

# NEW LOWER GIVETIAN AGE MIOSPORES OF THE PHYLLITE - QUARTZITE GROUP (SÃO FRANCISCO DA SERRA ANTICLINE, IBERIAN PYRITE BELT - PORTUGAL)

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## SUMMARY

Palynostratigraphical analysis of Phyllite – Quartzite (PQ) Group shales recovered from a drill core and outcrops at the São Francisco da Serra anticline, in the westernmost area of the Iberian Pyrite Belt, yielded a moderately preserved miospore assemblage assigned to the upper part of AD miospore Biozone, subzone Lem, of lower Givetian age. This is the oldest age recognized, up to this date, for any rocks in the Iberian Pyrite Belt.

**Keywords:** Palynostratigraphy, miospores, lower Givetian, Phyllite - Quartzite Group, Iberian Pyrite Belt

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## INTRODUCTION

The stratigraphy of the Iberian Pyrite Belt (IPB) consists of two major units; the Phyllite Quartzite Group (PQG) and the Volcano Sedimentary Complex (VSC). PQG is the detritic basement of the belt and consists mostly of interbedded phyllites, quartzites, quartzwackes and shales, with limestone lenses and nodules in the upper part of this unit. The base of the unit is still unknown and its thickness is in excess of 200m.

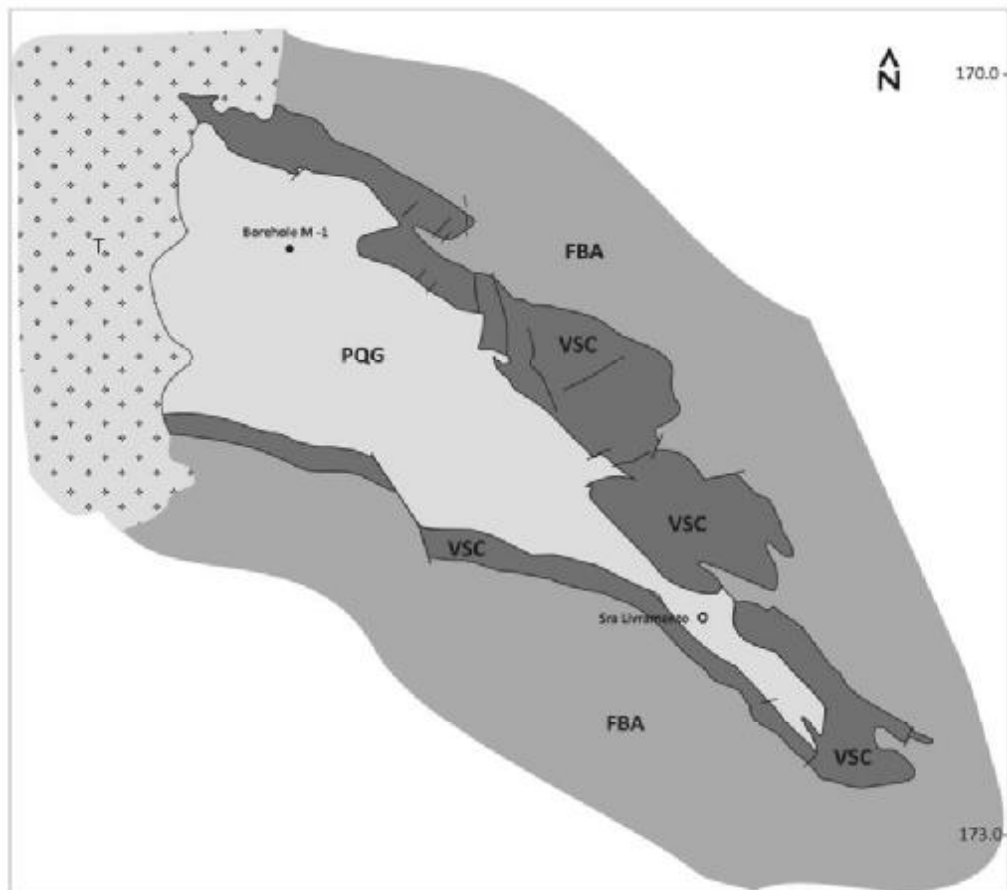
In the south branch of the IPB, the PQG occurs in the core of rooted anticline structures, from SE, the Pomarão Anticline (in the western termination of the Puebla de Guzmán anticline, in Spain), Rosário Anticline (where the Neves Corvo mine is located), to NW, the Lousal and São Francisco da Serra anticlines. All of these structures are being palynologically investigated. The PQG has been dated as Upper Devonian (lower Frasnian to late Strunian) by ammonoids, conodonts and palynomorphs in Portugal (BOOGAARD, 1967, FANTINET et al. 1976; CUNHA & OLIVEIRA, 1989; OLIVEIRA et al., 1997; OLIVEIRA et al., 2004, PEREIRA et al., 2004) and in Spain (González, 2005).

The aim of the present paper is to present the first palynological results from the São Francisco da Serra Anticline, which indicate the oldest age determined in the IPB stratigraphic sequence

## GEOLOGICAL SETTING

The S. Francisco da Serra Anticline represents the NW termination of the IPB in Portugal (Figure 1). The axis of the anticline plunges SE, whereas its western part is fault bounded and covered by Tertiary sediments.

The stratigraphic succession of the anticline shows the classic units of the IPB: at the base the PQG consisting mostly of shales interbedded with quartzites (sometimes massive) overlain by the Volcano-Sedimentary Complex (VSC), here dominated by fine volcanoclastic sediments, minor felsic volcanics, purple shales and dark carbonaceous shales in the upper part. The thickness of the PQG is unknown and that of the VSC is approximately 100 metres. Stratigraphically above the VSC are the deep-water turbiditic sediments of the Mértola Formation of Middle Late Viséan age.



**Figure 1.** Simplified geology of the S. Francisco da Serra Anticline (adap. Alves et al., 1985). FBA - Mértola Formation (Flysch); VSC - Volcano-Sedimentary Complex; PQG - Phyllite-Quartzite Group; Tertiary sediments.

## MATERIALS AND METHODS

Samples for this study were collected from a drill core (M1) and from outcrops located along the margins of a valley north of the Senhora do Livramento Chapel (Figure 2). Biostratigraphic research has been based on palynomorphs. 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, using a BX40 Olympus microscope equipped with an Olympus C5050 digital camera. All samples, residues and slides are stored in the LNEG-LGM (Geological Survey of Portugal) at S. Mamede Infesta, Portugal. The miospore biozonal scheme used follows the standard Western Europe Miospore Zonations (after: Clayton et al., 1977; Streeel et al., 1987; Higgs et al., 1988, Clayton, 1996, Pereira , 1999, Pereira et al., 2008).

## PALYNOSTRATIGRAPHY

The 'Senhora do Livramento' outcrop section and the M1 borehole were studied and sampled for palynostratigraphic investigation.

### *Senhora do Livramento Section*

This section is located along a river valley north of the Senhora do Livramento Chapel (Figure 2) and represents the upper 100 metres of the PQG succession in this anticline. The succession consists of grey/black shales interbedded with quartzites. The quartzite beds are concentrated in two intervals. The basal interval is organised in a thinning upward succession and the beds show wave ripples and hummocky cross stratification, suggesting deposition on a shallow siliciclastic platform. The upper interval, the Senhora do Livramento Quartzites, consists of 30 metres of massive amalgamated quartzites, sometimes coarse grained, showing as dominant structures, low angle current and parallel laminations, which also indicates deposition in a shallow marine environment.

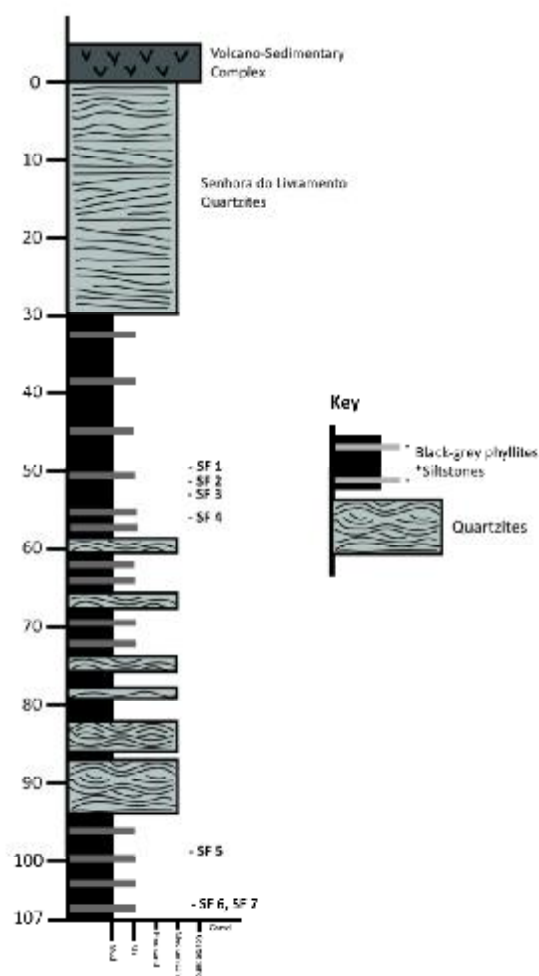
Seven samples were collected from the Senhora do Livramento measured section for palynostratigraphic research. However, all the samples were barren, probably due to the intense weathering of the shaley lithologies.

### *M1 Borehole*

The M1 borehole (a vertical borehole 367m deep drilled by the Sociedade Mineira Riofinex, at Quinta do Poço in 1993) is located in the central part of the anticline. The succession consists of highly fractured black shales interbedded with thin-bedded quartzites. Samples from this section yielded a moderately preserved miospore assemblage assigned to the upper part of AD miospore Biozone (subzone Lem), of lower Givetian age.

The most common species present are: *Acinosporites lindlarensis*, *Aneurospora greggsii*, *Cymbosporites magnificus*, *Emphanisporites annulatus*, *E. rotatus*, *Grandispora protea*, *Retusotriletes rugulatus*, *Verrucosisporites premnus* and *V. scurrus* in association with the guide specie *Geminispora lemurata*.

**Figure 2.** Senhora do Livramento section, corresponding to the upper 100 m of the PQG in the S. Francisco da Serra Anticline. Characters on the right refer to the samples studied.



*Cristatisporites triangulatus* is absent. The first occurrence of this species is at the base of the TA Biozone, confirming the position of the assemblage, as pre-TA Miospore Biozone.

Also present are reworked miospores of Lower Devonian age (e.g. *Archaeozonotriletes chulus*, *Brochotriletes* sp., *Camarozonotrilestes sextantii* and *Diatomozonotriletes franklini*).

## **CONCLUSIONS**

The present research confirms the autochthonous nature of the São Francisco structure and demonstrates that the age of PQG is not yet definitively achieved. Our new results suggest that the lower part of the PQG may be as old as lower Givetian in the westernmost part of the IPB. The first appearance of *Geminospora lemura* marks the base of Lem Subzone of the AD Biozone of lower Givetian age (Streel et al., 1987). According to Loboziak & Streel (1980; 1987; 1988; 1989), *G. lemurata* first occurs close to the proposed base of the Givetian stage. However, the common presence of reworked Lower Devonian miospores in many of the samples studied in this basin suggests that the PQG could extend down into the Lower Devonian.