

Early Ruminants from Dhok Bin Mir Khatoon (Chakwal, Punjab, Pakistan): Systematics, Biostratigraphy and Paleoecology

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Abstract.- New ruminant material recovered at the Dhok Bin Mir Khatoon site is described and compared. The specimens are attributed to cf. *Eotragus*, *Eotragus* sp. (large size) and cf. *Palaeohypsodontus zinensis*. *Palaeohypsodontus zinensis* was originally known from Oligocene deposits of Pakistan, China and Mongolia but the new material extends its presence to the early Miocene/earliest middle Miocene of Asia. The results allow preliminary discussion on the biostratigraphy and paleoecology of the site and the diversity of early Asian artiodactyls.

Key words: *Eotragus*, *Palaeohypsodontus*, Early Miocene, Pakistan.

INTRODUCTION

In 1967 and 1969, two specimens of small ruminants were collected from Dhok Bin Mir Khatoon, Chakwal District, Pakistan and shelved unidentified in the Laboratory of Palaeontology, Department of Zoology, Punjab University, Lahore, Pakistan. The senior author visited the area in May 2008 and recovered several mammalian remains. The small bovid specimens collected from the locality are considered in this paper.

The fossil site (72° 55' 45.4 E, 32° 47' 26.4 N) is located in Dhok Bin Mir Khatoon village, 23 km West of Chakwal District, Punjab, Pakistan (Fig. 1). The fossiliferous deposits consist of shales, siltstones and sand stones. The locality represents lateral facies associations and pedogenesis within the fine grained fossil-bearing floodplain deposits that are characteristic of fluvial depositional environment (Behrensmeyer, 1987, 1988, 1995; Willis, 1993; Barry *et al.*, 2002).

The material provides additional evidence for the early Miocene/earliest middle Miocene small ruminant fauna of Pakistan. The basic aim of the

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paper is to describe poorly documented early ruminants.

The morphological and metrical characters of the specimens are described and their systematic determination is discussed. Measurements are given in millimeters (mm). Uppercase letters stand for upper teeth and lowercase letters for lower teeth. The catalogue number of the specimens consists of series *i.e.*, yearly catalogued number and serial catalogued number, so figures of the specimen represent the collection year (numerator) and serial number (denominator) of that year (e.g. 08/01).

Abbreviations

PC-GCUF, Paleontological Collection of Government College University Faisalabad; PUPC, Punjab University Paleontological Collection; Ma, million years; d, deciduous; m, molar; l, largest length; w, width; w(tr), width of trigonid; w(ta), width of talonid; h, height.

SYSTEMATIC PALAEONTOLOGY

Order Artiodactyla Owen, 1848
Suborder Ruminantia Scopoli, 1777
Family Bovidae Gray, 1821

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Subfamily Bovinae Gray, 1821
Tribe Boselaphini Knottnerus-Meyer, 1907

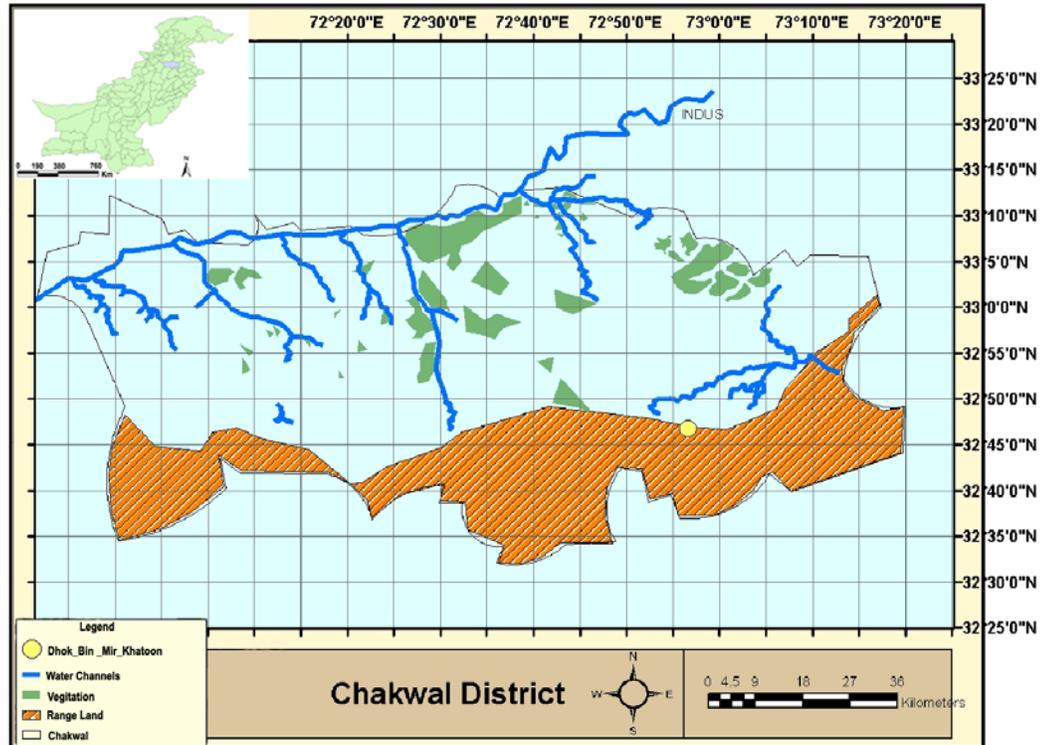


Fig. 1. Map of Pakistan (inset) with an enlargement of the Chakwal area and the location of Dhok Bin Mir Khatoon where the described material has been found.

Genus *EOTRAGUS* Pilgrim, 1939
Eotragus sp.
(Fig. 1)

Material

PC-GCUF 08/01 a right lower third molar (m3: l = 11, w(tr) = 4.85, w(ta) = 4.67).

Description

The right third lower molar, is moderately worn, dainty, with selenodont morphology (Fig. 1, Table I). Central fossettes on the occlusal surface are isolated from the exterior even in the middle wear stage (Fig. 1). A trace of anterior cingulum is present. Buccal lobes are pointed. The molar bears a small ectostylid, no diagonal fold on the rear wall of the protoconid, a weak metastylid and a weak anterior rib on its lingual wall. The anterior and posterior ribs are slightly damaged. A small goat

fold connected with the parastylid forms a transverse anterior flange. The cusp tips are rounded and sharp. The hypoconulid is present, obliquely situated and comparatively lower in height than the other four major conids.

Table I.- Comparative measurements of the cheek teeth of *E. noyei* Solounias *et al.* (1995) in mm (millimeters). Data also from Alfarez *et al.* (1980).

Number	Position	Length	Width	W/L
*PC-GCUF	m3	11	4.85	0.44
*PUPC 69/272	m1	13.5	8.0	0.59
	m2	13.5	8.0	0.59
GSP-Y 41459	m2	10.7	12.1	1.13
GSP-Y 41459	M3	10.4	10.7	1.02
CO-483	M1	10.1	11.3	1.11
CO-484	M1	10.1	10.5	1.03
CO-485	M1	10.7	11.3	1.05
CO-487	M3	11.5	11.9	1.03
CO-488	M3	11.6	12.0	1.03

CO-489	m1	9.4	6.2	0.65
CO-490	m2	11.6	7.9	0.69
CO-491	m3	14.2	7.0	0.49

*The studied specimen.

Discussion

The selenodonty pattern of the molar confirms its inclusion to Ruminantia. Morphological and metrical features of the specimens clearly indicate a small sized Miocene bovid. The presence of anterior transverse flange, the less bulky stylids and obliquely situated hypoconulid are characters that correspond to the genus *Eotragus* (Gentry, 1999; Rössner, 2006) but more material is needed for precise species identification.

Eotragus sp. (large size)
(Fig. 2)

Material

PUPC 69/272 right mandibular fragment with first and second molar (m1: l = 13.5, w = 8, h = 11.4; m2: l = 13.5, w = 8, h = 12).

Description

The preserved length of the right mandibular ramus is 35.0 mm and shows a number of fractures owing to seasonal weathering (Figs. 2a-c). The m1 is in early-middle stage of wear and it can be firmly determined as an m1, because of the typical rounded shape of the anterior contact facet for the premolar and the wider anterior part of the tooth comparatively to the posterior (Rössner, 1995). The m2 is almost completely preserved but the mandibular fragment is broken posteriorly at the entostylid of the molar. Ectostylids are attached posteriorly to the base of the protoconid and the molars show anterior transverse flange. The median ribs and the mesostylid are weakly developed, whereas the metastylid and the entostylid are well developed. The enamel is rugose especially on the buccal side of the molars. All the crown features are preserved and the teeth show the confluence of the metacristid, the protocristid and the postmetacristid. The anterior ribs are stronger than the posterior ones. The fossettes are extremely narrow and their buccal sides are slightly steeper than the lingual ones.

Discussion

The increased selenodonty with conical cusps, ectostylids, and anterior transverse flange clearly indicate a middle Miocene representative of a small sized Boselaphini. Boselaphines found in the middle Miocene of Pakistan are *Eotragus*, *Sivaceros*, *Protragocerus* and *Helicopotax* but all are known by horn cores and skull remains (Pilgrim, 1937, 1939) preventing a direct morphological comparison. Several morphological features such as the oblique situated teeth without lined up buccal walls and the confluence of the metacristid, protocristid and postmetacristid correspond to the genus *Eotragus*. However, the teeth are too large (Table I) for *Eotragus noyei* described from the the Kamlial formation (Solounias *et al.*, 1995), Hasnot, Dhok Pathan formation (Khan, 2007) and Dhok Bin Mir Khatoon (this paper), Therefore it is referred to as *Eotragus* sp. (large size) waiting for more material.

Superfamily Bovoidea Gray, 1821

Family *Incertae sedis*

Genus *Palaeohypsodontus* Trofimov, 1958, cf.

Palaeohypsodontus zinensis Métais, Antoine,

Marivaux, Welcomme, Ducrocq, 2003

(Fig. 3)

Material

PUPC 67/431 right mandibular fragment with fourth deciduous molar and first molar (d4: l = 13.3, w = 4.5, h = 7.5; m1: l = 11.5, w(tr) = 4.3, w(ta) = 4.8, h = 9).

Description

The height of the broken hemimandible is 13 mm posteriorly and 12 mm anteriorly. The labial side of the hemimandible is clearly convex anteriorly and the lingual side is slightly concave below the m1. The teeth are early in wear, rectangular in occlusal view and strongly compressed transversely. The lingual cusps are strongly compressed transversely and higher than the labial ones, which are crescentic.

The d4 is birooted, well preserved with three lobes and obliquely implanted. The first lobe is smaller in height comparatively to the second and the third ones. The transverse valley between the

first and the second lobes is joined at the base by a third lobe. The posthypocristid consists of a bulky minor tubercle and the ectostylid is present in the transverse valley between the second and the

Table II.- Comparative measurements (in mm) of the referred *Palaehypsodontus* specimens.

	<i>P. cf. zinensis</i> Dhok Bin Mir Khatoon (Pakistan) this paper	<i>P. zinensis</i> Bugti Hills (Pakistan) (Metias <i>et al.</i> , 2003)	<i>P. asiaticus</i> Ulan Tatal (type) Tatal Gul (Mongolia) (Trofimov, 1958)	<i>P. cf. asiaticus</i> Ulan Tatal (China) (Haung, 1985)	<i>Hanhaicerus qii</i> Ulan Tatal (China) (Haung, 1985)
ld4	13.3	-	-	-	-
wd4	4.5	-	-	-	-
hd4	7.5	-	-	-	-
lm1	11.5	10.6	-	7.4	-
w(tr)m1	4.3	5.1	-	5.1	-
w(ta)m1	4.8	5.6	-	6.2	-
hm1	9.0	10.8	-	6.1	-

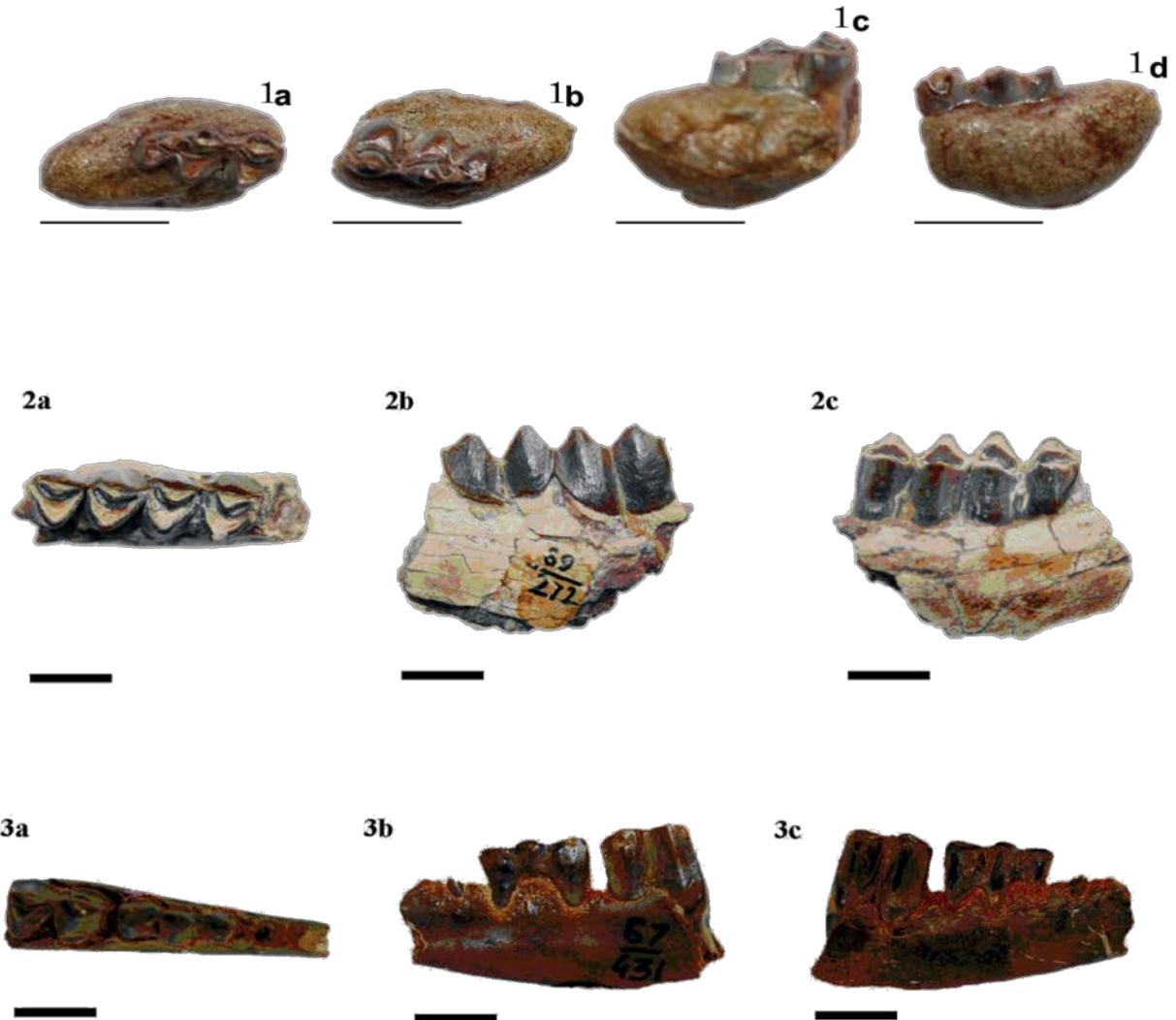


Fig. 1. 1, *Eotragus* sp., GCUF-PC 08/01; a-b, occlusal views, labial view, d, lingual view. 2, *Eotragus* sp., PUPC 69/272, a, occlusal view; b, lingual view; c, labial view; 3, *Palaeohypsodontus zinensis* PUPC 67/431; a, occlusal view; b, lingual view; c, labial view. Scale bar 10 mm.

structure which forms a distinct pillar in the postero-lingual corner of the tooth. The first lobe is bulbous lingually and the central fossettes are isolated. The enamel is thin and smooth.

The molar (m1) is rectangular in occlusal outline. The height to width ratio (hypsodonty) is 2.09 and height to length ratio is 0.78 (Table II). The lingual cusps are strongly compressed transversely and higher than the labial ones. The metaconid and the entoconid are flattened labially and lingually, and the protoconid and hypoconid are selenodont. The praemetacristid joins the praeprotocristid, while the posthypocristid contacts the postentocristid, closing off the posterolingual end of the median valley and forming a projecting entostylid. Weak median ribs are present on the lingual side of the tooth and a narrow vertical groove occurs between the two lobes. The trigonid and the talonid are equal in length but the trigonid is slightly narrower. There is no trace of a *Palaeomeryx* fold on the protoconid or of a *Dorcatherium* fold, but a distinct metastylid occurs on the postmetacristid. The enamel is smooth. No ectostylid occurs between the labial strongly crescentic cusps (protoconid and hypoconid). The stylids are not very bulbous, except for the relatively prominent entostylid which forms a postero-lingual pillar on the tooth. The labial cingulum forming a goat fold is missing from the tooth due to weathering and a gap is present between the m1 and the d4.

Discussion

The relative hypsodonty, the fusion of praentocristid with praehypocristid and postmetacristid with postprotocristid very early in wear, the small metastylid, the strong entostylid, the possibly salient "goat-fold," the slightly oblique metaconid and entoconid with an embayment in the lingual wall between the metaconid and the entoconid are sufficient characters to allow the inclusion of the studied specimen to the genus *Palaeohypsodontus* (Métais *et al.*, 2003; Barry *et al.*, 2005).

Palaeohypsodontus from Bugti hills shows

rather flatter lingual wall of the first molar comparatively to the first molar found in the Dhok Bin Mir Khatoon which has vertical ribs on the lingual wall. Both forms differ however from their Asian counterpart found from the Middle Oligocene of Ulan Tatal, China and Tatal Gul, Mongolia in the more pronounced hypsodonty (Barry *et al.*, 2005). The fourth deciduous tooth of the species was hitherto unknown, although Métais *et al.* (2003) described a broken specimen. Despite scarcity of the material, the lower first molar shows several diagnostic characteristics of the species *P. zenensis* (Métais *et al.*, 2003; Barry *et al.*, 2005), in particular the marked hypsodonty, selenodonty, the lack of *Palaeomeryx* fold and *Dorcatherium* fold, the absence of cingula and of any ectostylid. Nevertheless, more material is needed for precise identification.

CONCLUSION

The Dhok Bin Mir Khatoon site has yielded a rich and diversified vertebrate fauna, including both micro- and macromammals. Lithofacies and faunal compositions suggest a fluvial depositional environment with two successive fossiliferous layers. *Chilotherium*, *Brachypotherium*, tragulids (*Dorcatherium*), giraffids and bovids are common elements of the fauna (unpublished data). The resemblances of the Dhok Bin Mir Khatoon fauna to the late Oligocene and early Miocene localities of Bugti hills (Welcomme *et al.*, 2001) is striking. The presence of *Chilotherium blandfordi*, ruminants (*Dorcatherium* sp., *Eotragus* sp. *Eotragus* large size sp.), *Palaeohypsodontus* sp., and a listriodont suid in the lower stratum suggests an Early Miocene age (Welcomme *et al.* 1997, 2001, Antoine and Welcomme, 2000). *Eotragus* is known from the late early Miocene of Europe (Gentry *et al.*, 1999), Pakistan (Solounias *et al.*, 1995) and from the middle Miocene of China (Ye, 1989) and *Palaeohypsodontus* is known from the Oligocene of Mongolia (Trofimov, 1957, 1958), China (Huang, 1982, 1985) and Pakistan (Métais *et al.*, 2003; Barry *et al.*, 2005) but the presence of this taxon in the

Dhok Mir Bin Khatoon site considerably extends its geographical distribution.

The selenodonty of the ruminants may be interpreted for fibrous foods which may have been the swamp vegetation due to the depositional environment. The combined occurrence of such taxa in the locality suggests open but no grassy habitats, including some elements of fairly abrasive vegetation (Janis *et al.*, 2002). The rare occurrence of *Palaeohypsodontus* together with *Eotragus* and *Dorcatherium* is rather indicative of swampy-paludal habitats (Köhler, 1993; Rössner and Mörs, 2001). Hitherto *Palaeohypsodontus* has been known from the late Oligocene of China, Mongolia and Pakistan but the fauna of Dhok Mir Bin Khatoon is thought to have an earliest middle Miocene. This discrepancy would be for the specimen to have different lithostratigraphic position from the major mammal fauna and it would be anomalous in an earliest middle Miocene locality by being younger than other specimens of *Palaeohypsodontus*.

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