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A new species of *Chleuastochoerus* (Artiodactyla: Suidae) from the Linxia Basin, Gansu Province, China

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Abstract

The Linxia Basin, Gansu Province, China, is known for its abundant and well-preserved fossils. Here a new species, *Chleuastochoerus linxiaensis* **sp. nov.**, is described based on specimens collected from the upper Miocene deposits of the Linxia Basin, distinguishable from *C. stehlini* by the relatively long facial region, more anteromedial-posterolaterally compressed upper canine and more complicated cheek teeth. A cladistics analysis placed *Chleuastochoerus* in the subfamily Hyotheriinae, being one of the basal taxa of this subfamily. *Chleuastochoerus linxiaensis* and *C. stehlini* are considered to have diverged before MN 10. *C. tuvensis* from Russia represents a separate lineage of *Chleuastochoerus*, which may have a closer relationship to *C. stehlini* but bears more progressive P4/p4 and M3.

Key words: Linxia Basin, upper Miocene Liushu Formation, Hyotheriinae, *Chleuastochoerus*, phylogeny

Introduction

Chleuastochoerus Pearson 1928 is a small late Miocene-early Pliocene fossil pig (Suidae). Isolated teeth of *Chleuastochoerus* were first reported by Schlosser (1903) under the name "*Sus stehlini.*" Cranio-mandibular specimens and postcranial skeletal elements of this small suid were subsequently recovered from the upper Miocene "*Hipparion* Red Clays" of northern China and a new genus *Chleuastochoerus* was established, primarily based on primitive features of the teeth and a distinctive snout and zygomatic structure (Pearson 1928). In general, this genus is characterized by the "supra-canine arch-niche" (a bony arch above the upper canine, with a niche in front of the upper canine to accommodate the lower canine when the mouth is closed), and the "pre-zygomatic plate" (a shelf-like expansion of the anterior end of the zygomatic arch). Despite the presence of notable range of metric variation, Pearson (1928) was against splitting all the material of this small suid into different species, and she included all the material into a single species, *Chleuastochoerus stehlini*. Later studies were mostly simple reports of new records and did not venture beyond Pearson's study (Young & Liu 1948; Liu & Zhou 1959; Chow *et al*. 1965; Liu *et al*. 1978; Tang *et al*. 1985). *Chleuastochoerus* was long thought to be endemic to northern China. Beginning in the early 1990s, however, *Chleuastochoerus* specimens began to be reported from southern China (van der Made & Han 1994; Pan *et al*. 2006), Vietnam (Covert *et al*. 2001), and Asiatic Russia (Vislobokova 2009b). Of these new findings, only those from Russia include cranio-mandibular material that clearly shows *Chleuastochoerus* characteristics. The specimens from southern China and Vietnam are fragmentary, including only isolated teeth, to be certain of their identity (Pickford & Liu 2001; Liu *et al*. 2004). Therefore, the geographic range of *Chleuastochoerus* may be limited to northern China and the southwestern part of Asiatic Russia.

Pearson (1928) did not discuss the systematic affinities of *Chleuastochoerus*, and only mentioned that this genus might be a terminal taxon of an unknown lineage that derived independently of *Hyotherium* von Meyer 1834 from some Oligocene *Palaeochoerus* Pomel 1847. Since Pearson (1927) had already included *Palaeochoerus* into Suidae based on the comparison of primitive suids and tayassuids, *Chleuastochoerus* was also included in Suidae.

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APPENDIX 1. List of the characters used in the data matrix.

1. Nasal bone—shape of the anterior part of the nasal bone: (0) long and sharp; (1) short and rounded. (Orliac *et al*. 2010, char 1; Orliac 2013, char 31)
2. Premaxilla—extension of the premaxilla anterior to the canine fossa: (0) weak; (1) important. (Orliac *et al.* 2010, char 2; Orliac 2013, char 32)
3. Premaxilla/Maxilla—relative width of the ante- and post- canine part of the palate: (0) ante-canine part slenderer than the postcanine part; (1) ante-canine part wider or of same width compared to the post-canine part. (Orliac *et al*. 2010, char 3; Orliac 2013, char 33)
4. Premaxilla/Maxilla—ante-canine constriction: (0) absent; (1) present. (Orliac *et al*. 2010, char 4; Orliac 2013, char 34)
5. Maxilla—canine niche: (0) absent; (1) present. (Orliac *et al*. 2006, char 37; Orliac *et al*. 2010 char 5; Orliac 2013, char 35)
6. Maxilla—canine niche, shape: (0) high, posterior face straight, and dorsal part close to the nasal lateral wall; (1) low, posterior face inflated, dorsal part far away from the lateral wall of the nasal. (Orliac *et al*. 2010, char 6; Orliac 2013, char 36)
7. Maxilla—*crista alveolaris*: (0) absent; (1) present. (Liu 2003, char 65; Orliac *et al*. 2010, char 7; Orliac 2013, char 37)
8. *Maxilla –position of the upper canine: (0) at the posterior part of the alveolus (including canine niche or *crista alveolaris*); (1) in the middle; (2) at the anterior part.
9. Maxilla—position of the infraorbital foramen: (0) anterior to the level of P4; (1) at the level of the P4 or posteriorly to it. (Boisserie *et al.* 2005, char 10; Orliac *et al*. 2010, char 8; Orliac 2013, char 38)
10. Maxilla/lacrymal/jugal—preorbital fossa: (0) absent; (1) present. (Liu 2003, char 81; Orliac *et al*. 2010, char 9; Orliac 2013, char 39)
11. *Maxilla /jugal – prezygomatic plate: (0) absent; (1) present.
12. Jugal/Squamosal—shape of the zygomatic arch: (0) constant height; (1) anterior part slenderer; (2) anterior part wider. (Orliac *et al*. 2010, char 10; Orliac 2013, char 40)
13. Jugal—prominence on the jugal: (0) absent; (1) present. (Gentry & Hooker 1988, char 69; Liu 2003, char 54; Orliac *et al*. 2010, char 11; Orliac 2013, char 41)
14. Jugal/lacrymal/frontal—location of the anterior border of the orbit: (0) anterior to the level of M3; (1) at the level of the M3 or posteriorly to it. (Liu 2003, char 71; Orliac *et al*. 2010, char 12; Orliac 2013, char 42)
15. Jugal—infraorbital fossa: (0) absent; (1) present. (Liu 2003, char 74; Orliac *et al.* 2010, char 13; Orliac 2013, char 43)
16. *Lacrymal foramen: (0) one in each orbit; (2) two.
17. Frontal—prominence on the frontal: (0) absent; (1) present. (Liu 2003, char 61; Orliac *et al*. 2010, char; Orliac 2013, char 44)
18. Frontal/nasal—supraorbital sulcus, divergence: (0) anterior to the anterior margin of the orbit; (1) posterior to the anterior margin of the orbit. (Orliac *et al.* 2010, char 15; Orliac 2013, char 45)
19. Squamosal—articular joint height relative to the occlusal plane: (0) articular joint not elevated; (1) articular joint elevated above the occlusal plane. (Gentry & Hooker 1988, char 79; Liu 2003, char 58; Orliac *et al*. 2010, char 16; Orliac 2013, char 46)
20. Squamosal—suprameatic process: (0) absent; (1) present. (Gentry & Hooker 1988, char 70; Orliac *et al*. 2010, char 17; Orliac 2013, char 47)
21. Squamosal/jugal—posterior extension of the ventral margin of the jugal: (0) anterior to the glenoid surface; (1) posterior to the glenoid surface. (Boisserie *et al.* 2005, char 28; Orliac *et al*. 2010, char 18; Orliac 2013, char 48)
22. Maxilla/palatine—width of the palate at M2-3: (0) wide; (1) narrow. (Orliac *et al.* 2010, char 19; Orliac 2013, char 49)
23. Palatine—ectopterygoid crest of the palatine bone: (0) parallel and close to one another, their spacing being less than