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A preliminary report on some fossil mammals (Equidae, Perissodactyla and Hyracoidea) from the Pliocene Udunga fauna, Transbaikalia, Russia

Hideo Nakaya[1*], Masanaru Takai[2], Akira Fukuchi[3], Shintaro Ogino[2]

[1]*Graduate School of Science and Engineering, Kagoshima University, Kagoshima 890-0065, Japan*
[2]*Primate Research Institute, Kyoto University, Inuyama 484-8506, Japan*
[3]*Graduate School of Natural Science and Technology, Okayama University, Okayama 700-8530, Japan*
**Corresponding author. e-mail: nakaya@sci.kagoshima-u.ac.jp*

Abstract

The paleoenvironment of the middle Pliocene Udunga fauna has been estimated by many workers to date based on the composition of the mammalian fauna. In this short article we tried the paleoenvironmental analysis of the Udunga fauna using the mesowear method to equiids (*Hipparion*) cheek teeth. The result indicate the openland environment for the middle Pliocene Udunga. On the other hand, *Postschizotherium* of Udunga is likely differs from P. chardini, discovered from the late Pliocene to the early Pleistocene of Nihewan, Shanxi Province, China, suggesting the possibility of the new species for this specimen.

Introduction

The paleoenvironment of the middle Pliocene Udunga fauna has been estimated by many workers data (e.g. Devyatkin and Zazhigin, 1974; Zazhigin, 1989; Kalmykov, 1992; Erbajeva et al., 2003; Vislobokova et al., 1995; Kalmykov et al., 2005). The conclusion of these workers is that the paleoenvironment of the Udunga fauna is the mixture of the openland elements and forest dwellers. Here we tried the paleoenvironmental anlalysis of the fauna using the mesowear method, which was developed by Fortelius and his colleagues (e.g. Fortelius and Solounias, 2000). The specimens used in this study are of the cheek teeth of two large size ungulates, *Hipparion* sp. (Equiidae, Perissodactyla) and *Postschzotherium* cf. *chardini* (Pliohyrachidae, Hyracoidea) discovered from Udunga.

There are three types of *Hipparion* recognized in the Udunga fauna, such as *H. houfenense*, *H.* cf. *houfenense*, and *H. tchicoicum*, but *H.* cf. *houfenense*, is not established well but may be a intraspecific variation of *H. houfenense*.

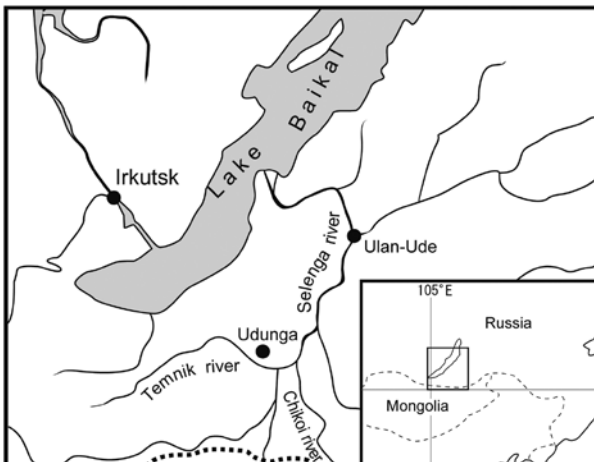

Figure 1. The location of the Transbaikal area. Modified from Kalmykov (2002).

On the other hand, *Postschizotherium* was originally included in the Chalicotheriidae (Perissodactyla) based on the first specimen discovered from the early Pleisocene Nihowan site, northern China (Teilhard de Chardin and Piveteau, 1930; Koenigswald; 1932). Later Teilhard de Chardin (1939) moved this animal to Hyracoidea, and now most workers support his classification (e.g. Rasmussen, 1989; McKenna and Bell, 1997). In this paper, we adopt this classification.

Mesowear of *Hipparion* cheek teeth

The dental specimens used in this analysis is listed in Table 1 and 2. Most of the specimens are isolated premolars or molars but right mandible with P_2-M_1 and left with P_2-M_3 (Figure 3 and 4). The series of the isolated upper teeth probably belong to the same individual (Figure 2).

The tooth mesowear method to equids is a new approach of reconstructing ungulate diets and its paleoenvironments (Fortelius and Solounias, 2000, and so on). We analyzed mesowear of *Hipparion* upper and lower cheek teeth (P4-M3) from the middle Pliocene Udunga Fauna, Transbaikalia, Russia. One taxon of fossil Primates, *Parapresbytis eohanuman*, was found from the middle Pliocene sediments of Udunga (Kalmykov and Maschenko, 1992, 1995) We analyzed the paleoenvironments of the Udunga Fauna by using the mesowear method to *Hipparion* cheek teeth. The occlusal relief of teeth is scored "high: or "low", the cusp shape is classified as "sharp", "round" and "blunt".

In the occlusal relief of *Hipparion* teeth, 57% of lower cheek teeth from Udunga were scored "high", 43% lower cheek teeth were scored "low". In the cusp shape, 70% of the lower cheek teeth from the Udunga Formation were classified as "round". 30% of lower cheek teeth were classified as "blunt". However, the occlusal relief and cusp shape of *Hipparion* teeth according to the difference between double knot type 2 and 4 of lower cheek teeth were divided into two types. 85% of type 2 lower cheek teeth were scored "high" and 88% type 4 lower cheek teeth were scored "low". 100% of type 2 lower cheek teeth were classified as "round" and 75% type 4 lower cheek teeth were classified as

Table 1. Mesowear classification of *Hipparion* upper tooth fossil from Udunga. R/L, right/left; PT, part; H/L, high/low; A, anterior; P, posterior; S, sharp; R, round; B, blunt.

Udg No.	R/L	PT	H/L	A	P	Remarks
661A/B	R	$M^{1/2}$	L	B	B	
665	L	$M^{1/2}$	H	S	S	
664	L	$P^{3/4}$	H	S	R	
662	R	$DP^{3/4}$	H	R	R	
663	L	M^1/P^4	-	-	-	unworn

Table 2. Mesowear classification of *Hipparion* lower teeth from Udunga. R, right; L, left; PT, part; H/L, high/low; A, anterior; P, posterior; S, sharp; R, round; B, blunt; DK, double knot. There are at least 7 individuals of *Hipparion*.

Udg-	side	PT	H/L	A	P	DK
667	R	P_2	H	B	R	2
666-F`	L	P_2	L	B	B	2
682-C	L	P_2	H	R	R	2
667	R	P_3	H	B	R	2
666-E	L	P_3	L	B	B	2
671	L	P_3	H	B	R	2
682-B	L	P_3	H	R	R	2
673	L	P_4	H	R	R	2
682-A	L	P_4	H	R	R	2
667	R	P_4	H	R	R	2
666-D	L	P_4	L	R	R	2
667	R	M_1	H	R	R	2
1296-C	L	M_1	H	R	B	2
666-C	L	M_1	L	R	R	2
672	L	M_1	H	R	R	2
680	L	M_2	H	S?	R?	2
1296-B	L	M_2	H	R	R	2
666-B	L	M_2	H	R	R	2
1296-A	L	M_3	H	R	R	2

Udg-	side	PT	H/L	A	P	DK
666-A	L	M_3	H	R	R	2
1269	L	$DP_{3/4}$	H	S	R	2?
681-E	L	P_2	L	B	B	2/4
681-J	R	P_2	L	B	R	4
681-I	R	P_3	L	R	R	4
668	L	P_3	L	B	B	4
681-D	L	P_3	L	B	B	4
670	R	DP_3	H	R	R	4
676	R	DP_4	H	R	R	4
679	L	P_4	L	B	B	4
681-H	R	M_1	L	B	B	4
677	L	M_1	L	B	B	4
675	L	$M_{2/1}$	H	R	R	4
669	L	M_2	L	B	B	4
681-G	R	M_2	L	B	B	4
681-F	R	M_3	L	B	R	4
678	L	M_3	L	B	B	4
674	R	$DP_{3/4}$	-	-	-	-

Individual No.1 includes Udg-682 (A, B, C) and 1296 (A, B, C)
Individual No.2 includes Udg-671, 672, 673, and 680
Individual No.3 includes Udg-681(D, E, F, G, H, I, and J)
Individual No.4 includes Udg-668, 669, 677, 678, and 679.
Individual No.5 includes Udg-667
Individual No.6 includes Udg-666 (A, B, C, D, E, and F)

"blunt". Mesowear score (Croft & Weinstein 2008) of double knot type 2 of lower tooth (p4-m3) is 1.18, and type 4 of lower tooth (p4-m3) is 2.75. This result indicates that the paleoenvironments of the Udunga fana may be openland environments (Hasumi 2009 MS).

Hyracoidea teeth

Order Hyracoidea
Family Pliohyracidae
Subfamily Pliohyracinae
Genus *Postschizotherium*
Postschizotherium sp.

Materials: left and right 1st incisor, 4th premolar to 2nd molar, and worn out right 4th milk molar.

Description: Cheek teeth are high crowned tooth. Ectoloph of cheek teeth curved buccally. Molar teeth have isolated protocone.

Remarks: Originally, genus *Postschizotherium* was named as the member of the family Chalicotheriidae by von Koenigswald (1932) without any detailed description. *P. chardini*, the type species of the genus, was discovered from the early Pleistocene Nihowan sediments. The first description of this material was made by Teilhard de Chardin and Piveteau (1930), and Teilhard de Chardin (1939) indicated the possibility that this material belongs to the Hyracoidea by suggestion from G.G. Simpson. *Postschizotherium* is now

Figure 3. Lower dentition of *Hipparion*. Scale bar, 1 cm. 987/50.

Figure 2. Upper dentition of *Hipparion*. Scale bar, 1 cm.

Figure 4. Lower dentition of *Hipparion*. Scale bar, 1 cm.

claasified in the subfamily Pliohyracinae, family Pliohyracidae, order Hyracoidea by most workers (Rasmussen, 1989; McKenna and Bell, 1997).

To date four species have been erected for *Postschizotherium*, such as *P. licenti*, *P. intermedium*, *P. chardini*, and *P. tibetense*. *P. licenti* and *P. intermedium* were established by Koenigswald (1966), but the former is now regarded conspecific with *P. chardini* (Qiu et al., 2002). *P. intermedium* is smaller with lower crowned cheek teeth than *P. chardini*. *P. tibetense* was errected by Zong (1996) based on the maxilla preserving the upper cheek teeth discovered from the early Pleistocene sediments of Dege, higher terrace of the Jinsha River, Yunnan Province, China (Zong, 1996). Qiu et al. (2002) regard *P. tibetense* as a primitive species of *Postschizotherium*. Furthermore, *P. tibetense* was revised genus name to *Hengduanshanhyrax* by Chen (2003) on the smaller size and some characters of teeth.

Postschizotherium differs from *Pliohyrax* from China (Tung and Huang, 1974) and Europe, on the character of hypsodont cheek teeth with cement and strongly reduced premolars relative to molars (Qui et al., 2002). Udunga hyracoids cheek teeth have same

Table 3. Dental measurements (mm) of *Postschizotherium* cf. *chardini*, Hyracoidea, fossil from Udunga. R,right; L, left; H, height; L, length; W, width.

Udg-	side	part	H	L	W	remarks
191-H	R	P^2	12.9	14.5	12.1	
191-G	L	P^2	10	14.7	12.6	
191-F	R	P^3	20.2	17.3	15.5	
191-E	L	P^3	21	16.9	15	
191-H	R	P^4	13.8	-	-	unworn, protocone fragment
191-L	R	DP^4	4.3	16.2	16.3	worn out
191-C	L	P^4	27.8	24.8	24.5	unworn
191-J	R	I^1	12.6	52.3	12.1	tip lacking
191-I	L	I^1	11.3	59.3	11.6	
191-K	R	M^1	21.71+	22.96+	23.27+	
191-D	L	M^1	30.5	17.1	17.6	
191-B	R	M^2	44.9	29.3	23.6	
191-A	L	M^2	36.94+	30.8	24.8	

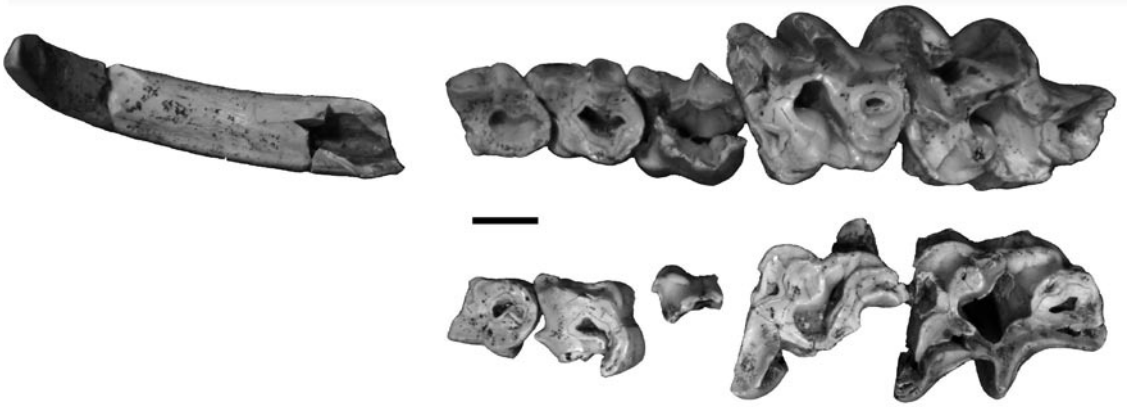

Figure 5. Upper dentition of *Postschizotherium* cf. *chardini* (Udg-0191). Isolated left I^1 and P^2-M^2 and right P^{2-3}, dP^4 and M^{1-2}. Scale bar, 1 cm.

characters of *Postschizotherium*. Compared with the type specimen of *P. chardini*, in P^4 (Udg-191-C, H) and M^1 (Udg-191-D, K) of the Udunga specimen the parastyle and mesostyle protrude more buccally, forming the "wing"(Figure 5). The occlusal outline of P^2 or P^3 also seems different between *P. chardini* and the Udunga specimen. The Udunga *Postschizotherium* may be different species of the genus.

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