

## Miocene crocodylian teeth from the Mizunami group, Central Japan

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瑞浪層群産ワニ目歯化石

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### (Abstract)

Four crocodylian teeth are reported from the Miocene Mizunami group as the oldest ones in Japan. This is the first occurrence of Miocene crocodiles in Northeastern Asia. Teeth are described as ? *Crocodylidae*, gen. et sp. indet., and a brief historical review of crocodiles in Japan is attempted.

### (要 約)

瑞浪層群産の4個のワニ目に属する歯化石を記載した。これは北東アジア地域における中新世ワニ目の最初の産出記録である。標本は、定林寺(明世累層久尻相)、桜堂(2個)・奥名(生俵累層名滝礫岩層)から得られたものである。いずれも不完全な標本で、分類上の位置は確定できない。北東アジア地域の新生代のワニ目についても簡単にふれてある。

The Mizunami group, distributed in the southeastern part of Gifu Prefecture, Central Japan, consists of the Lower Miocene marine and lacustrine sediments which deposited in three basins, Kani, Mizunami and Iwamura Basin, from west to east. It has attracted paleontological attentions because of its frequent occurrences of mammalian fossils including both terrestrial and marine habitants. As for the terrestrial mammals, the materials have been reported mainly from the Kani Basin. They are *Gomphotherium annectens* (MATSUMOTO), *Anchitherium hypohippoides* MATSUMOTO, *Palaeotapirus yagii* MATSUMOTO, *Chilotherium pugnator* (MATSUMOTO), *Amphitragulus minoensis* MATSUMOTO and a sciurid, gen. et sp. indet. (MATSUMOTO, 1918, 1921, 1926, etc.). But some of them are also reported from the Mizunami Basin. Also from the Mizunami Basin, almost all of the fossil marine mammals of the Mizunami group are found, such as the skull of *Desmostylus japonicus* TOKUNAGA et IWASAKI (YOSHIWARA & IWASAKI, 1902), whole skeleton of *Paleoparadoxia tabatai* (TOKUNAGA) (IJIRI & KAMEI, 1961, SHIKAMA, 1966), and many bones of whales including ? *Eurhinodelphis* sp. (KAMEI & OKAZAKI, 1974).

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The author has reported the result of the investigation with the members of the Mizunami Fossil Museum on mammalian fossils (KAMEI & OKAZAKI, 1974) including a brief note on the occurrence of a crocodylian teeth from the Mizunami group. Recently, the presence of some additional materials of crocodylian teeth was recovered among the materials of unidentified shark teeth collected by the Club for geology, Gifu-Kita High School.

In the present paper, the author describes the crocodylian teeth both previously and newly discovered.

(1) a tooth from Jorinji

The material from the Kujiri formation, briefly reported by KAMEI & OKAZAKI in 1974, is an almost perfect tooth, collected by K. KATO from Jorinji, Izumi-machi, Toki City. The Kujiri formation has deposited in shallow embayment associated with river sediments, containing abundant marine molluscs (ITOIGAWA, 1960, 1974). It yields also mammalian fossils such as *Paleoparadoxia tabatai* (TOKUNAGA), Canidae, gen. et sp. indet. and ? *Eurhinodelphis* sp. (KAMEI & OKAZAKI, 1974). Besides mammalian fossils, a turtle fossil, which belongs to the collection by K. KATO, occurred also from the Kujiri formation at Nanamagari, Izumi-machi, Toki City.

(2) teeth from Sakurado and Okuna

Three teeth, in which two are imperfect but doubtless and one suspicious, are found from the Nataki conglomerate. The Nataki conglomerate occupies the base of the Oidawara formation, and yields abundant shark teeth from many localities. The chondrichthyes fauna of the Mizunami group, consisting of 26 species, has been occupied dominantly by the genus *Charcharinus* (63-90%), but it should be noted that the composition of each formation varies reflecting the sedimentary environment (ITOIGAWA & NISHIMOTO, 1974). The crocodylian teeth from the Nataki conglomerate are, however, possibly derived from lower beds of the Mizunami group, judging from their fragmental preservation. The Nataki conglomerate yields some vertebrae of whales and a canine tooth of a carnivorous mammal (the latter was erroneously identified as a whale tooth in KAMEI & OKAZAKI, 1974).

In Japan, there are no living crocodiles, and fossil crocodiles have not been known also except following materials from the Pleistocene; from Machikane Hills, Osaka Prefecture, Southwest Honshu, a skeleton of *Tomistoma machikanense* KAMEI et MATSUMOTO is reported from the Osaka group (ISHIDA, 1965, KOBATAKE et al., 1965, KOBATAKE & KAMEI, 1966). The age of the ash layer just below the fossil-bearing horizon is estimated about 0.38 m.y. B. P. by the fission track method. Another crocodylian fossil of the Osaka group was also found from different horizon and place, but unfortunately it has been only listed up in some stratigraphical reports without paleontological description (as ITHARA et al., 1973). Fourteen teeth and a vertebra are reported from Tsubami, Nagasaki Prefecture,

Kyushu as Crocodylia, fam., gen. et sp. indet. (OTSUKA, 1969), from the Kuchinotsu group. Further, from fissure deposits at Yage, Shizuoka Prefecture, Central Honshu, crocodylian bones are unearthed (TSUCHI, 1974). On the other hand, the "crocodylian bone" which was reported from Tertiary formation at Orio, Fukuoka Prefecture, Kyushu (anonym, 1951), is known as a dolphin or porpoise bone (KOBATAKE et al., 1965). In Northeastern Asia, the only living crocodylian species, *Alligator sinensis* FAUVEL, has its restricted distribution at Yangze Valley, China. As fossil ones, from the Triassic to the Eocene species in China are listed by YOUNG (1964), as follows; twelve Mesozoic species from mostly South China and Mongolia, in the Palaeocene, two species, *Asiatosuchus nanlingensis* YOUNG and *Eoalligator chunyi* YOUNG, both recognized from Nanhsiung, Kwangtung, in the Eocene, *Asiatosuchus grangeri* MOOK from Inner Mongolia, *Lianghusuchus hengyangensis* YOUNG from Hengyang, Hunan, *Tienosuchus hsiangi* YOUNG also from Hengyang, Hunan, and *Tomistoma petrolica* YEH from Nanhhsing, Kwantung. In contrast with these older species, Neogene crocodiles are known rather rarely in the coast region; *Tomistoma taiwanicus* SHIKAMA (SHIKAMA, 1972) and an unidentified crocodile, Gavialidae or Tomistomidae, gen. et sp. indet. (TOKUNAGA, 1936), are documented from the Early Pleistocene of Tsochin, southwestern Taiwan. These are all of Neogene crocodiles in Northeastern Asia (OTSUKA, 1969, SHIKAMA, 1972). Accordingly, the present occurrence is the first discovery of Miocene crocodylian remain in Northeastern Asia on the one hand, and is the oldest in Japan on the other. The systematic situation of the present species could not be determined because of poorly preserved materials, but as the teeth show somewhat similar shape and ornamentations with those of Crocodylidae, it is treated here as ? Crocodylidae, gen. et sp. indet. The identification is also supported by the fact that all the Neogene species hitherto known in Northeastern Asia belong to the single family Crocodylidae (OTSUKA, 1969). Compared with the teeth from the Kuchinotsu group, the present materials are distinguished from them by less depressed apex of the crown and less dominant two ridges. Teeth of *Tomistoma taiwanicus* SHIKAMA show fairly different characters from the present ones such as blunt apex and faint strial ornamentations. Further, the present teeth are distinguishable from those of *Tomistoma machikanense* by their obvious striations and more curved profile.

### Conclusions

The occurrence of four crocodylian teeth from the Mizunami group confirms the existence of crocodylian reptile in Japanese Miocene vertebrate fauna. Unfortunately, the systematic position of the species is not determined satisfactorily because of its poor preservation. From two different horizons were yielded crocodylian teeth in the Mizunami group.

A brief history of Cenozoic crocodiles in Northeastern Asia is as follows; in the

Palaeocene and Eocene, five species are reported from Kwangtung and Hunan district, in the Miocene, a certain species at Mizunami region, in the Pleistocene species of the genus *Tomistoma* distributed rather widely in Japan and Taiwan, and Recent *Alligator sinensis* with restricted distribution at China.

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#### Description

? Crocodylidae, gen. et sp. indet.

#### Material;

1. An almost perfect detached tooth from Jorinji, Izumi-machi, Toki City.
2. An apex part of tooth from Okuna, Toki-cho, Mizunami City.
3. A broken tooth from Sakurado, Toki-cho, Mizunami City.
4. A suspicious fragment of tooth from Sakurado, Toki-cho, Mizunami City.

#### Horizons;

Material 1; Kujiri formation

Materials 2-4; Nataki conglomerate

#### Observation;

Material 1, an almost complete tooth, is conical in shape, moderately curved and rootless. Its transverse section is almost round. Superficial longitudinal striations are observed on it, and among them, two distinct ridges are situated oppositely, dividing others into inner eleven and outer twelve striations. The striations are less distinct near apex except the two ridges.

Material 2, a partly preserved tooth of apex, is also conical with two ridges like material 1 but other striations are obscure.

Material 3, a broken tooth, is conical, moderately curved as material 1. It exhibits ridges distinctly but the striae ornamentations are more faint than material 1.

Material 4, a doubtful one of a fragmental tooth, curves stronger than other specimens. It shows smooth surface unlike others.

## Measurements in mm.

materials	a	b	c
1	26.2	11.5	10.5
2	6.0	4.5	3.8
3	15.2	6.4 (+) *	7.8
4	4.9	2.4	2.6

a; maximum height as preserved

b; maximum fore-and-aft diameter as preserved

c; maximum inner-outer diameter as preserved

\* the specimen broken obliquely at its base

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1a



1b



1c



2a



2b



2c



3a



3b



3c



4a



4b



4c