

Notes on the Cretaceous invertebrate faunas of Portugal I: a new species of *Anadromus* (Mollusca, Gastropoda) from the Campanian-Maastrichtian of Taveiro (Coimbra, West central Portugal)

Pedro Callapez

Departamento de Ciências da Terra, Universidade de Coimbra, 3000-272 Coimbra, Portugal. callapez@ci.uc.pt.

Abstract

Key-words: *Anadromus*; Gastropoda; Campanian-Maastrichtian; Cretaceous; Taveiro; Portugal.

A new species of terrestrial gastropod – *Anadromus penai* sp. nov. (Fam. Anadromidae) – is described from a set of composite moulds collected in reddish silts and clays of Campanian-Maastrichtian age, found in the lower part of the Taveiro Formation (Taveiro, Coimbra, West Central Portugal). The known occurrences of this new species are restricted to the type locality. The main differences from other contemporaneous Anadromidae are the profuse spiral sculpture of the body-whorl, with 20-22 sub-equal, close, and regular ribs.

Resumo

Palavras-chave: *Anadromus*; Gastropoda; Campaniano-Maastrichtiano; Cretácico; Taveiro; Portugal.

Procede-se à descrição sistemática de uma nova espécie de gastrópode terrestre – *Anadromus penai* sp. nov. (Fam. Anadromidae), a partir de moldes recolhidos em níveis silto-argilosos vermelhos, de idade campaniana-maastrichtiana, pertencentes à parte inferior da Formação das Areias e Argilas de Taveiro (Taveiro, Coimbra). A repartição desta nova espécie cinge-se por ora à localidade tipo. Difere significativamente das restantes espécies de *Anadromus* portuguesas, dada a sua ornamentação muito característica: cerca de 20-22 cordões espirais apertados, regulares e subiguais, dispostos ao longo da volta do corpo.

Introduction

The occurrence of fossil faunas with abundant and well-preserved shells of terrestrial gastropods is always scarce and of exceptional interest, when Palaeogene, upper Cretaceous or older continental units are concerned. The most remarkable examples known in Portugal have been sampled from volcano-sedimentary tufts interbedded with basaltic flows of the Volcanic Complex of Lisbon (Cotter, 1901; Roman, 1917; Choffat, 1950; Zbyszewski & Jesus, 1954; Zbyszewski, 1963). These rich and nicely-preserved faunas are a remarkable evidence of the primitive Stylommatophora that inhabited the emerged lands of Western Europe, during Late Mesozoic times.

An additional assemblage of land snails with exceptional specimens, analogous to the faunas of the Volcanic

Complex of Lisbon, was found some years ago, on the upper part of the promontory of Nazaré (littoral of West Central Portugal). This assemblage was sampled from conglomerates and red clays of Campanian-Maastrichtian age (Sitio da Nazaré Formation, Antunes, 1979), and is currently in course of study.

Also recently, P. Callapez (2002) described a new fauna of small freshwater gastropods from the Late Palaeocene-Early Eocene of the Silveirinha Formation (Figueira da Foz), but with a taxonomic structure rather different from the assemblages mentioned above.

Both fossil faunas, of Lisbon and Nazaré, have in common the frequency of *Anadromus ribeiroi* (Tournouer, 1879), a large terrestrial species with a solid and conical-ovate shell, which is a typical member of the Late Cretaceous family Anadromidae. A few other examples related

with the genus *Anadromus* have also been recorded from continental sediments exposed in the regions of Aveiro-Viso (Choffat, 1900, 1902) and Baixo Mondego (Antunes & Pais 1978). As a rule, these records are limited to poorly preserved and distorted internal moulds of difficult classification. Nevertheless, the stratigraphic range of these moulds was used for several times as a complement to the vertebrate and palaeobotanic data, suggesting a Late Campanian or Maastrichtian age.

The present paper intends to confirm the occurrence of *Anadromus* in the region of Baixo Mondego, after the description of a new species found in siliciclastic sediments of the clay-pits of Taveiro, near Coimbra. The type specimens are a set of composite moulds already mentioned as "*Bulimus gaudryi*" by M. Antunes & J. Pais (1978).

Geologic setting

The Late Cretaceous sedimentary record of the Baixo Mondego region ends with a succession of continental yellow sandstones and reddish clays, usually designated as Taveiro Formation (=Areias e Argilas de Taveiro, Rocha *et al.*, 1981; Soares *et al.*, 1982; Reis, 1981) (fig.1). With a maximum thickness of nearly 200 meters, this succession rests unconformably on upper Cretaceous alluvial and marine sandstones (Oia Formation and Furadouro Formation, Barbosa *et al.*, 1988), as well on Cenomanian and Turonian platform carbonates (Costa d'Arnes Formation, Rocha *et al.*, 1981; = Carbonate Formation, Soares, 1966, 1980).

The Taveiro Formation has been the bulk of numerous studies on palaeontology, with emphasis in the description of abundant faunas of fossil vertebrates (Antunes, 1979; Antunes & Pais, 1978; Antunes *et al.*, 1986; Antunes & Broin, 1988). The stratigraphic setting and the obvious importance of the unit in the Late Cretaceous paleogeographic evolution of the West Portuguese Margin, northwards the Nazaré-Leiria-Pombal fault system, were also analysed by A. Soares (1966), M. Antunes & J. Pais (1978), A. Soares & R. Reis (1980), R. Reis (1981, 1998, 2000), R. Reis & R. Meyer (1982), P. Cunha (1992), and

P. Cunha & R. Reis (1992, 1995). The last of these studies pointed to the existence of a large alluvial plain, with a meandering system oriented northwestwards and controlled by tectonic reactivations and uplifts along the "Nazaré fault" and related diapiric axis.

The internal moulds of *Anadromus* were found in the lower part of the Taveiro Formation, in layers of reddish carbonated silts and clays exposed below a conglomeratic bed with vertebrate bones (Antunes & Pais 1978). The alluvial plain palaeoenvironments subjacent to these sediments are congruent with the ecologic requirements presumed to Anadromidae: a family of archaic land snails, with species adapted to the life in emerged areas situated near the proximity of freshwater environments.

Systematic palaeontology

The next systematic description follows A. Zilch (1959-60), with reformulations on supra-family classification after S. Tillier (1989).

- Phylum MOLLUSCA Linné, 1758
 - Class GASTROPODA Cuvier, 1797
 - Subclass PULMONATA Cuvier, 1817
 - Order STYLOMMATOPHORA Schmidt, 1856
 - Suborder BRACHYNEPHRA Tillier, 1989
 - Superfamily Clausiliodea Mörch, 1864
 - Family Anadromidae Zilch, 1959
 - Genus *Anadromus* Sandberger, 1870
- [Type species: *Anadromus proboscideus* (Matheron, 1832)]

Anadromus penai sp. nov.
(Plate 1, figs. 1a-b, 2a-c, 3a-b)

Type material: Four composite moulds with ornamentation and spires partly preserved.

Type locality: The type specimens were collected in the slopes of a clay-pit exploited near the village of Taveiro, in the southern suburbs of Coimbra (West Central Portugal).

Repository of specimens: The type specimens are housed in the collections of palaeontology of the Earth Sciences Department of the New University of Lisbon (Departamento de Ciências da Terra da Universidade Nova de Lisboa).

Etymology: The specific name is an homage to Prof. R. Pena dos Reis, author of significant contributions on the stratigraphy and sedimentology of the Late Cretaceous and Cenozoic formations of West Central Portugal.

Diagnosis: Medium sized shell, globose, ovoid, with a large and convex body-whorl and a short spire reduced to 3 1/2-4 curved whorls. Aperture large, inversely auriculate. Sculpture dominated by a pattern of numerous and delicate spiral ribs, close and sub-equal.

Dimensions: Diameter 32 mm; Height 30 mm.

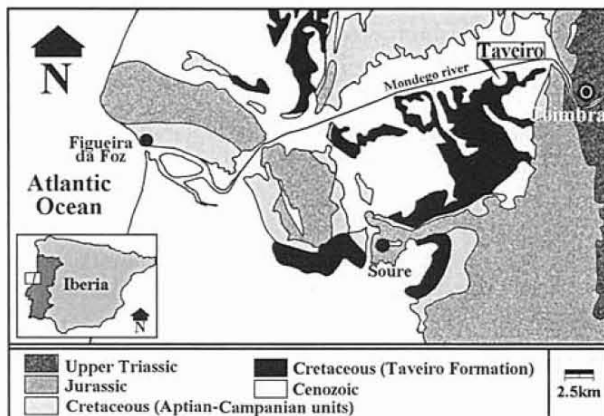


Figure 1 – Simplified map of Baixo Mondego with indication of the Campanian-Maastrichtian clays and sandstones of Taveiro Formation, as well the type locality for *Anadromus penai*.

Discussion: Both the holotype and the paratypes are composite moulds with the sculpture partly preserved. The estimated number of spiral ribs found in the body whorl of the holotype is of 22. The same style of ribbing is also perceptible in the 3 figured paratypes.

The sculpture of these specimens seems to be considerably distinct, if compared with the remaining species of Anadromidae already known in the Campanian-Maastrichtian of Portugal. The first of these species, *Anadromus ribeiroi* (Tournouer, 1879), is well-known after a large number of shells assembled from the volcanic tufts of Lisbon, since the second half of the XIX century. In what refers to *A. penai* the shells have a simpler sculpture, reduced to axial growth-lines.

In 1902, P. Choffat described a second species of Anadromidae, after a set of internal moulds collected in

the Campanian-Maastrichtian of Beira Litoral, near the locality of Santo-André, Vagos. This species - *A. gaudryi* (Choffat, 1902) - was also identified in the suburbs of Aveiro (clay-pits of Cerâmica Vouga factory), and connoted with the moulds of Taveiro (Antunes & Broin, 1988). However, the syntypes figured by P. Choffat have a more elongated form and are devoid of radial sculpture.

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Plate 1

1a-b – *Anadromus penai* sp. nov. (x 2,5). Holotype.

2a-c – *Anadromus penai* sp. nov. (x 2,5). Paratype.

3a-b – *Anadromus penai* sp. nov. (x 2,5). Paratype.

PLATE 1

