THE DISCOVERY OF Pliopithecus FROM NORTHERN JUNGGAR BASIN, XINJIANG

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Abstract A new species of Pliopithecus - P. bii sp. nov., is erected on dental morphology of

Pliopithecus bii sp. nov.
m2 and m3 and a central lower incisor, which were collected from the early Middle Miocene Halamagai Formation of Tieersihabahe in the northern Junggar Basin of Xinjiang Uygur Autonomous Region, China. The new species is especially characterized by a deep buccal funnel, which is enclosed by the cristid obliqua, the crest descending along the buccal slope of protoconid, and the buccal branch of prehypocristid. One P4 collected from near the same locality is assigned to *Pliopithecus* sp. because of its smaller size in relation to the m2 and m3. The associated mammal fauna of *P. bii* is approximately comparable to Tongxin fauna. Consequently *P. bii* is of early Middle Miocene in age, equivalent to the European Neogene land mammal age MN6. The high similarity between *Dionysopithecus* shuangouensis and *Pliopithecus* especially *P. bii* supports the inference made by Harrison and Gu (1999) that pliopithecini (*Pliopithecus*) was derived from an Asian rather than an African source.

**Key words** Xinjiang, northern Junggar Basin, early Middle Miocene, *Pliopithecus*

![Sketch map of Ulungur River Region of the northern Junggar Basin indicating *Pliopithecus* locality 98017](image)

During the 1997 and 1998 field seasons four *Pliopithecus* teeth were found in the second sands at the bottom of Halamagai Formation of Tieersihabahe, northern Junggar Basin (Fig. 1 and Fig. 2). The m2 and m3 were found at site 98017 (46°39.997'N, 88°30.412'E), and the il and P4 were collected near this site. Site 98017 is located east to the 00TEe section (Ye et al. 2001a). The sediment is much thinner at locality 98017 than at section 00TEe. Site 98017 is the second *Pliopithecus* locality in China in addition to Tongxin of Ningxia. It is therefore necessary to make it known to the public, though the material is limited. Morphologically the il is typical of the pliopithecines, the three cheek teeth are also of pliopithecine but different from those of all known *Pliopithecus* species. The classification and nomenclature here adopted are after Harrison and Gu (1999).

![Sketch geological section at *Pliopithecus* locality 98017](image)
Order Primates Linnaeus, 1758
- Infraorder Catarrhini Geoffroy, 1812
  - Superfamily Pliopithecioidea Zapfe, 1961
    - Family Pliopithecidae Zapfe, 1961
      - Subfamily Pliopithecinae Zapfe, 1961
        - Genus Pliopithecus Gervais, 1849
          - Pliopithecus bii sp. nov. (Fig. 3, 2a ~ 2c, 3a ~ 2c; Fig. 4)

Holotype [Left m2 and m3 from one individual, V 13323.1 - 2.]

Type locality, horizon and age [Site 98017 at Tiersihabahe in northern Junggar Basin of China, 46°39.997′ N, 88°30.412′ E. The second sands from the bottom of Halamagai Formation, early Middle Miocene.]

Etymology [In honor of Mr Bi Shundong who found the Holotype.]

Diagnosis [Pliopithecus characterized by, and differing from all other known species of Pliopithecus in m2 and m3 having a deep buccal funnel ,which is enclosed by the cistid obliqua ,the crest descending along the buccal slope of the protoconid and the buccal branch of the prehypocristid. Besides it is characterized by m2 and m3 having slender and low cusps and sharp crests ,developed enamel wrinkles and distinct pliopithecine triangle ,by m3 being slightly shorter and smaller in area than m2.]

Referred specimen [A right il (V 13324) found from nearby the type locality in the level where the holotype was collected.]

Measurements (in mm)
- il 3.02 × 1.58 (Length × breadth of occlusal surface), 2.30 × 3.38 (at base of crown), remained crown height 3.6mm, remained root height 11.82mm
- m2 7.70 × 6.80 (Length × breadth), Breadth/length index 88.3
- m3 7.36 × 6.40 (Length × breadth), Breadth/length index 86.95
- m2/m3 size differential in area is 100:89.95

Description [The m2 and m3 are obviously from a single immature individual because m2 is only slightly worn and m3 is partially erupted so that its occlusal surface is completely fresh with the enamel being incompletely developed at the crown base. The m3 is slightly shorter and narrower, and smaller in area than the m2. The cusps are slender and not highly elevated. The enamel surface is wrinkled with secondary crestlets.]

The m2 is rounded rectangle in shape with a slight buccal constriction (waisting) midway along its length. The crown is slightly broader in its mesial moiety than in its distal moiety. The five main cusps are subequal in size. A mesostylid is present, which is at the distal end of the cingulum high up on the lingual wall of the metaconid.

Four sharp crests originate from the protoconid apex. 1) The protoprotocristid is sharp and terminates mesially at the margin of the crown. 2) The hypoprotocristid extends lingually to meet the hypometacristid, forming the distal trigonid crest parallel to the mesial margin of the tooth. 3) The postprotoconid extends mesial-distally and is in alignment with the protoprotocristid, and meets the prehypocristid posteriorly, forming the cristid obliqua, which is slightly obliquely oriented in relation to the longitudinal tooth axis. A V-shaped notch between the postprotoconid and the prehypocristid can be seen from buccal view. A lingual branch of the postprotoconid runs distolingually and terminates in the talonid basin, forming the mesial arm of pliopithecine triangle. 4) The fourth crest descends distobuccally along the buccal slope of the protoconid and terminates at the buccal cingulum.

The metaconid is located slightly distal to the protoconid. From the metaconid descend three sharp cusps: 1) The premetacristid runs mesially and ends at the margin of the crown. 2) The postmetacristid extends distally and meets the preprotoconid. Between the two cistids is a V-shaped notch. 3) The third crest is the hypometacristid, which extends labially to meet the hypoprotocristid.
High around the lingual wall of the metaconid is a developed cingulum. From the hypoconid apex originate three sharp crests: 1) The prehypocristid, which is only slightly obliquely oriented. A buccal crest branches out halfway along the prehypocristid, which runs buccomesially till the buccal cingulum, and encloses a deep funnel together with the cristid obliqua and the crest on the buccal slope of the protoconid. 2) The distal arm of pliopithecin triangle extends mesiolingually, and terminates and bifurcates in the center of the talonid. 3) The posthypocristid extends distolingually and meets the prehypoconulid cristid.

![Fig. 3 Cheek teeth of *Pliopithecus* from Middle Miocene Halamagai Formation of Loc. 98017 in northern Junggar Basin, Xinjiang, X6](image)

1. Left P4 of *Pliopithecus* sp., V 13325, 1a. buccal view; 1b. occlusal view; 1c. lingual view
2. Left m2 of *Pliopithecus bii* sp. nov., V 13323.1, holotype, 2a. buccal view; 2b. occlusal view; 2c. lingual view
3. Left m3 of *Pliopithecus bii* sp. nov., V 13323.2, holotype (from the same individual as m2), 3a. buccal view; 3b. occlusal view; 3c. lingual view

The hypoconulid is located distolingually to the hypoconid and slightly buccal to the longitudinal axis of the tooth. Four crests originate from the hypoconulid apex: 1) The prehypoconulid cristid descends mesiobuccally and meets the posthypocristid mesially. 2) The postcristid runs
mesiolingually, terminates and bifurcates in the talonid basin. 3) The posthypaconulid cristid extends along the distal margin of the tooth. 4) The fourth crest passes along the steep buccal slope of the hypaconulid and meets the buccal cingulum below.

Three crests originate from the apex of the entoconid: 1) The preentoconid cristid extends mesially and nearly meets the postmetacristid with a notch in between, forming the mesial boundary of the distal fovea. 2) The postentoconid cristid extends distally, then turns buccally along the distal margin, defining the distal fovea posteriorly. 3) The hypoentoconid cristid descends along the buccal slope of the entoconid, terminates in the talonid basin, and almost meets the postcristid with a notch in between, forming the mesial boundary of the distal fovea.

The trigonid basin (mesial fovea) is transversely extended and very slightly obliquely oriented. It is narrower and higher than the talonid basin. A paraconid is indistinct.

The buccal cingulum is well developed and beaded, extends from the mesial side of the protoconid to the distobuccal side of the hypaconulid and weakens below the hypoconid.

The m3 is quite similar to the m2 in morphology with the following differences: 1) The tooth is distinctly narrowed distally. 2) The hypoconulid is located more buccally and nearly in alignment with the protoconid and hypoconid. 3) The postcristid does not meet the hypaconulid cristid but the postentoconid cristid. 4) The hypaconulid cristid bifurcates whose mesial branch is short and ends in the talonid basin, while the distal branch extends mesiobuccally until to the lingual slope of the hypoconid, so that the distal fovea is differently defined on m3 from that on m2. 5) The distal crest arches forward probably because of incompletely developed enamel. 6) The hypoprotocristid extends against the hypometacristid but is not connected with the latter, the trigonid basin is therefore confluent with the talonid basin. 7) The mesostylid and the lingual cingulum on the metaconid are less developed.

The right i1 is chisel-like, and mesiodistally waisted towards the base of the crown. It is rather worn but seems high-crowned judging from the remained crown height. From lingual view the mesial margin is slightly more oblique than the distal margin. The buccal surface is vertical and flat while the lingual surface slopes down lingually. The lingual surface is smooth with an indistinct vertically extended ridge near the distal margin. The root is rather long (about 12mm), slightly curved distally and very slightly damaged at the tip.

Comparison Because of the limited material available from Xinjiang, the comparison and discussion are restricted to the i1 and m2−m3.

The Xinjiang form possesses rather high-crowned central incisor. Its m2 and m3 have distinct pliopithecan triangle, well-defined mesial and distal foveae, slightly obliquely oriented mesial margin, mesial fovea and cristid obliqua, and a much developed buccal cingulum. The m2 hypoconulid is located distolingually to the hypoconid and slightly buccal to the longitudinal axis of the tooth, and the m3 hypoconulid is located more buccally and nearly in alignment with the protoconid and hypoconid. Besides, the m2 and m3 possess a distinct cingulum high around the lingual wall of the metaconid and a mesostylid at the distal end of the cingulum. All these features are identical to those of Pliopithecus. Therefore the Xinjiang form should be assigned to the genus Pliopithecus, although its m3 is slightly smaller in area than m2.

Compared with all known Pliopithecus species the Xinjiang Pliopithecus is characterized particularly by a deep buccal funnel that is enclosed by the cristid obliqua, the crest on the protoconid buccal slope, and the buccal branch crest of the prehypocristid. This feature distinguishes the Xinjiang species from other known species of the genus. In addition, the Xinjiang species differs from other species respectively in the following characters on m2 and m3.

It differs from P. zhanxiangi (Harrison et al. 1991, Qiu and Guan 1986) of the early Middle Miocene from Tongxin, Ningxia in having 1) smaller size; 2) less elevated and less voluminous cusps and crests; 3) a greater degree of enamel wrinkling; 4) more distinct or developed pliopithecan triangle; 5) much more developed and beaded buccal cingulum; 6) larger and well-defined mesial and distal foveae; 7) much more developed cingulum on lingual wall of the metaconid; 8) m3 being slightly
shorter and smaller in area than m2.

It differs from European Miocene (MN5–8) *P. antiquus* (Roger, 1898; Stömer, 1928; Hürzeler, 1954; Bergounioux and Crouzel, 1965; Heissig and Fiest, 1987; Ginsburg, 1990; Andrews et al., 1996; Köhler et al. 1999; Môrs et al., 2000) in having much larger size, much more wrinkled enamel, much more developed and beaded buccal cingulum, and in m3 being slightly shorter and smaller in area than m2. We noticed that the m3 of *P. antiquus* from Mantheian of France (Hürzeler, 1954; Bergounioux and Crouzel, 1965) is also shorter than m2, which Andrews et al. (1996) considered as intraspecific variation.

Its size falls within the size-range of *P. platyodon* from Miocene (MN5–6) of Göriach of Austria and Elgg of Switzerland (Hofmann, 1893; Hürzeler, 1954). It differs from *P. platyodon* in having better-developed buccal cingulum, and m3 being slightly shorter and smaller than m2. In contrast, the lower molars of *P. platyodon* increase posteriorly in size. Otherwise, the Xinjiang species is quite similar to *P. platyodon*.

It differs from latest Early Miocene *P. vindobonensis* of Slovakia (Zapfe and Hürzeler, 1957; Zapfe, 1960) in having more developed and distinct ploipithecine triangle, in the breadth/length ratios of m2 and m3 of the Xinjiang form being higher than those of *P. vindobonensis* (Harrison et al., 1991: Table 2; Bergounioux and Crouzel, 1965: Table on p. 61). Finally, its m3 being slightly
shorter and smaller than m2, while the lower molar size of *P. vindobonensis* is greatly increased from m1 to m3.

*P. priensis* from earliest Late Miocene (MN9) of France (Welcomme et al., 1991) was established on only a right mandible with m[f][2]. It is similar to *P. zhanxiangi* in size and with small size differences between m1 and m2 (Andrews et al., 1996). It is undoubted that the Xinjiang form is a separate species from *P. priensis*.

**Discussion** The above comparisons demonstrate that the Xinjiang form is different from all known *Pliopithecus* species. We therefore name a new species, *Pliopithecus bii*.

*Pliopithecus bii* is the second *Pliopithecus* species found in China. The first Chinese *Pliopithecus* species is *P. zhanxiangi* (Harrison et al., 1991; Qiu and Guan, 1986) from Tongxin of Ningxia, which is about 1700km apart from Tieershabahe. We have enumerated the morphological differences between these two species. As a whole *Pliopithecus bii* is smaller and slender than *P. zhanxiangi*, which possesses voluminous and rounded cusps and crests. Among all *Pliopithecus* species *P. bii* is more similar to the European species than to *P. zhanxiangi* in slenderness, in larger mesial and distal foveae, and more developed enamel wrinkles. The dental morphological differences imply, as we consider, that *P. bii* has closer affinities with European species than with *P. zhanxiangi*, or they might reflect different ecological adaptations and different diet. However confirmation of this inference needs adequate material and further study of these fossil animals.

When studied the enlarged sample of *Dionysopithecus shuangouensis* and *Platodontopithecus jianghuaiensis* from Shihong Jiangsu, and based on analysis of characters in dental, cranial as well as postcranial morphology, Harrison and Gu (1999) established for these two genera a new subfamily Dionysopithecinidae under the family Pliopithecidae. Pliopithecidae was considered as the sister subfamily of Dionysopithecinidae, and was subdivided into two tribes: Crouzeliini and Pliopithecini. *Pliopithecus* is the only genus of tribe Pliopithecini. According to Harrison and Gu (1999), these two subfamilies share several derived features on lower incisors and lower molars besides those on P3 and upper central incisors, including: 1) lower incisors mesiodistally waisted towards the base of the crown; 2) presence of a distinct pliopithecine triangle on lower molars (at least on m[f][2] 3); 3) a relatively long trigonid that is narrower than the talonid, at least on m1; 4) the mesial crest linking the metaconid and protoconid is obliquely oriented; and 5) the cristid obliqua is obliquely aligned relative to the long axis of the crown. According to Harrison and Gu (1999: Table 10, Node 5), the lower molars of Dionysopithecinidae are distinguished from those of Pliopithecinae by the high incidence of a well-developed mesostylid and m3 being smaller in area than m2.

We found that *Dionysopithecus shuangouensis* is very similar to *Pliopithecus* although they are assigned to different subfamilies. The *D. shuangouensis* is much more similar to *Pliopithecus bii* than to *Platodontopithecus jianghuaiensis* in dental morphology. In addition to the above-mentioned features shared by these two subfamilies, the m2 and m3 of *D. shuangouensis* and of *Pliopithecus bii* are further similar with each other in having developed pliopithecine triangle, in having distinct, sharp occlusal crests (contrary to what Harrison and Gu (1999, p. 232) mentioned that the upper and lower molars of Dionysopithecinidae possess "low, rounded cusps and crests"), well-defined mesial and distal foveae, moderately developed mesostylid, m3 being smaller than m2, similar enamel wrinkles, and the distinct cingulum up on the lingual wall of the metaconid and the crest descending from the protoconid which is downwards along the protoconid buccal slope till to meet the buccal cingulum. We consider these common features as their synapomorphic characters. Of course, *D. shuangouensis* is different from *Pliopithecus bii* in a few features. Its m2 and m3 differ from those of *P. bii* in being much smaller in size, in having much longer and narrower tooth crown, in having slightly higher cusps and greater occlusal relief, in having more elevated and more obliquely directed trigonid basin (mesial fovea), more obliquely oriented cristid obliqua, smaller and more lingually situated hypoconulid as well as the less developed buccal cingulum. These differences indicate that *D. shuangouensis* is more primitive than the Xinjiang form.
We noticed that the m2 and m3 of Platodontopithecus jianghuaiensis have "low, rounded cusps and crests" (Harrison and Gu, 1999: p. 232) and the relevant ill-defined mesial and distal foveae, less developed buccal cingulum, much more developed and seeming isolated mesostylid, and absence of a cingulum on the lingual wall of metaconid. Pliopithecus bii can be easily distinguished from it mainly by smaller size, much more distinct crests, well-defined mesial and distal foveae, a much more developed buccal cingulum, less developed mesostylid, and more distinct cingulum on the lingual wall of metaconid. These features also differentiate D. shuangouensis from Platodontopithecus jianghuaiensis.

It should be emphasized that the mesostylid on the lower molars of Platodontopithecus jianghuaiensis is significantly different from that of Pliopithecus bii and Dionsyopithecus shuangouensis. The mesostylid on the m2 and m3 of the former is large and isolated, and the mesostylid of the latter two species is small and is the end part of the cingulum on the lingual wall of the metaconid, as in other Pliopithecus species (at least P. platyodon, P. antiquus, P. zhanxiangi, P. vindobonensis). This indicates that the mesostylid and the cingulum on the lingual wall of the metaconid of Pliopithecus and Dionsyopithecus shuangouensis is very probably homogenous character. However, the mesostylid in Platodontopithecus jianghuaiensis is probably non-homologous with that in Pliopithecus and Dionsyopithecus shuangouensis. Harrison and Gu (1999: p. 265, Table 10, Node 4) indicated that Dionsyopithecus and platodontopithecus share the feature in lower molars "with a high incidence of a wall developed mesostylid". Because the mesostylid in Pliopithecus bii and Dionsyopithecus shuangouensis and the mesostylid in Platodontopithecus jianghuaiensis are non-homogenous we may not compare the incidence of the different types of mesostylids in these forms.

Further, we have noticed that the frequency of mesostylid is not very low in Pliopithecus, at least it can be recognized in most observed specimens. In consideration of the foregoing analysis the classification of Pliopithecoida might be reevaluated after detailed study and more material being available.

Another feature shared by Dionsyopithecus shuangouensis and Pliopithecus bii is that the m3 is shorter and smaller than m2. Because there is only a single m2 and single m3 from one individual of Pliopithecus bii from Tieersihabahe we may not assert whether it is the character of the species or it is simply individual variation.

Taking account of the high similarity between Dionsyopithecus shuangouensis and Pliopithecus we suspect that Dionsyopithecus shuangouensis is more closely related to Pliopithecus, at least Pliopithecus bii, than to platodontopithecus jianghuaiensis. Pliopithecus bii could be derived from Dionsyopithecus shuangouensis-like ancestor or its close relative.

Pliopithecus sp.
(Fig.3.1a-c)

Material □ A left P4 (V 13325).
Measurement (in mm) □ Length × breadth of occlusal surface: 3.91 × 4.69.
Description □ The tooth is unworn with the crown much higher labially than lingually. It seems not fully developed. It is oval in occlusal outline with parallel mesial and distal margins. Three main cusps are present: paracone, protocone and hypocone.

The paracone is high and buccal-lingually compressed. It is positioned almost midway mesiodistally. The preparacrista and postparacrista are sharp and in alignment mesiodistally. The preparacrista descends mesially and terminates at the parastyle. The postparacrista descends distally and ends at a style on the marginal ridge. Both styles are pillar-like that project buccally and slightly converge towards the crown base.

The protocone is low and located slightly mesial to the paracone. It is ridge-like but quite
bulged and the lingual wall is vertically positioned. The preprotocrista curves mesiobuccally and is continuous with the mesial margin ridge, while the postprotocrista descends distolingually to the hypocone.

The hypocone is even lower than the protocone and also ridge-like but slightly thickened. A crest extends from the hypocone distobuccally and continues with the distal margin ridge.

Mesiolingually at the base of the paracone originates a crest (hypoparacrista) that extends parallel to the mesial margin and terminates at the protocone on halfway of the protocone height and slightly mesial to the apex of the protocone. Together with the mesial margin crest, preparacrista and preprotocrista, it delimits the mesial fovea. Distolingually at the base of the paracone originates another crest that runs mesiobuccally and terminates midway and bifurcates in the basin. Opposite to this crest, slightly distal to the apex of the protocone, extends a short crest from the base of the protocone, the distal fovea is thus confluent mesially with the central basin. Both mesial and distal foveae are much lower than the central basin.

No lingual and buccal basal cingula are present. However we may not conclude whether they are present or not because the tooth crown is not fully developed, it is extremely fresh and lacks roots.

Comparison

The P4 from Tieersihabahe is recognized as *Pliopithecus* for it is similar to those of *Pliopithecus* species in having two transverse lophs across the tooth basin, and in the presence of a parastyle and a distal style as in P4 of *P. vindobonensis* and *P. platyodon*, though the P4 of *P. zhanxiangi* possesses only one transverse loph. The Tieersihabahe P4 is very narrow in relation to the length, which differs from the P4 of all known *Pliopithecus* species in which P4 are usually wider than long. In addition it is particularly small in relation to the m3 of *Pliopithecus bii*. The ratio is much smaller than those in other species (see Table 1). It will therefore be reasonable not to refer this P4 to the new species but to a nomenclatura aperta. We noticed that the Tieersihabahe P4 also resembles that of *Dionysopithecus shuangouensis* in possessing two transverse lophs in the tooth basin, as well as the metastyle and distal style. However its protocone is located more mesially than in *D. shuangouensis* and it has an initial hypocone, which is absent in the P4 of *D. shuangouensis*.

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<tr>
<th>Table 1</th>
<th>Size differential of P4 to m2 and m3 of <em>Pliopithecus</em> species</th>
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<tr>
<td>Species</td>
<td>Size ratio of P4/m2</td>
</tr>
<tr>
<td>Xinjiang material</td>
<td>3.91 × 4.69/7.7 7.6 8 0.35</td>
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<tr>
<td>P. zhanxiangi</td>
<td>40.3 (n = 4)/47.6 (n = 3) = 0.60</td>
</tr>
<tr>
<td>P. vindobonensis</td>
<td>29.4 (n = 2)/42.3 (n = 3) = 0.695</td>
</tr>
<tr>
<td>P. platyodon</td>
<td>31.5/43.8 = 0.719</td>
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*The measurements used for calculation is after Harrison et al., 1991.
**The measurements used for calculation is after Zafe, 1960, p. 17.
***The measurements used for calculation is after Hofmann, 1893, p. 15.

Tongxin fauna in composition, and is considered as early Middle Miocene (Qiu et al., 1999; Ye et al., 2001a,b) in age, equivalent to the European Neogene land mammal age MN6. A better age determination of the fauna should be made after a detail study of the fauna.

The genus *Pliopithecus* has occurred in Miocene of Eurasia, including Spain (Harrison et al., 2002), France, Switzerland, Germany, Austria, Slovakia, Poland and China (Andrews et al., 1996; Köhler et al., 1999). Its earliest appearance is in MN5 of Europe (France, Germany, and Switzerland). The new locality from Xinjiang is about 1700km far from Tongxin and nearly 3000km from Shihong. Poland is about 4860km away from Xinjiang locality. The occurrence of *Pliopithecus* in Xinjiang increases the density of its geographical distribution between Asia and Europe. The high similarity between *Dionysopithecus shuangouensis* and *Pliopithecus bii* supports the inference made by Harrison and Gu (1999) that pliopithecins were derived from an Asian rather than an African source. New finds of *Pliopithecus* of earlier age, at least MN5 equivalent, are expected in North China.

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**References**


Schwaben und Neuburg in Augsburg, 33:1~46