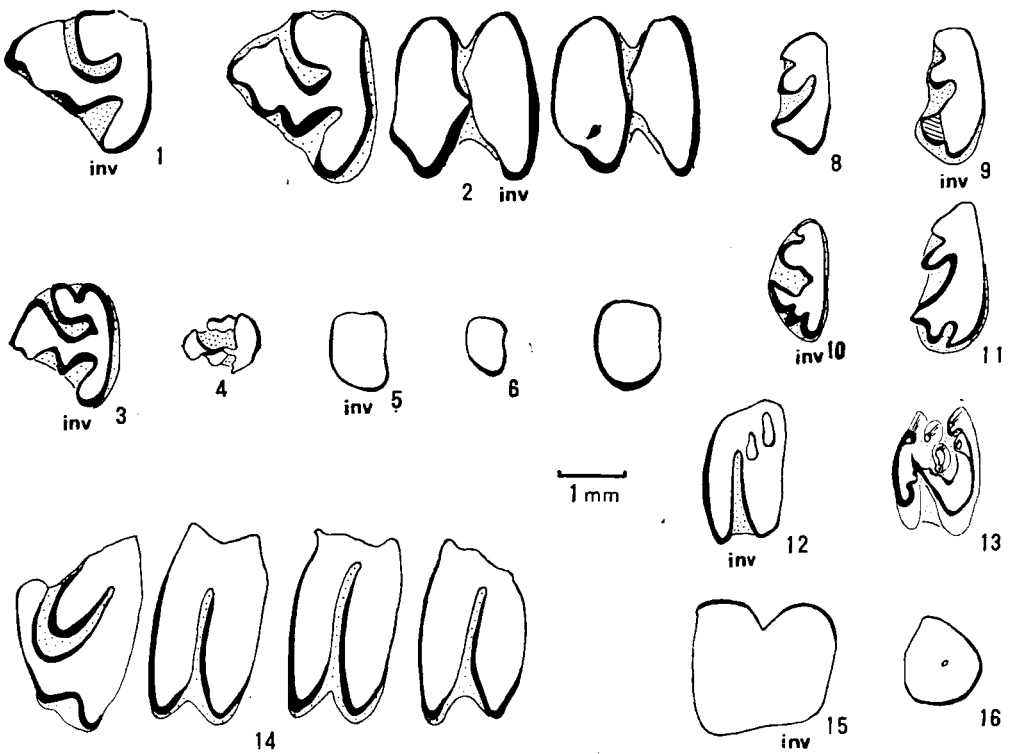

图 VI　*Alloptox* sp. 套子梁 V8836

Fig. VI　*Alloptox* sp.from Taoziliang V8836

1.右 P_3 (P_3dex) V8836.13; 2.右 P_3-M_1 (P_3-M_1dex) V8836.9; 3.右 P_3 (P_3dex) V8836.2; 4.左 P_3 (P_3sin) V8836.11 轻微磨蚀 (slightly worn); 5.右 M_3 (M_3dex) V8836.27; 6. 左 M_3(M_3sin) V8836.26; 7.左 M_3 (M_3sin) V8836.25; 8.左 P^2 (P^2sin) V8836.18; 9.右 P^2 (P^2dex)V8836.19; 10.右 P^2 (P^2dex) V8836.5 底面视 (bottom view); 11.左 P^2 (P^2sin) V8836.6; 12.右 P^4(P^4dex) V8836.21; 13. 左 P^4 (P^4sin) V8836.20 轻微磨蚀 (slightly worn); 14. 左 P^3-M^2 (P^3-M^2sin) V8836.7; 15.右 I^2 (I^2dex) V8836.15; 16.左 I^3(I^3sin) V8836.16

琅质最厚；后方珐琅质薄，且有很浅的沟。V8836.26 呈内宽外窄的肾形，后方中沟很明显，外侧和后方珐琅质最厚，外侧边弧度大于内侧边。V8836.27 形似直角梯形，内宽外窄，内侧边几乎为直线(图 VI-5、6、7)。该地点的 M_3 小于其它地点的 M_3，且长宽比明显大于其它标本(见表 1)。

二、比较与讨论

1. 同心的 *Alloptox* 的归属

同心的 *Alloptox* 的标本虽然来自不同层位和地点，在牙齿尺寸和形态上也表现出较大的变异性，在有些地点，标本的线性量度的变异系数 (Coefficient of variation) 超出了一般哺乳动物的平均值(4 至 10)，但这些形态上的以及尺寸大小的变异主要是由于年龄差异和个体差异造成的。我们观察到一些年轻个体的齿柱由上至下迅速变大，个别

表1 *Alloptox* 测量数据(毫米)

Table 1 Comparison of teeth measurements of *Alloptox* (in mm)

Measurements / Species	P_3 (Length × Width)		M_3 (Length × Width)		
	Range	Mean (N)	Range	Mean(N)	Length: Width ratio
A. minor (Li,1978) Lantian	(1.42—1.71)× (1.42—1.86)	1.56×1.64(2)			
A. chinghaiensis (Qiu et Li, 1981) Qinghai	1.66 × (1.66—1.76)	1.66×1.71(2)		0.68×1.12(1)	0.607
A. gobiensis (Young, 1932) Tung Gur		1.96×2.05(1)		0.78×1.17(1)	0.67
A. sp. (Boule et Teilhard, 1928) Shuidonggou		1.98×1.97(1)		0.98×1.51(1)	0.649
A. near *A. gobiensis* (Dawson, 1961) Tung Gur	(2.00—2.30)× (2.10—2.20)	2.13×2.17			
A. anatoliensis (Ünay, 1976) Anatolia	(1.50—2.00)× (1.30—2.00)	1.80×1.72			
A. gobiensis (Erbajeva, 1981) Mongolia	(1.40—2.40)× (1.50—2.40)	2.00×2.00	(0.6—0.8)× (1.1—1.5)	0.7×1.3(8)	0.538
A. gobiensis Tongxin	(1.46—2.25)× (1.51—2.45)	1.92×2.00(50/54)	(0.73—1.02)× (1.22—1.51)	0.92×1.40(5)	0.66
A. sp. Tongxin (Taoziliang)	(1.56—2.15)× (1.66—2.45)	1.87×2.02(4)	(0.63—0.98)× (0.90—1.27)	0.83×1.14(3)	0.728

（续表 1）

Measurements / Species	Length of P_3-M_3		P^2(Length × Width)		P^3-M^2 (Length)		P^3-M^1 (Length)	
	Range	Mean(N)	Range	Mean(N)	Range	Mean(N)	Range	Mean(N)
A. minor (Li, 1978) Lantian	7.92(1) 64-蓝-044							
A. chinghaiensis (Qiu et Li, 1981) Qinghai	8.70(1) V6009.1							
A. gobiensis (Young, 1932) Tung Gur	10.36(1)							6.06(1)
A. sp. (Boule et Teilhard, 1928) Shuidonggou	9.80(1)							
A. near *A. gobiensis* (Dawson, 1961) Tung Gur					10.1—10.9	10.4(3)	7.8—8.6	8.03(3)
A. anatoliensis (Ünay, 1976) Anatolia	7.90(1)				7.00—8.30	7.65(2)		
A. gobiensis (Erbajeva, 1981) Mongolia	8.0—10.2	9.2(8)	(1.00—1.20) × (1.70—2.00)	1.10×1.80 (3)	7.80—9.30	8.60(5)	6.0—7.0	6.4(5)
A. gobiensis Tongxin	8.31—10.46	9.39(2)	(0.78—1.17) × (1.37—1.90)	0.95×1.65 (16)	7.73—9.29	8.59(14)		6.26(1)
A. sp. Tongxin (Taoziliang)			(0.88—1.27) × (1.76—2.20)	1.02×1.96 (4)				

的咀嚼面形态与成年个体相差甚大(下面还要较详细地介绍)。但除套子梁的 P^2 形态较特殊外,其它地点和层位的标本在形态上没有明显的间断,因此我们将除套子梁地点外的标本都作为同一个种。

总结前节描述,套子梁标本除外,同心的 *Alloptox* 的牙齿特征如下: P^2 具有两个较深的前褶,将牙齿分为明显的外、中、内三叶,在内叶上还有一较浅的前内褶。下门齿(I_2)都起始于 M_1。P_3 三角形,下后尖前端大多为角状,且横向拉长,两侧也呈角状,以致冠面视近似于横宽的菱形;一般具两个前外沟,前前外沟较浅;前内沟先伸向后外方,然后折向后内方;齿的后内角圆,珐琅质薄;跟座的下内尖长,其内侧常有一或深或浅的沟。少数 P_3 的下后尖较窄,前端较圆,仅有一个前外沟,前内沟向后直伸或伸向后外方,下内尖内侧无沟。在磨蚀很浅的 P_3 上其前内沟明显地直伸向后方,下后尖前端圆钝。

已知的 *Alloptox* 的各种的建立主要依据 P_3 的形态。依据原作者的描述及笔者对标本的观察,将各个种的特征总结如下。

李传夔(1978)描述的陕西蓝田中中新世的 *Alloptox minor* 尺寸较小。P_3 下后尖窄,前端及内侧圆,仅有一前外沟;前内沟向后方直伸;下门齿起始于 P_4 跟座(笔者观察到,另一采自冠家村的下颌标本上,下门齿起始于 M_1 的齿座)。

邱铸鼎等(1981)建立和描述的青海中中新世的 *Alloptox chinghaiensis* 的尺寸介于 *A. minor* 和 *A. gobiensis* 之间; P_3 下后尖窄,前端及内侧圆,仅具一个前外沟;前内沟先伸向后外方,然后折向后内方(据原作者描述,该沟向后直伸); 下门齿始于 M_1 齿座前方;颏孔位于 P_3 前方。

另一批内蒙通古尔中中新世的 *Alloptox* 标本,由于其个体较大,Dawson (1961)将其订为 *Alloptox* near *A. gobiensis*。据原作者 Dawson 的描述和插图,其它主要特征是: P^2 仅具一前褶,将牙齿分为内、外两叶,内叶上另有一前内褶。P_3 下后尖横向伸展,前端和内侧圆,略呈角状,具两个前外沟,前前外沟特别浅;前内沟先伸向后外方,然后折向后内方;下内尖短,内侧几乎无沟。

土耳其中中新世的 *Alloptox anatoliensis* (Ünay, 1976) 个体小,P_3 下后尖仅具一个前外沟或多出一个很浅的前前外沟; 前内沟向后直伸或稍向后内弯,后内角几乎呈直角。

产自宁夏灵武水洞沟、可能属于晚中新世的 *Alloptox* sp. (Boule et Teilhard, 1928; p. 96, fig.23A), 大小和 P_3 的嚼面形态与 *A. gobiensis* 很接近,但下后尖相对窄些,前端角状,有两个前外沟;前内沟先伸向后外方,然后折向后内方;下内尖内侧有一浅沟。与 *A. gobiensis* 的区别在于白垩质更发育,M_3 较短宽(图 IV-15)。

1970—1972 年,蒙苏古生物考察队及蒙苏地质考察队新生代组在蒙古人民共和国乌兰—托洛戈伊中新世剖面的第三层中采集了大量小哺乳动物化石,包括丰富的兔形类。1981 年 Erbajeva 描述了 *Alloptox*, 并定为 *A. gobiensis*。材料较丰富,有测量数据的 P_3 67 枚; P_3-M_3 齿列 8 个, P^2 三枚。1988 年 Erbajeva 在她的"新生代鼠兔"专著中又结合对苏联斋桑萨勒布拉克斯克组及哈萨克斯坦等地点的材料的研究提出了 *A. gobiensis* 的种特征是: "P_3 前缘直,前尖(此处意指下后尖——作者注)有两个深度不同的外褶,后外褶深,内褶的形态和深度多变。"这里 Erbajeva 没有提到 P^2 的特征,但其描述和

插图表明，P^2 具有两个前褶，分为内、中、外三叶，内叶上有一浅的前内褶。因此乌兰一托洛戈伊的 *Alloptox* 的 P_3 和 P^2 的主要特征与同心种群基本上是一致的。在插图上观察到的它们之间的细微差别，由于无对比标本无从讨论。参照 Erbajeva 的描述，两地标本还存在着一些其它方面的差别：1）同心种群的 M_3 较窄长，蒙古标本较短宽（参见 Erbajeva 1981，图 1 δ 或 1988，图 17 及本文表 1）；2）同心种群下门齿 I_2 起始于 M_1，这一特征在同心所有标本中无变化，最为稳定；在蒙古的标本上起始于 M_2 的三角座（见 Erbajeva 1981，86 页）。在这种情况下我们暂保留其种的归属。

作者观察了杨钟健(1932)首次描述的内蒙通古尔的 *A. gobiensis* 标本，尤其是带有 P_3 的下颌。经对比，我们认为宁夏同心的标本在 P^2 形态特征上与 *A.* near *A. gobiensis* 不同，其 P_3 的形态与 *A. minor*, *A. chinghaiensis* 及 *A. anatoliensis* 都显然不同，而与 *A. gobiensis* 最为接近。通古尔的 *A. gobiensis* 的 P_3 的下后尖也是前端尖并向侧方伸展的菱形；前内沟先向后外伸，再折向后内方，其前后壁近于平行；下内尖的舌侧具有明显的侧沟。此外，通古尔的标本上的下门齿起始于 M_1，M_3 也较窄长，与同心标本一样。因此，将同心的 *Alloptox* 归为 *A. gobiensis* 是较可靠的。

关于套子梁标本的种的归属：套子梁标本中的 P^2 明显变宽，其中有两枚 P^2 的构造较为复杂，其内叶前内侧具有两个较深的褶，而不是一浅褶。这或许表明套子梁的 *Alloptox* 是一新种，或许可认为 *A. gobiensis* 已开始分化，处于向新种进化的过程中。我们将套子梁的标本暂订为 *Alloptox* sp.。

表 1 为 *Alloptox* 各个种的测量数据对比表，表 2 比较了 *Alloptox* 属内各个种的下颌形态。

2. P_3 及 P^2 的形态特征在研究 *Alloptox* 的种的划分和系统进化方面的意义

对同心 *Alloptox* 的研究表明，不仅 P_3 对兔形类的分类具有一定的意义，P^2 也相当重要。由于到目前为止，我们所掌握的有关 *Alloptox* 的材料尚不很多，仅提出一些粗浅的看法。

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邱铸鼎等(1981)在研究 *A. chinghaiensis* 时，依据 P_3 的形状、前内褶（即本文的前内沟——作者注）的深度及伸达方式将 *Alloptox* 分为两类：一类“P_3 前缘圆、前内褶深且极向后伸”；另一类“P_3 前缘角状、前内褶浅，向后外伸”，并将 *A. gobiensis* 归为后一类。丰富的同心材料中大部分 P_3 的下后尖呈前缘角状、并向两侧伸展的菱形，具两个前外沟，其前内沟先向后外伸，然后弯向后内方。仅少数标本下后尖窄、前端圆钝，具一个前外沟，前内沟向后直伸。我们认为：较简单的、窄而前端圆，仅具一个前外沟的下后尖和向后直伸的前内沟代表了 *Alloptox* 的原始性状；前端角状、轮廓近似横宽菱形，具两

表2 *Alloptox* 各个种的下颌特征比较

Table 2 Comparison of mandible morphology among species of *Alloptox*

Species 种 / Characters 特征		标本数 N	下门齿后端起点 Beginning position of I_2	颏孔位置 Position of mental foramen	下颌高度 (P_3 后缘处) Height posterior to P_3
A. minor	64-蓝-044	1	P_4 跟座 Talonid of P_4	P_3 跟座后方 Posterior to the talonid of P_3	6.32 mm
	寇家村 Koujiacun	1	M_1 三角座 Trigonid of M_1	P_3 下后尖 Metaconid of P_3	6.32 mm
A. chinghaiensis 青海 Qinghai		2	M_1 三角座前方 anterior to trigonid of M_1	P_3 前方 anterior to P_3	7.6mm; 7.29 mm
A. gobiensis (RV32130.1) 通古尔 Tung Gur		1	M_1 跟座 Talonid of M_1	—	8.9 mm
A. sp. 水洞沟 Shuidonggou		1	M_1 三角座 Trigonid of M_1	—	8.9 mm
A. gobiensis 同心 Tongxin		8	M_1 三角座或跟座 Trigonid or talonid of M_1	P_3 前缘或 P_3 三角座的前部 anterior to P_3 or at metaconid of P_3(1)	8.42—9.23 mean 8.9mm
A. gobiensis 蒙古 Улан-Тологой Mongolia		?	M_2 三角座 Trigonid of M_2	—	—

插图表明，P^2 具有两个前褶，分为内、中、外三叶，内叶上有一浅的前内褶。因此乌兰一托洛戈伊的 *Alloptox* 的 P_3 和 P^2 的主要特征与同心种群基本上是一致的。在插图上观察到的它们之间的细微差别，由于无对比标本无从讨论。参照 Erbajeva 的描述，两地标本还存在着一些其它方面的差别：1）同心种群的 M_3 较窄长，蒙古标本较短宽（参见 Erbajeva 1981，图 1 δ 或 1988，图 17 及本文表 1）；2）同心种群下门齿 I_2 起始于 M_1，这一特征在同心所有标本中无变化，最为稳定；在蒙古的标本上起始于 M_2 的三角座（见 Erbajeva 1981，86 页）。在这种情况下我们暂保留其种的归属。

作者观察了杨钟健(1932)首次描述的内蒙通古尔的 *A. gobiensis* 标本，尤其是带有 P_3 的下颌。经对比，我们认为宁夏同心的标本在 P^2 形态特征上与 *A.* near *A. gobiensis* 不同，其 P_3 的形态与 *A. minor*, *A. chinghaiensis* 及 *A. anatoliensis* 都显然不同，而与 *A. gobiensis* 最为接近。通古尔的 *A. gobiensis* 的 P_3 的下后尖也是前端尖并向侧方伸展的菱形；前内沟先向后外伸，再折向后内方，其前后壁近于平行；下内尖的舌侧具有明显的侧沟。此外，通古尔的标本上的下门齿起始于 M_1，M_3 也较窄长，与同心标本一样。因此，将同心的 *Alloptox* 归为 *A. gobiensis* 是较可靠的。

关于套子梁标本的种的归属：套子梁标本中的 P^2 明显变宽，其中有两枚 P^2 的构造较为复杂，其内叶前内侧具有两个较深的褶，而不是一浅褶。这或许表明套子梁的 *Alloptox* 是一新种，或许可认为 *A. gobiensis* 已开始分化，处于向新种进化的过程中。我们将套子梁的标本暂订为 *Alloptox* sp.。

表 1 为 *Alloptox* 各个种的测量数据对比表，表 2 比较了 *Alloptox* 属内各个种的下颌形态。

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层的时代最可能相当于 MN6。在余家梁，黄家水一带与 *A. gobiensis* 共生的化石有肉食类、洞角类、鹿类和一些奇蹄类，因研究工作尚在进行之中，还不能最终确定其时代。目前，我们可以认为 *A. gobiensis* 的生存时间较长，相当于欧洲新第三纪陆相哺乳动物分期 MN6-8。

关于套子梁的 *Alloptox* sp.，其 P^2 的形态表明它可能较 *A. gobiensis* 进步。在此层位还发现有 *Amebelodon* 的一段门齿。 *Amebelodon* 在北美出现的时代是 Clarendonian 和 Hemphillian，晚于通古尔期。由于断层构造和覆盖，套子梁地点的层位与周围地层的关系尚不很清楚，而且，发现的共生化石种类和数量还太少，有待于做进一步的工作。但依据 *Alloptox* sp. 本身的性质和 *Amebelodon* 的出现，套子梁的层位的时代有可能晚于其它层位。

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ON *ALLOPTOX* (LAGOMORPHA, OCHOTONIDAE) FROM THE MIDDLE MIOCENE OF TONGXIN, NINGXIA HUI AUTONOMOUS REGION, CHINA

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Key words　Tongxin (Ningxia); Middle Miocene; *Alloptox*; dental morphology

Summary

Rather abundant sample of *Alloptox*, including skulls, maxillae, mandibles and isolated teeth, was collected from the middle Miocene of Tongxin County, Ningxia Hui Autonomous Region during the two field seasons in 1985 and 1986, when reconnaissance and geological mapping of the middle Miocene in this region were conducted by a joint party of the Institute of Vertebrate Paleontology and Paleoanthropology, *Academia Sinica* (IVPP) and the Bureau of Geology, Ningxia Hui Autonomous Region. The specimens came from 18 localities pertaining to 9 levels in a sequence of middle Miocene fluviatile sediments with a thickness of ca. 200m. Except for the specimens assigned to *Alloptox* sp. from locality Taoziliang, all are recognized as *Alloptox gobiensis*. The present paper deals with only their dental morphology which is probably phylogenetically significant. Altogether 327 specimens of *Alloptox gobiensis* and 27 specimens of *Alloptox* sp. have been described. The text figures are drawn by the authors and Mrs. Yang Mingwan. All teeth are presented as left ones, the abbreviatd word "inv" is used under the figures of right teeth. All specimens are stored in IVPP under the inventory number V8822-V8839. The authors are much obliged to Prof. Qiu Zhanxiang for reading and correcting the English version of this paper.

Ochotonidae Thomas, 1897

Alloptox Dawson, 1961

Alloptox gobiensis (Young, 1932)

(Figs. II-V)

Holotype　A right lower jaw with P_3-M_3, RV 32130.1.

Type locality　About 15 li(=7.5km) south of the lamasery Bolok in Sum, Tung Gur Basin, Nei Mongol.

Stratum typicum and age White soft marls intercalated between the red basal clays and the white upper sands and sandstones (*Platybelodon* beds). Tungguri-an, middle Miocene.

Referred material of Tongxin (arranged in localities and levels)

1. Beizuizigou level 4 (V8822.1-23): $6P_3$, $1P_4$, $1M_{1/2}$, $2I^2$, $1P^2$, $5P^3$, $2P^4/M^1$, $5M^2$.

2. Beizuizigou level 7 (V8823.1-30): $10P_3$, $1P_4$, $2M_{1/2}$, $5I^2$, $1DP^2$, $3P^2$, $4P^3$, $1P^4/M^1$, $3M^2$.

3. Beizuizigou level 11(V8824.1-28): $3DP_3$, $4P_3$, $2P_4$, $3I^2$, $2I^3$, $3P^2$, $4P^3$, $4P^4/M^1$, $5M^2$.

4. Baquan level 7-11(V8825.1-50): 8 mandibles with various number of cheek teeth or incisor; 2 maxillae with incisor or various number of cheek teeth; 40 isolated teeth: $6I_2$, $1DP_3$, $9P_3$, $1P_4$, $6I^2$, $1I^3$, $4P^2$, $7P^3$, $4P^4/M^1$, $1M^2$.

5. Baquan level 14 (V8826.1-11): $1I_2$, $1P_3$, $4I^2$, $2P^3$, $3P^4/M^1$.

6. Baquan level 15(V8827.1-19): $1I_2$, $2P_3$, $1DP_4$, $1M_{1/2}$, $5I^2$, $1P^2$, $3P^3$, $2P^4/M^1$, $2M^1$, 1 right maxilla with P^3-M^2.

7. Huangjiashuigou level 26(V8833.1-50): 18 mandibles with various number of cheek teeth, sometimes with incisor; 11 maxillae with various number of cheek teeth; 21 isolated teeth: $3I^2$, $1I^3$, $3P^2$, $3P^3$, $1P^4/M^1$, $3M^2$, $2I_2$, $3P_3$, $2M_3$.

8. Xihuangjiashuigou level 26(V8832.1-20): $2I_2$, trigonid of P_3, $2P_4$, $3M_1/M_2$, $1I^2$, $4P^3$, 1 frag. DP^4, $6P^4/M^1$.

9. Huangjiashuigou level 28 (V8834. 1-6): $1I_2$, $1DP_3$, $1M_{1/2}$, $1I^2$, $1P^4/M^1$, $1M^2$.

10. Duanbozixinggou,? level 28(V8835.1-10): $1I_2$, $2P_3$, $1I^2$, $1P^2$, $2P^3$, $1P^4/M^1$, $2M^2$.

11. Simatai level 26(V8837.1-14): $1I_2$, $2I^2$, $3P^3$, $6P^4/M^1$, $1M^2$, 1 left maxilla with P^3-M^1.

12. Yehulijuanzigou level 26(lower sand bed) (V8828.1-19): $1I_2$, $7P_3$, $1P_4$, $1M_1$, $2I^2$, $1I^3$, $4P^3$, $1M^2$, a left maxilla with P^3-M^1.

13. Yehulijuanzigou level 28 (upper sand bed) (V8829. 1-17): a right mandible with P_3-M_1; $1I_2$, $5P_3$, $1P_4$, $2I^2$, $1I^3$, $3P^3$, $3P^4/M^1$.

14. Jinjialiangnangou level 26 (V8830.1-19): $1I_2$, $5P_3$, $1M_1/M_2$, $3P^2$, $2P^3$, $4P^4/M^1$, $3M^2$.

15. Houtougou level 28(V8831): $1DP_3$.

16. ? Gunzilinggou level 26(=middle level of Beigou) (V8838.1-9): 4 mandibles with various number of cheek teeth, sometimes with incisor. 5 maxillae with P^3-M^2.

17. ? Gunzilinggou level 28 (=upper level of Beigou)(V8839): $1P^4/M^1$.

Descriptions I^2: The shaft is strongly curved. On the anterior (dorsal) surface is a wide and unsymmetrical V-shaped groove with its internal side much steeper

than its external one. The enamel covers only the anterior face of the shaft and slightly extends to the outside (fig. III-12).

I^3: The shaft is slightly backward curved, with rounded triangular cross-section, medially flat with thin enamel, anteroexternal-and posteroexternally more curved with slightly thicker enamel (fig. III-13).

P^2: Two distinct deep anterior reentrant folds divide the tooth into three lobes. The internal lobe is the largest one with an anterior acute or indistinct hook and usually a shallow reentrant fold on its anterior wall. The middle and external lobes are approximately equal. The morphology of the occlusal surface changes sometimes: On V8824.14 the three lobes are approximately equal, the internal lobe is not hook-shaped and a shallow fold present on the anterior wall of the middle lobe (fig. II-29); On V8825.35-36 there is an additional shallow fold on the anterior wall of the external lobe, one shallow fold or no fold on the internal lobe (figs. III-4,5). All the folds persist constantly to the base of the shaft and the teeth are covered by cement (fig. III-10).

P^3 is characterized by the labially bulged anterior loph. The labial end of the posterior loph acute or blunt (V8823.25, fig. II-14). A slightly worn tooth (V8823.23, fig. II-13) with short shaft consists of external, middle and internal lobes which are divided by two posteroexternally extended anterior folds: the internal anterior fold is crescent-shaped and larger than the external one. A hypostria is present, dividing the internal lobe into anterior and posterior parts. A fold presents also on the middle lobe internally. Both the hypostria and the fold on the middle lobe are filled with cement.

A slightly worn P^4 and M^2 should be described here particularly.

The slightly worn P^4 from Huangjiashuigou level 26 is together with M^1 and M^2 on a maxilla (V8833.27,fig. IV-8). It is formed by anterior and posterior lophs. The hypostria extends anteroexternally into a quarter of the occlusal surface. Labially between the anterior and posterior lophs there is an externally opened elliptical fossette, in which exist two small columns: an anterolabial and a posterolingual, they are connected through wearing. A vestigial small column is present at the external end of the posterior loph.

The M^2 from Yehulijuanzigou level 26 (V8828.18, fig. V-2) is small in size and without root. The anterior loph is wider than the posterior one. The hypostria is of two thirds of the tooth width. An unworn small column of 0.7mm high is present labially in the open valley between the anterior and posterior lophs and disappears downwards the tooth shaft.

I_2 begins at the level of talonid or trigonid of M_1.

P_3: Altogether 57 teeth, including isolated and those in the jaws, with rather large morphological variation. The occlusal surface is mostly triangle-shaped. The metaconid is angular anteriorly, transversely expanded and angular laterally too, forming a transversely elongated rhomboid. The anterointernal fold extends posteroexternally at first, then bends posterointernally; The anterior and posterior walls of the fold

are mostly parallel with each other. Two cement-filled anteroexternal folds are present, the posterior one is deeper than the anterior one. The entoconid is long, posterointernally rounded, normally with a deep (30.5%), or shallow(47.7%) lingual fold, on 22% of the teeth this fold is absent. The enamel is distinctly thinner on the posterior end and the anterior wall of the anterointernal fold, and the posterointernal corner of the entoconid. The tooth shaft is covered by the cement (figs. V-5,6).

In a few P_3 the anterointernal fold extends differently: in V8824.5 and V8822.1 (figs. II-26,6) it extends first posteroexternally, then turns to posteriorly, but its interior wall is still somewhat posterointernally directed. In V8823.2 the anterointernal fold is posteroexternally extended. In 10% of P_3 the anterior edge of the metaconid is slightly rounded (figs. II-17, III-1).

Three slightly worn P_3 should be described particularly. On V8830.2 from Jinjialiangnangou level 26 (fig. V-3) the anterior part of the entoconid is still unworn; The metaconid is angular anteriorly and laterally, and transversely extended. Two anteroexternal folds are present, the anterior one is very shallow, the posterior one deeper. The anterointernal fold extends posteriorly and persists constantly to the base of the tooth. The internal fold in the entoconid is deep but becomes shallower downwards. V8828.1 from Yehulijuanzigou level 26 (fig. V-1): The metaconid is narrow and rounded anteriorly but bcomes acute downwards. The anterointernal fold extends posteriorly, at the base of the tooth it extends first posteroexternally and then posteriorly. One anteroexternal fold is present above and two below on the tooth. The entoconid is long with a deep lingual fold persisting to the base of the shaft. V8829.2 from Yehulijuanzigou level 28(fig. V-4) is a slightly worn tooth of young individual. The metaconid is angular anteriorly and laterally. Both anteroexternal folds are well developed but the posterior one is even deeper. The anterointernal fold bends posterointernally. The entoconid is long anteroposteriorly with a deep lingual fold. The shaft becomes thicker downwards.

P_4-M_2: All are typical ochotonid pattern.

M_3:Oval to kidney-shaped occlusal surface with labial side narrow, rounded and posterior side grooved. The shaft becomes thicker downwards and curves backwards (fig. IV-3, 6,7; III-1).

DP^2 sin (V8823.19, Beizuizigou, level 7): The only one DP^2 is small (0.64 × 1.22) and low-crowned. A posteroexternally extended anterior fold divides the occlusal surface into external and internal lobes, and persists to two thirds of the tooth shaft. Two roots are present: the lingual one is long and thick; the labial one is thin, extremely short and higher positioned (fig. II-12, anterior view and occlusal view).

DP^4dex (V8832.14, Xihuangjiashuigou, level 26): The tooth is small (1.17×1.46), slightly worn and very low-crowned (1.46mm), formed by two lophs with approximate width. The hypostria is not observable because of the loss of the inner part. A small oval-shaped enamel column is present labially between two lophs and separated from them by a U-shaped fold. The column is anterointernally connected to the posterior wall of the anterior loph with an enamel "bridge", externally it merges down-

wards into the posterior loph (fig. IV-12).

DP_3 (V8824.1-3 from Beizuizigou level 11; V8834.2 from Huangjiashuigou level 28; V8831.1 from Houtougou level 28): This tooth is morphologically similar to that of *Ochotona lagreli*, formed by three anteroposteriorly followed lophs connected longitudinally with a narrow enamel bridge. The third loph is longer lingually than labially. The roots have been broken away (figs. II-20, 21, 22; V-11).

DP_4dex (V8827.4, Baquan level 15):similar to that of *Ochotona lagreli*, it consists of two anteroposteriorly followed lophs (trigonid and talonid) and is wider below than above. An unworn, transversely extended accessory loph is situated in front of the upper part of the trigonid and disappears downwards at one fourth height of the tooth. The posterior wall of the trigonid is posteriorly directed in V-shape. The trigonid is higher than the talonid. The tooth roots are broken away.

Alloptox sp.

(fig. VI)

Material V8836.1-27: a left maxilla with P^3-M^2 (V8836.7); I_2 and P_3-M_1 pertaining to a lower dentition (V8836.9); Anterior part of a pair of lower jaws with I_2 (V8836.1); $1I_2$, $4P_3$, a left lower jaw with M_1-M_2 (V8836.14), $3M_3$, $3I^2$, $2I^3$, $4P^2$, $2P^4$, $2P^4/M^1$, $2M^2$.

Locality and horizon Taoziliang; Stratigraphically perhaps higher than level 28.

Description Emphasis is placed on the P^2, slightly worn P^4, P_3 and M_3.

P^2 is rather wide. Two specimens are morphologically similar to those from other localities whereas the other two (V8836.5-6) possess two rather deep folds anteriorly on the inner lobe (figs. VI-10, 11).

P^4: It is wider below than above and without roots. The inner occlusal surface is slightly worn and the outer unworn. The hypostria extends anteroexternally, ending at one fourth width of the occlusal surface, but getting deeper into the tooth downwards. Two small enamel columns are present within the labially opened oval-shaped fossette between the anterior and posterior lophs. The anteroexternal one is visible on the external wall of the tooth but disappears at a depth of 0.63mm downwards; the other one is posterointernally situated. At the outer end of the posterior loph there is another distinct small enamel cusp which would be away with slight wear (fig. VI-13). V8836.21, P^4dex., well worn, the oval-shaped fossette has disappeared with worn and the small enamel columns become two elongated enamel rings situated in the outer part of the posterior loph (fig. VI-12).

P_3: All specimens present here are as a whole morphologically identical with the specimens from other localities of lower levels. One of them (V8836.11, fig VI-4) is slightly worn and is similar to V8830.2 (Jinjialiangnangou level 26) but the anterior anteroexternal fold is absent, the anterointernal fold extends at first posteriorly and then turns externally, at the base of the tooth it turns slightly internally. Except for this juvenile individual all P_3 of adult individual are embedded in cement (figs.

VI-1,2,3).

M_3: These three isolated teeth are quite different from each other in occlusal outline: subrectangle, rightangular trapezium and subkidney respectively, but always labially rounded and narrow. They are especially characterized by the greater length: width ratio than that of other specimens from other localities of lower levels (Table 1).

Comparison and discussion

1. The species assignment of the *Alloptox* from Tongxin

Although the *Alloptox* from Tongxin displays a rather large variation range both in morphology and dimensions due probably to the individual variation and the different stage of wear, all specimens except those from locality Taoziliang are referred to one species. The specimens from Taoziliang are assigned to a separate form mainly because of the different morphology of P^2, the greater length: width ratio and smaller size of M_3 (Table 1).

The features of the species from localities other than Taoziliang are as follows: P^2 possesses two deep anterior reentrant folds dividing the tooth into three distinct lobes, and an additional shallow anterointernal reentrant fold is present on the inner lobe. The lower incisor (I_2) begins at M_1. The P_3 is triangle-shaped. Its metaconid is mostly angular anteriorly and laterally, transversely broadened, forming a laterally extended rhomboid. Usually two anteroexternal cement-filled folds are present, the anterior one is shallower. The anterointernal fold extends at first posteroexternally, then bends posterointernally. The entoconid is long with rounded thinenameled posterointernal corner; an internal fold of different depths is usually present on its inner wall. On a few P_3 the metaconid is narrow, or rounded anteriorly, or with single anteroexternal fold, or the anterointernal fold extends posteriorly or posteroexternally, or with no fold on the inner wall of the entoconid. On an early stage of wear the anterointernal fold extends posteriorly and the metaconid rounded anteriorly.

All known species of *Alloptox* were established mainly on the morphology of P_3. According to the original descriptions as well as our observation the characters of various species are summarized as follows.

Alloptox minor Li (1978) from middle Miocene of Lantian is small-sized. The metaconid of P_3 is narrow, rounded anteriorly and interiorly, with only one anteroexternal fold. The anterointernal fold extends posteriorly. The lower incisor (I_2) begins at the talonid of P_4 (As the present authors observed, the lower incisor on the other mandible from Koujiacun begins at the trigonid of M_1 instead of P_4).

The traits of *A. chinghaiensis* (Li and Qiu, 1981) from middle Miocene of Qinghai are: Between *A. minor* and *A. gobiensis* in size; The metaconid of P_3 is narrow, rounded anterior-and interiorly, with single anteroexternal fold. The anterointernal fold extends at first posteroexternally, then bends posterointernally. The lower incisor begins anterior to the trigonid of M_1. The mental foramen is situated anterior to P_3.

Alloptox near *A. gobiensis* from middle Miocene of Tunggur (Dawson, 1961) is characterized by the larger size than *A. gobiensis*. However the present authors hold the view that it is also characterized by the P^2 which possesses only one anterior reentrant fold dividing the tooth shaft into two lobes, and with an accessory shallow anterointernal fold on the inner lobe.

Alloptox anatoliensis from middle Miocene of Anatolia (Ünay, 1976): Small in size. The metaconid on P_3 possesses single anteroexternal fold, sometimes with one more very shallow anterior anteroexternal fold. The anterointernal fold extends posteriorly or slightly bends posterointernally. The posterointernal corner of the entoconid is almost rectangular.

Alloptox sp. probably from late Miocene of Shuidongou, Ningxia province (Boule et Teilhard, 1928, p. 96, fig. 23A) is morphologically and dimensionally close to *A. gobiensis* in P_3 but with much more developed cement and lower length: width ratio of M_3 (fig. IV-15).

Apart from the above-mentioned species Erbajeva (1981, 1988) described abundant specimens from middle Miocene micromammal Улан-Тологой fauna of Mongolia, whicn she assigned to *A. gobiensis*. Judging from the description and text-figures, the morphology and size of P_3 and P^2 are similar to the specimens from type locality as well as those of Tongxin, but with wider and shorter M_3 and with I_2 beginning at the trigonid of M_2 (Erbajeva, 1981, p. 86). Because of the insufficient description and wanting of comparison specimens we prefer not to discuss the problem in detail and keep Erbajeva's assignment temporarily.

The first described species *Alloptox gobiensis* was collected from middle Miocene of Tunggur, Nei Mongol (Young, 1932), based on which Dawson (1961) coined the genus *Alloptox*. Young did not assign a holotype for his new species and Dawson did not appoint the genotype for *Alloptox* either. However, Li (1978, pp 143—145) mentioned the material described by Young (including a pair of lower jaws and a right upper jaw which belong to one individual) as the holotype of *A. gobiensis* and this species as genotype, but with no inventory number. These specimens are now given IVPP inventory number RV32130.1—3.

The sample from Tongxin other than locality Taoziliang is identical with *Alloptox gobiensis* in the morphology and size of P_3, the length: width ratio of M_3 as well as the beginning of I_2 at the level of M_1. There should be no problem to refer the Tongxin form to *Alloptox gobiensis*.

The P^2 of Taoziliang is on an average wider and morphologically more complicated. It is considered that the Taoziliang's *Alloptox* could be already a new species, or it might be in the process of speciation from *A. gobiensis*. We refer it here temporarily to *Alloptox* sp.

Table 1 and 2 show the measurements and mandible morphology of the various species of *Alloptox*.

2. Evolutionary trend of P_3 and P^2 of Alloptox

The considerally large number of specimens (57 P_3) has enabled us to have a

comprehensive view on the P_3 morphology of *Alloptox gobiensis*. The comparison of the various species of *Alloptox* demonstrates that the main difference of P_3 among species are: the size, the contour of metaconid, the number and depth of anteroexternal fold, the extension direction of the anterointernal fold. These features are rather stable in most P_3 of Tongxin, while distinct variations exist only on a few specimens. The above-mentioned features therefore can undoubtedly be considered as the criteria in the classification of *Alloptox* at the species level.

While studying *A. chinghaiensis*, Qiu and Li (1981), based on the morphology of the anterior end of metaconid and of the anterointernal fold,already divided *Alloptox* into two groups. Group I, with P_3 anteriorly rounded and its anterointernal fold extending far posteriorly; Group II, with P_3 anteriorly angular and its anterointernal fold extending posterointernally. *A. gobiensis* was referred by them to group II.

Most P_3 of Tongxin's *A. gobiensis* possess an anteriorly angular, transversely extended rhomboid-shaped metaconid with two anteroexternal folds and the anterointernal fold extending posteroexternally at first, then bending posteriorly. Only a few P_3 possess narrow, anteriorly rounded metaconid with single anteroexternal fold, and posteriorly extending anterointernal fold.

From the foregoing we infer that the simpler, narrow and anteriorly rounded metaconid with single anteroexternal fold and the posteriorly extended anterointernal fold are primitive characters of *Alloptox*; while the more complicated, anteriorly angular and transversely extended rhomboid-shaped metaconid with two anteroexternal folds and the posterointernally bent anterointernal fold are advanced or derived characters. It is suggested that the morphology of the metaconid be closely related to that of the anterointernal fold; the complication and transverse extension of the metaconid cause corresponding morphological modification of P^2. We have noticed that a few P_3 of Tongxin's specimens keep more primitive characters and some P_3 possess mixed features of primitive and derived characters. Such phenomena are as a matter of fact, universally observed in a population. We have described above a P_3 (V8828.1) from Yehulijuanzigou level 26. It seems that characters present on the top occlusal surface are primitive ones and those observed at the tooth base are advanced.

Only a few specimens of P^2 have been recovered and they are limited to *A.* near *A. gobiensis* from Tunggur, *A. gobiensis* and *A.* sp. from Tongxin, *A. gobiensis* from Улан-Тологой. The P^2 of *A. near A. gobiensis* possesses only two lobes. *A. gobiensis* of Tongxin and Улан-Тологой possesses three lobes. The inner lobe on most of P^2 from Tongxin is hook-shaped with its anterior end slightly bending externally, therefore more close to P^3 in morphology. It is probably an advanced character. The P^2 of *A.* sp. from Taoziliang is more complicated as we described above. As we know that P^2 comes into contact with the metaconid of P_3 when the upper cheek teeth occlude with the lower ones. It is reasonable to infer that the morphology of P^2 must have changed adaptively to the corresponding P_3, especially its metaconid, that is, the presence of two anterior reentrants and the complexity of internal lobe on P^2 of Taoziliang is an adaptation to the transversely extended and anteriorly angular metaco-

nid with double anteroexternal folds. Such changes are of significance for more effective mastication.

A speculation about the evolutionary trend of P^2 and P_3 of *Alloptox* is given as follows:

1. The P_3 of the most primitive species of *Alloptox* may possesses round-headed and narrow metaconid.

2. Due to the dominant transverse masticatory movement a transversely extended but still round-headed metaconid is developed with initial enamel differentiation in thickness.

3. Some well-adaptable species developed even wider metaconid with two anteroexternal folds, more differentiated enamel——thicker at the anterior end, forming anteriorly angular metaconid.

4. Corresponding to the morphological change of the metaconid, the extension of the anterointernal fold changed to be posterointernal and the P^2 becomes wider and more complicated.

3. The geological age of *Alloptox gobiensis*

The holotype of *Alloptox gobiensis* was recovered in the bed directly under the *Platybelodon*-bed of Tunggur without any associated mammals. The excavation carried out by Qiu and colleagues of IVPP in 1986 recovered abundant micromammals, including *A. gobiensis*, from *Platybelodon*-bed which was thought to be Tunggurian in age, comparable with the European land mammal unit MN 7—8 (Qiu Zhuding 1988, Qiu Zhanxiang *et al.* 1988). The micromammal fauna from the third bed of Улан-Тологой, in which *A. gobiensis* is included, was considered by Бадамгаров et al. (1975) to be comparable with that of Сарыбупакскии Formation, and similar to the Tunggur fauna.

Studies on the associated macromammals of Tongxin indicate that *Alloptox gobiensis* could appear prior to Tunggurian (MN 7—8). *Pliopithecus* sp. (Qiu and Guan 1986) and *Kubanochoerus lantienenensis* (Qiu et al., 1988) from Maerzuizigou (=Beizuizigou level 14), *Percrocuta primordialis* (Qiu et al. 1988) from Maerzuizigou and Yinziling (=Beizuizigou level 14) and *Platybelodon tongxinensis* (Ye *et al.* 1986) from Dingjiaergou (=Beizuizigou level 14), Shataigou (level 19), Yuetaizi (level 19) suggest that the lower levels in the studied area of Tongxin be probably MN 6 in age. As to the ages of the upper levels (levels 20—28) we prefer to leave it open before the result of the studies on the associated mammals are available. However it can now be accepted that the existence of *A. gobiensis* last probsbly from MN 6 to MN8.

The P^2 of *Alloptox* sp. from locality Taoziliang is morphologically more complicated, namely, more advanced. The associated fossil is only a tusk segment of *Amebelodon* which occurs in Clarendonian and Hemphillian in North America, that is, later than Tunggurian. The geological background of this locality is still unclear.