

## Dispersed cuticles from the Upper Carboniferous from Bulgaria (Dobrudja Coal Basin)

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(Received 08.02.1996; accepted 29.02.1996)

Т. Димитрова, К. Узунова — Позднекарбонские дисперсные кутикулы из Болгарии (Добруджанский угольный бассейн). Эта статья включает исследования дисперсных кутикул, которые относятся к трем таксонам из Добруджанского угольного бассейна — вестфальский возраст. Предварительные результаты указывают на хорошие условия для сохранности кутикул и их систематическое определение.

**Abstract.** This article reports about the dispersed cuticles, belonging to three taxa from the Dobrudja Coal Basin — Westphalian age. The preliminary results show that the sedimentary environment was favourable for preservation of the cuticles which are good enough for systematic determination.

Dimitrova, T., Uzunova, K. 1996. Dispersed cuticles from the Upper Carboniferous from Bulgaria (Dobrudja Coal Basin). — *Geologica Balc.*, 26, 4;

**Key words:** Upper Carboniferous; Dobrudja coal basin; dispersed cuticles

### Introduction

Small pieces of cuticles were found in the palynological material from the Dobrudja Coal Basin. Up to now all the information available about the Carboniferous vegetation of the Dobrudja Coal Basin was based on the macro- and microfloristic analysis from borehole samples. The age of this stratigraphical interval was established by miospore analysis as Westphalian.

The cuticles described in this paper have been obtained from coal-bearing shales within coal-seams of the boreholes R-186 (1543.40 m depth) and R-198 (1502.90 m depth). The studied samples lack miospore index-species. The dominant miospores of the assemblage belong to no more than five species, the genus *Lycospora* being represented the biggest number of specimens. The assemblage of microflora illustrates the hydrophilous and coal-forming character of the Westphalian plants. In addition, cuticles can give also important paleoecological information. The established co-

occurrence of the miospore assemblages and the pieces of cuticles provide the possibility for a better investigation of the paleocoenoses of a certain formation in Dobrudja Coal Basin. The relation between the cuticles and macroflora can be proved by direct isolation of cuticles from a taxonomically determined macrofossil.

The cuticular analysis has become generally accepted as a very valuable method for the study of fossil Pteridosperms (Kerp, Barthel, 1993).

The following taxonomical groups of Westphalian age from Dobrudja Basin were defined: Pteridophytina, Pteridospermopsida and Gymnospermae. The macrofloristic analysis showed the presence of morphogenera *Neuropteris* and *Alethopteris* (Тенчов et al., 1988).

### Methods and terminology

The cuticles and miospore have been isolated from the rock using 35% hydrofluoric acid (HF), nitric acid (HNO<sub>3</sub>) and 10% potassium

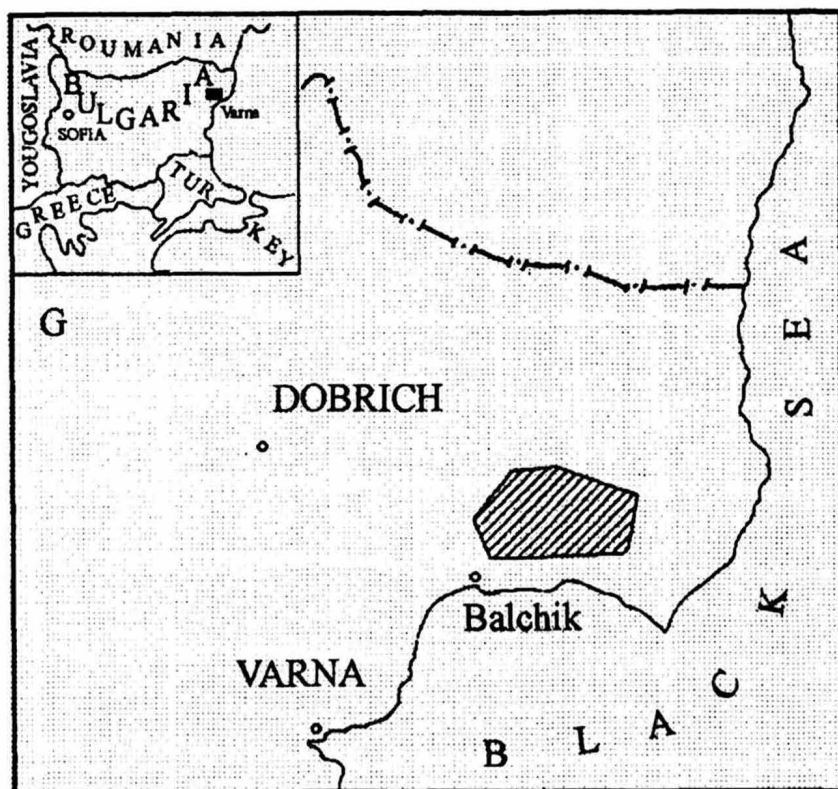


Fig. 1. Geographic position of Dobrudja Coal Basin and the boreholes: R-198 and R-186

hydroxide (KOH) to remove oxidation products.

Cuticles were mounted in glycerine jelly slides.

The cuticular analysis of rock material retrieved from the basin was made for the first time on the territory of Bulgaria.

For the taxonomical identification of epidermal structure have been used the publications of the following authors: Cleal, Zodrow (1989); Cleal, Shute (1991); Kerp, Barthel (1989). The cuticles are described using the standard terminology applied by Dilcher (1974) and Harris (1956).

## Description of the cuticles

Division Pinophyta Meyen (1987)

Class Cycadopsida Meyen (1987)

Order TRIGONOCARPALES Meyen (1987)

Satellite form genus *Neuropteris* (Brongniart) Sternberg emend. Zodrow and Cleal

*Neuropteris* cf. *macrophylla* Brongniart

Pl. I, Fig. 1, 4, 5, 7

The pieces of adaxial cuticle are with some stomata. The epidermal cells are irregularly polygonal, their size being 30-50  $\mu\text{m}$ ; walls are

with straight to slightly convex. The stomata are randomly distributed. The guard cells are sunken and almost rectangular, 15-20  $\mu\text{m}$  long and 6  $\mu\text{m}$  wide.

The stomatal type is brachyparacitic. The subsidiary cells are 2-5 in number, slightly raised above the surrounding cells, sometimes with deep cutinised walls.

The peculiarities of the epidermal cells of the recognized cuticles are very similar to the description given by Cleal, Zodrow (1989, Pl. 6, Fig. 3). The cuticles obtained from palynological preparations of the Dobrudja Coal Basin lack some typical features such as trichomes on costal cells. The description of the cuticles is based in this case on the size of the epidermal cells and the stomatal apparatus.

Satellite form genus *Alethopteris* Stenberg

*Alethopteris* cf. *zeilleri* (Ragot) Wagner

Pl. I, Fig. 6

This piece of cuticle is from the innercostal field. The epidermal cells are irregularly polygonal with straight to slightly convex walls, 60-70  $\mu\text{m}$  long and 37-30  $\mu\text{m}$  wide. The ellipsoidal trichome has a base 67  $\mu\text{m}$  long and 47  $\mu\text{m}$  wide. The size of the pore is 32 $\times$ 17  $\mu\text{m}$ . The trichome base is surrounded by two or three cells with deep cutinised walls.

The described cuticles show best resemblance to the description given by Kerp, Barthel (1993, Pl. II, Fig. 7). Their similarity is in size and structural peculiarities of the epidermal cells as well as the trichome base.

#### Cycadopsida insertae sedis

Pl. I, Fig. 2, 3

This piece of cuticle is with polygonal cells with thick convex walls. There is a single stomata ? of cyclocytic type. The subsidiary cells form a rosette above the cell level. The cells are with deep cutinised walls. It is possible for this structure to be a trichome base surrounded by a rosette.

A similar structure can be observed in some representatives of Cycadopsida. The information about the cuticles from the Late Paleozoic is very limited which also explains the great interest shown by a constantly increasing number of authors.

#### Conclusion

The results show that the cuticular analysis has a great potential for pteridosperm studies. Quite often the spores in the palynological preparations are badly preserved. In some cases in the preparations can be found pieces of cuticles which are recognisable and systematically determinable. The application of this type of ana-

lysis is very important for the form-genera *Neuropteris* and *Alethopteris* which are widely distributed in the Westphalian sediments from Dobrudja Coal Basin. Many of the species from these plants are index-fossils for different stages of the Carboniferous. As an example can be used *Neuropteris ovata* Hoffmann, the appearance of which determines the Westphalian D Stage.

The relation between the identified cuticles and the fossil macroflora directly and spore in situ is a significant contribution to the natural groups of the systematic classification of the Westphalian vegetation.

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#### Explanations to the plate

#### PLATE I

- 1, 4, 5. *Neuropteris* cf. *macrophylla* Brongniart; lower epidermis with stoma; 1, 4.  $\times 400$ ; 5.  $\times 160$ .  
 2, 3. Cycadopsida incertae sedis; epidermis with stoma ?;  $\times 400$ .  
 6. *Alethopteris* cf. *zeilleri* (Ragot) Wagner; lower epidermis with randomly distributed stomata;  $\times 400$   
 7. *Neuropteris* cf. *macrophylla* Brongniart; lower epidermis with randomly distributed stomata,  $\times 400$

PLATE I

