



NEW ELEMENTS OF AN ARMORED ARCHOSAUR FROM THE MIDDLE TO UPPER TRIASSIC, SANTA MARIA FORMATION, SOUTH OF BRAZIL⁽¹⁾

(With 3 figures)

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ABSTRACT: New elements of the osteology of *Aetosauroides subsulcatus* Zacarias, 1982 are presented, comprising of the braincase, some skull roof elements, two dorsal, one sacral and two caudal vertebrae, gastralia, the proximal two-thirds of the left tibia, and several osteoderms related to the dorsal, lateral and ventral armors, some of them in natural position. The material is housed in Laboratório de Estratigrafia e Paleobiologia (UFSM 11070). The cranial bones suggest an association with the Argentinean form *Aetosauroides scagliai* Casamiquela, 1960 while osteoderm ornamentation assigns this new specimen to the Brazilian form *Aetosauroides subsulcatus*. The latter is here considered *nomina dubia*.

Key words: *Aetosauroides*, Triassic, Santa Maria Formation.

RESUMO: Novos elementos de um arcossauro com armadura do Triássico Médio a Superior, Formação Santa Maria, Sul do Brasil.

Novos elementos da osteologia de *Aetosauroides subsulcatus* Zacarias, 1982 são apresentados, correspondendo à porção posterior do crânio, bem como a alguns ossos do teto craniano, duas vértebras dorsais, uma sacral e duas caudais, costelas gastrais, dois terços proximais da tibia esquerda, e vários osteodermas relacionados aos escudos dorsal, lateral e ventral, alguns em posição natural. O material encontra-se tombado na Coleção do Laboratório de Estratigrafia e Paleobiologia sob o número UFSM 11070. A associação de ossos do teto craniano sugere alguma relação à forma argentina *Aetosauroides scagliai* Casamiquela, 1960, enquanto a comparação dos osteodermas aponta semelhanças com a forma brasileira, *Aetosauroides subsulcatus*, aqui considerada *nomina dubia*.

Palavras-chave: *Aetosauroides*, Triássico, Formação Santa Maria.

INTRODUCTION

The Santa Maria Formation, Middle to Upper Triassic of the Paraná Basin, comprises a well-studied sedimentary sequence of southern Brazil, based on its fossiliferous content: a reptilian fauna (e.g., BARBERENA, ARAÚJO & LAVINA, 1985), the *Dicroidium* flora (e.g., BORTOLUZZI, 1974), conchostracans (KATOO, 1971) and insects (PINTO, 1956). The earliest known dinosaur was found in these rocks, namely *Staurikosaurus pricei* Colbert, 1970.

Permian and Triassic formations of the Paraná Basin crop out in a narrow belt along the central part of Rio Grande do Sul State, called Peripheral or Central Depression (DNPM, 1989). The outcrop belt of the Santa Maria Formation extends from the cities of Mata through Montenegro (Fig.1).

The studied fossil was found in March/1997 at the 'Faixa Nova' or 'Cerrito' outcrop, in the crossing of the BR158 and the RS278 roads, in the vicinities of Santa Maria. An alternation of massive to stratified reddish mudstones and lenticular fine sandstones of the Santa Maria Formation (Fig.2) can be visualized. The fossil remains were collected in the most basal levels. Portions of the skull roof, axial and apendicular skeleton are housed in the paleontological collection of the Laboratório de Estratigrafia e Paleobiologia, Departamento de Geociências, Centro de Ciências Naturais e Exatas, Universidade Federal de Santa Maria, under the number UFSM 11070.

DESCRIPTION

A preliminary description of UFSM 11070 is provided (Fig.3).

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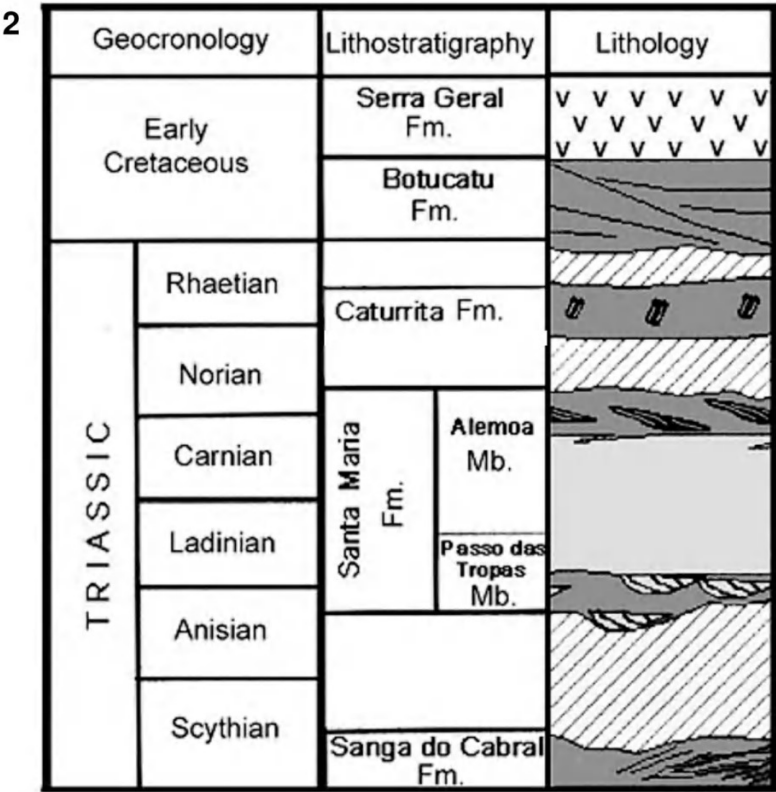
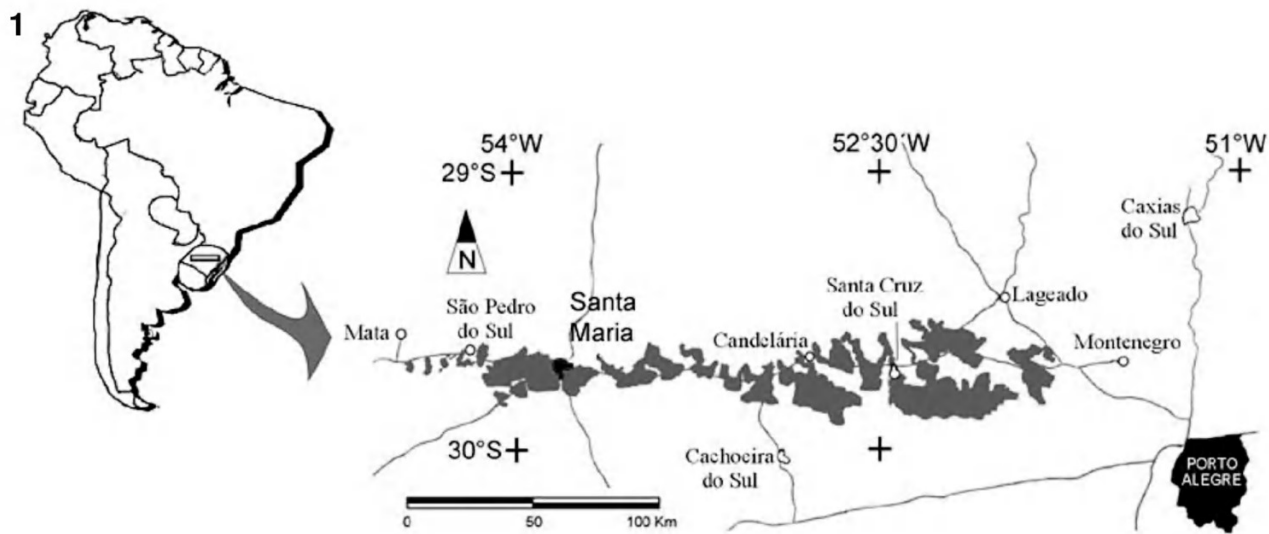


Fig.1- The shaded area define the outcrop belt of the Santa Maria Formation. The specimen was discovered close to the town of Santa Maria, Southern Brazil; fig.2- Lithostratigraphic chart of Paraná Basin of the Southern Brazil modified from FACCINI (1989).

Skull – A partial occiput and braincase preserves occipital condyle, supraoccipital, basioccipital, basipterygoid processes, basisphenoid, and part of the paraoccipital process. Fragments of the cervical armor are preserved in the occiput region.

Part of the left parietal, in which there was preservation of the suture zone with the right one, preserves the crest over occipital, aside of the insertion zone with the dermo-occipital (partially preserved), as well as the supratemporal fenestra. A fragment of the right

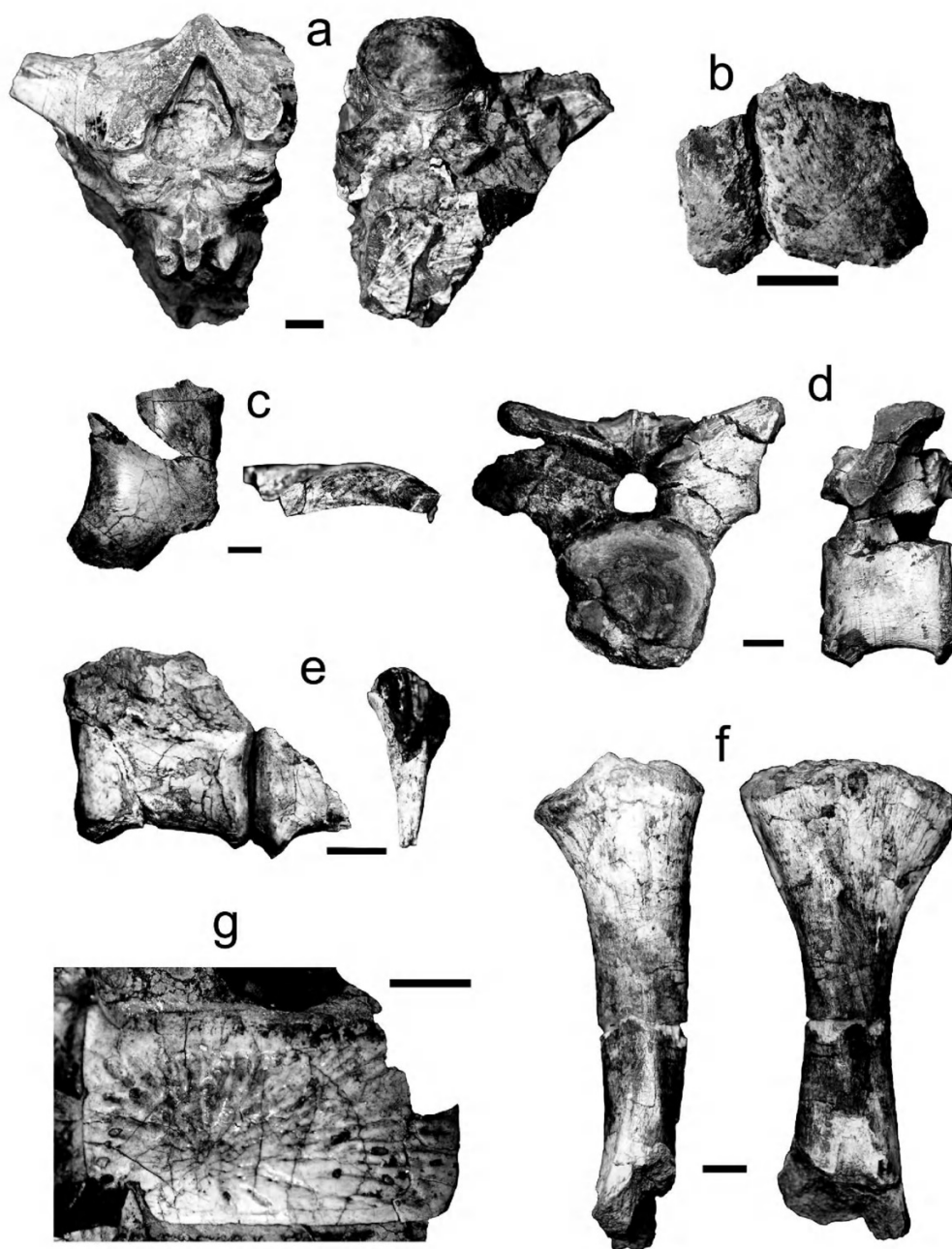


Fig. 3- *Stagonolepid* UFSM 11070: (a) occiput and braincase in dorsal and ventral view; (b) dermo-occipital in dorsal view; (c) left parietal in dorsal and lateral view, showing a detail of the insertion zone with the postfrontal-postorbital; (d) dorsal vertebrae in cranial and lateral view; (e) caudal vertebrae in lateral view and chevron in detail; (f) left tibia in cranial and lateral view; (g) dorsal osteoderm in detail. Scale bars = 10mm.

post-frontal is also preserved, together with other four unidentified elements. The parietal is thicker in the proximal portion, near the braincase. The contact with the post-frontal is preserved, as well as the suture with the right parietal.

The left parietal, together with the dermo-occipital, indicates a non-overprotected forehead, as the junction of parietal and dermo-occipital lies in the same line of the skull roof. The right post-frontal indicates a large orbital fenestra.

Axial skeleton – The axial skeleton is partially preserved, highly fragmented and dispersed in the matrix. The dorsal vertebrae present very thin transverse processes and neural spines. One presumably sacral vertebra is well preserved, bearing a thick transverse process. Both dorsal and caudal vertebrae are weakly amphicoelic.

Two unarticulated caudal vertebrae have very shallow ridges at the region of insertion of the hemal arch, and one unarticulated hemal arch is well preserved.

A sequence of seven neural spines is still connected with the dorsal armor, and shows a distinct craniocaudal diminution, as depicted by the narrowing and shortening of the transverse processes. The dorsal armor is placed over the thin transverse processes of the neural spines, and some are partially preserved in the original paramedian armors. However, much of the osteoderms are collapsed, being arranged over the transverse processes.

Appendicular skeleton – The appendicular skeleton is represented by the proximal two-thirds of the left tibia, associated with the vertebra sequence, which is about 135mm long. The proximal end of the tibia is robust, semi-triangular in dorsal view and weakly rugose. The distal end is not preserved.

Osteoderms – Isolated osteoderms from the dorsal, ventral, lateral and cranial armor are preserved. All of them show a sunburst pattern in which shallow grooves radiate from a prominent region located in the posterior portion of the plate. Dorsal and ventral plates are rectangular, with a low depth/length ratio, and the lateral plates are subcircular.

BIOCHRONOLOGICAL DISCUSSION

The UFSM 11070 shows some resemblance with *Aetosauroides scagliai* Casamiquela, 1960 and with the unpublished material of *Aetosauroides subsulcatus* Zacarias, 1982.

The Brazilian aetosaurs were found in red beds from

different localities. *A. subsulcatus* was collected at the Inhamandá outcrop, near the town São Pedro do Sul, which corresponds to the middle portion of the Santa Maria Formation. The UFSM 11070 comes from the 'Faixa Nova' or 'Cerrito' outcrop, in the city of Santa Maria, from the upper portion of Santa Maria Formation, which is considered to be Ladinian – middle Carnian (SCHULTZ, SCHERER & BARBERENA, 2000).

A first attempt for a biostratigraphic discussion in the southern Brazilian Triassic was done by BARBERENA (1977), who recognized three local faunas, namely Pinheiros, Chiniquá and Alemoa faunal associations. SCHULTZ, SCHERER & BARBERENA (1994, 1998, 2000) and SCHULTZ (1995) revised that biostratigraphic framework, defining the Therapsida Cenozoone (early Ladinian), the Rhynchosauria Cenozoone (late Ladinian – late Carnian), and the *Jachaleria* Level (early Norian). Recent findings may expand the Caturrita Formation till the end of Triassic or the beginning of the Jurassic (FERIGOLO & RIBEIRO, 2000). These cenozoones correspond to the Santa Maria and the Caturrita Formation (Fig.2). Both aetosaurs were collected in the Rhynchosauria Cenozoone.

HECKERT & LUCAS (1998) defined an aetosaur-based biostratigraphic scheme for the Triassic of Pangea. The *Stagonolepis* biochron, for which *Aetosauroides* would be a synonym (LUCAS & HECKERT, 2001), is dated as latest Tuvanian (late Carnian), in agreement with the Brazilian biostratigraphic scheme (SCHULTZ, SCHERER & BARBERENA, 1994, 1998, 2000).

A preliminary comparison with *Aetosauroides scagliai*, *Stagonolepis robertsoni* Agassiz, 1844, and *Typothorax* sp. is presented in Table 1. There is no clear correlation with the described species, although very few diagnostic elements were preserved in the studied material.

The skull roof morphology allows the interpretation that the studied specimen is different from the Argentinean form, *A. scagliai*, an explanation also presented by the study of osteoderms ornamentation (ZACARIAS, 1982). However, as it remained unpublished, the name *Aetosauroides subsulcatus* must be considered as *nomina dubia*.

CASAMIQUELA (1961, 1967) states that *Aetosauroides* is defined mainly by its pelvis. However, BONAPARTE (1997) considers dentition and cranial anatomy as the most important taxonomic elements for these specialized thecodonts. According to LONG & MURRY (1995), the armature structure was the main element in

TABLE 1
Preliminary comparison among cranial elements

Species \ Material	Parietal (lateral view)	Post-frontal (dorsal view)	Dermo-occipital
<i>Aetosauroides scagliai</i>	trapezoidal	triangular	thick and robust
<i>Stagonolepis robertsoni</i>	sheet-like	trapezoidal	??
<i>Typothorax</i> sp.	wide and triangular	arch, out of the supratemporal fenestrae	??
UFSM 11070	sheet-like, somewhat curved	triangular	thin

distinguishing the American aetosaurs, giving the first steps to a phylogenetic framework.

The preliminary comparison presented points to differences among the studied specimen and other aetosaurs. A more detailed work is needed, comparing South American forms and testing the Heckert & Lucas hypothesis, in which *Aetosauroides* is a synonym for *Stagonolepis* (HECKERT & LUCAS, 1999).

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