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The Early Miocene Lignite Deposit of Oberdorf N Voitsberg (Styria, Austria) | Editor: F.F. Steininger

Petrified, Lignified and Carbonized Wood Remains from the Early Miocene Lignite Opencast Mine Oberdorf (N Voitsberg, Styria, Austria)

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1 Plate

Styria
Pannonian Basin
Styrian Basin
Lignite
Paleobotany
Wood

Österreichische Karte 1 : 50.000
Blatt 163

Contents

Mineralisierte, inkohlte und verkohlte Holzreste aus dem Braunkohlentagebau Oberdorf (N Voitsberg, Steiermark, Österreich)

Zusammenfassung

Alle bisher untersuchten strukturbietenden Holzreste aus dem Tagebau Oberdorf stammen von Gymnospermen mit einreihigen Markstrahlen und zerstreut angeordnetem Axialparenchym mit glatten Querwänden. Harzgänge und Spiralverdickungen in den Tracheiden fehlen. Ein verkieseltes Stück konnte anhand der erhaltenen 2 bis 5 taxodioiden Kreuzungsfeldtüpfel als *Taxodioxylon sequoianum* (MERCKLIN) GOTHAN bestimmt werden, das dem Holz der rezenten *Sequioa sempervirens* ENDL. entspricht. Die anderen Holzreste ohne erhaltene Kreuzungsfeldtüpfel entsprechen entweder dieser Art oder der ähnlich gebauten Gattung Glyptostrobus oder einer anderen Gattung der Taxodiaceae oder Cupressaceae.

Sowohl alle mineralisierten als auch viele der als Fusit erhaltenen Stücke weisen stark abgebaute und zusammengesunkene Frühholzzonen auf und sind daher vor ihrer Verkieselung bzw. Verkohlung einem länger dauernden Abbauprozeß ausgesetzt gewesen.

Abstract

All identifiable samples examined till now belong to the Gymnospermae. They show uniseriate rays and no resin ducts or spiral thickenings. Horizontal walls of axial parenchyme are without any thickenings. A petrified sample with 2 to 5 well preserved taxodioid crossfield pits belongs to *Taxodioxylon sequoianum* (MERCKLIN) GOTHAN, which corresponds to wood of recently living *Sequoia sempervirens* ENDL. The other wood remains without preserved crossfield pits belong either to this species or the genus Glyptostrobus or to other genera of the Taxodiaceae or Cupressaceae.

As all petrified fragments as well as most of the fusain samples show degraded and collapsed early wood zones, they had undergone a long lasting decomposition process before their petrification resp. charcoalification.

1. Introduction

The seam of the lignite-bearing sequence at Oberdorf is composed of varying proportions of different plant tissues. Woody remains are found not only as lignite, but also as lignified xylites, fusain and occasionally as petrified wood. As part of project P-10337 GEO, sponsored by the Austrian Science Fund FWF, this investigation was carried out to identify the trees forming this mass of wood.

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2. Methodology

Lignified wood was cut into thin sections with a rotating microtome after softening the tissue by soaking in a 1:1:1 solution of ethanol, glycerin and water. Petrified wood was cut with a diamond saw and ground into thin sections. Fusain was embedded in 2-hydroxyethyl methacrylate and cut on the microtome (CICHOCKI, 1992; IGERSHEIM & CICHOCKI, 1995). Some samples were investigated with a SEM.

3. Preservation and Floristic Spectrum of the Wood Remains

The preservation of anatomical features is generally very poor. This is largely but not solely the result of the lignification process, which decomposes the structure of the cell walls and makes the crossfield pitting invisible. Almost all samples, regardless of whether they were lignified, carbonized or petrified, show similar cell collapses in the early wood areas, so the wood must have decomposed before undergoing one of the three types of fossilization. This decomposition may have occurred owing to a swampy depositional site (KOLCON & SACHSENHOFER, this volume) and in any case produced a zigzag folding of rays and ring borders, which often makes it impossible to prepare satisfactory radial and tangential sections.

A remarkable aspect of the floristic remains is that all samples identified to date belong to the Gymnospermae. All of them have uniseriate rays, no resin ducts and no spiral thickenings. These features are characteristic of Taxodiaceae and Cupressaceae. Angiosperm remains were found only as macerals after palynological preparation (e.g., isolated tracheae).

4. Petrifications

Petrified stems were found in the area of Zangtal at the beginning of this century. Two segments of one of these are on exhibit in the Styrian Country Museum Joaneum at Graz. Although they have diameters of some 90 cm and still have cylindrical shapes, examination of the inner part reveals badly compressed and Z-folded wood structure (Table 1, Fig. 1). Early wood is almost completely homogenized, whereas late wood cells can be seen in some areas. Pits have disappeared completely in the radial sections.

One smaller piece of petrified wood (50×15×8 cm) was found without depositional context, but within the seam of the western subbasin, and turned out to be the best preserved wood specimen.

The cross section (Table 1, Fig. 2) shows bending and decomposition of the early wood. But, in some areas (Table 1, Fig. 3) the position and dimension of cells has not been much affected. Thickened late wood cell walls are an artifact caused by long soaking in water before impregnation with silica. In tangential section (Table 1, Fig. 4), the uniseriate rays are two to thirty-four cells in height. The horizontal walls of the axial parenchyme are filled with dark particles that are not thickenings. As seen in radial section, two to five taxodioid crossfield pits (small flat ellipses) are arranged in one row (Table 1, Fig. 5 and 6). Bordered pits in the tracheid walls are aligned in one row, or in up to four rows opposite to one another (Table 1, Fig. 7). Bars of Sanio are visible.

These anatomical features are typical for living *Sequioa sempervirens* ENDL. and for the corresponding fossil wood *Taxodioxylon sequoianum* (MERCKLIN) GOTHAN. Sequoia cones, seeds and twigs are found at this site (MELLER; KOVAR-EDER, this volume) and also indicate the presence of this genus.

Although the most dominant genus according to macrofossils was *Glyptostrobus*, it has not been found so far as fossil wood. The reason for this might be the high similarity between the anatomy of *Sequoia* and *Glyptostrobus* wood, which can only be separated by the type of crossfield pittings, which are rarely well preserved. If the crossfield pits have disappeared completely, such samples may represent other genera of Taxodiaceae or Cupressaceae.

5. Lignifications (Xylites)

Xylites often occur as compressed stems (one sample had an elliptical cross section of 55×8 cm) or sometimes as in situ stumps. An impressive stump was unearthed in the area of "Barbarapfeiler". Samples showing both preservation modes provided only enough features to identify them as Gymnosperms, because lignification and the pressure of overlying rock layers had closed most cell lumina. The cell wall material has become almost homogeneous. Only late wood areas can be distinguished by their different color from the rest of the material.

Xylites have been found with inclusions of sphaerosiderite, especially in the Zangtal area. Grains with a diameter of up to 1 cm are contained within the woody tissues.

6. Fusain

Fossil charcoal was found within the seam as distinct layers (e.g., NE at the lower edge of the lower seam) and in the remains of sediments washed for fructifications. They appear to be well preserved when studied with an SEM, and only the internal structures of the crossfield pittings cannot be clearly seen, so the samples were embedded and microtome-sectioned. The extremely high optical density of most of the samples, and problems with penetrating the wall layers with the resin, were surprising. No comparable problems have arisen before, even in weathered prehistoric charcoals. This situation made it impossible to prepare satisfactory radial sections for studying the crossfield pits.

Further investigations will clarify the microscopic characteristics of fusain and semifusain (a transition to coal [CHRISTOPHER, 1961]).

The same arrangement of rays and axial parenchyme can be seen in tangential sections (Table 1, Fig. 9) of fusain as in petrified samples (Table 1, Fig. 4).

Most cross sections (Table 1, Fig. 8) show early wood deformation, which is also similar to petrified samples. Since charcoal is very brittle, it is unlikely that these changes in structure occurred after the carbonization process. This excludes the theory of wildfire (JONES, 1993), or at least of burning woods. It is probable that dried swamp layers occasionally burned and produced charcoal from degraded wood. On the other hand, this should also have produced Angiosperm charcoal, which is entirely missing. Therefore, this carbonizing process must have acted after the selective degradation of Angiosperms had taken place.

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Plate 1

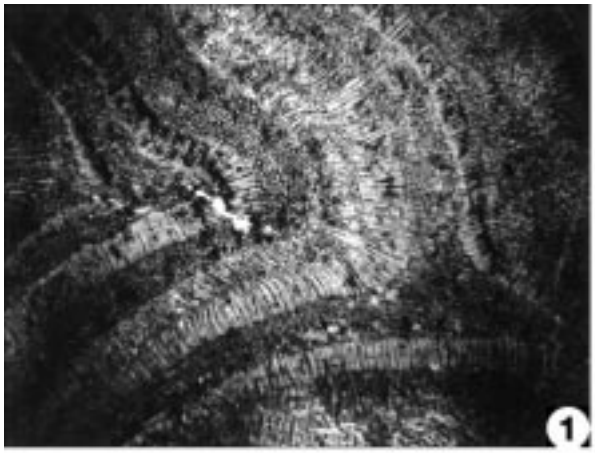
Fig. 1: Degraded petrified wood.
Zangtal.
Cross section, 20 ×.

Petrified wood of *Taxodioxylon sequoianum* (MERCKLIN) GOTHAN.
Köflach, seam of western subbasin.

Fig. 2: Cross section, bended early wood tissue.
20 ×.
Fig. 3: Cross section, ring border.
70 ×.
Fig. 4: Tangential section, uniseriate rays, smooth horizontal walls of axial parenchyme.
70 ×.
Fig. 5: Radial section, ray architecture, crossfield pitting.
420 ×.
Fig. 6: Radial section, crossfield pitting.
700 ×.
Fig. 7: Radial section, bordered pits in tracheid walls.
700 ×.

Fusain.
Köflach, NE at the lower edge of the lower seam.

Fig. 8: Cross section, bended early wood tissue.
70 ×.
Fig. 9: Tangential section, uniseriate rays, smooth horizontal walls of axial parenchyme.
70 ×.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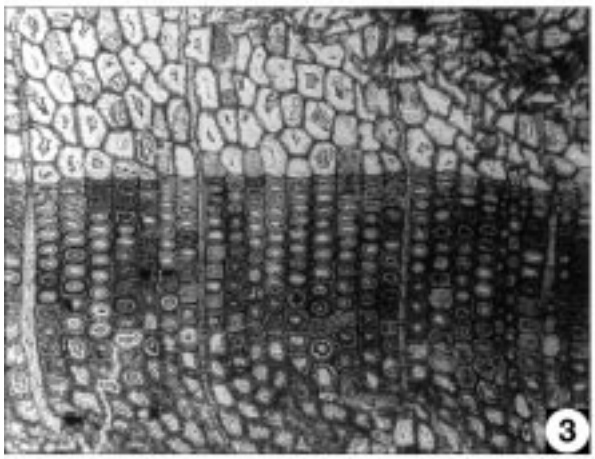
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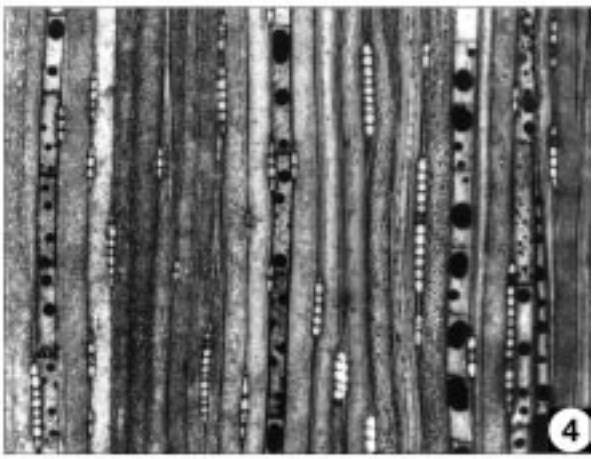
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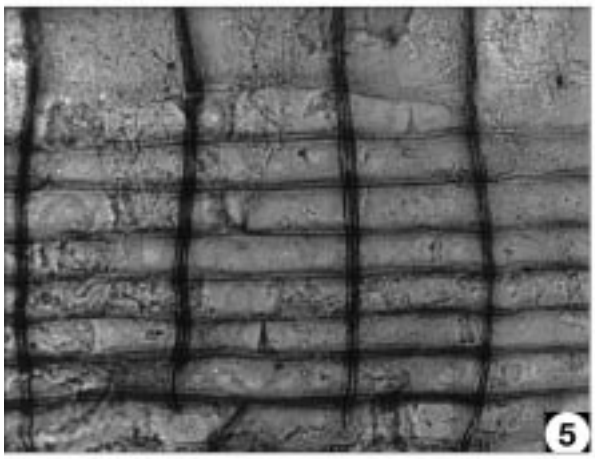
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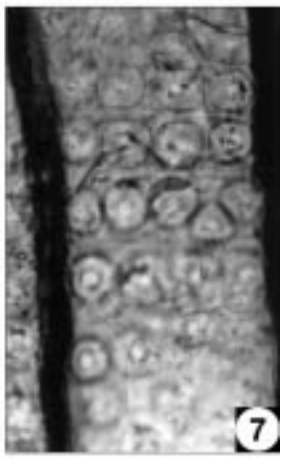
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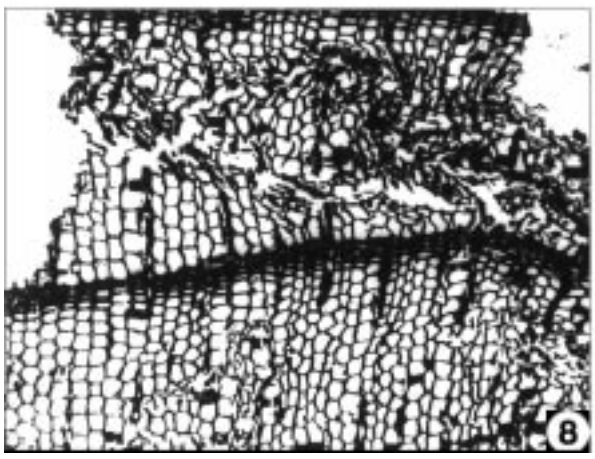
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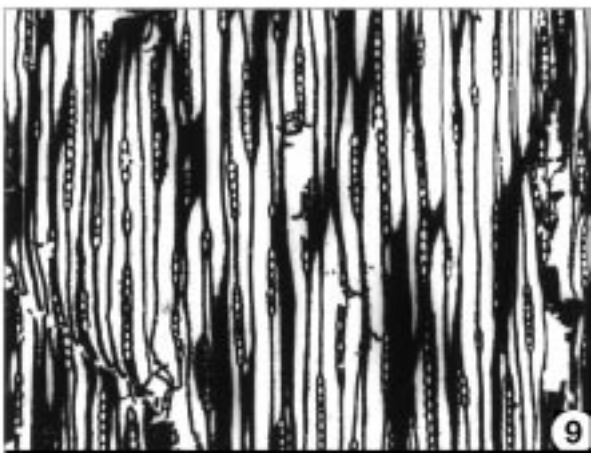
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