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DENTAL MORPHOLOGICAL STUDY OF PLIOCENE BOVID FROM HASNOT (PAKISTAN)

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Abstract: Well preserved upper right and left M^2, upper right M^3 belonging to different individuals have been described from Hasnot, Jhelum district, the Punjab province, Pakistan. All described specimens have basic features of the genus *Pachyportax* and species *Pachyportax latidens*.

Key words: Molar, Hasnot, *Pachyportax.*

INTRODUCTION

Bovids, a group belongs to class Mammalia, family Bovidae, super order Paraxonia and order Artiodactyla. Artiodactyls are named for even numbers of manual and pedal digits found on each hand and foot in extant taxa. Ankle or tarsal bones are the most diagnostic elements of the artiodactyle skeleton. Artiodactyla relationship at various taxonomic levels has attracted considerable attentions (Beintema *et al.,* 1977; Miyamoto *et al.,* 1993; Douzery and Scatzeflis., 1995; Kleineidan *et al.,* 1999) and the relationship between the artiodactyla and cetaceans (whale, dolphins and porpoises) has been the subject of number of muscular studies (Graud and Higgins, 1994; Arnason and Gullberg, 1996; Shimamura *et al.,* 1997; Gingerich *et al.,* 2001). The family is highly diverse with numerous extinct species, and an extensive fossil record with species in Africa, Eurasian and North America. The bovids appear to have had three major adaptive radiations at 14, 7.5 and 2 Ma (Gentry 1966, 1970, Solounias, 1982a; Ye 1989) but few fossils are known from sediments older than 14 Ma (Solounias *et al*., 1995). The comparative studies of the specimens under study have revealed that they belong to the genus *Pachyportax* and

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the species *Pachyportax latidens*. The Classification is based upon Simpson (1945).

Abbreviations

AMNH American Museum of Natural History, New York, USA; BMNH, British Museum of Natural History, London, UK; GSI, Geological Survey of India, Kolkata, India; GSP, Geological Survey of Pakistan, Islamabad, Pakistan; Myr, million years; Ma, Million years ago; PUPC, Punjab University Palaeontological Collection, stored in the department of Zoology, University of the Punjab Lahore, Pakistan; CI Crown shape index; (W/Lx100, a ratio between width and length of crown of tooth). HI, Hypsodont index (H/Wx100, a ratio between height and width of tooth); L, Maximum preserved anteroposterior crown length of tooth. W Maximum preserved crown width of tooth; H, Maximum reserved crown height of tooth. M^2, Second upper molar; M^3, Third upper molar.

Systematics

Tribe	Boselaphini Simpson, 1945
Genus	*Pachyportax* Pilgrim, 1937
Species	*Pachyportax latidens* (Figs: 1-9)

Holotype

A right upper M^3 (GSI B219)

Type locality

Hasnot, Jhelum district, the Punjab province, Pakistan.

Stratigraphic range

Middle Siwaliks

Diagnosis

Large sized bovid, quadrate upper molars with strong median basal pillar much extended transversely; relatively strong styles and ribs, enamel moderately thick and rugose with traces of cement. The parastyle moderately developed, central cavities with simple outline and poor development of mesostylids.

MATERIALS STUDIED

Few isolated second right molar (PUPC 86/90 (Figure 1), 86/203 (Figure 2), 86/210 (Figure 3), 98/60 (Figure 4). 200/77 (Figure 5), 83/744 (Figure 6). Three isolated third right molars. P.U.P.C. NOs. 83/840 (Figure 7), 87/88 (Figure 8), 2000/87 (Figure 9).

Locality

Hasnot, Jhelum district, the Punjab province, Pakistan.

DESCRIPTION

PUPC No.* 86/90 *(Figure 1)

It includes an upper second right molar. It is extremely hypsodont and narrow crowned tooth. The median basal pillar is badly damaged and only small portion of it can be seen in the transverse valley between the protocone and hypsodont. The enamel is moderately thick and wrinkled. The dentine is more prominent in the inner cusps than the outer cusps. The protocone is slightly outward than hypocone. The protocone is relatively narrower transversely than the hypocone. The paracone is well developed and pointed in the middle with two running ridges. The metacone is also well developed and pointed in the middle with two running ridges anteroposteriorly. It is slightly vertically lower than the paracone. The hypocone is crescentic in its general appearance. The styles are well developed. The parastyle is damaged anteriorly. The mesostyle is moderately strong and divergent. The metastyle is very prominent and slightly damaged at the anterior side. The ribs are also well developed. The anterior central cavity is broad while posterior central cavity is narrow.

PUPC No. 86/203 (Figure 2)

The specimen under study and description is an isolated upper right second molar. It is brachyodont and extremely broad crowned tooth. The median basal pillar is badly damaged at the anterior end and only some portion of it is visible at the transverse valley between the protocone and

hypocone. All the major cusps are well developed and prominent except the paracone and metacone whose outer portions are missing. The protocone, metacone and paracone are pointed in the middle with two ridges. The hypocone is slightly higher vertically than the protocone. The outer parts of the paracone, metacone, styles and median ribs are missing. The anterior portion of the anterior central cavity is narrower than the posterior portion, which is wider. Similarly, the anterior central cavity is also slightly wider than the posterior one.

PUPC No. 86/210 (Figure 3)

It is an isolated second right molar of maxilla. This specimen presents an excellent state of preservation. It is in an early middle stage of wear. It is narrow crowned and extremely hypsodont tooth. The median basal pillar is badly damaged. The enamel is smooth and relatively thick. All the cusps are fully developed. Both the paracone and metacone are provided with two running ridges anteroposteriorly. The styles are fully and strongly developed. The parastyle is more strong and broad at the base than the apex of the crown. The mesostyle is also more broad and thick at the base of the crown. The metastyle is also prominent and seems to be the strongest among styles. The anterior median rib is more prominent than the posterior one and is connected to the posterior end of the parastyle at the base of the crown. The anterior central cavity is narrower than the posterior one.

PUPC No. 98/60 (Figure 4)

The specimen under study is a second left molar of maxilla. It is well preserved lingually except the outer portions of the paracone and metacone are missing. It is in an early stage of wear. It is extremely hypsodont and narrow crowned tooth. The enamel is rugose and moderately thick. A very strong median basal pillar is present in the transverse valley between the protone and hypocone. The major cusps are well developed. The protocone is relatively narrower transversely than the hypocone with two running ridges towards the parastyle and mesostyle. The outer part of the paracone is missing. The outer part of the metacone is also missing but the inner portion is pointed in the middle with two running ridges. The hypocone is slightly higher vertically than the protocone. It is

crescentic in shape. The outer portions of the paracone, metacone including styles and median ribs are missing. Both the anterior and posterior central cavities are wide and deep. The posterior cavity is narrow anteriorly and broad posteriorly

PUPC No. 200/77 (Figure 5)

The specimen under study is an isolated second right molar of maxilla. It is in a good state of preservation. It is in middle stage of wear. It is hypsodont and narrow crowned tooth. A strong median basal pillar is present. The enamel is moderately thick and rugose. The major cusps are well developed except the upper parts of paracone and metacone are slightly damaged. The protocone is V-shaped and its anterior ridge is larger than the posterior one. The outer part of the paracone is missing. The metacone is very much similar in general structure to the paracone. The hypocone is roughly U-shaped in its general appearance. The styles are well developed. The parastyle and mesostyle are strongly developed while the metastyle is moderately developed. The anterior median rib is slightly damaged at upper side. It is more prominent than the posterior median rib. The central cavities are broad due to the middle stage of wear.

PUPC No. 83/744 (Figure 6)

The specimen under description is a third right molar of maxilla. The tooth is in an excellent state of preservation. It is in an early stage of wear and the major cusps have just touched by wear. It is extremely hypsodont and narrow crowned tooth. The enamel seems to be moderately thick and rugose. The median basal pillar is strongly developed but anteriorly it is slightly damaged. All the cusps are well developed. The protocone is crescentic in shape. The paracone is pointed in the middle with two running ridges anteroposteriorly. The anterior ridge of the paracone is smaller than posterior one. The metacone is also pointed in the middle with two running ridges. The hypocone is crescentic in shape. Its anterior ridge is larger than the posterior one. The styles are strongly developed. The parastyle is more prominent among the styles. The metastyle is slightly damaged anteroposteriorly. The mesostyle is present but slightly damaged. The central cavities are very broad and filled with sandstones.

PUPC No. 83/840 (Figure 7)

The specimen under study is a right third molar of maxilla. It is well preserved and in an early stage of wear. It is narrow crowned and extremely hypsodont tooth. The enamel seems to be moderately thick. The median basal pillar is strongly developed. It is thick at the tip while thin at the base. The major cusps are well developed. The protocone is crescentic in its general appearance and pointed in the middle. The paracone is higher vertically than the other major cusps. The metacone is also pointed in the middle with two running ridges. The posterior ridge of hypocone is larger than anterior one. The styles are seemed to be isolated pillars. The parastyle is the strongest among the styles. The height of parastyle is greater than mesostyle and metastyle. The anterior median rib is strongly developed than the posterior one. The central cavities are narrow anteroposteriorly and broad transversely.

PUPC No. 87/88 (Figure 8)

It is an isolated third right molar of maxilla. It is in a good state of preservation lingually but outer parts of the outer cusps are missing. It is in an early stage of wear. It is extremely hypsodont and narrow crowned tooth. Median basal pillar is very strong. All the principal cusps are well developed except the paracone and metacone whose outer parts are missing including styles and ribs. The protocone is crescentic in its general appearance and slightly damaged lingually. The inner part of the paracone is slightly pointed in the middle with two running ridges. Some portion of dentine is also preserved in the middle of the paracone. Metacone is in the same way of preservation as the paracone and also similar with the general structure. The hypocone is slightly higher vertically than the protocone. Both the anterior and posterior central cavities are wide and deep.

PUPC No. 2000/87 (Figure 9)

The specimen under study and description is an isolated third left molar of maxilla. The outer portion of the tooth is strongly embedded in the hard sandstones. The styles and ribs are hardly seen due to preservation in the hard sandstones. The enamel is moderately thick and rugose. The median basal pillar is practically unworn. The tooth is extremely hypsodont and narrow crowned. The major cusps are well developed. The protocone

and hypocone are badly damaged. Anteriorly the protocone is more damaged than posteriorly. The paracone is pointed in the middle with two running ridges anteroposteriorly.

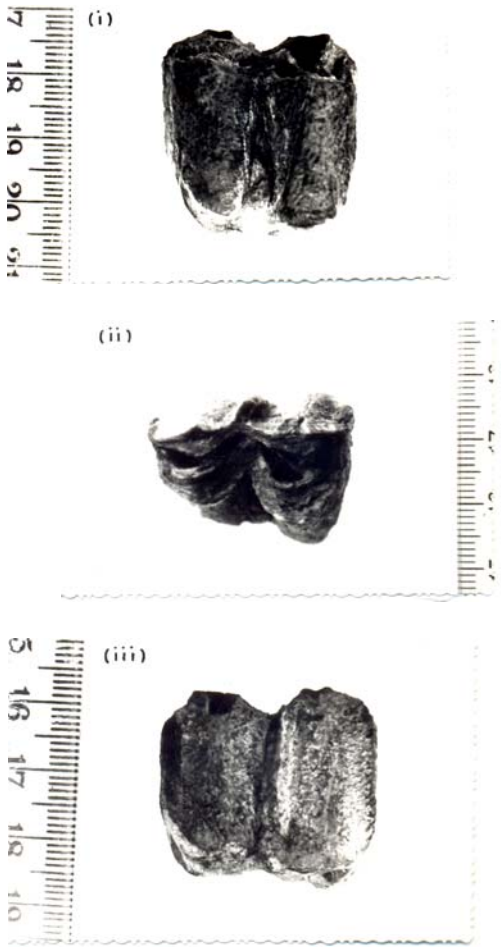

Figure 1: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated second molar of right maxilla (PUPC No. 86/90), collected from Dhok Pathan, Chakwal district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view, iii) Outer view.

The metacone is well-developed. It is slightly broader than the paracone. The wear is more confined to the anterior ridge. The inner part of hypocone is well preserved, while outer part is missing or badly damaged. The styles and median ribs are also well-developed but they are embedded in the hard sandstones, which is difficult to remove. The anterior central cavity is more damaged than the posterior one but both are filled with sandstones.

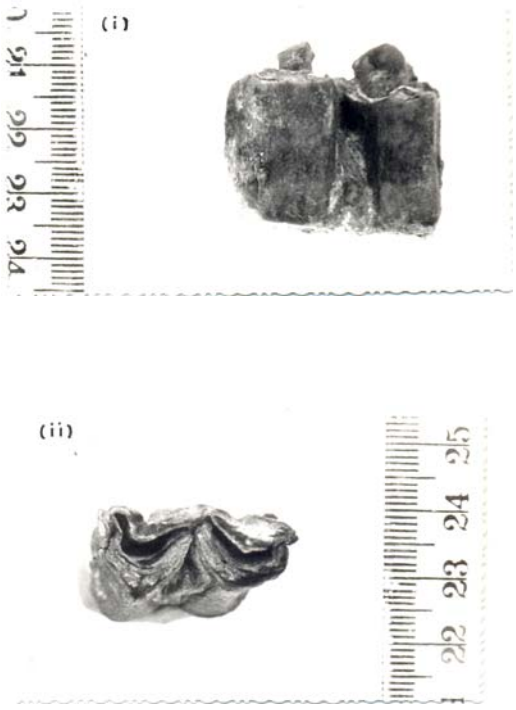

Figure 2: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated second molar of right maxilla (PUPC No. 86/203), collected from Dhok Pathan, Chakwal district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view.

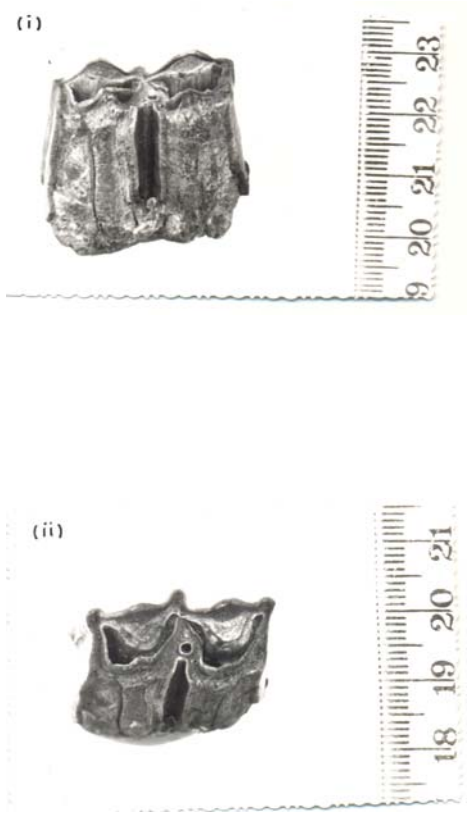

Figure 3: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated second molar of right maxilla (PUPC No. 86/210), collected from Dhok Pathan, Chakwal district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view.

Figure 4: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated second molar of right maxilla (PUPC No. 98/60), collected from Hasnot, Jhelum district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view.

Figure 5: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated second molar of right maxilla (PUPC No. 200/77), collected from Dhok Pathan, Chakwal district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view.

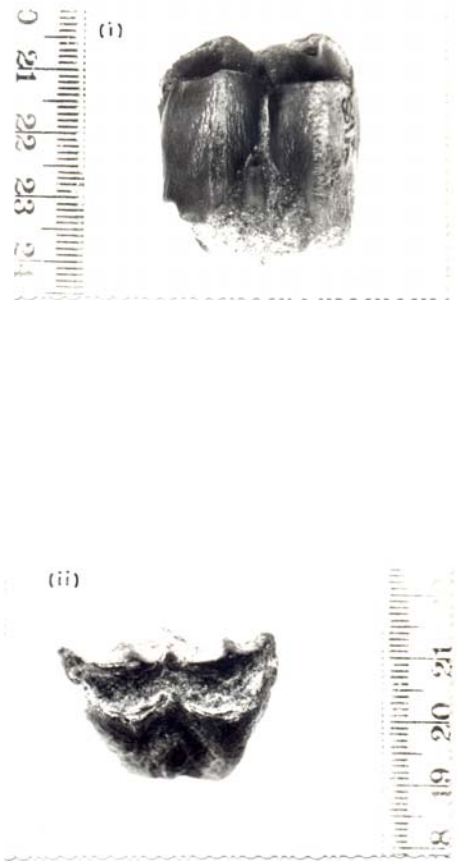

Figure 6: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated second molar of right maxilla (PUPC No. 83/744), collected from Dhok Pathan, Chakwal district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view.

Figure 7: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated third molar of right maxilla (PUPC No. 83/840), collected from Tatrot, Jhelum district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view.

Figure 8: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated third molar of right maxilla (PUPC No. 87/88), collected from Hasnot, Jhelum district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view.

Figure 9: *Pachyportax latidens* (Lydekker) Pilgrim, an isolated third molar of left maxilla (PUPC. No. 2000/87), collected from Hasnot, Jhelum district, the Punjab Province, Pakistan: i) Inner view, ii) Crown view.

Table I: Comparative dental measurements (mm) of second upper molars referred to *Pachyportax latidens* (Lydekker) Pilgrim.

	PUPC						AMNH	AMNH
	86/90	86/203	86/210	98/60	2000/77	83/744	29964	19730
L	29	27	26	23	26	30	28	28.5
W	22	17	17	16	23.6	20	25	28.5
W/L Index	78.5	62.5	65.9	69.5	90.7	66.6	89.3	100

Table II: Comparative dental measurements (mm) of third upper molars referred to *Pachyportax latidens* (Lydekker) Pilgrim.

	PUPC			AMNH	AMNH
	83/840	87/88	2000/87	29913	19730
L	32	27	26	31	29.5
W	22.4	17	15	29	27
W/L Index	70	62.9	57.6	93.5	91.5

DISCUSSION

The genus *Pachyportax* was erected by Pilgrim (1937) when he applied the generic name *Pachyportax* to all the specimens, which were described and figured by Lydekker (1876) under the name *Cervus latidens, (Capra,* 1878*; Oreas,* 1884). He determined two species *P. latidens* Lydekker and *P. nagrii*, one subspecies *P. latidens dhokpathanesis* and one variety *P. latidens var. dhokpathanesis* to the genus. Akhtar (1995) synonymized the subspecies *P. latidens dhokpathanesis* with the species *P. latidens* (Lydekker) Pilgrim and added a new species, *P. gignateus* to the genus, *Pachyportax*. The type species comes from the Late Miocene, possibly extending into the Pliocene. The type specimen of *P. latidens* is an upper molar, but it is the best represented by a cranium described by Pilgrim (1939) and stored in Kolkata museum (India) of which there is a

cast in London (BMNH), BMNH M 26573. The most important recognized feature of the upper molars is the transverse extension of the median basal pillar as mentioned by Pilgrim (1937). In some specimens the enamel is rough and in others owing to weathering it is smooth. The studied specimens present all the distinguished features of the species *Pachyportax latidens*, Pilgrim. The M^2 and M^3 molars compare well with the referred specimens present in AMNH, New York and described by Pilgrim (1937). The referred specimen present in the AMNH, is a fragment of maxilla having M^{2-3}. They resemble each other in all the structural details like cusps, styles, and median ribs. Hence the studied specimens are being referred to *P. latidens* on the basis of the above-mentioned similarities. (Table 1- 2).

REFERENCES:

AKHTAR, M., 1995. *Pachyportax gignateus*, new species (Mammalia, Artiodactyla: Bovidae) from the Dhok Pathan, district Chakwal, Punjab, Pakistan. *Pakistan J. Zool.*, **27** (4): 337-340.

ARNASON, U. AND GULLBERG, A., 1996. Cytochrome b nucleotide sequence and the identification of five primary lineages of extant cetaceans. *Molecular Biology and Evolution,* **13**: 407-417.

BEINTEMA, J.J., GAASTRA, W., LENSTRA, J. A., WELLING, G.W. AND FITCH, W.M., 1977. The molecular evolution of pancreatic ribonuclease. *Molecular Biology and Evolution,* **10:** 49-71.

DOUZERY, E. AND SCATZEFLIS, F.M., 1995. Molecular evolution of the mitochondrial 12S rRNA in Ungulata (Mammalia). *Molecular Biology and Evolution*, **12:** 622-636.

GENTRY, A.W., 1966. Fossil Antilopini of East Africa. *Bull. Brit. Mus. Nat. Hist.* (Geol.), **12:** 45-106.

GENTRY, A.W., 1970. The Bovidae (Mammalia) of the fort ternan fossil fauna; In: *Fossil Vertebrates of Africa*, Vol. 2. (eds. L.S.B. Leakey and R.J.G. Savage). Academic Press, London. pp. 243-323

GINGERICH, P.K., HAQ, M., ZALMOUNT, I.S., KHAN, I.H. AND MALKANI, M.S., 2001. Origin of whales from early artiodactyla. Hands and feet of Eocene Protocetidae from Pakistan. *Science*, **293:** 2239-2242.

GROUD, D, AND HIGGINS, D.G., 1994. Molecular evidence for the inclusion of cetaceans within the order Artiodactyla. *Molecular Biology and Evolution*, **11:** 357-364.

KLIENIDAM, R.G., PESOLE, G., BREUKELMAN, H.J., BEINTEMA. J.J. AND KASTELEIN, R.A., 1999. Inclusion of cetaceans within the order Artiodactyla based on phylogenetic analysis of pancreatic ribonuclease genes. *Molecular Biology and Evolution*, **48:** 360-368.

LYDEKKER, R., 1876. Molar teeth and other remains of Mammalia from Indian Territories. *Pal. Ind.* (10), **1** (2): 19-87.

LYDEKKER, R., 1878. Crania of Ruminants from the Indian Territories and Supplement. *Pal. Ind.*, 10 (1): 88-181.

LYDEKKER, R., 1884. A sketch of the history of the fossil vertebrata of India. *J. Asiatic.Soc. Bengal*, XLIX, Pt.2, pp. 8-40, from Colbert, 1935.

MIYAMOTO, M.M., KRAVS, F., LAIPIS, P.J., TANHAUSER, S.M. AND WEBB, S.D., 1993. Mitochondrial DNA phylogenies within artiodactyla. In, *Mammal phylogeny* (eds. F.S. SZALAY, M.J., NOVACEK. AND M.C. MCKENNA). Springer Verlag New York Inc. pp. 268-281

PILGRIM, G.E., 1937. Siwalik antilopes and oxen in the American Museum of Natural History. *Bull. Am. Mus. Nat. Hist*., **72:** 729-874.

PILGRIM, G.E., 1939. The fossil Bovidae of India. *Pal. Ind. (n.s.),* **26** (1): 1-356.

SHIMAMURA, M., YASUE, H., OHSHIMA, K., ABE, H., KATO, H., KISHIRO, T., GOTO, M AND MUNECHIKA, I., 1997. Molecular evidence from retroprosons that whales form a clade within even-toed Ungulates. *Nature*, **388:** 666-670.

SIMPSON, G.G., 1945. The principles of classification and a classification of Mammals. *Bull. Am. Mus. Nat. Hist.* **85:** 1-350.

SOLOUNIAS, N., 1982. Evolutionary Patterns of the Bovidae (Mammalia). Proceeding of North American Palaeontology convention III, 2: 495-499.

SOLOUNIAS, N., BARRY, J.C., BERNOR, R.L., LINDSAY, E.H. AND RAZA, S.M., 1995. The oldest Bovid from the Siwaliks, Pakistan. *J. Vertebrate Palaeontology*, **15:** (4): 806-814. YE, J., 1989. Middle Miocene artiodactyla from the northern Junggar Basin. *Vertebrate Pal Asiatica*, **27:** 37-52

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