

Palynostratigraphy of the Toca da Moura and Cabrela Complexes, Ossa Morena Zone, Portugal. Geodynamic implications

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Abstract

Two volcano-sedimentary complexes, the Toca da Moura Complex (TMC) and the Cabrela Complex (CAC), situated in the southwestern border of the Portuguese part of the OMZ, were investigated for palynostratigraphy. The TMC studied sections provided miospores assigned to the middle late Viséan NM spore Biozone, early Viséan Pu Biozone and late Tournaisian CM Biozone. Several stratigraphic sections of the CAC provided miospores of the same age. Reworked Devonian and Tournaisian palynomorph assemblages are quite common in the studied samples. The TMC and the CAC thus appear to be coeval. The TMC crops out in close association with the plutono-volcanic suite of the Beja Massif while the CAC is discordant on a Variscan (Silurian?) well-structured substrate. The geochemical signature of the TMC volcanic rocks indicates their relationship with an orogenic volcanic arc generated in close association with a north deeping subduction zone. The CAC has probably the same origin. Both complexes were laid down in intra-arc small basin(s) whose margins were the locus of intense erosion.

Palynological assemblages obtained from the Ossa Morena Zone are comparable to those recognized from the Late Devonian and Mississippian of the South Portuguese Zone. Similarities between the assemblages from the two crustal blocks show that they were close to each other during this interval. Thus, the oceanic basin that existed between the two blocks and to which the Beja-Acebuches Ophiolite is related was closed prior Late Devonian.

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1. Introduction

The Ossa Morena Zone (OMZ) has been subdivided into different tectonostratigraphic units, also called “sectors” or “domains” (Carvalho et al., 1971; Delgado et al., 1977; Apalategui et al., 1990; Oliveira et al., 1991) where the Paleozoic stratigraphic sequences are

different in thickness and lithology. Stratigraphic studies and correlations between these sequences are particularly difficult, due to the scarcity of fossiliferous levels and biostratigraphic data. The age of Paleozoic stratigraphic formations has frequently been deduced from lithological similarities or from their stratigraphic position in structural units. Recent progress that came from palynological studies in the Portuguese part of the OMZ (Cunha in Andrade et al., 1991; Pereira, 1999; Pereira and Oliveira, 2001a,b; Pereira et al., in press) shows that palynostratigraphy represents an important

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tool to date the OMZ formations and can open new perspectives for biostratigraphy and for correlations.

The Toca da Moura (TMC) and Cabrela Complexes (CAC) are the aim of the present study. The former occurs in the Santa Susana–Odivelas region of the Beja Massif, the southwestern sector of the Portuguese part of the OMZ; the latter occurs in the Cabrela syncline of the Montemor–Ficalho “sector” (Oliveira et al., 1991). Their paleogeographic and geodynamic significance within the context of the evolution of the OMZ has been a matter of debate, particularly due to uncertainties concerning their ages. Data from new studied sections confirm previous preliminary age determinations and allow a better understanding of the significance of these complexes in the regional geology of this part of the OMZ.

2. Geological setting

2.1. Toca da Moura Complex

The Toca da Moura Complex (TMC) is a volcano-sedimentary sequence that belongs to the Beja Massif, a calc–alkaline plutono-volcanic suite located at the southwestern border of the Portuguese part of the OMZ. The TMC is exposed in scattered outcrops between the villages of Santa Suzana and Alfundão (Fig. 1) where it is composed of basalts, diabases, microdiorites, andesites, rhyolites and reworked tuffs, with metre-thick intercalations of shales (Gonçalves, 1985; Santos et al., 1987; Fig. 1). The complex is generally bounded by faults and the outcrops are restricted to road cuts and quarries. One only exception is the section along the São Cristovão River where alternations of basic, intermediate and acidic volcanic rocks and interbedded metre to decametre intercalations of shales are well exposed. Locally the basic volcanic rocks show pillow and hyaloclastite structures indicating a deposition in a sub-aqueous environment. The total thickness of the complex here is in excess of 500m.

Known ages of the TMC are based on miospores from shales from the Corte Pereiro quarry. They indicate a late Tournaisian age (Cunha in Andrade et al., 1991). More recently, it has been proved that the age of these shales reach the mid late Viséan (Pereira and Oliveira, 2001b; Pereira et al., 2004a).

The TMC is unconformably overlain by the continental coal-bearing detritic sediments of the late Moscovian Santa Susana Formation (Wagner and Sousa, 1983; Gonçalves and Carvalhosa, 1984).

2.2. Cabrela Complex

The Cabrela Complex (CAC) is exposed in the Cabrela Syncline, near the Ossa Morena Zone border (Fig. 1). According to Ribeiro (1983) and Carvalhosa and Zbyzewski (1994), the stratigraphic succession consists of (Fig. 1a) a polygenic conglomerate (0–2m) at the base, followed by the Pedreira da Engenharia calciturbidites (0–10m) which are in turn unconformably overlain by the Cabrela Formation. The latter is composed of a basal conglomerate (10m), shales, greywackes and limestone lenses, and interbedded acidic volcanoclastic rocks, with a total thickness of about 200m. The Pedreira da Engenharia calciturbidites provided conodonts of late Eifelian age (Boogard, 1972) and the limestone lenses of the Cabrela Formation, yielded conodonts of late Frasnian age (Boogard, 1983). Pruvost (1914) had already identified, poorly geographic and stratigraphical located and badly preserved macrofaunas, of possible Late Devonian age in the limestones. The unconformity between the Pedreira da Engenharia calciturbidites and the Cabrela Formation has been interpreted as a marker of the first Variscan orogenic episode (Ribeiro, 1983; Quesada et al., 1990; Ribeiro et al., 1990). More recently it has been shown (Pereira and Oliveira, 2001a; Pereira et al., in press) that the shales of the Cabrela Formation are of late Tournaisian to late Viséan age and that the intercalated Frasnian limestone lenses are true olistoliths. The stratigraphic situation for the Eifelian Pedreira da Engenharia limestones cannot be determined as their base is not exposed. The possibility that they are also olistoliths cannot be ruled out.

These data demonstrate that the Frasnian limestone lenses should not be used as markers of an unconformity related to an orogenic episode. The Estação de Cabrela Formation, where the limestones are intercalated, was only tectonically deformed in post middle Viséan times.

3. Materials and methods

Stratigraphic sections were logged and samples collected in road cuts and quarries (Figs. 2 and 3). Standard palynological laboratory procedures were employed in the extraction and concentration of the palynomorphs (Wood et al., 1996). The slides were examined with transmitted light, with a BX40 Olympus microscope equipped with an Olympus C5050 digital camera. All samples, residues and slides are stored in the Geological Survey of Portugal (INETI), S. Mamede Infesta, Portugal.

The spore biozonal scheme used follows the standard Western Europe Miospore Zonation (after: Clayton et al.,

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