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ORIGINAL ARTICLE

Tree-ring analysis of white cedar (*Thuja occidentalis* L.) archaeological and historical wood in Québec City (Québec, Canada)

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Abstract

In Québec City, a segment of an old wooden palisade built for protection was found buried *in situ*. The palisade was excavated by the Laval University archaeology field school in 2004–2005, and 29 posts were recovered and sampled. The palisade enclosed the Intendant's Palace compound, which was the residence of the governor of New France at the end of the 17th century. Tree-ring analysis was performed on wood excavated from the Intendant's Palace archaeological site (PDI) and additional wood from two historical military buildings, the Artillery Park (ART) (early 18th century) and the Québec Citadel (CIT) (17th–19th centuries). Wood identification revealed that white cedar (*Thuja occidentalis* L.) was used for wood construction at the three sites. Many trees used for the construction of the PDI palisade were felled after the 1690 growing season, likely in September/October 1690. Posts probably came from trees growing close to the site on the banks of the Saint-Charles River. A white cedar ring-width chronology from the Rimouski area, approximately 300 km northeast of Québec City, along the St. Lawrence River, was used for cross-dating. Archaeological and historical wood samples from two of the three sites (PDI and ART) were first assembled in a 235-year tree-ring chronology, called the Québec chronology, extending from 1489 to 1723. The two master chronologies (Québec and Rimouski) were merged into a single 513-year tree-ring chronology (1489–2001), called the Saint-Laurent chronology.

Keywords: Dendroarchaeology; Palisade; Cross-dating; Ring-width chronologies; New France; 17th century

Introduction

Because tree-ring records are limited back in time by the age of trees, archaeological and historical wood – i.e., from archaeological sites and historical buildings, respectively – is used extensively to construct long tree-ring chronologies (Baillie, 1982; Pilcher et al., 1984; Baillie and Brown, 2002; Towner, 2002). Since the early foundation of Québec City in 1608, wood has gone into buildings and infrastructure such as bridges and docks.

In Québec City, archaeological sites of paramount importance for documenting the early occupation by

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European populations were excavated recently: (1) the 1541–1543 Cartier-Roberval site, at the west end of Québec City and (2) the Intendant's Palace (*Palais de l'Intendant*: PDI), built in the Lower Town at the end of the 17th century. Large pieces of wood were collected at the Intendant's Palace site from a well-preserved palisade. Despite references to the existence of this palisade in historical documents (narratives and maps), its presence was unexpected because of the enlargement of Lower Town through landfilling and extensive residential development. The PDI palisade is the oldest wood fortification found in New France so far and is thus unique. Palisades were used for protection against enemy attacks during the establishment of early European populations. They were later replaced by the stone walls currently surrounding the fortified City of Québec. The palisade under investigation was probably built in the late 17th century (Charbonneau et al., 1982; Desjardins, 2006), but its construction has not yet been documented by direct evidence. Wood from two additional historical sites, i.e., the Artillery Park (ART) and the Québec Citadel (CIT) located in the upper town, with inner rings presumably going back to the 16th or 17th century, were also used in this study.

The objectives of our study were three-fold: (1) perform tree-ring analyses, including wood identification, on posts coming from the PDI palisade in order to provide the cutting years of trees used for its construction; (2) build a floating chronology from archaeological (site PDI) and historical wood (sites ART and CIT) and connect it to an appropriate tree-ring chronology and (3) document the ecological and historical background for the construction of the PDI palisade, from both tree-ring data and historical documents.

Materials and methods

Study area

Québec City (46°47′N, 71°22′W) is located on the north shore of the St. Lawrence River (Fig. 1A). The city is at the junction of three geological districts: the Canadian Shield to the north, the Appalachian Mountains to the south and the St. Lawrence Platform (Gadd et al., 1972; St.-Julien and Hubert, 1975; Landry and Mercier, 1984) (Figs. 1A and B). The regional topography is controlled primarily by bedrock. A description of the geographical setting and Quaternary events including glaciation/deglaciation of Québec can be found in Occhietti et al. (2001).

Climate in the Québec City area is continental temperate but rather humid. Mean annual temperature is 4.04 °C (Environment Canada, 2008). Total annual precipitation is 1230 mm, 26% of which falls as snow. The forests of the Québec City are parts of the hardwood forest zone (Rowe, 1972) and the sugar maple/basswood bioclimatic domain (Grandtner, 1966). Wetlands include tidal marshes along the St. Lawrence River; wet, herbaceous shrub and tree communities along rivers; and peatlands on poorly drained sites. White cedar is present on cliffs delineating the city.

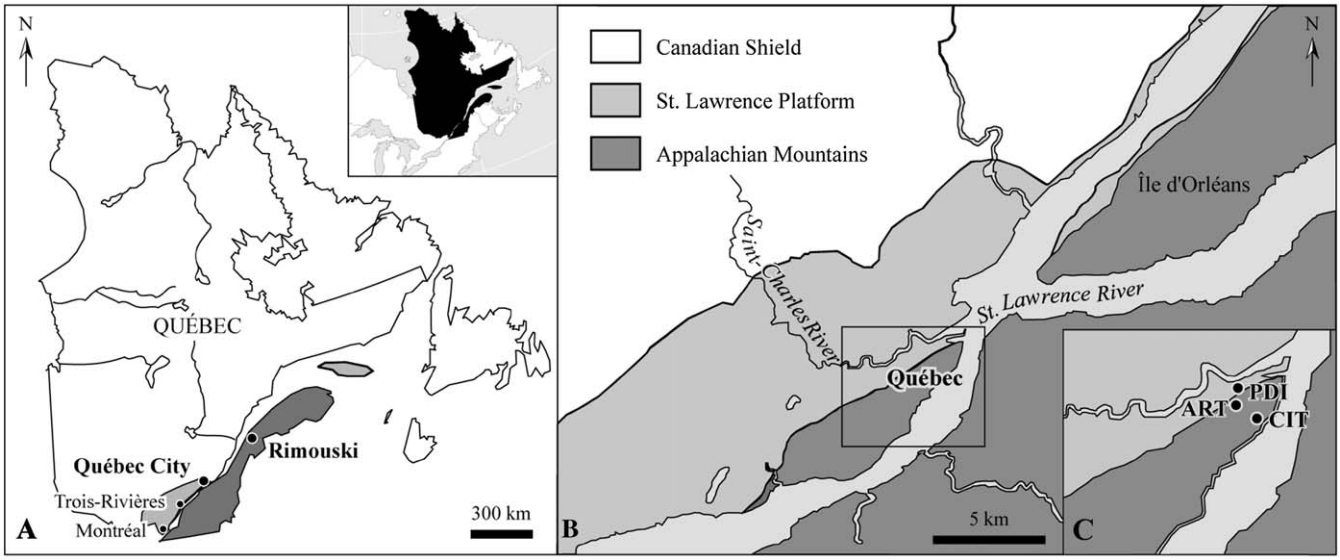

Fig. 1. (A) Location of the study area and settlements mentioned in the text. (B) Map showing the three geological districts in the Québec City area. (C) Location of the three study sites: PDI along the Saint-Charles River, and ART and CIT atop the Québec Promontory.