

THE FIFTH DIGIT OF *APROTODON* (RHINOCEROTIDAE) FROM THE MIOCENE KALKAMAN LOCALITY, KAZAKSTAN

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Abstract— We document the rare preservation of digit V of the manus in a fossil rhinoceros, *Aprotodon* from the Miocene Kalkaman locality, eastern Kazakstan. The digit V of *Aprotodon* described here is small and narrow—clearly not a weight-bearing part of the manus. This is the first record of a manus digit V in a teleoceratine rhinoceros. We predict that this is the morphology of any manus digit V of a fossil rhinoceros.

INTRODUCTION

Rhinoceroses have a functionally tridactyl manus in which the largest, central digit is digit III, flanked by somewhat smaller digits II and IV (e. g., Peterson, 1920; Scott, 1941; Klaitz, 1972; Prothero, 2005). However, in a few specimens digit V is preserved as a rudimentary structure, and we describe such a specimen here.

Aprotodon is a well known mid-Cenozoic rhinoceros from Asia (e.g., Forster Cooper, 1915; Borisyak, 1944). However, due to their rarity, limb bones of *Aprotodon* are poorly understood. The rhinoceros postcranial material discovered at the Miocene Kalkaman locality in eastern Kazakstan (Fig. 1), some of which is described here, is very similar to that of *Aprotodon ayakozensis*. Here, we describe a rare case of preservation and discovery of the manus digit V of *Aprotodon* from the Kalkaman locality.

PROVENANCE

The Kalkaman locality is on the northwestern shore of the salt lake Small Kalkamantuz, north of the village Solvetka in the Pavlodar region of eastern Kazakstan (N52°04.319, E076°31.126) (Fig. 1). Fossil remains of vertebrates were discovered there in the first half of the last century (Borisyak and Belyaeva, 1948). Further study revealed a large number of vertebrates of middle-late Miocene age (e. g., Bazhanov, 1955; Lychev, 1963) in deposits attributed to the Aral Formation (Lavrov, 1959). According to Lychev (1963), the bones were float washed out of an upper layer no longer present at the locality. Later, the deposits containing the Kalkaman fauna were assigned to the Ermak Formation (Biryukov et al., 1968), and then to the Kalkaman Formation (Zykin and Zazhigin, 2008). Lists of the fauna of the Kalkaman locality were given by Lychev (1963) and Tleuberdina et al. (1993).

As the result of research carried out by one of us (BB) at Kalkaman in 1984, in situ material was discovered of a large number of well-preserved fossils, mainly of the rhinoceros *Aceratherium gobiense* Beliajeva, 1960 (Bayshashov, 1988, 1993). Among the earlier described material from Kalkaman, Lychev (1963) referred a single tooth to the

rhinoceros *Aprotodon* (?) sp. The structure of the tooth is very similar to the teeth of *A. ayakozensis* Bayshashov, 2001, found at the early Miocene Ayakoz site (Bayshashov, 2001).

In 2009, during further fieldwork at Kalkaman, BB found part of the distal forelimb of a rhinoceros associated with other postcrania referable to *Aprotodon* (Figs. 2-3). Particularly interesting is the presence of a rudiment of the fifth finger (digit V of the manus). Although this is 2-3 times smaller than the functional fingers, it is a fully-developed bone (Fig. 3).

DESCRIPTION

The material described here (Figs. 2-3) is in the collection of the Institute of Zoology, Almaty, Kazakstan: № 19/61-09 mtc-III, № 19/62-09 mtc IV, № 19/64-09 mtc-V, and phalanges of digit III (№ 19/4-09 Ph-I, № 19/5-09 Ph-II, № 19/6-09 Ph-III), phalanges of digit IV (№ 19/7-09 Ph-I, № 19/8-09 Ph-II, № 19 / 9.9 Ph-III), phalanges of digit V (№ 19/12-09 Ph-I, № 19/13-09 Ph-II, № 19/14-09 Ph-III).



FIGURE 1. The Kalkaman locality in eastern Kazakstan.

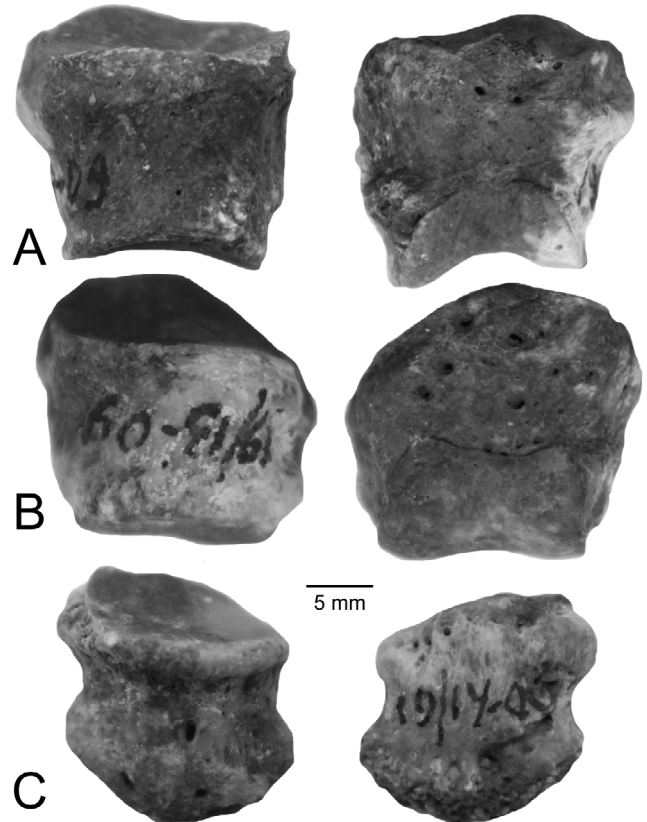


FIGURE 2. Phalanges of manus digit V of *Aprotodon*. **A**, is the proximal phalanx; **B**, the second phalanx; and **C**, the distal (ungual) phalanx. Each phalanx in two views, dorsal (left) and ventral (right).

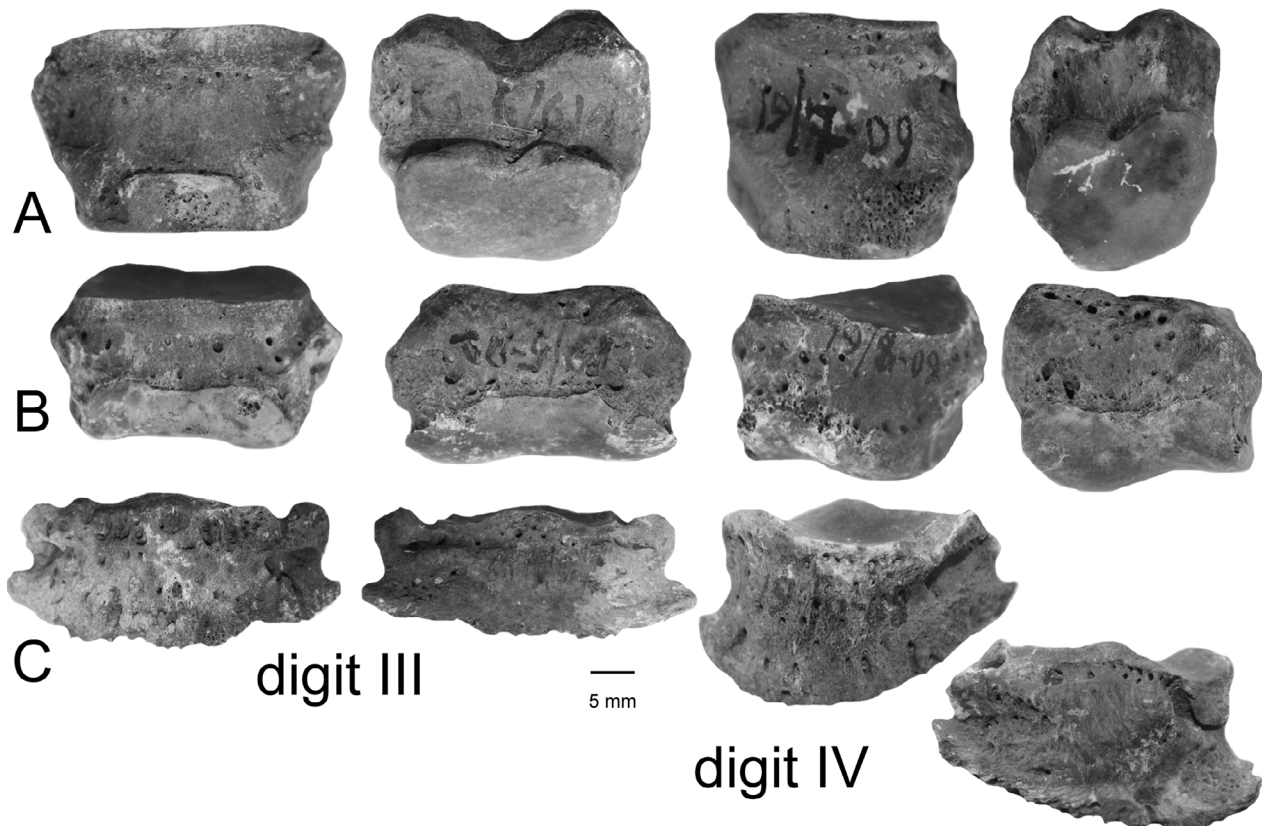


FIGURE 3. Phalanges of manus digits III and IV of *Aprotodon*. **A**, is the row of proximal phalanges; **B**, the second phalanges; and **C**, the distal (ungual) phalanges. Each phalanx in two views, dorsal (left) and ventral (right).

Measurements of these bones are in Appendix.

The phalanges of digits III and IV (Fig. 2) are short and broad and well resemble those of many other rhinoceroses (e. g., Prothero, 2005).

The digit V phalanges (Fig. 3), however, are much smaller and relatively longer and narrower (Appendix). The first (proximal) phalanx of digit V is nearly square in anterior view, with a large, concave proximal facet and a narrower, convex, distal articular facet that is a trochlea. The second phalanx is about the same size as the first and more nearly trapezoidal in anterior view. However, like the proximal phalanx, it has a broad and concave proximal articular facet and a distal articular facet that is narrower and trochlear in shape. The third (distal or ungual) phalanx is much smaller than the other two phalanges and more equant, in that the proximal and distal articular surfaces are nearly the same width. The shaft of the phalanx is constricted (waisted) between them. Unlike the ungual phalanges of digits III and IV, the distal end is not broadened and rugose, probably because digit V bore little or no weight.

DISCUSSION

The discovery of digit V in fossil rhinoceroses is very rare for three reasons: (1) in the majority of rhinoceroses this bone is absent; (2) fragile and small bones like those of digit V quickly break down after the death of the animal or are eaten by predators/scavengers and thus are not preserved; and (3) individual phalanges of digit V may be found, but are easily mistaken for the bones of another, smaller mammal. In contrast, metacarpal V is common and well known in various fossil rhinoceroses, though it is often reduced in size relative to the other metacarpals (Wood, 1964; Prothero, 2005, fig. 5.28).

Other than the *Aprotodon* manus digit V described here, information on this digit in fossil rhinoceroses is very limited in the published literature. Another example of digit V preservation in a fossil rhinoceros is a right manus of *Trigonias osborni* from the late Eocene (Chadronian) of North America illustrated by Scott (1941, pl. 83, fig. 7; reproduced in Prothero, 2005, fig. 5.18B). Scott (1941, p. 782) provided no description of this digit other than to remark that “the fifth digit, though complete in all its parts, is so reduced as to be little more than a vestige without function.” The digit V of *Aprotodon* described here is

very similar to that of *Trigonias* in being small and narrow—clearly not a weight-bearing part of the manus. This is the first record of a manus digit V in a teleoceratine rhinoceros. It is fair to predict that this is the morphology of any manus digit V of a fossil rhinoceros.

ACKNOWLEDGMENTS

We thank Peter Kondrashov and Donald Prothero for helpful reviews of the manuscript.

REFERENCES

- Bayshashov, B.U., 1988, Stages of development of the Neogene rhinoceroses of Kazakhstan; *in* Inter-regional comparison of the Mesozoic-Cenozoic faunas and floras of Kazakhstan: Alma-Ata, p. 74-82.
- Bayshashov, B.U., 1993, Neogene rhinoceroses of Kazakhstan. Almaty, Ed. “Gylym,” 192 p.
- Bayshashov B.U., 2001, New data on the location of the ancient ungulates Ayakoz and biostratigraphy: Geology of Kazakhstan, v. 5-6, p. 140-147.
- Bazhanov, V.S., 1955, Review the history of the terrestrial vertebrates of Kazakhstan: Materials on the History of the Fauna and Flora of Kazakhstan, v. 1, p. 5-13.
- Biryukov, M.D., Voskoboinikov M.E. and Savinov P.F., 1968, The stratigraphy of the Neogene Kazakhstan: Academy of Sciences of the Kazakh SSSR, Geological Series, no. 2, p. 11-19.
- Borislyak, A.A., 1944, *Aceratherium aralense* n. sp.: Doklady Akademiya Nauk SSSR, v. 43, p. 30-32.
- Borislyak A.A. and Belyaeva E. I., 1948, Location of Tertiary land mammals in the USSR: Proceedings of the Academy of Sciences of the USSR, v. 15, p. 1-114.
- Forster Cooper, C., 1915, New genera and species of mammals from the Miocene deposits of Baluchistan; preliminary notice: Annals and Magazine of Natural History, series 8, v. 16, p. 404-410.
- Klraits, B., 1972, The moving mesaxonic manus: A comparison of tapirs and rhinoceroses. *Extrait de Mammalia*, v. 36, p. 126-145.
- Lavrov V.V., 1959, Continental Paleogene and Neogene of the Aral-Siberian plains. Academy of Science, Alma-Ata, 230 p.
- Lychev, G.F., 1963, Neogene mammals of Small Kalkaman (Irtysh Pavlodar): Materials on the history of the Fauna and Flora of Kazakhstan, v. 4, p. 12-21.
- Peterson, O.A., 1920, The American diceratheres: Memoirs of the Carnegie Museum, v. 7, no. 6, 477 p.

Prothero, D.R., 2005, The evolution of North American rhinoceroses. Cambridge University Press, 218 p.

Scott, W.B., 1941, The mammalian fauna of the White River Oligocene. Part V. Perissodactyla: Transactions of the American Philosophical Society, new series, v. 28, p. 747-980.

Tleuberdina, P.A., Volkova, V.S., Gutieva, N., Kaipova, G.O., Luschaeva, T.T., Lychev, G.F., Pete, O.M., Tyutkova, L.A. and Chkhikvadze, V.M., 1993, Vertebrate fauna of Kalkaman (Irtysh Pavlodar): Materials on the History

of the Fauna and Flora of Kazakhstan, v. 12, p. 132-158.

Wood, H.E., II, 1964, Rhinoceroses from the Thomas Farm Miocene of Florida: Bulletin of the Museum of Comparative Zoology, v. 130, p. 129-146.

Zykin, V.S. and Zazhigin, V.S., 2008, The stratigraphy of the Neogene of the Pavlodar region: Proceedings of the International Scientific-Practical Conference "Paleontological Sites of Nature-Natural Heritage: The Study, Research Prospects and Problems of Conservation," Pavlodar, p. 15-21.

Appendix

Measurements and indexes of phalanges of *Aprotodon*.

Measurements (in mm and indexes in %)	Digit III			Digit IV			Digit V		
	Ph-I	Ph-II	Ph-III	Ph-I	Ph-II	Ph-III	Ph-I	Ph-II	Ph-III
1 Maximum length	29	23	33	29	24	31	19	14	17
2 Proximal width	48	46	69	33	35	44	21	17	17
3 Diameter	33	25	20	35	25	25	19	16	14
4 Width of upper articular surface	42	37	41	30	31	33	20	16	15
5 Diameter of upper articular surface	29	24	20	30	22	23	17	15	13
6 Distal width	37	41	76	30	28	57	17	15	18
Index 2:1	165.5	200	209	113.7	145.8	142	110.5	121.4	100
Index 3:2	68.7	54.3	28.9	106	71.4	56.8	95.2	94.1	82.3
Index 6:2	77.0	89.1	110.1	90.9	80.0	129.5	80.9	88.2	105.8

