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Jurassic plant macroremains from Portugal

JOÃO PAIS [1]

Palavras chave: Macrorrestos de vegetais; Triásico; Jurássico; Portugal.

Resumo

Após caracterização dos ambientes durante o Triásico e o Jurássico, apresentam-se as listas de jazidas e de táxones de macrorrestos de plantas conhecidos em Portugal, cujo estudo carece de revisão. Predominam as cicadófitas (Cycadales e Bennettitales) e as Coníferas, particularmente da Família Cheirolepidiaceae. Os fetos são relativamente escassos. As formas conhecidas sugerem clima quente e seco. Os géneros mais comuns, *Otozamites, Cupressinocladus*, têm cutículas espessas e estomas fortemente protegidos.

Key-words: Plant macroremains; Triassic; Jurassic; Portugal.

Abstract

General characterization of the Triassic and Jurassic environments as well as list of localities and taxa of plant macroremains of Portugal are presented. Cycadophytes and conifers, mainly from the Cheirolepidiaceae family, predominate.

No recent studies have been carried out, the latest date from the 70's. Systematic position of some taxa is uncertain. A deep review is needed.

The Upper Jurassic portuguese plant macroremains suggest warm and dry climates. The commonest forms (*Otozamites, Cupressinocladus*) show thick cuticles and strongly protected stomata. Ferns are rather scarce and the pinnules are smaller than those of homologous forms of other regions i.e. in Yorkshire (U.K.).

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Introduction

At the end of the Hercynian Orogeny in the early Mesozoic times, the colliding continents constitute the supercontinent Pangea. However, even before total aggregation, the progressive opening of the Atlantic Ocean began.

After Paleozoic glaciations, climates became warmer and large deserts developed. During Jurassic, and even more during Cretaceous, shallow seas covered large areas in Eurasia. Important coal deposit accumulated in lagoons in the border of these seas.

The abundance of red sandstones, shallow limestones and evaporites, as well as oxygen isotopes, shows a marked temperature rise during Mesozoic with Upper Jurassic and Lower Cretaceous maxima. The temperature seems to have been higher than today (fig. 1). In high latitudes precipitation was abundant although tropical regions must have been rather dry.

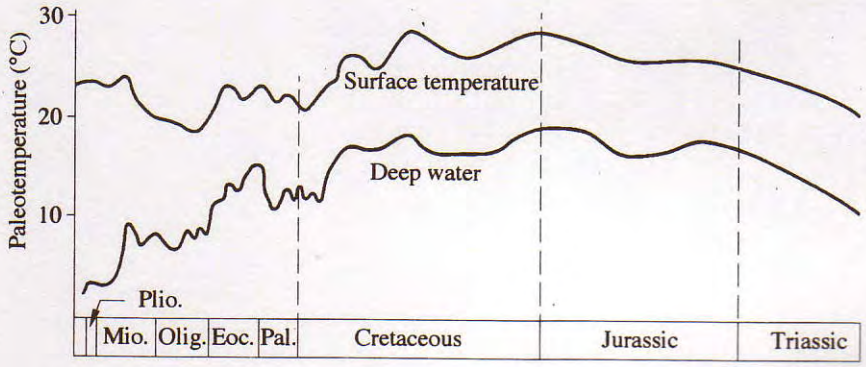

Fig. 1 – Oxygen isotopic paleotemperatures for low-latitude seawater during Mesozoic (CONDIE & SLOAN, 1998).

The eustatic level was low during Triassic times; red detrital deposits, sand dunes and evaporites were common between 30° of paleolatitude North and South suggesting large desertic areas. However, in the Tethys border fossils indicate tropical humid climates.

Jurassic climates were warmer than in the Triassic, with a Dogger minimum. Subtropical conditions seem to have extended till 60° of paleolatitude North and South.

Oxygen levels in the atmosphere were 15% in the Lower Triassic, and 25% in Late Jurassic (21% as now).

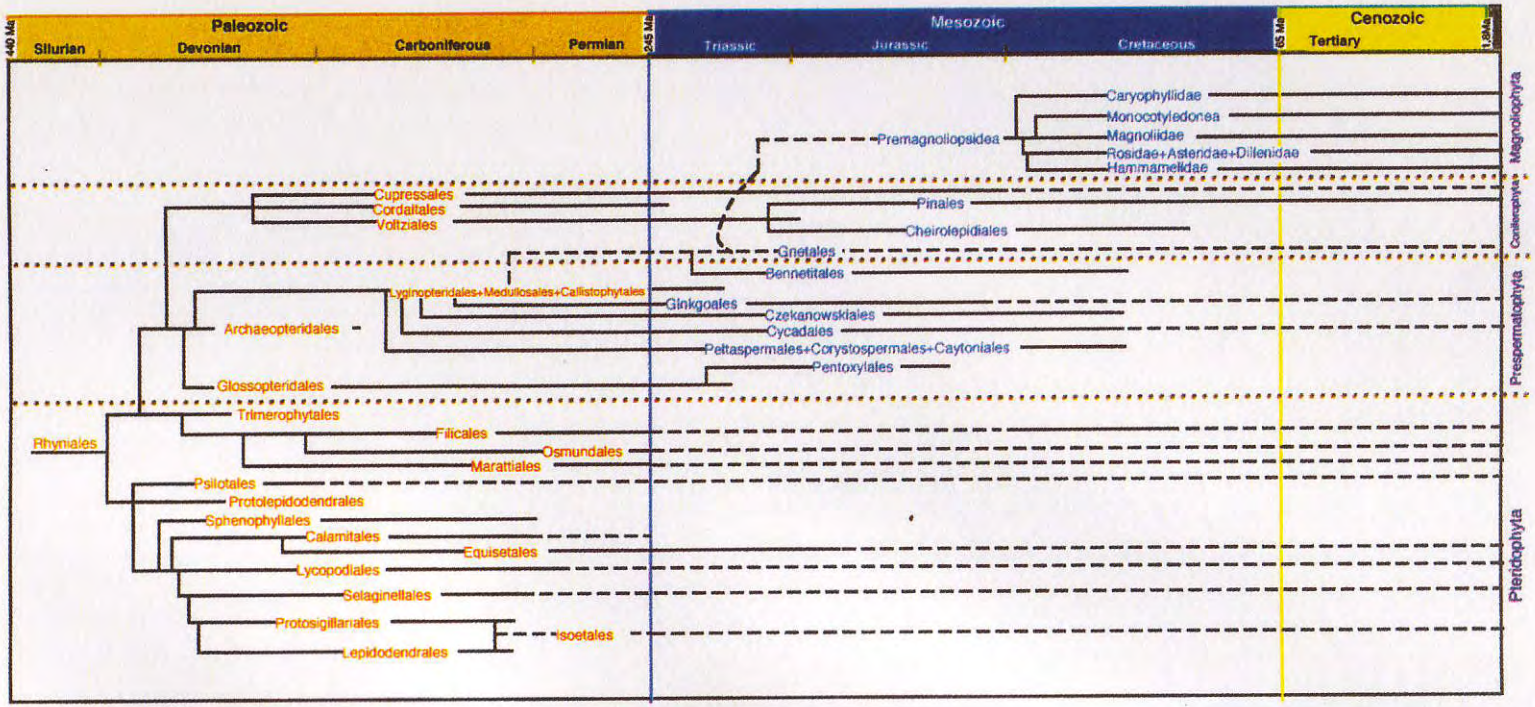

Fig. 2 – Phylogeny of plant Orders. Chronostratigraphic units at the same time scale (BOULTER, 1997, modified).

Mesozoic vegetation

Climatic changes were responsible by important changes in plant communities by the end of the Paleozoic. Many of the Pteridophytes became extinct or drastically reduced (fig. 2-3).

At the begin of the Triassic the vegetation was scarce and water-localities (lagoons, lakes, ...) dependent.

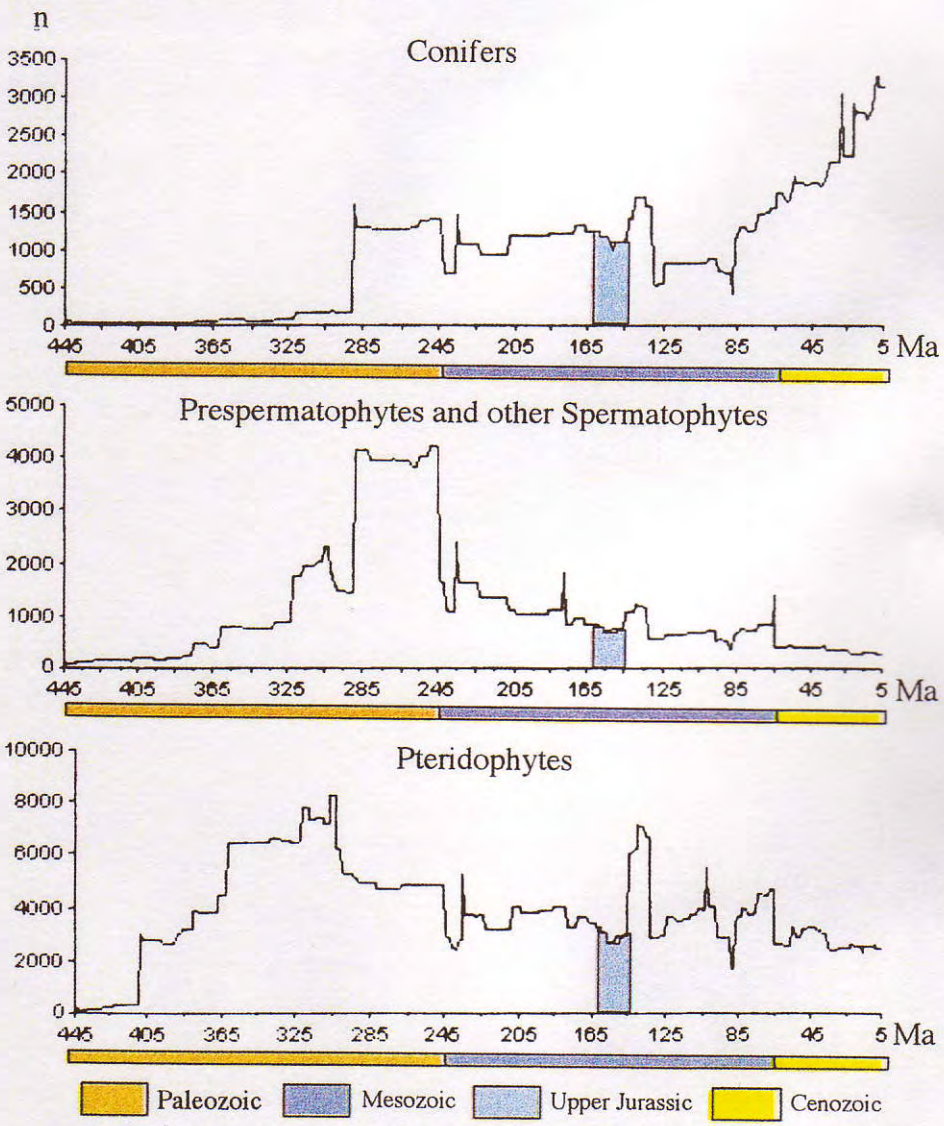

Fig. 3 – Number of references of taxa (BOULTER, 1997, modified).

Along the Jurassic vegetation became richer. This is related to the progressive improvement of climatic conditions. Forests were very different from the Paleozoic ones. Open conifer forests were the essential part of the arboreal covering (most of these conifers did not survive the Cretaceous). Among the Prespermatophytes, Cycadales and Bennettitales dominate the bush. Some Pteridophytes, including ferns, lived on hillsides and among rocks in wet and shadow places.

After a distinct vegetation impoverishment (that coincides with an important event of dinosaur extinction) at the beginning of the Cretaceous, a remarkable renewal occurs with the appearance of the angiosperms. The ferns found good growing conditions at the new forests.

Triassic and Jurassic plant macroremains in Portugal

In Portugal, plant macroremains are uncommon in Triassic and Jurassic deposits (TEIXEIRA, 1948; TEIXEIRA & PAIS, 1976). This may be related to poor plant cover in the Triassic and to the sea transgressions in the Jurassic. Only in Late Jurassic, regressive deposits became more favourable to plant macroremain preservation.

The main localities are (fig. 4):

Triassic

Coimbra
Silves

Jurassic

Lias

Coimbra (Peneireiro, Montes Claros, Carvalhais)
S. Pedro de Muel (Polvoeira)
Tomar

Malm

Cabo Mondego
Pederneira
Leiria
Alfeizerão
Torres Vedras (Cabanas de Torres, Vale de Gato, Salgueiro, Dois Portos, Figueiras, Granja, ...)
Alenquer
Bucelas
Arrábida (Serra de S. Luís)
Loulé.

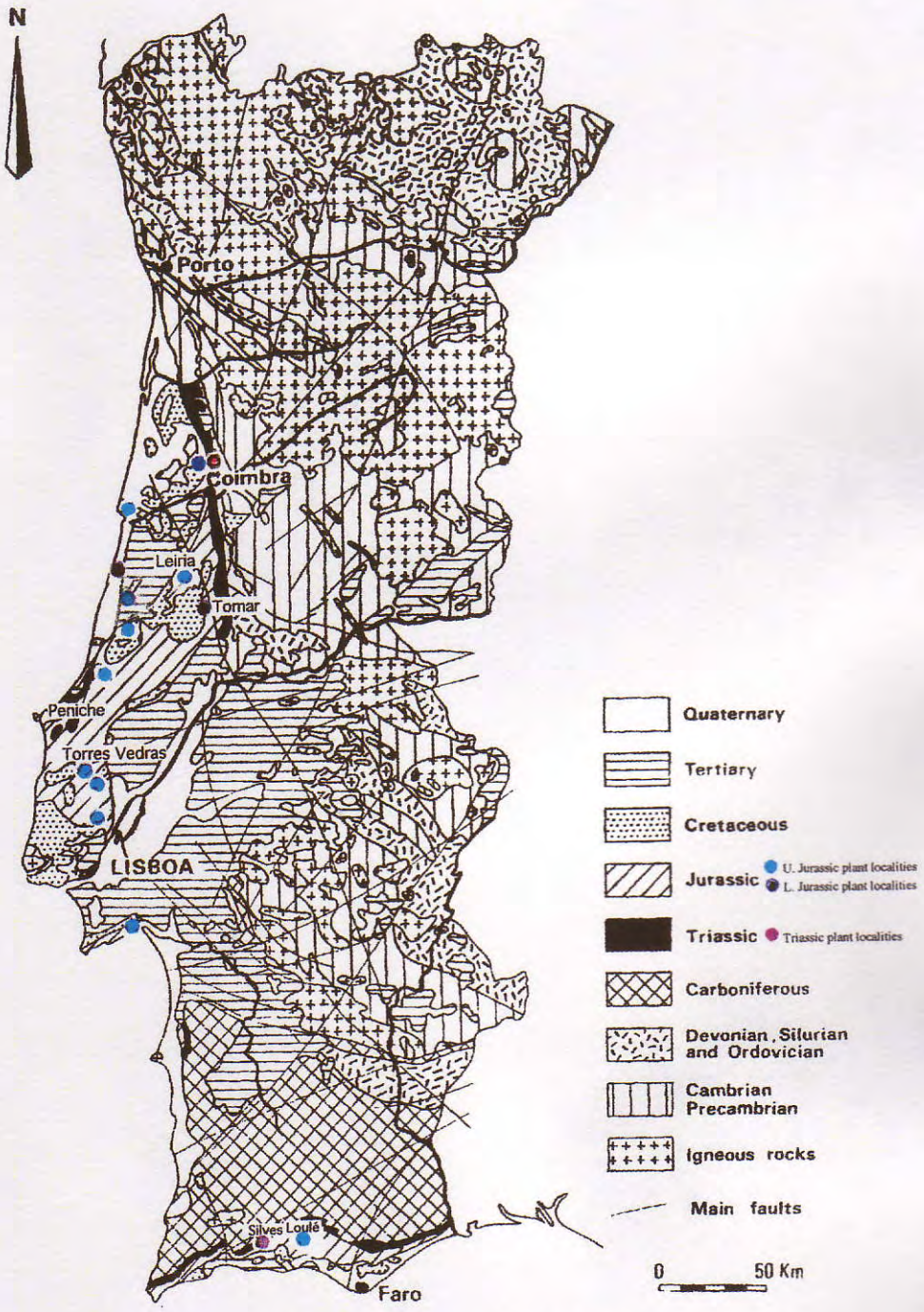

Fig. 4 – Triassic and Jurassic plant localities in Portugal.

The associations are generally poor. The Cabo Mondego (Upper Oxfordian) is the richest and contains the best preserved fossils; cuticles are preserved in many specimens (PAIS, 1974).

No recent studies have been carried out, the latest date from the 70's (PAIS, 1977). Systematic position of some taxa is uncertain. For instance, the Upper Jurassic species of *Sphenopteris* can be ascribed to *Coniopteris*. A deep review is needed.

Plant macro remains from the Triassic and Jurassic in Portugal

Division	Order	Family	Triassic and Lower Jurassic	Upper Jurassic (Malm)
			Taxa	Taxa
Coniferophyta	Coniferales	Cheirolepidiaceae	Pagiophyllum liasinum	Sphenolepis choffati Pagiophyllum lusitanicum Pagiophyllum **sp.** Elatides falcifolia Elatides curvifolia Cupressinocladus microm erum Brachyphyllum lusitanicum
		Ullmaniaceae (?)	Voltzia ribeiroi	
Ginkgophyta	Ginkgoales		Ginkgoites dilatata	Baiera viannae
Cycadophyta	Bennettitales	Cycadeoidaceae	Otozam ites conim bricensis	Ptilophyllum **cf.** acutifolium Pterophyllum m ondeguensis Pterophyllum **sp.** Otozam ites m undae Otozam ites **sp.**
	Cycadales			Nilssonia **cf.** kendalli Zam ites **sp.**
Pteridospermophyta	Peltaspermales (?)			Scleropteris sinuata
Pteridophyta	Filicales	Pteridaceae		Adiantum **sp. (?)**
		Osmundaceae		Todites falciform is
		Matoniaceae		Laccopteris **sp.**
		Dicksoniaceae		Coniopteris **cf.** m urrayana
		Dipteridaceae	Clathropteris m eniscoides	
				Pecopteris brow niana
				Sphenopteris sinuata
				Sphenopteris m inuta
				Sphenopteris **sp.**
	Equisetales	Equisetaceae	Schizoneura algarbiensis Equisetites pseudohoerense Equisetites **sp.**	Equisetites lusitanicum
		Calamitaceae	Neocalam ites **sp.**	
Hepatophyta	Marchantiales	Marchantiaceae		M archantites m archantiaeform is

The Upper Jurassic portuguese plant macroremains suggest warm and dry climates. The commonest forms (*Otozamites, Cupressinocladus*) show thick cuticles and strongly protected stomata. Ferns are rather scarce and the pinnules are smaller than those of homologous forms from other regions i.e. in Yorkshire (U.K.).

References

BOULTER, M. (1997). Plant macroevolution through the Phanerozoic. *Geology today*. Blackwell Science Ltd, May-June, pp. 102-106.

CONDIE, Kent C. & SLOAN, Robert E. (1998). *Origin and evolution of Earth. Principles of historical Geology*. Prentice Hall, 498 pp.

PAIS, J. (1974). Upper Jurassic plants from Cabo Mondego (Portugal). *Bol. Soc. Geol. Portugal*, Lisboa, vol. XIX, pp. 19-45.

PAIS, J. (1977). Vegetais do Oxfordiano (Lusitaniano) de Leiria. *Ciências da Terra* (UNL), Lisboa, 3, pp. 101-119.

TEIXEIRA, C. (1948). Flora mesozóica portuguesa. *Mem. Serv. Geol. Portugal*, Lisboa, 118 pp., 44 est.

TEIXEIRA, C. & PAIS, J. (1976). Introdução à Paleobotânica. As grandes fases da evolução dos vegetais. *Ed. autores*, Lisboa, 210 pp., 11 quad., 69 figs.

Plate I

Figs. 1, 2 – *Equisetites* cf. *lusitanicum* Heer, Leiria, Oxfordian. Fig. 1, ×1.1; fig. 2, ×0.9.

Figs. 3, 5 – *Todites falciformis* Pais, Cabo Mondego, Oxfordian. Fig. 3, ×1.1; fig. 5, ×2.9.

Fig. 4 – *Coniopteris* cf. *murrayana* (Brongniart) Harris, fertile frond, Leiria, Oxfordian. ×1.9.

PLATE I

Plate II

Figs. 1, 2 – *Coniopteris* cf. *murrayana* (Brongniart) Harris, Leiria, Oxfordian. Fig. 1, ×2.8; fig. 2, ×2.

Figs. 3, 4 – *Nilssonia* cf. *kendalli* Harris, Leiria, Oxfordian. Fig. 3, ×1.7; fig. 4. ×1.1.

PLATE II

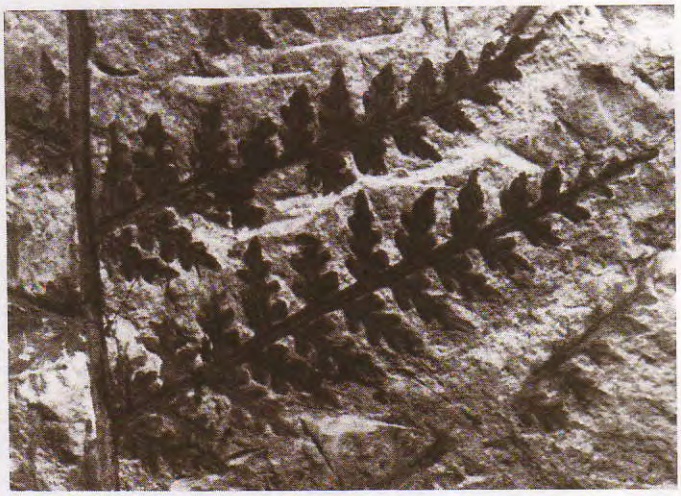

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Plate III

Fig. 1 – *Pterophyllum* sp., Leiria, Oxfordian. × 1.4.

Fig. 2 – *Otozamites mundae* (Morris) Teixeira, Cabo Mondego, Oxfordian. × 1.8.

Fig. 3 – Lower cuticle of *Otozamites mundae* (Morris) Teixeira with stomata, Cabo Mondego, Oxfordian. × 160.

Fig. 4 – Stomata of *Otozamites mundae* (Morris) Teixeira, Cabo Mondego, Oxfordian. × 1100.

PLATE III

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Plate IV

Fig. 1 – *Otozamites mundae* (Morris) Teixeira, Cabo Mondego, Oxfordian. ×1.5.

PLATE IV

Plate V

Fig. 1 – *Pterophyllum mondeguensis* Pais, Cabo Mondego, Oxfordian. ×0.8.

PLATE V

Plate VI

Fig. 1 – *Baiera viannae* Teixeira, Cabo Mondego, Oxfordian. ×0.9.

Fig. 2 – *Brachyphyllum lusitanicum* Pais, Cabo Mondego, Oxfordian. ×1.8.

Figs. 3, 4 – *Elatides curvifolia* Dunker, Leiria, Oxfordian. ×1.8.

Fig. 5 – *Elatides curvifolia* Dunker, female cone, Leiria, Oxfordian. ×1.8.

PLATE VI

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Plate VII

Fig. 1 – *Cupressinocladus micromerum* (Heer) Pais, Cabo Mondego, Oxfordian. ×0.7.

PLATE VII