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News and Views

A new middle Miocene pliopithecid from Inner Mongolia, China

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Introduction

In the nearly 80 years since the American Museum of Natural History Central Asiatic Expeditions first discovered fossil mammals in Inner Mongolia, subsequent paleontological research in the region has resulted in the recovery of extensive collections of Neogene mammals (Qiu et al., 2006). However, no primates have been found in this area, with the possible exception of one heavily worn M3 from Ertemte, described by Schlosser (1924) as *Pliopithecus posthumus*, but whose primate status has been questioned (see Harrison, 2005). During the past two decades, the discovery of several species of pliopithecids from the Miocene of China has contributed greatly to understanding the evolutionary history of this group. Pliopithecids are first represented in China by *Dionysopithecus* and *Platodontopithecus* from the late early Miocene of Sihong, correlated to ~17–18 Ma (Harrison and Gu, 1999). During the middle Miocene, at ~15 Ma, *Pliopithecus* sp. and *Pliopithecus zhanxiangi* are recorded at localities in Gansu Province and Xinjiang and Ningxia Hui Autonomous Regions (Harrison et al., 1991; Wu et al., 2003; Deng, 2003). Finally, *Laccopithecus robustus*, a crouzeliine pliopithecid, is known from the late Miocene (~6–7 Ma) of Shihuiba, Lufeng County, Yunnan Province (Wu and Pan, 1985; Pan, 1988; Pan et al., 1989).

During a field excursion in 2006, a team led by the first author found a productive middle Miocene mammal locality in Siziwangqi, Inner Monglia, which has produced a large collection of fossil mammals, including one well-preserved upper molar of a pliopithecid. The tooth has a unique suite of morphological features that indicate that it belongs to a species that has not previously been recognized. In addition, it has several specializations that can be inferred to be synapomorphies linking the specimen to crouzeliines. This find extends the geographic distribution of pliopithecids in China, but also raises interesting questions about the ecology and environmental change in eastern Asia during the middle Miocene/late Miocene transition. These changes may have had an important impact on the biogeography and evolution of pliopithecids and their associated faunas.

Geology, fauna, and biochronology

The Siziwangqi fossil locality of Damiao 01 is situated in the central region of Inner Mongolia, near Damiao village (N 42°00'31.4''; E 111° 34'50''; Fig. 1). A small gulley near Shara Murun River, with gently undulated slopes, exposes an outcrop with a section of about 20 m. Fossils were recovered from a gravel lens in horizontally bedded brown silty clays. Pebbles from this lens mainly consist of carbonate nodules, and a small proportion of quartz and feldspar. An initial survey and screen washing at the locality have yielded over 200 isolated mammalian teeth. Preliminary study of these fossils (Table 1) indicates a middle Miocene fauna comparable in many respects to that of the type Tunggurian fauna (late middle Miocene) (Qiu, 1996). However, the occurrence of primitive *Prosiphneus*, rather than *Plesiodipus lupinus* (which is the possible ancestor of *Prosiphneus*), and abundant *Euprox*, suggest that the Damiao fauna might be slightly younger than the Tunggurian fauna. In addition, ochotonids are represented

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Fig. 1. Location map showing Pliopithecid localities in China.

by *Bellatona* (the typical form from the middle Miocene), rather than *Ochotona* which has its earliest record in the late Miocene. The geological age can be provisionally considered as latest middle Miocene.

Table 1
Mammalian fossils from Damiao 01, Inner Mongolia

Carnivora	indet.
Artiodactyla Cervidae	*Euprox* sp.
Insectivora Erinaceidae	*Mioechinus* sp.
Primates Pliopithecidae	indet.
Rodentia Sciuridae	*Eutamias* sp.
Aplodontidae	*Ansomys* sp.
Cricetidae	*Prosiphneus* sp.
Gliridae	indet.
Eomyidae	indet.
Dipodidae	*Heterosminthus* sp.
Castoridae	*Eucastor tungurensis*
Lagomorpha Ochotonidae	*Bellatona forsythmajori*

Description

The specimen (V 15447) is the upper molar of a young adult individual, as indicated by the slight wear on the cusps (Fig. 2). It is relatively large (Table 2), being slightly larger than *Pliopithecus zhanxiangi*, but comparable in size to the late Miocene crouzeliines, *Anapithecus* and *Laccopithecus*. The occlusal surface is rectangular in outline, with a shorter length than breadth. The buccal length is slightly shorter than the lingual length, while the width of the trigon portion is slightly broader than the talon due to expansion of the buccal and lingual cingula. The paracone and metacone are sharp, steep and conical, while the protocone and hypocone are relatively blunt and more lingually inclined. The paracone is similar in size to the metacone, but slightly higher. Both the paracone and metacone have a prominent buccal rib. The protocone is not as elevated as the buccal cusps, while the

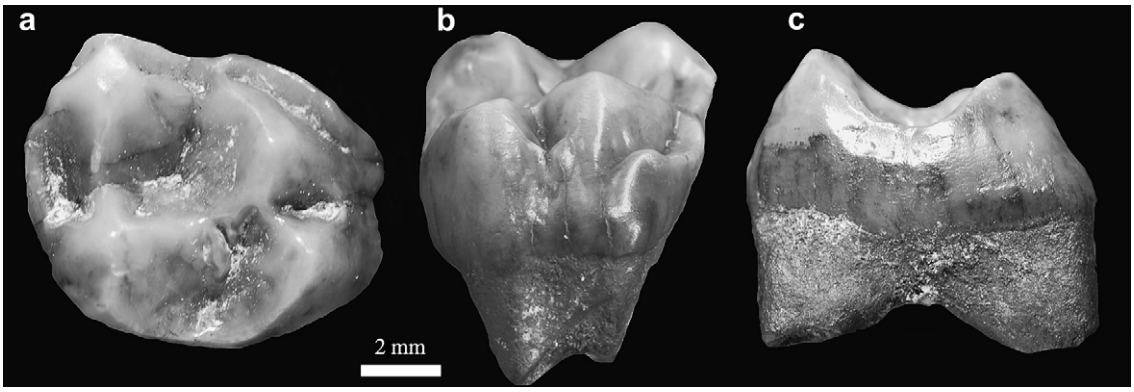

Fig. 2. Pliopithecid upper molar (V 15447) from Damiao 01, Inner Mongolia, China. (a) Occlusal, (b) lingual, and (c) distal views.

hypocone is the lowest cusp. The preparacrista, postparacrista, premetacrista, and postmetacrista are longitudinally aligned with the cusp tips of the paracone and metacone. The preparacrista terminates at a well-developed and protuberant parastyle on the mesial margin of the crown. A narrow groove separates the postparacrista and premetacrista. The protocone is the most voluminous cusp. The preprotocrista and hypoprotocrista are connected to the hypoparacrista and hypometacrista to enclose the trigon basin. The hypocone is set slightly lingually to the protocone. The prehypocrista is connected to the postprotocrista midway along the length of the crown. The posthypocrista diminishes towards the posterior edge of the tooth, leaving the distal fovea widely open distally. Large and small enamel ridges occur on the distal margin of the crista obliqua. A kidney-shaped mesial fovea is enclosed by the preparacrista, mesial marginal ridge, paraconule, and hypoparacrista. A short cingulum is developed along the mesiolingual side of protocone. The buccal cingulum is low and short, and restricted to the buccal side of the paracone. There are three roots. The lingual root is large; the buccal roots are smaller and mesiodistally compressed. The shape of the crown and the presence of mesial and distal contact facets indicate that this specimen is either an M1 or M2. Given that the crown tapers lingually, the talon width is narrower than that of the trigon, the lingual cingulum is not so well-developed, and the paracone is slightly buccally displaced, the specimen is most likely to be an M1 rather than M2.

Comparisons

The Damiao specimen differs from the upper molars of all other pliopithecoids in being relatively high-crowned, with tall conical cusps, strongly developed occlusal crests, and deep and well-defined basins. It can be further distinguished from *Dionysopithecus*, *Platodontopithecus* and *Pliopithecus* by its larger size, narrower crown (except *Dionysopithecus*) that tapers lingually (with a trigon that is only slightly broader than long), less well-developed lingual cingulum, and the absence of wrinkled enamel in the distal basin. Unfortunately, the upper molars of crouzeliine pliopithecids are known only for *Laccopithecus* and *Anapithecus*, so potential comparisons are limited. In several respects, however, the Damiao specimen shares unique characteristics with *Anapithecus* and *Laccopithecus* that can be considered to be derived features of crouzeliines. These include a relatively narrow crown that tapers lingually, a trigon basin that is only slightly broader than long, a well-developed and protuberant parastyle, a reduced lingual cingulum that does not continue uninterrupted around the lingual face of the protocone, and a distal basin with minimal wrinkling. The Damiao specimen is less advanced than *Anapithecus* and *Laccopithecus* in having a relatively broader crown, a relatively smaller and broader trigon basin, and less pronounced buccolingual flare. These comparisons suggest that the Damiao specimen probably belongs to a primitive crouzeliine, similar in size to *Laccopithecus* and *Anapithecus*, but differing from them in its detailed morphology and proportions.

Table 2
Measurements of V 15447 from Damiao 01 (mm)

Buccal length 7.5	Lingual length 7.4
Trigon breadth 9.3	Talon breadth 9.0
Crown height (at metacone) 5.3	Buccolingual breadth 9.3

Discussion

Although a diversity of pliopithecid taxa are known from a wide geographic and temporal range (from Spain to China and throughout the Miocene), the taxonomic and phylogenetic relationships within this group are still the subject of debate (Harrison et al., 1991; Andrews et al., 1996; Begun, 2002; Harrison, 2005). The present specimen contributes little to this issue, at least until more material becomes available with further excavations at Damiao, but it possibly implies the presence of a previously unrecognized species of primitive crouzeliine pliopithecid and a greater taxonomic diversity in the middle Miocene of China. However, the occurrence of several species of middle Miocene pliopithecids in mid-latitudes in China leads to an interesting question. Were they living in

warm humid forest habitats or were they occupying relatively dry grasslands or woodlands under strong seasonality? Detailed study of the paleoecology of pliopithecid localities in China should help resolve this issue. Nevertheless, it is possible to speculate that the absence of primates in northern China during the late Miocene might be related to the onset of the East Asian Monsoon, which produced a dry and strongly seasonal climate at mid-latitudes in central and eastern Asia. The mid-Miocene climate optimum (17–15 Ma) was followed by a gradual cooling, a global ocean-climate system marked by increased zonality, and profound changes in vertical thermal gradients (Zachos et al., 2001). In Europe, pliopithecid diversity declined during the middle and late Miocene in response to these climatic changes, and only crouzeliines survived beyond the mid-Vallesian (~10 Ma; Andrews et al., 1996). Further work is needed to establish whether or not middle and late Miocene pliopithecid diversity in northern China was impacted in a similar fashion to Europe as result of climatic and ecological change.

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