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New Fossil Remains of *Selenoportax vexillarius* From The Late Miocene of Hasnot

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Abstract.- First and second lower molars of *Selenoportax vexillarius*, collected from the late Miocene of Hasnot (Middle Siwaliks) are described in this paper. The studied specimens were collected during previous decades by palaeontological expeditions working in the late Miocene sediments of Hasnot, and are housed in the Abu Bakr Fossil Display and Research Center of Zoology Department, Punjab University, Lahore, Pakistan. The studied specimens are compared with relevant specimens at the American Museum of Natural History (AMNH) and the Punjab University Palaeontological Collection (PUPC). The variation in size in the dentition of *S. vexillarius* is also observed. The sediments of Hasnot comprise a late Miocene vertebrate fauna constrained to between 7 and 5 million years ago, including a variety of boselaphine bovids which distinguish the sediments from the other sediments of the Siwaliks.

Key words: *S. vexillarius*, Middle Siwaliks, Late Miocene, Hasnot, Molars.

INTRODUCTION

Pecorans, ruminants with cranial appendages such as horns, became widespread in the early Miocene. Subfamilies and tribes within the horned families began to differentiate in the Middle Miocene, but some modern groups of these ranks are known only from the late Miocene onward (Gentry, 2000). Bovids have no upper incisors, and vestigial minute upper canines occur in only a minority of individuals. The cheek teeth are selenodont and the crescentic cusps join to one another earlier in wear than in cervids and giraffids. A canon bone comprising fused metapodials III and IV is absent or more reduced than in cervids. Compared with cervids or giraffids, many bovids show more hypsodont teeth, stronger cursorial characters in their limb bones and territorial behavior (Gentry, 1990). By the latter Middle Miocene it is apparent that the Siwaliks region was inhabited by various boselaphines, caprines and the smaller *Gazella*. Bovids and giraffids are best known from Africa and southern Asia (Gentry, 1994). The large boselaphines in the Siwaliks include *Selenoportax* and *Pachyportax*, which were present in the Middle and Upper Siwaliks (Pilgrim, 1937, 1939; Akhtar, 1992, 1995, 1996). *Selenoportax* was a bovid abundant in the late Miocene of the Siwaliks.

The fossils described in this paper come from Hasnot about 70 kilometers west of Jhelum in the fresh water deposits of the Middle Siwaliks (Fig. 1). Lithostratigraphically the sediments belong to the Dhok Pathan Formation (Middle Siwaliks) which is characterized by sandstones with orange brown alternating clays and scattered conglomerates in lower part and more conglomerates with sandstones and clays in the upper part. The clays are orange brown in colour and the time of deposition ranges from 10.1-3.5 Ma (Pilbeam *et al*., 1977; Johnson *et al*., 1982; Barry *et al*., 1982, 2002; Barry, 1987). The aim of the paper is to describe the new findings of the *Selenoportax* dental remains from Hasnot.

ABBREVIATIONS

PUPC, Punjab University Palaeontological Collection, housed in the Department of Zoology, Punjab University, Lahore, Pakistan; AMNH, American Museum of Natural History, New York, United States of America; Ma, Million years ago; H, Hasnot; M_1, first lower Molar; M^2_2, second upper

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and lower molar.

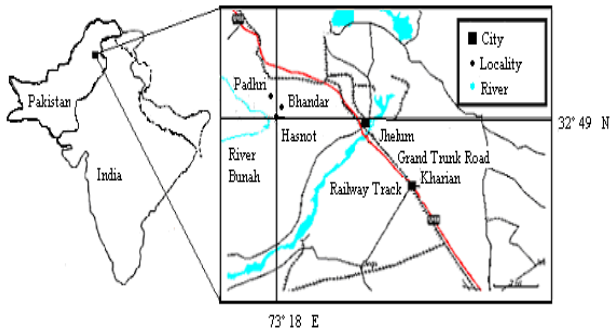

Fig. 1. Location of the study section; Hasnot and the surrounding localities of the study section.

SYSTEMATIC PALAEONTOLOGY

Family

BOVIDAE Gray, 1821

Subfamily

BOVINAE Gray, 1821

Tribe

BOSELAPHINI Knottnerus-Meyer, 1907

Genus

SELENOPORTAX Pilgrim, 1937

Type Species

Selenoportax vexillarius Pilgrim, 1937.

Abbreviated generic diagnosis

Moderate to large sized Siwalik bovid; with hypsodont to extremely hypsodont teeth, upper molars quadrate with strong divergent styles, median ribs well developed, entostyle strongly developed and ectostylid moderately developed, enamel very rugose (Pilgrim, 1937). Crown is narrow at the base and broad at the apex in *Selenoportax* whereas in *Pachyportax* the crown is not constricted at the apex. Entostyle is strong and much extending transversely in *Pachyportax*, while in *Selenoportax* it is not much extending transversely. In *Pachyportax* posterior median rib is flattened whereas in *Selenoportax* it is strong like anterior median rib (Akhtar, 1992).

Included species

Selenoportax vexillarius Pilgrim, 1937; *Selenoportax lydekkeri* Pilgrim, 1937; *Selenoportax dhokpathanensis* Akhtar, 1992.

Distribution

Middle and Upper Siwaliks.

Selenoportax vexillarius Pilgrim, 1937

Selenoportax tatrotensis Akhtar, 1992

Type specimen

A skull lacking maxilla and dentition and most of the basicranium (AMNH 19748).

Referred specimens

Left M^2 (PUPC 86/97), left M_1 (PUPC 96/44), right M_1s (PUPC 82/98; PUPC 83/96; PUPC 96/11), right M_2s (PUPC 83/117; PUPC 87/145), left M_2s (PUPC 85/4).

Locality

Hasnot, Jhelum district, the Punjab province, Pakistan.

Stratigraphic range

Middle and Upper Siwaliks.

Diagnosis

Cheek teeth large but smaller than *S. lydekkeri* and strongly hypsodont, enamel very rugose. Upper molars quadrate with strong and divergent styles near the neck of crown, ribs quite large, entostyle/ectostylid strongly developed. Fossettes without indentations and simple in outline, anterior transverse flange poorly developed at front of lower molars.

DESCRIPTION

Cranial material described here are eight isolated teeth including one upper molar and seven lower molars of *S. vexillarius*. PUPC 86/97 is a left upper second molar and well preserved except the

lingual part which is slightly damaged. The enamel is moderately thick, rugose and the rugosity is more on the buccal side than on the lingual side. The four major cusps are completely developed but the protocone is damaged anteriorly and the entostyle is missing. The buccal cusps are higher than the lingual ones. The styles seem to be an isolated pillar and the median ribs among the styles are strongly developed. The anterior rib is more developed than the posterior one. The anterior central cavity is narrower than the posterior central cavity due to an early stage of wear.

Among the seven lower molars, four are first lower molars among which one is a left molar and the other three are right molars. PUPC 96/44 is an isolated first molar of left mandibular ramus and all the four conids are fully developed. The tooth is in an early stage of wear and hypsodont. The enamel is strongly plicated and the plications are more prominent on the buccal side than on the lingual side. PUPC 82/98, PUPC 83/96 and PUPC 96/11 (Fig. 2 A, B, C) are the isolated molars of the right mandibular ramii. PUPC 82/98 is in an advanced stage of wear and the ectostylid is very well developed. It is high, equal in length like the buccal conids and circular in transverse section. The anterior and posterior central cavities are narrow lacking spurs. The entostylid, entoconid and posterior median rib are slightly damaged in the specimen PUPC 83/96. A prominent feature of the molar is the rugosity of the enamel. The central cavities have no indentations. PUPC 96/11 has damaged hypoconid and owing to the worn condition of the molar, the buccal conids and the lingual conids have been separated from one another. PUPC 83/117 and PUPC 87/145 (Fig. 2 D, E) are right second lower molars which are well preserved and have nicely preserved major conids. PUPC 83/117 is in a middle stage of wear and has externally damaged hypoconid. The entoconid of the tooth is also damaged internally as well as externally. In PUPC 87/145 the metaconid and entoconid with metastylid and median ribs are missing. The ectostylid is well developed and prominent. PUPC 85/4 (Fig. 2 F) is a second lower molar of the left mandible and in the early stage of wear. The protoconid and metaconid have just touched to the wear while the remaining posterior conids are practically unworn. The crown of the specimen is narrow and hypsodont. The ectostylid is very low and practically unworn. The protoconid is crescentic in shape and the lingual conids are higher than the buccal ones. The praehypocristid and posthypocristid are not united with the other conids. The metaconid is pointed in the middle with two narrow and slightly worn sloping cristids running down. The anterior median rib is moderately developed and more distinct to the base of the crown. The tooth has a long furrow between the anterior and posterior ribs. The postprotocristid is not united with praehypocristid which indicate that the molar belongs to a young individual. The hypoconid is looking more crescentic in shape than the protoconid with the posthypocristid slightly longer and lower than the praehypocristid. The central cavities are moderately wide, deep and have not indentation. The comparative measurements of the described molars are provided in Table I.

PUPC 86/97, the second upper molar compares more favorably with already described specimens PUPC 96/39, PUPC 01/23, and AMNH 19844 and found resemblance in morphologically and metrically (Table I). PUPC 96/44, PUPC 82/98, PUPC 83/96 and PUPC 96/11 are identified as first lower molars because they have depression marks only posteriorly and the conids are narrower than those of upper molars (which have comparatively broad cones). The first lower molars are compared with AMNH 29917, AMNH 19844 and AMNH 19514, described and figured by Pilgrim (1937) and observed similarities among them with slight differences which are believed to be the individual variations. The specimens PUPC 83/117, PUPC 87/145 and PUPC 85/4 are the second lower molars with depression marks anteriorly as well as posteriorly. The molars have the same morphological and metrical values as found in the type specimens AMNH 29946, AMNH 19844 and AMNH 19514 of the American Museum collection (Table I). The second lower molars are larger than the first ones but in some animals the first molars seem to be getting the size of the second molars (Fig. 3). The size variation in the specimens are shown that the collected specimens belong to the different animals having various age and size.

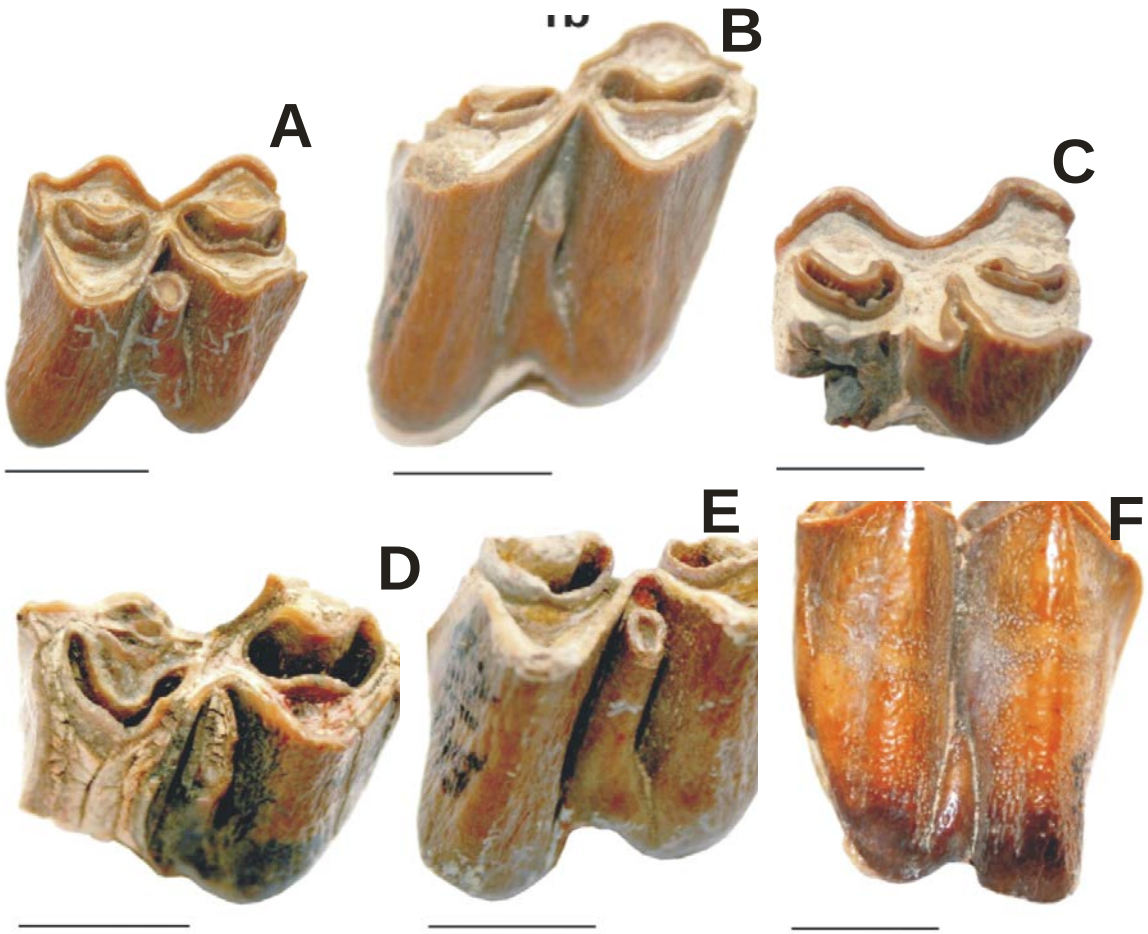

Fig. 2: *Selenoportax* vexillarius; A, right first lower molar (PUPC 82/98), occlusal view; B, right first lower molar (PUPC 83/96), buccal view; C, right first lower molar (PUPC 96/11), occlusal view; D, right second lower molar (PUPC 83/117), occlusal view; E, right second lower molar (PUPC 87/145), buccal view; F, left second lower molar (PUPC 85/4), buccal view. Scale bar 10 mm.

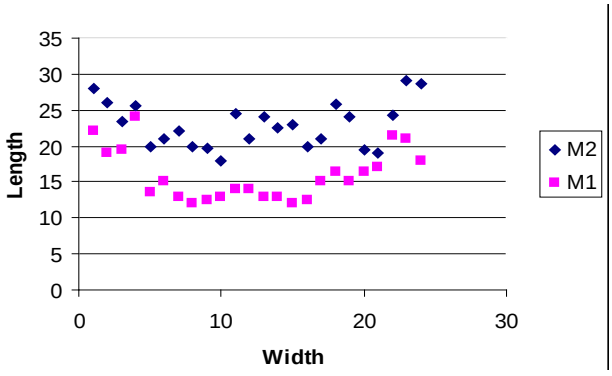

Fig. 3. Bivariate scatter diagram showing the size variation in the first and second lower molars of *Selenoportax vexillarius.*

DISCUSSION

Bovids are very common in the Middle and Late Miocene of the Siwaliks (Akhtar, 1992; Barry *et al*., 2002; Pilbeam *et al*., 1977; Khan and Farooq, 2006). These range from the tiny *Elachistoceras* to large *Bison* found from the Siwaliks of Pakistan and India. Remains of *Selenoportax* are known from the Nagri, Dhok Pathan and Tatrot Formations of the Siwaliks. These are characterized by moderate to large size with hypsodont teeth, strong and divergent styles and well developed median ribs. The specimens are collected from the late Miocene

of Hasnot, the Middle Siwaliks, have crescentic

Table I.- Comparative measurements of the cheek teeth of *Selenoportax vexillarius* in mm (millimeters). * The studied specimens.

Number	Side	Position	Length	Width	W/L ratio
PUPC 86/97*	left molar	M^2	28	22	0.78
PUPC 96/39	right molar	M^2	26.0	19.0	0.73
PUPC 01/23	left molar	M^2	23.5	19.5	0.82
AMNH 19844	right molar	M^2	25.7	24.0	0.93
PUPC 96/44*	left molar	M_1	20.0	13.5	0.67
PUPC 82/98*	right molar	M_1	21.0	15.0	0.71
PUPC 83/96*	right molar	M_1	22.0	13.0	0.67
PUPC 96/11*	right molar	M_1	20.0	12.0	0.60
PUPC 85/40	left molar	M_1	19.7	12.5	0.63
AMNH 29917	left molar	M_1	18	13	0.72
AMNH 19844	left molar	M_1	24.5	14	0.57
AMNH 19514	left molar	M_1	21	14	0.66
PUPC 83/117*	right molar	M_2	24.0	13.0	0.54
PUPC 87/145*	right molar	M_2	22.5	13.0	0.57
PUPC 85/4*	left molar	M_2	23.0	12.0	0.52
PUPC 04/12	left molar	M_2	20.0	12.5	0.62
AMNH 29946	left molar	M_2	21.0	15.0	0.71
AMNH 19844	left molar	M_2	25.9	16.5	0.63
AMNH 19514	left molar	M_2	24.0	15.0	0.62
PUPC 87/19	a maxillary part of the skull having right P^3-M^3 and left P^4-M^3	P^3	19.5	16.5	0.84
		P^4	19	17	0.89
		M^1	24.2	21.5	0.88
		M^2	29	21	0.72
		M^3	28.7	18	0.62

cones/conids, strong median ribs, and styles/stylids with prominent ectostylids. These are the basic characteristics of the genus *Selenoportax*. Pilgrim (1937) based this genus on a collection of fossils from the various Siwalik localities of Pakistan and India. Pilgrim referred all the collected specimens to the genus *Selenoportax* and added two species in it, *S. vexillarius* and *S. lydekkeri*. Later, Akhtar (1992) added two more species, *S. dhokpathanensis* (PUPC 86/248) from Dhok Pathan type locality on the basis of a damaged cranium differing from *S. vexillarius* by its gigantic size, and *S. tatrotensis* (PUPC 87/19) from the Tatrot Formation of the Upper Siwaliks based on a maxillary portion bearing right P^3-M^3 and left P^4-M^3. *S. tatrotensis* was described on the basis of the upper premolars and molars, these having strong and transversely extended entostyles/ ectostylids, styles that are slightly weaker and less divergent, weaker median ribs and less rugose enamel with traces of cement. These variations are observed within the species and metrically the specimen PUPC 87/19 falls within the range of *S. vexillarius*, which evidently proves its inclusion to *S. vexillarius* (Table I). The specimen collected from the Tatrot formation (Akhtar 1992) extends the range of *Selenoportax* from 10.3 to 2 Ma, contrary to the findings of Barry *et al.* (2002) who stated a maximum range of 10.3-7.9 Ma for this genus. Further work on two skulls of *Selenoportax* is in progress (Akbar and Akhtar, in prep.) and promises to clarify the exact phylogenetic position of this taxon.

REFERENCES

AKHTAR, M., 1992. *Taxonomy and distribution of the Siwalik bovids*. Ph.D. thesis, University of the Punjab, Lahore, Pakistan.

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

AKHTAR, M., 1996. A new species of the genus *Selenoportax*

(Mammalia, Artiodactyla, Bovidae) from Dhok Pathan, district Chakwal, Punjab, Pakistan. *Proc. Pakistan Congr. Zool.*, **16**: 91-96.

BARRY, J. C., 1987. The history and chronology of Siwalik cercopithecoids. *Human Evolut.*, **2**: 47-58.

BARRY, J. C., LINDSAY, E. H. AND JACOBS, L. L., 1982. A biostratigraphic zonation of the Middle and Upper Siwaliks of the Potwar Plateau of northern Pakistan. *Palaeogeog. Palaeoclimat. Palaeoecol.*, **37**: 95-130.

BARRY, J., MORGAN, M., FLYNN, L., PILBEAM, D., BEHRENSMEYER, A. K., RAZA, S., KHAN, I., BADGELY, C., HICKS, J. AND KELLEY, J., 2002. Faunal and environmental change in the Late Miocene Siwaliks of Northern Pakistan. *Paleobiology*, **28**: 1-72.

GENTRY, A. W., 1990. Ruminant artiodactyls of Pasalar, Turkey. *J. Human Evolut.*, **19**: 529-550.

GENTRY, A. W., 1994. The Miocene differentiation of Old World Pecora (Mammalia). *Hist. Biol.*, **7**: 115-158.

GENTRY, A. W., 2000. The ruminant radiation. In: *Antelopes, deer and relatives: fossil record, behavioral ecology, systematics and conservation* (eds. E. S. Vrba and G. B. Schaller), Yale University Press, New Haven, pp. 11-25.

JOHNSON, G.D., ZEITLER, P., NAESER, C.W., JOHNSON, N.M., SUMMERS, D. M., FROST, C.D., OPDYKE, N.D. AND TAHIRKHELI, R.A.K., 1982. The occurrence and fission-track ages of Late Neogene and Quaternary volcanic sediments, Siwalik group, northern Pakistan. *Palaeogeog. Palaeoclimat. Palaeoecol.*, **37**: 63-93.

KHAN, M. A. AND FAROOQ, U., 2006. Paleobiogeography of the Siwalik ruminants. *Int. J. zool. Res.*, **2**: 100-109.

PILBEAM, D., BARRY, J., MEYER, G. E., SHAH, S. M. I., PICKFORD, M. H. L., BISHOP, W. W., THOMAS, H. AND JACOBS, L. L., 1977. Geology and palaeontology of Neogene strata of Pakistan. *Nature*, London, **270**: 684-689.

PILGRIM, G.E., 1937. Siwalik antelopes 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**: 1-356.

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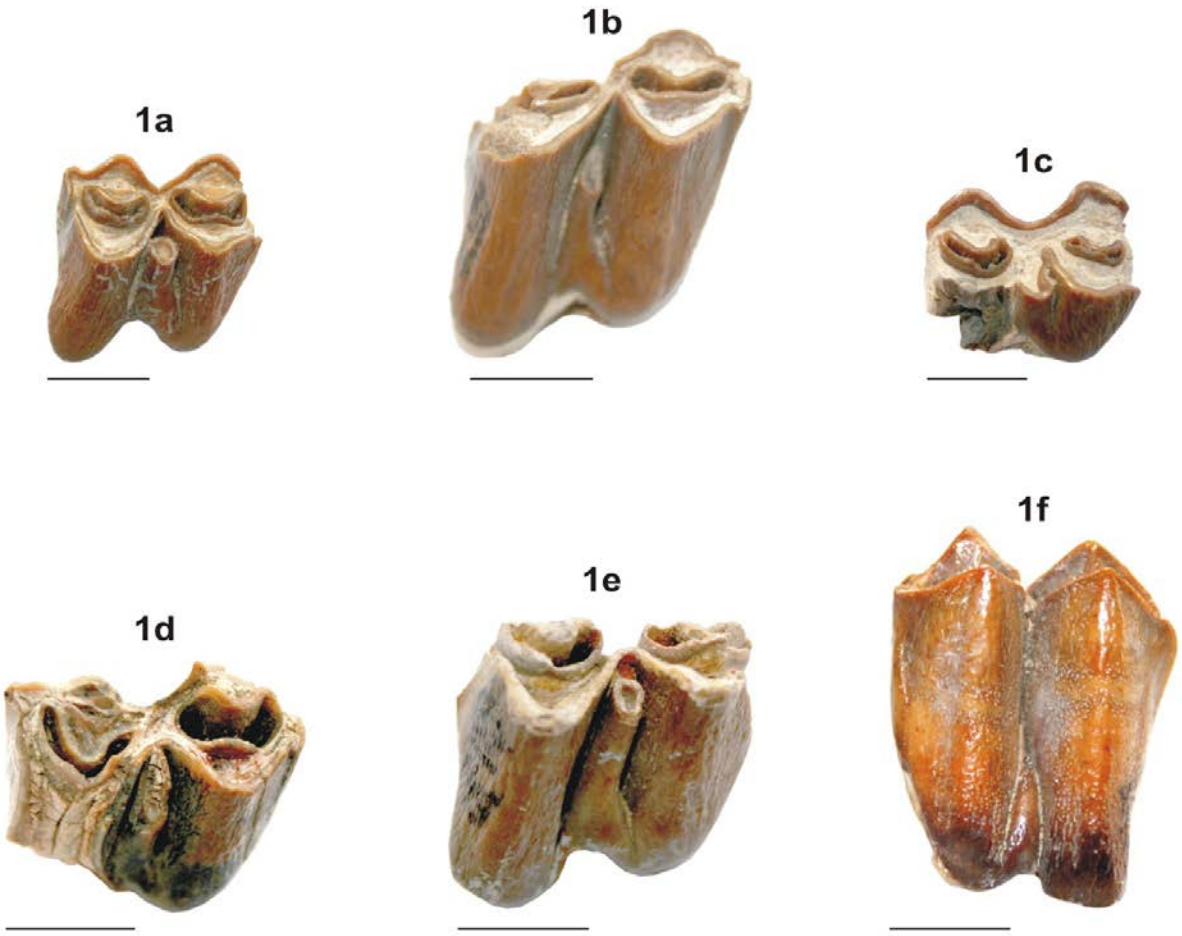
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