Short communication

Shuichi Noshiro[1]: Latest record of *Hemiptelea mikii* fossil wood from a late Pleistocene deposit along the Hanamuro River, Tsuchiura City, Ibaraki Prefecture

能城修一[1]：茨城県土浦市花室川の上部更新統から産出したヒメハリゲヤキの木材化石

Hemiptelea mikii Minaki is an extinct species established from fossil fruits and woods found in Japan by Minaki et al. (1988). It has been recorded from Early Pleistocene to last glacial strata in central Honshu between Osaka and Tokyo (Minaki et al., 1988; Suzuki & Noshiro, 1992). The only extant species of this genus, *Hemiptelea davidii* (Hance) Planch., grows from Korea to central and northern China and is a deciduous tree up to 10 m tall (Fu et al., 2003). In Europe fossil fruits assigned to this genus have been reported from Miocene to Pliocene strata, but were found to have a deeper saddleback depression, different to *Hemiptelea mikii* or *H. davidii* (Minaki et al., 1988). *Hemiptelea mikii* can be distinguished from *H. davidii* in having shorter nutlets and several distinct wood anatomical features.

The Hanamuro River in Ibaraki Prefecture is known to yield fossils of *Palaeoloxodon naumanni* Makiyama (Masuda et al., 1978; Nakashima et al., 2002, 2004). During a series of excavation for mammalian fossils, plant fossils were collected from the same stratum to reconstruct the palaeoenvironment. Identification of those plant fossils was reported by Nakashima et al. (2002) based on a forum report, but without any description of or reference to specimens or any discussion from a palaeobotanical perspective. One fossil wood brought to the wood anatomy laboratory of the Forestry and Forest Products Research Institute was identified as *Hemiptelea mikii*. Here I will describe the wood structure of this specimen and report the latest occurrence of this species.

Locality and stratigraphy

The Hanamuro River dissects Tsukuba Upland located to the southwest of the Sakura River and runs into Kasumi-ga-ura Lake. Its river bed was lowered ca. 5 m in 1970s during the construction of Tsukuba Science City, which lead to frequent discovery of *Palaeoloxodon naumannii* fossils. The fossil wood of *Hemiptelea mikii* was discovered at Location D of Nakashima et al. (2002) below Nagata bridge, Tsuchiura City (36° 03'45"N 140°08'48"E). According to Nakashima et al. (2002), the fossil yielding stratum consists of gentle slope deposits correlated with the Sakura-gawa Terrace Deposit and unconformably overlies the Kamiiwahashi Formation and is overlain by alluvial deposits. Its facies is coarse sand with developed cross lamination and includes gravel and fossils. One radiocarbon date obtained from a fossil wood at the bottom of this stratum was 27,340 ± 860 yBP (GaK-13276), and two other dates obtained from fossil woods in the same terrace deposits at two upstream localities were over 30,970 yBP (GaK-6206) and 24,760 ± 1050 yBP (GaK-6862).

Description of wood structure

The fossil wood was sectioned manually, mounted with Gumchloral (a mixture of Chloral Hydrate 50 g, Arabic Gum 40 g, Glycerin 20 ml, and pure water 50 ml), and numbered as IB-273. The specimen is deposited in the xylariorum of the Forestry and Forest Products Research Institute (TWTw).

Hemiptelea mikii Minaki (IB-273; Figs. 1–6)

Description. Wood is ring-porous; growth rings are distinctly delineated by ring porosity, 0.5–5.2 mm wide, or are indistinct due to lack of latewood in narrow growth rings (Fig. 1). Earlywood consists of 2–3(–4) rows of large, mostly solitary vessels, 50–160 μm in tangential diameter, and occasional clusters of small vessels, 10–40 μm in tangential diameter. Among large vessels in the earlywood, smaller ones tend to line along the growth ring boundaries, and larger ones to form lax, second and third rows. Latewood vessels

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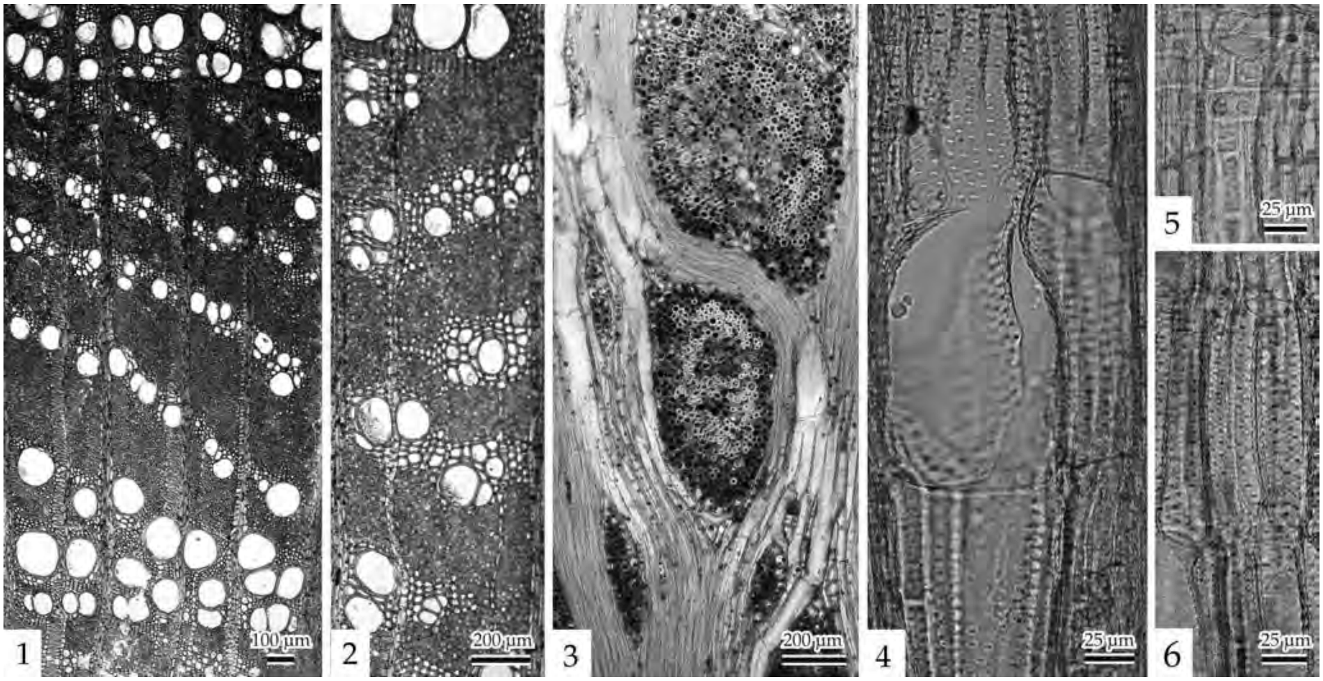

Figs. 1–6 Fossil wood of *Hemiptelea mikii* from a late Pleistocene deposit along the Hanamuro River (IB-273). — 1: cross section showing ring-porous wood with earlywood vessels in 2–3 rows forming an initial vessel zone and latewood vessels of irregular sizes forming oblique bands. — 2: cross section showing latewood vessels of irregular sizes forming oblique bands together with vascular tracheids and wood parenchyma. — 3: tangential section showing heterocellular rays which are occasionally extremely wide. — 4: radial section showing an unusual, inflated (left) and a normal (right) latewood vessel elements. — 5: radial section showing prismatic crystals in square to procumbent ray cells. — 6: radial section showing simple perforations and spiral thickenings in latewood vessel elements.

form oblique bands, 4–9 vessels in radial width (Figs. 1, 2); oblique bands mainly consist of small square vessels, 10–30 µm in tangential diameter, but large vessels, 50–80 µm in tangential diameter, often intermingle in oblique bands. Vessel elements are (70–)120–160 µm long with exclusively simple perforation plates; spiral thickenings are distinct in narrow vessel elements (Fig. 6); in the latewood, vessel elements which are inflated horizontally occur sporadically (Fig. 4).

Vascular tracheids are scattered marginally in latewood oblique bands of vessels, ca. 10 µm in tangential diameter, 140–160 µm long, with distinct spiral thickenings.

Wood parenchyma is scanty paratracheal, marked around latewood oblique bands of vessels, 2–4 cells per strand.

Fibers with few slit-like pits constitute the ground mass of the wood, thick-walled, walls ca. 5 µm thick.

Latewood vessel elements, vascular tracheids, and parenchyma strands are often storied (Fig. 3)

Rays are heterocellular, uniseriate and multiseriate. Uniseriate rays occupy ca. 21% of all rays, consist of square to upright cells. Multiseriate rays are usually 1–10 cells wide and 100–550(–930) µm tall with 1–2 marginal rows of square to upright cells; they occasionally become very wide, 24–32 cells and 150–350 µm wide; incomplete sheath cells partly cover the sides of multiseriate bodies (Fig. 3).

Prismatic crystals often in marginal or incomplete sheath cells of multiseriate rays and in square to upright cells of uniseriate rays (Figs. 3, 5).

Affinity. The fossil wood shared the following features with the stemwood of *Hemiptelea mikii* or *H. davidii*: 1) ring-porous wood; 2) earlywood consisting of large, mostly solitary vessels and clusters of small vessels; 3) oblique bands of small latewood vessels with intermingling large vessels; 4) simple perforations, spiral thickenings in narrow vessels; 5) sporadic occurrence of inflated latewood vessel elements; 6) heterocellular rays, occasionally becoming extremely wide. Compared with the stemwood of *H. davidii*, this fossil wood had distinct features of the stemwood of *H. mikii* (Minaki et al., 1988): 1) smaller earlywood vessels; 2) radially narrower bands of latewood vessels;

3) shorter vessel elements; 4) more frequent uniseriate rays; 5) extremely wide rays; and 6) prismatic crystals in ray cells.

Stratigraphical correlation and fossil habitat

Ishii et al. (1987) studied the distribution and formation of gentle slope deposits in Tsukuba Upland and showed that the slope deposits uncorformably overlie the Joso and Narita Formations and are overlain by the upper Younger Loam intercalating Aira-Tn ash. In the Sakuragawa Lowland ca. 3 km north, Suzuki et al. (1993) presented two profiles across the lowland and clarified the stratigraphy since 32,000 yBP. According to their study, there were three periods of gravel formation, before 32,000 yBP, 24,000–22,000 yBP, and 11,000–10,000 yBP. Judging from the facies and radiocarbon dates, the gentle slope deposits that yielded fossils along the Hanamuro River seems to be correlated with the period 32,000–24,000 yBP of Suzuki et al. (1993) that formed the Yahagi terrace over Tsuchiura Gravel Bed. Although more critical correlative studies are necessary, the fossil yielding stratum seems to be deposited just before the last glacial maximum. If this correlation is correct, the fossil wood from the Hanamuro River becomes the latest record of *Hemiptelea mikii* after that at Kita-egota, Nakano-ku, Tokyo dated at ca. 50,000 yBP (Minaki, 1987; Suzuki & Noshiro, 1987) and that at Oise-yama, Tokorozawa City, Saitama dated at 30,000–35,000 yBP (Tsuji et al., 1991; Suzuki & Noshiro, 1992).

Habitat of *Hemiptelea mikii* seems to have varied through the Pleistocene period, judging from changes in coexisting taxa (Minaki et al., 1988). At three localities of the last glacial period, *Hemiptelea mikii* was accompanied by various temperate taxa (Table 1). The fossil strata at the Hanamuro River yielded cones of *Picea* cf. *shirasawae* Hayashi, *Tsuga sieboldii* Carrière, and *Larix*, seeds of *Pinus koraiensis* Siebold et Zucc., *Styrax japonica* Siebold et Zucc., and *Corylus*, and woods of *Picea, Abies, Tsuga, Salix, Betula, Sorbus, Ulmus*, and *Fraxinus* (Nakashima et al., 2002). At the Kita-egota site, *Hemiptelea mikii* was mainly accompanied by *Corylus, Alnus japonica* (Thunb.) Steud., *Ulmus*, *Sorbus*, *Rubus, Maackia amurensis* Rupr. et Maxim. subsp. *buergeri* (Maxim.) Kitam., *Acer*, *Rhamnus* cf. *japonica* Maxim., *Fraxinus mandshurica* Rupr. var. *japonica* Maxim., *Ligustrum*, and *Syringa reticulata* (Blume) Hara, and various herbaceous plants including *Isoetes japonica* A. Br., *Carex*, and *Scirpus* (Minaki, 1987; Suzuki & Noshiro, 1987). At the Oise-yama site, *Hemiptelea mikii* was accompanied mainly by *Picea*, *Juglans mandshurica* Maxim. var. *sachalinensis* (Mi-

Table 1. Main taxa accompanying *Hemiptelea mikii* in late Pleistocene

Taxon	Hanamuro River		Kita-egoda site		Oise-yama site	
	PM	W	PM	W	PM	W
Abies		+				
Larix	+					
Picea cf. *shirasawae*	+					
Picea		+				+
Pinus koraiensis	+					
Tsuga sieboldii	+					
Tsuga		+				+
Juglans mandshurica var. *sachalinensis*			+		+	
Salix		+				
Alnus japnica			++			
Alnus sect. *Gymnothyrsus*				++		+
Betula		+				
Corylus	+			+		
Ostrya japonica						+
Quercus subgen. *Cyclobalanopsis*						+
Celtis						+
Hemiptelea mikii		+	+	++		+
Ulmus		+		+		
Subfam. *Maloideae*		+		+		++
Rosa						+
Rubus				+		
Maackia amurensis var. *buergeri*				+		
Wisteria floribunda				+	+	
Phellodendron amurense					+	
Acer				+		+
Aesculus turbinata				+		+
Rhamnus			+	+		
Styrax japonicus	+				+	
Symplocos sawafutagi						+
Chionanthus retusus						+
Fraxinsu mandshurica var. *japonica*			+			
Fraxinus		+		++		++
Ligustrum				+		+
Syringa reticulata				+		++
Ring-porous wood D						+
Chara			+			
Isoetes japnica			+			
Potamogeton cf. *distinctus*			+			
Carex			+		+	
Scirpus			+			
Polygonum			+			
Duchesnea, Fragaria, Potentilla			+			
Impatiens			+			
Viola			+			
Mosla			+			
Labiatae			+		+	

PM: plant macrofossil, W: fossil wood.
++: more than 100 for PM/more than 10% for W.

yabe et Kudo) Kitam., *Alnus* sect. *Gymnothyrsus*, *Ostrya japonica* Sarg., *Celtis*, Subfam. *Maloideae*, *Rosa*, *Wisteria*, *Phellodendron amurense* Rupr., Acer, *Styrax japonica* Siebold et Zucc., *Fraxinus*, *Syringa reticulata* (Blume) Hara, *Chionanthus retusus* Lindl. et Pax., and *Carex* (Tsuji et al., 1991). The fossil assemblage at the Hanamuro River included temperate coniferous taxa not found either at the Kita-egota or Oise-yama Sites. Except for two fossil woods of *Quercus* subgen. *Cyclobalanopsis* found at the Oise-yama site, all the other dicotyledonous taxa are deciduous woody plants. Thus, during the last glacial period, *Hemiptelea mikii* seems to have grown in the cool temperate forest consisting of temperate coniferous taxa and various kinds of deciduous broad-leaved trees.

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