

Early Permian Marine Fauna from the Quebrada Larga Formation, San Juan Province, Argentine Precordillera: Biostratigraphical Implications

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“Fauna marina pérmica temprana de la Formación Quebrada Larga, provincia de San Juan, Precordillera argentina: implicancias bioestratigráficas”,

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Outcrops of the Quebrada Larga Formation (Scalabrini Ortiz, 1972) can be recognized on the western flank of the Punilla Hill in the Carrizalito area (San Juan province) and belong to the northern sector of the Río Blanco Basin (Argentine Precordillera). The type locality of this stratigraphical section, Quebrada Larga, is located on the left margin of the Blanco River, about 60 km north of Malimán (figure 1).

The first mentions of the marine fauna from the Quebrada Larga Formation were provided by Furque (1958, 1965), who indicated the presence of the fossils *Orthoceras* sp., *Conularia* sp., gastropods and ostracods in outcrops located on the right margin of the Blanco River. From the type locality, Antelo (1972) described and illustrated several brachiopod species with the names *Orbiculoidea* aff. *saltensis* Reed, *Streptorhynchus inaequiornatus* Leanza, *Lisochonetes jachalensis* Amos, *Heteralosis cornelliana* (Derby), *Buxtonia riojana* (Leanza) and “*Septosyringothyris*” sp. However with the new collections, brachiopods and bivalves that integrate the marine fauna from the Quebrada Larga Formation, have been understood in modern terms by the present study.

The fossils documented herein come from the upper part of the Quebrada Larga Formation, fundamentally from the fossiliferous horizons studied by Antelo (1972). This sequence is characterized by a predom-

inance of sandstones with occasional interbedded fine conglomerates and mudstones that contain remains of flora (figure 2). Towards the upper part, two fossiliferous horizons associated to grey sandstone beds have been identified in a stratigraphical interval of about 120 m in thickness, which is essentially composed of alternating sandstones and mudstones. The first horizon is dominated by *Septosyringothyris* sp. aff. *Septosyringothyris jaguelensis* Lech accompanied by *Tivertonia jachalensis* Amos, *Orbiculoidea* sp. and very scarce and fragmentary *Streptorhynchus inaequiornatus* Leanza (figure 3 K-O; Q-R), gastropods (probably *Peruvispira* sp.) and bivalves indet. In the second fossiliferous horizon, located about 100 m above horizon 1, an assemblage composed of *Coronalosia* sp., *Svalbardia* sp. (figure 3 A-J; P) and *Septosyringothyris* sp. aff. *Septosyringothyris jaguelensis* Lech, accompanied of scarce gastropods, has been also recognized.

On the left margin of the Blanco River, immediately to the north of the Quebrada Larga locality, and other fossiliferous site has been identified. Herein, the fauna appears in calcareous horizons interbedded in a predominantly mudstone stratigraphical interval. These fossil accumulations (interpreted as sedimentologic in origin) appear concentrated in densely packed beds about 1 to 4 cm thick. The shells show a poor preservation (high degrees of abrasion and fragmen-

tation and some of them are slightly deformed), hence the taxonomic identification is very difficult. However, a preliminary taxonomic analysis of these skeletal concentrations reveals that the bioclastic deposits are dominated by the infaunal bivalves *Schizodus* sp., *Pleurophorella* sp., *Edmondia* sp. and *Modiolus?* sp., and the epibyssate subor-

inated *Aviculopecten* sp. and *Streblochondria* sp. (figure 4). Gastropods (*Peruvispira?* sp.) and brachiopods (*Septosyringothyris* sp. and Productida indet.) have been also identified in these concentrations.

From the same margin of the river, about 600 m to the north of the Quebrada Larga, other fossiliferous site has been documented by Scalabrini Ortiz (1972). This author recorded the species *Orbiculoidea saltensis* Reed, *Lissochonetes jachalensis* Amos, *Syringothyris keideli* Harrington, *Peruvispira* sp. and *Neilsonia* sp. but this faunal assemblage has not been recognized in this opportunity by the authors.

From the biostratigraphical viewpoints, the marine assemblage from the Quebrada Larga Formation has been considered to be included in the *Tivertonia jachalensis*-*Streptorhynchus inaequiornatus* Biozone (Sabattini *et al.*, 1990), recently regarded as being of early Permian age (Cisterna and Simanauskas 2000; Cisterna *et al.*, 2002b; Archbold, *et al.*, 2004; Cisterna *et al.*, 2005; Gutiérrez *et al.*, 2005; Cisterna *et al.*, 2006a). The brachiopod assemblage that characterizes this biozone (i.e. *Streptorhynchus inaequiornatus* Leanza, *Tivertonia jachalensis* (Amos), *Kochiproductus riojanus* (Leanza), *Kochiproductus* sp., *Costatumulus* sp., *Coronalosia argentinensis* Archbold and Simanauskas, *Tupelosia paganzoensis* Archbold and Simanauskas, *Pericospira pericoensis* (Leanza) (formerly *Spirifer* (*Spirifer*) *pericoensis* Leanza (Leanza, 1945) and then *Trigonotreta pericoensis* (Leanza) (Cisterna *et al.*, 2002a), *P. riojanensis* (Lech), *Septosyringothyris* sp. aff. *S. jaguelensis* Lech, *Cruithyris?* sp. and *Orbiculoidea* sp.), exhibits clear Permian gondwanic affinities which have been widely discussed by Cisterna *et al.* (2002a) and Cisterna *et al.* (2006b).

Although the bivalves herein identified belong to cosmopolitan genera, these taxa usually appear associated to the brachiopods of the *Tivertonia jachalensis*-*Streptorhynchus inaequiornatus* Biozone in the Río del Peñón and Tupe formations (González, 1997; Sterren, 2000; 2004).

The *Tivertonia jachalensis*-*Streptorhynchus inaequiornatus* Biozone, originally named the *Lissochonetes jachalensis*-*Strepto-*



Figure 1. Location map showing the geographical position of the fossiliferous site.

rhynchus inaequiornatus Biozone, was referred to the Late Carboniferous by Sabattini *et al.* (1990). Because of the inclusion of the species *Lissochonetes jachalensis* Amos in the Permian genus *Tivertonia* Archbold and Gaetani, Archangelsky *et al.* (1996) suggested that this biozone would be extended to the Permian. The Tupe Formation at La Herradura Creek in the Paganzo Basin was proposed as the stratotype of this biozone and the stratigraphical sections of the Tupe Formation at La Delfina Creek (Paganzo Basin) and the Río del Peñón Formation at Rincón Blanco locality (Río Blanco Basin), were also considered as the parastratotypes (Sabattini *et al.*, 1990).

The *Tivertonia jachalensis-Streptorhynchus inaequiornatus* fauna was later reviewed in the Río del Peñón Formation (Cisterna and Sabattini, 1998; Cisterna and Simanuskas, 2000), as well as in the different localities of the Tupe Formation (La Herradura Creek, La Delfina Creek, La Ciénaga and Paslean), where it appears associated to the Latest Carboniferous-Earliest Permian Paleo-Pacific transgression into the western Paganzo basin (Cisterna *et al.*, 2002b; Cisterna *et al.*, 2005; Gutiérrez *et al.*, 2005; Cisterna *et al.*, 2006a).

Although diagnostic species that distinguish the *Tivertonia jachalensis-Streptorhynchus inaequiornatus* Biozone have been recognized in the type locality of the Quebrada Larga Formation, compositional variations can be noted, i.e. the occurrence of *Coronalosia* sp. and *Svalbardia* sp., probably two new species. *Coronalosia* Waterhouse and Gupta is a Gondwanan Permian genus described from the Early Permian (Sakmarian) of India and Western Australia. The species *Coronalosia* sp. herein identified was previously referred to *Heteralosia cornelliana* (Derby) by Antelo (1972). However, the material described by this author shows the widely spaced ventral spines that characterizes *Coronalosia* and it is closely allied to *Coronalosia argentinensis* Archbold and Simanuskas from the Tupe Formation at La Herradura Creek (Archbold and Simanuskas, 2001; Cisterna *et al.*, 2002b). *Svalbardia* Barkhatova, described from the Permian (Kungurian-Kazanian) of Rusia, the Ca-

nadian Arctic and Australia, as well as other Permian conetids, has a disjunct or bipolar distribution (Archbold, 1981). *Svalbardia* appears to be closely related to *Tivertonia* and probably evolved from this genus (Simanuskas, pers. comm.). However distinct characters of the *Svalbardia*, such as a markedly planoconvex shell, coarsely pseudopunctate ventral valve, dorsal interior with anteriorly prominente median septum and anderidia posteriorly fusing anterior to cardinal process pit, have been recognized in the specimens from Quebrada Larga.

The review of the brachiopods and bivalves from the Quebrada Larga Formation allows to confirm the presence of the *Tivertonia jachalensis-Streptorhynchus inaequiornatus* fauna in this locality as well as to enlarge the knowledge about its compositional variation. The occurrence of this fauna is also related to the definition of the Carboniferous-Permian boundary in Precordillera. In the Tupe Formation (western Paganzo Basin)

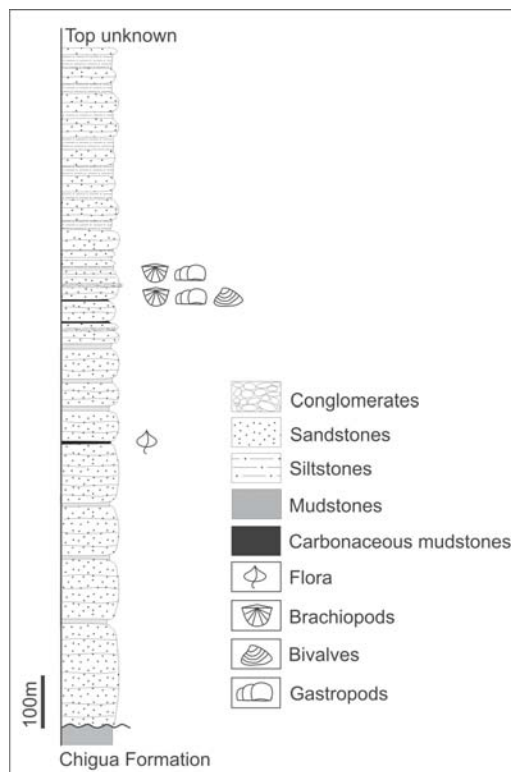


Figure 2. Stratigraphical section of the Quebrada Larga Formation at the type locality.

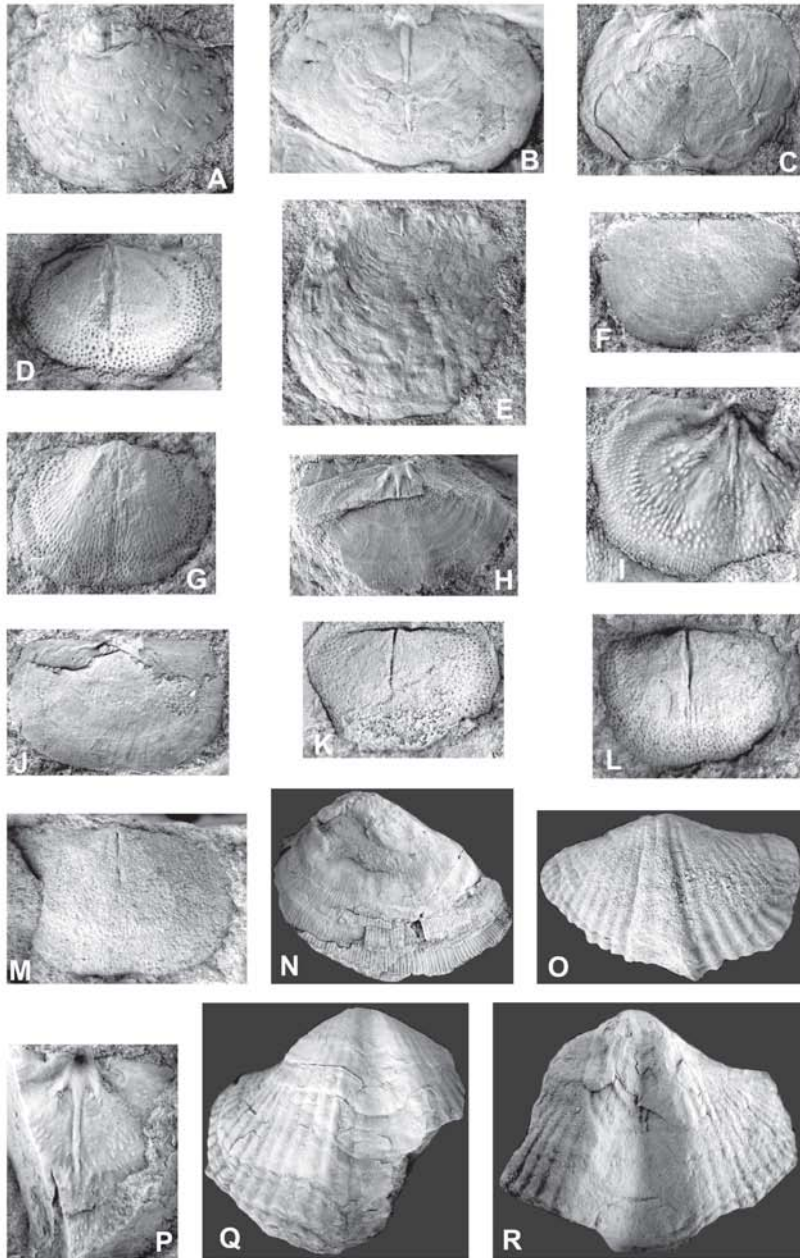


Figure 3. A-C, E. *Coronalosia* sp. A, ventral valve CEGH-UNC 22847, x 2.5; B, dorsal interior CEGH-UNC 22848, x2; C, external mould of dorsal valve CEGH-UNC 22849, x1.5; E, external mould of dorsal valve CEGH-UNC 22850, x2; D, F-J, P. *Svalbardia*, sp. D, internal mould of ventral valve CEGH-UNC 22851, x2.5; F, dorsal valve exterior CEGH-UNC 22852, x3; G, internal mould of ventral valve CEGH-UNC 22853, x3; H, incomplete dorsal interior CEGH-UNC 22854, x2.5; I, dorsal interior CEGH-UNC 22855, x3.5; J, external mould of dorsal valve CEGH-UNC 22856, x2.8; P, dorsal interior CEGH-UNC 22857, x3.8; K-M, *Tivertonia jachalensis* (Amos). K, internal mould of ventral valve CEGH-UNC 22858, x2; L, internal mould of ventral valve CEGH-UNC 22859, x2.5; M, internal mould of ventral valve CEGH-UNC 22860, x2.5; N, *Streptorhynchus inaequiornatus* Leanza, fragmentary internal mould of ventral valve CEGH-UNC 22861, x1; O, Q-R, *Septosyringothyris* sp. aff. *Septosyringothyris jaguelensis* Lech. O, internal mould of dorsal valve CEGH-UNC 22862, x1; Q, incomplete ventral valve in ventral view CEGH-UNC 22863, x1; R, incomplete ventral valve in ventral view CEGH-UNC 22864, x1.

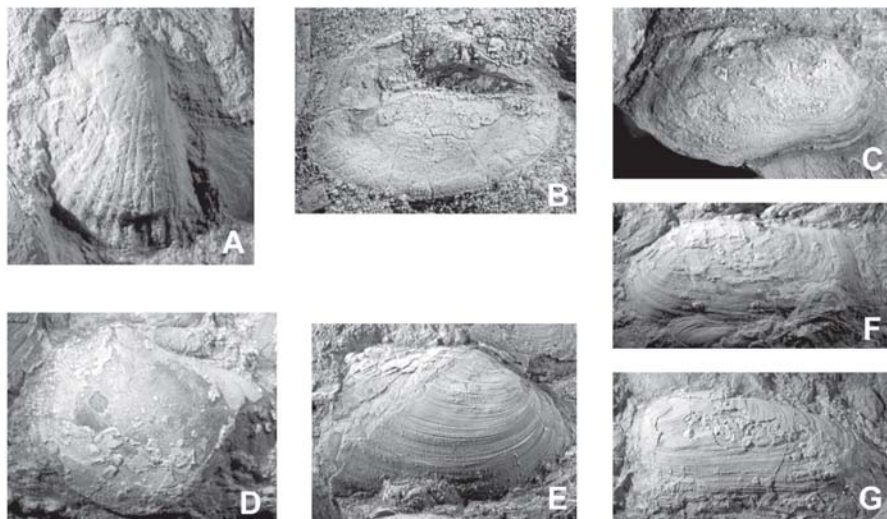


Figure 4. A, *Aviculopecten* sp., composite mould of left valve CEGH-UNC 23108, x 2,75; B, *Schizodus* sp., interior of left valve CEGH-UNC 23110, x2; C, F, *Pleurophorella* sp. C, composite mould of right valve CEGH-UNC 23114, x2,5; F, composite mould of left valve CEGH-UNC 23112, x0,9; D, *Streblochondria* sp., composite mould of right valve CEGH-UNC 23109, x2,7; E, *Edmondia* sp., composite mould of right valve CEGH-UNC 223113, x1,4. G, *Pleurophorella?* sp., composite mould of left valve CEGH-UNC 23115, x1,3.

Repository. CEGH-UNC - "Centro de Investigaciones Paleobiológicas (CIPAL), Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba".

and Río del Peñón Formation (Río Blanco basin), the *Tivertonia jachalensis-Streptorhynchus inaequioratus* fauna has been described immediately above of beds carrying the Latest Carboniferous megafloristic assemblages NBG (Archangelsky and Azcuy, 1985) and the Interval Phytozone (Archangelsky and Cúneo, 1991). This relationship, as well as the palynological data from the associated horizons to this fauna (Vergel and Fasolo, 1999), allowed to identify the Latest Carboniferous-Earliest Permian interval in Preordillera. From the lower part of the Quebrada Larga Formation at the type locality, the megafloristic assemblage NBG has been documented by Arrondo (in Scalabrini Ortiz, 1971). Hence, because of the presence of early Permian *Tivertonia jachalensis-Streptorhynchus inaequioratus* fauna, the Quebrada Larga Formation is also proposed as a key section for studies of the Carboniferous-Permian boundary.

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