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Research paper

First anatomical description of silicified calamitalean stems from the upper Carboniferous of the Bohemian Massif (Nová Paka and Rakovník areas, Czech Republic)

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ABSTRACT

Silicified stems are very abundant in the upper Palaeozoic basins of the Czech Republic. The results of an anatomical study of the silicified calamitalean stems from the Krkonoše Piedmont and Kladno–Rakovník basins are presented here for the first time. In the Krkonoše Piedmont Basin, there are various silicified plant remains, but the presence of calamitalean wood is restricted to only one stratigraphic unit, to the so-called "Ploužnice Horizon". Only a few data on the systematics of permineralised or petrified stems from the Kladno–Rakovník Basin are available, anatomical descriptions are largely lacking and fossilised calamitalean stems were unknown. The fossils can be attributed to two species: the common *Arthropitys* cf. *bistriata* and the rare *Calamitea striata*; the occurrence of the latter is limited to the Krkonoše Piedmont Basin.

1. Introduction

The Carboniferous–Permian of the Krkonoše Piedmont area is historically well known for its abundant fossil stems. Their frequency and aesthetic value attracted the attention of local and foreign researchers (Březinová, 1970), but a modern systematic overview is still lacking. One might even say that in the past decades only collectors have shown their interest. The fossil stems were illustrated in several popular books on fossil plants (e.g., Dernbach, 1996; Dernbach et al., 2002). Only Matysová and Mencl in their MSc theses (Matysová, 2006; Mencl, 2007) and three consecutive papers (Matysová et al., 2008; Mencl et al., 2009; Matysová et al., 2010) presented the first detailed systematical and geochemical data, mainly focused on the "*Dadoxylon*" type of wood. Holeček in his MSc thesis (Holeček, 2011) studied the succession in the Kladno–Rakovník Basin in Central/Western Bohemia, which also contains abundant fossil wood and can be correlated with the succession in the Krkonoše Piedmont area.

The present contribution summarises new and old evidences of silicified calamite stems from the upper Carboniferous of the Czech Republic and provides the first anatomical description with special emphasis on the Krkonoše Piedmont Basin as well as the Kladno–Rakovník Basin, from which calamite stems were previously unknown. We apply the taxonomic concept recently developed for calamitaleans from the early Permian petrified forest of Chemnitz, Germany (Rößler and Noll, 2006, 2007, 2010; Rößler et al., 2012a).

2. Historical research

2.1. Krkonoše Piedmont Basin

Silicified stems in the Nová Paka region (Fig. 1A) were mentioned by many authors, probably first by Maloch (see Heber, 1844). The first scientific descriptions of silicified plant remains from localities such as Nová Paka, Pecka and Kozinec are by Goeppert (1858), who described the conifer wood *Araucarites schrollianus* (=*Dadoxylon saxonicum*; synonym: *Dadoxylon schrollianum*), *Calamites* and *Psaronius*. Frič (1912) noticed several types of silicified stems from Nová Paka and Lázně Bělohrad (stem types *Medullosa*, *Psaronius* and "*Dadoxylon*") and silicified peat. He paid special attention to insect borings on the woods, and to small axes of the climbing fern *Ankyropteris brongniartii*, which were preserved inside the root mantle of *Psaronius* trunks. Common findings of silicified wood in the Nová Paka and Pecka surroundings were also mentioned by Jokély (1861), Feistmantel (1873a,b,c) and Purkyně (1927). Several pieces of silicified stems ("*Dadoxylon*", *Psaronius*, *Medullosa*) were found in the village of Pecka; mostly as loose pieces but some of them in outcrops, although not in upright position (Purkyně, 1927). The age of these findings was initially considered

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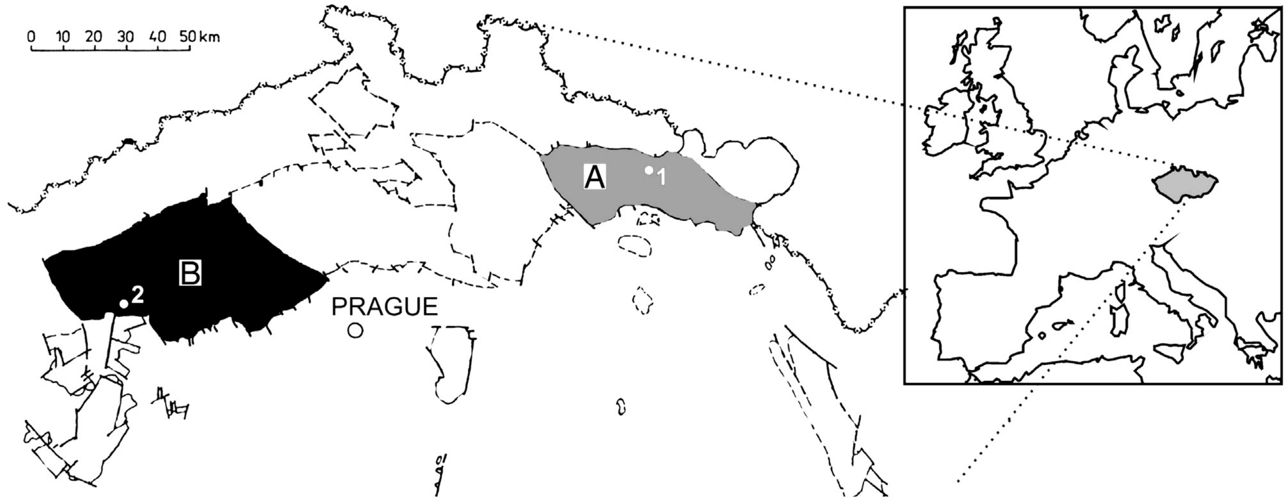

Fig. 1. Carboniferous–Permian basins of the Czech Republic with the position of the Krkonoše Piedmont Basin (A) and Kladno–Rakovník Basin (B) and two studied localities Nová Paka (1) and Bílenec (2) with most abundant fossil wood.

to be early Permian (Feistmantel, 1873a,b,c), but is now regarded to be Kasimovian–Gzhelian (Matysová, 2006; Mencl, 2007; Mencl et al., 2009). No detailed anatomical descriptions of calamitalean stems were published to date, only the historical report by Goeppert (1858), some photos by Němejc (1963, Plates XXXII–XXXIII), a few notes by local collectors (e.g., Soukup, 1997) and a short note by Sakala et al. (2009).

2.2. Kladno–Rakovník Basin

Findings of silicified wood in the Kladno–Rakovník Basin (Fig. 1B) are not as common as in the Krkonoše Piedmont Basin. The first study was carried out by Feistmantel (1873b). He described silicified wood from localities such as Rakovník, Lubná, Hředle, Řevničov, Klobuky and Krušovice as *Araucarites schrollianus* and *Psaronius*. Frič (1912) mentioned sandy strata with silicified wood near Kněževes. Purkyně (1927) provided a summary of findings from Bohemia, including the new localities Očihov and Kryry; he also mentioned an occurrence of black silicified wood from Slaný Formation. The most recent petrological study was performed by Skoček (1970), who divided the petrified wood in two categories: dark wood with organic matter and lighter wood without organic matter. Skoček (1970) assumed that the dark wood was deposited in swamps or marshes in a wet climate regime, while the more common pale-coloured wood was regarded as being deposited under dry climatic conditions. Finally, a short note about the silicified peat and fossil wood in the Kloubuky area was recently published by local collectors (Dvořák and Švancara, 2003). It can be said that the research in the Kladno–Rakovník Basin was not as thorough as in the Krkonoše Piedmont Basin.

3. Geological settings

3.1. Krkonoše Piedmont Basin

The Krkonoše Piedmont Basin is situated in the northern part of the Czech Republic, at the foot of the Krkonoše–Jizerské hory crystalline complex (Fig. 1A) and belongs to a system of post-orogenic extensional/transtensional basins of the Bohemian Massif. Continental deposits in the Krkonoše Piedmont Basin are early Moscovian (Asturian) to Early (or even Middle) Triassic. The maximum thickness of the succession is about 1800 m (Pešek et al., 2001). Despite the fact that occurrences of "*Dadoxylon*" type of wood are confirmed from three stratigraphic levels (Mencl et al., 2009), silicified remains of calamitaleans (*Arthropitys*, *Calamitea*), ferns (*Psaronius*) and seed-ferns (*Medullosa*) are restricted to a single stratigraphic level — the so-called "Ploužnice Horizon" (Fig. 2, right column).

The Ploužnice Horizon belongs to the middle part of the Semily Formation and is Gzhelian (Stephanian C) in age. It is known from the southern part of the basin, only from a number of localities that are situated approximately around Syřenov, Stará Paka, Nová Paka (with the well-known Balka locality), Borovnice and Pecka. This unit is usually up to 100 m thick and sediments are mostly lacustrine (Pešek et al., 2001). They consist of fine-grained, reddish mudstones and siltstones with limestone-enriched horizons, calcareous and silicic concretions, and intercalations of tuff and tuffitic sandstones that were deposited as bedload (Stárková et al., 2009). Common occurrences of silicified wood and nodules of carnelian are restricted to the lower part of the Ploužnice Horizon. Silicified stems in growth position have never been observed. They are very rarely found in outcrops, but they are always transported and redeposited in lacustrine and fluvial sediments. Most of fossil trunks are split into pieces and found in eluvial sediments.

3.2. Kladno–Rakovník Basin

The Kladno–Rakovník Basin is situated in the central and northwestern part of the Czech Republic (Fig. 1B). It was also formed as part of a post-orogenic extensional/transtensional basin of the Bohemian Massif. The oldest sediments are early Moscovian and the youngest are Gzhelian in age. These mostly lacustrine sediments are usually divided into four formations, i.e. the Kladno, Týnec, Slaný and Líně formations. Silicified wood is usually found in all formations, but it is most abundant in the Týnec and Líně formations (Fig. 2, left column).

The Týnec Formation (Kasimovian) is typified by coarse-grained reddish sediments, without or with little volcanic material. Up to 10 m long silicified trunks were described from this formation by Pešek et al. (2001). The Týnec and the Líně formations are separated by a hiatus. The Líně formation (Gzhelian) was deposited in a drier environment and primarily consists of reddish to crimson-coloured siltstones and claystones. Tuffs and tuffites are more common than in the underlying Týnec Formation. Three horizons can be distinguished within the Líně Formation: the Zdětín, Klobuky and Stránka horizons (Pešek et al., 2001). Unfortunately, there are no outcrops of this formation in the Kladno–Rakovník Basin and all fossil trunks have been found in eluvium. Whole trunks are extremely rare, petrified wood is often fragmented into small pieces without branches. Therefore, we suppose that the trees were transported by rivers and eventually buried far from their original place of growth.

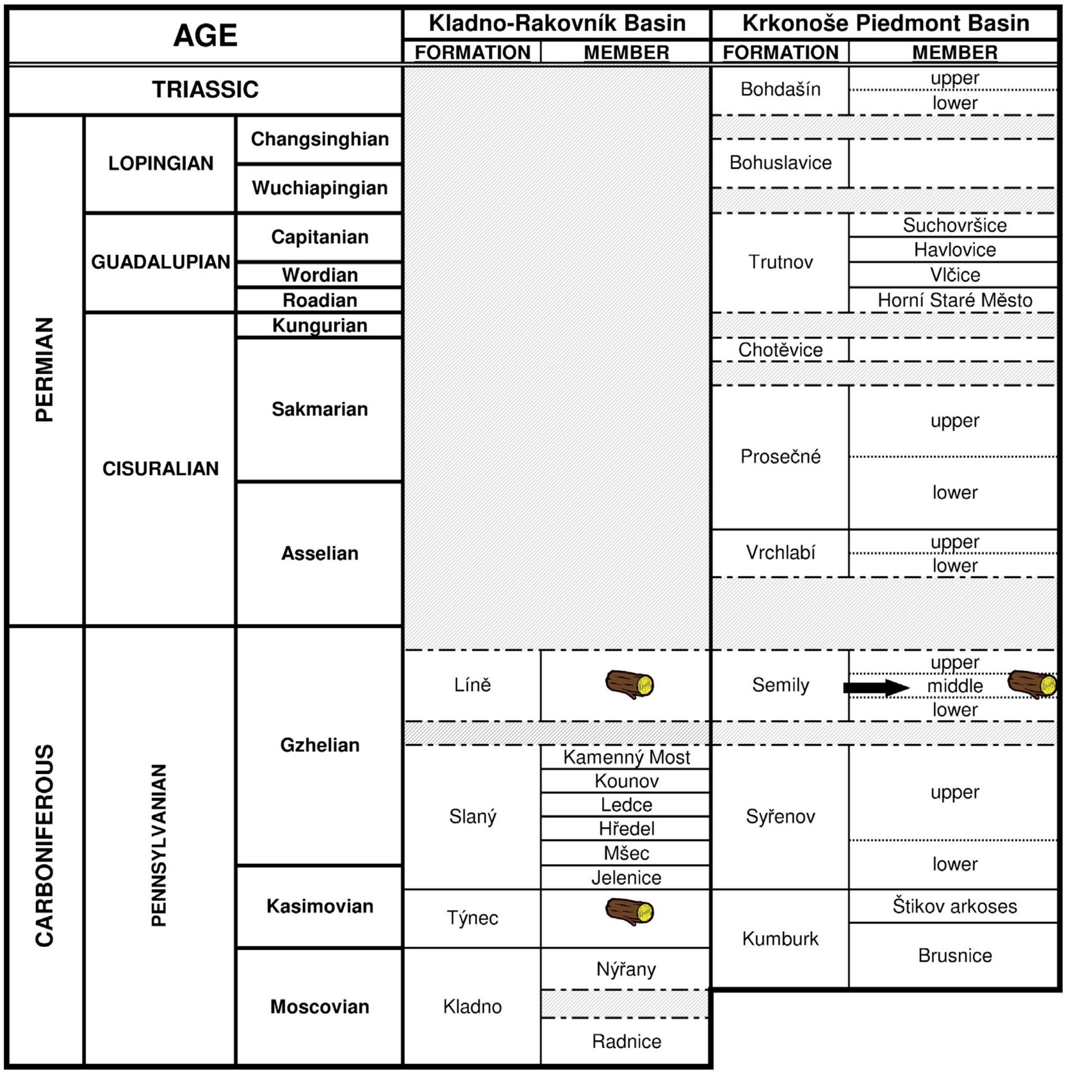

Fig. 2. Stratigraphy of the Kladno–Rakovník Basin in comparison with the Krkonoše Piedmont Basin; positions of the silicified calamitalean stems are figured by three small logs, the arrow shows the position of the Ploužnice Horizon.

4. Materials and methods

The samples from the Krkonoše Piedmont Basin are either from the palaeontological collections of the Municipal Museum Nová Paka, which have been collected during the last 100 years (signature P) and the Museum of Eastern Bohemia in Hradec Králové (abbreviation H), or by a private collector (specimen DVO5/XLVI). One specimen of *Calamitea striata* is from the Leuckart collection at Museum für Naturkunde Chemnitz (signature K). The samples from the Kladno–Rakovník Basin were provided exclusively by private collectors (abbreviations SVE, REH, ZAJ, DVO).

Only the best preserved samples were selected for further study. Cross sections of several dozens of well-preserved samples were polished and examined in reflected light with a Leica EZ 5 stereomicroscope and a Nikon Eclipse LV100Pol microscope. Several samples were selected for thin sectioning and transverse, tangential longitudinal and radial longitudinal sections were studied microscopically in transmitted light.

Thin sections were studied with an Olympus BX-51 microscope. Images were made with Olympus Camedia 3030 and Canon D500 digital cameras and processed with imaging software AnalySIS and NIS-Elements, with the help of Microsoft Excel 2007–2010.

5. Results

5.1. Systematics

Class: Sphenopsida.
Order: Equisetales.
Family: Calamitaceae.

Arthropitys Goeppert.
Arthropitys cf. *bistriata* (Cotta) Goeppert emend. Rößler, Feng and Noll (Fig. 3; Plates I, II).
Material: P1584, P1591, P1952, P1992, P3207, P4672, P5072, P5657, P5956, H74692, H74697 and DVO5/XLVI from the Krkonoše Piedmont Basin and SVE001/1, SVE002/1, SVE003/1, SVE004/1, SVE005/1, REH002/1, ZAJ004/1 and DVO5/XXXIII from the Kladno–Rakovník Basin.

Macroscopic description: all samples are small; pieces are only several centimetres long. Samples from the Krkonoše Piedmont Basin are dark, red-brown or orange (Plate I, 5; Plate II, 3, 6), only few are beige or whitish. On the other hand, samples from the Kladno–Rakovník Basin are mostly beige to greyish (Plate II, 1, 4), with one exception (ZAJ004/1) that is brown-yellow. Some samples (P1584, DVO5/XLVI) show nodes and another one (SVE005/1) nodes and a branch trace.

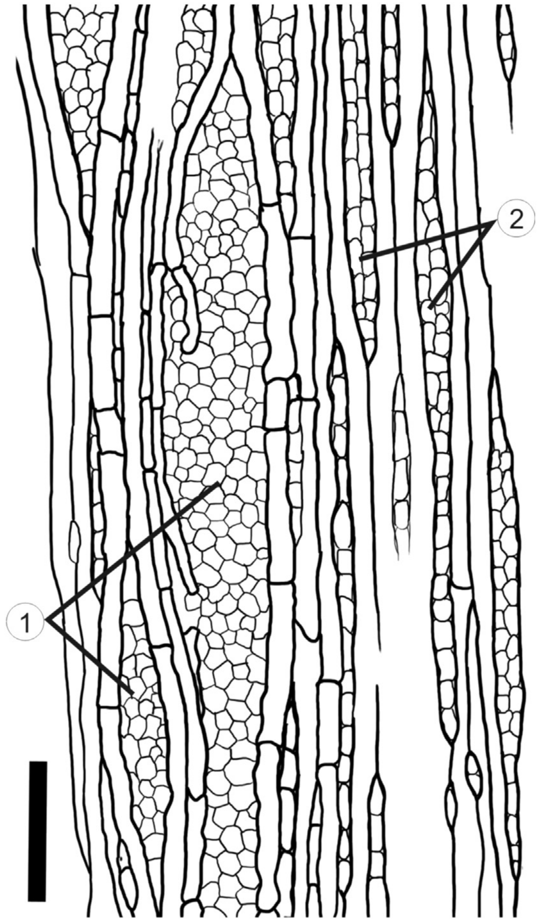

Fig. 3. Drawing showing the zones of wider interfascicular rays (1) and narrower fascicular rays (2), see Plate I/7 (specimen ZAJ004/1, Kladno–Rakovník Basin). Scale bar = 0.5 mm.

Microscopic description: well-preserved secondary xylem tracheids separated by interfascicular rays were observed in all studied samples (Plate II, 5). Sometimes also the primary vascular system with carinal canals and poorly preserved metaxylem in the external part of the pith cavity is preserved (Plate I, 2, 3, 6). The amount of parenchyma is about 46%. Interfascicular rays are distinguishable through the whole secondary xylem thickness (Plate I, 7; Fig. 3).

All specimens show one type of tracheid; tracheids are arranged in radial rows, slightly varying in size and shape in each row (Plate II, 5). Tracheids close to the pith are usually oval, square or brick-shaped in cross-section, and slightly elongated in radial direction; they are 25–100 μm (mean 56 μm) in diameter in radial direction and 22–76 μm (mean 44 μm) in tangential direction. Parenchyma cells in the fascicular rays are usually oval, square or brick-shaped, 22–108 μm (mean 57 μm) in diameter. Tracheids are arranged in five to eighteen files separated by interfascicular rays. These rays are distinguishable to the very edge of the specimens and consist of one to seven rows of parenchyma cells, rectangular, brick-shaped and obviously elongated in radial direction. Tracheids in the external parts of the stems are slightly widened compared to those in the internal part, which are 50–100 μm (mean 70 μm) radially and 45–60 μm (mean 51 μm) wide tangentially. Scalariform pitting is visible in radial longitudinal sections (Plate I, 4). The pits are bordered and the distance between two neighbouring ones is 2–4 μm. Carinal canals and the surrounding metaxylem are sometimes preserved next to the pith cavity (Plate I, 6). Carinal canals are usually circular in transverse section, and 105–171 μm (mean 140 μm) in diameter. Metaxylem elements are rectangular, arranged in two to three rows surrounding the carinal canals and are 15–57 μm (mean 27 μm) in diameter. The samples interpreted as roots lack carinal canals and have pith parenchyma cells preserved (Plate II, 2ab).

Discussion: thin sections were prepared from specimens P4672, P5956, SVE001/1, SVE002/1, REH002/1 and ZAJ004/1. They all show the same anatomical characteristics. There is only one type of tracheid; all tracheids are oval, square to brick-shaped in transverse section and some of them have bordered scalariform pits in their radial walls as illustrated in Marguerier (1970). Generally, fascicular and interfascicular rays consist of parenchyma cells and almost 50% of the secondary body consists of parenchyma. Moreover, it is possible to distinguish fascicular and interfascicular zones up to the periphery of the wood and the tracheids have scalariform pitting (Röβler and Noll, 2006, 2010; Röβler et al., 2012a). After a detailed comparison with the Chemnitz material, we think that all samples belong to the most common calamitalean *Arthropitys bistriata*. However, because the typical branching pattern of this species (Röβler et al., 2012a) is not recognised in our material, we identify our fossils as *Arthropitys* cf. *bistriata*.

Calamitea Cotta emend. Rößler and Noll.

Calamitea striata Cotta (Plate III).

Material: P3173, P2660A, P2660C, and K2121, all from the Krkonoše Piedmont Basin.

Macroscopic description: only small parts of secondary xylem with badly preserved external portions of the central pith and carinal canals are present. Other parts of plant tissues (e.g., phloem, cortex) are not preserved. The colour of all specimens varies from dark, red-brown or orange to light, whitish or beige. The size of the samples ranges from 50 to 100 mm.

Microscopic description: the secondary xylem consists of two different types of tracheids, one having a larger diameter than the other (Plate III, 5, 6). Both tracheid types are arranged in radial files and are separated by thin continuous rays. The tissues are sometimes deformed during fossilisation. Wide tracheids (SX1) are present in front of the carinal canals and alternate with zones of narrow tracheids (SX2) which the fill lateral parts of secondary xylem fascicles. The two types of tracheids differ in colour (Plate III, 1–4); note that wide (SX1) and narrow (SX2) tracheids correspond to "large-diameter tracheids" and "small-diameter tracheids" sensu Rößler and Noll (2007).

Type 1: wide tracheids are mostly in dark, brown-red. This part of secondary xylem has more parenchyma than the Type 2, but the exact shape and size of these parenchyma cells forming fascicular rays cannot be estimated due to poor preservation. Tracheids are variously polygonal with circular to oval lumen in transverse section; the radial rows are usually less deformed. Tracheid diameters vary from 39 to 173 μm (mean 61 μm) radially and from 49 to 120 μm (mean 67 μm) tangentially. Brick-shaped parenchyma cells are mostly poorly preserved (Plate III, 6).

Type 2: these narrow tracheids are usually preserved as lighter parts of secondary xylem and occur on both sides of the Type 1 tracheids toward the interfascicular ray; they are arranged in regular, often deformed radial rows (Plate III, 6). The tracheids are polygonal in transverse section and slightly elongated in radial direction; their diameter varies from 26 to 54 μm (mean 38 μm) radially and from 24 to 51 μm (mean 36 μm) tangentially.

Tracheid pitting in radial walls has not been observed due to the poor preservation.

Interfascicular rays are usually 11–37 μm (mean 25 μm) wide and are composed of one to four rows of cells. Rays are enlarged from the pith to the periphery of the wood cylinder, often deformed and visible as darker zones in the middle of the lighter portions of the secondary xylem Type 2 (see Plate III, 7). Rectangular, thick-walled cells of interfascicular rays are obviously elongated in radial direction. Their diameter varies from 31 to 73 μm (mean 42 μm) in radial direction and from 11 to 22 μm (mean 17 μm) tangentially.

Discussion: only small pieces of secondary tissues were available, but two types of tracheids and ray parenchyma cells are conspicuous. More delicate details like tracheid pitting in radial walls could not

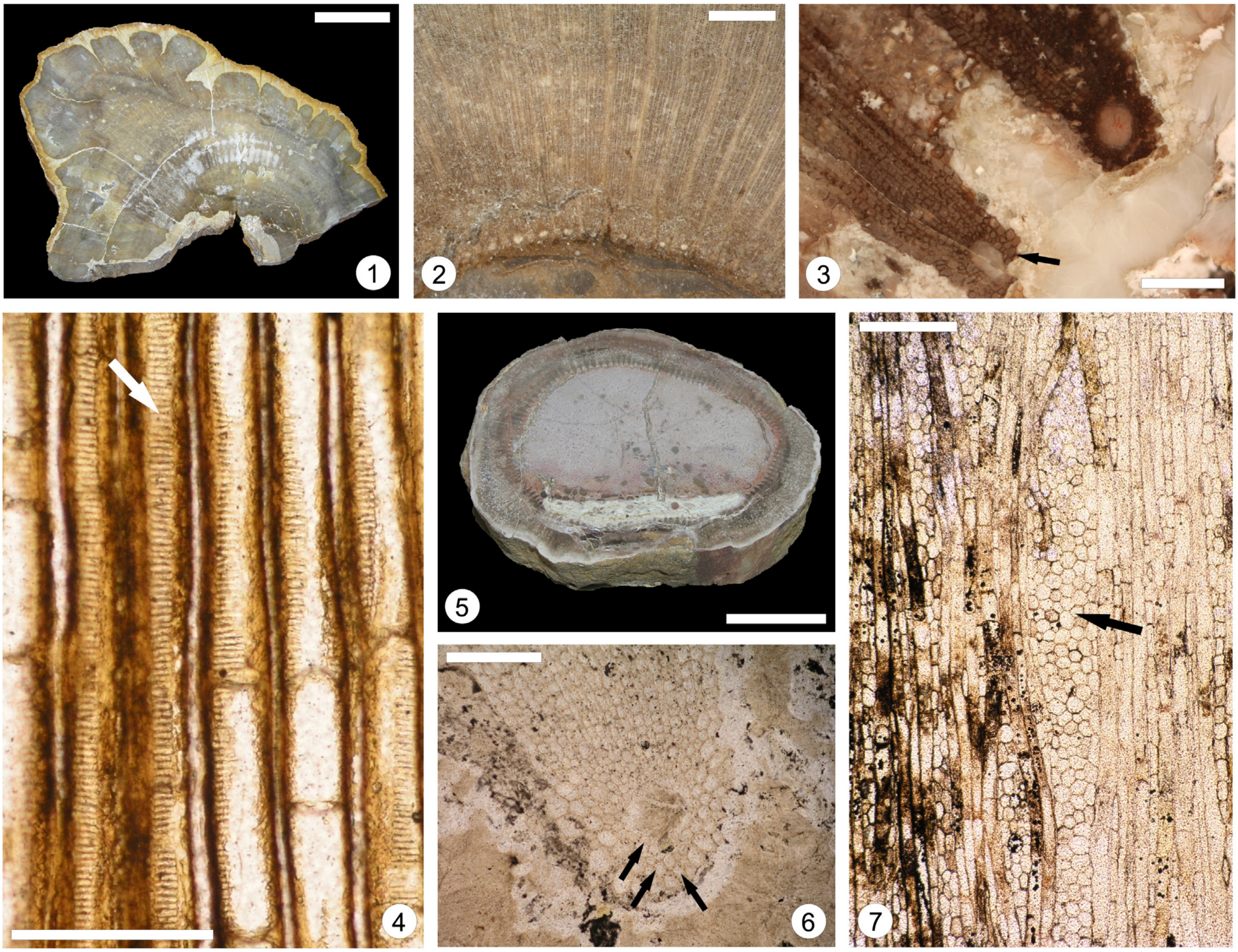

Plate I. *Arthropitys* cf. *bistriata* from the Kladno–Rakovník Basin and the Krkonoše Piedmont Basin.

1. General view of one of the biggest specimens from the Kladno–Rakovník Basin, TS (specimen DVO5/XXXIII). Scale bar = 40 mm.
2. Pith periphery surrounded by secondary xylem composed of fascicular wedges and interfascicular rays, TS (specimen SVE004/1, Kladno–Rakovník Basin). Scale bar = 2 mm.
3. Detail of the central pith secondary filled, TS (specimen P1992, Krkonoše Piedmont Basin), showing pith periphery, detail of innermost interfascicular ray, fascicular secondary xylem and two carinal canals surrounded by badly preserved tracheids of metaxylem (arrow). Scale bar = 0.5 mm.
4. Tracheids of secondary xylem with scalariform bordered pitting (arrow), RLS (specimen ZAJ004/1, Kladno–Rakovník Basin). Scale bar = 0.2 mm.
5. Large central pith secondary filled surrounded by a narrow secondary xylem composed of fascicular wedges and interfascicular rays, TS (specimen P5956, Krkonoše Piedmont Basin). Scale bar = 30 mm.
6. Detail of the previous picture with a carinal canal surrounded by three rows of metaxylem tracheids (arrows). Scale bar = 0.3 mm.
7. A multiseriate interfascicular ray (arrow) among tracheids and fascicular rays, TLS (specimen ZAJ004/1, Kladno–Rakovník Basin). Scale bar = 0.5 mm.

TS = transverse section; TLS = tangential longitudinal section; RLS = radial longitudinal section.

be studied due to the poor preservation of the specimens and low contrast of the structures when observed with stereomicroscope; in fact, it was not possible to make additional thin longitudinal sections because of the rarity of the museum specimens. However, all observed features, mainly the differences in shape of various types of tissue and thickness of their walls, are typical of *Calamitea striata* (Rößler and Noll, 2007). The samples from the Krkonoše Piedmont Basin differ in colour from those of the Permian petrified forest of Chemnitz; all samples from the Krkonoše Piedmont Basin typically show wide, dark-coloured tracheids, whereas narrow tracheids are lighter. On the other hand, the samples from the type locality Chemnitz (except for sample MfNC K 5204: Rößler and Noll, 2007, Plate I, 6) are coloured reversely: narrow tracheids are dark and wide tracheids are light (Rößler and Noll, 2007). This is probably caused by different conditions during taphonomic processes.

5.2. Taphonomy

The silicification of trees represents a very complex process, which involves both the filling of pore spaces in the wood (permineralization) and the replacement of the organic cellular tissue with SiO_2 under various conditions (Ballhaus et al., 2012) and its complete understanding and detailed description are over the scope of the present paper. According to Matysová et al. (2010) silicification can take place in four different palaeoenvironments: (1) in fluvial sediments, (2) in fluvial facies with volcanic influence, (3) in lacustrine facies with volcanic influence, and (4) in environments under direct influence of diverse volcanic emplacement events.

In the Krkonoše Piedmont Basin, silicified stems occur in at least four stratigraphic levels, but only one, the Ploužnice Horizon, shows volcanic influence. According to Matysová et al. (2010) this unit can

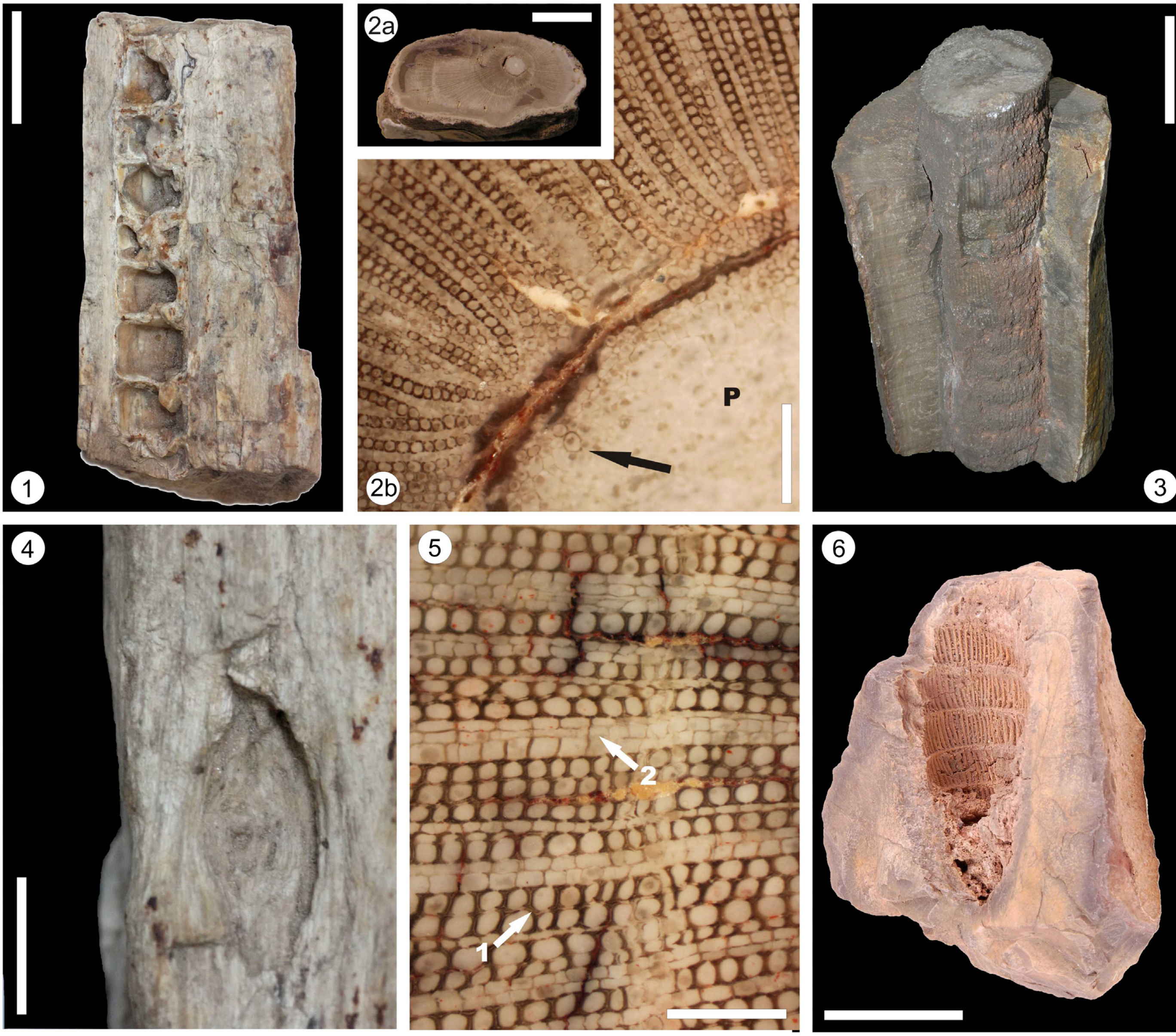

Plate II. *Arthropitys* cf. *bistriata* from the Kladno–Rakovník Basin and the Krkonoše Piedmont Basin.

1. Pith cavity with short internodes and diaphragms at levels of nodes (specimen SVE005/1, Kladno–Rakovník Basin). Scale bar = 30 mm.
2. Small root — general view (a) and detail (b) of its central, solid parenchymatous pith (P), showing parenchyma inside (arrow), and pith periphery without carinal canals but with curved both rays and rows of secondary xylem tracheids, TS (specimen H74692, Krkonoše Piedmont Basin). Scale bars in 2a = 10 mm and in 2b = 0.5 mm.
3. Unusual sample showing both well preserved pith cast and secondary xylem (specimen P1584, Krkonoše Piedmont Basin). Scale bar = 30 mm.
4. Single branch scar as seen on reverse side of the specimen illustrated in Plate II, 1 (specimen SVE005/1, Kladno–Rakovník Basin). Scale bar = 5 mm.
5. Detail of circular-shaped tracheids of secondary xylem (1) and elongated, rectangular parenchyma cells (2) of multiseriate interfascicular rays, TS (specimen H74697, Krkonoše Piedmont Basin). Scale bar = 0.5 mm.
6. Well preserved pith cavity with longitudinal striation of short internodes and transverse diaphragms of a basal tapering portion of the vertical stem (specimen P5657, Krkonoše Piedmont Basin). Scale bar = 50 mm.

TS = transverse section.

be interpreted as a lacustrine environment with influence of volcanism. This horizon contains a much more varied assemblage of silicified stems than the other strata, but the preservation of anatomical detail is often rather poor. The sediments of the Kladno–Rakovník Basin do not contain significant amounts of volcanic material and the fossiliferous sediments are purely lacustrine to fluvial. Silicified stems are known from several units and their anatomy is usually much better preserved than in the specimens from the Krkonoše Piedmont Basin or the Intra Sudetic Basin (Mencl, 2007; Mencl et al., 2009). Finally, the Chemnitz Petrified Forest can be mentioned as comparative example of an environment under direct influence of volcanism. Surprisingly, there is a very high percentage of well-preserved petrified trunks, although there was a direct influence of explosive and therefore destructive volcanic events (Rößler et al., 2012b).

6. Conclusions

Silicified calamitalean stems are reported from two Carboniferous–Permian basins in the Czech Republic.

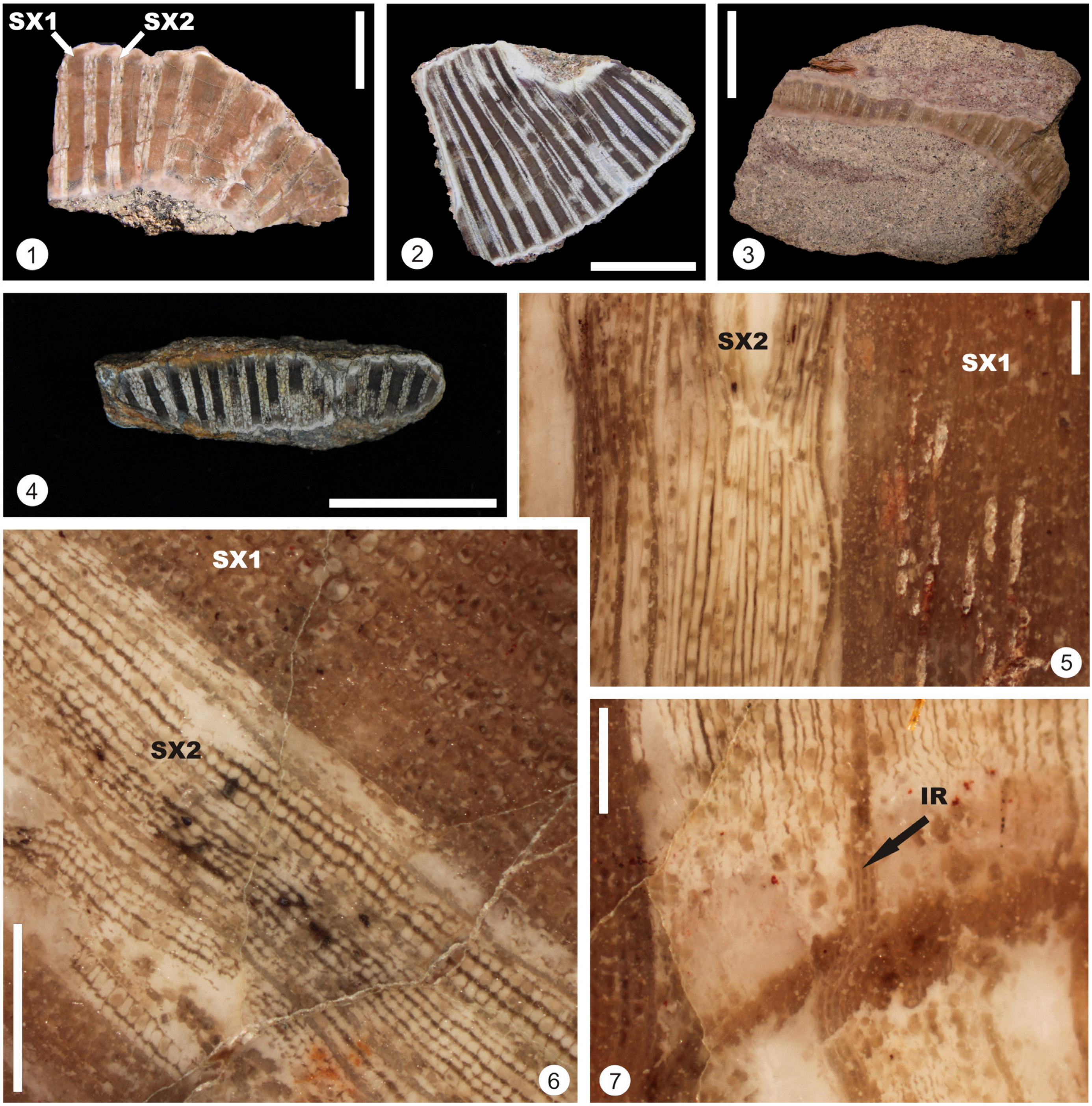

Plate III. *Calamitea striata* from the Krkonoše Piedmont Basin.

1.–4. General view showing the difference in colouration of darker wide (SX1) and lighter narrow (SX2) tracheids, TS (specimens P3173, P2660A, P2660C, K2121). Scale bars in 1 = 10 mm and in 2, 3 and 4 = 20 mm.
5. Detail showing difference between wide (SX1) and narrow (SX2) tracheids, TLS (specimen P3173). Scale bar = 0.25 mm.
6. Detail showing two types of tracheids (SX1, SX2), arranged in slightly deformed rows, TS (specimen P3173). Scale bar = 0.5 mm.
7. Rectangular parenchyma cells of interfascicular ray (IR), TS (specimen P3173). Scale bar = 0.25 mm.

TS = transverse section; TLS = tangential longitudinal section.

In the Krkonoše Piedmont Basin, several hundred specimens have been found, but only few were suitable for anatomical studies. After an evaluation of all available samples we recognise two taxa. *Arthropitys* cf. *bistriata* is very common, whereas *Calamitea striata* is rather rare. The attribution of the former is based on the similarity in parenchyma ratio, the presence of scalariform pitting and interfascicular rays running continuously through the entire wood. The latter was identified on the basis of the two types of tracheids found in the secondary xylem and the small proportion of parenchyma. This type represents only about 1% of all calamitalean stems in the Krkonoše Piedmont Basin, but is also very rare in other coeval fossil forests. Contrary to the "*Dadoxylon*" type of wood, silicified stems of calamitaleans and other "pteridophytes" are in the Krkonoše Piedmont Basin strictly limited to a single stratigraphic unit that contains volcanics. The fossils are usually fragmented and preserved without branchlets or extraxylary tissues, but are less damaged than "*Dadoxylon*" stems in other stratigraphic levels. They were probably transported by rivers and streams as bedload before they were deposited. Moreover, most of the woody tissue is strongly recrystalised and cell structures are damaged considerably.

In the Kladno–Rakovník Basin, calamitalean stems, although being the second most abundant after the common "*Dadoxylon*" type, are quite rare; other types, such as *Psaronius* or *Medullosa* are very scarce. Stems can mainly be found in two stratigraphic levels, but most of them are found in the Týnec Formation. Both stratigraphic levels are without any volcanic content. The trunks are usually fragmented without branches or extraxylary tissue. They were probably transported and finally embedded in fluvial sediments. Calamitaleans are rarer than "*Dadoxylon*" stems; bigger specimens are not mentioned in literature. The fragmentary nature of the specimens can be related to the nature of the wood that was parenchyma-rich, soft and therefore more prone to destruction. However, we cannot exclude that calamitalean wood remains unidentified in private collections. All samples were found in the field in eluvium. Therefore, the stratigraphic position of the source strata is assumed from the general geological situation.

The present contribution fills a gap in giving the first anatomical description of silicified calamitalean stems from the upper Carboniferous of the Bohemian Massif, which represents a classical area of palaeobotanical interest, well studied both in the past and present, but without a modern systematic overview on fossil wood and petrified stems in general.

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