

# The age of the first pulse of continental rifting associated with the breakup of Pangea in Southwest Iberia: new palynological evidence

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## ABSTRACT

The first palynological age for the base strata of the Silves Sandstones of Silves Group in the Algarve Basin. Deposited unconformably over late Pennsylvanian turbidites of the Mira formation, folded and faulted during the Variscan Orogeny, is the oldest sedimentary unit of the Algarve Basin. The detrital red bed succession represents the earliest phase of sedimentation associated with initial rifting of Pangea. A grey mudstone bed positioned 2,5m above the Variscan unconformity yielded palynomorphs that allowed the dating of the beginning of sedimentation in the basin to the early Carnian age (Late Triassic). The moderately well preserved palynological association comprises *Aulisporites astigosus*, *Enzonalsporites densus*, *Ovalipollis pseudoalatus*, *Samaropollenites speciosus*, *Tulesporites briscoensis* and *Vallasporites ignacii*, indicative of a lower Carnian age.

## MATERIALS AND METHODS

Standard palynological laboratory procedures were employed in the extraction (treatments with hydrochloric and hydrofluoric acids and concentration of the organic matter). Twenty-five palynological samples were collected, yielding moderate preserved sporomorphs on an outcrop along the studied section in the CM1054 road towards the International Roadtrack of Algarve, located in Portimão. The residues were sieved using a 15µm sieve and were mounted on microscope slides using Entellan®, a commercial resin-based mounting medium. Semi-quantitative abundance was determined by counting 250 specimens per slide. Two or three slides were then scanned for rare taxa, which were recorded as present outside of the count. The slides were examined with transmitted light, in Leica ICC50W microscope equipped with a camera.

## GEOLOGICAL SETTING

This road cut provides a good exposure of the Variscan angular unconformity, and a ca. 24 m thick sequence assigned to the Silves Group lowermost unit, the Silves Sandstones. Below the unconformity the lithologies consist of folded greywackes and shales belonging to the Mira Formation (Serpukhovian to middle Bashkirian age) (Oliveira and Wagner-Gentis, 1983; Fernandes et al., 2020). Above the unconformity, the Silves Group include a ca. 2,5 m thick succession consisting mainly of red mudstones, interbedded with a 20 cm thick bed of fine to medium-grained sandstone showing reduction spots. Above the basal beds, is a 25 cm thick bed of coarse to medium-grained sandstones showing current ripples cross-lamination and diagenetic calcite nodules. This latter unit is followed by a 3 m thick bed consisting of grey mudstones with common small plant impressions and parallel lamination. Towards the top of this bed the color of the mudstones change from grey to red. This features suggests either deposition in a shallow lake, or the fill of an abandoned river channel. All the palynological productive samples were collected in this latter bed.

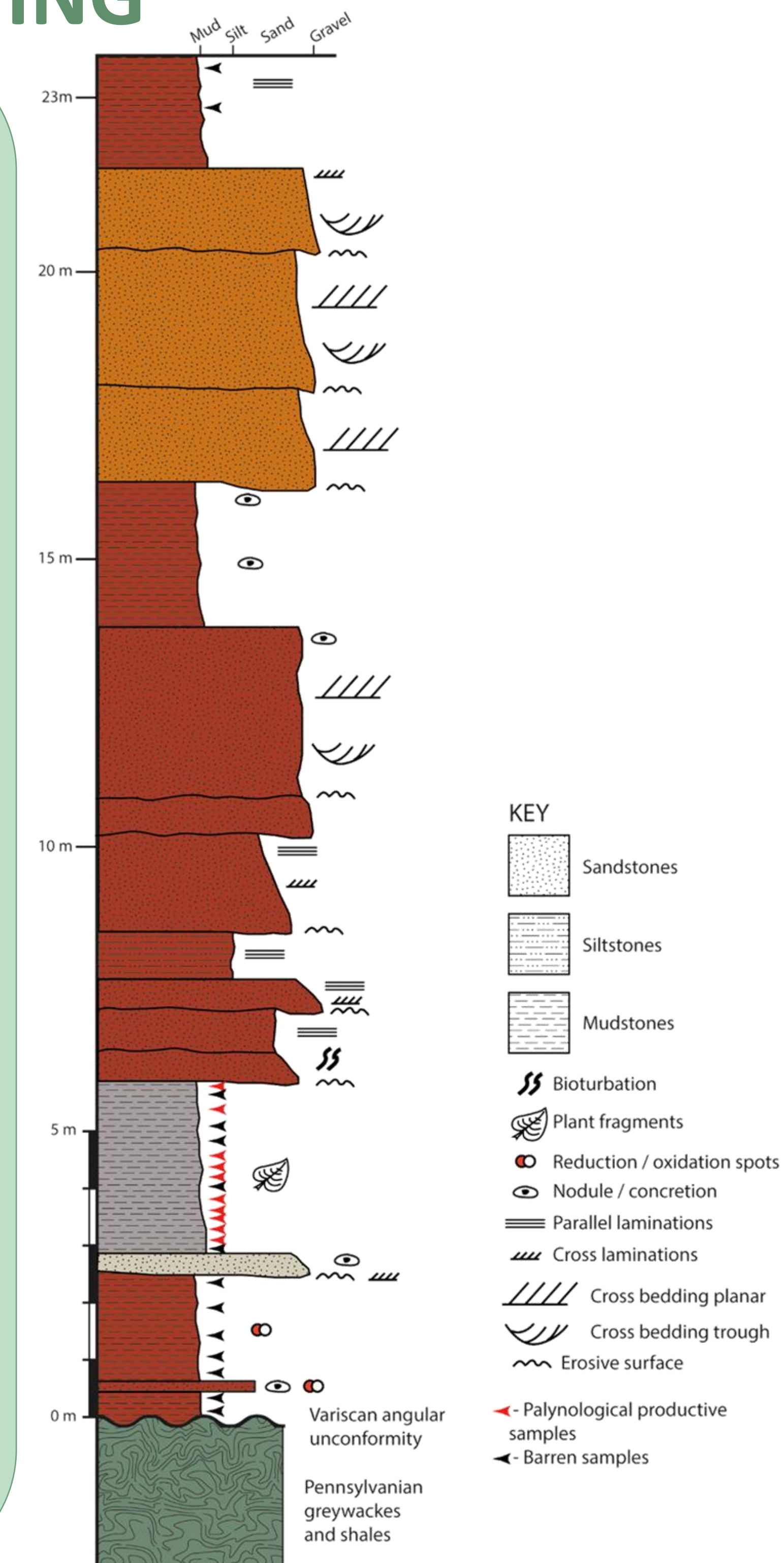


Figure 2 - Log of the studied outcrop with location of the studied samples.

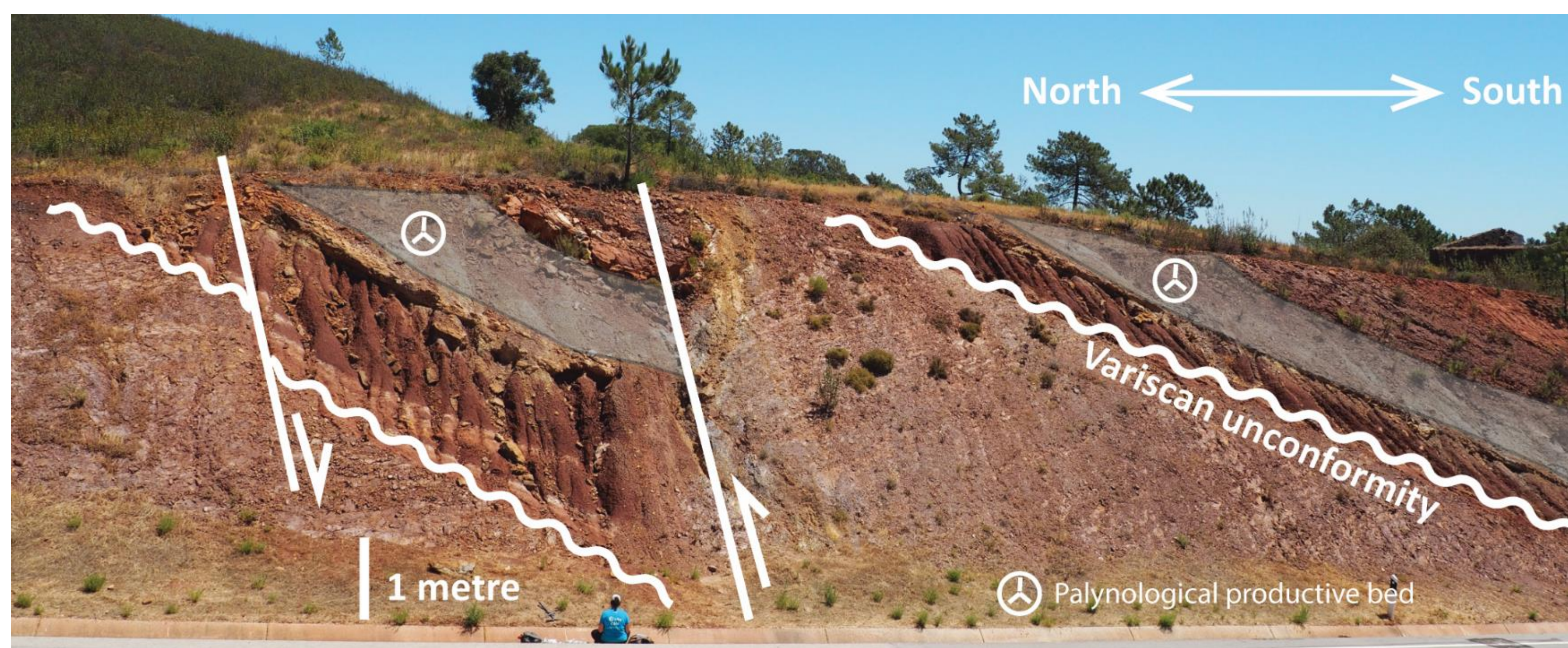


Figure 1 - Photography of the outcrop, with the Variscan unconformity and the bed that yielded palynomorphs marked.

## RESULTS

The stratigraphic range of some key taxa recorded in the palynological assemblage shed new light on the age of this lithostratigraphic unit and provide important age constraints for the opening Algarve Basin. This preliminary palynological study provides a first biostratigraphic dating of the basal levels of the Silves Sandstones of the Silves Group which can now confidently be referred to the lower Carnian (Julian). The joint occurrences of some taxa like *Tulesporites briscoensis* and *Aulisporites astigosus* suggests a mixture of palynoflora typical of the North American Carnian with palynoflora from Central Europe, respectively. Other taxa present both in North America and Europe are *Enzonalsporites vigens* and *Samaropollenites speciosus*. This data is consistent with the paleogeographic position of the Algarve Basin, Portugal in the Upper Triassic (Palain, 1976; Terrinha et al., 2013).

## CONCLUSIONS

- The basal part of the Silves Group in the Algarve Basin yielded a biostratigraphically significant palynological assemblage referable to the early Carnian;
- This age attribution constrains the beginning of the sedimentation within the Algarve Basin to the Late Triassic;
- The palynological assemblage indicates a mixing of lower Carnian palynoflora elements from Central Europe and North America which is consistent with the paleogeographic position of the Iberian Peninsula in the Late Triassic;
- The palynological similarities found between Iberia and North America, indicates that these two land masses were connected in early Carnian times, allowing interchange of floras.

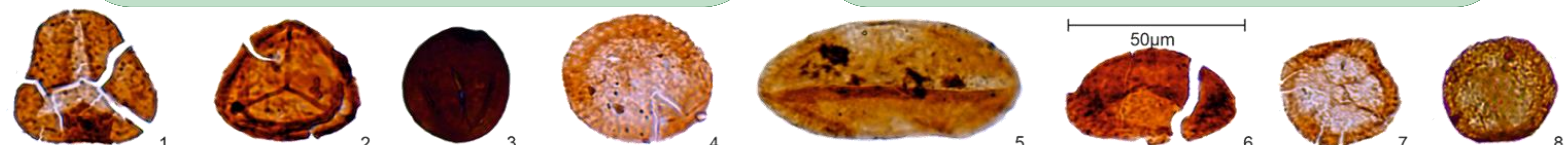


Figure 3 - Selected palynomorphs from the Silves Sandstone, Silves Group, Portimão section. 1. *Clathropteris walkeri* Ash, 1970, sample AUTO3, slide A, EF T47[3]; 2. *Nevesisporites vallatus?* Jersey & Paten, 1964, sample AUTO3, slide C, EF K36[1]; 3. *Aulisporites astigosus* (Leschik, 1956) Klaus 1960, sample AUTOB5(+0,60), EF P35[1]; 4. *Enzonalsporites vigens* Leschik, 1956 emend. Scheuring, 1970, sample AUTO3, slide A, EF D46[2]; 5. *Ovalipollis pseudoalatus* Krutzsch, 1955, sample AUTO3, slide C, EF E51[2]; 6. *Samaropollenites speciosus* Terrinha, P., Rocha, R., Rey, J., Cachão, M., Moura, D., Roque, C., Martins, L., Valadares, V., Cabral, J., Azevedo, M.R., Barbero, L., Clavijo, E., Dias, R.P., Matias, H., Madeira, J., Silva, C.M., Munhá, J., Rebelo, L., Ribeiro, C., Vicente, J., Noiva, J., Youbi, N., Bensalah, M.K.. A Bacia do Algarve: Estratigrafia, paleogeografia e tectónica. R. Dias, A. Araújo, P. Terrinha, J.C. Kullberg (Eds.), Geologia de Portugal, Geologia Meso-cenozóica de Portugal, vol. II (2013), pp. 29-166

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