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OLIGOCENE ANGIOSPERM WOODS FROM NORTHWESTERN BOHEMIA, CZECH REPUBLIC

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SUMMARY

Two species of fossil angiosperm wood are described from the Oligocene of northwestern Bohemia in the Czech Republic. One specimen from Kadaň–Zadní vrch Hill is identified as *Cercidiphylloxylon kadanense* Prakash et al. Because of its superior preservation, the specimen is designated as an epitype to the original holotype specimen of the species and genus. *Cercidiphylloxylon kadanense* is known only from the locality of Kadaň–Zadní vrch Hill, and it represents the oldest fossil wood of true *Cercidiphyllum* Sieb. & Zucc. Three other wood specimens from Žichov are attributed to *Liquidambaroxylon speciosum* Felix. Modern wood of some species of *Cercidiphyllum* Sieb. & Zucc., *Liquidambar* L., *Altingia* Noronha, *Corylopsis* Sieb. & Zucc., *Distylium* Sieb. & Zucc., and *Hamamelis* L. was examined to determine how to distinguish the wood of *Cercidiphyllum* (Cercidiphyllaceae) from similar woods of Hamamelidaceae. The number of bars in the scalariform perforation plates of the vessels is about 40 in *Cercidiphyllum*, and about 20 in the Hamamelidaceae. Rays are variable, even at intra-specific level, and are not suitable for distinguishing these woods. These criteria were found to be useful in evaluating affinities of the fossil woods.

Key words: *Cercidiphylloxylon, Liquidambaroxylon*, fossil wood, Oligocene, Czech Republic, Cercidiphyllaceae, Hamamelidaceae, modern wood.

INTRODUCTION

The Tertiary of northwestern Bohemia, consisting of the volcanics of České středohoří and Doupovské hory Mts. and the sediments of Most basin, is intensively explored. Most palaeobotanical data are based on fossil leaves, fruits and seeds (e.g., Kvaček 1998; Kvaček & Walther 2003). The present paper, dealing with two types of Oligocene angiosperm woods, is part of recent systematic publications on the fossil wood from this region (Sakala & Teodoridis 2001; Sakala 2002, 2003a). Woods in different states of preservation are very abundant there. However, except for material from the Doupovské hory Mts. (e.g., Prakash et al. 1971), they have not been studied system-

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atically, only described sporadically (see the overview in Prakash et al. 1971: 104) or recorded if present (e.g., Radoň 2001). This study of fossil woods from northwestern Bohemia adheres to the so-called 'Whole-Plant' concept (Sakala & Teodoridis 2001) by combining detached leaves and reproductive organs with fossil wood. The woods described hereafter are similar, but they can be distinguished by the number of bars in the scalariform perforation plates of the vessels. They are attributed here to two fossil species and compared to the modern wood of the Cercidiphyllaceae and the Hamamelidaceae.

MATERIALS AND METHODS

The fossil woods described herein were found at two neighbouring localities: Kadaň–Zadní vrch Hill (50° 23' 33" N, 13° 16' 06" E) and Žichov (50° 29' 26" N, 13° 47' 26" E) in northwestern Bohemia, in the Czech Republic. The locality of Kadaň–Zadní vrch Hill belongs to the volcanic complex of the Doupovské hory Mts. The fossiliferous horizon is formed of tufites. Numerous angiosperm woods have been described from this locality, which is the richest for fossil angiosperm wood in the Czech Republic (Prakash et al. 1971). All woods at the locality are calcified. Our wood specimen comes from a 60 × 60 cm trunk, yellow-brown to red in colour. The origin of the locality as a whole is interpreted as a maar relic (P. Hradecký, pers. comm.). Its age is believed to be Oligocene but radiometric dating and further biostratigraphic studies are needed. At Žichov, the diatomite transformed into semiopal has yielded fossil fish, insects and foliage. In 1983, a small silicified fragment of a trunk, 20–25 cm in diameter, was found there and determined by D. Březinová as *Taxodioxylon* sp. (Radoň 2001). Although this site is inaccessible today, several small isolated pieces of silicified wood have recently been found in a nearby field. Based on growth ring curvature, it seems that they came from a trunk or a large branch. The locality, together with volcanoclastics at the Matrý Hill, represents the youngest fossiliferous level of the volcanic region of the České středohoří Mts. and belongs to the Děčín formation, Late Oligocene in age (Kvaček & Walther 2003).

Woods were thin sectioned following the standard techniques. The original pieces and thin sections of the wood described herein are deposited in the National Museum of Prague (one specimen/epitype from Kadaň–Zadní vrch Hill), and in the palaeontological collections of Doly Bílina–Bílina Mines (the three specimens from Žichov). Except for *Cercidiphyllum japonicum* No. 24-Mertz and *Liquidambar styraciflua* No. 708 from the collections of the Laboratoire de Paléobotanique et Paléoécologie, Université Pierre-et-Marie Curie, Paris, all modern woods studied were from the Jodrell Laboratory of the Royal Botanical Garden in Kew. The type specimen of *Cercidiphylloxylon spenceri* was studied and photographed in the palaeontological collections of the Department of Palaeontology in The Natural History Museum of London.

RESULTS

CERCIDIPHYLLACEAE

Cercidiphylloxylon Prakash et al.

Cercidiphylloxylon kadanense Prakash et al. 1971 — Fig. 1A–D, 2A

Material: G 8113 (epitype), collections of the Palaeontological department of the National Museum, Prague.
Locality: Kadaň–Zadní vrch Hill (Oligocene, northwestern Bohemia, Czech Republic).

Growth rings: distinct, 1.3–3.6 mm wide.
Wood pattern: diffuse-porous.
Vessels: mostly solitary, sometimes in tangential and radial pairs, 110–165 pores per mm^2; mostly angular in outline, but also elliptical to rounded; tangential diameter 25–80 µm, mean 50 µm; radial diameter 30–110 µm; vessel walls about 3 µm thick; scalariform perforation plates with (25–)40(–45) bars with a spacing of 19–22 per 0.1 mm; vessel pits on longitudinal walls scalariform, vessel-ray pits also scalariform.
Axial parenchyma: sparse, diffuse; cell dimensions (transverse diameter × height): 15–24 × 70–100 µm.
Rays: heterocellular, 1–4-seriate, mostly 2–3-seriate, about 10–13 per mm; multiseriate rays with uniseriate rows of 1–8 upright and sometimes procumbent cells; multiseriate rays 15–47 µm wide, and up to 55 cells (1300 µm) high; rays often vertically interconnected, composed of several multiseriate portions joined together by uniseriate portions (= end-to-end ray fusion); ray cell dimensions (tangential height × tangential width × radial length) are 10–42 × 9–24 × 18–70 µm; large quadrangular crystals present, mostly in upright ray cells.
Fibres: quadrangular to polygonal in cross-sectional outline, thick-walled (3–8 µm), disposed in 1–6 rather regular radial lines between two rays; tangential and radial diameters 12–33 µm; fibre pits not preserved.

HAMAMELIDACEAE

Liquidambaroxylon Felix

Liquidambaroxylon speciosum Felix 1884 — Fig. 1E–H

Material: specimens No. 02/98, 33/99 and 34/99 (collections of Doly Bílina).
Locality: Žichov (Late Oligocene, northwestern Bohemia, Czech Republic).

Growth rings: distinct, 0.4–4.6 µm wide.
Wood pattern: diffuse porous.
Vessels: mostly solitary, sometimes in tangential multiples of 2 due to overlapping of end walls, very rarely radially grouped, 155–185(–240) pores per mm^2; angular to oval in outline; tangential diameter 20–60 µm, mean 40 µm; radial diameter 20–80 µm; vessel walls 1–2 µm thick; vessel elements 470–650(–800) µm long; scalariform perforation plates with (15–)17–23(–27) bars with a spacing of 13–17 bars per 0.1

mm; bars sometimes (rarely) forked; vessel pitting on longitudinal walls generally in one or rarely in two series of round to horizontally elongated, scalariform pits (6 × 6–12 μm); vessel-ray pits horizontally flattened, 3–5 μm high, up to 15 μm long; tyloses conspicuous.

Axial parenchyma: diffuse, not abundant; up to 7 cells per strand; cell dimensions (tangential diameter × radial diameter × height): 12–18 × 9–23 × 90–120 μm; cell walls 2 μm thick.

Rays: heterocellular, (1–)2-seriate, rarely triseriate, about 20 per mm; uniseriate rays of upright cells, sometimes shorter cells in the middle of the rays; multiseriate rays with marginal rows of 1–6(–10) upright cells and bodies of procumbent cells; uniseriate ray height 1–22 cells (62–640 μm), width 7–18 μm; multiseriate rays 15–30 μm wide (up to 35 μm in very rare triseriate portions), height 3–62 cells (116–1294 μm); rays often interconnected; ray cell dimensions (tangential height × tangential width × radial length) are 9–80 × 6–30 × 15–120 μm; ray cells often with crystal contents, often 2 crystals per one horizontally divided upright cell; ray cells markedly pitted.

Fibres: quadrangular to polygonal, mostly hexagonal in cross-sectional outline; 1–5 rather regular radial rows between two rays; tangential and radial diameters 7–30 μm; thick-walled (3–9 μm), lumen 2–9 μm; pits, observed on radial walls, rounded in outline, in one vertical row, 7–9 μm in diameter with a vertically elongated lumen.

DISCUSSION

The two fossil wood types described here are very similar. Both are diffuse-porous with mostly solitary, angular vessels, and scalariform perforation plates. They also have heterocellular, 2(–3)-seriate rays with uniseriate marginal rows (tails), which sometimes join several multiseriate ray portions together, forming the so-called ‘interconnected rays’ sensu Carlquist (1988: 202), or ‘end-to-end ray fusion’ sensu Prakash et al. (1971). The specimen G 8113 from Kadan has slightly wider, mostly 2–3-seriate, less heterocellular rays and more numerous bars (about 40 and more) in the scalariform perforation plates (Fig. 1A–C). The three specimens from Žichov have narrower, mostly biseriate and more heterocellular rays, which are frequently interconnected, and fewer bars (about 20) in the scalariform perforation plates (Fig. 1E–H). This combination of characters (diffuse-porous pattern, angular, mostly solitary vessels with scalariform pitting and perforations, rather thin rays with uniseriate marginal rows sometimes joined together, rare diffuse parenchyma, and presence of crystals in rays) is found in the families Cercidiphyllaceae and Hamamelidaceae (Wheeler & Manchester 2002).

Conspectus of the representatives of the morpho-genus Cercidiphylloxylon

The specimen G 8113 from Kadaň belongs to *Cercidiphylloxylon kadanense*, which is the type species of the morpho-genus *Cercidiphylloxylon*. *Cercidiphylloxylon kadanense* was originally defined by Prakash et al. (1971) on a single type specimen (= ZV-12) from the locality of Kadaň–Zadní vrch Hill of the Oligocene of northwestern Bohemia (Czech Republic). Our new specimen (= G 8113) comes from the same locality. As its

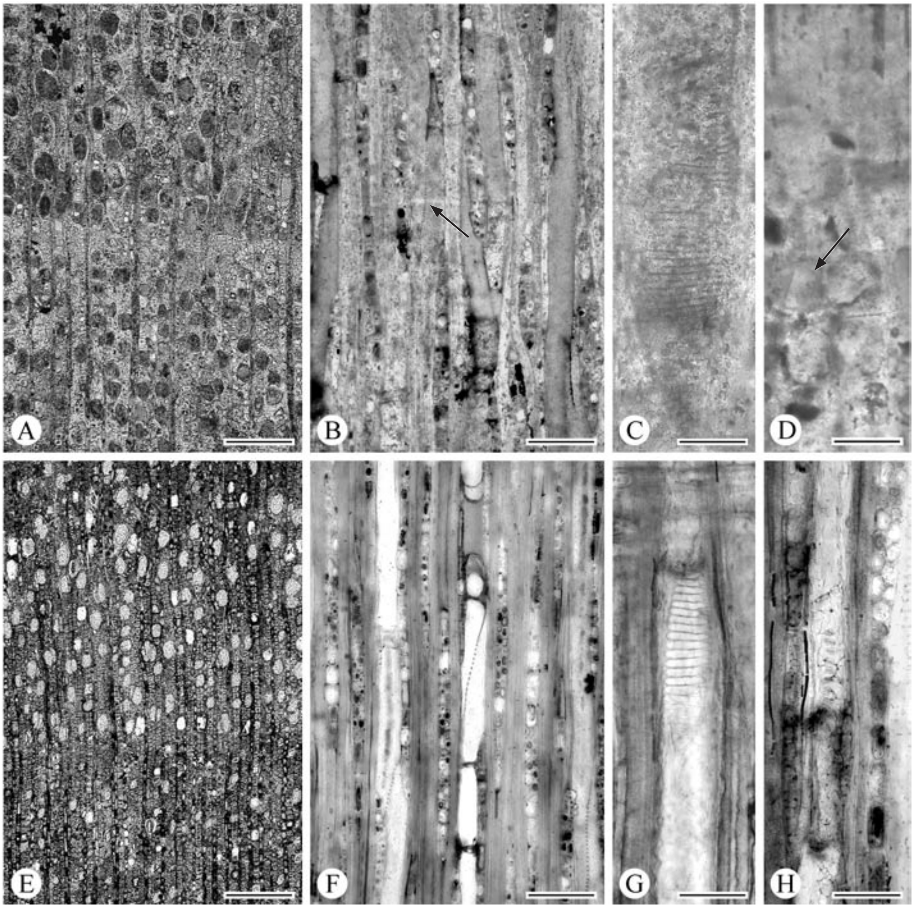

Fig. 1. A–D: *Cercidiphylloxylon kadanense* Prakash et al. (G 8113, epitype). – A: Diffuse-porous wood with mostly solitary vessels, angular in outline, XS. – B: 2–4-seriate rays with some interconnected rays (4-seriate ray lower right), and scalariform perforation plate (arrow), TLS. – C: Scalariform perforation plate with 40 bars, RLS. – D: Crystal in the upright ray cell (arrow), RLS. — E–H: *Liquidambaroxylon speciosum* Felix (02/98). – E: Diffuse-porous wood with mostly solitary vessels, angular in outline, XS. – F: Uni- to biseriate rays with long uniseriate extremities & frequent interconnected rays, and scalariform perforation plates, TLS. – G: Typical scalariform perforation plate with 20 bars, RLS. – H: Scalariform vessel pitting, TLS. — Scale bars = 200 µm in A, E; 100 µm in B, F; 50 µm in C, D, G, H.

preservation is much better than the original type specimen, we propose designating this new specimen as an epitype of *C. kadanense*, as well as of *Cercidiphylloxylon*. Information from this new specimen complements the original specific/generic diagnosis (Prakash et al. 1971: 112). New observations on *C. kadanense* and *Cercidiphylloxylon* are: 1) rays can be up to 4-seriate, observed in both holotype and newly designated epitype (Fig. 2A, B), 2) the presence of crystals in the rays of *C. kadanense* (Fig. 1D),

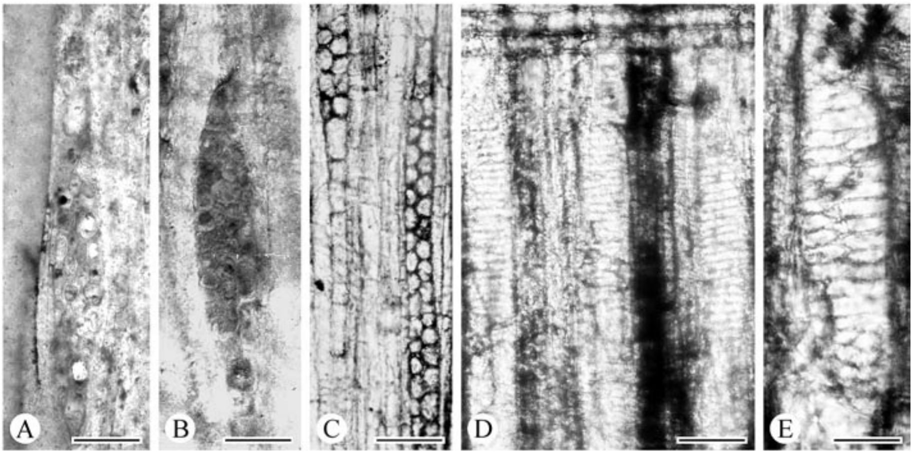

Fig. 2. A & B: *Cercidiphylloxylon kadanense* Prakash et al. (A: G 8113, epitype; B: ZV-12 (= G 4055), holotype). – A: 4-seriate ray (same as shown in Fig. 1B lower right), TLS. – B: 4-seriate ray, TLS. — C–E: *Cercidiphylloxylon spenceri* (Brett) Pearson (C–E: V.23438, one of the syntypes; C: V.23438c; D & E: V.23438b). – C: Biseriate rays with uniseriate marginal rows (tails), TLS. – D: Scalariform perforation plates with 19–25 bars, RLS. – E: Scalariform, often forked, perforation plate with about 20 bars, RLS. — Scale bars = 50 µm in A, B, C; 40 µm in D; 25 µm in E.

and 3) the density of bars in the scalariform perforation plates is about 20 bars per 0.1 mm in *C. kadanense* (Fig. 1C). This last feature, together with the total number of bars (about 40), is diagnostic of *C. kadanense*; the spacing of the bars can be used to help identify specimens where only a part of the scalariform perforation plate is preserved.

The second species of *Cercidiphylloxylon* (*C. spenceri*) is based on the wood described as *Cercidiphyllum spenceri* by Brett (1956) from the Eocene of London Clay, and later transferred to the morpho-genus *Cercidiphylloxylon* by Pearson (1987). Pearson's argumentation is consistent with a more general concept of *Cercidiphylloxylon*, which agrees with the botanical affinities of this morpho-genus, discussed hereafter. Crawley (1989) attributed two specimens from the Palaeocene of Scotland to *C. spenceri*. He also included the wood of *Cercidiphyllum alalongum* Scott & Wheeler (1982) from

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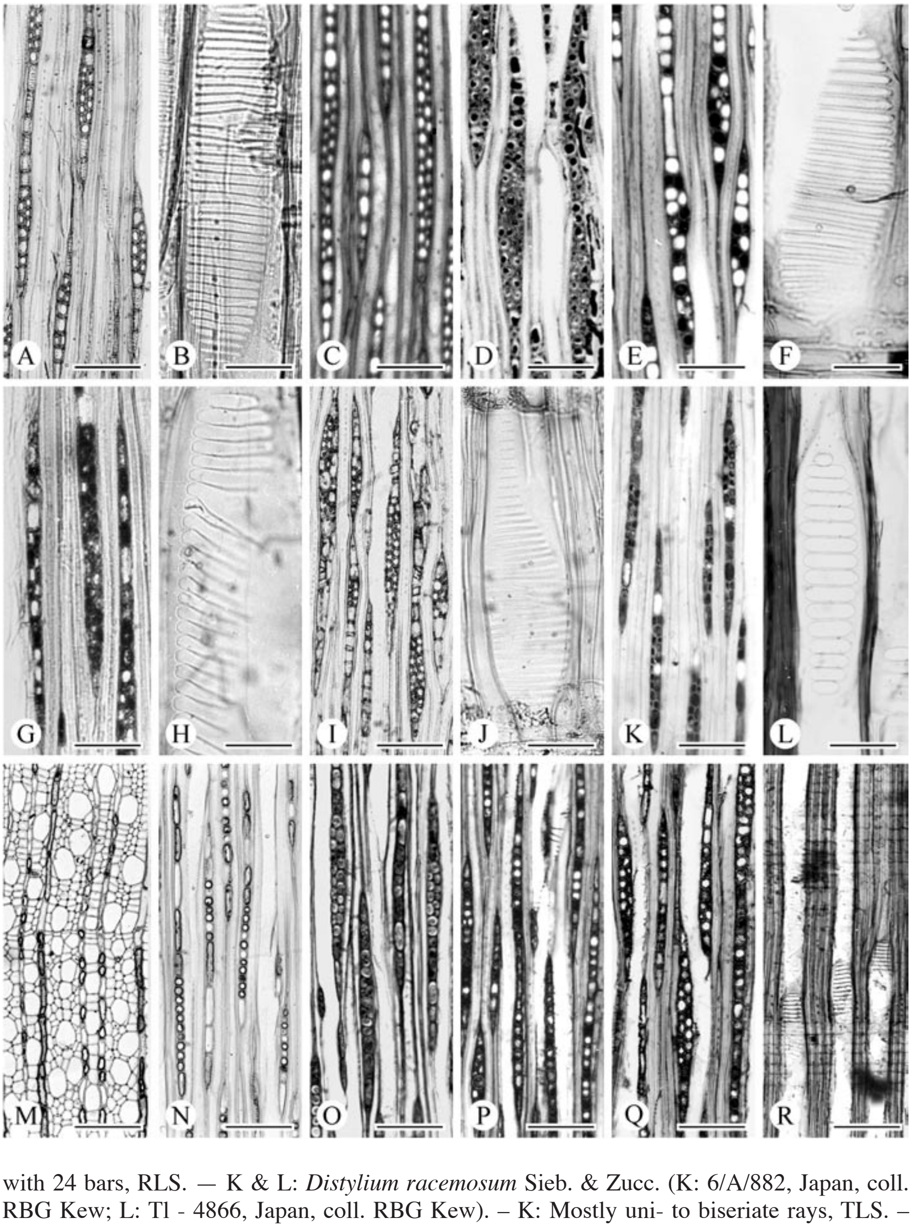
Fig. 3. A & B: *Cercidiphyllum japonicum* Sieb. & Zucc. (No. 24-Mertz, coll. LPP UPMC Paris). – A: Biseriate rays, often interconnected, TLS. – B: Scalariform perforation plate with closely spaced 45 bars, RLS. — C & D: *Liquidambar formosana* Hance (C: 600-69-31275w, coll. RBG Kew; D: Formosa, Hort. Kew, RBG Kew). – C: Uni- to biseriate rays, TLS. – D: Bi- to triseriate rays, TLS. — E & F: *Liquidambar styraciflua* L. (E: SE USA trade 1962, coll. RBG Kew; F: SE USA, coll. RBG Kew). – E: Uni- to biseriate rays, sometimes interconnected, TLS. – F: Scalariform perforation plate with about 25 bars, RLS. — G & H: *Altingia excelsa* Noronha (G, H: specimen from Burma, coll. RBG Kew). – G: Bi- to triseriate rays, TLS. – H: Part of a scalariform perforation plate with 28 bars, RLS. — I & J: *Corylopsis* sp. (I, J: specimen from Wakehurst, coll. RBG Kew). – I: Bi- to triseriate rays, TLS. – J: Scalariform perforation plate



with 24 bars, RLS. — K & L: *Distylium racemosum* Sieb. & Zucc. (K: 6/A/882, Japan, coll. RBG Kew; L: Tl - 4866, Japan, coll. RBG Kew). – K: Mostly uni- to biseriate rays, TLS. – L: Scalariform perforation plate with 16 bars, RLS. — M–O: *Hamamelis japonica* Sieb. & Zucc. (M, N: 1045, Japan, coll. RBG Kew; O: TI-4852, Japan, coll. RBG Kew). – M: Diffuse-porous wood with solitary vessels, angular in outline, XS. – N: Exclusively uniseriate rays, TLS. – O: Uni- to biseriate rays, sometimes interconnected, TLS. — P–R: *Hamamelis virginiana* L. (P: PACw 6078, USA, coll. RBG Kew; Q, R: PACw 7215, USA, coll. RBG Kew). – P: Mostly uniseriate rays with some biseriate portions, TLS. – Q: Frequent biseriate interconnected rays, TLS. – R: Scalariform perforation plates with less than 20 bars, RLS. — Scale bars = 100 μm in A, C–E, G, I, K, M–R; 40 μm in B, F, H, J, L.

the Eocene of the Clarno Formation into the synonymy list of *Cercidiphylloxylon spenceri* (Crawley 1989: 600). Our observations on the type material of *Cercidiphylloxylon spenceri* support the view of Crawley (1989) that all these specimens belong to the same morpho-species, i.e., *Cercidiphylloxylon spenceri* (Brett) Pearson sensu Crawley. All differences seem to be only intraspecific (for a summary, see table 2 in Crawley 1989: 604). The wood recently assigned to *Cercidiphyllum alalongum* Scott et Wheeler by Wheeler and Manchester (2002) would also belong to *Cercidiphylloxylon spenceri*. The only discrepancy between the type and other specimens of *C. spenceri* is in the number of bars in the scalariform perforation plates. In the type, where Brett (1956) counted 25–30 bars, we have seen 27 bars at maximum, generally 19–25 bars, forked sometimes (Fig. 2D, E). This may be due to the type specimen V.23438 being a small fragment with immature (juvenile) wood.

Thus, the morpho-genus *Cercidiphylloxylon* has two species: *C. kadanense* Prakash et al. known only from the Oligocene of the Czech Republic and *C. spenceri* (Brett) Pearson from the Palaeocene and Eocene of the British Isles and the Eocene of the United States. These species may be distinguished, as already pointed out by Crawley (1989), by wider rays and a larger vessel diameter in *C. kadanense*. Ray width is also useful diagnostically: *C. kadanense* has mainly 2–3-seriate, but also 4-seriate rays (Fig. 1B; 2A, B), *C. spenceri* has 1–2-seriate rays (Fig. 2C).

Botanical affinities of Cercidiphylloxylon

The wood of *Cercidiphylloxylon* does not correspond only to *Cercidiphyllum* Sieb. & Zucc., but also to diverse extinct Cercidiphyllaceae.

Cercidiphylloxylon spenceri, only Palaeocene and Eocene in age, undoubtedly represents wood of extinct *Cercidiphyllum*-like plants, known from infructescences and foliage (Crane & Stockey 1986). As pointed out by Kvaček & Konzalová (1996), true *Cercidiphyllum*, based on fruits, is not older than Oligocene (Jähnichen et al. 1980; Meyer & Manchester 1997). Although never found in direct connection, nor closely associated with other organs (Crane 1984), the wood of *C. spenceri* belongs most probably to the plant with leaves of *Trochodendroides* Berry emend. Crane and fruits of the *Nyssidium*-type.

Cercidiphylloxylon kadanense has been recorded at a single locality, at the Kadaň–Zadní vrch Hill, in the Oligocene of NW Bohemia. In the Oligocene and Early Miocene of NW Bohemia, the fossil *Cercidiphyllum crenatum* (Unger) R.W. Brown occurs (Kvaček & Konzalová 1996), and is known from foliage, fruits, seeds, staminate inflorescences, and in situ pollen. Hence, the wood of *Cercidiphylloxylon kadanense* might be associated with this species.

Comparison with extant wood types

Both fossil woods described here are close to the Cercidiphyllaceae and Hamamelidaceae, as stated above. There are numerous descriptive works on the wood of *Cercidiphyllum japonicum* Sieb. & Zucc. (e.g., McLaughlin 1933; Swamy & Bailey 1949; Metcalfe & Chalk 1950; Kribs 1968). However, the wood of *C. magnificum* (Nakai) Nakai has never been mentioned, except for a note about spiral thickening in the tips of vessels (Ilic 1987: 40). *Cercidiphyllum japonicum* (Fig. 3A, B) is similar to the specimen G 8113, which we assign to *Cercidiphylloxylon kadanense*. However, as pointed out by Prakash et al. (1971), the rays of modern *Cercidiphyllum* (1–2-seriate) and fossil *Cercidiphylloxylon kadanense* (mostly 2–3-seriate) differ. In ray width, the modern *Cercidiphyllum* is closer to *Cercidiphylloxylon spenceri*, which, however, likely represents the wood of extinct *Cercidiphyllum*-like plants.

A similar wood structure, including 1–2-seriate rays, may be observed in *Liquidambar* L. (Fig. 3C–F) of the Hamamelidaceae. Prakash et al. (1971) proposed a distinction between *Liquidambar* and *Cercidiphyllum* based on the number of bars in scalariform perforation plates and the character of rays: *Liquidambar* with less (12–25) bars and occasional interconnected rays, contrary to *Cercidiphyllum* with numerous (20–50) bars and rays frequently interconnected. We studied extant wood material of two species of *Liquidambar*: *L. formosana* Hance (Fig. 3C, D) and *L. styraciflua* L. (Fig. 3E, F). Our observations confirm the difference in interconnected rays, but we believe this to be a rather subjective distinction. The rays of *Liquidambar* are variable; we observed narrower uni- to biseriate rays, sometimes interconnected, with various height of biseriate portions (Fig. 3C, E), but also wider bi- to triseriate rays (Fig. 3D). On the other hand, we found 15–20 bars in *L. formosana*, and up to 25(–30) bars in *L. styraciflua* (Fig. 3F), similar to Prakash et al. (1971). In addition, the bars in perforation plates of *Liquidambar* are more widely spaced: with 15 bars per 0.1 mm in *Liquidambar*, and about 20 bars per 0.1 mm in *Cercidiphyllum*.

We have examined rays and perforation plate number in other Hamamelidaceae: *Altingia* Noronha (Fig. 3G, H), *Corylopsis* Sieb. & Zucc. (Fig. 3I, J), *Distylium* Sieb. & Zucc. (Fig. 3K, L), and *Hamamelis* L. (Fig. 3M–R). Some authors have already compared the rays of some of these genera to *Cercidiphyllum*, e.g., comparison with *Corylopsis* was done by Scott and Wheeler (1982). Our observations of Hamamelidaceae show that their rays are very similar to each other. They are in general rather thin, uniseriate and biseriate with biseriate portions of different form and size and uniseriate marginal rows, with variation in frequency of interconnected rays (Fig. 3G, I, K, N–Q). The rays sometimes vary within one specimen, sometimes significantly within one species, as in *Hamamelis*. One specimen of *H. japonica* has exclusively uniseriate rays (Fig. 3 M, N); the other has uni- to biseriate rays, which are sometimes interconnected (Fig. 3O). Similar variation in ray character also occurs in *H. virginiana* (compare Fig. 3P vs. 3Q). *Cercidiphyllum* can be distinguished from these genera of Hamamelidaceae by the number of bars in the scalariform perforation plates. Hamamelidaceae have about 20 bars (Fig. 3J, L, R) with a maximum of 28 in *Altingia* (Fig. 3H), in contrast to *Cercidiphyllum* with 40 or more bars (Fig. 3B). We have found the perforation plate bar number to be very consistent and we believe it taxonomically useful. Consequently, the second fossil wood from the locality of Žichov, which is similar to modern *Liquidambar* in having fewer and more widely spaced bars, is attributed to the fossil morphospecies *Liquidambaroxylon speciosum* Felix. No other fossil remains of *Liquidambar* are reported from Žichov, contrary to *Cercidiphyllum* leaves (Ettingshausen 1869).

Finally, *Cercidiphylloxylon kadanense* from Kadaň–Zadní vrch Hill has some similarity to the wood of modern *Nyssa* Gronov ex L. (Sakala 2003b). However, *Nyssa* has more radial multiples and radial groups of vessels, and no crystals in the rays (Noshiro & Baas 1998), in contrast to *Cercidiphyllum* and our fossil wood. The presence of crystals in the rays differentiates our wood from *Diplopanax* Hand.-Mazz., another similar wood of the Cornaceae alliance (Noshiro & Baas 1998). Being able to distinguish between the wood of *Nyssa* and *Cercidiphyllum* is useful because they both represent important elements in the Tertiary of northwestern Bohemia. In the Early Miocene of Most basin, *Nyssa* is known by its leaves, endocarps, whole fruits and inflorescences with pollen in situ as a notorious swampy plant (Dašková 2000; Sakala 2000; Sakala et al. in progress). In the Oligocene, there are typical dentate leaves of *Nyssa altenburgensis* Walther & Kvaček from Seifhennersdorf (Kvaček & Walther 1981). This volcanoclastic deposit, situated near the Czech borders in the German part of the České středohoří Mts., is late Early Oligocene in age (Kvaček & Walther 2003).

CONCLUSIONS

The family Cercidiphyllaceae is represented today by a single genus, *Cercidiphyllum* Sieb. & Zucc. (katsura tree) with two species, confined to China and Japan (e.g., Spongberg 1979). However, the family was more diversified in the past, containing some extinct genera based on various plant organs (Crane & Stockey 1986; Kvaček & Konzalová 1996). Fossil cercidiphyllaceous woods have already been described (Brett 1956; Prakash et al. 1971; Scott & Wheeler 1982; Crawley 1989; Wheeler & Manchester 2002; wood mentioned in the taxonomic list as '*Cercidiphyllum* sp.' by Beck 1945 was subsequently described in detail by Prakash & Barghoorn 1961 as '*Liquidambar* cf. *styraciflua*'; S.R. Manchester, pers. comm.). New excavations at the locality of Kadaň–Zadní vrch Hill (Oligocene, northwestern Bohemia, Czech Republic) have yielded several specimens of calcified wood. One of them is identified here as *Cercidiphylloxylon kadanense* Prakash et al. (1971). Its preservation, which is better than in the holotype specimen, allows its designation as an epitype of *Cercidiphylloxylon kadanense* as well as *Cercidiphylloxylon*, both defined originally by Prakash et al. (1971) in the same locality. We conclude that the wood of *Cercidiphylloxylon kadanense* represents the oldest record of the fossil wood of true *Cercidiphyllum* because of its Oligocene age and the occurrence of leaves, fruits, seeds, staminate inflorescences, and pollen of *Cercidiphyllum* in the region.

We compared *Cercidiphylloxylon kadanense* with another similar wood type from the neighbouring locality, treated here as *Liquidambaroxylon speciosum* Felix as well as with similar modern woods from the Cercidiphyllaceae and Hamamelidaceae. Generally, the number of bars in the scalariform perforation plates of the vessels is a reliable criterion to distinguish the wood of *Cercidiphyllum* Sieb. & Zucc. from woods of the Hamamelidaceae. Rays among the Cercidiphyllaceae and Hamamelidaceae can vary, even at intra-specific level, and we believe ray characteristics are not suitable for distinguishing them. However, the co-occurring differences of the rays of two fossil woods, viewed here as a subsidiary feature, corroborate the recognition of two genera.

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