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First occurrence of charophyte algae from a Triassic Paleolake in Argentina and their paleoenvironmental context

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ABSTRACT

This paper presents the first record of charophytes from the Triassic sedimentary rocks of Argentina and the entire southern hemisphere. Algal remains were found in the Cerro Puntudo Formation dated as Anisian (243.8 ± 1.9 Ma). The formation is part of the Cuyana Basin, which formed as consequence of the Triassic rifting of Pangaea. The paleoenvironments represented by this succession include from bottom to top: (1) a proximal to medial alluvial fan system; (2) a distal alluvial fan deposit; (3) a braided fluvial system with small channelized bodies; (4) a distal fluvial system containing rare carbonates; and (5) a carbonate-rich lacustrine system. The lacustrine facies association corresponds mainly to carbonate microbialites with three recognized facies, namely disrupted micritic limestones (**Lmd**), stromatolitic limestones (**Ls**), and oncolitic limestones (**Lo**). The **Lo** facies is rich in oncolites formed by filamentous algae in the cortex and charophyte remains (gyrogonites) in the nucleus and is interpreted as being deposited in a carbonate-rich pond environment, perhaps sourced from springs. Filamentous algae are thought to cause the precipitation of carbonates and trigger the development of micritic coatings in the ponds. Sedimentary and paleobiologic evidence suggest minor movement of the oncolites in a ponded environment where charophytes developed. The charophyte remains found in the Cerro Puntudo Formation are gyrogonites attributed to the Porocharaceae family. All the previous records for Triassic Charophyta correspond to Laurasia in the northern hemisphere, therefore, the paleolatitudinal location of this finding allows the expansion of the paleobiogeographic distribution of the group into Gondwana.

1. Introduction

Calcified algae are an important element in paleoecologic studies of carbonate sediments to unravel past environmental conditions (Cózar et al., 2003; Zatón et al., 2005; Ottone and Mancuso, 2006). Particularly, charophyte algae can be powerful indicators in paleolimnologic multidisciplinary studies. This group is important to the fossil record because this algae calcifies its reproductive structure (nucule). The fossil record of charophytes is mainly based on these biocalcified fructifications, referred to as a gyrogonite by paleobotanists. Gyrogonites and their features are useful to reconstruct the phylogeny, taxonomy and systematics of the taxa (Feist and Grambast-Fessard, 1984; Feist and Grambast-Fessard, 1991; Martín-Closas, 2003; Soulië-Marsche, 2005).

Charophytes have been extensively documented from the Silurian until today worldwide (Musacchio, 2000; De, 2003; Feist et al., 2005a; Kubota, 2005). Paleozoic families have been studied in detail and phylogenic reconstructions have been made based on the spiralization of the gyrogonite cells or its basal plate, among other features (Feist et al., 2005b; Soulië-Marsche, 2005). In spite of that, studies on charophytes from the Triassic are scarce. They have only been found in southern Sweden (Horn af Ratzien, 1954), in the USA (Peck and Eyer, 1963; Kietzke, 1989), in Germany (Breuer, 1988), in SW Poland (Zatón et al., 2005), and Slovenia (Martín-Closas et al., 2009). They occur abundantly in China (Wang and Huang, 1978; Huang, 1983).

Regarding the record in Gondwana, charophytes belonging to the Porocharaceae family have been reported from the Permian (Guadalupian) of the Paraná Basin, Brazil (Faria and Ricardi-Branco, 2009). The intracratonic basin extended up to the NE Argentina into the Chaco–Paraná Basin (Limarino and Spalletti, 2006). Notwithstanding, no charophytes have been reported from the Argentinean part of the basin.

In Argentina, several micropaleontologic investigations have been carried out in continental sediments of the Triassic (Ottone et al., 2005; Ottone and Mancuso, 2006; Zavattieri and Prámparo, 2006). Despite this, charophytes have not been described in this sedimentary context probably because previous studies have only focused on palynologic or sedimentologic research. The techniques for the extraction

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of spores most likely eliminated all evidence of charophytes in the samples.

This paper presents the first record of charophytes from the Triassic sediments of Argentina and the entire southern hemisphere. They are present in the Cerro Puntudo Formation (Mombrú, 1973), which is part of a complete nonmarine succession in the Cuyana Basin of western Argentina. This Triassic rift basin covers 60,000 km^2 with outcrops in Mendoza and San Juan provinces. The upper section of the Cerro Puntudo Formation has been dated recently, by palynologic and U–Pb zircon (SHRIMP) data, as 243.8 ± 1.9 Ma (Mancuso et al., 2010). So far paleontologic studies of this formation have been focused on the paleoflora and trace fossils (Krapovickas et al., 2008; Mancuso, 2009). A detailed facies analyses of the Cerro Puntudo Formation is provided in this contribution to determine the paleoenvironmental context of the charophyte record. The aim of this paper is to describe the paleoecologic conditions under which the charophytes lived and provide a glimpse of the distribution of the group in Pangaea.

2. Geologic setting

Triassic sedimentary basins of Argentina formed as part of the rifting event associated with the pre-breakup of Pangaea in the SW margin of Gondwana (Uliana and Biddle, 1988). This event originated

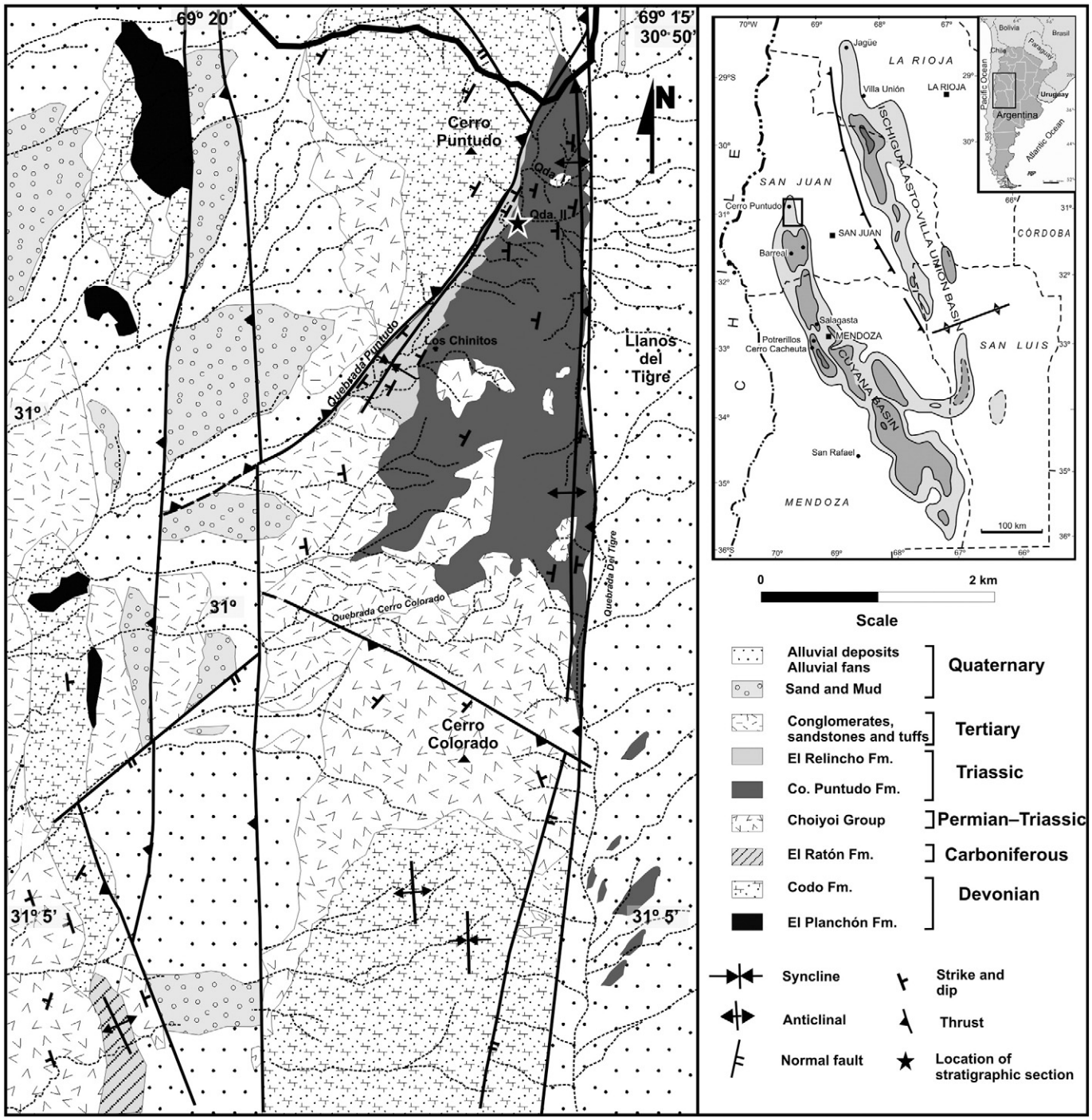

Fig. 1. A) Location map of Cuyana Basin, and geologic map of Cerro Puntudo area. Modified from Mancuso et al. (2010).