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KENTRIODONTIDAE (ODONTOCETI, CETACEA) FROM MIOCENE SEDIMENTS OF THE PIETRA LECCESE (APULIA, ITALY)

Abstract - Some fossil odontocete cetaceans from Miocene sediments of the Pietra leccese (Apulia, Italy) are here described. Such fossils, which are isolated auditory bones, refer to the extinct Kentriodontidae family, discovered in the Mediterranean Basin for the first time. The revision of other findings of other Mediterranean fossiliferous localities shows, in reality that the Kentriodontidae were largely represented in this basin during the Miocene.

Riassunto - *Kentriodontidae (Odontoceti, Cetacea) nei sedimenti miocenici della Pietra leccese (Puglia, Italia).*

Vengono descritti alcuni resti fossili di cetacei odontoceti, provenienti dai sedimenti miocenici della Pietra leccese (Puglia). Tali reperti, rappresentati da ossa uditive isolate, vengono riferiti alla estinta famiglia dei Kentriodontidae, segnalata per la prima volta nel Bacino mediterraneo. Con la revisione di altri ritrovamenti di altre località fossilifere del Mediterraneo, è stato possibile mettere in evidenza che in realtà questa famiglia nel Miocene era largamente rappresentata in questo bacino.

Key words - Cetacea, Odontoceti, Kentriodontidae, Auditory bones, Systematics.

INTRODUCTION

The studied fossil remains are represented by some auditory bones that are kept in the Paleontological Museum, University of Florence and in the Museum of Gruppo Naturalisti Salentini, University of Lecce.

These remains are referred to Kentriodontidae, an extinct family of relatively small odontocete.

The Kentriodontidae were known in some extra-Mediterranean fossiliferous localities, from the Late Oligocene to the end of the Miocene.

Barnes & Mitchell (1984) consider a close filogenetic relationships

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between the Kentriodontidae and the modern Delphinidae possible. According to Muizon (1988b), the relationships between Kentriodontidae and other families of Delphinoidea are not yet completely clear. He suggest several possible filogenetic hypotheses.

Terminologies suggested by Kasuya (1973), Fordyce (1981), Barnes & Mitchell (1984), Muizon (1987, 1988b) integrated and modified by Bianucci *et al.* (1984a, 1984b) have been used for the description of these structures.

SYSTEMATICS

Class MAMMALIA Linnaeus, 1758

Order CETACEA Brisson, 1762

Suborder ODONTOCETI Flower, 1867

Superfamily DELPHINOIDEA (Gray, 1821) Flower, 1864

Family KENTRIODONTIDAE (Slijper, 1936) Barnes, 1978

Kentriodontidae indet.

(Fig. 1, 21a-1d)

Remains - One isolated right periotic.

Repository - Museum of "Gruppo Naturalisti Salentini", University of Lecce, Apulia, Italy.

Locality - Rudiglione (Alessano), "La Signura" quarry, Salento Peninsula, Apulia, Italy. This remain has been found by one of us (A.V.).

Formation: "Pietra leccese". In age between the late Burdigalian and the early Messinian (Bossio *et al.* 1991).

Age - It as not been possible a more precise datation.

Description - Small periotic (total length: 22.6 mm), similar in size to *Nannolithax* Kellogg, 1931, smaller than *Kentriodon* Kellogg, 1927.

Dorsal or ventral views show an overall sinuosity within the anterior process bent medially and posterior process bent laterally, as noted by Barnes & Mitchell (1984) in several periotics of Kentriodontidae.

Such as in all Delphinida Muizon, 1984 the anterior process is relatively brief. Besides, this is as thick as in all Delphinoidea. However its apex is pointed and relatively thinner than in some Kentriodontidae and in all living taxa of Delphinoidea. In this respect the anterior process is similar to that of *Belenodelphis peruanus* (Muizon, 1988a, fig. 104) while it differs from that of *Kentriodon pernix* by Kellogg (1927,

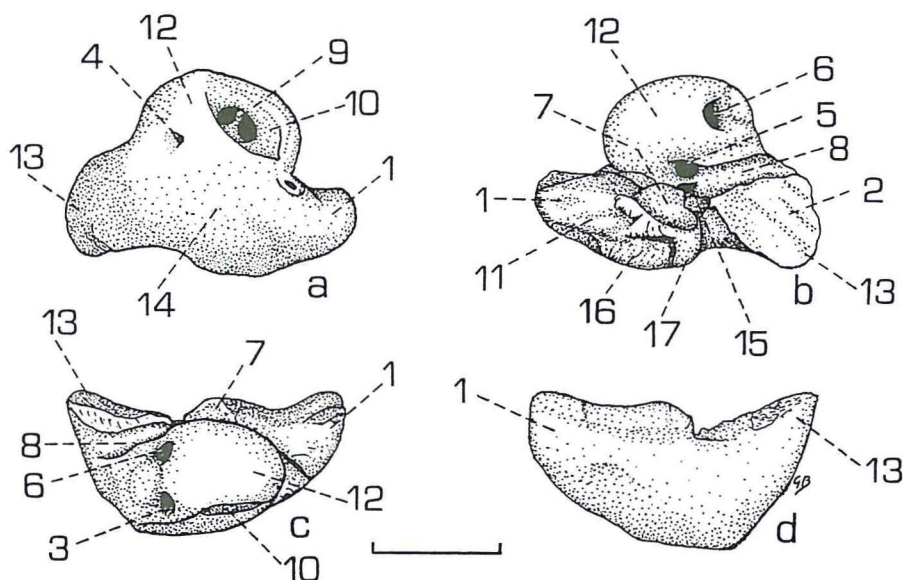


Fig. 1 - Kentriodontidae indet., Pietra leccese, Miocene, Apulia (Italy), right periotic in dorso-lateral view (a), ventral view (b), medial view (c) and lateral view (d) (scale = 1 cm). 1 = anterior process; 2 = articular facet for periotic; 3 = dorsal opening of the aquaeductus cochleae; 4 = dorsal opening of the aquaeductus vestibuli; 5 = fenestra ovalis; 6 = fenestra rotunda; 7 = fossa capitis mallei; 8 = fossa for stapedial muscle; 9 = internal auditory meatus; 10 = internal auditory window; 12 = pars cochlearis; 13 = posterior process; 14 = superior process.

pl. 3, figs. 2-4) which shows a sub-rectangular section. An even thinner and relatively longer anterior process can be observed in *Nannolithax* (Kellogg 1931, figs. 123, 124). In ventral view, the *fossa capitis mallei* is relatively large and ventro-medially oriented. Anteriorly to the ventral tuberosity, the ventral swelling is particularly developed in its posterior half as in many Kentriodontidae. Medially to ventral swelling, the notch for unciform process of the tympanic is not emphasized. The epitubarian fossa is absent as in all Delphinoidea, except for some primitive Kentriodontidae.

The posterior process is very bent ventrally forming a right angle from the body of the periotic, as in many Kentriodontidae. In ventral view the articular facet for the posterior process of the tympanic is relatively large, gently concave with poor transversal striations.

The notch between the anterior and posterior processes (upper tympanic aperture according to Kasuya, 1973) is very deep as generally in Kentriodontidae and in Delphinidae.

The superior process shows a vague oval surface with a rounded lateral border, without the lateral keel as is present in *Kentriodon pernix*. In this character it resembles *Belenodelphis* and some periotics described by Barnes & Mitchell (1984) and referred to *Kentriodon obscurus*.

The *pars cochlearis* is not very high and it is gently dorso-ventrally compressed. The internal auditory window is elliptical-shaped, and its major axis is obliquely oriented. The confluence of edges of the internal auditory window in its antero-lateral portion produces a small foramen connected with the dorsal opening of the *aquaeductus Fallopii*. This condition is also found in some periotics of other fossil genera of Delphinoidea (ex.: *Lomacetus* Muizon, 1986 and *Lamprolithax* Kellogg, 1931; see respectively Muizon 1988a, fig. 16g and Kellogg 1931, fig. 119). The *foramen singulare* is very small and is separated from the dorsal opening of the *aquaeductus Fallopii* by a poorly developed *crista transversa*. The dorsal opening of the *aquaeductus cochleae* is located on a postero-medially prominence and it is medio-posteriorly oriented, as in many Delphinoidea. Between this opening and the *fenestra rotunda* there is a developed tubercle on the posterior side of *pars cochlearis*. The dorsal opening of the *aquaeductus vestibuli* is very small and postero-laterally oriented and is surrounded by a broad plate in the postero-laterally zone of internal auditory window. In ventral view the *fenestra rotunda* is semicircular-shaped and relatively large.

Comparisons - This periotic has been assigned to the Kentriodontidae family for it presents close affinities with those belonging to the *Kentriodon*, *Kampholophus* Rensberger, 1969 and *Delphinodon* Leidly, 1869 genera assigned to the Kentriodontinae subfamily by Muizon (1988b) (see Rensberger, 1969, pl. 4, figs. f-h. and True, 1912, pl. 25, figs. 6-11 respectively for periotic of *Kampholophus* and *Delphinodon*).

Besides, as in the periotics of these genera the posterior process is very bent ventrally forming a right angle with the body of the periotic. Particularly the Pietra leccese periotic is very similar to those referred to *Kentriodon obscurus* by Barnes & Mitchell (1984). Anyway, considering these periotics, the specimen of Apulia presents much smaller dimensions, comparable to those of *Nannolithax*. Nevertheless this periotic differ from *Nannolithax* by having a bigger strength of the anterior process and for not having a flat superior process.

The Pietra leccese periotic is also similar to that of *Belenodelphis*, from which it essentially differs for the smaller size and the minor inclination of the internal auditory window.

Lamprolithax? sp.
(Fig. 22a-5b)

Remains - Three isolated periotics: entire left one (IGF 1923/1V), a left one without the posterior process (IGF 1923/2V), and a right one without the anterior process (IGF 1923/3V); an incomplete right tympanic (IGF 1923/4V). The belonging of the latter remain and of one of the periotics to the same individual can not be proved. Nevertheless the similar size and the similar state of preservation and fossilisation make it probable.

Repository - Geological and Paleontological Museum, University of Florence, Italy. Bequeathed by dr. Major in 1868.

Locality - Not precise locality of Salento Peninsula

Formation - "Pietra leccese". In age between the late Burdigalian and the early Messinian.

Age - Late Serravallian - earliest Tortonian: interval *Discoaster kugleri* Zone - *Discoaster hamatus* Zone of nannofossil zonal scheme of Okada and Burky (1980).

Description - The size of periotics is more developed than the specimen previously described and similar to those of many Kentriodontidae (total length of IGF 1923/1V: 25.5 mm). The right periotic (IGF 1923/3V) is more large than the other two. The general shape is sinuous in the dorsal or ventral view and more emphasized than in the previous periotic. Especially in the IGF 1923/2V the anterior process is strongly medially turned like in the periotics of *Lamprolithax* Kellogg, 1931 (Kellogg 1931, figs. 119, 122).

The anterior process is relatively brief like in all Delphinida and it's relatively stronger compared to the specimen above described but not as much as the *Kentriodon pernix* one. It shows a medial keel in the dorsal view as it might be pointed out in the *Lamprolithax*. The ventral morphology of the anterior process is similar to that of the above described periotic even though the ventral swelling and the notch for the unciform process are lightly more emphasised, whereas the ventral tubeosity is less developed. The epitubarian fossa is absent.

The posterior process, like in the previous specimen and in many Kentriodontidae, is ventrally turned and the postero-dorsal angle is right in the two periotics in which it is kept. In ventral view, the posterior process show an articular facet for the posterior process of tympanic which has the main axis postero-laterally directed, like in *Lamprolithax simulans* (Kellogg 1931, fig. 120). The articular facet is slightly concave and presents some longitudinal striations.

The notch which separates the anterior process from the posterior

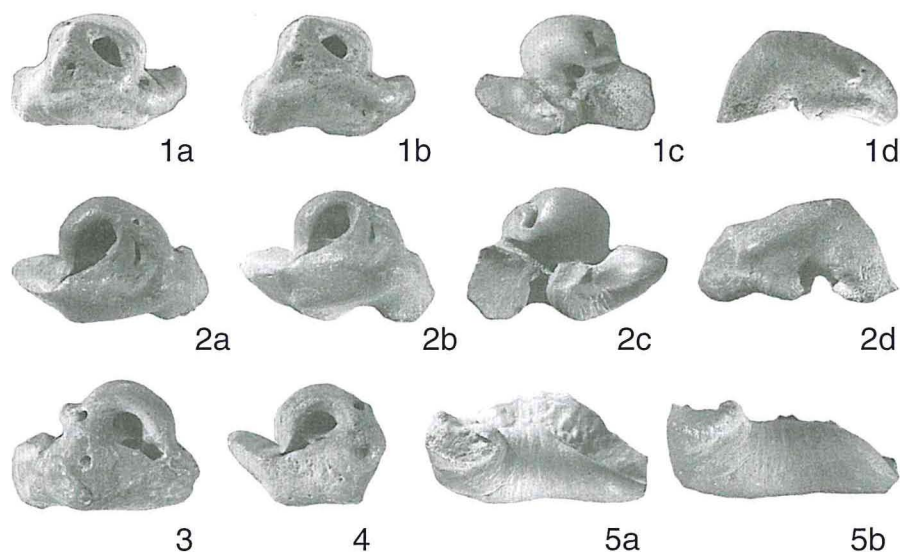


Fig. 2 - 1: Kentriodontidae indet., Pietra leccese, Miocene, Apulia (Italy), right periotic in dorsal view (a), dorso-lateral view (b), ventral view (c) and lateral view (d). 2-5: *Lamprolithax?* sp., Pietra leccese, late Serravallian-earliest Tortonian, Apulia (Italy); 2: IGF 1923/1V, left periotic; in dorsal view (a), dorso-lateral view (b), ventral view (c) and lateral view (d); 3: IGF 1923/3V, incomplete right periotic; 4: IGF 1923/4V incomplete left periotic; 5: IGF 1539/5V, incomplete right tympanic in dorsal view (a) and medial view (b) (all natural size).

one is very deep also in these specimens.

The superior process has an oval surface clearly delimited by a sharp lateral keel.

The *pars cochlearis* is slightly bent on the anterior side, has a roundish shape and is less low than the previously specimen described. The internal auditory window as the typical pirofalciforme shape and in IGF 1923/1V and IGF 1923/2V there is a certain tendency to the union of the lateral and medial borders of the dorsal opening of the *aquaeductus Fallopii* hole, even though it is not isolated an anterior foramen. The *crista transversa*, which divides the *foramen singulare* from the dorsal opening of the *aquaeductus Fallopii* hole, is relatively developed, especially in the IGF 1923/3V. The dorsal opening of the *aquaeductus cochleae* is partially posteriorly oriented but is still visible on dorsal view, It is separated from the *fenestra rotunda* by a posterior tubercle, which is very developed in IGF 1923/3V. The *fenestra rotunda* has a semicircular and very large shape. The dorsal opening of the *aquaeductus vestibuli* has different dimensions and shape in the three periotics:

in IGF 1923/1V is a long slit postero-laterally oriented; in IGF 1923/3V is a little hole similar to that of above described periotic and in IGF 1923/2V is a little hole placed at the bottom of a marked sinking. Such aperture is surrounded by a large plain zone, which is posteriorly delimited by a lifted edge like in the *Lamprolithax simulans* specimen pictured by Kellogg (1931, fig. 119).

The tympanic is relatively small size, comparable to those of the present little Delphinidae and of the extinct Kentriodontidae. In ventral view the almost total lack of the lateral lobe and the partial damage of the preserved surface do not allow the identification of significant systematic characters. The only well preserved part, which is possible to describe, is the *involucrum*. It is very similar to that of *Kentriodon* and of other Kentriodontidae for it does not show a strongly sigmoidal shape like generally in present Delphinida. The notch in the anterior base of the posterior process is effectively slightly emphasized and the swelling of the anterior side is limited. The postero-ventral angle is right and the ventral edge of the *involucrum*, in ventro-medial view, is almost straight, slightly concave and not convex as is generally in the Phocaenidae.

Comparisons - These auditory bones present close affinities with those of Kentriodontinae subfamily (*sensu* Muizon, 1988b). Like in the periotics of these genera the anterior process is posteriorly bent forming a right angle with the body and, like in the tympanic of these genera, the *involucrum* doesn't have a very marked sigmoidal shape. Anyway the examined periotics present some characters such as a very sinuous shape in the dorsal and the ventral view, which make them differ from the genera referred to the subfamily. On the other hand, considering other already described periotics, they present many similarities with those of the *Lamprolithax*. This genus, based upon some isolated periotics, have been placed in Odontoceti *incertae sedis* by Barnes (1979) and in Delphinoidea *incertae sedis* by Muizon (1988b). We consider *Lamprolithax* a probable Kentriodontidae on the basis of the characters described by Kellogg (1931) and on the basis of the affinity of Pietra leccese specimens.

THE MIOCENE KENTRIODONTIDAE DISTRIBUTIONS

The Kentriodontidae, though not much represented from a quantitative point of view, present a cosmopolite distribution during the Miocene.

Barnes & Mitchell (1984) have made clear a large distribution of

this family in the northern hemisphere, in the western an eastern Pacific Ocean and in the western an eastern Atlantic Ocean beside the Parathethys during the Miocene.

Afterward Muizon (1988a), Cione & Cozzuol (1989) have discovered the presence of this family also in the southern hemisphere respectively in the eastern Pacific Ocean (Peru) and in the western Atlantic Ocean (Argentina).

The here described findings, coming from Pietra leccese, allow us to extend the distribution of this family to the Mediterranean Basin proving once again its cosmopolite character.

Anyway a direct or bibliographical study on auditory bones, collected from different Mediterranean fossiliferous localities, shows that this family was widely represented in this basin even though such findings had previously been attributed to other families of odontocete.

Some auditory bones belonging to this family are in the Rosignano and Vignale (Early Miocene; Piedmont, Italy) collection of Geological and Paleontological Museum of University of Turin. Specifically, the specimens (MGPT 13907b and MGPT 13907c) figured by Pilleri *et al.* (1989, pl. 11a-12) and attributed to Delphinidae belong to Kentriodontidae. A better preparation of these auditory bones (fig. 3) has indeed allowed to make clear some characters, first of all the ventral bending of the posterior process of the periotics, which distinguish some Kentriodontidae. In particular, these auditory bones are very similar those of *Kentriodon*, *Kampholophus* and especially *Delphinodon* genera. In the periotic MGPT 13907c there is also a small epitubarian fossa on the ventral side of the anterior process; a primitive character which can be found, still among Delphinoidea, just in some Kentriodontidae. The tympanics does not show, in lateral view, a strongly sigmoidal shape and bear close resemblance to the Pietra leccese specimen above described and to the tympanics of Kentriodontinae. Also, in lateral view, the lateral furrow is clearly visible. This is a primitive character existing among Delphinoidea, only in Kentriodontidae. The mallei of these findings have been isolated. These show a relatively developed *processus muscolaris* (*sensu* Muizon, 1985) and a reduced *manubrium* as Muizon (1988) has observed in all Delphinida.

From the Rosignano and Vignale sediments come also four incomplete tympanics (MGPT 1394f, MGPT 1394g, MGPT 13910 and MGPT 13904h) referred to Delphinidae by Pilleri *et al.* (1989, pp. 217-220), which are yet very similar to the above described one. Also the periotics MGPT 13907d and MGPT 13904d figured by the same authors (Pilleri *et al.* 1989, pls. 14, 15) and classified as Iniidae must be attributed to the Kentriodontidae family. These specimens are indeed very

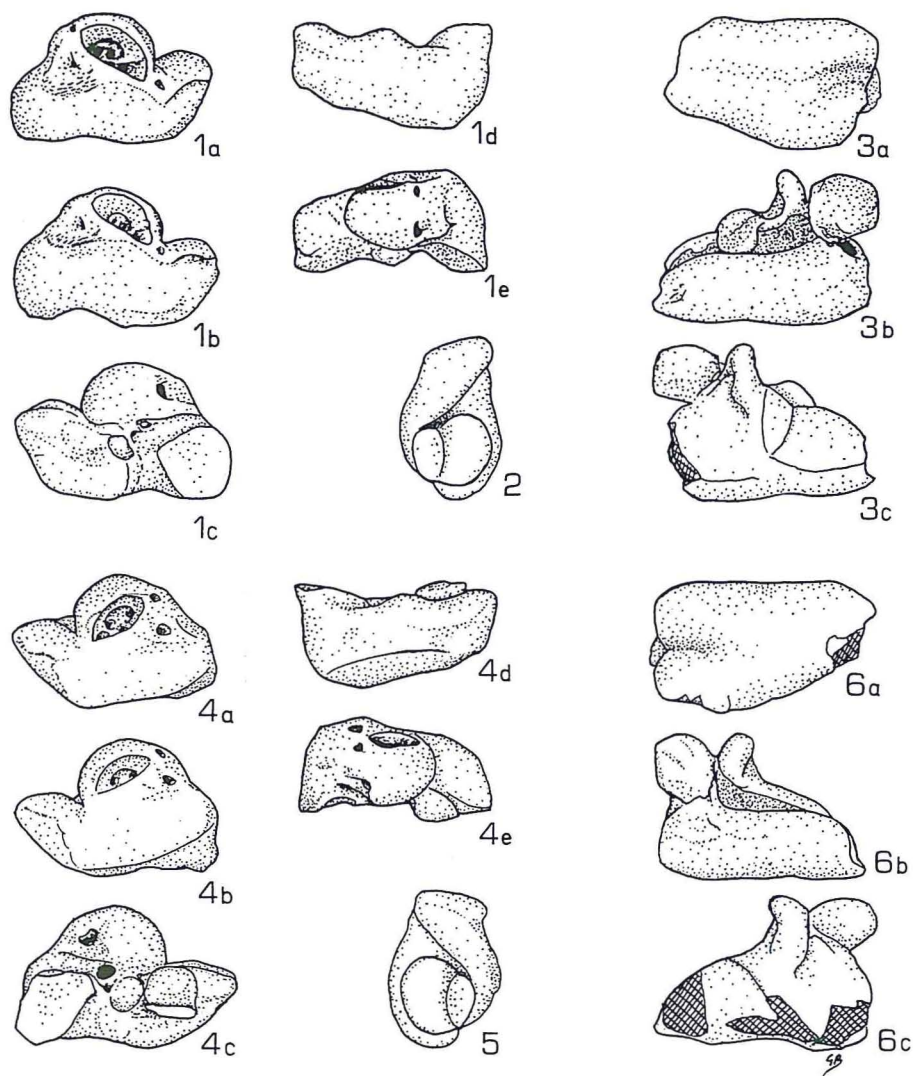


Fig. 3 - Kentriodontidae indet., Early Miocene, Piedmont (Italy). 1-3: MGPT 13907b right auditory bones; 1 periotic in dorsal view (a), dorso-lateral view (b), ventral view (c), lateral view (d) and medial view(e); 2 malleus in postero-medial view; 3: tympanic in ventral view (a), medial view (b) and lateral view (c). 4-6: MGPT 13907c left auditory bones; 4 periotic in dorsal view (a), dorso-lateral view (b), ventral view (c), lateral view (d) and medial view(e); 5 malleus in postero-medial view; 6: tympanic in ventral view (a), medial view (b) and lateral view (c) (all natural size, except to 2 and 5, that are increased).

similar to those above described and on the other hand do not show the drastic reduction of the anterior and posterior processes which can be found in the Iniidae as pointed out by Muizon (1984, 1988b).

This family is probably well represented also in the periotics collected from the Serravallian sediments of Visiano (Parma, Italy) (Cigala Fulgosi & Pilleri, 1985, pl. 5, figs. 1-10; Pilleri *et al.*, 1989, pl. 16,17).

Among the fossil cetaceans of the Early Miocene molasse of Baltringen (Pilleri, 1986a) there are also some auditory bones which might be referred to Kentriodontidae. Particularly some periotics referred to Delphinidae Gen et sp. ind. (Pilleri, 1986a, pl. 7, figs. a,c,d,e) present the typical characters of Kentriodontinae. Two periotics attributed to a Delphinidae Gen. et sp. ind. (Pilleri, 1986, pl. 7, fig. b, pl. 22, fig. 1) and to a Iniidae sp. (Pilleri *et al.* 1989, p. 238, text-fig. 18), belong to primitive Delphinoidea. These last periotics present a relatively longer anterior process compared to the ones above mentioned and also an evident epitubarian fossa. They show similarities with those of *Liolithax* Kellogg, 1931 (Kellogg, 1931, figs. 15, 16, Barnes, 1978, text-figs. 1, 2). There are also some incomplete tympanics (Pilleri, 1986a, pl. 25, figs. 5-7) which are very similar to those of some Kentriodontidae.

In conclusion, among the Swiss molasse cetacean remains (Early Miocene), the periotics attributed by Pilleri (1986b, pl. 5, figs. d,g) to Delphinidae sp. might belong to this family.

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