



NEW FISH RECORDS FROM THE TURONIAN OF THE SERGIPE BASIN, NORTHEASTERN BRAZIL ¹

(With 7 figures)

VALÉRIA GALLO ^{2, 3}
HILDA MARIA ANDRADE DA SILVA ²
EDILMA DE JESUS ANDRADE ⁴

ABSTRACT: Recent fieldwork carried out in two quarries from the Cotinguiba Formation, Sergipe Basin, has yielded three new fish specimens. The Sergipe Basin is located in the coastal offshore portion of the State of Sergipe, northeastern Brazil. The basin contains one of the most extensive upper Mesozoic rock successions among the northern South Atlantic basins, mainly the well-represented Cretaceous carbonate succession. It includes the Cotinguiba Formation, which ranges from Cenomanian to Coniacian. In this paper, we reported new occurrences of fishes represented by an indeterminate teleostean from the lower Turonian and an amiid and a dercetid from the middle Turonian. These new records widen the paleogeographical distribution of the Amiidae and Dercetidae in the Turonian.

Key words: Amiidae. Dercetidae. Teleostei *incertae sedis*. Turonian. Sergipe Basin.

RESUMO: Novos registros de peixes do Turoniano da Bacia de Sergipe, nordeste do Brasil.

Recentes trabalhos de campo realizados em dois afloramentos da Formação Cotinguiba, Bacia de Sergipe, renderam três novos espécimes de peixes. A Bacia de Sergipe está localizada na costa do Estado de Sergipe, nordeste do Brasil. A bacia contém uma das mais extensas sucessões rochosas do Mesozóico Superior dentre as bacias do norte do Atlântico Sul, principalmente, a bem representada sucessão carbonática do Cretáceo. Ela inclui a Formação Cotinguiba, que se estende do Cenomaniano ao Coniaciano. Neste trabalho, nós registramos novas ocorrências de peixes representadas por um teleosteo indeterminado do Turoniano Inferior e um amiídeo e um dercetídeo do Turoniano Médio. Esses novos registros ampliam a distribuição paleogeográfica dos Amiidae e Dercetidae no Turoniano.

Palavras-chave: Amiidae. Dercetidae. Teleostei *incertae sedis*. Turoniano. Bacia de Sergipe.

INTRODUCTION

The marine Cretaceous rocks exposed in the Sergipe Basin contain a rich macroinvertebrate fauna dominated by molluscs. Ammonites and bivalves (*e.g.*, HESSEL, 1988; BENGTON, 1996; ANDRADE *et al.*, 2004) are generally the most common and diverse groups. Fish records are relatively rare and represented by ptychodontids (CARVALHO & GALLO, 2002), pycnodonts (*e.g.*, COPE, 1886; WOODWARD, 1907; SILVA SANTOS & FIGUEIREDO, 1988; HOOKS *et al.*, 1999; MACHADO, 2005), and enchodontids (*e.g.*, SCHAEFFER, 1947; SILVA SANTOS & SALGADO, 1969; COELHO, 2004; GALLO & COELHO, 2005). Here we describe three new fish specimens from the Turonian (Upper Cretaceous) of the Sergipe

Basin, northeastern Brazil. We recognized a probable amiid, a dercetid, and an indetermined teleostean, which are reported for the first time from the Cotinguiba Formation.

GEOGRAPHICAL AND GEOLOGICAL SETTING

The Sergipe Basin is located in the coastal and contiguous offshore part of the State of Sergipe in northeastern Brazil (Fig.1). The onshore portion of the basin occupies a narrow coastal strip, approximately 15 to 50km wide and 200km long. The offshore portion extends to water depths greater than 2,000m. The paleogeographical setting of the Sergipe Basin during the late Early and Late

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² Universidade do Estado do Rio de Janeiro, Instituto de Biologia, Departamento de Zoologia, Laboratório de Sistemática e Biogeografia. Rua São Francisco Xavier, 524, Maracanã, 20550-900, Rio de Janeiro, RJ, Brazil.

³ E-mail: gallo@uerj.br; hmasilva@yahoo.com.br.

⁴ Universidade Federal da Bahia, Programa de Pós-Graduação em Geociências. Rua Caetano Moura, 123, Federação, 40210-340, Salvador, BA, Brazil. E-mail: edilma@phoenix.org.br.

Cretaceous is a direct consequence of the strong tectonic activity that affected the area since the beginning of the rifting between South America and Africa in the Early Cretaceous. Structurally the basin consists of a series of half-grabens with a regional dip averaging 10-15° to the southeast, resulting from NE-SW-trending normal faults (KOUTSOUKOS *et al.*, 1993).

The basin contains one of the most extensive upper Mesozoic rock successions among the northern South Atlantic basins, a fact that is further enhanced by the existence of numerous outcrops. In particular, it contains the well-represented Cretaceous carbonate succession, spanning the Aptian to Coniacian interval (SOUZA-LIMA *et al.*, 2002). The geological evolution and the development of the marine Cretaceous of the Sergipe Basin have been discussed by several authors. More detailed information can be found in OJEDA & FUGITA (1976), OJEDA (1982), BENGTON (1983), CHANG *et al.* (1988), LANA (1990), FEIJÓ (1994), and SOUZA-LIMA *et al.* (2002), among others. The marine Cretaceous succession consists of the carbonate

Riachuelo (Aptian-Albian) and Cotinguiba (Cenomanian-Coniacian) formations and the clastic Calumbi and Marituba formations. The material described herein derives from the Cotinguiba Formation, which was deposited in neritic to upper bathyal environments of a carbonate ramp.

MATERIAL AND METHODS

The material for this study was collected in the marine limestones from two localities (Fig.2) of the Cotinguiba Formation, in the Sergipe Basin, northeastern Brazil. It comprises three specimens: an indetermined teleostean was found in the lower Turonian of the locality Retiro 26; an amiid came from the middle Turonian of the locality Retiro 26 and a dercetid was collected from the middle Turonian of the locality Muçuca 5. The locality Muçuca 5 was described by BENGTON (1983, Appendix 1) and Retiro 26 by HESSEL (1988) and ANDRADE (2005).

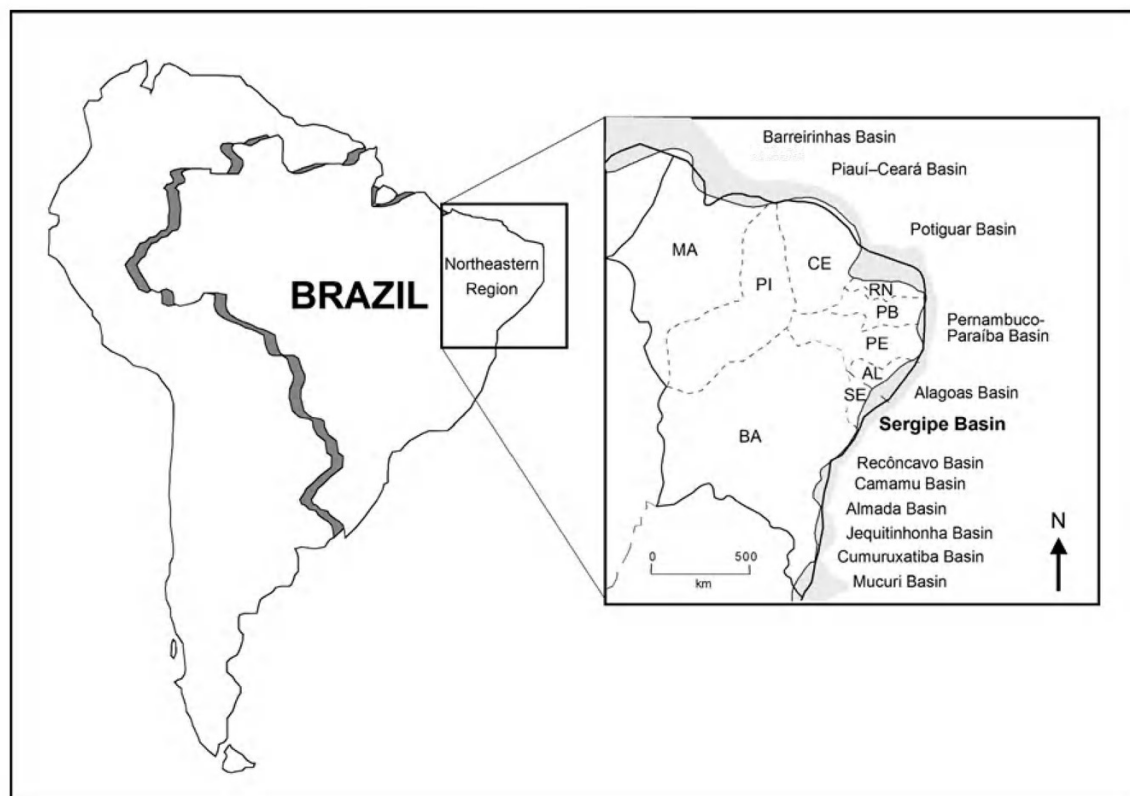


Fig. 1- Location map of the Sergipe Basin and others continental margin basins (dotted) of northeastern Brazil. Abbreviations of state names: (AL) Alagoas, (BA) Bahia, (CE) Ceará, (MA) Maranhão, (PB) Paraíba, (PE) Pernambuco, (PI) Piauí, (RN) Rio Grande do Norte, (SE) Sergipe.

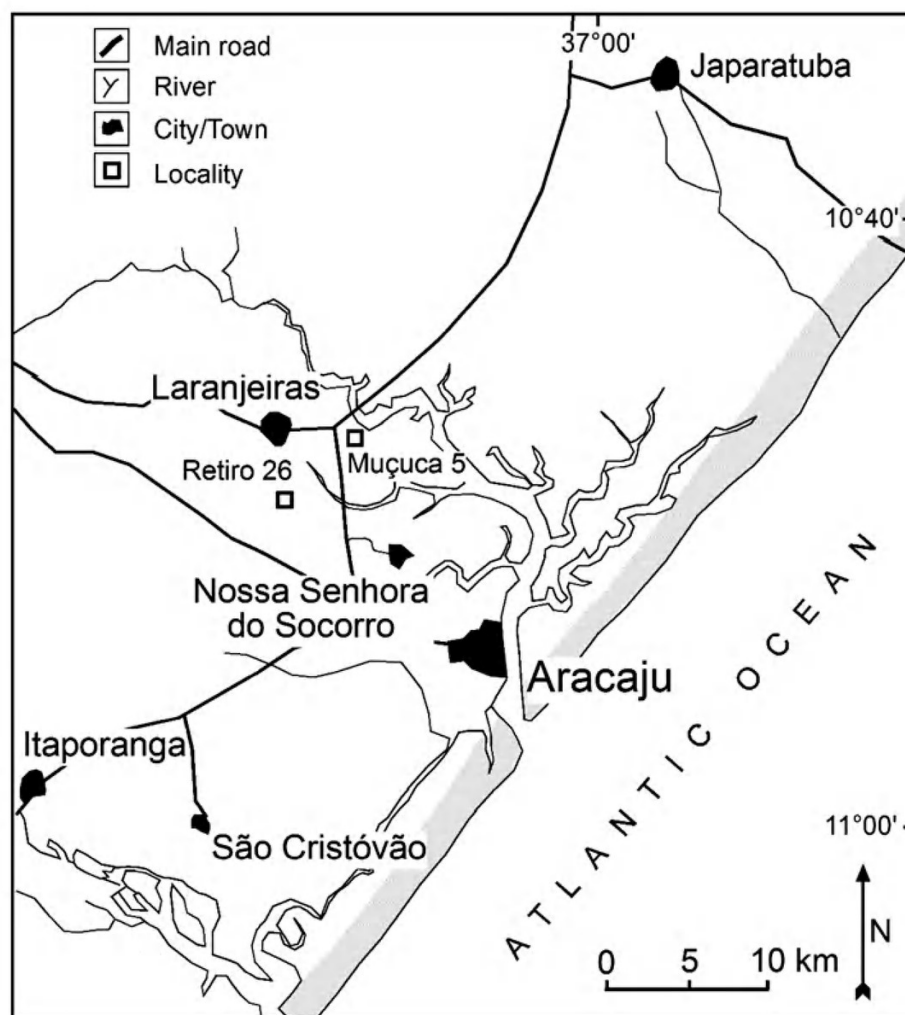


Fig.2- Simplified map of the onshore area of the Sergipe Basin, with localities Retiro 26 and Muçuca 5 (modified after SEEING & BENGTON, 2003).

The specimens are housed at the paleontological collection of the Museu Nacional, Rio de Janeiro, Brazil, under the registration numbers MN 7028-V, MN 7029-V, and MN 7030-V.

The specimens are only mechanically prepared with the aid of steel and carbide needles. Methacrylate resin (Paraloid B-67) was used to consolidate and to protect the bones. Ethyl acetate was dropped to emphasize anatomical details during the observation under a Leica Zoom 2000 stereomicroscope.

RESULTS

Paleoichthyofauna

- 1) Actinopterygii
 - Neopterygii
 - Amiiformes
 - Amiidae

The specimen MN 7028-V is represented by part of the vertebral column showing the boundary between abdominal and caudal regions. The preservation does not allow a clear observation of diplospondyly. The centra are large, as long as deep, smooth-sided, and show a slight lateral depression. The pleural ribs are long and well-ossified bones that are abruptly truncated at their distal ends. They articulate directly on the side of the centra. Parapophyses are not verified. The neural spines are very large but not very elongate.

The haemal spines are elongate and stout; the haemal arches are fused to their respective centra. Intermuscular bones are lacking as it does with all amiids (Fig.3A).

Due to the incompleteness of the specimen, it can be only tentatively assigned to the Amiidae, possibly to Vidalamiini (*sensu* GRANDE & BEMIS, 1998) (Fig.3B).

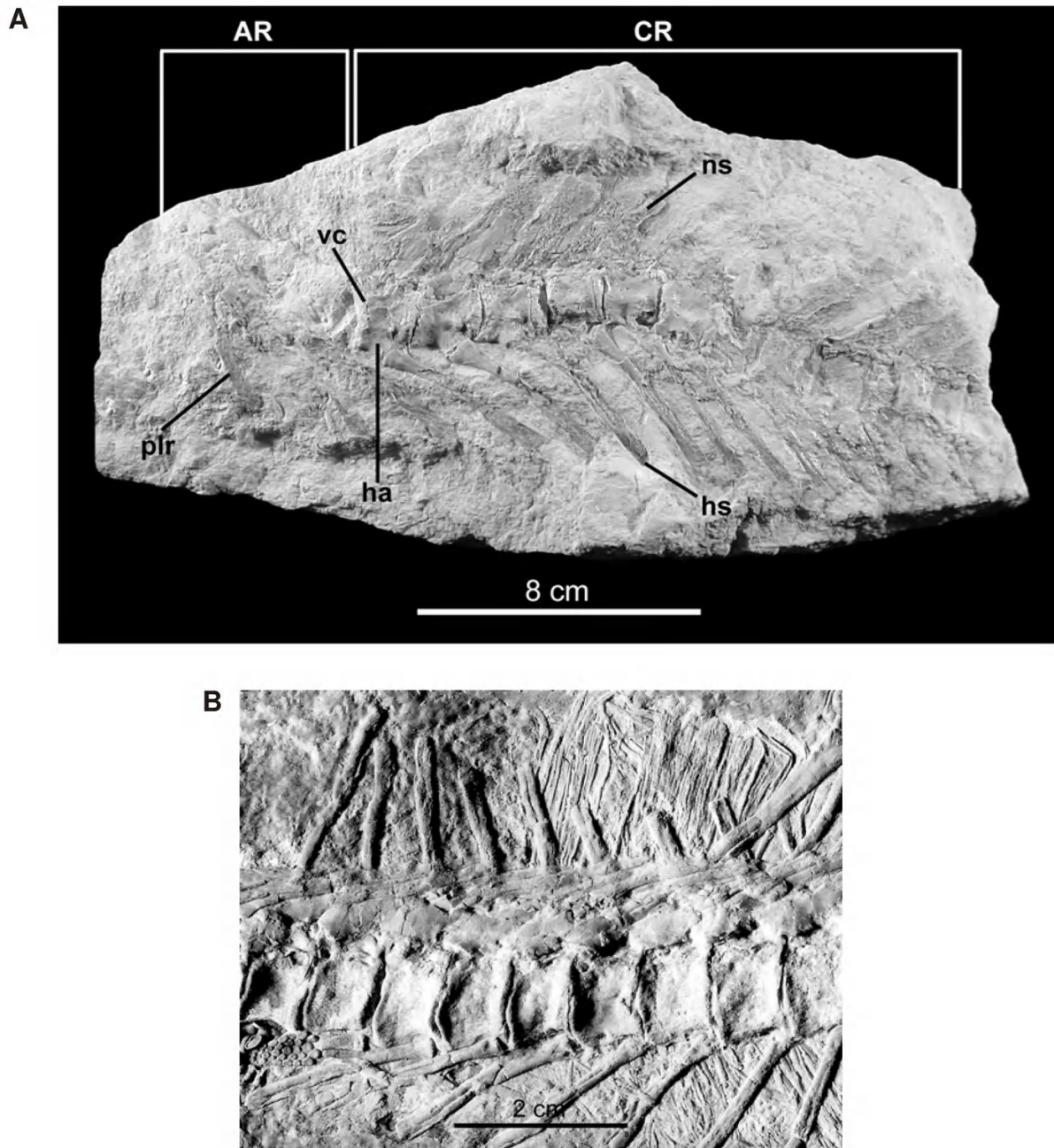


Fig.3- Portion of the vertebral column of Vidalamiini: (A) specimen from the Cotinguiba Formation (MN 7028-V), in left lateral view; (B) the Vidalamiini *Pachyamia mexicana*, in right lateral view (modified after GRANDE & BEMIS, 1998). Anatomical abbreviations: (AR) abdominal region; (CR) caudal region; (ha) haemal arch; (hs) haemal spine; (ns) neural spine; (plr) pleural rib; (vc) vertebral centrum.

2) Teleostei
 Neoteleostei
 Aulopiformes
 Dercetidae

The material MN 7029-V consists of a set of 11 vertebrae from the abdominal and caudal regions. The precaudal vertebrae are strong, longer than deep, medially constricted, with neural arch markedly curved. They bear two pairs of transverse processes per centrum. The anterior processes incline slightly forwards, whereas the posterior ones incline slightly toward the posterior region (Fig.4). The caudal vertebrae are deeper than long and medially constricted. The entire length of the dorsal surface of all centra is occupied by an elongated neural arch; the neural spine is short and inclined; the haemal spine is long and posteriorly projected (Figs.5-6).

Similar vertebrae are found in certain Dercetidae, such as *Rhynchodercetis gortanii* (see GOODY, 1969).

3) Teleostei indetermined

The material (MN 7030-V) is represented by part of the opercle and cleithrum and a large part of the trunk. The caudal fin is not preserved. The body is covered by thin cycloid scales, apparently cordiform, strongly imbricated. Several concentric circuli are observed on their surface but radii seem to be absent. The scales of the lateral line are easily discernible by

bearing tubes of the sensory canal (Fig.7).

The specimen is provisorily identified as a Teleostei *incertae sedis*.

DISCUSSION

Considering the amiid, the specimen was compared with literature data (*e.g.*, CHALIFA & TCHERNOV, 1982; GRANDE & BEMIS, 1998), which allow to tentatively assign it to the Vidalamiini. The similar features are (Fig.3): presence of smooth centra and short and well-ossified ribs abruptly truncated at their distal ends and the pattern of attachment of the haemal spines (autogenous). According to GRANDE & BEMIS (1998), the peculiar truncation of the ribs is a diagnostic character of Vidalamiini (*Vidalamia* + *Pachyamia*). So far as known, the genus *Vidalamia* occurs from the Berriasian to the Hauterivian of Spain (WENZ & POYATO-ARIZA, 1994; GRANDE & BEMIS, 1998). Hitherto, *Pachyamia* was found in the marine Cenomanian of Israel (CHALIFA & TCHERNOV, 1982) and ?late Albian of Mexico (GRANDE & BEMIS, 1998).

The specimen MN 7029-V (Figs.5A-6A) shows a very reduced neural spine, which is proposed as a synapomorphy of the family Dercetidae by GALLO *et al.* (2005). Representatives of this family are found in the Cenomanian to the Danian deposits of Tethyan Europe, Asia, Africa, Central and South America.

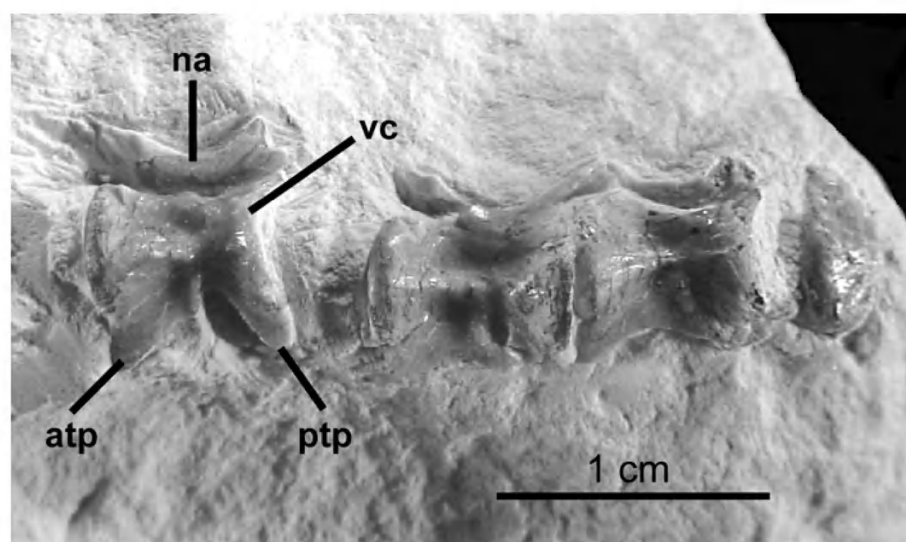


Fig.4- Precaudal vertebrae of the Dercetidae from the Cotinguiba Formation (MN 7029-V), in left lateral view. Anatomical abbreviations: (atp) anterior transverse process; (na) neural arch; (ptp) posterior transverse process; (vc) vertebral centrum.

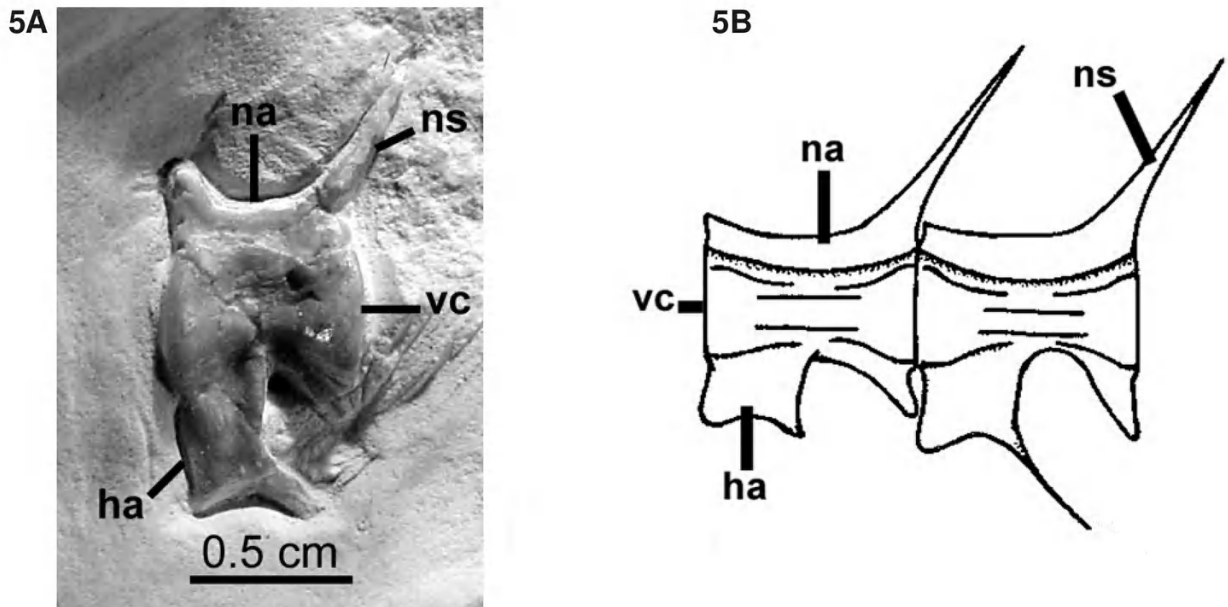


Fig.5- Anteriormost caudal vertebra of the Dercetidae, in left lateral view: (A) specimen from the Cotinguiba Formation (MN 7029-V); (B) first and second caudal vertebrae of *Rhynchodercetis gortanii* (modified after GOODY, 1969). Original drawing without scale. Anatomical abbreviations: (ha) haemal arch; (na) neural arch; (ns) neural spine; (vc) vertebral centrum.

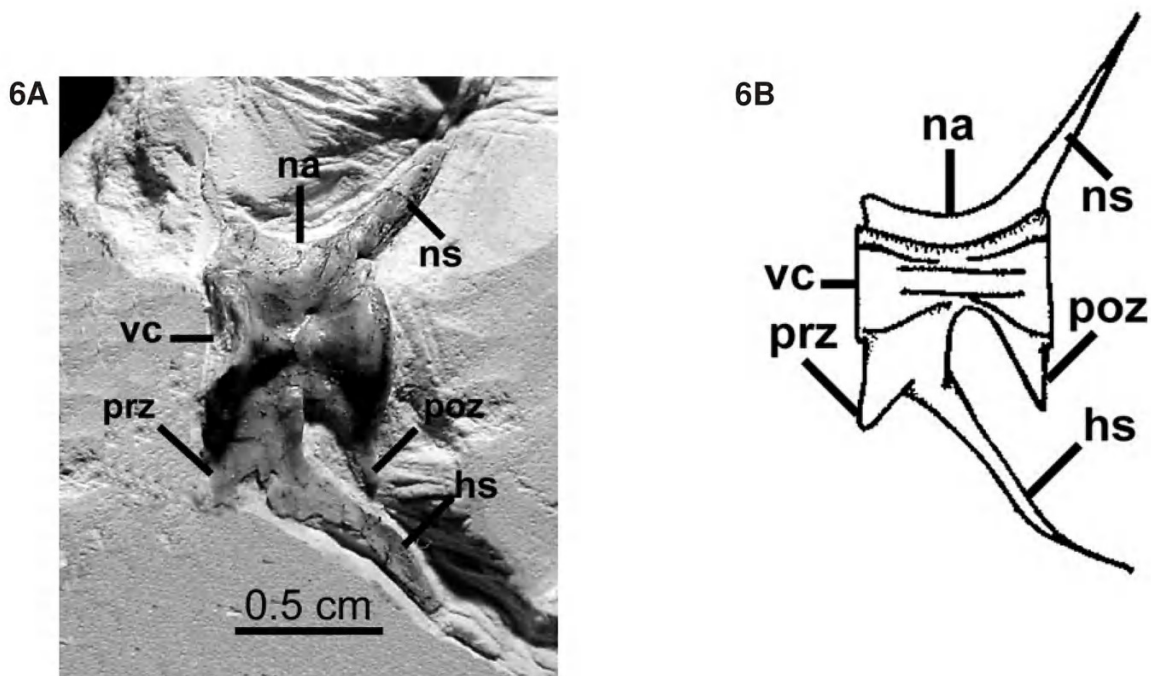


Fig.6- Caudal vertebra of the Dercetidae, in left lateral view: (A) specimen from the Cotinguiba Formation (MN 7029-V); (B) fifteenth caudal vertebra of *Rhynchodercetis gortanii* (modified after GOODY, 1969). Original drawing without scale. Anatomical abbreviations: (hs) haemal spine; (na) neural arch; (ns) neural spine; (poz) postzygapophysis; (prz) prezygapophysis; (vc) vertebral centrum.

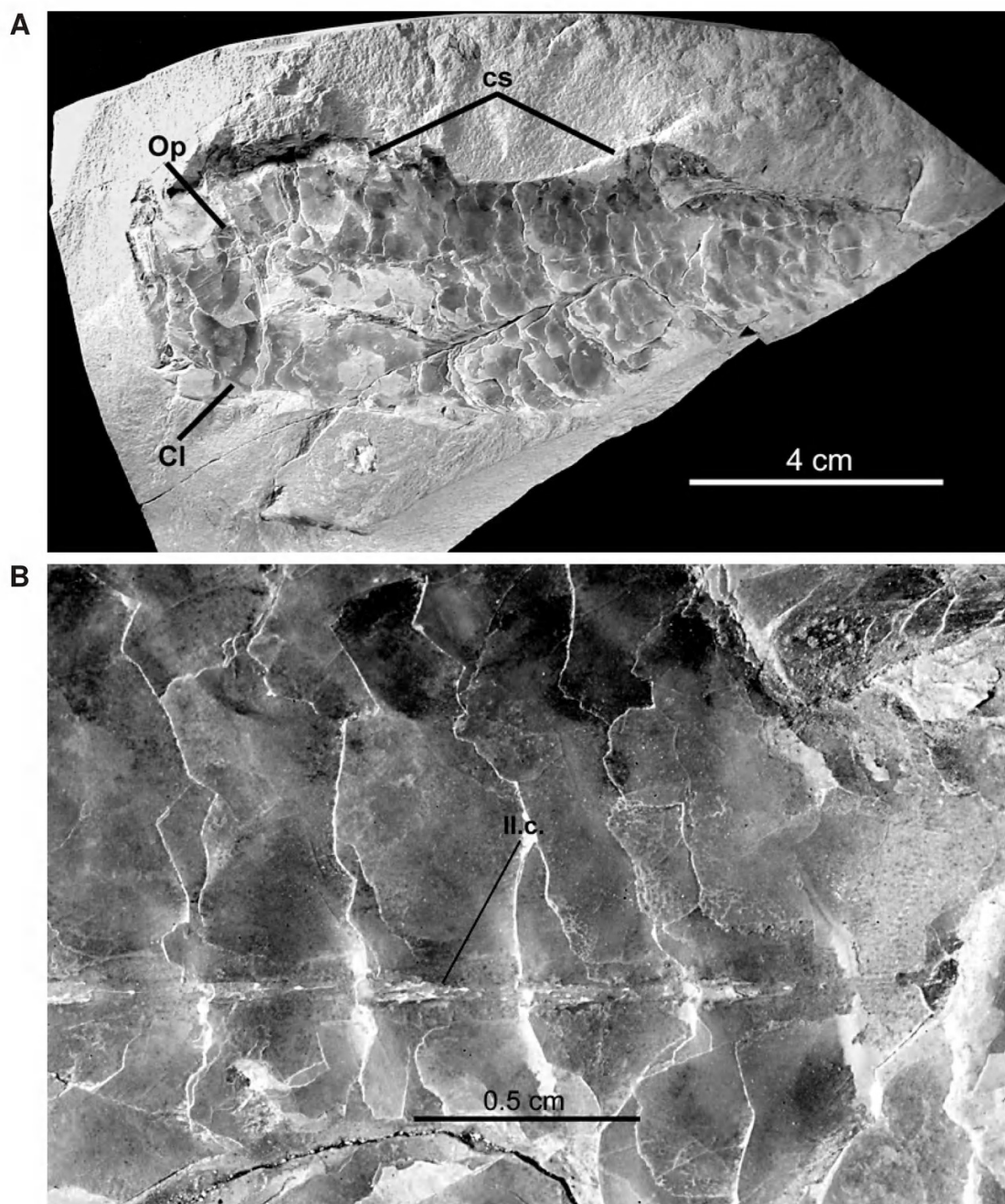


Fig.7- Teleostei *incertae sedis* from the Cotinguiba Formation (MN 7030-V): (A) articulated cycloid scales; (B) detail of the scales of the lateral line. Anatomical abbreviations: (Cl) cleithrum; (cs) cycloid scales; (ll.c.) lateral line canal; (Op) opercle.

This latter record comes from the early Turonian of the Pelotas Basin (southern Brazil) and occurs together with chondrichthyan and osteichthyan. This association shows remarkable taxonomic correspondence with members from the Turonian assemblages of northeastern Brazil, Morocco, and

Mexico, suggesting a biogeographical hypothesis which was investigated (Gallo *et al.*, 2007).

Regarding the specimen MN 7030-V (Fig.7), the scales represent most of the preserved material. These structures are very generalized, which make difficult a more inclusive classification within Teleostei.

The age of the fishes above described is established using the biostratigraphical zonation for the Turonian of the Sergipe Basin by ANDRADE *et al.* (2003, 2005) and ANDRADE (2005), which is based on inoceramids and ammonites. The amiid and the dercetid fishes occur in the middle Turonian in the *Mytiloides hercynicus* Zone. The Teleostei *incertae sedis* comes from the lower Turonian in the *Mytiloides labiatus* and *Mammites nodosoides-Kamerunoceras turoniense* zones.

These new records of Amiidae and Dercetidae in the Cotinguiba Formation widen their paleogeographical distribution during Turonian.

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