https://doi.org/10.35463/j.apr.2025.02.02 ACTA PALAEONTOLOGICA ROMANIAE (2025) V. 21 (2), P. 11-24

NEW MID-MIOCENE PETRIFIED WOOD IN GALATA FORMATION FROM THE BULGARIAN BLACK SEA SHORE

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Received: 11 February 2025 / Accepted: 17 September 2025 / Published online: 25 September 2025

Abstract. This study analyzes petrified wood samples collected from the Bulgarian Black Sea shore near the Byala locality. These specimens originate from the Galata Formation and date to the Chokrakian age (mid-Miocene). The three well-preserved specimens were identified as *Cupressinoxylon* sp. (cf. *Thujoxylon* sp.). In contrast, one poorly preserved specimen suggested a dicot structure and was recognized as *Populoxylon* sp. (cf. *Populus tremula* L.). The geological characteristics of the Galata Formation in this region are also discussed.

Keywords: Black Sea, Bulgaria, Chokrakian, petrified wood, *Cupressinoxylon, Populoxylon*.

INTRODUCTION

The Middle Miocene, particularly the Chokrakian stage, was a pivotal period in the geological history of the Eastern Paratethys, which included regions of the present-day Black Sea, Caspian Sea, and surrounding areas (Popov et al., 2022, 2023). The end of this epoch witnessed significant environmental and vegetational changes, primarily influenced by the transition from the Middle Miocene Climate Optimum (MMCO) to the Middle Miocene Climate Transition (MMCT) (Mourik et al., 2010; Ivanov et al., 2011; Methner et al., 2020).

During the Chokrakian regional stage, which forms part of the Middle Miocene (Palcu et al., 2019; Raffi et al., 2020), the Eastern Paratethys region was characterized by a warm temperate to subtropical climate that supported a rich diversity of plant life. The vegetation during this period reflected a gradual transition from subtropical, humid conditions in the early Tarkhanian, towards more arid conditions in the Chockrakian (Vernyhorova et al., 2023). In this study, we present the results of an investigation of petrified wood material from an emerged section of a petrified forest preserved submerged in East Bulgaria.

SAMPLES AND GEOLOGICAL CONTEXT

The petrified wood samples analyzed in this study were collected by Dr. Palcu and his team during stratigraphic fieldwork along the Bulgarian Black Sea coast near Byala, south of Varna (Fig. 1) in 2017-2018. The specimens were found as fragmented pieces (Fig. 2) and, in some cases, as in situ petrified tree trunks (Fig. 3), preserved within the mid-Miocene deposits located in the lower part of Galata Formation. A total of 65 petrified wood fragments were encountered outcropping or lying washed on the beach. The clustering of these fragments suggests that they were removed from outcrops in the vicinity of the beach and redeposited along the shore due to wave and storm action. The samples were mapped (Fig. 4), and a subset was collected for specific investigations, which are presented in this paper.

The samples were found in the lowermost part of the base of the Galata Formation (Georgiev 2012). This stratigraphic unit spans the Chokrakian, Karaganian and Konkian regional stages of the Eastern Paratethys (Palcu et al., 2019). The samples, corresponding to the lowermost part of the Galata Fm., correspond to the Chokrakian regional stage. This regional stratigraphic unit corresponds to the upper part of the Langhian stage (Raffi et al., 2020) and is also equivalent to the lower part of the Badenian regional stage of Central Paratethys (see Palcu in Popov et al., 2022). The formation is well-exposed along the coastline of the Black Sea (Fig. 1) between the Black Cape in the South, sitting uncomfortably above the Oligocene with anoxic sediments of the Ruslar Fm. (Tulan et al., 2020), and Varna, in the North, where it is overlain by oxic sediments of the Middle Miocene sediments of the Evksinograd Fm. (see Zdravkov et al., 2015).

The base of the Galata Fm. (Fig. 5) is defined by an erosional boundary with an angular unconformity of approximately 10° relative to the underlying Oligocene deposits. This basal contact is visible along a rocky beach for about 1 km and exhibits significant irregularities, including erosional depressions ranging from 10 to 15 meters deep and 20 to 50 meters wide.

The Galata Formation begins with polygenic conglomerates containing clasts measuring between 5 and 30 cm along the b-axis, alongside larger clay fragments

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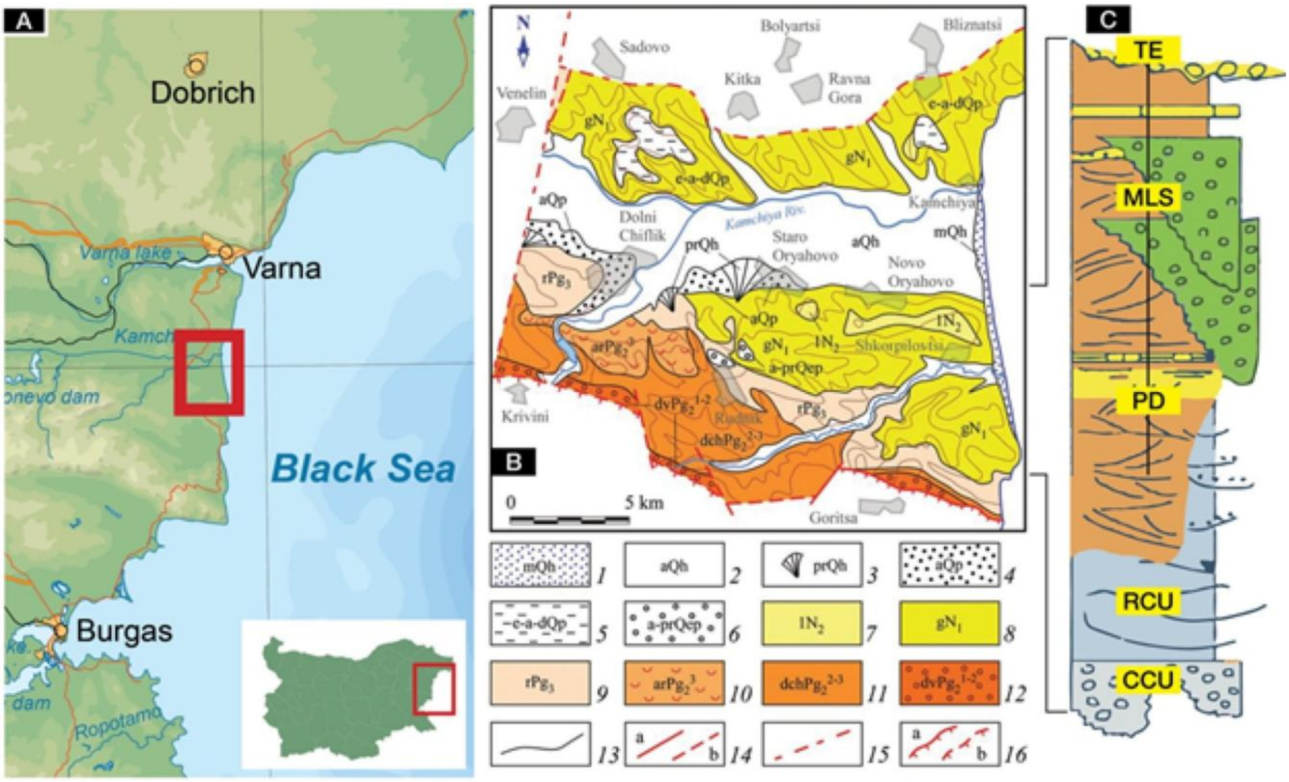

Fig. 1. The location of the studied area (**A**), a geological sketch (**B**) of the region of Dolna Kamchiya Basin (after Cheshitev et al., 1991; Kančev & Gerčeva, 1992, modified) and a simplified lithological column of the Galata Fm. (**C**). Geological sketch symbols represent: 1 – recent marine beach sands (Holocene); 2 – alluvial deposits of river bed and flood plain (Holocene); 3 – proluvial deposits (Holocene); 4 – alluvial deposits of 1st and 2nd terraces above flood plain (Pleistocene); 5 – eolian–alluvial–talus deposits (Pleistocene); 6 – alluvial–proluvial deposits (Pleistocene); 7 – undivided Pliocene sediments; 8 – Galata Fm. (Miocene); 9 – Ruslar Fm. (Oligocene); 10 – Arnautlar Fm. (Priabonian); 11 – Dolni Chiflik Mb. of the Avren Fm. (Bartonian–Priabonian); 12 – Dvoynitsa Fm. (Ypresian–Lutetian); 13 – lithostratigraphic boundary; 14 – normal fault (a – certain, b – uncertain); 15 – fossilized normal fault; 16 – trust (a – certain, b – uncertain).

derived from Oligocene fine-grained deposits near the base (Fig. 5B, 5C). The conglomerates are clast-supported with a minimal sandy matrix, displaying poorly defined festoon stratification and clast imbrication (Fig. 5, 6A). These features suggest deposition associated with high-energy processes, such as fast flooding or slope collapses.

Above this basal unit, conglomerates associated with fluvial and distributary channel systems are present (Fig. 5A). Pebble imbrication and erosional bases within these deposits indicate sediment transport in a braided stream environment, with paleocurrents directed toward the NNE. The fluvial deposits transition sharply into cross-bedded sandstones, which overlie the conglomerates with no evidence of a gradual shift. These sandstones exhibit both tabular and trough cross-bedding, with sets measuring 20 to 40 cm in thickness. Tabular cross-bedding is dominant, with sandstone bodies forming tabular units 3 to 5 meters thick and bounded by erosional surfaces.

Within the middle stratigraphic interval of the Galata Formation, petrified wood fragments were found scattered along the shore. Detailed observations revealed that their source was a cross-bedded sandstone bed containing petrified tree trunks preserved in situ. These trunks were encased in coarse sandstone concretions measuring 20 to 30 cm thick (Figs. 2, 3). Such deposits reflect sedimentation within a fluvial to shallow marine environment influenced by tidal and geostrophic currents.

SEDIMENTARY STRUCTURES AND DEPOSITIONAL ENVIRONMENTS

The Galata Formation features a complex suite of sedimentary structures indicative of varying depositional conditions. In its southern exposures, large-scale cross-bedded sands dominate, with individual sets ranging between 5 and 10 meters in thickness and characterized by low-angle internal stratification (Fig. 6). These deposits are interpreted as sand wave formations, likely generated by tidal or geostrophic currents. Their coarse grain size and absence of wind-formed separation cells differentiate them from eolian deposits.

Fine-grained intervals, comprising silty mudstones interbedded with sandstones, occur sporadically within the formation. One notable interval includes a 1.5-meter-thick succession of muddy siltstone capped by a 20 cm thick micritic limestone bed containing siliciclastic

Fig. 2. Plant remains found in the studied area are very diverse: leaf imprints (**A**), petrified wood in a concretion (**B**), loose light-colored petrified wood fragments (**C, D**), loose dark coloured petrified wood fragments (**E, F**).

detritus and weak bioturbation. These deposits suggest periods of low-energy sedimentation in environments such as salt marshes, shallow coastal lakes, or lagoons. The presence of such fine-grained facies indicates episodes of reduced fluvial input and lower energy conditions, potentially linked to transgressive events.

Erosional features within the formation include scours measuring 5 to 10 meters deep and 30 to 40 meters wide, filled with conglomerates and sandstones. These scours exhibit fining-upward sequences, indicative of strong erosional currents followed by sediment infill. Such features, often associated with entrenched channels or paleo-valleys, are prominent in the southern part of the Galata Formation.

In the upper stratigraphic levels, transgressive deposits appear as horizontally extensive units of micritic limestone and coquina beds (Fig. 7). These units, spanning approximately 2 km laterally, consist of basal sands overlain by micritic limestone beds that represent rapid transgressive events over a shallow marine

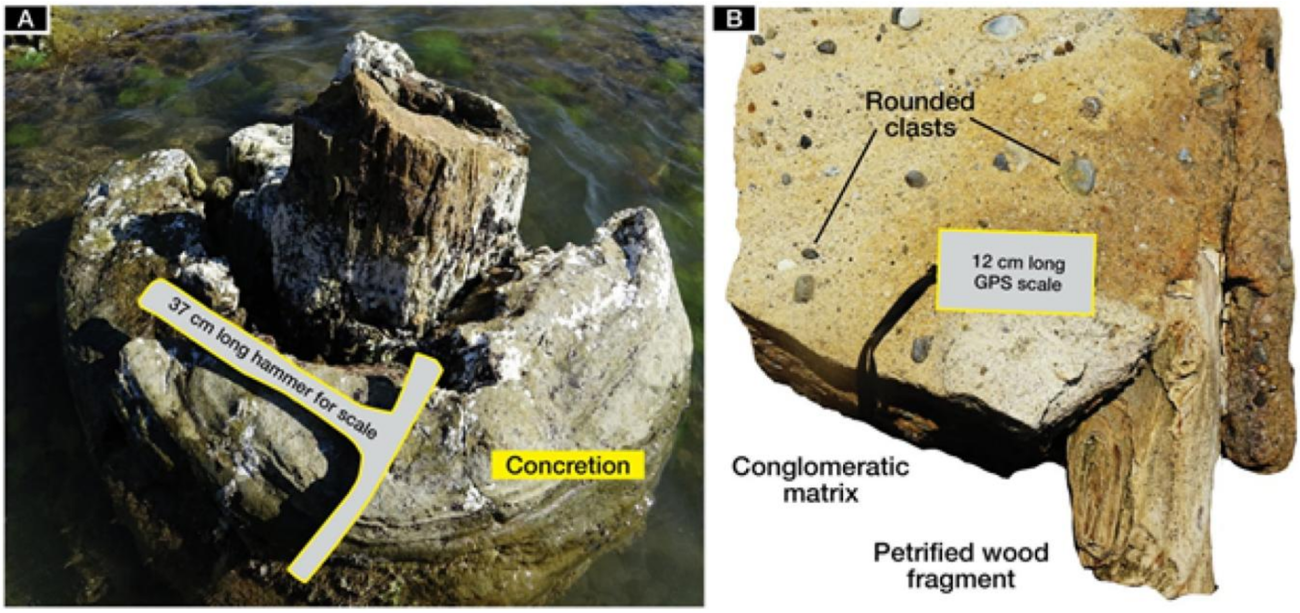

Fig. 3. Petrified trunk in original position (A) enveloped in a sandstone concretion. Conglomerate block preserving a petrified wood fragment (B), evidence of at least one of the sources of the petrified wood in the Black Cape coastal section.

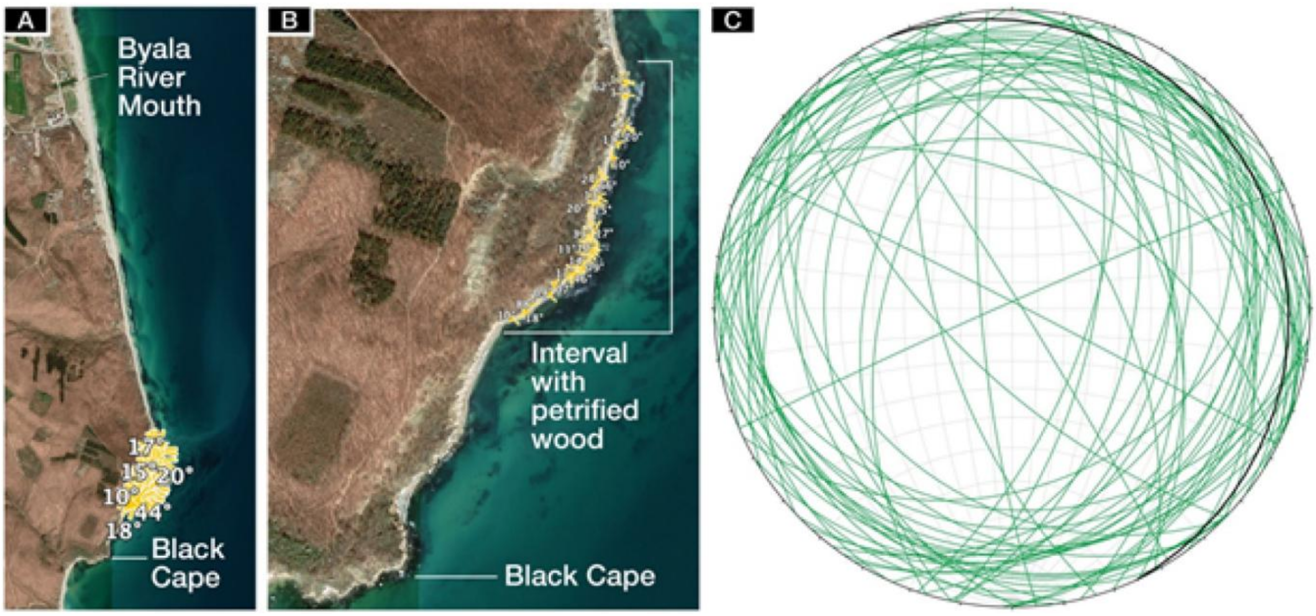

Fig. 4. Detailed position of the petrified wood fragments (A, B) and statistics (C) for 65 petrified wood fragments found in the Black Cape coastal section, note the lack of an orientation and dominance of the horizontal and sub-horizontal inclinations (41 samples with inclinations between 0˚ and 22˚) – associated with recently redeposited loose fragments, over intermediate (17 samples with inclinations between 22˚ and 60˚) and steep inclinations (7 samples with inclinations > 60˚) that are more likely associated with large conglomerate blocks or are preserved *in-situ*.

platform. Coquina layers at the top of these sequences indicate further deepening of the basin and a transition to low-energy conditions below the wave base. These transgressive sequences, observed at multiple levels, highlight repeated shifts in sea level during the mid-Miocene.

The final depositional stages in the Galata Formation are represented by beach deposits observed near Galata Cape. These deposits, comprising sandstone layers with parallel stratification dipping seaward at low angles (2°–5°), reflect a prograding beach environment. Lower shoreface to offshore facies exhibiting hummocky cross-stratification are also present, further illustrating the dynamic depositional history of the formation.

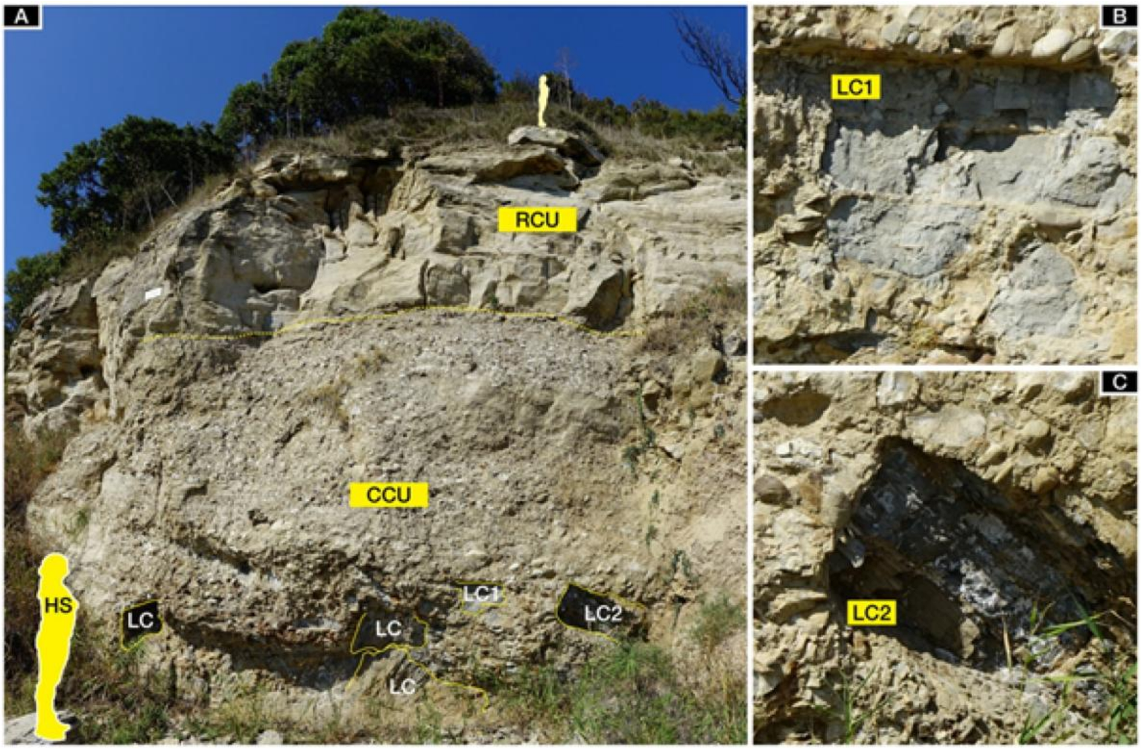

Fig. 5. Base of the Galata Fm. (**A**). Please note the lithological boundary and the large clasts (LC) present in the base and highlighted in panels (**B** - LC1) and (**C** - LC2). The human silhouettes (HS - 1.7 meters) are meant to highlight the perspective effect in the picture and correct the perception of the outcrop size.

Fig. 6. Conglomerates corresponding to the fluvial and distributary channels (**A**), and cross-bedded sands (**B**, **C**).

PALAEOXYLOTOMICAL STUDY

Material and methods. Some samples of fossil wood were collected from the Bulgarian shore of the Black Sea, south of Varna, near the Byala locality (Fig. 1). They were found as petrified wood fragments scattered along the shore (Fig. 5), originating from the basal conglomerates, or even as in situ petrified trunks (see Fig. 4), and from the fluvial cross-bedded deposits in the basal part of the Galata Formation, of lower Badenian age, i.e. Chokrakian (see D.V. Palcu in Popov et al., 2022).

For the xylotomical study, oriented thin sections of petrographic type were prepared from each sample, according to the recommended three standard directions: transverse, tangential, and radial. These sections were examined using a transmitted light microscope. Four specimens exhibited wood structure and were subjected to the microscopic study.

All anatomical details were studied and described for each specimen, using the scientific terms as defined by the IAWA lists of microscopic features for softwood and hardwood identification, as published by the IAWA Committee (Wheeler et al., 1989). Photos of the xylotomical details were captured with an ”EverFocus“ video camera adapted to the microscope, using the software „AVerMedia“, and the images were processed with specialized computer programs.

The identification of the unknown original tree was subsequently performed by comparing it with previously described similar aspects of fossil or recent wood structures from published scientific papers (all included in the References section). The systematics followed A.P.G. IV (2016) and the ICN-Shenzhen Code (Turland et al., 2018).

SYSTEMATICS

GYMNOSPERMS

Family **Cupressaceae** Bartlett (*sensu lato* – Gadek et al., 2000)
Genus ***Cupressinoxylon*** Göppert emend. Dolezych, 2005

***Cupressinoxylon* sp. (cf. *Thujoxylon* sp.)**
Fig. 8, photos. a-i. Fig. 9, photos. a-i.

Material: The studied material consists of small fragments of petrified wood collected from the Bulgarian shore of the Black Sea, near the Byala locality, south of Varna. These fragments come from the sedimentary deposits of the Galata Formation, of Chokrakian age (Lower Badenian), outcropping along the Black Sea shore (see details above). The petrified wood samples are labeled with the field numbers BW2, BW3, and BW5 and are deposited in the GIR Collection at the National Geological Museum, in Bucharest, under the inventory numbers 27722, 27723 and, respectively 27725.

Microscopic description: Growth rings – appear variably sized in cross-section, ranging from 10 to 30 cells wide, or more, with a gradual reduction occurring only in the late wood. The late wood consists of 6-8 rows of smaller pores and 2-4 rows of radially flattened cells (the final wood), marking the boundaries of the growth rings, which become quite distinct, as the early wood always starts with larger cells. Axial canals are absent.

The tracheids – in cross-section – have a polygonal shape with rounded corners, sometimes deformed by compression. In the early wood, their radial/tangential diameters range from 20–60(70) µm / 25–50(60) µm, and

Fig. 7. Transgressive (coquina) deposits alternating with poorly cemented sands.

they are thick-walled, with double walls measuring 10–15 µm. In the late wood, the diameters gradually decrease, and in the final wood, smaller tracheids appear, measuring 7–17 / 15–25 µm in diameter with slightly thicker walls (12–17 µm for the double wall). In cross-section, the cells are regularly arranged in 2–13 or more radial rows between two successive rays, with intercellular spaces often present. Their density ranges from 650 to 950 tracheids per mm². On the radial walls, the pits are arranged in a uniseriate pattern, occasionally biseriate and opposite. The pits are round, of the bordered type, with a diameter of 8–12 µm, a large chamber, and a round to elliptic aperture. On the tangential walls, pitting is usually absent or, rarely, appears as smaller pits (5–8 µm), arranged uniseriately. Helical or callitroid thickenings, crassulae, and organic deposits are generally absent.

Axial parenchyma – is present as a few cells in a diffuse arrangement, scattered in the late wood, thick-walled, and usually present. In vertical view, the parenchyma cells show few nodules on the end walls.

Rays – appear thin and linear in cross-section, and in tangential view, they are exclusively uniseriate. They are low to medium tall, with 3–9 (–15) cells or more. Ray density is 5–7 rays per tangential mm. Regarding the ray composition, the rays are homogeneous, composed of parenchymatous ray cells, all procumbent, with the marginals slightly taller. Ray tracheids are absent. The end walls of ray parenchyma cells are smooth. The horizontal walls of ray parenchyma cells are smooth and pitted. Indentures are not visible or are absent. In the cross-fields, small cupressoid pits of 3–5 (7) µm in diameter appear, as 1–2 (–3) pits, with inclined slit-like apertures, on the marginals in 2–3 superposed rows or slightly disordered. Resin canals (axial or radial) are absent. Mineral inclusions (as crystals) are not present.

Affinities and discussions: We studied some samples of petrified wood collected from the Bulgarian shore of the Black Sea, originating from the basal sedimentary deposits of the Galata Formation, of Chokrakian age. Three of these samples exhibited a coniferous structure, with distinct growth rings, no resin ducts, thick-walled tracheids, and few parenchyma cells scattered, especially in the late wood. The parenchyma cells show few nodules on the end walls. The tracheids have uniseriate, and rarely biseriate, radial pitting. Tangentially, pitting is rarely uniseriate and smaller. In the cross-fields, cupressoid pits appear, often in 2–3 superposed rows.

These anatomical features suggest an affinity to the cupressaceous wood type (see Vaudois & Privé, 1971; Watson & Dallwitz, 2008; Schweingruber, 1990; Ibrahim, 2015). Such a xylotomy points to a possible structural similarity with *Cupressus* or *Thuja* types, both from the Subfamily Cupressoideae Rich. ex Sweet, 1826, as described in the latest classification of the Cupressaceae family sensu lato (see Gadek et al., 2000; Farjon, 2000; Christenhusz et al., 2011).

For this type of fossil wood, Göppert (1850) created the fossil genus *Cupressinoxylon* Göppert, describing more specimens, but not specifying a very clear diagnosis. Vaudois & Privé (1971) cited a diagnosis reformulated after many previous authors. The diagnosis, attributed to Göppert was emended by Dolezych (2005). Interesting observations on it were also made by Bodnar et al. (2015) and Ruiz & Bodnar (2019).

Even though this genus name was previously considered a „wastebasket taxon" (see Müller-Stoll & Schultze-Motel, 1990; Wang et al., 1996), a proposal to conserve the name *Cupressinoxylon* against *Retinodendron* was made by Bamford et al. (2002).

Fossil forms equivalent to this genus were described from Cretaceous rocks of northern Europe and up to the Pliocene, it appears to have migrated to more southerly regions. After the Pliocene, it is believed to have disappeared from Europe (see Farjon, 2000).

Species of *Cupressinoxylon* were, more recently, described from the Aegean area: from Turkey, by Akkemik & Yaman (2012), Akkemik (2019), and Güngör et al. (2019), as fossil equivalents of the current species *Cupressus sempervirens* L., known as the Mediterranean cypress.

Taking into account the observed features of the studied specimens, we compared their description with other cupressaceous fossil forms previously described, such as species of *Cupressinoxylon* sp. of *Thuja* type (see Iamandei et al., 2008a, b; 2011; 2012), or even as *Thujoxylon* (see Iamandei & Iamandei, 2017), to which they show some general xylotomical resemblances. In the Aegean area, no other fossil remains related to this genus have been identified (see Velitzelos D. et al., 2014), except for a doubtful form of fossil wood from Lesbos Island, described as *Thujoxylon antissum* by Süss et Velitzelos (2008), and interpreted as root wood.

In fact, for the Aegean area, and possibly for entire Europe, the presence of fossil *Thuja* is debatable, since the current genus has (or perhaps had) a disjunct distribution in the Northern Hemisphere, in Eastern Asia and North America. Anyway, since the xylotomy of the studied specimens, which are quite poorly preserved, is more comparable with the *Thuja* type, we assign them to *Cupressinoxylon* sp. (cf. *Thujoxylon* sp.).

ANGIOSPERMS

Family **Salicaceae** Mirbel
Genus ***Populoxylon*** Mädel-Angeliewa, 1968

***Populoxylon* sp. (cf. *Populus tremula* L.)**
(Fig. 10a-i)

Material: The studied specimen is represented by a fragment of petrified wood, collected from the Bulgarian shore of the Black Sea, near the Byala locality, south of Varna. This fossil comes from the sedimentary deposits

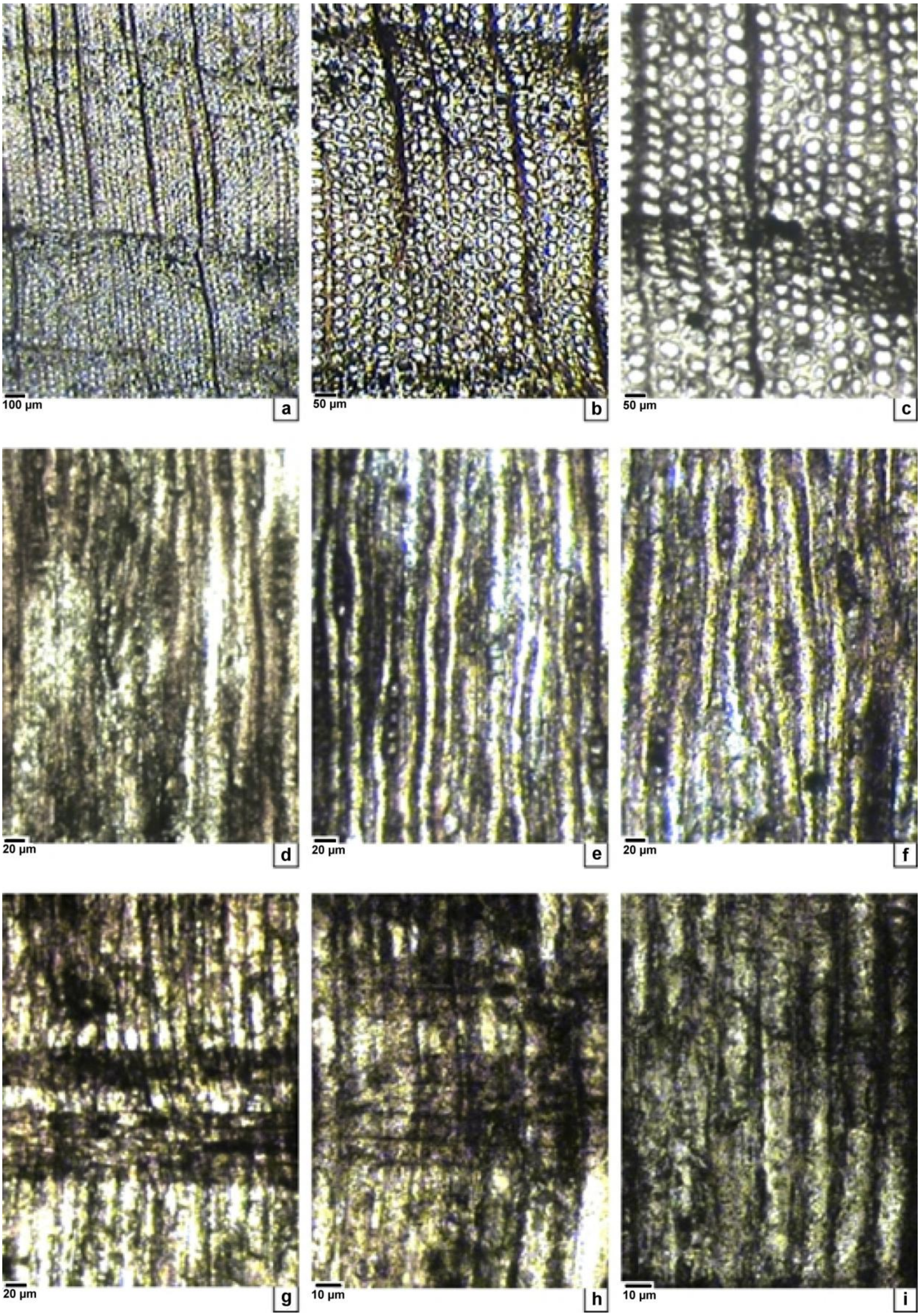

Fig. 8. photos a-i, (graphic scale). *Cupressinoxylon* sp. (cf. *Thujoxylon* sp.). (Specimen 27722). **Photos a–c**. Cross section: distinct growth rings, gradual transition to the late wood; parenchyma few, diffuse; rays uniseriate. **Photos d–f**. Tangential section: pitting on tracheids usually absent or very rare; axial parenchyma with nodular end wall (**e**); rays exclusively uniseriate. **Photos g–i**. Radial section: tracheidal pitting 1(-2)-seriate, opposite; rays homogeneous; badly preserved cross-fields with 1-2 cupressoid pits.

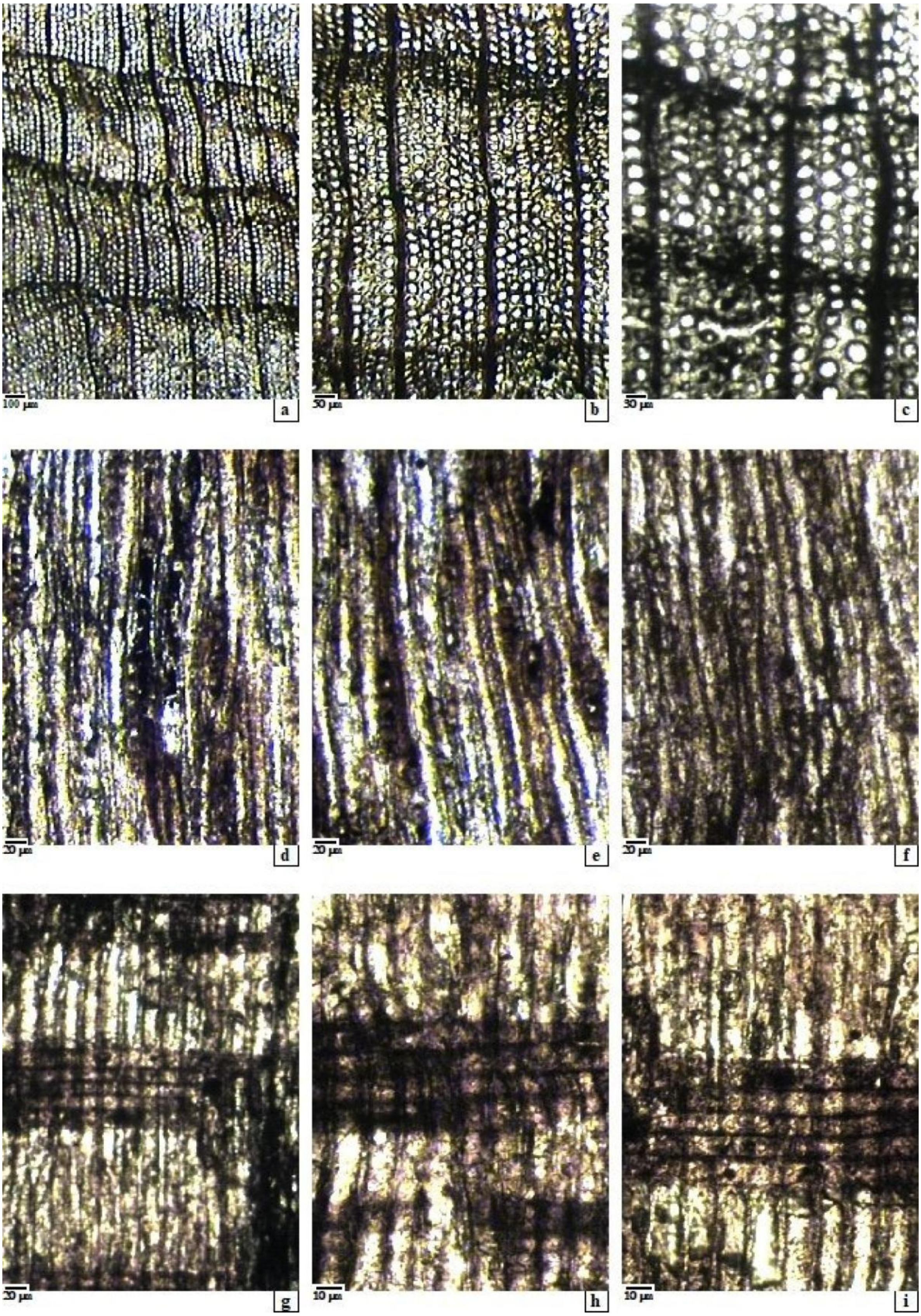

Fig. 9. photos a-i, (graphic scale). *Cupressinoxylon* sp. (cf. *Thujoxylon* sp.). (Specimen 27725). **Photos a–c**. Cross section: distinct growth rings, thick-walled tracheids with gradual transition to the latewood; parenchyma few, diffuse (**a**). **Photos d–f**. Tangential section: pitting on tracheids absent or rare, as uniseriate small pits (**f**); rays exclusively uniseriate. **Photos g–i**. Radial section: tracheidal pitting 1(-2)-seriate, opposite; rays homogeneous, poorly preserved cross-fields with 1-2(-3) cupressoid pits.

of the Galata Formation, of Chokrakian age (lower Badenian), which outcrop along the shore of the Black Sea. The petrified wood sample has the field number BW4 and is deposited in the GIR Collection at the National Geological Museum in Bucharest under the inventory number 27724.

Microscopic description: The growth rings, in cross-section, are not very distinct, showing a diffuse porous to semi-ring porous wood structure with quite indistinct ring boundaries. It is difficult to distinguish between the late wood, with smaller pores, and the early wood, which suddenly starts with large pores.

The vessels appear, in cross-section, either solitary or in radial multiples of 2–3 (up to 5) pores or more. When solitary, they have a polygonal or rounded to oval contour, but in multiples, the larger vessels may appear deformed by compression. The mean tangential diameter of the solitary vessel lumen ranges from 50 to 120 µm, with thick walls of 5–8 µm (simple wall). The density is 30–50 or more vessels per square millimeter, sometimes exceeding this number. In a longitudinal view, the vessels show simple perforation plates, which are inclined and often poorly preserved. The intervessel pits are polygonal, of the bordered type, of medium size (7–10 µm in diameter), with horizontal-elliptic apertures measuring 3–4 µm. These pits are numerous, alternately arranged, but usually very poorly preserved. The vessel-element length is probably 200–500 µm or more, but it is difficult to measure due to poor preservation. Tyloses, gum remains, and helical thickenings were not observed.

Fibro-tracheids are sometimes present, as a few smaller cells linking the radial groups of vessels.

The ground tissue includes libriform fibers and parenchyma, which are usually mixed. The libriform fibers have a polygonal cross-section, with a diameter of 12–16 µm, are relatively thick-walled, and are non-septate. The axial parenchyma appears in cross-section as few and scarce, diffuse, or rather indiscernible.

The rays appear, in cross-section, fine, as radial fascicles of rectangular, radially elongated cells, often filled with gum content, making it difficult to see details on their horizontal walls. The ray trajectory is usually linear or slightly sinuous. Tangentially, the rays appear exclusively uniseriate, though occasionally some biseriate rows can be seen. The ray height ranges from 3 to 15 (–25) cells, or even more. The ray cells have a polygonal shape, rounded to vertically elongate. The ray frequency is ≥ 12 per mm. Radially, the ray body is composed of thin-walled, homocellular cells, all procumbent, with marginal cells slightly taller or even square, suggesting a tendency toward heterocellularity. The cross-fields with vessels contain 1–2 (–4), weakly bordered pits per field, sometimes more numerous in the marginal fields. The pits are polygonal, rounded to oval, with diameters ranging from 4 to 7 µm, arranged in 1–4 horizontal rows, more numerous in the margins, but often difficult to observe due to poor preservation.

Special details on rays, such as sheath cells or tile cells, are absent. Additionally, storied structures, secretory elements, intercellular canals, cambial variants, and included phloem are not present.

Affinities and discussions: The xylotomical features observed in the studied specimen indicate a dicotyledonous tree type, typical of the current members of the Salicaceae family. These features include the diffuse-porous distribution of the vessels, usually in radial multiples of 2–3(–5) pores, with few solitary pores. The rays are exclusively uniseriate and homocellular, with cross-fields specifically pitted, which are characteristics that align with the xylotomy of the current genus *Populus* L. Similar features also appear in the current *Salix* L., where the cross-section shows only a diffuse-porous distribution of vessels, which are usually solitary, and the rays are heterocellular (Greguss, 1959; Schweingruber, 1990; Sakala et al., 2018). There are several current species of *Populus* L. naturally growing in Europe and the Anatolian area today, including *Populus euphratica* Oliver, *P. nigra* L., *P. alba* L., *P. tremula* L., and *P. × canescens* (Aiton) Sm., which is considered a hybrid between the last two species (see *https://en.wikipedia.org/wiki/Populus_×_canescens*).

All of these current species have very similar xylotomy, making it difficult to distinguish them from one another based solely on anatomical details. However, some differences may exist, as in the fossil species, where the rays appear to be taller and the marginal axial parenchyma could be more prevalent (Schweingruber, 1990; Sakala et al., 2018).

As a fossil correspondent, the genus *Populoxylon* was established by Mädel-Angeliewa (1968), who described the species *Populoxylon priscum* Mädel-Angeliewa 1968 as the type species. The original genus diagnosis is as follows: „Diffuse porous wood with usually grouped vessels that has simple perforations and numerous alternate intervascular pitting. The uniseriate rays have all-procumbent cells, the marginals higher, the cross-fields simple pitted, in 2–3 horizontal rows of slightly oval pits, and few parenchyma“.

For comparison with our studied specimen, we considered several described European fossil species. Greguss (1969) described a *Populoxylon* sp. (cf. *Populus tremula* L.) from the Sarmatian of Mikfalva (Hungary), which exhibited a semi-ring-porous wood structure with radially grouped vessels that had simple perforation plates, alternate polygonal intervessel pits, and uniseriate rays. However, Sakala (2006) and Sakala et al. (2018) noted that, due to the lack of a radial section in Greguss' identification, it cannot be confirmed whether the rays are homocellular, as in *Populus* L., or heterocellular, as in *Salix* L. Doutrelepont et al. (1997) described a fossil poplar from Belgium as *Populoxylon* sp., which featured biseriate rays and a vessel distribution in cross-section similar to the current *Populus euphratica* Olivier, making it distinct from our specimen.

Iamandei et al. (2005, 2011) described a *Populoxylon* sp. (cf. *Populus alba* L.), collected from several Mid-

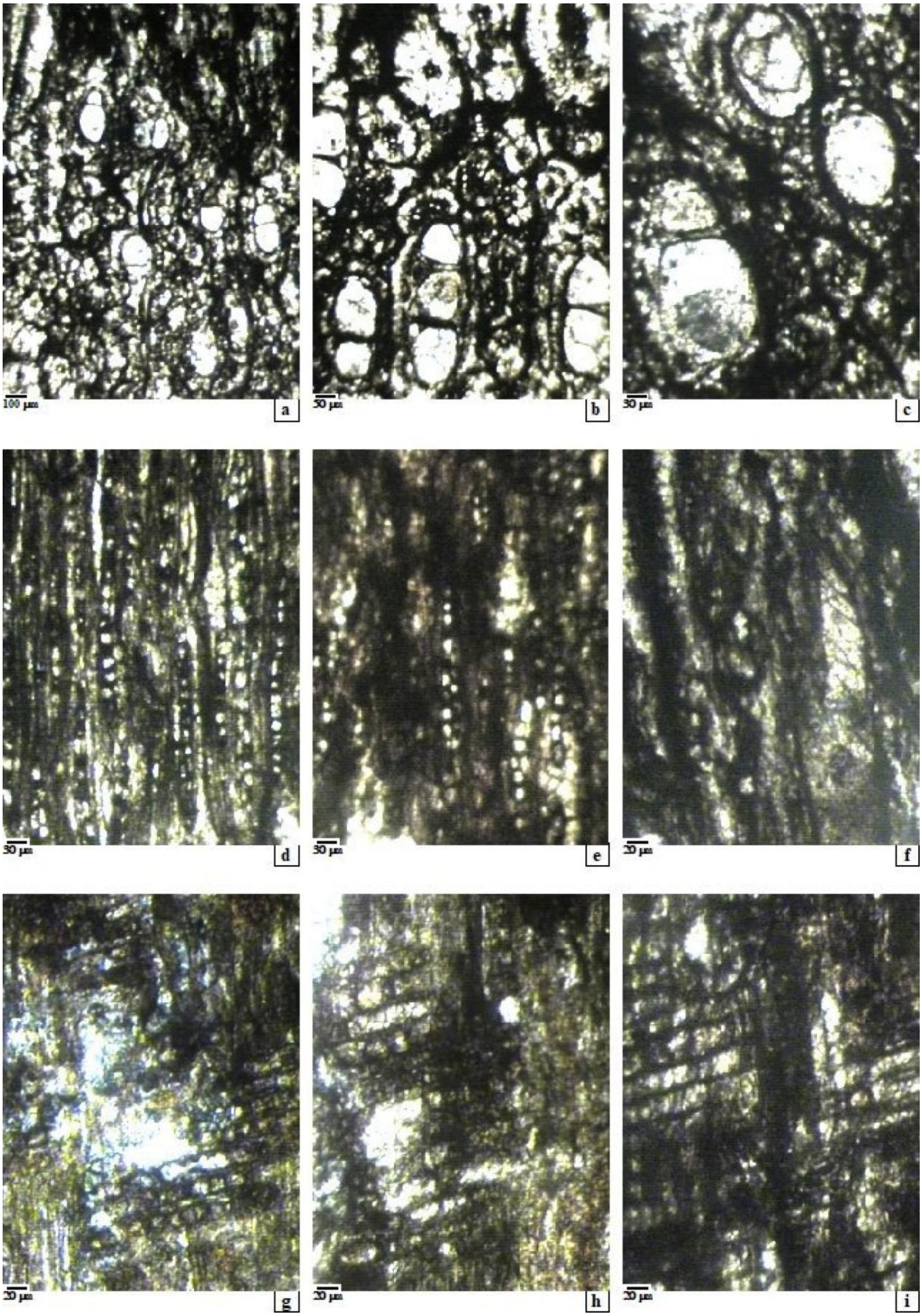

Fig. 10. photos a-i, (graphic scale). *Populoxylon* sp. (cf. *Populus tremula* L.). Specimen 27724. a-c – cross-section: growth rings with diffuse porous distribution of vessels, poorly preserved; d-f – tangential section: exclusively uniseriate rays; inclined thin helical thickenings on vessels (f); g-i – radial section: homocellular rays, with poorly preserved cross-fields; vessels with simple perforated plates (h-i).

Miocene sites in Romania, noting a significant xylotomical similarity to the current *Populus alba* L. However, it differs slightly from the specimen studied here, particularly in terms of its porosity. Additionally, Akkemik (2021) described a new species of fossil poplar from Turkey, *Populoxylon sebenense* Akkemik, which differs from our specimen due to the obvious presence of marginal axial parenchyma.

Numerous Miocene wood remains, exhibiting a xylotomy very similar to the current species *Populus tremula* L., were collected from the Apuseni Mountains (Romania) and were described by us as *Populoxylon tremuloides* in the unpublished Ph.D. thesis (Iamandei, 2002).

Additionally, some other Miocene wood remains collected from the Moldavian platform, including those from the Otovasca quarry near Chișinău (Iamandei et al., 2008 b), and from the Simila quarry in the Bârlad area (Iamandei et al., 2023a), displayed a xylotomical structure very similar to the current species *Populus tremula* L., as well as to the material studied here.

More recently, while studying some fossil wood samples collected by a Bulgarian geological team from the same Bulgarian site, on the beach of the Black Sea, near Byala, we found that their structure is almost identical to the specimen studied here (see Iamandei et al., 2023 b).

Thus, considering all the above discussion and noting the strong xylotomical similarity between the studied specimen and the xylotomy of the current *Populus tremula* L. (see Greguss, 1959; Schweingruber, 1990), we assign it to the fossil form *Populoxylon* sp. (cf. *Populus tremula* L.). Additionally, the genus *Populus* was widespread in the Bulgarian Cenozoic flora, with thirteen species identified through leaf imprints. Otherwise, the species *Populus tremula* L. is also recorded in Bulgaria, from the Upper Miocene to Upper Pliocene (Palamarev et al., 2005).

CONCLUSION

The Galata Formation exhibits variations in depositional environments and stratigraphic features indicative of significant geological processes, including tectonic activities, transgressive events, and fluctuations in sedimentation energy. The basal part frequently contains strange concretions of unclear origin, as well as remains of petrified wood, including in situ tree trunks and fragmented pieces (Figs. 2 and 3). This suggests the presence of a petrified forest, possibly submerged in the Black Sea, as indicated by recent reports from sea divers.

To further investigate this potential Petrified Forest, a research project was initiated (Kenderov et al., 2022), and new samples of petrified wood collected from the area are currently being studied for taxonomic identification to determine the floristic composition of the fossil forest. In this study of 5 samples, we have identified *Cupressinoxylon* sp. (cf. *Thujoxylon* sp.) and *Populoxylon* sp. (cf. *Populus tremula* L.). The last one was also identified previously (see Iamandei et al., 2023b).

New geological prospections and palaeoxylological studies in the fossiliferous sites along the Bulgarian shore of the Black Sea, as well as in the submerged zone, will lead to the description of a partially submerged petrified forest.

ACKNOWLEDGMENTS

The authors are grateful to the Dan V. Palcu PNRR C9 - I8 project „Multiproxy reconstruction of Eurasian Megalakes, connectivity and isolation patterns during Neogene-Quaternary times“, code 97/15.11.2022, Contract No. 760115/23.05.2023, and the Dutch Research Council (NWO) project (grant 865.10.011).

The anonymous reviewers are also thanked for their constructive comments, which helped to improve the manuscript.

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