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DISCOVERY OF A DESMOSTYLIAN TOOTH FROM KITAMI CITY, NORTHEASTERN HOKKAIDO, JAPAN

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ABSTRACT

A fragmentary tooth of *Desmostylus* sp. was found in the pebbly sandstone of the lower Toika Formation exposed near Tomisato, Kitami City, Hokkaido, which is the second record of the genus from Kitami area. It is identified as the unworn metaconid cusp (column) of a left lower third molar of the genus, and is probably one of the youngest fossil records of the genus in Japan (late Middle Miocene).

Key words: *Desmostylus,* tooth, late Middle Miocene, Hokkaido

冨田幸光・太田敏量（2007）北海道北見市からデスモスチルスの歯化石の発見．福井県立恐竜博物館紀要６：57－61．

北海道北見市富里付近に露出する登以加層下部の礫質砂岩から，*Desmostylus* sp. に同定される臼歯の破片が発見された．本属の化石としては，北見地域では二番目の記録である．化石は*Desmostylus* 属の左下顎第三大臼歯のメタコニッド咬柱で，萌出直前の未咬耗状態である．種の同定はできないが，本属としては日本ではもっとも若い年代（中期中新世後期）を示す化石の一つと考えられる．

INTRODUCTION

A fragmentary tooth of the genus *Desmostylus* was newly found in Kitami City, Hokkaido in 1996. It was collected directly from the sediments and is the second discovery of the genus in Kitami area (see Uozumi et al., 1966 for the first discovery). Although over 20 localities of various fossils of the genus (including a nearly complete skeleton to a tooth fragment) have been known within Hokkaido (Inuzuka, 2000a), some of them were found float, and their stratigraphic positions may not be clear (Yahata and Kimura, 2000). Thus, it is worth to note this fragmentary tooth as a new addition to the fossil records of the genus in Hokkaido.

The fossil tooth was found by Mr. Yukio Sakakibara, a local amateur geologist, from an exposure along Kita-ainonai forest path (see below for detail) near Tomisato, Kitami City, while he was looking for fossils. The tooth was donated to Kitami Region Museum of Science, History and Art for study and custody.

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LOCALITY AND GEOLOGIC SETTING

The tooth fragment was found directly in the sediments of an exposure at Shohan “I” of Rinpan 246 of Tomisato National Forest in Kitami City, Hokkaido, Japan (43° 52’ 03” N, 143° 46’ 11”, based on GPS system after 2002), which is located on the left bank of Samakke-Nikoro River, a tributary of Nikoro River, and northwest of Tomisato of Kitami City (Figs. 1 and 2). Kita-ainonai forest path reaches to the upper stream along the Samakke-Nikoro River.

The fossil-bearing bed is the Miocene Toika Formation, which overlies the Late Jurassic to Late Cretaceous Nikoro Group (Ishida et al., 1968). The Toika Formation is subdivided into 4 “members” as sandstone, solid shale, mudstone, and tuffaceous sandstone in ascending order (Ishida et al., 1968; although they used “beds” for subdivisions of the formation, they meant members in current usage). The fossil tooth was yielded from a pebbly sandstone bed within the lowest sandstone “member” (Fig. 2). The pebbly sandstone bed includes small to medium-sized pebbles of tuff, green rock, chert, and limestone derived from the Nikoro Group, and sand grains consist also of the same

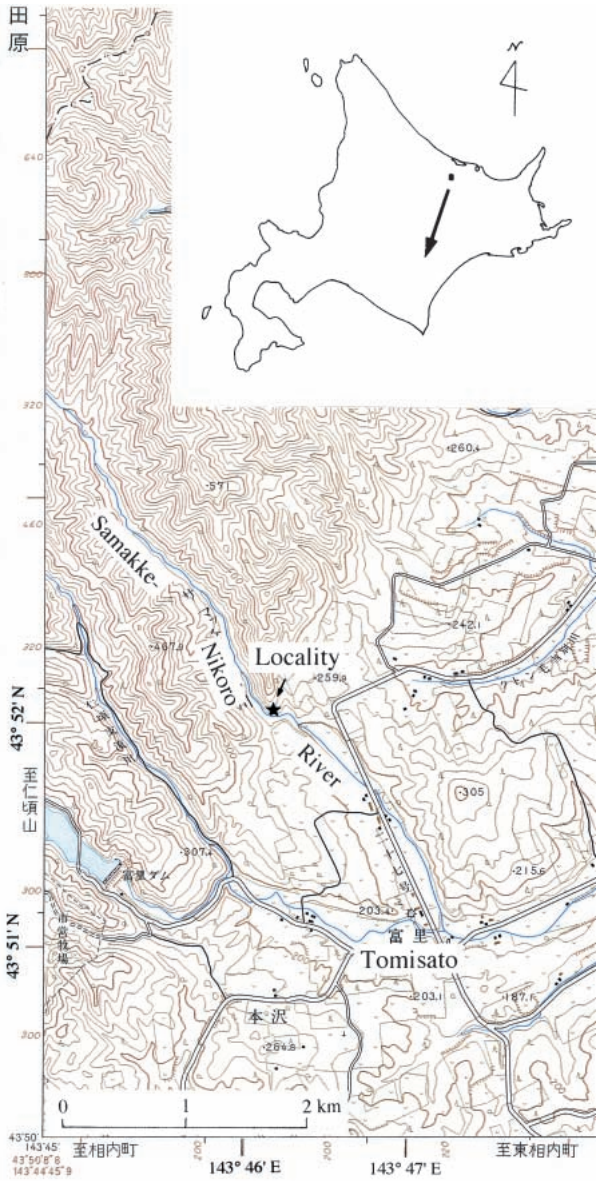

FIGURE 1. Map showing the locality (solid star) of the desmostylian tooth (KRMSHA 2–4–480) reported in this paper (after 1:50,000 topographic map "Tan-no" published by Geographical Survey Institute).

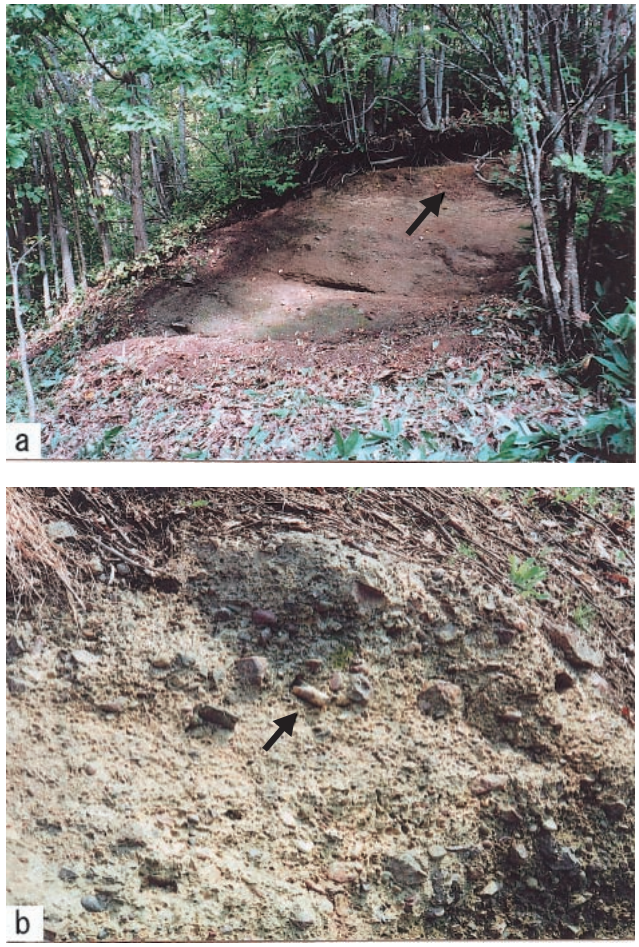

FIGURE 2. Exposure of the locality (a) and a close-up (b) of the fossil (KRMSHA 2–4–480). The fossil horizon is the top layer (arrow) of the exposure (a), and the fossil (arrow) is seen near the center of the photo (b). Photo (a) was taken September 15, 2006, and (b) was taken May 17, 1996 when the specimen was found.

rocks. The pebbles are angular to subangular and are poorly sorted. It is well consolidated when fresh, but it is crumbled easily when weathered.

The Toika Formation is correlated with Ainonai and Notoro Formations (Ishida et al., 1968), and Notoro Formation is correlated with Atsunai Formation (Kato et al., 1990). Ishida et al. (1968) and Ishida and Sawamura (1968) correlated the Toika and Ainonai Formations to the Miocene, but not specific age within Miocene, while Kato et al. (1990) correlated Notoro and Atsunai Formations to the Late Miocene. The Ainonai Formation has yielded *Desmotylus* tooth (Uozumi et al., 1966). So-called Okoppezawa specimen of *Desmostylus* was a float, but Yahata and Kimura (2000) mentioned that it might have been from Atsunai Formation. Yahata and Kimura (2000) correlated Ainonai Formation to the late Middle Miocene, while they correlated Atsunai Formation to the Late Miocene in their figure 2 but mentioned the Middle Miocene in the text (p. 42).

The first specimen of *Desmostylus* from Kitami area is from the tuffaceous sandstone "member" (basal subdivision) of Ainonai Formation (Sawamura and Hata, 1965; Uozumi et al., 1966), and the sandstone "member" of Toika Formation is correlated with the former, based on the rock facies and invertebrate fossils (Ishida et al., 1968). Thus, according to geologic age of the Ainonai Formation by Yahata and Kimura (2000), at least the lower part (sandstone "member") of Toika Formation should be the late Middle Miocene, and the new specimen of *Desmostylus* reported here consists with this correlation. No specimen of the genus *Desmostylus* is known

FIGURE 3. KRMSHA 2–4–480, the unworn metaconid cusp (column) of a left lower third molar (left m3) of *Desmostylus* sp., found near Tomisato in Kitami City, Hokkaido, Japan. **a**, lingual; **b**, distal; **c**, buccal; **d**, mesial; **e**, occlusal views.

FIGURE 4. Comparison of KRMSHA 2–4–480 with the left m3 of *Desmostylus* sp. (NSM-PV 16632). **a & b**, NSM-PV 16632 from the Middle Miocene Temblor Formation of Monocline Ridge, Fresno Co, California, USA; **c–g**, KRMSHA 2–4–480. **a & c**, occlusal views; **b & d**, lingual; **e**, distal; **f**, buccal; **g**, mesial views.

from the Late Miocene or younger sediments (younger than ca. 11 Ma) (Ogasawara, 2000; Yahata and Kimura, 2000).

SYSTEMATIC DESCRIPTION

Order DESMOSTYLIA Reinhart, 1953
Family DESMOSTYLIDAE Osborn, 1905
Genus ***DESMOSTYLUS*** Marsh, 1888
Desmostylus sp.
(Figs. 3 and 4)

Referred specimen.— Unworn metaconid cusp (column) of left lower third molar (left m3), cataloged as Kitami Region Museum of Science, History and Art (KRMSHA) 2–4–480.

Locality and horizon.— A small exposure at Shohan "I" of Rinpan 246 of Tomisato National Forest in Kitami City, Hokkaido, Japan (43° 52' 03" N, 143° 46' 11"; Figs. 1 and 2). The sandstone "member" of Toika Formation, supposed to be the late Middle Miocene (Ishida et al., 1968; Yahata and Kimura, 2000).

Description.— Directions of the tooth fragment are actually defined after the identification of taxon and dental species (tooth position) of the fossil is completed, and identification would be made after description and comparisons are made. However, it is extremely difficult to describe without directional terms (mesial, buccal, etc.), and therefore, those terms will be used in the following description, as if the tooth position is already identified.

The specimen is an isolated single cusp (column) of a molar tooth typical of advanced desmostylians. It is unworn but is almost erupted as indicated by a shallow concavity of occlusal surface with a tiny convexity in the center and the size of the column (Fig. 3e). Because it is unworn, the thickness of enamel on the occlusal surface is unobservable, but it is rather thick on the cross section at the bottom of the column. In lingual view, the column becomes wider toward the bottom, mesio-distal diameter approximately 13.3 mm near the top to 26.3 mm near the bottom of the column. It curves gently as a whole, with the middle part convex mesially. The mesial edge is slightly concave at about 52 mm from the top of the column. The lingual surface is rugose in general but particularly so on the approximately lower one third. Maximum height of the preserved portion is 68.3 mm (Fig. 3a)

In distal view (Fig. 3b), the column is slightly curved lingually, and the buccal side is gently concave, while lingual side is more convex at about the middle of the height. Transverse width at the top and that of near the bottom of the column are about the same. The surface is rather rugose in general except for the bottom part, which is rather flat indicating a contact with another column. The buccal surface (Fig. 3c) is rather flat with a slight concavity as a whole, indicating the whole surface contacting to another column. Therefore, the distobuccal corner near the bottom of the column forms rather sharp edge, the angle

of which is about 90 degrees or slightly less. The mesio-distal diameter in buccal view increases from the top toward the bottom of the column as observed on the lingual view. There is a small step-like structure, an indication of extra cuspule, on the mesial side of the column, which is also visible from the buccal view (Fig. 3–c, d). The general morphology in the mesial view is similar to but mirror image of distal view, except for the extension of the bottom part with rugose surface.

Comparisons.— Based on the general morphology and the size, KRMSHA 2–4–480 is obviously one of the major cusps (columns) of molars of the genus *Desmostylus* or closely related genera (see Discussion section below). As described above, KRMSHA 2–4–480 has two flat surfaces (distal is only on the lower part) that form an angle about 90 degrees, indicating that it must be a cusp of a lower molar and is possibly one of the four corner cusps. However, the distal two cusps are smaller, lower, and more strongly curved than the two mesial cusps, and therefore, KRMSHA 2–4–480 must be one of two mesial cusps (protoconid and metaconid). Mesiolingual cusp (metaconid) of the lower molar tends to be located slightly more mesial than the mesiobuccal cusp (protoconid), and therefore, the angle between the two flat surfaces of metaconid tends to be sharper (less than 90 degree) than that of protoconid. Also, mesiolingual cusp tends to expand laterally more than buccal cusps. Thus, we identified KRMSHA 2–4–480 as the metaconid of left lower molar, and also based on the size, as the third (left m3). KRMSHA 2–4–480 is in fact almost identical, not only in general morphology but also in size and growth stage, with the metaconid of the National Museum of Nature and Science (used be National Science Museum) NSM-PV 16632 (identified as left m3 based also on the characters mentioned above) among the numerous isolated teeth of *Desmostylus* sp. (generally referred to *D. hesperus*) from the Temblor Formation of Monocline Ridge, Fresno County, California, USA (Fig. 4).

DISCUSSION

Studies on the order Desmostylia have greatly advanced since 1980's (see Inuzuka, 2000a), and particularly after the symposium entitled "Evolution of Desmostylia—commemorating 100th anniversary of the discovery of Togari specimen and opening of Ashoro Museum of Paleontology—" that held at Ashoro, Hokkaido, Japan in 1998 (Inuzuka et al., 2000, 2001; see the papers in those volumes). Among the named genera whose molars consist of thick columnar cusps with thick enamel, *Cornwallius* has obviously shorter cusps than KRMSHA 2–4–480 (Inuzuka et al., 1994). *Kronokotherium* (Pronina, 1957) is poorly known genus but can be separated from *Desmostylus* by the arrangement of major cusps of molars (Inuzuka et al., 1994) and its small size. KRMSHA 2–4–480 is an isolated single cusp, and so, the cusp arrangement pattern cannot be used. *Kronokotherium* is, however, clearly smaller in general size (height is unclear) than KRMSHA 2–4–480. *Vanderhoofius* is now synonymized with *Desmosylus* (Kohno, 2000; Inuzuka, 2000b). Therefore, KRMSHA 2–4–480 can be identified as a species of the genus *Desmostylus.*

Within the genus, three species are currently recognized, namely *D. japonicus, D. hesperus,* and *D. coalingensis* (Inuzuka, 2000b). But, because they are characterized by the morphology of the skulls and mandibles and not by dental morphology, it is impossible to distinguish them by isolated tooth alone (Inuzuka et al., 1994; Inuzuka, 2000b). Thus, KRMSHA 2–4–480 cannot be identified at specific level. *D. japonicus* is known only from the Early Miocene, and *D. hesperus* is known only from Middle Miocene as far as specific identifications are certain, and *D. coalingensis* is known only from North America (Kohno, 2000). Geologic age of the sandstone "member" of Toika Formation, from which KRMSHA 2–4–480 was found, is correlated to the late Middle Miocene (see above), the possibility of KRMSHA 2–4–480 to be *D. hesperus* is quite high.

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REFERENCES

Inuzuka, N. 2000a. Research trends and scope of the order Desmostylia. Bulletin of Ashoro Museum of Paleontology 1: 9–24.*

Inuzuka, N. 2000b. Primitive Late Oligocene desmostylians from Japan and phylogeny of the Desmostylia. Bulletin of Ashoro Museum of Paleontology 1: 91–123.

Inuzuka, N., D. P. Domning and C. Ray, 1994. Summary of taxa and morphological adaptations of the Desmostylia. The Island Arc 3: 522–537.

Inuzuka, N., M. Kimura, N. Kohno and H. Sawamura (eds.). 2000. Evolution of Desmostylia—Incorporating the proceeding of the desmostylian symposium of the Fossil Research Society of Japan 16th Annual Meeting held at the Ashoro Museum of Paleontology, Hokkaido, Japan, 22–23 August 1998. Bulletin of Ashoro Museum of Paleontology 1: 1–172.**

Inuzuka, N., M. Kimura, N. Kohno and H. Sawamura (eds.). 2001. Evolution of Desmostylia 2. Bulletin of Ashoro Museum of Paleontology 2: 1–32.***

Ishida, M., K. Hirayama, K. Kuroda and T. Bamba. 1968. Explanatory text of the geological map of Japan, Scale 1: 50,000, Tanno (Abashiri-36). Hokkaido Development Agency, 49 pp.*

Ishida, M., and K. Sawamura. 1968. Geology of the Kitami

District. Quadrangle Series Scale 1: 50,000, Abashiri (1), no. 47, Geological Survey of Japan, 40 pp.*

Kato, M., Y. Katsui, Y. Kitagawa and M. Matsui (chief eds.). 1990. Regional geology of Japan Part 1 Hokkaido. 337 pp., Kyoritsu Shuppan, Tokyo.

Kohno, N. 2000. A century of studies on the holotype (NSM-PV 5600) of *Desmostylus japnoicus* Tokunaga and Iwasaki, 1914. Bulletin of Ashoro Museum of Paleontology 1: 137–151.*

Marsh, O. C. 1888. Notice of a new fossil sirenian from California. American Journal of Science 35: 94–96.

Ogasawara, K. 2000. Paleoenvironments of desmostylid and Cenozoic events of the northwestern Pacific. Bulletin of Ashoro Museum of Paleontology 1: 25–34.*

Osborn, H. F. 1905. Ten years progress in the mammalian palaeontology in North America. Verhandlungen des internationalen Zoologen-Kongresses, VI, Bern, 1904, p. 86–113, pls. 1–15.

Pronina, I. G. 1957. A new desmostylid, *Kronokotherium brevimaxillare* gen. nov., sp. nov., from Miocene deposits of the Kamchatka. Doklady Akademii nauk SSSR, NS 117: 310–312, 1 pl.****

Reinhart, R. 1959. Diagnosis of the new mammalian order Desmostylia. Journal of Geology 61: 187.

Sawamura, K., and M. Hata. 1965. Explanatory text of the geological map of Japan, Scale 1: 50,000, Rubeshibe (Abashiri-46). Hokkaido Development Agency, 46 pp. *

Uozumi, S., T. Fujie and M. Matsui. 1966. Neogene molluscan fauna in Hokkaido. Part III. Description of the Ainonai fauna associated with *Desmostylus* cf. *minor* Nagano, from Kitami district, East Hokkaido. Journal of Faculty of Science, Hokkaido University, Series IV, 13(2): 165–183, 2 pls.

Yahata, M., and M. Kimura, 2000. Modes of occurence of desmostylian fossils in Hokkaido and Sakhalin, northwestern Pacific Ocean. Bulletin of Ashoro Museum of Paleontology 1: 35–56.*

* : in Japanese with English abstract
** : mostly in Japanese with English abstracts
*** : partly in Japanese with English abstracts
**** : in Russian

＜ 地名・地層名 ＞

Ainonai Formation ‥‥‥‥‥‥相内層
Ashoro ‥‥‥‥‥‥‥‥‥‥‥‥足寄
Atsunai Formation ‥‥‥‥‥‥厚内層
Kita-ainonai ‥‥‥‥‥‥‥‥‥北相内
Samakke-Nikoro River ‥サマッケ仁頃川
Nikoro Group ‥‥‥‥‥‥‥‥仁頃層群
Notoro Formation ‥‥‥‥‥‥能取層
Okoppezawa ‥‥‥‥‥‥オコッペ沢
Rinpan 246 ‥‥‥‥‥‥‥‥246林班
Shohan “I” ‥‥‥‥‥‥‥‥い小班
Toika Formation ‥‥‥‥‥‥登以加層
Tomisato ‥‥‥‥‥‥‥‥‥‥富里