A Possible New Amphicyonid from the Miocene of the Linxia Basin

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Abstract

Here we report a new form of amphicyonid from an uncertain locality in the Linxia Basin. The derived dental traits imply an affinity to Magericyon, previously known from Europe and possibly southern Asia. The specimen suggests a higher diversity of amphicyonids in eastern Asia than previously thought, and more discovery with stratigraphic information will be needed to elucidate the evolution of Amphicyonidae in eastern Asia.

Full Text

Preamble

A Possible New Amphicyonid from the Miocene of the Linxia Basin

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Abstract
Here we report a new amphicyonid from an uncertain locality in the Linxia

Basin. Its derived dental traits suggest affinity with *Magericyon*, previously known from Europe and possibly southern Asia. This specimen indicates greater amphicyonid diversity in eastern Asia than previously recognized, though additional discoveries with stratigraphic context will be required to elucidate the evolution of Amphicyonidae in this region.

Key words
China, Amphicyonidae, *Magericyon*

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Main Text

Amphicyonidae were diverse and widespread Cenozoic carnivores, particularly abundant during the Oligocene and Miocene epochs (Kuss, 1965; Viranta, 1996; Hunt, 1998; Ginsburg, 1999). The fossil record is most extensive in Europe and North America (Kuss, 1965; Viranta, 1996; Hunt, 1998; Ginsburg, 1999; Morales et al., 2019, 2021a, b), less abundant in Africa (Morales et al., 2016), but only a few fragmentary specimens are known from eastern Asia (Qiu et al., 1986; Wang et al., 2005; Jiangzuo et al., 2018, 2019a, b; Sun et al., 2021). Consequently, any new specimens from East Asia are significant.

Recently, a partial mandible preserving most of the cheek teeth was donated to the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences (IVPP). The specimen was discovered by a local farmer from Hezheng County and sold to the donor. Unfortunately, the exact locality information is unknown. Judging from the surrounding sediment (red clay), the specimen most likely derives from the Late Miocene, though it could also be from the late Middle Miocene—the age of previously described *Gobicyon* from the same region (Jiangzuo et al., 2019b). The specimen exhibits traits that differ from all previously known amphicyonids from both Europe and Asia and likely represents a new species. However, the lack of precise stratigraphic constraints diminishes its value as a potential type specimen for a new species. Here we report the discovery of this specimen but refrain from erecting a new species, awaiting additional material with associated locality information and stratigraphic control.

Abbreviations
IVPP, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, China; MNCN, Museo Nacional de Ciencias Naturales, Madrid, Spain; UNSM, University of Nebraska State Museum, Lincoln, NE, USA.

Systematic Paleontology

Order Carnivora Bowdich, 1821

Suborder Caniformia Kretzoi, 1943
Infraorder Arctoidea Flower, 1869
Family Amphicyonidae Trouessart, 1885
Subfamily Amphicyoninae Trouessart, 1885
Genus *Magericyon* Peigné et al., 2008
Magericyon sp. (Figs. 1–3)

Description

IVPP V33030 (Fig. 1 [Figure 1: see original paper]) is a partial left mandible preserving most of the horizontal ramus, which is broken distal to the m2. The ramus deepens posteriorly. The symphysis is robust, elongated, and rugose, with its posterior border reaching the level of the p2.

Four small mental foramina occur on the lateral side of the ramus, positioned roughly beneath the canine, p2/p3, p3/p4, and p4, respectively. The incisors and canine are broken, but the alveolus indicates the canine was large and robust. A long diastema (17.88 mm) separates the canine from p1. The p1 and p2 are closely spaced (diastema 0.96 mm), both small, button-shaped, and single-rooted. The p2 is slightly longer and much wider than p1. The p3 is more elongated and double-rooted, with a very low crown comparable to those of p1 and p2. The diastema between p2 and p3 is large (8.72 mm), while that between p3 and p4 is small (1.24 mm). The p4 is much larger and higher than the anterior premolars, yet relatively small compared to m1. Weak anterior and posterior cingulid cuspids are present. Both anterior and posterior profiles of the tooth are concave laterally, and the distal ridge is slightly serrate on its posterior half.

The m1 is elongated. In lateral view, the ventral convexity of the enamel is moderately developed between the trigonid and talonid. Among the three major cuspids, the paraconid, protoconid, and hypoconid are tall, with the paraconid and hypoconid subequal in height. The metaconid and entoconid are very reduced but present. The talonid is broader than the trigonid. Two distal ridges extend from the protoconid: one connecting to the hypoconid and one incorporating the metaconid. The entoconid is curved. The m2 is broken at the root level; based on the alveolus, it was double-rooted and probably relatively short.

Comparison

Fossil material of Amphicyonidae is typically fragmentary, represented by jaw fragments or isolated teeth, with only a few complete crania and mandibles known (Viranta, 1996). The strongly reduced premolars of IVPP V33030 indicate affinity with either Amphicyoninae or Thaumastocyoninae. Thaumastocyoninae are medium- to large-sized amphicyonids with typically hypercarnivorous dentition (Morales et al., 2019, 2021a). Two evolutionary trends characterize this lineage: reduced premolars and high-crowned molars with reduced lingual cusps functioning as strict shearing-cutting apparatuses (Morlo et al.,

2020). This subfamily includes *Thaumastocyon*, *Peignecyon*, *Tomocyon*, *Agnotherium*, and *Ammitocyon* (Viret, 1929; Kuss, 1965; Morales et al., 2019, 2020, 2021a). Amphicyoninae typically possess moderately reduced premolars and low-crowned molars that function as both cutting and crushing tools (Kuss, 1965; Viranta, 1996; Hunt, 1998; Ginsburg, 1999). However, derived forms within this subfamily also convergently reduced their premolars and developed high-crowned cheek teeth, as exemplified by *Hubacyon* and *Magericyon* (Kretzoi, 1985; Peigné et al., 2008).

The strongly reduced premolars and short rostrum observed in V33030 suggest affinity with either Thaumastocyoninae or derived Amphicyoninae. However, the p4 is relatively small compared to m1, with a reduced posterior accessory cuspid. In Thaumastocyoninae, p4 is typically large, high-crowned, and posteriorly oriented, bearing a strong posterior accessory cuspid that forms a cutting apparatus together with m1 (Morales et al., 2019, 2020, 2021a). In the new amphicyonid, p4 is much lower than m1 and unlikely to have functioned similarly. Furthermore, the m1 exhibits horizontal wear facets on the paraconid and hypoconid. These traits exclude assignment to Thaumastocyoninae.

The reduced size of the premolars, particularly p4, is observed in derived amphicyonids such as *Heizmannocyon* and *Magericyon* from the late Middle Miocene and Late Miocene (Fraas, 1885; Helbing, 1936; Heizmann, 1973; Ginsburg et al., 1981; Peigné et al., 2008). The p4/m1 length ratio is similar in both genera (all < 0.5). The anterior premolars of *Heizmannocyon* are larger than those of V33030, whereas the two *Magericyon* species—*Magericyon anceps* and *M. castellanus*—have more reduced premolars, some of which are absent. The p4 of *Heizmannocyon* retains a posterior accessory cuspid, which is absent in both V33030 and *Magericyon*. The m1s of both known *Magericyon* species lack the metaconid, which is present in V33030 and *Heizmannocyon*. The overall m1 shape of the specimen is elongate and narrow, similar to *Magericyon*, whereas the m1 of *Heizmannocyon* is much wider. Another Late Miocene amphicyonid, *Hubacyon*, possesses a somewhat similar m1 shape and tooth development (Kretzoi, 1985), but its talonid is much higher. Unfortunately, *Hubacyon* is known only from m1, precluding further comparison.

A new basal arctoid with possible amphicyonid affinity, *Lonchocyon*, was recently described from the Late Eocene Baron Sog Formation of the Erlian Basin in East Asia (Zhang et al., 2023). V33030 is comparable in having reduced premolars, but its p4 is not as reduced as in *Lonchocyon*, and its m1 is much larger. V33030 likely does not derive from deposits of similar age and is probably not related to *Lonchocyon*.

In summary, IVPP V33030 exhibits intermediate traits between *Heizmannocyon* and *Magericyon*, but also possesses unique features such as the premolar arrangement and a wide m1 talonid. Its resemblance to *Magericyon* is supported by synapomorphies of p4: loss of the posterior accessory cuspid and a narrow m1. We therefore tentatively assign the specimen to *Magericyon*. It is undoubtedly distinct from the two known European species and likely represents

a new species. New fossil discoveries and chronological data will be needed to elucidate the evolution of this amphicyonid.

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Note: Figure translations are in progress. See original paper for figures.