Quaternary Research 75 (2011) 552–565

Contents lists available at ScienceDirect

Quaternary Research

journal homepage: www.elsevier.com/locate/yqres

Associated terrestrial and marine fossils in the late-glacial Presumpscot Formation, southern Maine, USA, and the marine reservoir effect on radiocarbon ages

Woodrow B. Thompson [a,*], Carol B. Griggs [b], Norton G. Miller [c], Robert E. Nelson [d], Thomas K. Weddle [a], Taylor M. Kilian [d,e]

[a] *Maine Geological Survey, 22 State House Station, Augusta, ME 04333-0022, USA*
[b] *Tree-Ring Laboratory, Cornell University, B48 Goldwin Smith Hall, Ithaca, NY 14853, USA*
[c] *Biological Survey, New York State Museum, 3140 Cultural Education Center, Albany, NY 12230, USA*
[d] *Department of Geology, Colby College, 5804 Mayflower Hill, Waterville, ME 04901-8858, USA*
[e] *Department of Geology and Geophysics, Yale University, New Haven, CT 06511, USA*

A R T I C L E I N F O

Article history:
Received 24 February 2010
Available online 31 March 2011

Keywords:
Presumpscot Formation
Maine
Late Pleistocene
AMS and β-decay radiocarbon ages
Radiocarbon age calibrations
Marine reservoir effect
Dendrochronology
Marine bivalves and barnacles
Fossil mosses and insects
Plant macrofossils
Pollen
Landslides

A B S T R A C T

Excavations in the late-glacial Presumpscot Formation at Portland, Maine, uncovered tree remains and other terrestrial organics associated with marine invertebrate shells in a landslide deposit. Buds of *Populus balsamifera* (balsam poplar) occurred with twigs of *Picea glauca* (white spruce) in the Presumpscot clay. Tree rings in *Picea* logs indicate that the trees all died during winter dormancy in the same year. Ring widths show patterns of variation indicating responses to environmental changes. Fossil mosses and insects represent a variety of species and wet to dry microsites. The late-glacial environment at the site was similar to that of today's Maine coast. Radiocarbon ages of 14 tree samples are 11,907 ± 31 to 11,650 ± 50 ^{14}C yr BP. Wiggle matching of dated tree-ring segments to radiocarbon calibration data sets dates the landslide occurrence at *ca.* 13,520 + 95/−20 cal yr BP. Ages of shells juxtaposed with the logs are 12,850 ± 65 ^{14}C yr BP (*Mytilus edulis*) and 12,800 ± 55 ^{14}C yr BP (*Balanus* sp.), indicating a marine reservoir age of about 1000 yr. Using this value to correct previously published radiocarbon ages reduces the discrepancy between the Maine deglaciation chronology and the varve-based chronology elsewhere in New England.

© 2011 University of Washington. Published by Elsevier Inc. All rights reserved.

Introduction

Excavations in 2007 near the Fore River in Portland, Maine, for the new Mercy Hospital, revealed *Picea* logs, other plant fossils, insect remains, and shells of marine invertebrates in late-glacial marine clay of the Presumpscot Formation. The Presumpscot sediments occur widely across southern Maine, but the site described here is only the second known locality where they have been found to contain well-preserved tree remains. The first such occurrence was found in 1976 at a gravel pit just 150 m northeast of the 2007 hospital site (Fig. 1). A vertical pit face at the 1976 site exposed 3–5 m of marine clay with tree fragments and other terrestrial fossils near the base of the clay (Fig. 2; Hyland et al., 1978). Anderson et al. (1990) concluded that the tree remains and diverse biota at the 1976 site were eroded from a forest floor and were transported only a short distance in the ocean before being rapidly buried. Here we offer a more comprehensive paleoenvironmental interpretation of these two fossil localities, based on the stratigraphy of the hospital site and its surroundings along with detailed analysis of associated organic remains.

We collected plant and shell samples from trench and pit exposures immediately southeast of the hospital buildings that were under construction in 2007. Marine shells were found adjacent to tree remains, enabling us to compare terrestrial and marine radiocarbon ages from coeval organics. Marine shell ages underpin much of the deglaciation chronology for southern Maine (Borns et al., 2004), but their utility has been limited by reservoir effect uncertainty.

Our objectives are to (a) describe and interpret the origin of stratigraphic units and associated organic materials at the new site in reference to the 1976 exposure; (b) evaluate the terrestrial fossil assemblage relative to the late-glacial and Holocene environmental and climatic history of Maine and northeastern North America; (c) use the radiocarbon ages of decadal tree-ring segments to obtain wiggle-matched calibrated ages; and (d)

* Corresponding author. Fax: +1 207 287 2353.
E-mail addresses: woodrow.b.thompson@maine.gov (W.B. Thompson), cbg4@cornell.edu (C.B. Griggs), nmiller2@mail.nysed.gov (N.G. Miller), renelson@colby.edu (R.E. Nelson), thomas.k.weddle@maine.gov (T.K. Weddle), Taylor.Kilian@yale.edu (T.M. Kilian).

0033-5894/$ – see front matter © 2011 University of Washington. Published by Elsevier Inc. All rights reserved.
doi:10.1016/j.yqres.2011.02.002

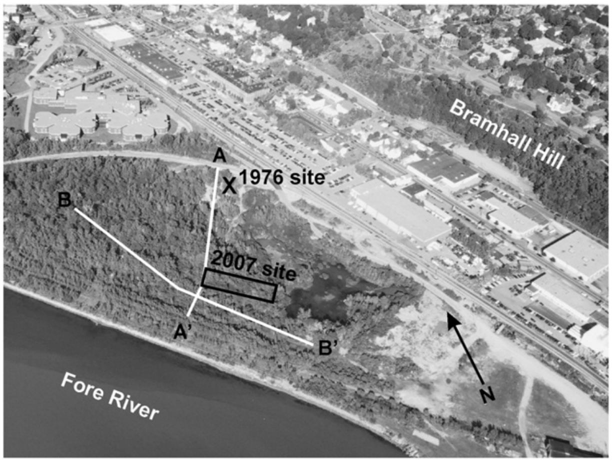

Figure 1. Pre-construction view of the Mercy Hospital property (forested area in foreground) and vicinity, showing locations of the 1976 and 2007 fossil sample sites, geological cross-sections (Fig. 3), and west side of Bramhall Hill.

compare radiocarbon and calibrated ages of coeval marine and terrestrial organics to determine the local marine reservoir effect and assess its impact on previously published deglaciation chronologies for southwestern Maine. Different parts of this paper represent contributions by Thompson, Weddle, Miller, and Griggs (field study), stratigraphy (Thompson and Weddle), paleobotany and paleoecology (Miller and Griggs), dendrochronology (Griggs), paleontology (Thompson and Weddle), and paleoentomology and palynology (Nelson and Kilian).

Methods

Shallow excavations (typically 2–3 m deep) at the Mercy Hospital construction site were examined during the spring of 2007. We recorded the stratigraphy of these exposures and collected samples of tree remains and associated organic materials. Data from the new site were compared with Thompson's unpublished 1976–1984 field notes for the nearby locality where tree remains were discovered in 1976.

We supplemented our observations at the hospital site with photos and other information from Shaw Brothers Construction Inc. and Haley & Aldrich Inc. Their records were used to interpret the stratigraphy in excavations that had been backfilled prior to our visits. We also examined numerous test-boring logs from the study area compiled by Haley & Aldrich, Inc. (2005, 2006).

Figure 2. Desiccated spruce log protruding from marine clay in pit face at the 1976 site. This is specimen no. 3 of Hyland et al. (1978). Exposed part of log was 18–23 cm in diameter and 102 cm long. Shovel blade marks sloping clay/gravel contact.

Paleobotany

Seven samples of organic detritus from the area of exposure (~150 m^2), Thompson locality numbers 07-6 and 07-13, were cleaned in the field and wrapped for transportation to the laboratory where surface area was determined by planimetric measurement of sample outlines traced on graph paper and volume was measured by displacement in water. Samples were disaggregated by hand in deionized water heated overnight. Slurries were washed through a 125-μm sieve aided by a weak jet of tap water, with flow controlled by squeezing the end of the rubber delivery hose. The wet volume of each residue was measured in a graduated funnel-flask. Fossils in the residues were picked, sorted, and identified, using dissecting microscopes. Botanical reference collections at the Biological Survey, New York State Museum were employed in the identification process. Fossil mosses, dissected and mounted in Hoyer's solution on microscope slides, were studied at low and high magnification, using reference samples to aid identification. Samples for plant macrofossil analysis were sieved within a week of collection, and the residues were refrigerated for up to four months during picking. Names of mosses follow Anderson et al. (1990), and those of vascular plants follow Gleason and Cronquist (1991). The plant fossils have been deposited in the Quaternary Paleobotanical Collection of the New York State Museum.

Small (5–10 cm^3) subsamples for pollen analysis were taken in the lab from two macrofossil samples collected by Weddle from different localities. Processing proceeded using standard techniques in a hot water bath (10% KOH for 5 min, washing over a 0.25-mm screen, 48% HF for 1 h, acetolysis for 5 min, followed by fine-washing over a 10-μm sieve to remove fine detritus, and dewatering using ethanol and tertiary-butyl alcohol washes). Residues were mounted on standard microscope slides in silicone oil using 22 × 40-mm cover slips, and counted at 200× magnification in non-overlapping transects; difficult grains were identified at 400× magnification. Percentages were calculated on the basis of the total number of identifiable pollen grains encountered in a count of at least 300 total grains.

Wood and dendrochronology

Griggs and Miller collected samples from tree trunks and branch segments representing at least five different trees at the hospital site, and Griggs studied notes describing one log collected by Thompson at the 1976 site (Log # 7 in Thompson field notes, 28 March 1978). Branch samples of unusual context were also collected. The excavated wood segments were cleaned in the field with a trowel and, for most segments, one or more samples were cut from the ends, choosing the end with the largest diameter. In the laboratory the samples were cleaned with tap water and further cut at the widest point with a band saw. The samples were further cleaned with tap water in the laboratory, microtomed, and the thin sections identified (Panshin and de Zeeuw, 1970); all are spruce (*Picea* sp.). Transverse surfaces of samples with over 50 rings were cut with steel blades for ring-width measurements. Ring-widths were measured on a computer-linked moving table beneath a stereomicroscope with crosshairs. Each series of ring-widths was compared with all others, and a chronology was built from the ring-width series of all tree trunk samples, with patterns matched visually and statistically, using CORINA software (available at http://dendro.cornell.edu/) and the COFECHA 6.06 program (Holmes, 1983). Seven segments of 10–24 yr were selected from across the site chronology for wiggle-matched radiocarbon dating and the corresponding rings were cut from two samples (see "Radiocarbon dating" below). In addition, the average ring width of the first 100 yr of growth in all sampled trees was compared with the average ring width of the first century in the lives of *Picea glauca* trees from other periods across northeastern North America.

Download English Version:

https://daneshyari.com/en/article/1045827

Download Persian Version:

https://daneshyari.com/article/1045827

Daneshyari.com