

On the paleoichthyofauna from the Aiuruoca Tertiary Basin, Minas Gerais State, Brazil

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Abstract. A new fish fauna from the Tertiary Aiuruoca Basin is presented in a preliminar overview. This recently reported basin is located in southern Minas Gerais State, between the Mantiqueira Mountain Range and the south border of the Minduri Range, in the Alto Rio Grande Plateau. The Aiuruoca Basin is filled up by sediments of two formations: Entre-Córregos (lacustrine) and Pinheirinho (alluvial fan). The shales of the Entre-Córregos Formation are dated as Eocene-Oligocene based on palynomorphs. Its fossil content also includes plants, insects, amphibians and fishes. In a preliminar examination the paleoichthyofauna includes cichlids (Teleostei, Perciformes) and characids (Teleostei, Characiformes), most of them complete and articulated. Members of these groups are primary freshwater fishes corroborating the continental paleoenvironment assigned to this formation. First studies have demonstrated a close similarity between these fish species and those from the Taubaté Basin.

Resumen. PALEOICTIOFAUNA DE LA CUENCA DE AIURUOCA (TERCIARIO), ESTADO DE MINAS GERAIS, BRASIL. En este trabajo se presenta un estudio preliminar de los peces fósiles de la cuenca terciaria de Aiuruoca, ubicada entre la Sierra da Mantiqueira y el borde sur de la Sierra de Minduri en el planalto del Alto Rio Grande, al sur del Estado de Minas Gerais. La cuenca de Aiuruoca está constituida por sedimentos de las formaciones Entre-Córregos (facies lacustres) y Pinheirinho (abanicos aluviales). Las lutitas de la Formación Entre-Córregos están datadas como Eoceno-Oligoceno en base a palinomorfos. Su contenido fosilífero incluye además plantas, insectos, peces y anfibios. La paleoictiofauna está formada principalmente por cíclidos (Teleostei, Perciformes) y carácidos (Teleostei, Characiformes), representados en su mayoría por ejemplares completos y articulados. Los representantes de estos dos grupos son peces esencialmente de agua dulce, corroborando el ambiente lacustre atribuido a esta formación. Resultados preliminares revelan una gran semejanza entre los peces de las cuencas cenozoicas de Aiuruoca y Taubaté.

Key words. Paleoichthyology. Tertiary. Cichlidae. Characidae. Brazil.

Palabras clave. Paleoictiología. Terciario. Cichlidae. Characidae. Brasil.

Introduction

The Aiuruoca Basin is located in southern Minas Gerais State between the Mantiqueira Mountain Range and the southern border of the Minduri Range, in the Alto Rio Grande Plateau. It is a recently discovered Tertiary basin (Santos, 1999), located between 44°15'W and 44°45'W, and 22°15'S and 21°30'S (figure 1). The area is drained by the Aiuruoca river, that crosses it in a northward direction. The Aiuruoca Tertiary Basin presents a complex morphotectonic framework, which resulted from two tectonic events in the Paleogene and Neogene-Quaternary. The first one, extensional, is related to the Atlantic Ocean opening processes, and the sec-

ond one, transcurrent, to intraplate neotectonical activity (Santos, 1999; Santos *et al.*, 1999). The sediments filling up this basin are recognized as Aiuruoca Group (Santos *et al.*, 1999) comprising two formations: Pinheirinho (alluvial fan) and Entre-Córregos (lacustrine). Conglomerates, breccias, diamictites and arkoses characterize the Pinheirinho Formation. The Entre-Córregos Formation is constituted by mudstone sediments as paper shales intercalated with clays. The sequence of the beds in this basin suggests that the coarse clastic sediments represent gravitational flow deposits in a lacustrine system. Based on palynological data, Garcia *et al.* (2000) assigned an Eocene-Oligocene age to the Entre-Córregos Formation.

The fossil content of the Entre-Córregos Formation includes plants, palynomorphs, insects and vertebrates (Garcia *et al.*, 2000; Bedani and Haddad, 2001; Franco-Delgado and Bernardes-de-Oliveira, 2003). Recent fieldwork carried out by the Labo-

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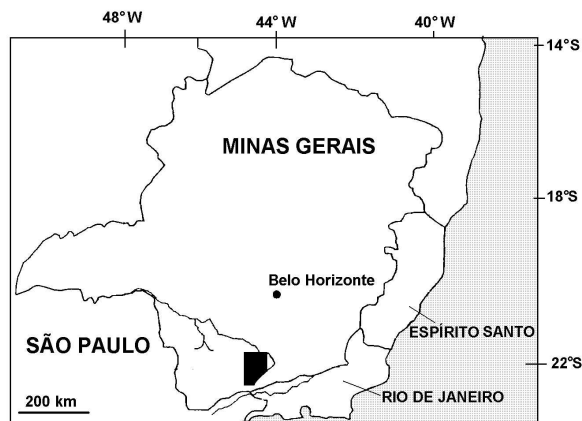


Figura 1. Location map of the Tertiary Aiuruoca Basin area (in black) / Mapa de ubicación de la Cuenca Terciaria de Aiuruoca (en negro).

ratório de Geociências of the Universidade de Guarulhos (State of São Paulo) found out an outcrop characterized by a remarkable concentration of fossils, mainly amphibians and fish. The amphibians are represented by dozens of pipid specimens (Anura) in an excellent state of preservation (Bedani and Haddad, 2001).

The paleoichthyofauna is represented by specimens of cichlids (Teleostei, Perciformes) and characids (Teleostei, Characiformes), most of them complete and articulated, besides several young and small undetermined individuals. This is the first report of a fossil fish fauna from the Aiuruoca Tertiary Basin. The occurrence of characids and cichlids in the Taubaté Basin (Malabarba, 1998, 2003) suggests a similar ichthyofaunal composition for these two basins. The information provided from these new findings offers an opportunity to re-evaluate the Taubaté Basin connections, and also the Tertiary fish fauna in general, in terms of diversity and paleoecology.

Material and methods

The paleoichthyofauna reported here includes several fishes preserved in gray shales from the Entre-Córregos Formation. The fossiliferous outcrop is about 2 m long and located on the left margin of the Entre-Córregos stream (21° 50' S, 44° 35' W). All material studied belongs to the Laboratório de Geociências of the Universidade de Guarulhos (Guarulhos, State of São Paulo) collection, and is deposited under the acronym UnG-2T.

The fossils were prepared using standard paleontological tools under a microscope. Fish specimens

are preserved complete and most present teeth and bones still articulated. However, due to fragility of the bones, sometimes they are fragmented and smashed. In these cases, the bones were removed from the sediments in order to reveal their impressions that are anatomically more helpful than fragmented bones. Frequently the shape of the scales and their arrangement as well as parts of the lateral sensorial line can be distinguished.

In counts of fin rays, unbranched rays are indicated by lower case Roman numerals, and the branched rays are indicated by Arabian numerals. Counts of vertebrae do not include those vertebrae incorporated into the Weberian apparatus.

Paleoichthyofauna description

Order PERCIFORMES Bleeker, 1859

Family CICHLIDAE Gill, 1872

Tremembichthys sp.

Figure 2

Material. UnG-2T 180, whole specimen preserved as mold and counter mold.

Description. A deep-bodied cichlid measuring 115 mm standard length, characterized by a short body, dorsally well arched. Greatest body depth at the vertical through the middle of the spiny dorsal fin. Head with triangular shape in lateral view. Orbit anterior and highly positioned. Dorsal fin origin just after the supraoccipital crest; dorsal fin prolonged through the dorsal margin of the body. Dorsal-fin rays: xvi + 15. Anal fin opposite to the posterior one third of the dorsal fin. Anal-fin rays iii + 11. Two supraneurals; anterior vertebrae with thick neural spines. Vertebrae 33.

Discussion. *Tremembichthys pauloensis* (Schaeffer, 1947) was described from the Tremembé Formation of the Taubaté Basin, in the State of São Paulo. Unfortunately, there is no synapomorphy defining this genus (Silva Santos and Santos, 1993). The Aiuruoca basin specimen shares with *T. pauloensis* features such as compressed body, a divided lateral line system, a well developed spiny dorsal fin, and 2 supraneurals. Despite the similarity, UnG-2T 180 can be distinguished from *T. pauloensis*, based on number of dorsal-fin rays (xvi + 15 versus xiv + 12 in *T. pauloensis*) and anal-fin rays (iii + 11 in UnG-2T 180 versus iii + 9 in *T. pauloensis*). These differences suggest that the Aiuruoca cichlid is a new species of *Tremembichthys*. Ongoing phylogenetic analysis involving recent and fossil species will try to define synapomorphies for *Tremembichthys* and establish its relationship with other cichlids.

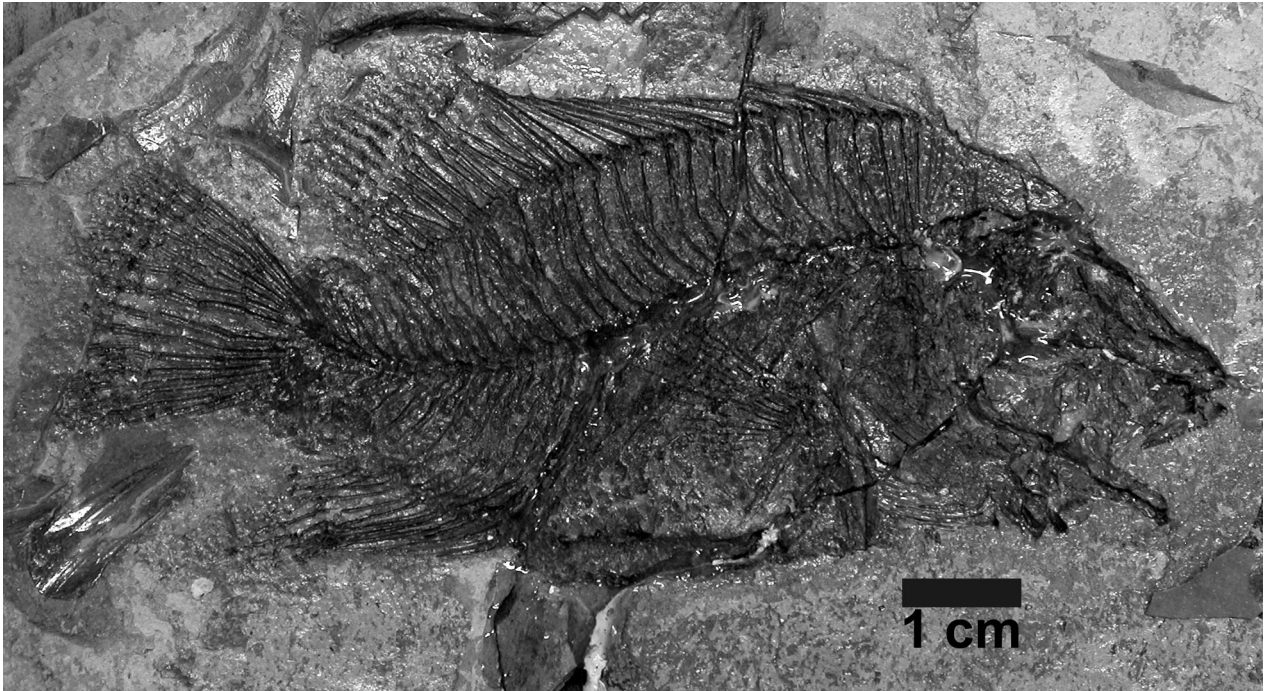


Figura 2. *Tremembichthys* sp. UnG-2T 180. General view of the specimen / vista general del espécimen.

Order CHARACIFORMES Muller, 1843
Family CHARACIDAE Muller, 1843

cf. *Brycon avus* (Woodward, 1898)
Figure 3

Material. UnG-2T 181, articulated specimen missing the anterior region of the snout.

Description. A small characid, measuring 90 mm standard length, lacking the anterior region of the snout. Elongate body; greatest body depth at dorsal fin origin 30% of standard length. Coracoid not expanded; pectoral fin short not reaching the pelvic fin.

Dorsal fin opposite to the gap between the pelvic and anal fins; dorsal-fin rays ii + 9. Pelvic fin short, not reaching the anal fin, with i + 7 rays. Anal-fin origin opposite to the last dorsal-fin ray; anal-fin rays iv + 22; no hooks on the fin rays. Caudal fin well forked; caudal-fin rays 18; procurent rays 9-10 dorsally. Vertebrae 33.

Discussion. The features in UnG-2T 181 specimen (elongate body with coracoid not expanded, dorsal-fin position, number of anal-fin rays, size of pectoral fin) agree with those in *Brycon avus* from the Tremembé Formation, Taubaté Basin. However, due to the absence of the most anterior snout bones (max-

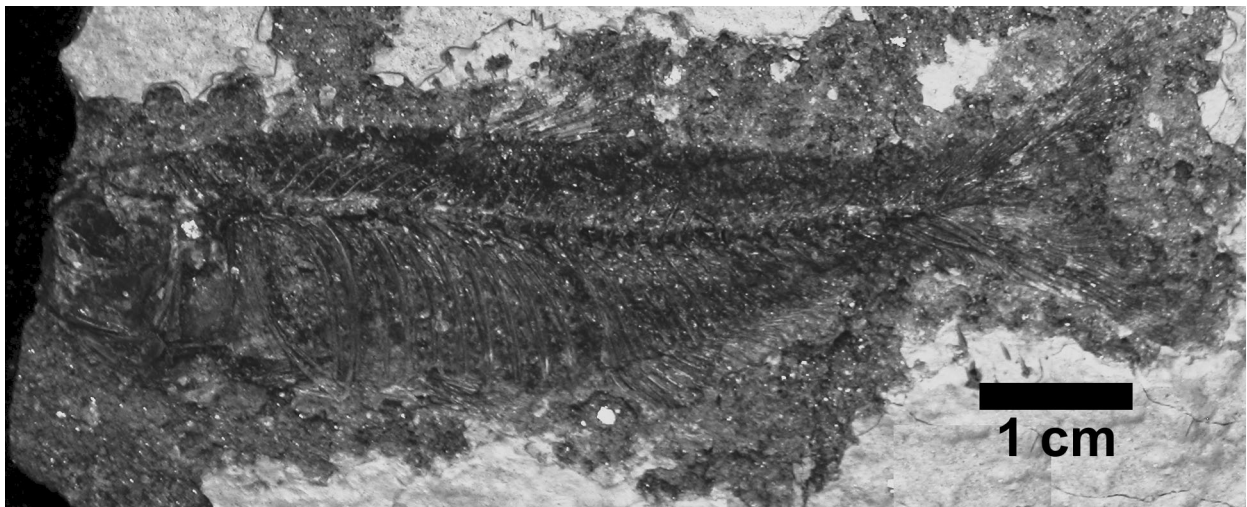


Figure 3. cf. *Brycon avus*. UnG-2T 181. General view of the specimen / vista general del espécimen.



Figure 4. Characidae indet. UnG-2T 182. **A**, general view of the specimen / *vista general del espécimen*. **B**, a premaxillary tooth / *un diente premaxilar*.

illa and premaxilla) the tooth shape and number of tooth rows are not checkable, precluding an unquestionable identification for this material.

Characidae indet. Figure 4

Material. UnG-2T 182, a whole articulated specimen.

Description. Small characid with 62 mm of standard length. Elongate body, with no ventral expansion in the pectoral girdle region. Greatest body depth 30% of standard length. Premaxilla and dentary teeth with three to five cusps (figure 4.B); two premaxillary tooth rows. Maxilla elongate and strong, edentulous. Dorsal fin located in the middle of the dorsal border, opposite to pelvic fin; dorsal-fin rays $ii + 9$. Anal-fin origin opposite to last dorsal-fin ray; anal-fin rays $iv + 19$; fin rays without bony hooks. Caudal fin well forked, lobes with same size. Procurrent rays 10 dorsally and 5 ventrally. Vertebrae 32.

Discussion. The presence of Weberian apparatus, multicusp teeth arranged in two rows in the premaxilla and a long based anal fin, allows to assign tentatively this specimen to Characidae (a phylogenetic definition for Characidae is still missing). The UnG-2T 182 specimen can be distinguished from those characids known from the Taubaté Basin, *Megacheiroidon unicus* (Travassos and Santos, 1955), *Lignobrycon ligniticus* and *Brycon avus* (Woodward, 1898) based on differences concerning jaws, fins and pectoral girdle, such as shape of maxilla and premaxilla, maxilla without teeth, number of anal-fin rays, dorsal fin position, and coracoid not expanded. Further studies will provide information to support a conclusive specific identification for this specimen.

Concluding remarks

The paleoichthyofauna from the Entre-Córregos Formation, Aiuruoca Basin, is characterized by the

presence of freshwater species, represented by the families Characidae (tetras) and Cichlidae. Cichlids and characids are speciose fish groups inhabiting freshwater environments, mostly in South America and Africa, being among the most diversified families within Teleostei. The occurrence of freshwater fish groups, associated with the good preservation of the specimens, even the small ones, indicate that the habitat was an undisturbed continental environment as a lake or a pool. This fact corroborates the lacustrine paleoenvironment assigned to the Entre-Córregos Formation (Santos, 1999; Santos *et al.*, 1999; Garcia *et al.*, 2000).

Besides the material just described, there are several additional smaller specimens, which need more detailed studies. However, based on these preliminar identifications of the Entre-Córregos Formation fishes, it is possible to infer a great ichthyofaunal similarity between the Aiuruoca and Taubaté basins. Remarkable litostratigraphic, biostratigraphic and chronological similarities between these two basins were already pointed out in Santos (1999) and Santos *et al.* (1999). The Aiuruoca Basin could represent a northern expansion of the Tremembé paleolake, whose sediments have been dated as Oligocene based on palynomorphs (Lima *et al.*, 1985) and Upper Oligocene-Lower Miocene based on vertebrates (Alvarenga, 1990). An older age for the Taubaté Group sedimentation, Paleogene (Eocene-Oligocene), was suggested by Riccomini *et al.* (1991), based on geochronological, geomorphological and other data.

Based on the association of insects and frogs (Bedani and Haddad, 2001), the Entre-Córregos Formation can be interpreted as a marginal paleoenvironment of the lake, not so deep as that represented by the Tremembé Formation in the Taubaté Basin (Riccomini, 1989). This hypothesis is supported by the great amount of young specimens among the fossil fishes, which preferably inhabit marginal and shallow waters.

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