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Marine Mammal Teeth (Otariidae and Delphinidae) from the Early Pleistocene Setana Formation, Hokkaido, Japan

By

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Abstract Two marine mammal teeth from the Early Pleistocene Setana Formation, which have been catalogued at the National Science Museum as lower cheek teeth of *Physeter*? sp. (Cetacea: Physeteridae), are re-identified as a right lower canine of the extinct huge sea lion of the subfamily Otariinae in the family Otariidae and a right lower cheek tooth of the killer whale, *Oricnus* sp., of the subfamily Globicephalinae in the family Delphinidae. Because of these re-identifications, no published fossil record of the genus *Physeter* is presently known in Japan, and it became clearer that a huge species of sea lion was present in northwestern Pacific during the Early Pleistocene although its generic assignment is still not possible.

Introduction

Two marine mammal fossil teeth described and re-identified in the present paper have been stored at the Department of Geology, National Science Museum since 1954 when they were catalogued as cheek teeth of *Physeter*? sp. According to the catalogue record, they were donated by Mr. Kakutaro HIRAO of the Neppu Mine, located at Hon-Neppu, Miwa-mura, Suttsu-gun, Shiribeshi-koku, Hokkaido, which is, according to the present administrative divisions, Neppu, Kuromatsunai-cho, Suttsu-gun, Shiribeshi-shicho, Hokkaido (Fig. 1). The Neppu Mine, which was quarrying sea shells for farm improvement, had been abandoned and is not present any more.

When one of us (YT) was examining the catalogued specimens of the Department of Geology, National Science Museum for computer data base (TOMIDA & SAKURA, 1988; TOMIDA, 1992), he noticed that those teeth do not belong to a same taxon, but he did not examine in detail since it was not the purpose of the specimen census. When one of us (NK) was examining the pinniped specimens among the NSM vertebrate paleontology collection for his dissertation research, he noticed those specimens and realized that they belonged to a large otariid and a killer whale. Thus, these two specimens are described for the first time and re-identified below.

Systematic Description

Class Mammalia LINNAEUS, 1758

Order Carnivora BOWDICH, 1821

Suborder Caniformia KRETZOI, 1945

Infraorder Arctoidea FLOWER, 1869

Family Otariidae GILL, 1866

Subfamily Otariinae VON BOETTICHER, 1934

Otariinae gen. et sp. indet.

(Figure 2; Table 1)

Material: NSM-PV 3713–1, right lower canine.

Locality: Neppu, Kuromatsunai-cho, Suttsu-gun, Shiribeshi-shicho, Hokkaido, northern Japan (Fig. 1).

Formation and Age: The specimen, NSM-PV 3713–1, was found from the marine deposits at a sand quarry in Neppu, Kuromatsunai-cho, and thus it apparently came from the middle part of the Setana Formation that is exposed in that area (SUZUKI, 1989). Based mainly on the molluscan faunas, several workers (*e.g.*, UOZUMI, 1962; HASHIMOTO *et al.*, 1963) had considered the Setana Formation to be the Early or Late Pliocene in age. More recent correlations (UOZUMI *et al.*, 1986; SUZUKI, 1989; TSUBAKIHARA *et al.*, 1989) have suggested that the Setana Formation corresponds to N 22 of the planktonic foraminiferal zone of BLOW (1969) and *Actinocyclus oculatus* Zone and *Rhizosolenia curvirostris* Zone of the diatom zonation of KOIZUMI (1985), indicative of Early Pleistocene age.

Description: The canine is nearly complete, but its surface is slightly damaged by postmortem abrasion. It is extremely large and long, and has a conical crown which is gently curved posteriorly at the apex. The enamel on the crown, which is preserved only at the medial surface, is thin and crenulated. There is a deep and wide wear facet which is obliquely oriented on the posterolateral surface of the crown. The root is long and robust, and is slightly compressed transversely. The lateral side of the root is slightly concave, but the medial surface is relatively flat, especially at the base. The surface of the root is longitudinally grooved at the anterolateral, posterolateral, and anteromedial sides, of which the anteromedial groove is the deepest and widest. The base of the root, though broken off, is relatively thick-walled, and the pulp cavity is remained as a small vacuity. The base of the root represents the greatest anteroposterior diameter of the tooth. This fact indicates the tendency toward protracted root closure, typical of the male individuals of the otariids (SCHEFFER & KRAUS, 1964).

Discussion: The specimen NSM-PV 3713–1, as well as NSM-PV 3713–2, from the Early Pleistocene Setana Formation had been listed as a cheek tooth of the sperm

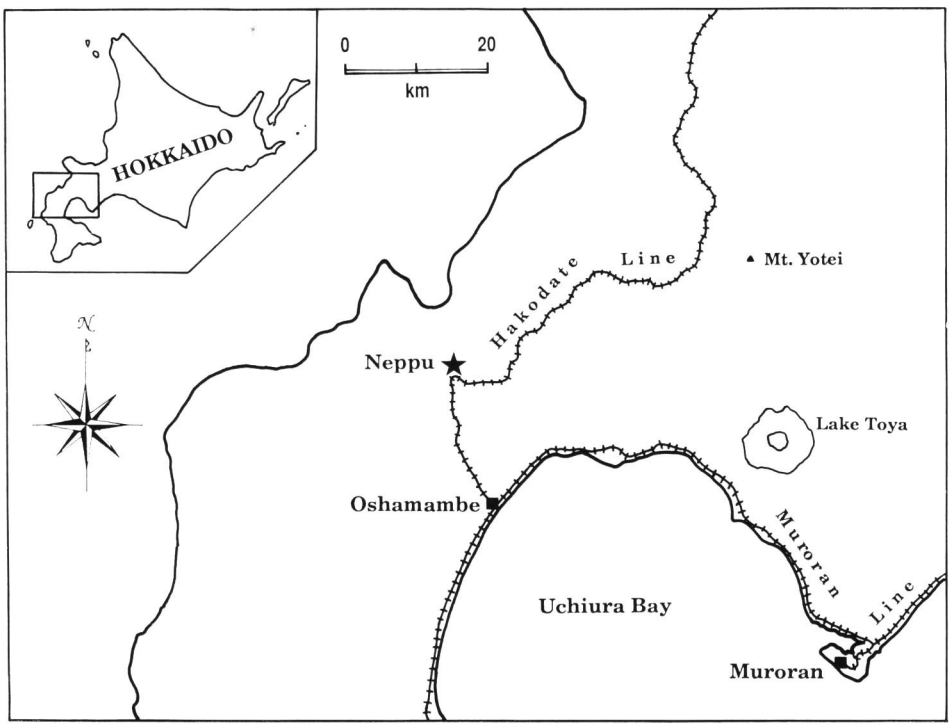

Figure 1. Map showing the locality, Neppu, of the two marine mammal tooth fossils described.

whale (KIMURA, 1985: 138) or as *Physeter*? sp. (TOMIDA & SAKURA, 1988: 29; KIMURA, 1992: 179). However, the characters of NSM-PV 3713–1 described above indicate that this tooth is a right lower canine belonging apparently to the pinniped family Otariidae. Several characters such as the extremely large size and the tendency toward protracted root closure are distinctive features for male individuals of large sea lion genera within the subfamily Otariinae (*sense* BERTA & DEMÉRÉ, 1986, but see BARNES, 1989).

Among the five known named sea lion genera within the subfamily Otariinae, the lower canine of male individuals of the largest sea lion, *Eumetopias jubatus* (SCHREBER, 1776), closely resembles NSM-PV 3713–1 in its structure and proportion. But, NSM-PV 3713–1 differs from *E. jubatus* by being nearly 25 percent larger in size and by having a root that is transversely more inflated (Table 1). These differences seen in NSM-PV 3713–1 indicate that this animal represents at least a previously unknown species within the subfamily Otariinae.

Including the fossil records of published but unnamed sea lions, NSM-PV 3713–1 most closely resembles the lower canine of "*Allodesmus* sp." of KASENO (1951) in its structure, proportion, and size. This specimen consists of a right dentary with lower canine and several cheek teeth from the Early Pleistocene Onma Formation (1.36–0.89

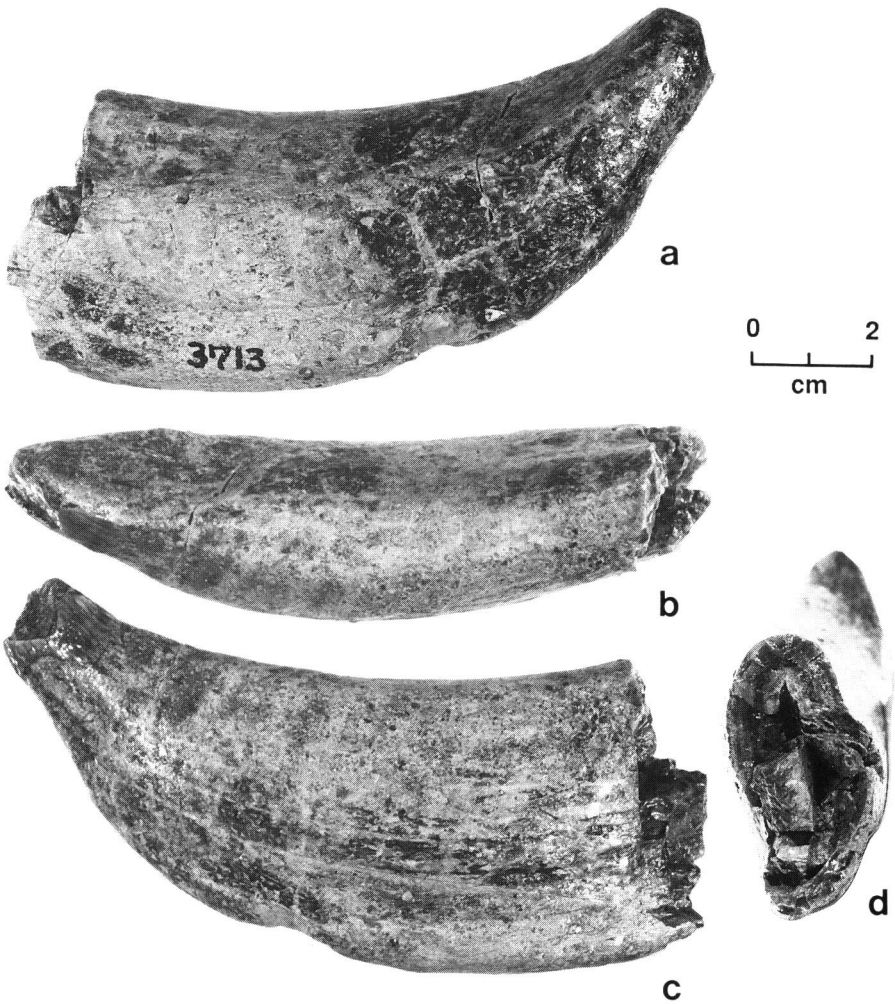

Figure 2. Otariinae gen. et sp. indet., NSM-PV 3713–1, right lower canine. a, lateral view; b, dorsal view; c, medial view; d, posterior view. ×0.8.

Ma: TAKAYAMA *et al.*, 1988) of Ishikawa Prefecture, Japan. Because of its large size and advanced cheek tooth morphology, this animal was re-identified later as "*Eumetopias* sp. cf. *E. jubatus*" by SHIKAMA (1953), "*Eumetopias* sp. ?" by MITCHELL (1968), or "*Eumetopias* sp." by REPENNING and TEDFORD (1977). NSM-PV 3713–1 and the lower canine of "*Eumetopias* sp." of KASENO (1951) are undoubtedly very similar and might belong to the same species. However, the assignment of the genus for the mandible from the Onma Formation is still in doubt (REPENNING & TEDFORD, 1977: 71), and the canine tooth has no generic and specific diagnostic character at all. For

Table 1. Comparative measurements (in mm) of the lower canine between the Recent Steller sea lion, *Eumetopias jubatus* (SCHREBER, 1776) and NSM-PV 3713–1.

	N	Min-Max	Mn
E. jubatus (SCHREBER, 1776): Male			
AC	23	21.2–26.9	24.0
TC	25	13.9–18.9	16.6
AR (9+)	4	38.6–42.4	39.1
TR (9+)	4	21.4–22.6	21.8
TR/AR × 100 (%)	4	51.6–61.8	56.6
NSM-PV3713–1: Referred male			
TL (as preserved)	1	125.8	
AC	1	(24.7)	
TC	1	(23.8)	
AR	1	50.4	
TR	1	32.0	
TR/AR × 100 (%)	1	63.5	

Abbreviations: N=number of specimens; Min=minimum value; Max=maximum value; Mn=mean; TL=total length; AC=anteroposterior diameter at the base of the crown; TC=transverse diameter at the base of the crown; AR=greatest anteroposterior diameter of the root; TR=greatest transverse diameter of the root; (9+)=over 9 years old (age determination is based on KUBOTA *et al.*, 1961).

Measurements in ( ) are direct measurements as preserved, which do not represent original ones because of the wear and abrasion but give fairly good estimate.

these reasons, it is infeasible to determine whether the canine from the Setana Formation, as well as "*Eumetopias* sp." of KASENO (1951), belongs to a species of the genus *Eumetopias* or of a new genus within the subfamily Otariinae. Thus, we identify NSM-PV 3713–1 herein only as an indeterminate genus and species of the subfamily Otariinae in the family Otariidae at present time.

Order Cetacea BRISSON, 1762

Suborder Odontoceti FLOWER, 1867

Superfamily Delphinoidea (GRAY, 1821)

Family Delphinidae GRAY, 1821

Subfamily Globicephalinae (GRAY, 1866)

Genus *Orcinus* LILLJEBORG, 1866

Orcinus sp.

(Figure 3)

Material: NSM-PV 3713–2, right lower cheek tooth.
Locality: Same as for NSM-PV 3713–1 above.

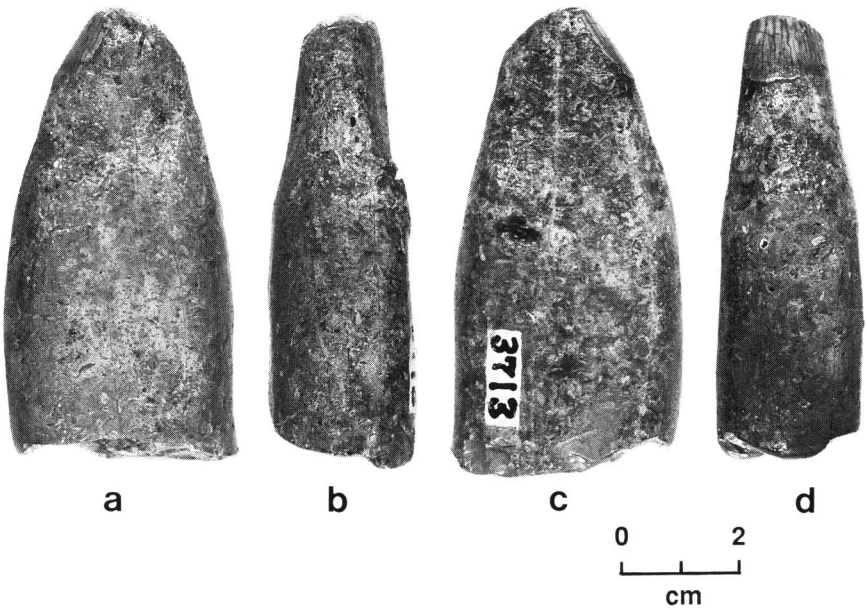

Figure 3. *Orcinus* sp., NSM-PV 3713–2, right lower cheek tooth. a, anterior view; b, medial view; c, posterior view; d, lateral view. ×0.8.

Formation and Age: Same as for NSM-PV 3713–1 above.

Description. The tooth is incomplete. The tip of the crown is heavily abraded, and half the length of the root is broken off. It is relatively large, robust, and straight. The lateral surface of the tooth is gently curved medially. The enamel of the crown, which is preserved only at the lateral surface, is thin and smooth. There are wear facets on both anterior and posterior sides of the crown, of which the posterior one is deeper and wider and oblique to the longitudinal axis of the tooth. The anterior wear facet is indistinctive. The root of the tooth is long, stout, and anteroposteriorly compressed. Both anterior and posterior sides of the root are nearly flattened but longitudinally slightly grooved at the mid-line. Of these the posterior groove is deeper and wider. The base of the root is broken off, and it reveals that the pulp cavity is filled with dentine, remaining only a tiny pit which is less than 2 mm in diameter.

Measurements of the tooth are: anteroposterior diameter at the base of the crown (as preserved) 15.7 mm; transverse diameter at the base of the crown (as preserved) 23.4 mm; greatest anteroposterior diameter of the root 26.1 mm; greatest transverse diameter of the root 40.1 mm.

Discussion: The specimen NSM-PV 3713–2 had also been listed as a cheek tooth of *Physeter* ? sp. (KIMURA, 1985; TOMIDA and SAKURA, 1988; KIMURA, 1992). This tooth is very large in size as a toothed whale, and has a relatively large crown and long, straight, and anteroposteriorly compressed root. These features are characteristic of

the genus *Orcinus* of the subfamily Globicephalinae in the family Delphinidae and precludes assignment of this animal to other large toothed whales within the suborder Odontoceti. A strong wear facet on the crown is also distinguishable from the cheek teeth of the genus *Physeter* in which there is no functional upper tooth. Most of the characters of NSM-PV 3713–2 are sufficiently identical to those of the recent killer whale, *Orcinus orca* (LINNAEUS, 1758), but the specimen is only a single incomplete tooth, and the cheek teeth of toothed whales might have no specific diagnostic character at all. Thus we identify it as *Orcinus* sp.

In comparison with the Recent *O. orca* specimens (NSMT-M 4510 and 21262), gently curved lateral surface of the specimen indicates that it is a lower cheek tooth. An upper cheek tooth has the crown more strongly curved medially.

Conclusion

Because of the above re-identifications, no published fossil record of the genus *Physeter* is presently known in Japan. The assignment of NSM-PV 3713–1 to a huge sea lion, very likely the same species of "*Eumetopias* sp." of KASENO (1951), more clearly indicates that a large species of sea lion was present in north-western Pacific during the Early Pleistocene although the generic assignment of the species is presently uncertain.

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