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New palynostratigraphical data of the Silves Group, Algarve Basin

Novos dados palinostratigráficos do Grupo de Silves, Bacia do Algarve

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Sumário: Este trabalho mostra dados palinostratigráficos que permitem aperfeiçoar a idade do Grupo de Silves na Bacia do Algarve. O Grupo de Silves constitui a unidade sedimentar mais antiga desta bacia e foi depositado de forma discordante sobre os turbiditos do Carbonífero superior da Formação Brejeira, dobrados e falhados durante a Orogenia Varisca. Os novos dados obtidos, permitem-nos apontar o início da sedimentação na Bacia do Algarve ao Carniano inferior e datar de idade Carniano todo o pacote sedimentar correspondente aos “Arenitos de Silves”. As camadas da base do “Complexo Margo-Carbonatado de Silves” correspondem ao Carniano superior, e os evaporitos possuem idade compreendida entre o Retiano superior e a base do Hetangiano, representando assim o limite entre o Triássico e o Jurássico, na bacia.

Palavras-chave: Grupo de Silves, Triássico-Jurássico, Esporos e pólenes, Palinostratigrafia, Bacia do Algarve

Key words: Silves Group, Triassic-Jurassic, spores and pollen, Palynostratigraphy, Algarve Basin

The Algarve Basin, located in the South of Portugal, is a Mesozoic sedimentary basin related to the breakup of Pangaea and the following extensional tectonic episodes that led to the opening of the North Atlantic Ocean. The sedimentation in the Algarve Basin began with detrital continental red beds that unconformably overlie Carboniferous turbidites, deformed and metamorphosed during the Variscan Orogeny (Palain, 1976; Terrinha *et al.*, 2013). The Grés de Silves Group is composed of sedimentary rocks whose depositional settings evolved from continental sedimentary environments, essentially fluvial, to shallow marine environments (Terrinha *et al.*, 2006). This group includes, from base to top, the “Silves Sandstones”, the “Silves Marl-Carbonated Evaporitic Complex” and the “Volcano-Sedimentary Series”.

The Grés de Silves Group's fossil content is poor and constrains its age determination. A Late Triassic age was assigned to the “Silves Sandstones”, based on the existence of branchiopod valves (*Eustheria* sp.), vertebrate remains *Phytosauria* (Mateus *et al.*, 2014) and *Metoposaurus* (Brusatte *et al.*, 2015). Based on geochronology, an Early Jurassic age (198.1 ± 0.4 Ma) dated a basalt flow at the top sequence of the “Volcano-Sedimentary Series”.

The present research aims to improve the ages of the Upper Triassic - Lower Jurassic stratigraphic record of the Grés de Silves Group in the Algarve Basin using palynology. For this, 250 samples were collected from 14 main sections. These sections were investigated to establish the detailed palynostratigraphic age and the depositional environmental settings based on a

qualitative and quantitative detailed study and the identification of key palynomorph taxa. Hereafter is a summary of the results attained.

In a roadcut along the CM1054 road, North of Portimão, palynomorphs were recovered from a 3 m thick layer located 2.5 m above the Variscan unconformity. The assemblage obtained shows moderate preservation and low diversity, allowing the identification of the following taxa: *Alisporites* sp., *Aulisporites astigmosus*, *Enzonalaspores vicens*, *Ovalipollis pseudoalatus*, *Samaropollenites speciosus*, *Tulesporites briscoensis*, and *Vallasporites ignacii* assigned to the early Carnian (Vilas-Boas *et al.*, 2022). This data indicates that sedimentation in the Algarve Basin began at the early Carnian (earliest Late Triassic).

In Vale Fuzeiros, near São Bartolomeu de Messines, a section representing the top layers of the “Silves Sandstones” was sampled. The mudstones yielded a low diversity and poorly preserved sporomorph assemblage. However, *Paracirculina quadruplicis*, *Patinasporites densus*, *Playfordiaspora* sp., *Samaropollenites speciosus*, *Triadispora* sp., *Vallasporites ignacii*, and *Verrucosisporites* sp., indicate a late Carnian age for the top limit of the “Silves Sandstones”.

The “Marl-Carbonate Evaporitic Complex” was studied along the northern cliffs of Amado Beach, Aljezur. Samples from the mudstone layers recovered a diverse and moderately well-preserved palynological assemblage. That assemblage includes the sporomorph taxa *Alisporites* sp., *Camerosporites*

secatus, *Enzonalaspores vicens*, *Lagenella martinii*, *Microcachrydites* sp., *Paracirculina quadruplicis*, *Playfordiaspora* sp., *Samaropollenites speciosus*, *Patinaspores densus*, *Vallasporites ignacii*, *Triadispora* sp., and *Verrucosisporites* sp.. Several taxa of algae complete the assemblage, such as *Botryococcus* sp., *Plaesiodyctyon mosellaneum* ssp. *variable*, *P. mosellaneum* ssp. *bullatum*, *Plaesiodyctyon* sp. (coenobial chlorophycean alga), Algae sp. A, and *Leiosphaeridia* sp. (prasinophycean algae). Sporomorphs indicate a late Carnian age for this section. Algae occurrence indicates lacustrine depositional environments, which are tentatively related to a short period of increased humidity during late Carnian times, during long-term paleoclimatic conditions characterised by aridity.

The evaporites at the top of the “Marl-Carbonate Evaporitic Complex” succession were sampled in the Loulé Salt Mine and the Albufeira diapir. In the Loulé Salt Mine two mudstone beds ca. 1 meter thick intercalated within the evaporites were sampled, and a diverse to moderately preserved palynological assemblage was recovered. The sporomorph taxa identified include the pollen *Alisporites* sp., *Araucariacites australis*, *Cerebropollenites macroverrucosus*, *Cerebropollenites* sp., *Classopollis*

meyerianus, *Classopollis torosus*, *Cycadopites* sp., *Perinopollenites elatoides*, *Playfordiaspora* sp., *Triadispora* sp., and the spores assigned to the species *Anapiculatisporis* sp., *Calamospora mesozoica*, *Calamospora tener*, *Deltoidospora* sp., *Kraeuselisporites reissingeri*, *Kraeuselisporites* sp., *Kyrtomisporis* sp., *Leptolepidites* sp., and *Porcellispora longdonensis*. In addition to these sporomorphs, prasinophycean algae, *Leiosphaeridia* sp., and reworked algae were also identified.

The palynological content of the Albufeira diapir includes *Araucariacites australis* and *Classopollis* spp. The data obtained from the Loulé Salt Mine and Albufeira diapir allows assigning the evaporite deposits to the uppermost Rhaetian - lowermost Hettangian. The recovered assemblages indicate the dominance of warm-climate flora living at the margins of the evaporitic basin.

The present study allows us to constrain, for the first time, the age of the Grés de Silves Group, in the Algarve Basin, to the early Carnian-early Hettangian (Triassic-Jurassic boundary) interval based on palynostratigraphy. Moreover, it contributes to the knowledge of the Iberian palynoflora, paleoenvironment and paleoclimate evolution.

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