

SHORT NOTE - NOTA BREVE

METAXYTHERIUM MEDIUM (MAMMALIA: SIRENIA) FROM UPPER MIOCENE SEDIMENTS OF THE ARENARIA DI PONSANO FORMATION (TUSCANY, ITALY)

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Abstract. Records of *Metaxytherium medium* (Mammalia: Sirenia) from Tortonian (Late Miocene) sediments from the Arenaria di Ponsano Formation (Tuscany, Italy) are described. They consist of fragmentary specimens, including several partial cranial elements representing at least three skulls, two humeri, fragments of vertebrae and some incomplete ribs. The new Tuscan records confirm the wide diffusion of *Metaxytherium* in the Mediterranean during the Miocene. This sirenian's occurrence in the Arenaria di Ponsano sediments is in accordance with the shelf environment indicated by other fossils. The low sea bottom was at least partially covered by seagrass meadows, the food source of this dugongid.

Riassunto. Vengono descritti resti di *Metaxytherium medium* (Mammalia: Sirenia) provenienti dai sedimenti tortoniani (Miocene superiore) dell'Arenaria di Ponsano (Toscana, Italia). Si tratta di reperti frammentari rappresentati prevalentemente da diversi elementi craniali appartenenti almeno a tre distinti crani, due omeri, frammenti di vertebre e alcune coste incomplete. Questa segnalazione conferma l'ampia diffusione di *Metaxytherium* nel Mediterraneo durante il Miocene. Il ritrovamento di sirenia nei sedimenti dell'Arenaria di Ponsano è in accordo con l'ambiente di piattaforma indicato anche dagli altri fossili. Il basso fondale marino era almeno in parte ricoperto da praterie algali, la sorgente di cibo di questo dugongide.

Introduction

Metaxytherium is an extinct dugongid sirenian that shows a wide geographical and biostratigraphical distribution. In fact, *Metaxytherium* remains have been collected in several Early-Late Miocene localities of the Mediterranean region (see below; summary in Domning & Thomas 1987), northern France (Cottreau 1928), North and South America (Muizon & Domning 1985; Domning 1988; Aranda-Manteca et al. 1994), and al-

so in Pliocene sediments of the Mediterranean Basin (Domning & Thomas 1987). The Miocene specimens from Mediterranean and adjacent areas were collected mainly from Central and Western Paratethyan deposits of Austria and Switzerland (Domning & Pervesler 2001), from Spain (Pilleri et al. 1989), and from many localities of southern Italy and Sardinia (Monchamot Zei & Monchamot 1986; Carone 1997; Bianucci et al. 2003).

New specimens referred to *Metaxytherium medium*, collected in 1965 by Dr. Angelo Varola from Tortonian sediments of the Arenaria di Ponsano Formation near Volterra (Tuscany, Central Italy) (Fig. 1), are described in this paper.

The sirenian remains examined here belong to an undescribed collection of marine mammals, containing also odontocete and mysticete specimens kept in the Museo di Storia Naturale e del Territorio (MSNT) of the University of Pisa. Anatomical terminology follows Domning (1988).

Systematic description.Class **Mammalia** Linnaeus, 1758Order **Sirenia** Illiger, 1811Family **Dugongidae** Gray, 1821Subfamily **Halitheriinae** (Carus, 1868) Abel, 1913Genus ***Metaxytherium*** de Christol, 1840***Metaxytherium medium*** (Desmarest, 1822) Hooijer, 1952

(Figs. 2-5; Pls. 1, 2)

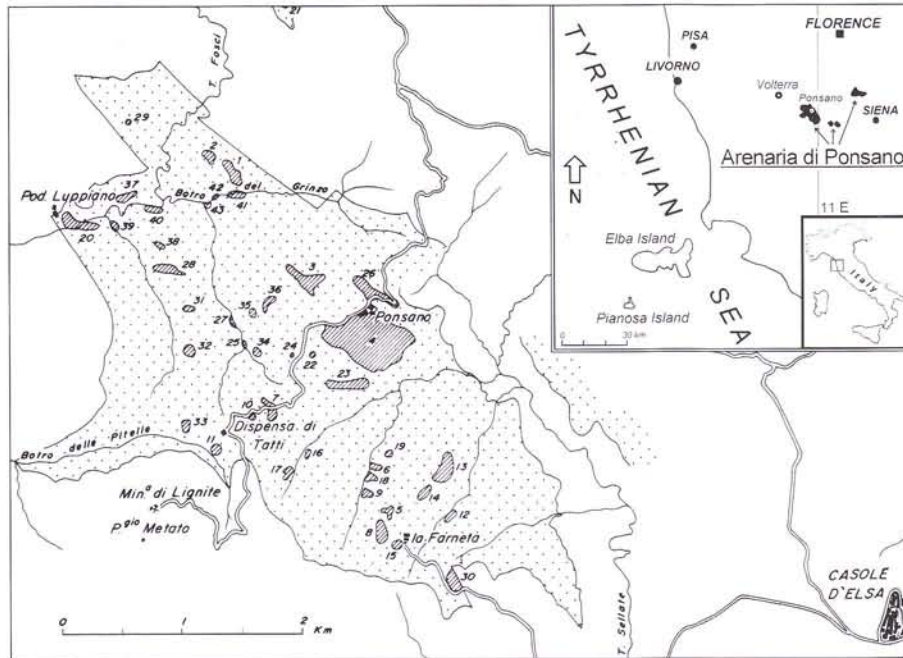


Fig. 1 - Geographic location of the Arenaria di Ponsano Formation where the sirenian specimens examined in this paper were collected. The numbers refer to the fossiliferous outcrops (modified from Menesini 1967a).

Referred specimens. Several fragments belonging to at least three animals; among these the most significant parts are two skull roofs (MSNT I10140; MSNT I10095), one right zygomatic process of the squamosal and the associated jugal (MSNT 10068), right (MSNT I10141) and left (MSNT I10138) humeri probably of the same animal, a fragment of a right scapula (MSNT I10148), and some incomplete vertebrae and ribs.

Description

Frontal - The dorsal surface of the preserved posterior portion of the frontals of MSNT I10095 is flat and narrow and it is laterally delimited by rounded and slightly laterally concave temporal crests (Fig. 2; Pl. 1, fig. 2). The crests are separated by a distance of at least 27 mm.

Parietal - Temporal crests on the parietal roof of MSNT I10140 correspond to the "type E" morphology described by Domning (1988) for *Metaxytherium floridanum* (Fig. 3; Pl. 1, fig. 1). They are prominent and lyri-form and they come closest to the midline (17 mm) about

55 mm anterior to the nuchal crest. The median valley between these temporal crests is concave and about 14 mm deep. In MSNT 10095, the temporal crests are less prominent and there is not a deep median valley. The crests of this specimen are of the "type A" of Domning (1988). The parietal roofs of the Ponsano specimens are narrower than in any of the specimens of *M. floridanum*.

Internally, the parietal of MSNT I10140 exhibits an evident bony falx cerebri that runs anteroposteriorly from the frontoparietal suture to the internal occipital protuberance.

Supraoccipital - This bone is entirely preserved in MSNT I10140 and partially in MSNT I10095. In lateral view, the supraoccipital of MSNT I10140 forms an angle of about 125° with the parietal roof. The nuchal crest is relatively rounded and the external occipital protuberance rises above plane of parietal roof, and below it, the median ridge separates two evident rugose semispinalis muscle insertions. The supraoccipital-exoccipital sutures form an angle of about 145°.

Jugal - The jugal (MSNT I10148) is laterally broad and triangular, and it has straight posteroventral and anteroventral margins forming an angle of about 100° (Fig. 4; Pl. 1, fig. 3). The ventral tip of the jugal is located under the orbit.

Squamosal - Only an anterior fragment of a left zygomatic process is preserved (MSNT 10068). The squamosal-jugal suture is straight.

Scapula - A fragment of a right scapula (MSNT I10148) is preserved (Pl. 2, fig. 6). The glenoid fossa is moderately concave and oval in shape; its greatest diameter is 48 mm and the smaller is 36 mm.

Humerus - The epiphyses of the two humeri are worn and the tubercles, heads and trochleae are not well

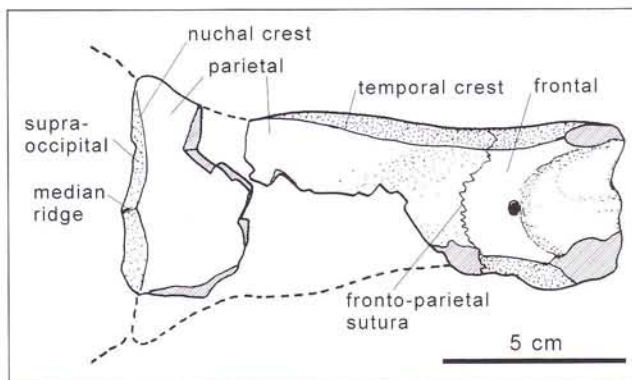


Fig. 2 - Skull roof (MSNT I10095) in dorsal view of *Metaxytherium medium* from the Arenaria di Ponsano Formation.

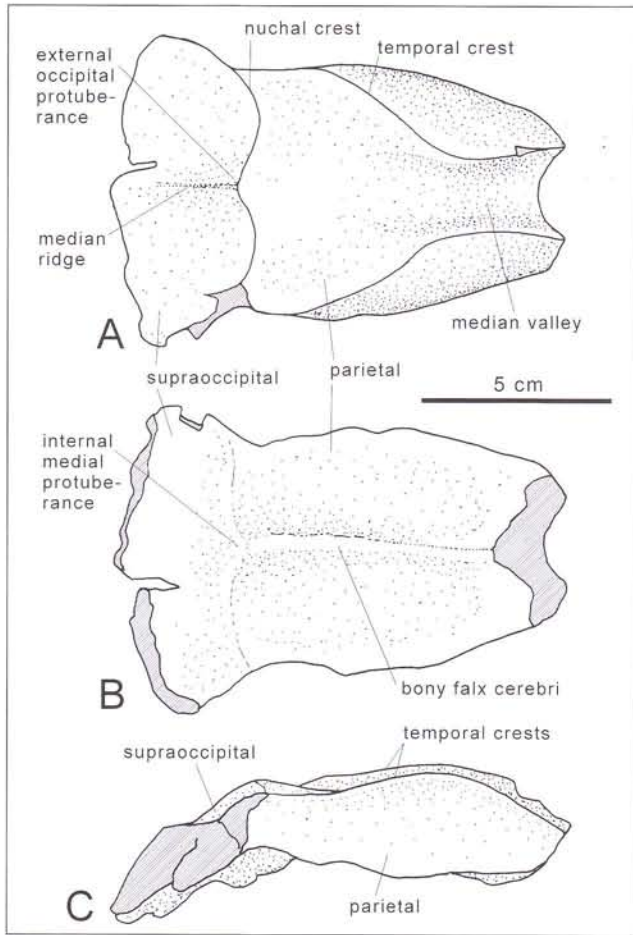


Fig. 3 - Skull roof (MSNT I10140) of *Metaxytherium medium* from the Arenaria di Ponsano Formation. A, dorsal view; B, ventral view; C, lateral view.

preserved (Fig. 5; Pl. 2, figs. 1, 2). The strong right humerus (MSNT I10141) is more than 205 mm long at it exhibits a prominent and elongated deltoid crest. Well-developed tubercles are separated by a deep and wide bicipital groove. The head apparently is relatively small (but it is worn) and hemispherical. The trochlea is an-

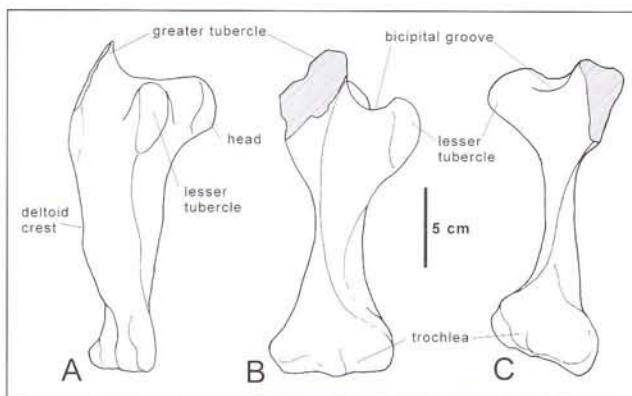


Fig. 5 - Humeri of *Metaxytherium medium* from the Arenaria di Ponsano Formation. A, right humerus (MSNT I10141) in medial view; B, the same in anterior view; C, left humerus (MSNT I10138) in anterior view.

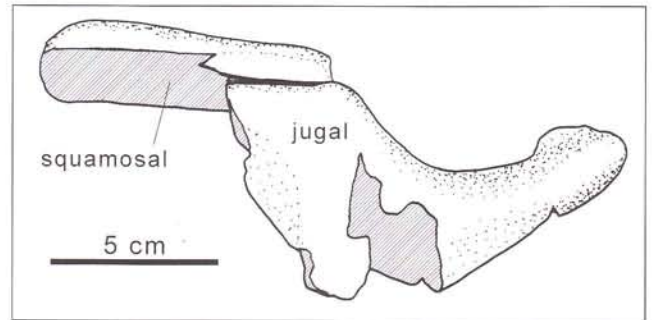


Fig. 4 - Portion of right squamosal and jugal (MSNT I0068) in lateral view of *Metaxytherium medium* from the Arenaria di Ponsano Formation.

teroposteriorly flattened and the oleocranon fossa is wide. The left humerus is almost as anteroposteriorly elongated as the right, but its diaphysis is unusually thin and apparently lacks the deltoid crest. This bone might have suffered a pathological malformation (Fornaciari, pers. com.).

Vertebrae - Only vertebral fragments are known. A small portion of an atlas, a corpus of a cervical vertebra, and some incomplete neural arches and transverse processes of thoracic vertebrae are preserved.

Ribs - Several fragments and some almost complete ribs are preserved (Pl. 2, figs. 3-5).

Comparison. The fragmentary sirenian remains from the Arenaria di Ponsano are referable to *Metaxytherium medium* because:

- some well-preserved skeletal elements, such as the skull roof and the humerus, show close resemblances to those of *Metaxytherium*;
- temporal crests of "type E" as in MSNT I10140, and a very narrow parietal roof as in MSNT 10095, are most frequent in *M. medium*, among the species of this genus;
- *M. medium* is the only known sirenian species in the Late Miocene of the Mediterranean and eastern North Atlantic.

Age and stratigraphic occurrence. All specimens were collected in the Arenaria di Ponsano, a Miocene formation that consists of sandstone and marls outcropping in three distinct areas between Volterra and Siena towns (Tuscany, Italy) (Fig. 1). The main outcrop is in the area of Ponsano farm, about 10 km southeastern of Volterra. The sirenian fossils here examined were collected in this Ponsano area where a succession over 500 m thick of sandy sediments representing the upper portion of the formation are exposed (Giannini & Tongiorgi 1959; Mazzanti et al. 1981; Foresi et al. 1997).

These sediments were attributed by Foresi et al. (1997) to the *Neogloboquadrina acostaensis* Zone. This zone is referable to the early Tortonian (Late Miocene) and to an age interval between about 10.5 and 8.14 MA.

In the 43 recognized fossiliferous outcrops of this area were collected also fishes (Menesini 1967a), mollusks (Tavani & Tongiorgi 1963), echinoids (Menesini 1967b), cirripeds (Menesini 1963, 1966), foraminifers (Bartolani 1966; Foresi et al. 1997) and calcareous nannoplankton (Bartolani & Pirini 1969).

Discussion and conclusions.

Specimens referred to *Metaxytherium* and here described represent the first Miocene sirenian occurrence from Tuscany and they confirm the wide diffusion of this genus in the Mediterranean area during the Miocene.

From a paleoecological point of view, the occurrence of sirenian remains contributes for a better definition of the environment already indicated by other fossil records.

Particularly, the ichthyofauna indicates a subtropical and shallow marine environment with possible estuarine conditions (Menesini 1967a).

The analysis of the foraminifers indicates deposition in the circalitoral-infralitoral zones and, relatively

to the upper part of the succession, a deltaic condition (Foresi et al. 1987).

These data are confirmed by the sirenians, considering that, as pointed out by Domning (2001) and Domning & Pervesler (2001), all fossil dugongids apparently have been exclusively marine shallow-water and (except for hydrodamalines) tropical.

Besides, the presence of sirenians indicates that the low sea bottom was at least partially covered by seagrass meadows. Infact Domning (2001) hypothesized for *Metaxytherium* spp. a diet based on leaves and rhizomes of small and mid-sized seagrasses in water deeper than 1 meter.

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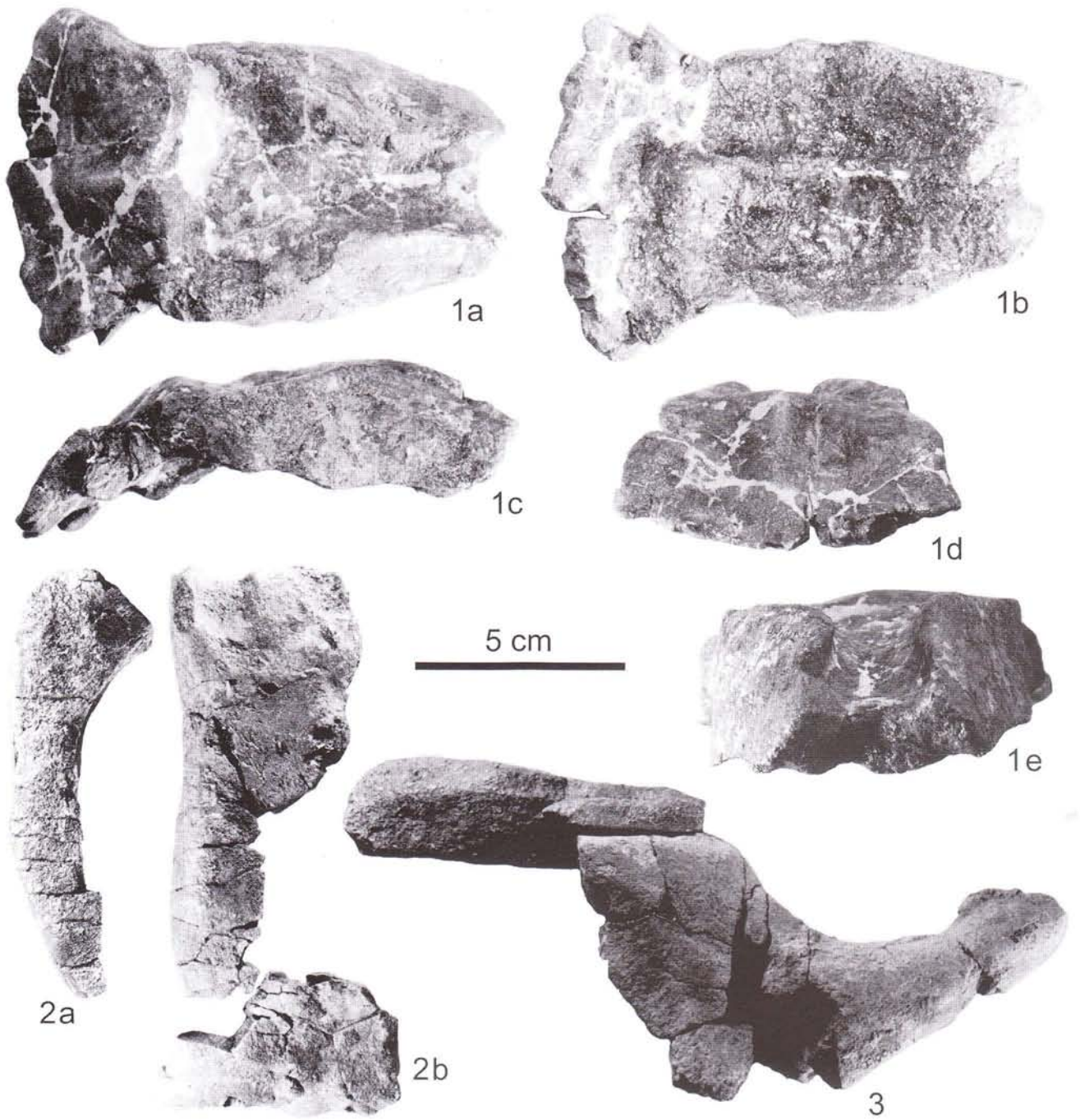


PLATE 1

Metaxytherium medium from the Arenaria di Ponsano Formation. 1, skull roof (MSNT I10140) in dorsal (a), ventral (b), lateral (c) and posterior (d) views; 2, skull roof (MSNT I10095) in lateral (a) and dorsal (b) views; 3, portion of right squamosal and jugal (MSNT I10068) in lateral view.

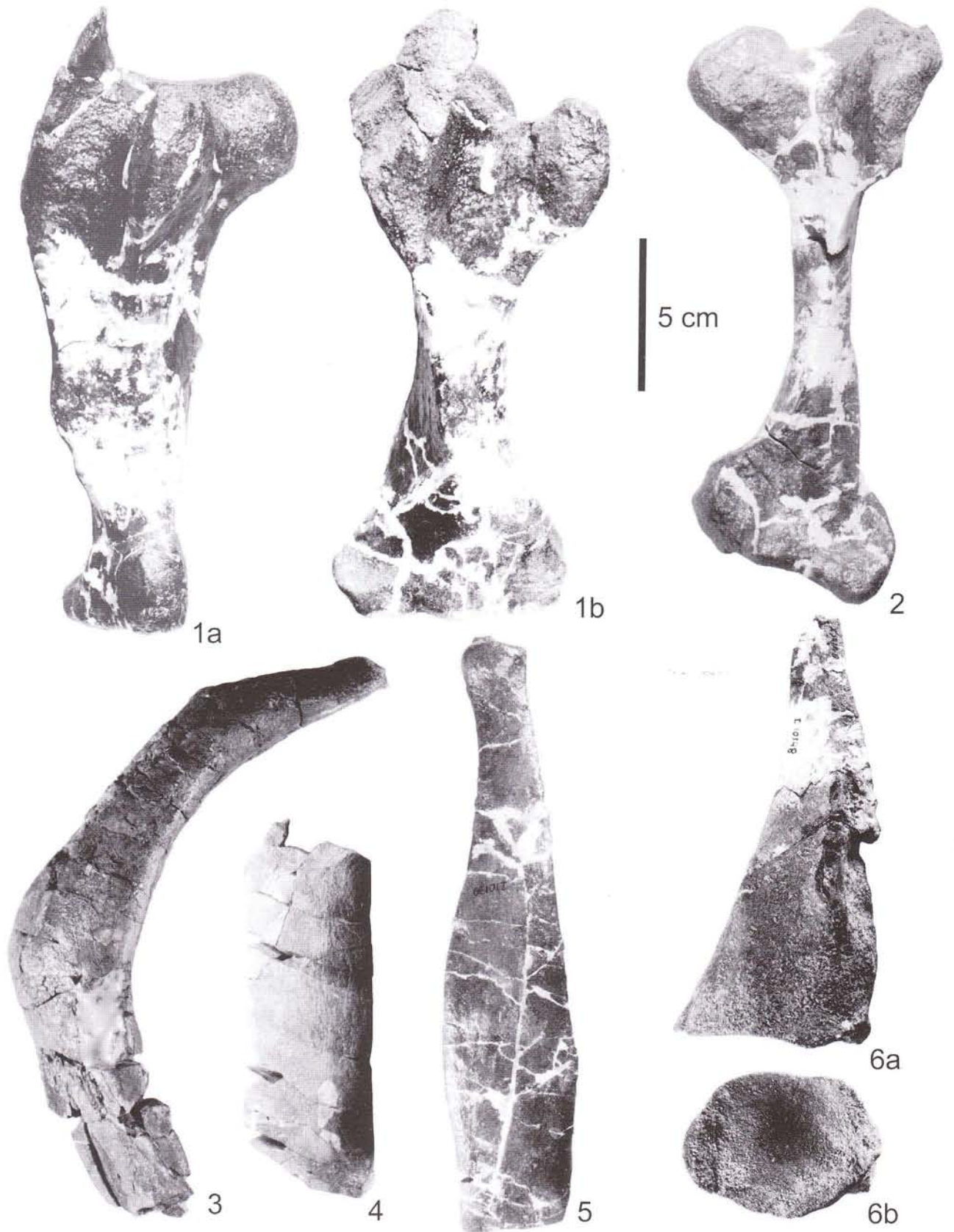


PLATE 2

Metaxytherium medium from the Arenaria di Ponsano Formation. 1, right humerus (MSNT I10141) in medial (a) and anterior (b) views; 2, left humerus (MSNT I10138) in anterior view; 3, 4, 5, ribs; 6, fragment of right scapula (MSNT I10148) in lateral view (a) and distal view of glenoid fossa (b).

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