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Fossil Wood *Sequoioxylon dimyense* sp. nov. (Cupressaceae) from the Upper Cretaceous of Zeya–Bureya Basin, Russian Far East

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Abstract—A new species *Sequoioxylon dimyense* (Cupressaceae) is described from the Middle Maastrichtian (Upper Cretaceous) deposits of the Zeya–Bureya basin (Russian Far East) based on the fossil wood anatomy. The new species is characterized by combination of anatomical wood characters of the modern representatives of the subfamily Sequoioideae.

Keywords: fossil wood, *Sequoioxylon*, Sequoioideae, Cupressaceae, Middle Maastrichtian, Upper Cretaceous, Zeya–Bureya basin, Russian Far East

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INTRODUCTION

Many works are dedicated to investigation of plant remains from the Cretaceous deposits of the Zeya–Bureya basin (Russian Far East). However, fossil woods have not been studied. The author began systematic research of fossil wood remains from the Cretaceous deposits of the Zeya–Bureya basin. Fossil woods were already described from the Astashikha locality of the Middle Maastrichtian age. The representatives of Pinaceae (*Piceoxylon burejense* M. Afonin) (Afonin, 2012) and Cupressaceae (*Sequoioxylon burejense* Blokh. et M. Afonin) (Blokhina, Afonin, and Kodrul, 2010) were erected on the basis of fossil wood anatomical characters from this locality.

The new species *S. dimyense* sp. nov. represents the morphogenus *Sequoioxylon* Torrey. It was described on the basis of the fossil wood anatomical characters from the Middle Maastrichtian (Upper Cretaceous) deposits of Zeya–Bureya basin. The new species is characterized by mixed anatomical characters of the modern representatives of Sequoioideae. The latter is considered as an independent subfamily of the family Cupressaceae (Gadek et al. 2000; Farjon, 2005; Schulz and Stützel, 2007). The subfamily Sequoiodeae includes three monotypic genera: *Sequoia* Endl., *Sequoiadendron* J. Buchh., and *Metasequoia* Hu et W.C. Cheng.

The geographic range of the modern representatives of Sequoioideae is much more limited than in the geological past. *Sequoia sempervirens* (D. Don) Endl. and *Sequoiadendron giganteum* (Lindl.) J. Buch. are widespread on the Pacific Coast of the United States of America. *Sequoia* grows on western slopes of the Cascade Range, Coast Mountains, and Sierra Nevada. *Sequoiadendron* is restricted to the western slopes of Sierra Nevada (*Flora of North* ..., 1993). *Metasequoia glyptostroboides* Hu et W.C. Cheng is known only in the Chinese provinces Sichuan and Hubei (*Flora of China*, 1999).

The macroremains of Sequoioideae often occur in the Cretaceous deposits of the Zeya–Bureya basin. Imprints of *Sequoia* shoots and cones were described from the deposits of Pashkovo stratum (Upper Albian) near Pashkovo village (*Flora and Dinosaurs* ..., 2001) and the Boguchan Formation (Turonian–Coniacian) on slopes of the Sagibovskiy Boguchan hill near Sagibovo village (Krassilov, 1976; *Flora and dinosaurs* ..., 2001). Numerous shoots of *Sequoia* and *Metasequoia* were uncovered in the middle (Santonian) and upper (Campanian) parts of the Kundur Formation in the Khingan–Mutnaya rivers interfluve (*Flora and Dinosaurs* ..., 2001; Markevich, Golovneva, and Bugdaeva, 2005; Golovneva, Sun, and Bugdaeva, 2008). Taxodioideae and Sequoioideae (especially *Sequoia*) dominate among conifer macroremains in Santonian–Campanian deposits of Zeya–Bureya basin (Markevich, Golovneva, and Bugdaeva, 2005; Golovneva, Sun, and Bugdaeva, 2008). Numerous imprints of Sequoioideae were also described from the Cretaceous–Paleogene deposits of the Zeya–Bureya basin, namely from deposits of the Tsagayan Formation of the Maastrichtian–Danian age (Krassilov, 1976; *Flora and Dinosaurs* ..., 2001; Akhmetiev et al., 2002). In particular, shoots and cones of *Sequoia* and *Metasequoia* were uncovered in the deposits of the

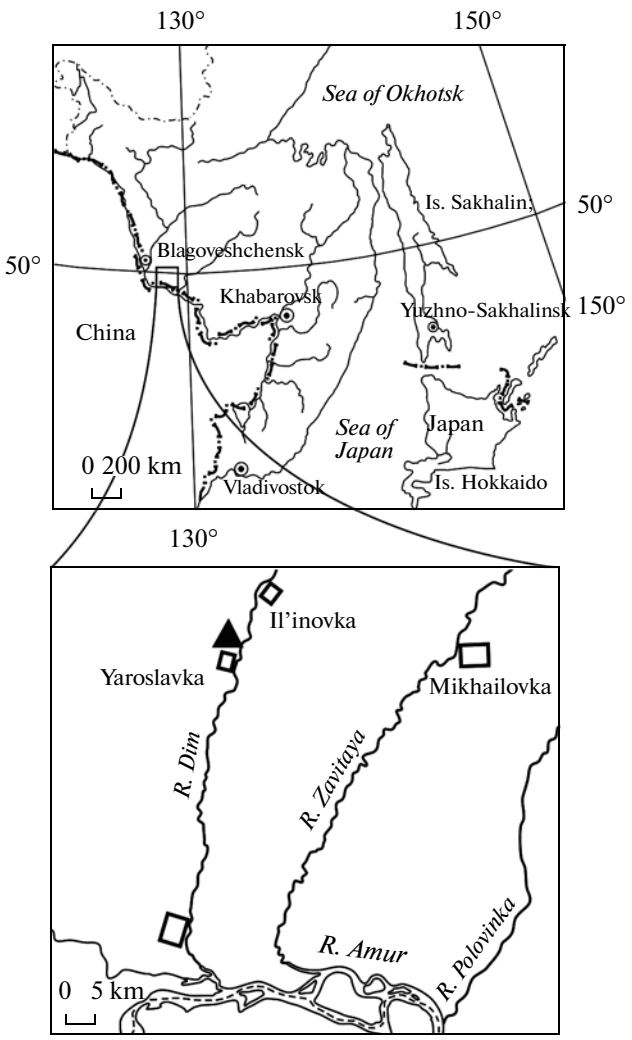


Fig. 1. Schematic map of the locality where fossil wood *Sequoioxylon dimyense* sp. nov. was discovered.
▲ point of sampling of the fossil wood.

Middle Tsagayan (Upper Maastrichtian) and Upper Tsagayan (Danian) subformations of the Arkhara–Boguchan brown-coal field, on the eastern slope of Arkhara hill near Arkhara village (Akhmetiev et al., 2002), and also in the deposits of the Upper Tsagayan Subformation on slopes of Mts. Belaya and Ploskaya of the Bureinskoe Belogor'e in the mouth of the Darmakan River (Krassilov, 1976; *Flora and Dinosaurs* ..., 2001; Akhmetiev et al., 2002) and on the Progress area of Raychikhinsk brown-coal field (Akhmetiev et al., 2002). As it was already mentioned above, the fossil wood *Sequoioxylon burejense* was described from the Astashikha locality of the Middle Maastrichtian age (Blokhina, Afonin, and Kodrul, 2010). The fossil wood *Taxodioxylon sequoianum* (Mercklin) Gothan (Terada, Nishida, and Sun, 2011), which is similar to modern Sequoioideae, occurs in deposits of the Upper Tsagayan Subformation of the Pioner area of Raychikhinsk brown-coal field.

Possibly, the first representatives of Sequoioideae appeared in the Zeya–Bureya basin at the end of the Early Cretaceous (Late Albian). The representatives of Sequoioideae apparently played an important role as part of woody vegetation in this territory at the middle-end of the Late Cretaceous (Santonian–Maastrichtian).

MATERIAL AND METHODS

The fossil wood of a new species *Sequoioxylon dimyense* sp. nov. was discovered by researchers of the Institute of Geology and Nature Management, Far Eastern Branch, Russian Academy of Sciences in the Zeya–Bureya basin during the field works. The fossil woods along with rare bones of hadrosaurs (Hadrosauridae, Lambeosaurinae) were collected on the right bank of the Dim River in the vicinity of Yaroslavka Village (Mikhailovsk District, Amur Region, Dim locality (Fig. 1)). Fossil wood originates from a layer of grit stone with pebbles in the upper part of the Lower Tsagayan Subformation of the Tsagayan Formation. Deposits of the upper part of the Lower Tsagayan Subformation are palynologically dated by Middle Maastrichtian (*Flora and Dinosaurs* ..., 2001; Markevich, Bugdaeva, and Bolotsky, 2010).

The palynoassemblage of the Dim locality is characterized by domination of Pteridophyta spores and Ulmaceae and Platanaceae pollen grains on the second place. Pinaceae pollen grains are abundant while those of Cupressaceae, Taxaceae, and *Ginkgocycadophytus* Samoil. are rare. (Markevich, Bugdaeva, and Bolotsky, 2010). The macroremains of plants were not described from this locality so far.

Fossil woods studied (samples nos. 36a/1, 36a/3, 36a/4) are solid, silicified, with growth rings, well distinguishable by naked eye. Apparently, these samples are fragments of trunks or very large branches. The fossil wood is slightly graveled that allows assuming their transfer from a place of growth of plants to the accumulation place. The Dim locality is in the area remote both from slopes of the depression, and from the central part of the Zeya–Bureya basin. Markevich, Bugdaeva, and Bolotsky (2010) noted that, probably, fossil woods from this locality were drifted from dry slopes to a girt by a stream and then were fossilized there.

We used the method of preparing transparent thin sections for solid mineralized wood by standard petrographic technic (Gammerman, Nikitin, and Nikolaeva, 1946). In view of the heterogeneous wood anatomical structure, preparations for investigations of wood anatomy are prepared in three mutually perpendicular planes: transverse, radial, and tangential. In total 24 transparent thin sections were investigated (thirteen sections from sample no. 36a/1; three, from 36a/3; and eight, from no. 36a/4). Thin sections

were microscopically studied with microphotographs of the anatomical structures with the microscope AxioScop-40, camera AxioCamHR (Carl Zeiss) on the basis of the center of collective using FEB RAS in the electronic microscopy laboratory of the Institute of Biology and Soil Science, Far Eastern Branch, Russian Academy of Sciences. The wood anatomy is described using the terminology proposed by A.A. Yatsenko-Khmelevsky (1954) and "IAWA List of Microscopic Features ..." (Baas et al., 2004).

Samples of fossil wood nos. 36a/1, 36a/3, and 36a/4 from a collection no. 36a are kept in the Institute of Biology and Soil Science, Far Eastern Branch, Russian Academy of Sciences.

SYSTEMATIC PALEOBOTANY

Family Cupressaceae Richard ex Bartling, 1830

Subfamily Sequoioideae (Luerssen) Quinn, 2000

Genus *Sequoioxylon* Torrey, 1923

***Sequoioxylon dimyense* M. Afonin, sp. nov.**

Plate 10, figs. 1–15

E t y m o l o g y. From the Dim River.

H o l o t y p e. Institute of Biology and Soil Science, Far Eastern Branch, Russian Academy of Sciences, collection no. 36a, sample no. 36a/1, fossil wood; Russian Far East, Zeya–Bureya basin, right bank of the Dim River; Tsagayan Formation, upper part of the Lower Tsagayan Subformation, Middle Maastrichtian (Pl. 10, figs. 1–15).

D i a g n o s i s. Growth rings distinct. Pitting in the radial walls of tracheids uniseriate, sometimes biseriate, opposite. Circular pits 12–18 (20) μm in diameter, elliptic pits – 12–18 × 15–20 μm in size. Crassulae present between biseriate pits. Tracheid pits with large and smooth torus margins. Pitting in the tangential walls of tracheids uniseriate; pits circular, 9–10 μm in diameter. Axial parenchyma abundant, diffuse; transverse walls smooth. Rays uniseriate, sometimes biseriate. Height of uniseriate rays 1–50 (60–110) cells, biseriate – 7–20 cells. Uniseriate rays often with biseriate (1–20 cells) and bi-triseriate (in triseriate range – one to four cells) ranges. Horizontal and tangential walls of ray cells smooth. Ray tracheids smooth-walled, peripheral. Pits of taxodioid type, one to four (six) per cross-field, 5–8 μm in diameter; in a single horizontal row up to four pits. Vertical resin canals traumatic.

D e s c r i p t i o n. The wood consists of tracheids, ray tracheids, ray and axial parenchyma and epithelial cells of resin canals.

The growth rings are distinct, 2–15 mm wide; consist mainly of early wood tracheids. The early wood is often strongly crushed. The transition from early to late wood is gradual (Pl. 10, fig. 1). The early wood tracheids are large, thin walled, with large lumina, and polygonal. Late wood tracheids are square and rectangular, compressed in radial direction at the growth ring boundary, with nearly slit like lumina. Tracheid ends in radial section are rounded, oblique, stocking shaped, needle-shaped or tapered. False growth rings are present.

Pitting in the early wood tracheid radial walls is abundant, uniseriate (Pl. 10, figs. 3, 4), rarely biseriate (Pl. 10, figs. 5, 6). Uniseriate pits are circular or infrequently slightly elliptic, horizontally elongated, with included circular or elliptical aperture, respectively; pits are scattered along the tracheid wall in close arrangement or crowded. Uniseriate circular pits are 12–18 (20) μm in diameter, the elliptic pits measure 12—18 × 15–20 μm; aperture is 5–6 μm in diameter. Biseriate pits are circular, 12–18 μm in diameter, with included circular aperture (5 μm in diameter); the pits are opposite. Crassulae are arranged between biseriate pits. Large smooth torus is well expressed both in uniseriate and biseriate pits (Pl. 10, figs. 3–6). Pitting in the late wood tracheid radial walls are uniseriate, circular, scattered along the tracheid; pits are absent in the last late wood tracheid layers. The tracheid tangential wall pitting is uniseriate; pits are circular, 9–10 μm in diameter, scattered along the tracheid (Pl. 10, fig. 7)

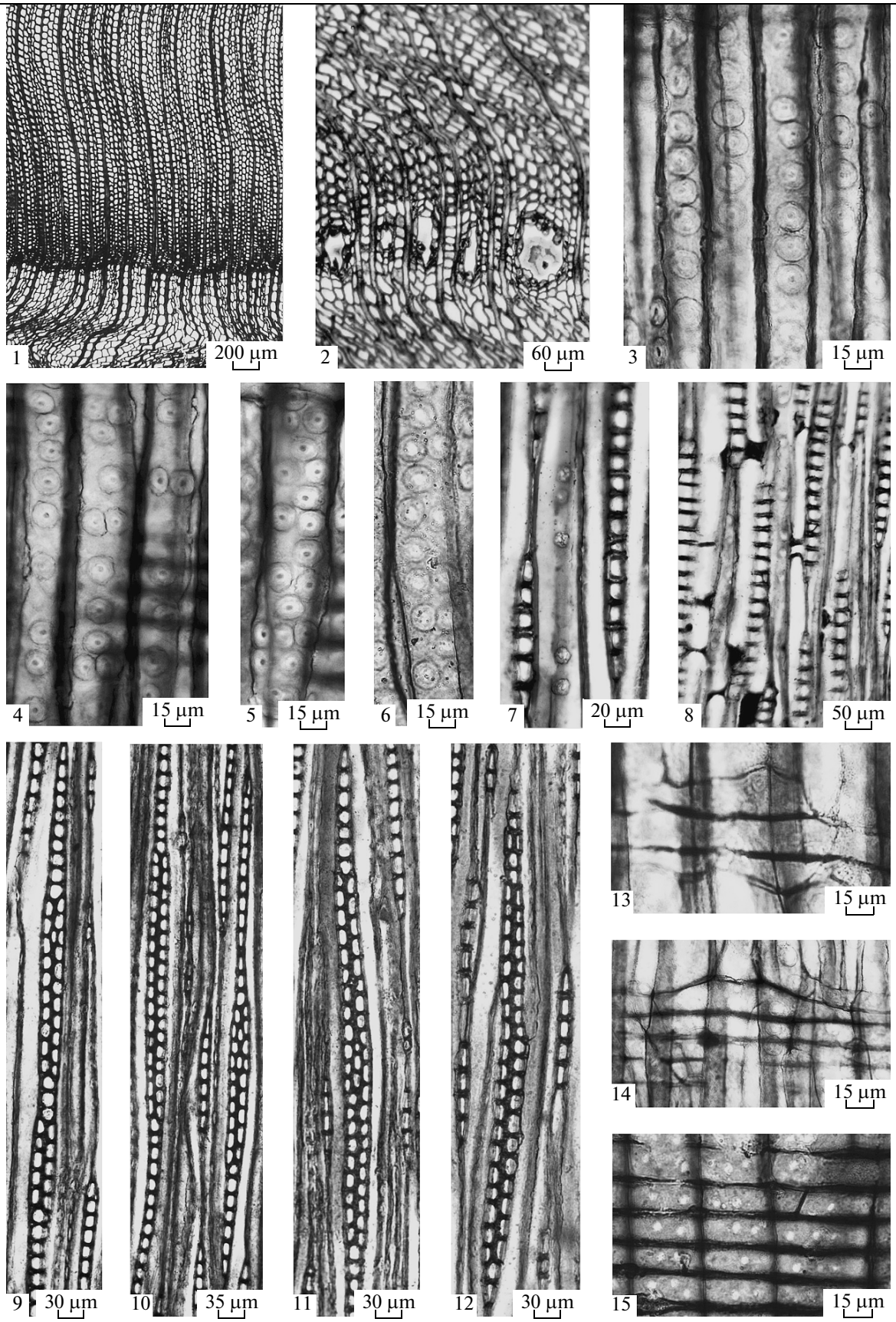
Axial parenchyma is abundant, with resin content, diffuse, dedicated to vertical traumatic resin canals; transverse cell walls are smooth (Pl. 10, fig. 8).

Rays are numerous, uniseriate ray, very frequently with biseriate regions, which are 1–20 cells long; one ray can include up to nine biseriate regions (Pl. 10, figs. 7, 9–11). Bi-triseriate regions are often present; triseriate regions consist of one to four layers; within one ray up to tree bi-triseriate regions can be present (Pl. 10, figs. 9–11). Sometimes, one ray includes biseriate and bi-triseriate regions (Pl. 10, fig. 9). Biseriate and bi-triseriate regions come to the ends of the rays. Rays are 1–50 (60–110) cells high, but mostly within 20–50 cells. Seldom entirely biseriate rays are present. They are 7–20 cells high (Pl. 10, fig. 12). Sample no. 36a/4 has an area with fifteen multiseriate rays; the rays are 3–5 cells wide and 20–68 cells high (Figs. 2a–2c). Most likely, these rays are traumatic. The median ray cells are circular, elliptic, rounded-rectangular, elongated along the ray; marginal ray cells are triangular or rounded-triangular and approximately of the same size as the median ones. The horizontal walls of rays are smooth, sinuous or slightly irregularly thickened; tangential walls of rays are smooth. There are intercellular spaces between cells. The ray tracheids have smooth cell walls; pits, 4–5 μm in diameter, are visible in the radial walls. The ray tracheids arrange in one layer at each ray margin (Pl. 10, figs. 13, 14).

Cross-fields with 1–4(6) taxodioid pits, 5–8 μm in diameter. Two or three (four) pits per cross-field are arranged in single horizontal row, more rarely two to six pits are in two horizontal rows (Pl. 10, fig. 15).

Normal resin canals are absent, but numerous traumatic vertical resin canals are present (Pl. 10, fig. 2). The canals are rounded or elliptic, 30–100 μm in diameter, lined with 6–14 thick-walled epithelial

Plate 10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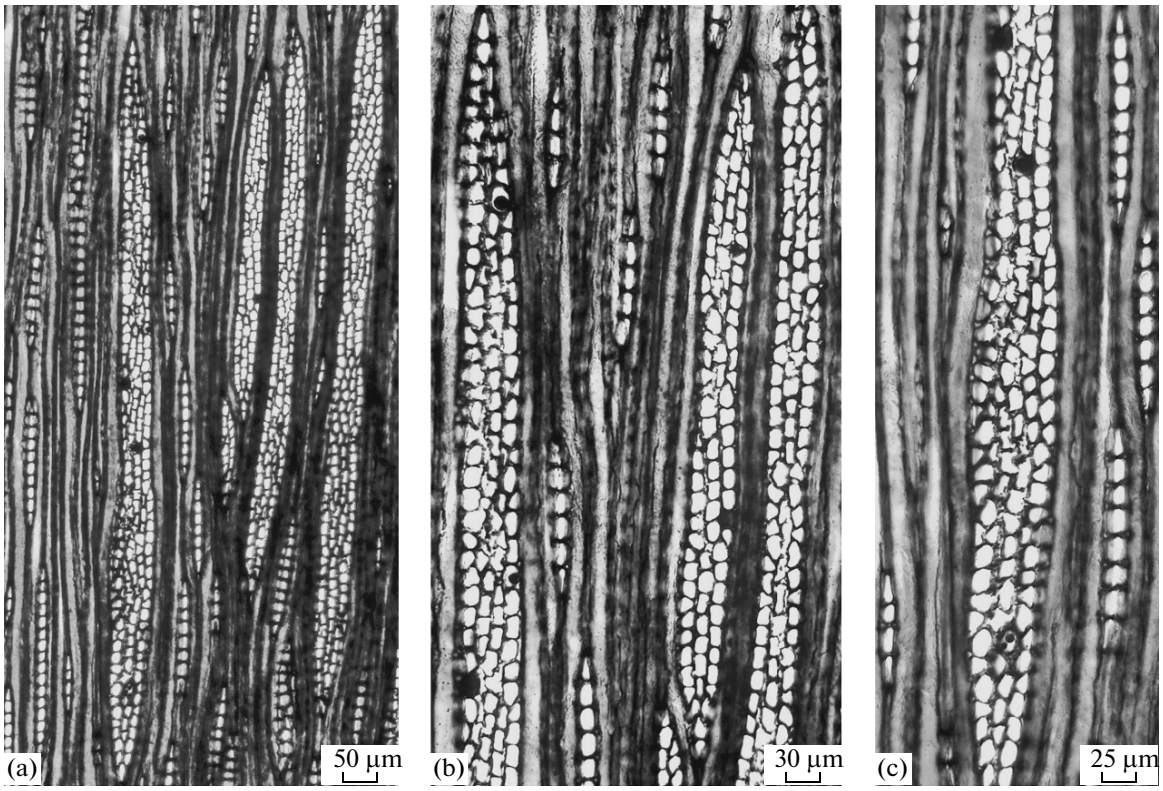

Fig. 2. *Sequoioxylon dimyense* sp. nov., sample no. 36a/4: (a–c) tangential section, multiseriate rays.

cells, which not always form continuous layer. Traumatic vertical resin canals are arranged in long chains in the early wood zone.

C o m p a r i s o n. Among fossil woods of *Sequoioxylon*, *S. dimyense* sp. nov. shows the most similarity to the woods *S. sizimanicum* Blokh. from the Paleogene of Siziman Bay (Khabarovsk Region) (Blokhina, 1986), and *S. chemrylicum* Blokh. from Chemurnaut Bay (Kamchatka Peninsula) (Blokhina, 1997). However the described fossil wood differs from *S. sizimanicum* in presence of triseriate layers in uniseriate rays, multiseriate rays, traumatic vertical resin canals, higher rays with more long biseriate regions, a greater number of pits in cross-fields, and also lack of small nodules in the transverse walls of axial parenchyma cells, and cupressoid pits in cross-fields (Table 1). Besides, both the diameter of pits in the radial and tangential walls of tracheids, and in cross-fields is not specified in the description of *S. sizimanicum*, that does not allow more detailed comparison.

The fossil wood studied differs from *S. chemrylicum* in presence of bi- and multiseriate rays, traumatic vertical resin canals, higher rays with more long biseriate regions, and also lack of uniseriate rays with tetraseriate regions (Table 1).

The fossil wood *S. dimyense* sp. nov differs from *S. burejense* described from the Middle Maastrichtian Astashikha locality of the Zeya–Bureya basin (Blokhina, Afonin, and Kodrul, 2010) in the absence of triseriate pits in the radial tracheid walls, presence of only smooth transverse tracheid walls of axial parenchyma cells, bi- and multiseriate rays, triseriate regions in uniseriate rays, considerably higher uniseriate rays and more long biseriate regions in them, and also smaller number of pits in one horizontal row in the cross-field (Table 1).

R e m a r k s. The presence of taxodioid cross-field pitting alongside with axial parenchyma, smooth horizontal and tangential walls of ray cells and the absence

E x p l a n a t i o n o f P l a t e 10

Figs. 1–15. *Sequoioxylon dimyense* sp. nov., holotype. no. 36a/1: (1) transverse section, growth ring boundary, transition from early wood to the late; (2) transverse section, traumatic resin canals; (3) radial section, uniseriate pits in the tracheid walls; (4–6) radial section, uniseriate and biseriate pits in the tracheid walls, crassulae; (7) tangential section, uniseriate rays, pits in the tracheid walls; (8) tangential section, axial parenchyma; (9–11) tangential section, uniseriate rays with biseriate and bi-triseriate regions; (12) tangential section, biseriate ray; (13, 14) radial section, ray tracheids; (15) radial section, pits in cross-fields; Zeya–Bureya basin, right bank of the Dim River; Tsagayan Formation, upper part of the Lower Tsagayan Subformation, Middle Maastrichtian.

Table 1. Comparative wood anatomy of the fossil wood *Sequoioxylon dimyense* sp. nov. and related fossil wood species of the subfamilies Taxodioideae and Sequoioideae of the family Cupressaceae

Anatomical characters	*Sequoioxylon dimyense* sp. nov.	*Sequoioxylon sizimanicum* Blokhina (Blokhina, 1986)	*Sequoioxylon chemrylicum* Blokhina (Blokhina, 1997)	*Sequoioxylon burejense* Blokhina et M. Afonin (Blokhina et al., 2010)	*Taxodioxylon multiseriatum* Ramanujam et Stewart	
					Ramanujam, Stewart, 1969a, b	Ramanujam, 1972
Pits in the radial walls of tracheids:						
uniseriate	+ +	+	+	+	+	+
biseriate	+	+ +	+ +	+	+ +	+ +
triseriate	–	–	–	+ –	+ +	+
tetraseriate	–	–	–	–	+	–
pentaseriate	–	–	–	–	–	–
pit diameter, μm	12–18(20)	?	15–18	11–17	15–25	10–15
Pits in the tangential walls of tracheids						
pit diameter, μm	9–10	+	12	7–11	–	–
Crassulae	+	+	+	+	+	+
Transverse walls of the axial parenchyma cells:						
smooth	+	+	+	+	+	+
nodular (number of nodules)	–	1–3	–	1–5	–	–
Uniseriate rays:						
height (in cells)	1–50 (60–110)	1–40 (50–80)	1–50 (60–70)	1–30 (50–70)	(2)18–40(90)	(2)12–25(70)
biseriate layers (number)	1–20	1–4(9)	1–9(13)	1–7(13)	+	+
triseriate layers (number)	1–4	–	1	–	?	?
tetraseriate layers (number)	–	–	1	–	?	?
Biseriate rays	+ –	+	–	–	+	+
Multiseriate rays	+ –	–	–	–	+ –	+ –
Ray tracheids	+	+	+	+	–	–

Table 1. (Contd.)

Anatomical characters	*Sequoioxylon dimyense* sp. nov.	*Sequoioxylon sizimanicum* Blokhina (Blokhina, 1986)	*Sequoioxylon chemrylicum* Blokhina (Blokhina, 1997)	*Sequoioxylon burejense* Blokhina et M. Afonin (Blokhina et al., 2010)	*Taxodioxylon multiseriatum* Ramanujam et Stewart	
					Ramanujam, Stewart, 1969a, b	Ramanujam, 1972
Pits in the cross-fields:						
number of pits	1–4(6)	1–3	1–4(5)	1–5(6)	1–5	1–4
pit diameter, μm	5–8	?	7–9	4–7(8)	4–8	8–12
number of pits in a single horizontal row	2–3(4)	2–3	2–3(4)	2–6	2–5	2–4
type of pits:						
cupressoid	–	+–	–	–	–	–
taxodioid	+	+	+	+	+	+
pinoid	–	–	–	–	–	–
Traumatic resin canals:						
vertical	+	–	–	+	–	–
horizontal	–	–	–	–	–	–

(+) character is present, (–) character is absent, (++) character dominates, (+–) character is occasionally present, (?) no data.

of normal resin canals (canals of traumatic origin occur sometimes) testifies that the fossil wood described is similar to the wood of the modern representatives of subfamilies Taxodioideae and Sequoioideae of the family Cupressaceae.

The modern Taxodioideae and Sequoioideae are hardly distinguishable by their wood anatomy characters. Nevertheless, representatives of Sequoioideae (*Sequoia*, *Sequoiadendron*, and *Metasequoia*), differ from the other Taxodioideae in the presence of only smooth (or slightly nodular, but never dentate or pitted, as in *Taxodium* Rich. and *Glyptostrobus* Endl., subfamily Taxodioideae) transverse walls of axial parenchyma cells, and by the presence of ray tracheids and traumatic resin canals or cysts (Yatsenko-Khmelevsky, 1954b; Greguss, 1955; Chavchavadze, 1979; Basinger, 1981; Visscher and Jagels, 2003).

The presence in fossil wood studied of only smooth transverse walls of axial parenchyma cells, ray tracheids and traumatic resin canals, testifies that the fossil wood belongs to the subfamily Sequoioideae. However, it is almost impossible to distinguish modern representatives of this subfamily by their anatomical characters (Table 2). Nevertheless, the presence in fossil wood studied of very high uniseriate rays (up to 110 cells) with long biseriate regions (up to 20 cells) and biseriate rays, and also a large number of pits in a single horizontal row in the cross-field (up to four pits), allows to suppose its somewhat greater similarity with the wood of modern *Sequoia* (Table 2). According to P. Greguss (1955), among modern Taxodioideae

Table 2. Comparative wood anatomy of the fossil wood *Sequoioxylon dimyense* sp. nov. and wood of modern representatives of the subfamily Sequoioideae

Anatomical characters	*Sequoioxylon dimyense* sp. nov.	*Sequoia* Endl. (Yatsenko-Khmelevsky, 1954b; Chavchavadze, 1979; Greguss, 1955)	*Sequoiadendron* J. Buchh. (Yatsenko-Khmelevsky, 1954b; Greguss, 1955)	*Metasequoia* Hu et W.C. Cheng (Chavchavadze, 1979; Greguss, 1955; Visscher, Jagels, 2003)
Pits in the radial walls of tracheids:				
uniseriate	+ +	+	+ +	+
biseriate	+	+ +	–	+ +
triseriate	–	+ +	–	+ –
tetraseriate	–	+ –	–	–
pentaseriate	–	+ – –	–	–
pit diameter, μm	12–18(20)	15–17(14–16)	14–17	18–20(20–22)
Pits in the tangential walls of tracheids				
pit diameter, μm	9–10	12–14(16)	11–13	9–11(13)
Crassulae	+	+	+	+
Transverse walls of the axial parenchyma cells:				
smooth	+	+	+	+
nodular (number of nodules)	–	1–3	?	1–5
Uniseriate rays:				
height (in cells)	1–50(60–110)	1–30(75)	1–20(30–50)	1–23(38)
biseriate layers (number)	1–20	1–15(20–30)	1–6(7)	1–3(8)
triseriate layers (number)	1–4	+	+	–
tetraseriate layers (number)	–	+ –	+ – –	–
Biseriate rays	+ –	+ –	+ –	–
Multiseriate rays	+ –	+ – –	+ – –	–
Ray tracheids	+	+	+	+
Pits in the cross-fields:				
number of pits	1–4(6)	1–6(8–10)	1–6	1–4
pit diameter, μm	5–8	5–6(12)	4.5–8	10–13
number of pits in a single horizontal row	2–3(4)	2–5	2–3	2–3
type of pits –				
cupressoid	–	+	+	+
taxodioid	+	+ +	+ +	+ +
pinoid	–	+	+	+ –
Traumatic resin canals:				
vertical	+	+	+	+
horizontal	–	+	+	–

(+) character is present, (–) character is absent, (++) character dominates, (+–) character is occasionally present, (+––) character is uncommon, (?) no data.

and Sequoioideae, only *Sequoia* and *Taxodium* may have in cross-fields up to four pits in a single horizontal row, and *Sequoia* even up to five pits.

R. Torrey (1923) proposed the morphogenus *Sequoioxylon* for fossil woods with characters of modern Sequoioideae. R. Kräusel (1949), analyzed fossil woods with Taxodioideae and Sequoioideae characters, recommended to use *Sequoioxylon* only for undoubted fossil woods of Sequoioideae, and assign all other woods of Cupressaceae with features of Taxodioideae and Sequoioideae to the formal genus *Taxodioxylon* Hartig emend. Gothan, which unites the fossil woods showing anatomical characters similar to those in woods of modern *Sequoia*, *Sequoiadendron*, *Metasequoia* (subfamily Sequoioideae) and *Taxodium* (subfamily Taxodioideae).

Among the *Taxodioxylon* fossil woods, those of *Sequoioxylon dimyense* sp. nov. show close similarity (especially in the constitution of rays) with *Taxodioxylon multiseriatum* Ramanujam et Stewart (1969a, b; Ramanujam, 1972) from the Campanian and Maastrichtian of Alberta, Canada. However, the fossil wood described differs from *T. multiseriatum* in presence of pits in the tracheid tangential walls, traumatic vertical resin canals, ray tracheids, absence of triseriate and tetraseriate pits in the radial walls of tracheids, and also a few higher rays (Table 1). It should be noted that there are areas of abnormally high multiseriate rays in both woods of *T. multiseriatum* and *Sequoioxylon dimyense* sp. nov. In opinion of C. Ramanujam (1972), these rays have a traumatic origin in *Taxodioxylon multiseriatum* wood. Probably, emergence of such multiseraite rays in *Sequoioxylon dimyense* sp. nov. was also connected with trauma, as a result of which the development of a strong ray parenchyma for reserve of nutrients was necessary.

In the present paper, the morphogenus *Sequoioxylon* is used for naming fossil woods of Sequoioideae. As far as the wood under study does not show the complete identify to the wood of any modern or fossil representative of subfamily Sequoioideae, it should be described as a new fossil species *Sequoioxylon dimyense* sp. nov., which is characterized by the combination of wood anatomical characters of modern representatives of subfamily Sequoioideae of the family Cupressaceae.

M a t e r i a l. Collection no. 36a, samples nos. 36a/1 (holotype), 36a/3, 36a/4.

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