Bull. Natn. Sci. Mus., Tokyo, Ser. C, 21(3,4): pp. 103–109, December 22, 1995

A New Record of *Youngofiber* (Castoridae: Mammalia) from the Early Miocene of Kani City, Central Japan

By

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Abstract An isolated cheek tooth of a large-sized rodent was collected in 1987 from the late Early Miocene Nakamura Formation, Kani City, central Japan. It has been described (along with other fossils), but direct comparisons with various Chinese and North American castorid specimens led to a revised identification. Its size, enamel pattern of occlusal surface, brachydonty, presence of an apression facet on the posterior surface of the tooth, and root pattern suggest that the tooth is left P^4 of *Youngofiber sinensis*, originally known from Xiacaowan, Jiangsu, China. This is a new record of *Y. sinensis* from central Japan and strengthens the closer relationship in paleogeography between Japan and Southern China during the Early Miocene.

Introduction

An exposure on the left bank of Kiso River in Kani City, central Japan, has been producing small mammal fossils for more than ten years (Tomida & Goda, 1995). Discoveries of two incisors and an isolated cheek tooth of large-sized rodents in 1983 and 1987 by one of us (KK) marked the beginning of those discoveries. These three specimens were initially identified as a single taxon of the family Hystricidae; they were later reidentified as a single taxon of the family Castoridae (Tomida & Setoguchi, 1994).

The enamel pattern of the occlusal surface of cheek teeth in lower crowned genera of castorids varies considerably, depending on the degree of wear. The specimen described below is well worn, and this excessive wear led to the previous misidentification. Therefore, direct comparisons with better preserved material permits a more secure identification. Furthermore, additional material collected since 1992 required revision of the above identification. As a result, it now appears that the first two incisors and the isolated cheek tooth represent two different taxa within the family Castoridae. That is, the incisors represent a species of the genus *Anchitheriomys*, and the isolated cheek tooth represents *Youngofiber sinensis*, the largest known beaver in Asia. This paper redescribes this isolated cheek tooth in light of the new identification. The two incisors will be included in a separate paper with the additional material.

Terminology of the cheek tooth morphology follows STIRTON (1935).

Systematic Description

Class Mammalia LINNAEUS, 1758

Order Rodentia BOWDICH, 1821

Family Castoridae GREY, 1821

Youngofiber CHOW and LI, 1978

Youngofiber sinensis (YOUNG, 1955)

Figures 2, 3A

Castoridae gen. et sp. indet. (A). TOMIDA & SETOGUCHI, 1994: 189 (in part).

Referred material: Isolated left upper fourth premolar (P^4), stored at Minokamo City Education Board (MCEB) and catalogued as MCEB A-26-3.

Locality: An exposure on the left bank of Kiso River near the Chuno-Ohashi, Kani City, Gifu Prefecture, central Japan (locality 1 of Fig. 1).

Stratigraphic horizon and age: Upper part of Nakamura Formation, Mizunami Group; late Early Miocene, approximately 18 Ma (TOMIDA & SETOGUCHI, 1994).

Description: Although the tooth is fairly worn, it is still obvious that the crown is brachydont as a member of Castoridae. Three fairly well developed roots are present: anteroposteriorly elongated lingual root and rounded anterobuccal and posterobuccal roots. The crown is well worn and the occlusal surface is a rounded square in outline. None of the striae is preserved, which means that all the flexi have become fossettes. There are four fossettes present. The medium-sized hypofossette is located anterolingually, and its lingual edge is flexed anteriorly. The short parafossette is located buccal to the anterobuccal 1/3 of the hypofossette. The long, somewhat L-shaped mesofossette is located nearly in the center of the occlusal surface, extending from the nearly posterolingual edge of the crown to the nearly buccal edge. The metafossette, about the same length as hypofossette and somewhat L-shaped, is located posteriorly and nearly parallel to the mesofossette (Figs. 2, 3-A). There is a small apression facet on the nearly center of the posterior surface of the tooth. Anteroposterior length and lateral width of the occlusal surface is 11.4 mm and 12.2 mm, respectively.

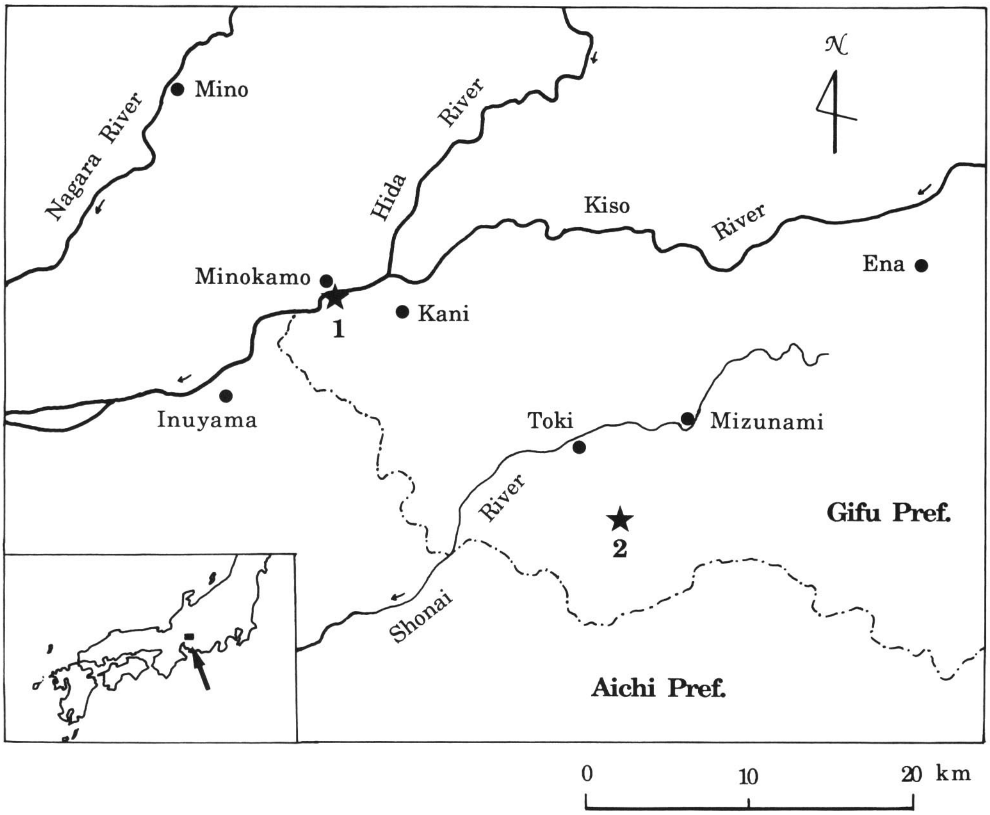

Fig. 1. Map showing the locality of *Youngofiber sinensis* in Japan. Star mark 1 is the locality of the specimen described in the present paper; star mark 2 is the locality of the previously known upper incisors in Toki City.

Comparison: Xu (1995) reviewed all the members of the family Castoridae, and his classification is followed in this paper. Although simplified, Chinese castorids and related part of Xu's (1995) manuscript are published in Xu (1994). In making comparison of MCEB A-26-3 with the members of the family, the following three points are important: size, height of the crown, and enamel pattern of cheek teeth.

In terms of size, MCEB A-26-3 is quite large among the castorid genera; those genera larger than *Castor* (e.g. *Castoroides*, *Youngofiber*, *Anchitheriomys*, *Trogontherium*, and *Procastoroides*) (Xu, 1994) should be considered. Within those five genera, *Castoroides* and *Procastoroides* have ever growing cheek teeth with no roots, and *Trogontherium* has very hypsodont cheek teeth with very weak roots. Furthermore, *Castoroides* and *Procastoroides* have an S-shaped enamel

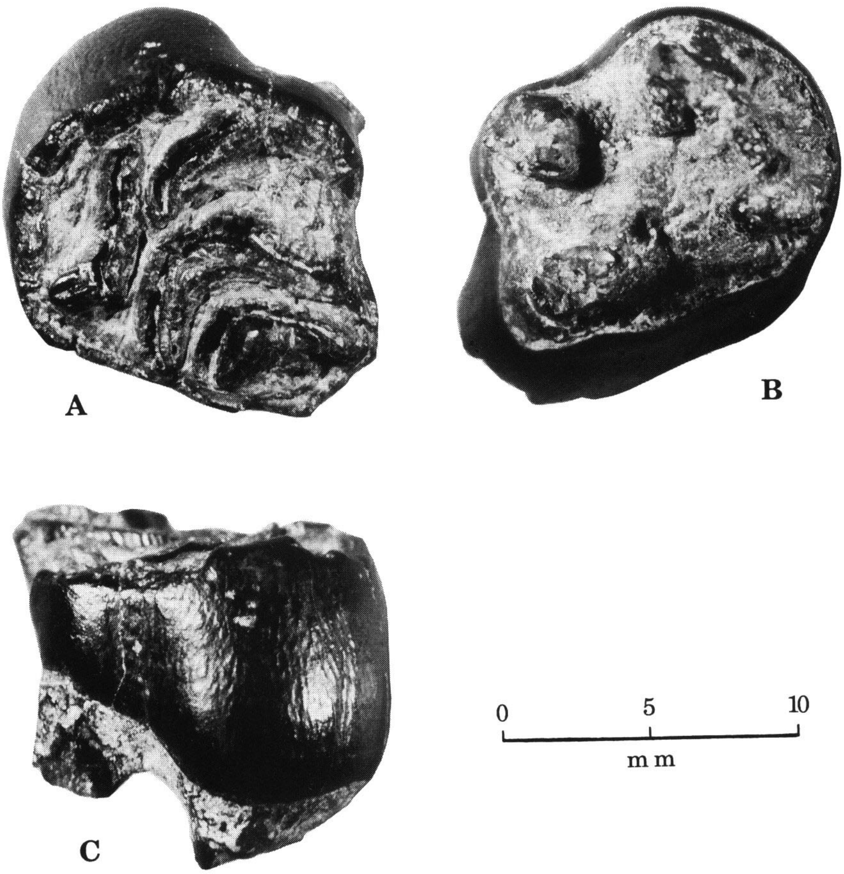

Fig. 2. Photographs of left P^4 of *Youngofiber sinensis* from Kani City (MCEB A-26-3). A, occlusal view; B, apex view; C, anterior view.

pattern on the occlusal surface (*Castoroides* dental pattern: XU, 1994) which is quite different from that of MCEB A-26-3.

On the other hand, *Asiacastor*, *Youngofiber*, *Anchitheriomys*, and *Trogontherium* have a common dental pattern called the *Asiacastor* dental pattern (XU, 1994). This dental pattern is characterized, in part, by having an additional flexus (fossette) posterior to the metaflexus (metafossette) on the upper cheek teeth. MCEB A-26-3 does not have the additional fossette posterior to metafossette. It is interpreted that the additional fossette was quite shallow, and it was lost by wear. This interpretation is supported by an old individual of *Trogontherium cuvieri* (IVPP 10461) which has P^4 with no additional fossette, M^1 with only one fossette (mesofossette), and M^2 with only two fossettes (meso- and metafossette).

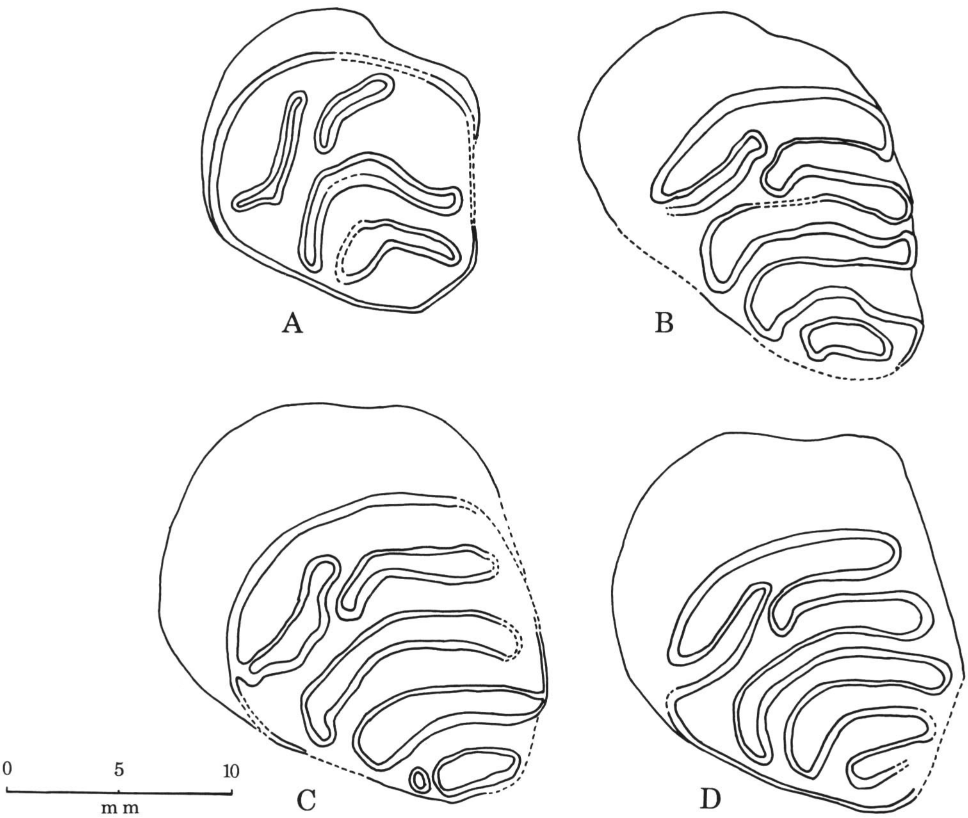

Fig. 3. Comparison of left P^4 in occlusal view among four specimens of *Youngofiber sinensis.* A, MCEB A-26-3 from Kani City; B, IVPP 793 (type specimen: reversed from right P^4); C, IVPP 5791.1 (reversed from right P^4); D, IVPP 10457; B, C, and D are from Xiacaowan, southern China; anterior to the top and lingual to the left.

Among those genera with the *Asiacastor* dental pattern, *Asiacastor* is much smaller (LYTSCHEV & AUBEKEROVA, 1971), and *Trogontherium* is more hypsodont and has weaker roots (XU, 1994) than MCEB A-26-3. *Anchitheriomys* is fairly large size but is significantly smaller than MCEB A-26-3, and the enamel pattern of the fossettes (flexi) is more complicated than in MCEB A-26-3 (STIRTON, 1934; XU, 1994). Thus, MCEB A-26-3 seems closest to *Youngofiber* among the known genera of the family Castoridae.

Genus *Youngofiber* includes a single species *Y. sinensis.* MCEB A-26-3 is 5–16% smaller than the type specimen (IVPP 793) and other topotypic specimens (IVPP 5791.1 and 10457) (Table 1, Fig. 3). This size difference is not large enough to consider a separate species. On the other hand, MCEB A-26-3 is comparable to P^4 of *Y. sinensis* in general pattern of fossettes (flexi), brachydonty,

Table 1. Measurements of P^4 in occlusal surface of *Youngofiber sinensis* (in mm).

Specimen	Length	Width
MCEB A-26-3 (left)	11.4	12.2
IVPP 793 (type) (right)	12.5	13.6
IVPP 5791.1 (right)	13.2	14.5
IVPP 10457 (left)	12.3	12.9
(right)	12.6	13.7

and pattern and condition of roots. The fossette pattern of MCEB A-26-3 compares favorably with that of P^4s of *Y. sinensis* in detail. *Y. sinensis* always has the hypofossette (hypoflexus) extending anterior to the parafossette (paraflexus) on the upper cheek teeth (CHOW & LI, 1978), and MCEB A-26-3 has this pattern. Also, the lingual edge of the hypofossette tends to flex anteriorly. The absence of an additional fossette posterior to the metafossette is interpreted as having been lost by wear, as mentioned above. Thus, the differences between MCEB A-26-3 and IVPP 793, 5791.1, and 10457 can be interpreted as either individual variations, or variations caused by wear. MCEB A-26-3 is also somewhat similar to M^3 of *Y. sinensis* (although 20–30% larger in size), but the presence of a small apression facet on the posterior surface of the tooth indicates that it can not be an M^3. Based on these evidences, we interpret the specimen MCEB A-26-3 as conspecific with *Y. sinensis.*

Discussion

Xiacaowan Formation, the type locality of *Y. sinensis*, was originally considered Pleistocene (YOUNG, 1955), but it is now correlated with MN 4 (late Orleanian; around 18 Ma) of Europe, based on the fauna associated with *Y. sinensis* (CHOW & LI, 1978; LI *et al.*, 1983; QIU, 1990). *Y. sinensis* is also known from the Toki Lignite Bed in Toki City, central Japan (TOMIDA & SETOGUCHI, 1994), about 20 km southeast to the locality of MCEB A-26-3 (Fig. 1, locality 2). Toki Lignite Bed is correlated with the Nakamura Formation, and both formations are estimated about 19–18 Ma in age (Fig. 2 of TOMIDA & SETOGUCHI, 1994), which is about the same chronological interval as the Xiacaowan Formation. Since identification of *Y. sinensis* from Toki has been based on the upper incisors alone, P^4 from Kani City described above further supports the presence of *Y. sinensis* in Japan, and hence strengthens a tight paleogeographic relationship between Japan and southern China during the Early Miocene. This also supports the hypothesis that the opening of the Japan Sea began at about 25 Ma in the northeastern part but did not open until about 16 Ma in the southwestern part, as suggested by tectonic studies (e.g. JOLIVET & TAMAKI, 1992).

Acknowledgments

We deeply thank Dr. Xiao-feng XU of Southern Methodist University (SMU) and of Institute of Vertebrate Paleontology and Paleoanthropology (IVPP), Academia Sinica for providing us an opportunity to examine many Chinese and North American castorid specimens, and for sharing some of the results of his on-going research. Also we thank Dr. Zhu-ding QIU of IVPP for providing cast of the type specimen of *Youngofiber sinensis*. We are also thankful to Dr. Louis L. JACOBS of SMU for his support and encouragement and for use of the SMU facilities, and to Mr. William DOWNS of Northern Arizona University for English translations of Chinese literature. We are also grateful to Dr. Everett H. LINDSAY of the University of Arizona for his helpful comments on the early version of this manuscript. This study was financially supported in part by the Grant-in-Aid for Scientific Research No. 07640627 for one of us (YT).

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