

NEW PALYNOLOGICAL ASSEMBLAGE FROM THE CHIGUA FORMATION (EARLY LATE-MIDDLE DEVONIAN), AT DEL CHACO CREEK, VOLCÁN RANGE, PRECORDILLERA ARGENTINA

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Introduction

In the northwestern of the Precordillera Range in San Juan Province (ca. 30° S and 69° W), Devonian deposits crop out belonging to the Chinguillos Group (Pircas Negras and Chigua formations), extended to the east of the Blanco River, in the western slope of the Punilla and Volcán ranges (Figure 1A) and comprised into the Cuyana or Precordillerana Basin (Padula *et al.*, 1967). The Chigua Formation (ca. 700 m), overlies in fault contact the Pircas Negras Formation and underlies in angular unconformity the Malimán Formation (Early Viséan, Amenábar, 2006, Figure 1B). The Chigua Formation is divided into two Members, the lower Chavela (marine) and the upper Ramadita (mixed-continental) (see Baldis and Peralta, 2000; Figure 1B). The lithology consists mainly of concretionary shales and calcareous lenses with subordinate sandstone layers, and was considered deposited under marine conditions. Some fossils have been found in this unit between La Cortadera and Del Chaco creeks (Figure 1A) including marine invertebrates (e.g., trilobites, cephalopods, cnidarians; see Baldis and Sarudiansky, 1975) and a paleoflora represented by the herbaceous lycophytes (e.g. "*Haplostigma*" *furquei* Frenguelli; see Gutierrez, 1996). New palynological data from these Devonian deposits at Del Chaco creek are presented in this contribution.

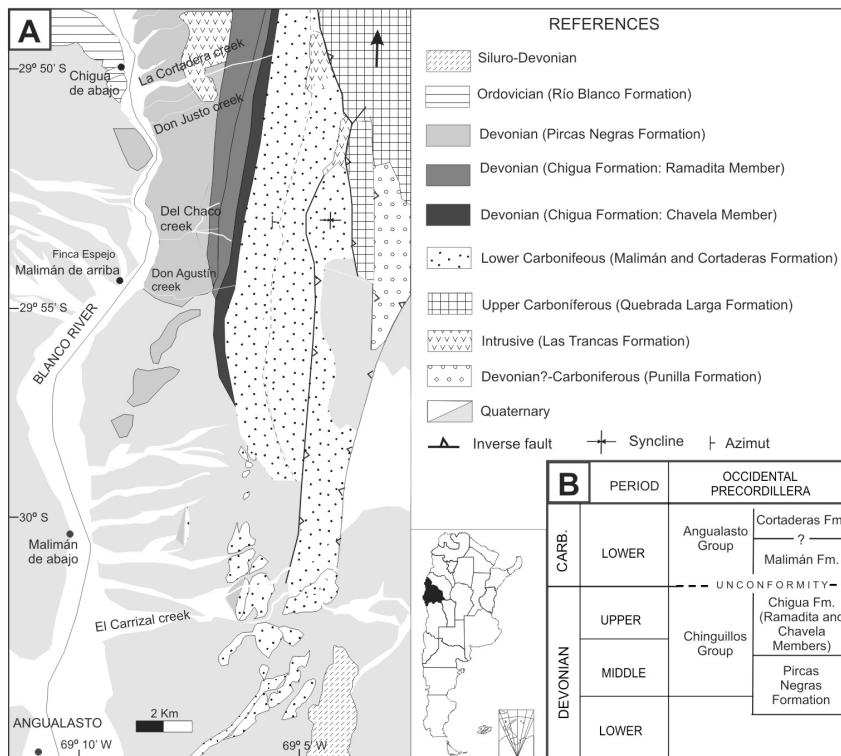


Figure 1.A. Geological map and geographical location of Del Chaco creek in San Juan Province, Argentina. **B.** Chronostratigraphy of the Chinguillos Group (Devonian), after Baldis and Sarudiansky (1975).

Palynological information and age of the palynoassemblages

The first detailed palynological study from the Chigua Formation was carried out by Amenábar *et al.* (2006) at La Cortadera creek. Palynological levels coming from the Del Chaco

creek (Figure 1A), are scarce (only 3 fertile of 5 sampled), but they have yielded rich microfloras with abundant and well-preserved palynomorphs in spite of the strong alteration that have suffered the rocks at this place. Two assemblages are distinguished (Figure 2): one obtained from shales (BAFC-PI 1797) is very rich in palaeomicroplankton (palynoassemblage 1) while the other (BAFC-PI 1780) has spores as dominant elements (palynoassemblage 2). This level was obtained from a carbonaceous shale that is intercalated with sandstones layers bearing megaflores remains assignable to a lycophyta (it is still under study). The third level (BAFC-PI 1798) has very few palynomorphs so it is not considered as part of the mentioned assemblages.

The **palynoassemblage 1** is characterized by a high palaeomicroplankton diversity (26 species are identified that represents the 72% of the total of the association) and some of the specimens reach large sizes (Figure 3). Spores are subordinated elements in the assemblage (10 species=28%) but some are biostratigraphically important such as *Dictyotriletes emsiensis* Morphon, *Emphanisporites decoratus*, *Acinosporites hirsutus* and the species of genus *Grandispora* (Figures 2, 3). *D. emsiensis* Morphon has been registered in the Talacasto Formation (Central Precordillera of Argentina), and the assemblage was attributed to late Lochkovian-Emsian (LeHérissé *et al.*, 1997). In Brazil, it is recognized in the late Lochkovian-Emsian deposits in the Solimões (Rubinstein *et al.*, 2005), Paraná (Dino, 1999) and Amazon basins (Melo and Loboziak, 2003). According to Melo and Loboziak (2003) the *Grandispora/Samarisporites* spp. (GS) Interval Zone defined in Amazon Basin, of the late Emsian-early Eifelian (Early to Middle Devonian) is characterized by the appearance of large-sized spinose pseudosaccates/zonates spores of the genera *Grandispora*, *Samarisporites* and *Craspedispora*. It can also present some species as remainders of the Early Devonian like *Dictyotriletes emsiensis* but it has not persisted into younger biozones. Thus, the presence of *D. emsiensis* Morphon together with some species of the *Grandispora* genus in the sample BAFC-PI 1797, allows to attributed it to the late Emsian-early Eifelian (Early late to Middle early Devonian) (Figures 2, 3).

On the other hand, the **palynoassemblage 2** is composed of dominantly continental elements (19 species of spores and only 5 species of palaeomicroplankton are identified; representing the 79.2 % and 20.8% respectively) where pseudosaccate spores of the genus *Grandispora* are especially dominant (e.g., *Grandispora mammillata*, *G. pseudoreticulata*) and other diagnostic spore species are: *Acinosporites hirsutus*, *A. macrospinosus*, *A. acanthomammillatus*, *Corystisporites horridus*, *Dibolisporites* sp. cf. *D. eifeliensis* and *Leiotriletes balapucensis* (Figures 2, 3). This level is comparable and so, correlatable to the level BAFC-PI 1505 and 1656 recorded from the La Cortadera creek (Amenábar *et al.*, 2006), as they share the spores species *Grandispora pseudoreticulata*, *Leiotriletes balapucensis*, *Dibolisporites* sp. cf. *D. eifeliensis*, *Acinosporites acanthomammillatus*. These taxa together with *Acinosporites hirsutus*, *A. macrospinosus*, *Acanthotriletes horridus* and *Grandispora mammillata*, registered in the Givetian palynozones *D. devonicus*-*G. naumovii* (DN) and *G. lemurata*-*C. magnificus* (LM) Richardson and McGregor (1986) of Euramerica and the Interval zones GS, Per and LLI of Amazon basin (Melo and Loboziak, 2003), allow to assign this assemblage to the early Givetian. The absence in both assemblages from Chavela Member at La Cortadera and del Chaco creeks of index species of the middle-late Givetian (e.g., *Samarisporites triangulatus*) avoids their correlation to the assemblage A2 from the Los Monos Formation (Tarija Basin, di Pasquo, 2007).

Age and palaeoenvironmental considerations

Based on the comparison with other microfloras of the world mainly with Brazil and Euroamerica, a late Emsian-early Eifelian, and an early Givetian age are proposed for the palynoassemblages 1 and 2 respectively (see Figure 2). Considering the simultaneous presence of trilobite fossils comparable to those of the *Acanthopyge balliviani* zone (Eifelian or Emsian, according to different authors, see Baldis and Saurdiannsky, 1975) defined in Bolivia, with the cephalopod genus *Tornoceras* (Fransian) in the Chigua Formation, Baldis and Sarudiansky (1975) suggested that the range of the unit would be comprised the Emsian-Eifelian boundary up to the Givetian-Frasnian boundary. Therefore, these authors indicated that the presence of

Tornoceras could induce to decrease the age of *A. balliviani* and thus they propose a tentative Givetian age for the Chavela Member of the Formation Chigua. Besides, a close affinity among the microfloras from the Precordillera and the north of Argentina and southern Bolivia (Tarija Basin) are reinforced by the several common species recorded (palynology and invertebrates and plant fossils) supporting a palaeogeographical connection between both areas during the Devonian (Baldis, 1967).

Although the scarce palyniferous levels studied at Del Chaco creek, the palaeomicroplankton/spore ratio was useful to interpret some palaeoenvironmental changes along the Chavela Member. Thus, a tendency to a continentalization of the succession since the Early late Devonian (Emsian-Eifelian) to the Middle Devonian (early Givetian), is suggested. These palaeoenvironmental considerations are coincident with previous palaeontological records (see Baldis and Peralta, 2000). Additional sedimentological studies and new fertile palynological samples will allow improving the recognition of transgressive-regressive cycles in the Devonian of Precordillera.

Finally, it is highlighted that the strong tectonic activity that occurred not only during the Middle to Late Palaeozoic but also during the Andean Orogeny (cf. Alonso *et al.*, 2005), mainly in this region of the Precordillera would have been the principal reason to explain the absence of the organic matter in most of the Devonian sediments and the difficulty to find more complete sections.

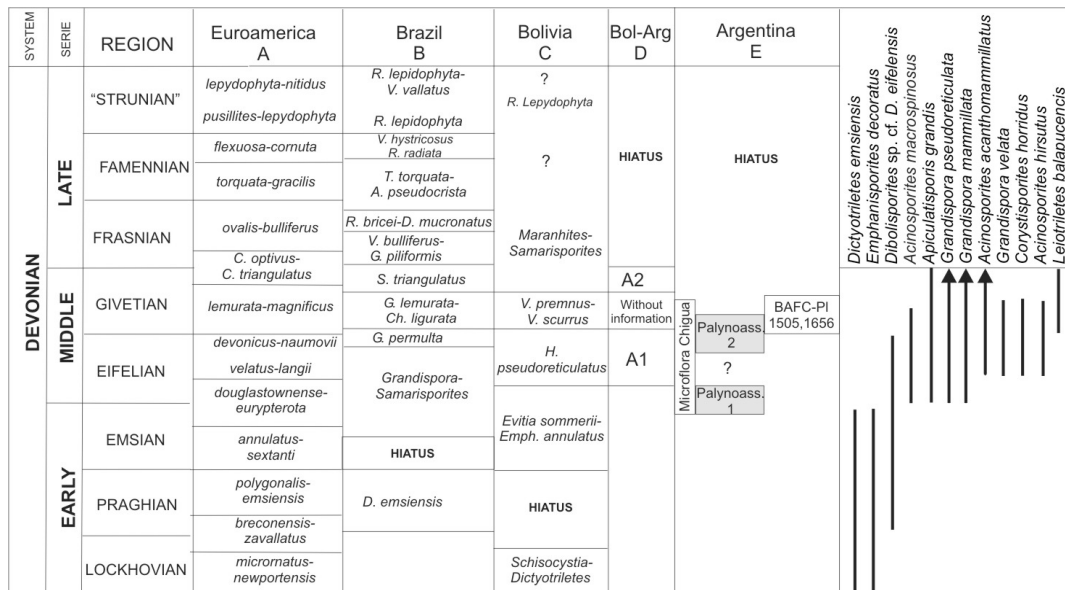


Figure 2. Summarised correlation chart of the assemblages here studied (E) with other Devonian biozones or assemblages of Euroamerica (A), Brazil (B), Bolivia (C), Argentina-Bolivia (D) and the stratigraphical ranges of selected spore species recovered from the Chigua Formation (Chavela Member) at Del Chaco creek. References: A: Richardson and McGregor (1986). B: Melo and Loboziak (2003). C: Suárez Soruco and Lobo Boneta (1983); Limachi *et al.* (1996). D: di Pasquo (2007). In the column E, the Microflora of the Chigua Formation (BAFC-PI 1505, 1656) at La Cortadera creek (Amenábar *et al.*, 2006) is included. Correlation chart modified from di Pasquo (2007).

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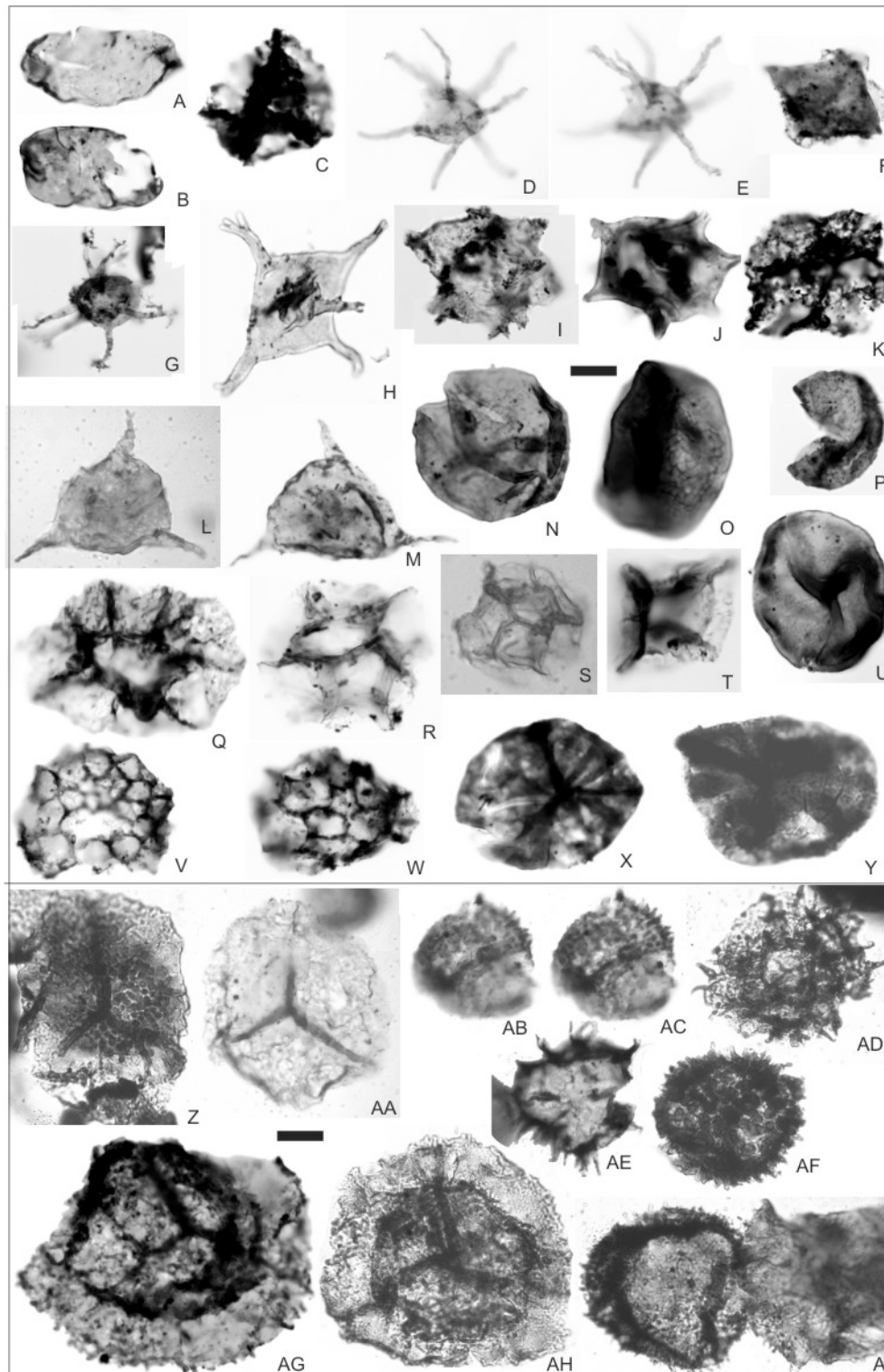


Figure 3. Palaeomicroplankton and spores of the Chigua Formation at Del Chaco creek. **A-Y.** PALYNOASSEMBLAGE 1. **A.B.** *Navifusa bacilla* (Deunff) Playford. **A.** BAFC-PI 1797 (2): 28/115.6. **B.** BAFC-PI 1797 (2): 21/100.6. **C.** *Arkonites bilixus* Legault. BAFC-PI 1797 (2): 49.1/115. **D.E.** *Diexallophasis simplex* Wicander and Wood. BAFC-PI 1797 (2): 26/98. **F.** *Duvernaysphaera angelae* Deunff. BAFC-PI 1797 (2): 32.3/117.9. **G.** *Multiplicisphaeridium ramusculosum* (Deflandre) Lister. BAFC-PI 1797 (2): 24.4/105.7. **H.** *Exochoderma arca* Wicander and Wood. BAFC-PI 1797 (2): 54.2/96. **I.** *Estiastra improcera* Loeblich. BAFC-PI 1797 (2): 23/99. **J.** *Evittia* sp. cf. *E. cymosa* Loeblich. BAFC-PI 1797 (2): 48.4/117.5. **K.** *Quadrisporites variabilis* (Cramer) Ottone and Rossello. BAFC-PI 1797 (2): 55/107. **L-M.** *Veryhachium trispinosum* (Eisenack) Deunff. **L.** BAFC-PI 1780 (1): 23.1/102.5. **M.** BAFC-PI 1797 (2): 46.7/119.8. **N-P, U.** *Dictyotidium* spp. **N.** BAFC-PI 1797 (2): 57/107.2. **O.** BAFC-PI

1797 (2): 22.3/102.7. **P.** BAFC-PI 1797 (2): 54.1/985. **U.** BAFC-PI 1797 (2): 23/98.5. **Q.** *Dictyotidium munificum* (Wicander and Wood) Amenábar, di Pasquo, Carrizo and Azcuy. BAFC-PI 1797 (2): 39.2/96. **R.** *Cymatiosphaera canadensis* Deunff. BAFC-PI 1797 (2): 19.9/102.2. **S.** *Cymatiosphaera perimembrana* Staplin. BAFC-PI 1780 (1): 23.4/102.5. **T.** *Polyedryxium embudum* Cramer. BAFC-PI 1797 (2): 21.7/107.2. **V-W.** *Dictyotriteles emsiensis* (Allen) McGregor. **V.** BAC-PI 1797 (2): 49.6/115.5. **W.** BAFC-PI 1797 (2): (N) 19.9/102.2. **X.** *Emphanisporites rotatus* McGregor emend. McGregor. BAFC-PI 1797 (2): 24.3/113.1. **Y.** *Emphanisporites decoratus* Allen. BAFC-PI 1797 (2): 46/109.6. **Z-AI.** PALYNOASSEMBLAGE 2. **Z.** *Grandispora mammillata* Owens. BAFC-PI 1780 (1): 32/93. **AA.** *Leiotriteles balapucensis* di Pasquo. BAFC-PI 1780 (1): 43.3/114. **AB-AC.** *Acinosporites acanthomammillatus* Richardson. BAFC-PI 1780 (1): 40/99.4. **AD.** *Acinosporites macrospinosus* Richardson. BAFC-PI 1780 (1): 30.7/106.4. **AE.** *Corystisporites horridus* (Hacquebard) McGregor and Camfield. BAFC-PI 1780 (1): 42.2/98.6. **AF.** *Acinosporites hirsutus* (Brideaux and Radforth) McGregor and Camfield. BAFC-PI 1780 (1): 38.6/106.8. **AG.** *Grandispora velata* (Eisenack) Playford. BAFC-PI 1797 (2): 51.6/118.5. **AH.** *Grandispora pseudoreticulata* (Menéndez and Pöthe de Bladis) Ottone. BAFC-PI 1780 (1): 25.8/99. **AI.** *Dibolisporites* sp. cf. *D. eifeliensis* (Lanning) McGregor. BAFC-PI 1780 (1): 40.8/93.8. Scale bar 1 cm=20 µm (x 500) in A-B, D-E, G-H, L-M, Q, Z-AI; 1 cm=15 µm (x 750) in C, K, N-P, R-Y; 1 cm= 10 µm (x 1000) in F, I-J. The slides are housed with sample numbers BAFC-PI from the Laboratory of Palynology (Department of Geology, Exact and Natural Sciences Faculty, University of Buenos Aires).

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