Anatomical and chemical characteristics of Miocene *Taxodiaceae* species from Bükkábrány (Hungary)

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Introduction

16 preserved trunks were found in an open cast coal (lignite) mine near Bükkábrány in north-eastern Hungary (Fig. 6). The trunks are 2-3 m in diameter and 5-6 m in high. The stumps stood in the lower level of the mine, at the beginning of the coal deposit. These trees lived in the marshland of the Pannon Lake and the river deltas in the Miocene (Fig. 1), approximately 7,5-8 million year ago. The trunks are especial, because they are not siliceous, and preserved their porous structure (Fig. 2-3).

Fig. 1. The position of the Pannon Lake at the Miocene (Magyar et al. 1999)

Fig. 2-3. Trunks in the open cast mine (Bükkábrány, Hungary)

Materials and methods

Samples from each trunks were collected (Fig. 4.), but just some of the were examined (Fig. 5.), the examination of the others is still running. The degradation of the samples were different. For control, samples were collected from the *Taxodium distichum* and *Sequoia sempervirens* in the Botanical Garden, Sopron. Anatomical examination (light and SEM microscopy) were taken for the 3 and 5 sample, chemical tests were done for the 1-5 samples. In these tests the cellulose, total phenol and total carbohydrate contents were measured and thermoanalitical behavior were examined. The lignin content of the samples wasn't measured, because of the degradation of the lignin there is no method. All contents indicted refer to the dry weight of the samples.

Fig. 4-6. Collecting samples and some of them, which were tested

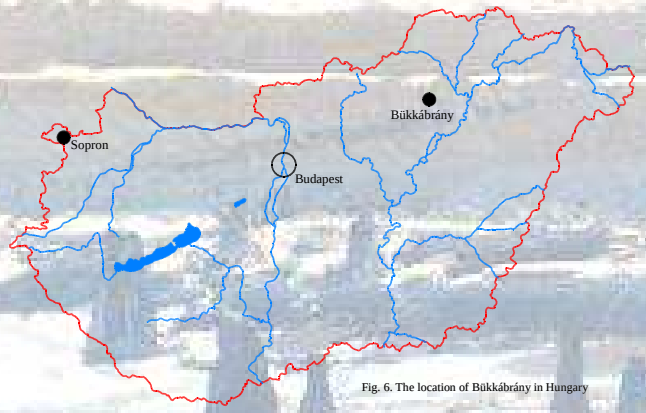

Fig. 6. The location of Bükkábrány in Hungary

Results

Anatomy

Looking the trunks in photos and in the mine, they were seemed to have two types. Some of them are slim (like *Sequoia sempervirens*), others became broad at the base (like *Taxodium distichum*).

The early wood of the annual rings were more degraded (red arrows) than the late wood (yellow arrows), so the cells in the early wood collapsed (Fig. 7-10). The rays are uniseriate, homogenous. The cells of the axial parenchyma are not grouped, these cells are containing some kind of material (green arrows). There are 2-4 taxodioid or cupressoid pits in the cross fields.

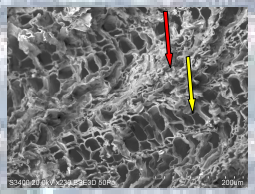

Fig. 7. SEM photo of the sample 3, the early wood is degradated

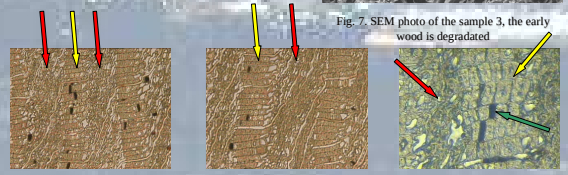

Fig. 8-10. Light microscopic photos of the sample 3. Cross section. Degraded early wood, axial parenchymas with some content

Fig. 11-12. The structure of the cell wall between axial parenchyma cells

The main differences between *Sequoia sempervirens* and *Taxodium distichium* are the visibility of the torus in the tracheids and the structure of the cell wall between the axial parenchyma cells. These walls in the *Sequioa* parenchyma cells are smooth, and in *Taxodium* they are nodular. As Fig. 11-12 show, one of them seem to be *Sequioa sempervirens* (sample 3), an the sample 5 is *Taxodium distichum*, so the two species lived there together.

Chemical tests

The Table 1. shows the results of the cellulose, phenol and carbohydrate tests. *Taxodium distichum* heartwood was the control.

Table. 1. Lignin, cellulose, phenol and carbohydrate contents of the samples

	cellulose [%]	t. phenol [mmol/100g]	carbohydrate [mg/g]
1	33.33 ± 2.00	0.461 ± 0.059	1.428 ± 0.109
2	18.17 ± 3.22	1.280 ± 0.066	2.875 ± 0.308
3	30.15 ± 2.98	0.587 ± 0.063	3.165 ± 0.082
4	35.52 ± 4.83	0.765 ± 0.016	3.990 ± 0.286
5	33.02 ± 4.84	0.932 ± 0.024	5.582 ± 0.264
controll	37.42	4.071±0.145	10.83±0.891

The cellulose content of the fossils is significantly lower, partly disintegrated, so the lignin content relatively higher (it wasn't measured), that's why the samples can be crumbled. Significantly lower concentration of phenols and sugars can be measured in the fossils. The degradation process of polyoses can be clearly seen in the case of the samples by DSC (Fig. 13-14). According to the DSC analysis too, the amount of cellulose is much lower in the fossils. The fossils show higher thermal stability, which could be explained by a higher lignin content.

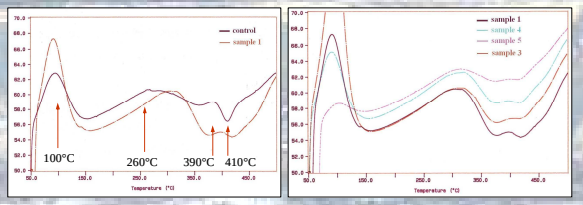

Fig. 13-14. Differential scanning calorimetric (DSC) measurements of the samples. 100°C – water; 260°C – hemicellulose deg.; 390°C – cellulose deg.; 410°C – polymerisation of the degradation products.

Summary

- The cellulose content of the fossils are between 20 and 30%.
- Although the strength of the wood was decreased, it could preserve the original shape.
- The examinations of the annual rings and the cell types show, that more species from the *Taxodiaceae* were present in the same time (*Taxodium distichum*, *Sequoia sempervirens*) in that flora.
- Further tests are needed (anatomical, macroscopic, some physical properties).

References

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