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Original Article

Some new fossils of *Hipparionine* from Dhok Pathan Formation of Siwaliks

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Abstract
Some new fossils have been reported from Neogene basin of the Dhok Pathan type locality in the district Chakwal, northern Pakistan. The sample includes isolated dentition. The remains are assigned to the hipparionine genus *Sivalhippus*. *Sivalhippus* is well known in the Pakistani Siwaliks during Late Miocene-Early Pliocene.
Key words: *Hipparion*, Equidae, Mammalia, Vertebrate, Miocene, Siwaliks.

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INTRODUCTION

The hipparionine remains comes from the Dhok Pathan village (Lat. 33° 07 N, Long. 72° 14 E), Chakwal district, northern Pakistan (Fig. 1). The thickness of the area is from 950-1200 m. The Dhok Pathan village is designated the type locality of the Dhok Pathan Formation (Cheem *et al*., 1977). The various field trips were carried out for the collection of hipparionine remains from the Dhok Pathan type locality. Fossils were collected thoroughly from the different parts of this type locality. The identifiable fossils were selected from the gross collection and were numbered and preserved for the taxonomic study. Many significant features in equid teeth required a special treatment to make the best use of their discriminating value. Some of them can be and should be measured, other will be counted, described or their presence or absence merely stated. For the various characters of different kind of teeth, a detail nomenclature has already been developed. When dealing with isolated teeth, the 1st step is to try to distinguish the different categories. No difficulties arise in separating P2 and M3 (both in upper and lower), but the distinction between P3 and P4, or M1 and M2 or even between premolar (P3 and P4) and molar (M1 and M2) may prove very difficult. The specimens under study have been catalogued e.g., GCS 11/14 (GCS- Government College of Science, Institutional abbreviation). A total 8 specimens are included in this study which consist of premolar and molar of *Sivalhippus theobaldi.* All the measurements are given in millimeters (mm) and taken with the help of metric vernier caliper. Tooth length and width were measured at occlusal level. Measurements given for teeth are occlusal length and occlusal width. Uppercase letter is used for upper dentition and the lower case letter for lower dentition. The terminology and measurement of the teeth follow Gentry and Hooker (1988).

SYSTEMATIC PALAEONTOLOGY

Family Equidae Gray, 1821
Subfamily Equinae Stinmann Doderloin, 1832
Genus *Sivalhippus* (Lydekker 1877)
***Sivalhippus theobaldi* (Lydekker), 1882**
Type specimen. GSI C153, left maxilla with milk teeth.
Type locality. Dhok Pathan, Chakwal district, Punjab province, Pakistan.
Horizon. Middle Siwaliks.
Known distribution. Asia.
Studied material. GCS 11/15, an isolated right upper 3rd premolar; GCS 11/14, an isolated right upper 4th premolar; GCS 11/21, an isolated right upper 2nd molar; GCS 11/16, an isolated left upper 3rd molar; GCS 11/17, an isolated left upper 3rd molar; GCS 11/19, an isolated left

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lower 2nd premolar; GCS 11/18, an isolated left lower 3rd premolar; GCS 11/20, an isolated right lower 1st molar.

DESCRIPTION AND COMPARISON

Upper dentition. The 3rd premolar is almost triangular with characteristically well developed cones (Fig. 2). It is in a good state of preservation and shows moderately the middle stage of wear. The enamel is thick. The cementation is present. The protocone is isolated compressed pillar and elongated in shape. The hypoconal groove is present but not well developed. The protocone and the hypocone present on the buccal side. The metacone and the paracone present on the lingual side. The styles are well developed and prominent. It is elongated and pillar like. The parastyle and mesostyle are similar in general appearance. Both are broad at the base and narrow at the apex. The metastyle is weak and not prominent like others.

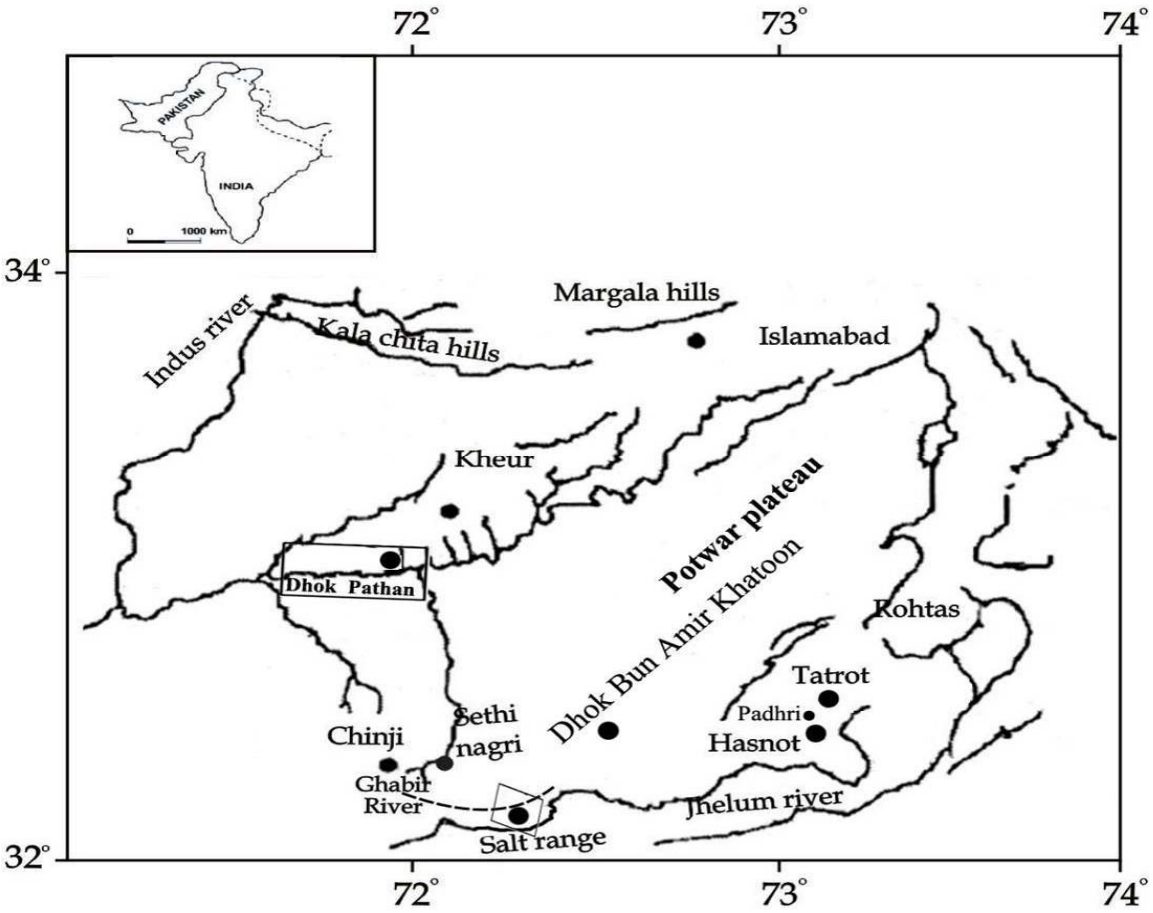

Figure 1. Map of the Potwar Plateau in northern Pakistan showing main fossil localities (modified from Barry *et al*., 2002); encircled studied area.

The fourth premolar is almost quadrate with characteristically well-developed main cones (Fig. 2). It is in a good state of preservation and in middle wear. The protocone is damaged in one side. The hypoconal groove is also well developed and prominent. The styles are well developed, preserved and prominent and pillar like. The parastyle and mesostyle are similar in general appearance. Both are broad at the base and narrow at the apex. The metastyle is weak and not prominent like other styles. The protoloph, the metaloph,

and the ectoloph are distinguished. The crown is highly plicated.

The upper third molars are narrow crowned and hypsodont (Fig. 2). The hypoconal groove is not prominent. All styles are present in good condition. The paracone, metacone and hypocone are complete. The metacone is board than the paracone. The protoloph, ectoloph and metaloph are well developed and prominent. The fossettes are clear. The pre-, and post-fossette are furnished with numerous plications of thickly banded enamel. All cusps are well developed and thick layer of cement is present all over the crown.

Lower dentition. The 2nd premolar is an early wear (Fig. 2). The premolar is molariform and the principal conids are not broad as in the case of the upper dentition. The protoconid and hypoconid are not clearly differentiated. The hypoconid is triangular in general appearance. The metaconid and entoconid are vertically higher than the other ones. The anterostylid is present in the premolar anteriorly. The anterostylid and the mesostylid are well preserved and prominent. There is a deep flexid formed by the union of the anterior side of the metastylid and posterior sides of the protoconid. On the lingual side, there are two flexids, the metaflexid and entoflexid. The metaflexid is broad in middle and narrow anteroposteriorly.

The lower 3rd premolar is molariform tooth (Fig. 2). The protoconid and hypoconid are not clearly differentiated. The metaconid is V-shaped and entoconid is triangular in general appearance. The protoconid and the hypoconid are comparatively broad and protoconid is somewhat broken partially. The metaconid is broad and triangular and united with narrow isthmus. The protostylid is bulky and narrow while endostylid has broken. The metaflexid is narrow while entoflexid is triangular is shape and narrow. The hypoconulid is absent but the mesostylid is present lingually.

Figure 2. *Sivalhippus theobaldi:* 1. GCS 11/15-rP3; 2. GCS 11/14-rP4; 3. GCS 11/21-rM2; 4. GCS 11/16-rM3; 5. GCS 11/17-rM3; 6. GCS 11/19-lp3; 7. GCS 11/18-lp4; 8. GCS 11/20-rm1 (a, occlusal view; b, lingual view; c, labial view). Scale bar equals 10 mm.

Table I: Comparative measurements of the studied specimens of *Sivalhippus theobaldi* (mm). *the studied material. Referred material is taken from Colbert (1935), Bernor and Hussain (1985), Ghaffar (2005) and Iqbal *et al*. (2009).

Number	Position	Length	Width	W/L ratio
GCS 11/15*	P3	28.0	26.0	0.93
PUPC 07/59	P3	30.5	20.0	0.66
PUPC 00/94	P3	25.0	18.0	0.72
PUPC83/498	P3	26.5	13.0	0.49
GCS 11/14*	P4	25.3	20.0	0.79
PUPC 07/78	P4	25.0	18.0	0.72
PUPC OO/94	P4	25.0	24.0	0.96
PUPC 87/309	P4	26.0	15.5	0.60
GCS 11/16*	M3	25.0	22.0	0.88
GCS 11/17*	M3	24.0	23.0	0.96
PUPC 07/58	M3	28.0	20.7	0.74
AMNH 19466	M3	24.0	22.0	0.92
AMNH 19857	M3	25.0	23.0	0.92
GCS 11/19*	p2	26.0	ca 14	-
GCS 11/18*	p3	ca 28	13.0	-
PUPC 07/60	p2	33.0	15.6	0.47
PUPC 83/498	p2	31.0	12.0	0.39
PUPC 83/285	p2	31.0	15.0	0.48
PUPC 83/290	p2	30.0	12.0	0.40
PUPC 83/786	p2	32.0	13.5	0.42
PUPC 83/183	p2	30.0	14.6	0.49
PUPC 00/94	p2	31.0	18.5	0.60
PUPC 07/59	p3	30.5	20.0	0.66
PUPC 00/94	p3	25.0	18.0	0.72
PUPC 83/498	p3	26.5	13.0	0.49
GCS 11/20*	m1	21.0	15.0	0.71

The second lower molar is in its excellent state of preservation (Fig. 2). The protoconid and the hypoconid are greater in their antero-posterior diameter than the meteconid and the entoconid. The metaconid is almost rounded in general appearance. The entoconid is smaller in size than the other major conids.The parastylid is the extension of the paraconid. The entostylid and mesostylid are strong.

The teeth reflect hipparionine feature in having longitudinally elongated, isolated protocone. The enamel bordering of the fossettes are relatively complex. The specimens are extremely

hypsodont and show high frequency of plications. The morphomatic study of the specimens (Table I; Fig. 2) reveals all the features of species *Sivalhippus theobaldi* (Christol, 1832; Lydekker, 1882; Colbert, 1935; Ghaffar, 2005) and consequently, assigned to *Sivalhippus theobaldi*. *Sivalhippus theobaldi* is larger than *S. S. perimense* and *S. nagriensis* (Wolf *et al*., 2013).

CONCLUSION

The fossil record indicates the occurrence of *Sivalhippus theobaldi* in the Late Miocene outcrops of Dhok Pathan. *Sivalhippus theobaldi* is always found common with other large mammals in the Middle Siwaliks.

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