Pinoid Woods with Resin Canals from the Upper Cretaceous of Hokkaido and Saghalien

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This paper describes six species of permineralized pinoid woods with resin canals from the Upper Cretaceous of Hokkaido, Japan and Saghalien: Piceoxylon transiens Shimakura, P. scleromedullosum Shimakura, P. macroporosum sp. nov., P. takahashii sp. nov., Pinuxylon microporosum Ogura and Pinuxylon dakotense (Knowlton) Read (new to Saghalien and the Cretaceous). Piceoxylon macroporosum is characterized by large resin canals and rays without ray tracheids and in lacking tylosoids in resin canals. Piceoxylon takahashii, which resembles P. scleromedullosum, is distinguished from the latter in having ray tracheids and nests of sclereids in pith.

Key words: Cretaceous — Hokkaido — Petrified wood — Pinoid wood — Pityoxyloid wood — Saghalien

The Upper Cretaceous shallow marine sediments in Hokkaido yield rich plant remains that contain various conifers as well as other gymnosperms, ferns and angiosperms.

As for coniferous remains, many belong to either the Taxodiaceae or the Araucariaceae. We have reported more than 10 species of taxodiaceous, araucarian and cedroid woods in the last 20 years (Nishida 1974, 1981, 1984, 1985, Nishida and H. Nishida 1986, H. Nishida and Nishida 1986, Stockey et al. 1990). Seven species of taxodioid and araucarian cones (Stopes and Fujii 1910, Nishida et al. 1991, 1992, Ohsawa et al. 1992a, 1993, Stockey et al. 1992, 1994), four types of araucarian seedlings (Stockey et al. 1990), and three types of taxodioid and araucarian shoots or twigs (Stopes and Fujii 1910, Ohsawa, private comm.) are known from the Upper Cretaceous of Hokkaido. The pinaceous remains are less rich in Hokkaido. Ogura (1932) reported a petrified picean leaf, two pine leaves and a sciadopityan leaf from the Upper Cretaceous of Yubari. Several species of pine leaves are described from several localities in Hokkaido (Ueda and Nishida 1982, Stockey and Nishida 1986). Ohsawa et al. (1991, 1992b) recently added three species of pityostrobidoid cones to the fossil flora. In Hokkaido and Saghalien to date, four species of pinoid woods have been described (Shimakura 1937, Ogura 1944): Piceoxylon transiens Shimakura from Utashinai, Kamisunagawa, Hokkaido; P. scleromedullosum Shimakura from Bykov (Miho), Dolinsk (Ochiai, Sakaehama-gun), Saghalien; Piceoxylon sp. (P. antiquius Gothan ? Shimakura 1937) from 22 km south of Sinegorsk (Namikawa), Yuzino-Sakhalinsk (Toyohara), Saghalien; and Pinuxylon microporosum Ogura from Ohyubari, Yubari, Hokkaido. All these species have resin canals characteristic of pinoid woods.

From the Mesozoic worldwide, about 40 species of pinoid woods with resin canals have been reported (Seward 1919, Kräusel 1919, 1949, Shimakura 1937, Ogura 1944, Sze 1951, Greguss 1967, Nishida et al. 1993). These woods are important to fully reconstruct the pinaceous plants from Hokkaido. However, we still have several undescribed specimens of pinoid woods from some localities in Hokkaido, which will be described here. We also reexamined the specimens from Saghalien collected by the late Drs. Yuzuru Ogura and Shunji Watari in 1940 and 1941. As a result, we have recognized six species including two new species and new locality for one species, although we could not examine the Piceoxylon antiquius type specimen.

Materials and Methods

The specimen numbers, collection localities and horizons are shown in Table 1. All examined micropreparations were made by the ordinary peel technique (Joy et al. 1956) using 0.5 N HCl as an etching reagent. They are housed in the Laboratory of Phylogenetic Botany, Faculty of Science, Chiba University.

Results


Specimen Nos. 73536, 73546, and 823420 are fragments of secondary woods, 3-5 cm in diameter and 5-12 cm long. Their histology is not well preserved. Specimen
Table 1. Localities, horizons and registration numbers of examined specimens

<table>
<thead>
<tr>
<th>Localities</th>
<th>Horizons</th>
<th>Specimen numbers</th>
<th>Collectors</th>
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<tbody>
<tr>
<td>Hokkaido: Dam site of Yubari Dam, Ohyubari, Yubari</td>
<td>As gravels on riverbed of Yubari River Senonian</td>
<td>68011, 73206, 73247</td>
<td>M. Nishida 1968 &amp; 1973</td>
</tr>
<tr>
<td>Hokkaido: Omakizawa, tributary of Yubari River Ohyubari, Yubari</td>
<td>As gravels on riverbed of rivulet Turonian</td>
<td>73306, 823420 823467</td>
<td>M. &amp; H. Nishida 1973 &amp; 1982</td>
</tr>
<tr>
<td>Hokkaido: Rivulet near south mouth of Sanyu Tunnel, Ohyubari, Yubari</td>
<td>As gravels on riverbed of rivulet Turonian</td>
<td>823504</td>
<td>M. &amp; H. Nishida 1982</td>
</tr>
<tr>
<td>Hokkaido: Manjizawa, tributary of Yubari River, Ohyubari, Yubari</td>
<td>As gravels on riverbed of rivulet Coniacian–Santonian</td>
<td>860212</td>
<td>T. Takahashi 1986</td>
</tr>
<tr>
<td>Hokkaido: Kumaoizawa, rivulet of northern area of Lake Katsurazawa, Mikasa</td>
<td>As gravels on riverbed of rivulet Coniacian–Santonian</td>
<td>77536, 773546</td>
<td>M. Nishida 1973</td>
</tr>
<tr>
<td>Saghalien: Aikawa River and tributary streams about 20 km from Bykov (Miho)*</td>
<td>As gravels on riverbed of streams Late Turonian–Santonian*</td>
<td>14089, 14096</td>
<td>Y. Ogura &amp; S. Watari 1940 &amp; 1941</td>
</tr>
<tr>
<td>Saghalien: Fukuryu River, tributary of Nayba River (Naibuchi River), near Sinegorak (Kawakami) Coal Mine*</td>
<td>As gravels on riverbed of tributary Late Turonian–Santonian*</td>
<td>12013, 12014</td>
<td>Y. Ogura &amp; S. Watari 1940 &amp; 1941</td>
</tr>
</tbody>
</table>

* For locality map and geology of region, refer to Nishida and H. Nishida (1986)

No. 12014 is a fragment of a twig with pith, 2 cm in diameter and 5 cm long, with well preserved histology.

Notes. Growth rings visible. Transition from early to late wood gradual. Wood parenchyma scattered solitary in terminal of increments or grouped around vertical resin canals and merged into epithelial cells. Vertical resin canals circular or oval in cross section, 25–125 μm in tangential and 30–120 μm in radial diameters and scattered solitary or in tangential groups of 2–5 canals. Traumatic resin canals aligned tangentially. Resin canals occluded with tylotoids. Epithelial cells 7–13 in number with thick walls 4–8 μm in thickness. Bordering pits on radial walls of tracheids arranged contiguously or separately in one, rarely in two rows. Two-row pits irregularly contact and alternate. Pits on tangential walls smaller and arranged in single row. Rays uniseriate or fusiform. Uniseriate rays 1–17, chiefly 1–9 cells high and include ray tracheids with spiral thickenings (Figs. 1B, C). Circular or ovoid cross field pits 2–4 in early wood and 1–2 in late wood. Fusiform rays usually lack uniseriate wings, rarely bear wings 4–8 cells high. Containing horizontal resin canals 20–65 μm in transverse and 29–77 μm in vertical diameters and encircled by 5–10 epithelial cells. Pith parenchymatous, lacking stone cells or sclereids.

Affinity. The above features closely fit the original description by Shimakura (1937).


Piceoxylon macroporum sp. nov. (Fig. 2).

Specimen No. 823487 (holotype) is a piece of secondary wood, measuring 4 × 5 × 12 cm in dimensions. The preservation is poor.

Description. Secondary wood consisting of tracheids, rays, wood parenchyma and vertical and horizontal resin canals. Traumatic resin canals not examined. Growth rings distinct. Transition from early to late wood gradual. Tracheids arranged regularly in radial rows, rectangular or circular or ovoid cross section (Fig. 1). Pits on ray tracheids with spiral thickenings (arrow). Scale bar = 50 μm. C: Tangential section showing fusiform rays without uniseriate wings. Scale bar = 100 μm. D: Cross section showing vertical resin canals. Scale bar = 100 μm. E: Cross section showing vertical resin canals and abietineous pits on horizontal wall of ray cells. Scale bar = 50 μm. F: Tangential section showing fusiform ray with uniseriate wing. Scale bar = 200 μm. G: Radial section showing ray without ray tracheid. Scale bar = 200 μm. H: Radial section showing cross field pits on ray cells. Scale bar = 50 μm. I: Tangential section showing fusiform ray and wood parenchyma cells with nodular septa. Scale bar = 100 μm.