

Some Shark Teeth from Miocene Ichishi Formation in Mie Prefecture, Japan

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Introduction

In the northwestern and southwestern regions of Tsu City in Mie Prefecture, Tertiary beds are developed. The area is stretched for more than 20 km from Anno County to Ichishi County. This Tertiary deposit is considered as Miocene in the age, and was named Ichishi Formation by SUZUKI and OYAMA (1948), and studied by ARAKI (1960) in detail. According to TAKIMOTO (1935), and ARAKI (1960), Ichishi Formation is divided into 6 layers. They are from the bottom to top: Kongoho conglomerate, Furutaike granitic sandstone, Kaisekizan muddy sandstone, Mitsugano tuffaceous shalestone, Ishibashi tuffaceous sand and shale stone. Shark teeth reported here were discovered from Kaisekizan muddy sandstone. From this bed, following fossil molluscs have been reported: *Acila divaricata* (HINDS), *Nuculana confusa miensis* ARAKI, *Partlandia watasei* (KANEHARA), *Anadara setoensis* (YOKOYAMA), *Musculus hattaii* ARAKI, *Patinopecten kobyamai* KAMADA, *Venericardia funayamaensis* ARAKI, *Soletellina minoensis* YOKOYAMA, *Periploma mitsuganoensis* ARAKI, *Turritella s-hattai* NOMURA, *Euspira isensis* ARAKI, *Fulugalari miensis* ARAKI, *Fulugalari Yanagidaniensis* ARAKI, *Eoscapander corpulenta* YOKOYAMA, *Vicarya* sp., etc. Above the Ichishi Formation, the Pliocene formation which yielded *Stegodon* cf. *S. elephantoides* (CLIFT), was deposited.

Fossil locality: Yanaidani, Misato Village, Age County, Mie Prefecture. A small valley along Iga Road which is located about 16 km northwest of Tsu City.

Description

Class Chondrichthyes
Order Lamniformes

Family Lamnidae
Genus *Carcharodon*

Carcharodon sulcidens AGASSIZ, 1843 (pl. 1, A and C)

NSMT-PV 16861 (pl. 1 A): This specimen is a left upper jaw tooth, probably positioned in the posterior portion of the jaw. There are about 38 serrations on the anterior cutting edge. About half of the serrations are broken in the posterior cutting edge. The posterior cutting edge curves slightly more than the anterior one. The thickness of the crown is 5.1 mm. The height of the crown at the outer surface is 9 mm; the distance between the anterior end of the cutting edge and the apex is 25 mm.

NSMT-PV 16863 (pl. 1 C): This specimen, which is almost equilateral triangle in the outline, is a left upper jaw tooth which is probably located in the middle part of the jaw. The anterior cutting edge is straighter and somewhat concave, and the posterior cutting edge is slightly curved. There are about 56 serrations on the anterior cutting edge, which is about 40 mm in length, and about 53 on the posterior cutting edge which is about 36 mm. The width of the crown is about 38 mm. The crown is 7.5 mm thick and rather thin. The outer surface is concave with some shallow grooves near the root, which run parallel toward the apex from the base of the crown. There is a low, weak ridge, running from the apex to the central part of the crown. The inner surface of the crown is convex, but flat at the central area. The root is broken. These two teeth can be distinguishable from teeth of *Carcharodon megalodon*, which are described below, by the combination of following characters: thin crown; concave outer surface; fewer number of serration; presence of shallow parallel grooves on the outer surface near the root; and the curve of the cutting edges which does not form S-shape.

Carcharodon megalodon AGASSIZ, 1843 (pl. 1, B and D)

NSMT-PV 16861 (pl. 1 B): The specimen lacks portions of the apex and ends of the cutting edges. This is a tooth of the lower right jaw. There are about 15 serrations in a distance of 10 mm along the cutting edge. The crown is 6.9 mm thick. The width of the crown is about 23 mm and the inner surface is greatly convex.

NSMT-PV 16864 (pl. 1 D): This is the right lower jaw tooth. This specimen is the largest one in the present collection, but the one third near the apex of the crown is missing. The anterior cutting edge is almost straight and the posterior cutting edge is somewhat curved. There are 12 to 15 serrations in 10 mm distance along the cutting edges. The width of the crown is about 58 mm in an estimation. The thickness is 21 mm. The central portion of the outer surface is convex and becomes thinner toward the cutting edges. The inner surface of the crown is greatly convex, and the neck is well developed.

Genus *Isurus**Isurus oxyrinchus* RAFINESQUE, 1810 (pl. 2, E, G–K)

NSMT–PV 16865 (pl. 2 E): This specimen is probably the fourth tooth of the upper right jaw. The specimen is almost complete. The outer surface is almost flat, and the inner surface is convex. The cutting edges without serration are thin and sharp as a razor blade. The crown is tilted toward the posterior direction. The root is roughly rectangular which is slightly bent at the middle.

NSMT–PV 16867–16871 (pl. 2 G–K): All of these specimens appear to belong to the species *Isurus oxyrinchus*. Teeth of *Isurus* are rather common in Miocene beds in various parts of Japan, with several other species of the genus, such as *I. retroflexus*, *I. hastalis*, *I. planus*, *I. desori*, etc. There still remain some questions as to distinguishing teeth of these species. Ranges of ontogenetic, individual, and interspecific variations among teeth have to be made clear before precise and reliable identifications are made.

Concluding Remarks

Two genera and three species, and an undetermined specimen are reported here from Miocene Ichishi Formation in Mie Prefecture. *Carcharodon sulcidens* is for the first time reported from Japan, which have been confused with *Carcharodon megalodon* or *C. carcharias* in previous literature. Fossil teeth of the genus *Carcharodon* have been abundantly discovered not only in Japan, but in various parts of the world. The age of beds yielding *Carcharodon* ranges from Eocene to Recent. However, there are no extensive comparative study which solved systematic problems. Until a such investigation is completed, we have to continue to describe available specimens in detail to accumulate data for future systematic analysis. The situation is similar for other genera of sharks.

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Explanation of Plates

Plate 1

Shark teeth of the genus *Carcharodon* from Miocene Ichishi Formation, A and C, *C. sulcidens*; B and D, *C. megalodon*. In A~C, photographs at the left side of each letter show the inner surface, and photographs at the right side of each letter show the outer surface. In D, the left photograph shows the outer surface, and the right photograph shows the inner surface. Catalogue number and magnification: A, NSMT-PV 16861($\times 3$); B, NSMT-PV 16862($\times 1.5$); C, NSMT-PV 16863 ($\times 1.5$); D, NSMT-PV 16864 ($\times 1.4$).

Plate 2

Shark teeth of the genus *Isurus* and gen. and sp. indet. from Miocene Ichishi Formation. E, G-K, *Isurus oxyrinchus*; F. gen. et sp. indet. The Photograph at the left side of each letter shows the inner surface, and photograph at the right side of each letter shows the outer surface. All photographs are enlarged 1.5 times of the actual size. E, NSMT-PV 16865; F, NSMT-PV 16866; G, NSMT-PV 16867; H, NSMT-PV 16868; I, NSMT-PV 16869; J, NSMT-PV 16870; K, NSMT-PV 16871.



