SILURIAN TO LOWER DEVONIAN PALYNOMORPHS FROM THE BARRANCOS REGION, OSSA MORENA ZONE, PORTUGAL – PRELIMINARY RESULTS

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SUMMARY

New miospore results were obtained from the Palaeozoic stratigraphic succession present in the Barrancos region, Portugal. The studied formations comprise the Silurian carbonaceous shales intercalated with cherts and rare lenticular carbonates of the Xistos com Nódulos Formation, as well as, the dark shales that alternates with thin psammit beds of Late Silurian to Early Devonian age from the Xistos Raiados Formation. Two miospore biozones were identified: the cf. *protophanus-verrucatus* Miospore Biozone, of the Lower Wenlock (Homerian) (Richardson & McGregor, 1986) and the *Verrucosisporites polygonalis* (Po) Miospore Biozone of the Lower Pragian (Streel et al., 1987). For the first time cryptospores are reported. Rare acritarchs and chitinozoans are also present. This new preliminary data allow correlation with the graptolite biozonation already established in this region (Piçarra, et al., 1995, 1998; Piçarra, 2000) and completes previous palynological studies (Pereira et al., 1999). Even so, detailed palynostratigraphic research is needed and is currently being undertaken to better understand the complex geology of the region.

Keywords: Cryptospores, trilete spores, Silurian to Lower Devonian, Barrancos, Portugal.

INTRODUCTION

The Palaeozoic geology of the Ossa Morena Zone is well represented in the stratigraphic succession of the Barrancos region, Portugal, and comprises sedimentary rocks from Cambrian to Early Devonian age (Delgado, 1908; Perdigão *et al.*, 1982; Oliveira *et al.*, 1991, Pereira *et al*., 1999, Piçarra, 2000) (Figure 1).

In this region, the Silurian and Devonian strata are represented by two formations, the Xistos com Nódulos and the Xistos Raiados Formations (Delgado, 1908). The Xistos com Nódulos consists of black carbonaceous shales intercalated with thin black cherts and rare lenticular carbonates at the top of the succession. This formation is rich in graptolites, which allow very accurate age determinations. Seventeen Silurian graptolite biozones were identified in the Xistos com Nódulos Formation (Delgado, 1908; Romariz, 1962; Perdigão *et al.*, 1982; Gutierrez-Marco, 1982; Rigby *et al,*. 1997; Piçarra *et al*., 1995, 1998; Piçarra, 2000).

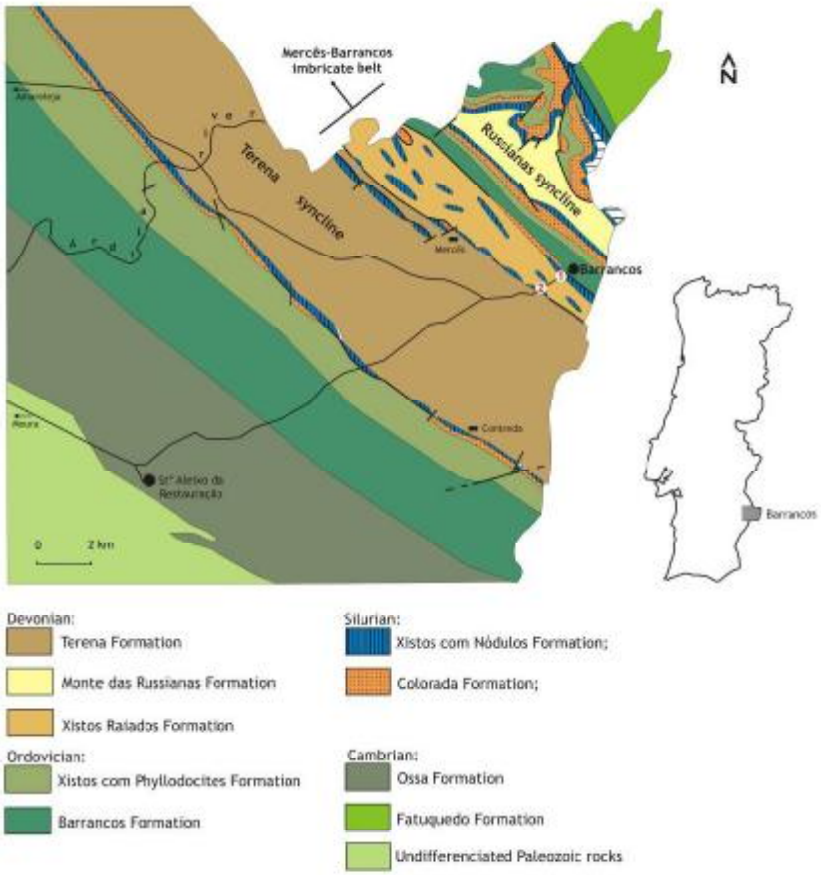

Figure 1. Simplified geological map of the Barrancos region (adapted from Piçarra et al., 1995; 1998; 2000 and Araújo et al., 2006), showing the position of the studied trenches.

The Xistos Raiados Formation is composed of dark shales that alternate with thin psammit beds. This formation has traditionally been considered Wenlock to Early Ludlow age (Delgado, 1908; Perdigão *et al*., 1982). However, more recent works indicate an age ranging from the Late Silurian (Ludlow-Prídolí) to the Early Devonian (Oliveira *et al*., 1991; Oliveira *et al*., 1993; Piçarra *et al*., 1998; Pereira *et al*., 1998, 1999).

The Xistos com Nódulos Formation reflects a euxinic sedimentary environment related to the end Ordovician glaciation, whose physical conditions remained stable throughout the Silurian. The Xistos Raiados Formation, on the other hand, indicates more shallow and oxygenated waters reflecting the beginning of a differentiated tectono-sedimentary evolution (Perdigão *et al.*, 1982; Oliveira *et al.*, 1991; Araújo *et al.*, 2006).

Palynological studies established during the last decade mostly concentrated on the upper part of the stratigraphic sequence, *e.g*. the Lower Devonian Xistos Raiados, Russianas, and Terena formations (Oliveira *et al*., 1993; Piçarra *et al*., 1995, 1998; Pereira *et al*., 1998, 1999; Piçarra, 2000). This presentation is a preliminary account of the palynological assemblages of miospores (cryptospores and trilete spores) of the Silurian to Lower Devonian strata of the Barrancos region, aiming toward a better understanding of the regional palynostratigraphy.

Produced by primitive land plants from the Ordovician to the Lower Devonian, cryptospores are here identified and reported for the first time.

Herein, we use the cryptospore definition proposed by Steemans (2000): "Alete miospores (non-pollen grains) produced by primate embryophyts. Single grains or monads, "permanent" dyads and tetrads, and sporomorphs from polyads which may or may not preserve contact areas, are included."

PALYNOSTRATIGRAPHY

Twenty-seven samples, collected in the road cut of EN 258, Km 103,7 near Barrancos and in the Eiras Altas Section (Figure 1), were processed for palynological studies.

Standard palynological laboratory procedures were employed in the extraction and concentration of the palynomorphs from the host sediments (Wood *et al*., 1996). The slides were examined with transmitted light, per BX40 and CX41 Olympus microscopes equipped with an Olympus C5050 and a SC20 digital cameras facility. All samples, residues, and slides are stored in the LNEG-LGM (Geological Survey of Portugal) at S. Mamede Infesta, Portugal.

The general miospore biozonal scheme for the Silurian to Lower Devonian used herein, follows Richardson and McGregor (1986), Burgess and Richardson (1995), Richardson *et al.* (2001), and Streel *et al.* (1987).

1. Road cut EN 258, Santo Aleixo da Restauração to Barrancos, km 103.7 (Figure 2)

This section is located in the road cut between kms 103.3 and 103.7 of the road from Santo Aleixo da Restauração to Barrancos, at the entrance of this village. The trench exposes, from northeast to southwest, a sedimentary succession that ranges from the Upper Ordovician to the Lower Devonian. It begins with the impure sandstones of the Colorada Formation (?Upper Ordovician-Lower Silurian/Rhuddanian) which is in fault contact with the black cherts of the basal part of the Xistos com Nódulos Formation. These are followed by black shales (when the weathering is very intense, the shales show pale colours) intercalated with thin black cherts and sporadic siliceous nodules (rare in the upper part), containing graptolites of Llandovery to Late Wenlock age.

The upper part of the Xistos com Nódulos Formation had four samples (BA4, 8, 9, 10) that yielded very poor to moderately preserved miospores (cryptospore and triletes spores) assigned to the cf. *protophanus-verrucatus* Miospore Biozone of the Lower Wenlock (Homerian) (Richardson & McGregor, 1986).

Also present in the assemblage are the cryptospores: *Gneudnaspora chibrikovae, Gneudnaspora chibrikovae?, Gneudnaspora plicata*?, *Imperfectotriletes vavrdovae, Pseudodyadospora petasus?*and *Quadritisporites variabilis.*

Completing the assemblage are the trilete spores *Ambitisporites avitus/dilutus* Morphon, *Ambitisporites tripapillatus, Amicosporites* sp., *Aneurospora* sp*., Archaeozonotriletes chulus* Morphon, *Emphanisporites multicostatus*, *Retusotriletes* sp., *Insolisporites anchistinus,* in association with the key species *Emphanisporites* cf. *protophanus.*

The last meters of the road-cut section expose dark shales with thin intercalations of sandstones with rare siliceous and ferruginous nodules that belong to the Xistos Raiados Formation. This part of the section was dated at the Pragian/Emsian boundary, based on miospores assigned to the upper part of the PE Biozone of Richardson and McGregor (1986), and *Dictyotriletes subgranifer* (Su) subzone of Streel *et al*. (1987).

New samples collected (BA12) in the mid part of the section yielded a very poor preserved miospore assemblage assigned to the *Verrucosisporites polygonalis* (Po) of Streel *et al*. (1987), that allows dating this part of the section as lower Pragian. The most common species present are: *Ambitisporites* sp., *A. tripapillatus*, *Amicosporites miserabilis*?, *Emphanisporites multicostatus*, and *Retusotriletes* sp., together with the guide species *Verrucosisporites polygonalis.* The cryptospores found was *Gneudnaspora chibrikovae.*

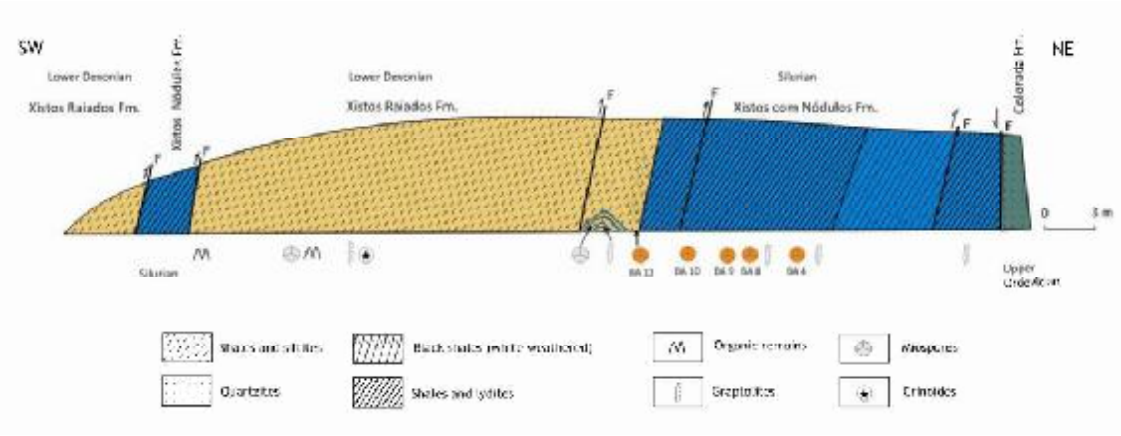

Figure 2. Scheme of the road cut EN 258, Sto Aleixo da Restauração to Barrancos, km 103,7, with location of productive palynostratigraphic samples (adapted from Oliveira, *et al*., 2000).

2. Eiras Altas Section

This section is located on the road Santo Aleixo da Restauração to Barrancos, at km 102.15, and shows the best known and complete, although condensed, Portuguese Silurian succession. The succession comprises the Xistos com Nódulos Formation and part of the Xistos Raiados Formation, and yielded 13 Silurian graptolite biozones (Piçarra *et al*., 1995, 1998; Piçarra, 2000). Here, the Xistos com Nódulos Formation consists of intensively weathered black shales that gradually pass to the base of the Xistos Raiados Formation, which is marked by the first occurrence of thin bedded dark shales and siltstones.

Twelve samples collected from the Xistos com Nódulos Formation were barren of palynomorphs, probably due to the intense weathering of the black shales as indicated by its pale colours. However, because of the importance of the section, a new sampling campaign was undertaken, and these samples are currently undergoing analysis.

CONCLUSIONS

Palynostratigraphy constitutes an important tool for precisely dating the Silurian to Devonian sequences of the Barrancos region. It is important and necessary that the correlation between the data obtained from palynology and the graptolite biozonations established in this region (Piçarra, *et al*., 1995, 1998; Piçarra, 2000).

The preliminary results obtained in this study allow the recognition of two miospore biozones in one of the studied sections (road cut EN 258, Sto Aleixo da Restauração to Barrancos, km 103.7):

The first one is the cf. *protophanus-verrucatus* Miospore Biozone of Richardson & McGregor (1986), and was obtained from the Xistos com Nódulos Formation, placing part of the studied section in the upper part of the Wenlock Series (Homerian stage), and confirming previous studies based on graptolites that assigned this section to the *?lundgreni* Graptolite Biozone (Piçarra, 2000).

The second one is the *Verrucosisporites polygonalis* (Po) Miospore Biozone of Streel *et al*. (1987), and comes from the Xistos Raiados Formation, and thus is assigned to the Lower Pragian. This new data completes previous studies that revealed miospores of the *Dictyotriletes subgranifer* (Su) subzone of Streel *et al*. (1987) of the Pragian/Emsian boundary (Pereira *et al*., 1999) (Figure 2). All of this information indicates that almost the entire Pragian Stage is represented in Xistos Raiados Formation, despite the complexity of local tectonism. A more detailed palynostratigraphic study from this road cut and other sections of the Barrancos region are currently underway.

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