

A Pleistocene Rhinocerotid (Mammalia, Perissodactyla) from Yage, Shizuoka Prefecture, central Japan

Author(s): Naoto Handa

Source: Paleontological Research, 19(2):139-142.

Published By: The Palaeontological Society of Japan

URL: <http://www.bioone.org/doi/full/10.2517/2014PR033>

BioOne (www.bioone.org) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/page/terms_of_use.

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

A Pleistocene rhinocerotid (Mammalia, Perissodactyla) from Yage, Shizuoka Prefecture, central Japan

NAOTO HANDA

Shinshushinmachi Fossil Museum, 88-3 Kamijo, Shinshushinmachi, Nagano 381-2404, Japan (e-mail: k1552325@kadai.jp)

Received February 21, 2014; Revised manuscript accepted September 19, 2014

Abstract. A fossil rhinocerotid tooth from the Yage Formation (Middle to Late Pleistocene), Yage in Shizuoka Prefecture, is described. The present specimen shows the following characteristics of the second lower incisor: tusk-like shape, enamel on the labial side, a teardrop-shaped cross section of the tooth crown, and an oval cross section of the root. The specimen is similar to the genus *Rhinoceros* in having a large and robust shape. However, owing to a lack of other elements, generic and specific identification are not possible. Previously, several large mammal fossils had been reported from the Yage area, but there were no rhinocerotids among them. Thus, this report is the first record of a rhinocerotid from the area. The Yage specimen suggests rhinocerotids were widely distributed during the Pleistocene of Far East Asia.

Key words: Japan, lower incisor, Pleistocene, Rhinocerotidae, Shizuoka Prefecture, Yage

Introduction

In this study, I describe a lower incisor of a rhinocerotid. According to the specimen label, it was collected by Takeshi Nishizawa in the Yage area in Inasa Town (a part of present-day Hamamatsu City) Shizuoka Prefecture, central Japan (Figure 1). Nishizawa (1972) further noted that it was found in “Yage mine”.

The Pleistocene Yage Formation is distributed in this area. Tomida (1978) subdivided the Yage Formation into the Lower and Upper Yage formations (Tomida, 1978). The lower part of the Yage Formation, which is composed of lacustrine deposits, has yielded fossils of fresh-water fish, crocodiles, turtles, and a river otter (e.g. Tomida, 1978; Nakajima and Hasegawa, 1982; Nojima, 2002). The geological age of the lower part is estimated as Middle Pleistocene by sedimentological and paleontological correlation with neighboring areas (Tomida, 1978; Nojima, 2002). The upper part of the Yage Formation, on the other hand, which consists of fissure deposits, has yielded various terrestrial mammal fossils (Takai *et al.*, 1958; Tomida, 1978; Nojima, 2002). Based on these vertebrate fossils, the upper part has been correlated to the upper part of the Kuzuu Formation (Upper Pleistocene) in Kuzuu, Tochigi Prefecture, and the upper part of the Isa Formation (Upper Pleistocene) in Isa, Yamaguchi Prefecture, Japan (Tomida, 1978; Nojima, 2002). Several

mammal bones from the upper part of the Yage Formation have also been dated to $18,040 \pm 990$ yrs BP by ^{14}C dating (Kawamura and Matsushashi, 1989).

Abbreviations.—KPM: Kanagawa Prefectural Museum of Natural History, Kanagawa Prefecture, Japan, GMNH: Gunma Museum of Natural History, Gunma Prefecture, Japan.

Systematic Paleontology

Order Perissodactyla Owen, 1848
Family Rhinocerotidae Owen, 1845
Subfamily Rhinocerotinae Owen, 1845
Genus and species indeterminate

Figure 2

Specimen.—SFM04-11306, a left lower second incisor.

Repository.—Shinshushinmachi Fossil Museum (SFM), Nagano Prefecture, Japan.

Locality and horizon.—Yage area, Inasa Town, Hamamatsu City, Shizuoka Prefecture, central Japan (Figure 1B). The specimen was collected from the lower or upper Yage Formation (Middle to Late Pleistocene; Tomida, 1978). Its precise locality and horizon is uncertain because this information was not provided on the label and literature.

Description.—The specimen described here represents

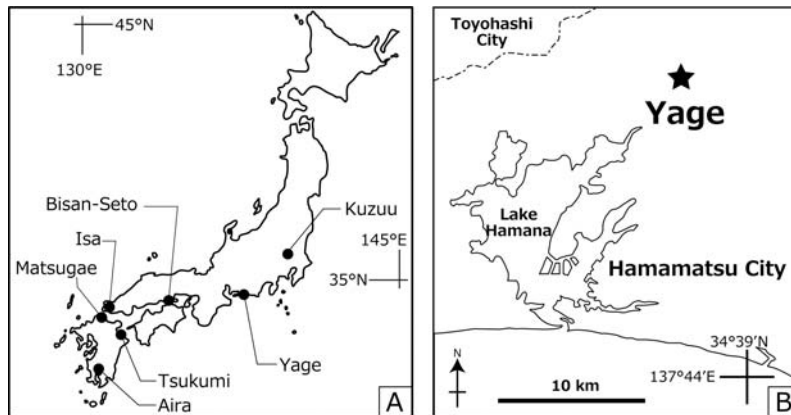


Figure 1. A, Map showing the fossil localities of the Pleistocene rhinocerotids in Japan. B, Map showing the Yage area, Hamamatsu City, Shizuoka Prefecture (modified from Tomida, 1978).

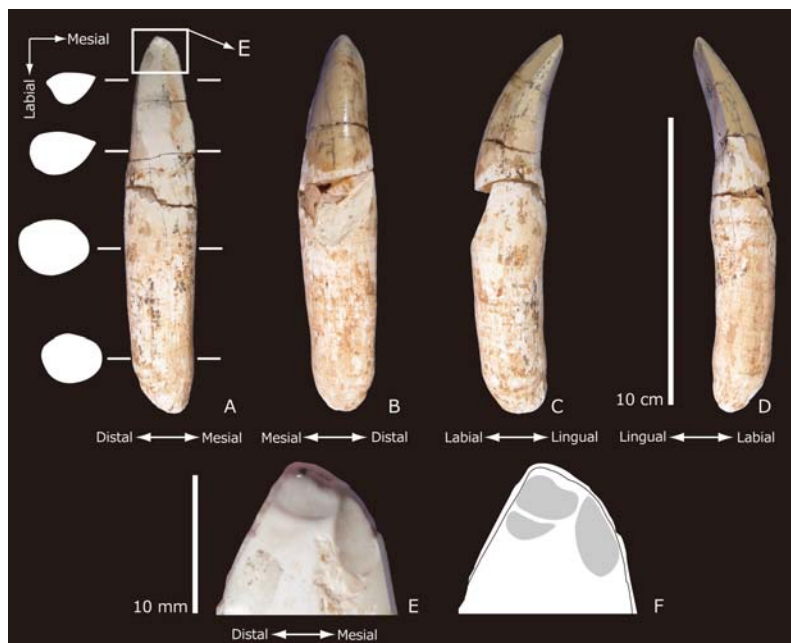


Figure 2. A lower second incisor of *Rhinocerotinae* genus and species indeterminate from the Yage area, Shizuoka Prefecture, central Japan (SFM04-11306). **A**, lingual view; **B**, labial view; **C**, distal view; **D**, mesial view; **E**, occlusal facets of *Rhinocerotinae* genus and species indeterminate; **F**, schematic drawing. White shaded areas represent cross sections. Gray shaded areas represent occlusal facets.

a left lower second incisor (*i*₂) (Figure 2), the labial part of which is partially lacking. The specimen was coated with reddish-brown-colored very fine sandstone. Relatively long and robust in size, the apex is slightly curved lingually, while the mid-part is slightly swollen labio-lingually. It has a maximum longitudinal length of 129.2 mm, a maximum labio-lingual width of 19.5 mm, and a maximum mesio-distal width of 26.0 mm. Several occlusal facets are observed on the apex of the tooth crown (Figure 2E, 2F). The cross section of the crown part is teardrop-shaped, with an acutely angled mesial margin, and a rounded distal margin. In contrast, the cross section

of the root is labio-lingually compressed into an oval shape. Light brown enamel covers the labial side of the tooth crown, while the lingual side of the tooth crown is smooth and lacking in enamel. The root end of the specimen is tapered with dense rings on the root surface.

Comparisons and discussion.—The specimen described here shows the following characteristics of the *i*₂ of *Rhinocerotidae*: tusk-like shape, enamel on the labial side, a teardrop-shaped cross section of the tooth crown, and an oval cross section of the root (Mermier, 1895; Osborn, 1898; Prothero *et al.*, 1986; Prothero, 2005).

Several taxa of the Subfamily *Rhinocerotinae* (including

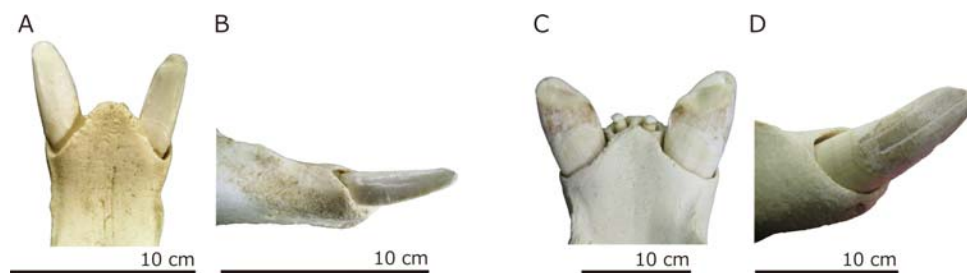


Figure 3. The lower second incisors of *Dicerorhinus* and *Rhinoceros*. **A, B**, *Dicerorhinus sumatrensis* (GMNH-VM-562: recent, adult individual, cast); **C, D**, *Rhinoceros unicornis* (KPM-NF1002747: Recent, adult individual). A and C, lingual view; B and D; right distal view.

Table 1. Measurements of the incisors of the present specimen, *Rhinoceros* and *Dicerorhinus* (in mm).

Taxon	Specimen number	Labio-lingual width	Mesio-distal width
Present specimen	SFM04-11306	19.5	26.0
<i>Rhinoceros unicornis</i>	KPM-NF1002747	28.4	41.9
<i>Rhinoceros sinensis hayasakai</i>	Specimens No. 5 (Otsuka and Lin, 1984)	–	17.4
<i>Dicerorhinus sumatrensis</i>	GMNH-VM-562	12.6	18.3

Dicerorhinus, *Rhinoceros*, *Coelodonta* and *Elasmotherium*), have been reported from the Pleistocene in East Asia (e.g. Tong and Moigne, 2000). Of these, *Dicerorhinus* and *Rhinoceros* have tusk-like i2 (Otsuka and Lin, 1984; Tong and Guérin, 2009; Schepartz and Miller-Antonio, 2010). Several species of *Dicerorhinus* (*D. choukoutiensis*, *D. yunchuensis*, *D. sumatrensis*, *D. nipponicus*) have been discovered in East Asia (Shikama *et al.*, 1967; Tong and Moigne, 2000; Tong and Guérin, 2009; Tong, 2012), and of these, *D. sumatrensis* is known to have i2. *Dicerorhinus sumatrensis* was discovered from Early to Late Pleistocene localities of China (Tong and Guérin, 2009; Tong, 2012 and references therein), such as Liucheng *Gigantopithecus* Cave, Guangxi; Xiawanggang, Henan; Yuyao, Zhejiang and Yunxian, Hubei. Tong and Guérin (2009) reported mandibles of *D. sumatrensis* from Liucheng *Gigantopithecus* Cave, Guangxi. Although these specimens lacked the lower incisors, they estimated that these mandibles had short and small lower incisors. The shape of the i2 of extant *D. sumatrensis* is short and slender and smaller in size (Table 1), unlike that of the specimen described here (Figure 3).

Some species of *Rhinoceros* (*R. sinensis*, *R. sivalensis*, *R. unicornis*) have been reported from Pleistocene localities of China (Tong and Moigne, 2000). *Rhinoceros sinensis* was discovered from many lower to Upper Pleistocene localities in South China (Tong and Moigne, 2000). *Rhinoceros sinensis hayasakai* was also reported from the lower Pleistocene T'ouk'oushan Group in Taiwan (Otsuka and Lin, 1984). *Rhinoceros sivalensis*

was found in the Middle Pleistocene of South China (e.g. Tong and Moigne, 2000). An isolated upper deciduous premolar, which is closer to *R. unicornis*, was discovered from the Late Pleistocene locality of Lijiang Basin, Yunnan (Li, 1961; Tong and Moigne, 2000). The i2 of *Rhinoceros* is large and robust (e.g. Otsuka and Lin, 1984; Tong and Guérin, 2009; Schepartz and Miller-Antonio, 2010) (Figure 3). Although the size of the specimen described here is smaller than that of extant *Rhinoceros* (Table 1), its morphology is similar to that of *Rhinoceros*. However, owing to a lack of other elements (e.g. skull, mandible, and cheek teeth), generic and specific identification are not possible.

The i2 of female individuals is less curved than that of males (Prothero, 2005). The specimen described here is almost straight, and is therefore from a female.

Previously, several large mammal fossils, such as *Ursus arctos*, *Panthera tigris*, *Nipponicerus* (*Nipponicervus*) *praenipponicus*, and *Palaeoloxodon naumanni* (Takai *et al.*, 1958; Tomida, 1978; Nojima, 2002), have been reported from the Yage area. However, rhinocerotid fossils have not been previously discovered from this area. Thus, this report is the first record of a rhinocerotid from the area.

In Japan, *Dicerorhinus* and *Rhinoceros* have been discovered in Pleistocene deposits (Figure 1A). A skull and mandibular fragments of *Dicerorhinus nipponicus* were discovered from the Middle Pleistocene of Isa, Yamaguchi Prefecture (Shikama *et al.*, 1967). Isolated upper milk teeth and mandibles of *Dicerorhinus* cf. *nipponicus* (Okazaki, 2007), and isolated cheek teeth of *Dicerorhinus* sp. (Ogino *et al.*, 2009) were reported from the Middle Pleistocene deposits of Matsugae in Fukuoka Prefecture, respectively. Upper and lower jaws with cheek teeth of *Rhinoceros* sp. and an undescribed juvenile rhinocerotid skeleton were discovered from the Pleistocene deposits in Kuzuu in Tochigi Prefecture (e.g. Nagasawa, 1961; Okazaki, 2007 and references therein). *Rhinoceros* aff. *sinensis* was reported from the Lower Pleistocene deposit in Aira in Kagoshima Prefecture (Shikama, 1967). A lower jaw of an indeterminate rhinocerotid was reported from the Middle Pleistocene of Tsukumi in Oita Prefecture

(Kawamura *et al.*, 1977). Limb bones of an indeterminate rhinocerotid were also recovered from the seabed of Bisan-seto (Taruno, 1988). These Japanese Pleistocene rhinocerotid specimens, however, did not include any *i2* specimens. Thus, direct comparisons of the specimen described here with other Pleistocene rhinocerotids in Japan are not possible. Nevertheless, the Pleistocene rhinocerotid specimens described previously and the specimen described here indicate the wide distribution of rhinocerotids during the Pleistocene in Far East Asia.

Acknowledgements

I am grateful to Hakuichi Koike (Shinshushinmachi Fossil Museum, Nagano, Japan) for preparation of the Yage specimen. I also thank Mitsuharu Oshima and Hiroko Hirotani (Kanagawa Prefectural Museum of Natural History, Kanagawa, Japan), Shinichiro Kawada (National Museum of Nature and Science, Tsukuba, Japan), and Gunma Museum of Natural History, Gunma, Japan, for providing access to other rhinocerotid specimens for comparison. I also thank Tao Deng (Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China), Claude Guérin (Laboratoire de Géologie de Lyon, Terre, Planètes, Environnement et Département des Sciences de la Terre, Université Claude Bernard-Lyon I, Lyon, France) and Hideo Nakaya (Kagoshima University) whose comments and suggestions improved the original and revised manuscripts. This study was partly supported by funding from the Nagano Society for the Promotion of Science, Japan.

References

- Kawamura, Y. and Matsushashi, Y., 1989: Late Pleistocene fissure sediments and their mammalian fauna at Site 5 of Yage quarry, Inasa, Shizuoka Prefecture, central Japan. *The Quaternary Research*, vol. 28, p. 95–102. (in Japanese with English abstract)
- Kawamura, Y., Ogawa, N. and Inoue, Y., 1977: The occurrence of a rhinocerotid fossil from Tsukumi, Oita Prefecture, Japan. *Journal of the Geological Society of Japan*, vol. 83, p. 59–61. (in Japanese)
- Li, Y., 1961: A Pleistocene mammalian locality in the Lijiang Basin, Yunnan Province. *Vertebrata Palasiatica*, vol. 2, p. 143–149. (in Chinese with English abstract)
- Mermier, E., 1895: Sur la découverte d'une nouvelle espèce d'*Aceratherium* dans la molasse burdigalienne du Royans. *Annales de la Société Linnéenne de Lyon*, vol. 42, p. 163–190.
- Nagasawa, J., 1961: A fossil rhinoceros from Kuzuu, Tochigi Prefecture, Japan. *Transactions and Proceedings of the Palaeontological Society of Japan, New Series*, no. 42 p. 63–67.
- Nakajima, H. and Hasegawa, Y., 1982: Crocodylian fossil from cave fissure deposits in the Yage area, Inasa, Shizuoka Prefecture. *Abstracts of the 89th Annual Meeting of the Geological Society of Japan*, p. 331. (in Japanese; original title translated)
- Nishizawa, T., 1972: On the teeth of mammals. *Kaseki no Tomo*, vol. 6. p. 7–9. (in Japanese; original title translated)
- Nojima, K., 2002: The Pleistocene vertebrate faunas from the “Yage” Limestone fissure deposits in Shizuoka Prefecture. *Geoscience Reports of Shizuoka University*, vol. 29, p. 1–11. (in Japanese with English abstract)
- Ogino, S., Otsuka, H. and Harunari, H., 2009: The Pleistocene Matsugae fauna, northern Kyushu, West Japan. *Paleontological Research*, vol. 13, p. 367–384.
- Okazaki, Y., 2007: Several fossils of Pleistocene rhinocerotid from the “Matsugae Cave”, Kitakyushu City, Japan. *Jubilee Publication in Commemoration of Prof. Kamei Tadao's 80th Birthday*, p. 135–140. Commemorative Association of Prof. Kamei Tadao's 80th Birthday, Tokyo. (in Japanese with English abstract)
- Osborn, H. F., 1898: The extinct rhinoceroses. *Memoirs of the American Museum of Natural History*, vol. 1, p. 75–164.
- Otsuka, H. and Lin, C.-C., 1984: Fossil *Rhinoceros* from the T'ouk'oushan Group in Taiwan. *Journal of Taiwan Museum*, vol. 37, p. 1–35.
- Owen, R., 1845: *Odontography; or a Treatise on the Comparative Anatomy of the Teeth, their Physiological Relations, Mode of Development, and Microscopic Structure, in the Vertebrate Animals*, 655 p. Baillière, London.
- Owen, R., 1848: *On the Archetype and Homologies of the Vertebrate Skeleton*, 1560 p. J. Van Voorst, London.
- Prothero, D. R., 2005: *The Evolution of North American Rhinoceroses*, 228 p. Cambridge University Press.
- Prothero, D. R., Manning, E. and Hanson, C. B., 1986: The phylogeny of the Rhinocerotidae (Mammalia, Perissodactyla). *Zoological Journal of the Linnean Society*, vol. 87, p. 341–366.
- Schepartz, L. A. and Miller-Antonio, S., 2010: Taphonomy, life history, and human exploitation of *Rhinoceros sinensis* at the Middle Pleistocene site of Panxian Dadong, Guizhou, China. *International Journal of Osteoarchaeology*, vol. 20, p. 253–268.
- Shikama, T., 1967: Note on the occurrence of fossil rhinoceros from Kagoshima Prefecture, southern Japan. In, Committee for the Commemoration of Prof. Ichiro Hayasaka's 76th Birthday ed., *Contributions to Celebrate Prof. Ichiro Hayasaka's 76th Birthday*, p. 117–119. Hashimotokabundo, Kanazawa.
- Shikama, T., Hasegawa, Y. and Okafuji, G., 1967: On a rhinocerotid skull from Isa, Yamaguchi Prefecture, Japan. *Bulletin of the National Science Museum*, vol. 10, p. 455–462.
- Takai, F., Shikama, T., Inoue, M. and Hasegawa, Y., 1958: On fossil milk teeth of elephant from Inoya-mura, Inasa-gun, Shizuoka. *The Quaternary Research*, vol. 1, p. 58–61. (in Japanese with English abstract)
- Taruno, H., 1988: Vertebrate fossils from the Bisan Seto, part 1, Proboscidea etc. In, Kurashiki Museum of Natural History ed., *Vertebrate Fossils from the Sea Bottom of Bisan-Seto, West Japan. Report of Researches on the Yamamoto Collection I*, p. 11–61. (in Japanese)
- Tomida, S., 1978: On the Quaternary cave and fissure deposits and vertebrate fossils from Yage Quarry, near Lake Hamana, central Japan. *Bulletin of the Mizunami Fossil Museum*, vol. 5, p. 113–141. (in Japanese with English abstract)
- Tong, H.-W., 2012: Evolution of the non-*Coelodonta* dicerorhinine lineage in China. *Comptes Rendus Palevo*, vol. 11, p.555–562.
- Tong, H.-W. and Guérin, C., 2009: Early Pleistocene *Dicerorhinus sumatrensis* remains from the Liucheng *Gigantopithecus* Cave, Guangxi, China. *Geobios*, vol. 42, p. 525–539.
- Tong, H.-W. and Moigne, A.-M., 2000: Quaternary rhinoceros of China. *Acta Anthropologica Sinica*, vol. 19, p. 257–263.