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Collated by R. McNeely

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CONTENTS

Figures

This Date List, GSC XXXIV, is the twenty-third to be published directly in the Geological Survey of Canada. Lists prior to GSC XII were published first in the journal *Radiocarbon* and were reprinted as GSC Papers. The lists through 1967 (GSC VI) were given new pagination, whereas lists VII to XI (1968 to 1971) were reprinted with the same pagination.

GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES XXXIV

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McNeely, R., 2005: Geological Survey of Canada radiocarbon dates XXXIV; Geological Survey of Canada, Current Research 2005, 113 p.

Abstract: This list presents 533 radiocarbon age determinations: 364 made by the Radiocarbon Dating Laboratory, Geological Survey of Canada and 169 dates done by other laboratories (Alberta Environmental Centre–Vegreville [AECV], Beta Analytic Inc. [Beta], Brock Geological Sciences [BGS], Geochron Laboratories [GX], University of Saskatchewan [S], Simon Fraser University [SFU], and Isotrace Radiocarbon Facility–Toronto [TO]). The distribution of the 529 samples is as follows: Newfoundland (17); Prince Edward Island (7); Nova Scotia (4); New Brunswick (13); Quebec (90); Ontario (8); Manitoba (70); Saskatchewan (1); Alberta (13); British Columbia (240); Yukon Territory (4); Arctic, mainland (25); Arctic Archipelago, Nunavut (24); Arctic Archipelago, Northwest Territories (11); and Washington State, United States (2).

Tables 1 and 2 summarize the background and standard counts for the 2 L and 5 L counters during the period from January 5, 1993, to January 4, 1994. Figures 1 to 4 show the details of the count period.

Résumé: Ce rapport présente les résultats de 533 datations au radiocarbone : 364 effectuées par le laboratoire de datation au radiocarbone de la Commission géologique du Canada et 169 effectuées par d'autres laboratoires (Alberta Environmental Centre,Vegreville [AECV]; Beta Analytic, Inc. [Beta]; Brock Geological Sciences [BGS]; Geochron Laboratories [GX]; Université de la Saskatchewan [S]; Université Simon Fraser [SFU]; Isotrace Radiocarbon Facility, Toronto [TO]). Les échantillons datés, au nombre de 529, proviennent des régions suivantes : Terre-Neuve (17), Île-du-Prince-Édouard (7), Nouvelle-Écosse (4), Nouveau-Brunswick (13), Québec (90), Ontario (8), Manitoba (70), Saskatchewan (1), Alberta (13), Colombie-Britannique (240), Territoire du Yukon (4), Arctique continental (25), archipel Arctique, Nunavut (24), archipel Arctique, Territoires du Nord-Ouest (11), et état de Washington, États-Unis (2).

Les tableaux 1 et 2 résument les taux de comptage obtenus pour le bruit de fond et pour un étalon par les compteurs de 2 L et de 5 L entre le 5 janvier 1993 et le 4 janvier 1994, tandis que les figures 1 à 4 montrent les détails de la période de comptage.

INTRODUCTION

This publication includes all samples that have either been dated more than 2 years ago and not published in a 'date list', or had their descriptions revised since initial publication. The date list in this publication has been compiled by R. McNeely from descriptions of samples and interpretations of age determinations provided by the collectors and submitters. The presentation of dates within each section or subsection of the text is ordered from east to west. All GSC dates, up to and including GSC-5700, are now accessible on a computer database. The 'Date Locator File' provides convenient, fast access to GSC dates by allowing the user to interactively select indexed parameters, such as laboratory number, submitter, locality, material, and age range, to retrieve samples (McNeely, 1988). Supplementary information on this database is available from the Director, Terrain Sciences Division, Geological Survey of Canada.

Several of the geographic names in this report are not included in the federal government's list of formal geographic names; however, these informal names are considered important local landmarks and are included offset by single quotation marks around the name.

Sample gas preparation and purification were carried out as described in Lowdon et al. (1977). Carbon dioxide gas proportional counting techniques have been discussed by Dyck (1967). For a review of laboratory operations, the reader is referred to Lowdon (1985).

During the period from January 1993 through December 1993, both the 2L counter (Dyck and Fyles, 1963) and the 5L counter (Dyck et al., 1965) were operated continuously, except for the month of August, when the count laboratory was closed, and no samples were counted in the 5L counter in October. The 2L counter was operated at 2 atmospheres (atm) throughout this period, and the 5L counter was operated at 1 atm.

On a monthly basis, the counting rates for backgrounds and standards were within statistical limits, except for the 2L background in October and the 5L standard in November. The average background and oxalic acid standard counting rates, and the number of one-day counts used to determine the average, are shown in Tables 1 and 2, respectively. Figures 1 to 4 provide a graphical illustration of the details in the background and standard counts, which show a high degree of variability in the 2L counter and a baseline offset in the 5L counter resulting from electronic instability late in 1993. As indicated on the figures, the count laboratory was closed during August 1993 (Julian day 222 to 250).

Age calculations during the report period were based on a ^{14}C half-life of 5568 ± 30 years and 0.95 of the activity of the NBS oxalic acid standard. Ages are quoted in radiocarbon years before present (BP), where 'present' is taken to be 1950. The error assigned to each age has been calculated using only the counting errors of sample, background, and standard, and the error in the half-life of ^{14}C (Lowdon and Blake, 1973). Nonfinite dates (i.e. greater than ages) are based on a 4σ criterion (99.9% probability), whereas finite dates are based on a 2σ criterion (95.5% probability). All GSC dates are therefore rounded according to the following criteria:

Age (years BP)	Significant figures
0–99	1
100–999	2
1000–9999	3
>10 000	3
nonfinite	2

Table 1. Monthly average count rate for backgrounds and the number of individual counts (N) made during the period January through December 1993.

Month	2L Counter (2 atm) cpm*	(N)	5L Counter (1 or 4 atm) cpm*	(N)
January	1.213 ± 0.025	(3)	2.148 ± 0.033	(3)
February	1.214 ± 0.024	(3)	2.200 ± 0.056	(3)
March	1.214 ± 0.024	(2)	2.176 ± 0.051	(2)
April	1.216 ± 0.035	(4)	2.208 ± 0.053	(4)
May	1.179 ± 0.020	(4)	2.169 ± 0.035	(3)
June	1.227 ± 0.024	(3)	2.197 ± 0.031	(3)
July	1.223 ± 0.023	(4)	2.193 ± 0.027	(4)
August	No count		No count	
September	1.191 ± 0.020	(4)	2.165 ± 0.052	(3)
October	1.266 ± 0.025	(3)	No count	
November	1.246 ± 0.025	(2)	2.229 ± 0.044	(2)
*counts per minute				

Table 2. Monthly average count rate for oxalic acid standards and the number of individual counts (N) made during the period January through December 1993.

Month	2 L Counter (2 atm) cpm*	(N)	5 L Counter (1 or 4 atm) cpm*	(N)
January	18.316 ± 0.104	(2)	28.377 ± 0.182	(1)
February	18.146 ± 0.102	(2)	28.346 ± 0.137	(2)
March	18.297 ± 0.145	(1)	28.307 ± 0.186	(1)
April	18.123 ± 0.108	(2)	28.186 ± 0.139	(2)
May	18.355 ± 0.109	(2)	28.159 ± 0.131	(2)
June	18.146 ± 0.137	(2)	28.117 ± 0.130	(2)
July	18.286 ± 0.110	(2)	28.110 ± 0.129	(2)
August	No count		No count	
September	18.338 ± 0.103	(2)	28.136 ± 0.136	(2)
October	18.088 ± 0.145	(1)	No count	
November	18.110 ± 0.145	(1)	28.572 ± 0.185	(1)
*counts per minute				

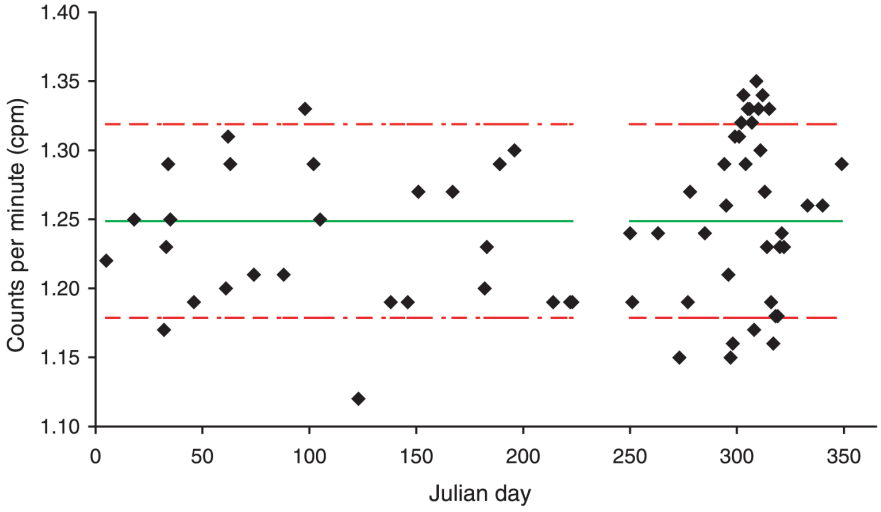


Figure 1.

Background data for the 2L counter (– mean; – . – ± sigma).

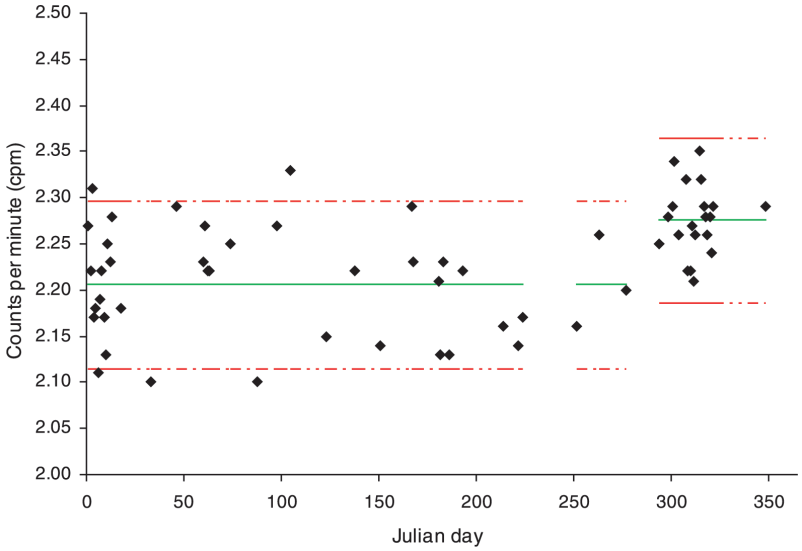


Figure 2.

Background data for the 5L counter (– mean; – . – ± sigma).

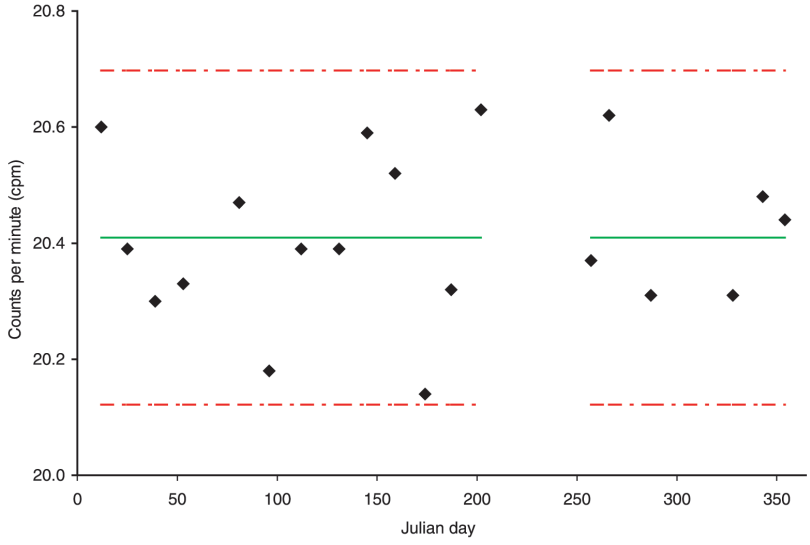


Figure 3.

Oxalic acid standard data for the 2L counter (– mean; – . – ± sigma).

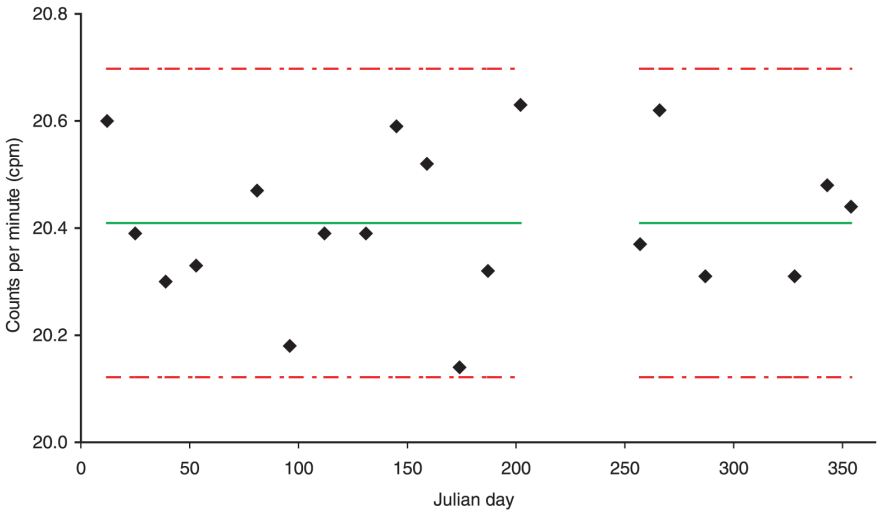


Figure 4.

Oxalic acid standard data for the 5L counter (– mean; – . – ± sigma).

If $^{13}C/^{12}C$ ratios ($\delta^{13}C$) were available, a 'correction' for isotopic fractionation was applied to the sample age, and the $\delta^{13}C$ value reported. For terrestrial and nonmarine organic materials and terrestrial and marine bones, the ages are conventionally normalized to a $\delta^{13}C$ = -25.0‰ PDB, whereas marine shell ages are unconventionally corrected to a $\delta^{13}C$ = 0.0‰ PDB and normalized to a $\delta^{13}C$ = -25.0‰ PDB; freshwater shell ages are not corrected, but normalized to a $\delta^{13}C$ = -25.0‰ PDB. All δ13C determinations were made on aliquots of the sample gas used for age determinations. Since 1989, all $\delta^{13}C$ values have been determined under contract by the Stable Isotope Facility of the Ottawa-Carleton Geoscience Centre (OCGS), Ottawa, Ontario. From 1975 to 1989, the $\delta^{13}C$ values were determined under contract by R.J. Drimmie of the Department of Earth Sciences, University of Waterloo, Waterloo, Ontario, or by Waterloo Isotope Analysts, Inc., Kitchener, Ontario (R.J. Drimmie, chief analyst) using the same equipment as at the University of Waterloo. Prior to that time, some $\delta^{13}C$ determinations were done by the GSC Geochronology Section (R.K. Wanless, Head) and by Teledyne Isotopes, Westwood, New Jersey.

Acknowledgments

Appreciation is expressed to A.M. Telka (1980 to 1986), L.M. Maillé (1986 to 1989, and 1991 to 1993), M. Leflar (1990), I.M. Robertson (1964 to 1989), and J. Brennan (1989 to 1995) for the preparation, purification, and counting of samples in the laboratory. Supervision of laboratory operations has been as follows: W. Dyck (1960 to 1965), J.A. Lowdon (1965 to 1981), and R. McNeely (1981 to present).

Identification of materials used for dating or associated with the dated material has been carried out by the following specialists:

Arthropods (fossil):	J.V. Matthews, Jr. and A.M. Telka
Macrofossils (plant):	J.V. Matthews, Jr. and A.M. Telka
Molluscs:	F.J.E. Wagner, C.G. Rodrigues, and J-M. Gagnon
Vertebrates:	C.R. Harington
Wood:	R.J. Mott, and H. Jetté

The GSC clientele extend their sincere thanks to these individuals.

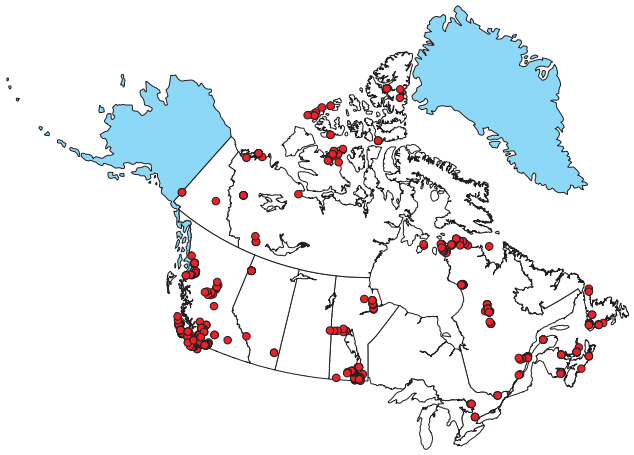


Figure 5. *Radiocarbon-dated sites in Canada.*

EASTERN CANADA

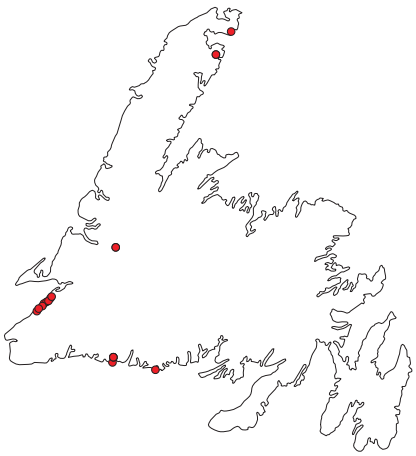


Figure 6. *Radiocarbon-dated sites in Newfoundland.*

Newfoundland

GSC-5253. St. Anthony

normalized age:	6750 ± 100
$\delta^{13}C$:	-26.7‰
uncorrected age:	6770 ± 100

The lake sediment, basal detritus peat, was enclosed in dark grey silty clay below and dark brown gyttja above. Sample AP-85-3 (350–360 cm depth) was collected by T.W. Anderson on July 6, 1985, on the east side of Highway 73, 4.5 km southwest of St. Anthony, Newfoundland (51°20′48″N, 55°38′30″W), at an elevation of 84 m. The sample was submitted by T.W. Anderson to gain information on peat accumulation and deglaciation.

The sample (123.2 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (25.5 g) yielded 6.18 L of CO_2 gas. The age estimate is based on two counts for 2550 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.908 ± 0.064, 1.213 ± 0.021, and 18.379 ± 0.137 cpm, respectively.

Comment (T.W. Anderson): GSC-5253 was on detritus gyttja that overlies grey silty clay. The clay is interpreted to represent marine inundation of the area. The date provides a maximum age for sea level retreat in the St. Anthony area, as the elevation of the lake (84 m) is well below the local marine (postglacial) limit (122 m).

GSC-5241. Tom Roses Pond

normalized age:	8730 ± 80
$\delta^{13}C$:	-26.3‰
uncorrected age:	8750 ± 80

GSC-5241. (2nd count)

normalized age:	8750 ± 80
$\delta^{13}C$:	-26.3‰
uncorrected age:	8770 ± 80

The basal peat was underlain by dark grey sand and stony clay and overlain by peat. Sample AP-85-10 (200 cm depth) was collected by T.W. Anderson on July 15, 1985, from east of Tom Roses Pond, 13 km southeast of Main Brook, Newfoundland (51°05′20″N, 55°54′50″W), at an elevation of about 75 m. The sample was submitted by T.W. Anderson to gain information on peat accumulation and deglaciation.

The sample (100.3 g wet weight) was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (25.4 g) yielded 6.6 L of CO_2 gas. The age estimate for GSC-5241 is based on one count for 3900 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.533 ± 0.061, 2.055 ± 0.028, and 28.334 ± 0.123 cpm, respectively.

Second count (to check the 5L counter replication): The age estimate is based on one count for 3900 minutes in the 5 L counter with a mixing ratio of 1.00. The count rate for the sample (net) and for monthly backgrounds and standards (net) were 9.492 ± 0.066, 2.196 ± 0.038, and 28.279 ± 0.131 cpm, respectively.

Comment (T.W. Anderson): GSC-5241 is a date on basal peat that had started to accumulate during early Holocene warming. The date indicates there may be a time lag of up to 1250 years between the end of the Younger Dryas cool interval (10 000 BP) and onset of peat deposition. Compared with the date of 8000 ± 170 BP (GSC-4333, McNeely and McCuaig, 1991) at the top of the Anguille Mountains, the 8770 ± 80 BP date suggests that the northern high elevations of the Long Range Mountains may have been deglaciated earlier than equivalent elevations to the south.

GSC-5206. Hermitage

normalized age:	10 600 ± 140
$\delta^{13}C$:	-19.1‰
uncorrected age:	10 500 ± 140

The lake sediment, basal gyttja sample AP-82-4A was collected by T.W. Anderson on August 20, 1982, from about 1.5 km south of the town of Hermitage, on the south coast of Newfoundland (47°32′45″N, 56°55′30″W), at an elevation of 3.5 m. The sample was submitted by T.W. Anderson to gain information on deglaciation.

The sample (32.6 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (24.5 g) yielded 3.80 L of CO_2 gas. The age estimate is based on one count for 2515 minutes in the 2 L counter with a mixing ratio of 1.17. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.965 ± 0.062, 1.065 ± 0.026, and 18.277 ± 0.188 cpm, respectively.

Comment (T.W. Anderson): GSC-5206 is a date on a sample from the base of an upper gyttja unit that overlies a downward sequence of banded, grey, silty clay gyttja interspersed with silt and clay bands, to grey, sandy, stony clay at the bottom. A date of 12 600 ± 130 BP (GSC-5008, McNeely and Atkinson, 1996) at the top of the lower gyttja suggests this gyttja unit predates the Younger Dryas cool interval (10 000–11 000 BP). The upper gyttja probably commenced during early Holocene warming. GSC-5206 postdates the Younger Dryas, which is represented by the grey silty clay unit. The date is too old by up to 600 years.

South Brook valley series

GSC-5302. South Brook valley I

normalized age:	13 100 ± 220
$\delta^{13}C$:	-26.3‰
uncorrected age:	13 200 ± 220

The lake sediment, basal gyttja was overlain by banded detritus gyttja, and underlain by grey sandy clay. Sample AP-86-4 (261.5–268 cm depth) was collected by T.W. Anderson on August 11, 1986, from South Brook Valley, 11.5 km south of Pasadena, Newfoundland (48°54′48″N, 57°37′37″W), at an elevation of 111 m. The sample was submitted by T.W. Anderson to gain information on deglaciation and the rate of peat accumulation.

The sample (245.8 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (91.5 g) yielded 5.49 L of CO_2 gas. The age estimate is based on two counts for 2100 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 3.571 ± 0.089, 1.188 ± 0.059, and 18.396 ± 0.155 cpm, respectively.

TO-5707. South Brook valley II

normalized age:	9540 ± 90

The twigs of *Salix* (identified by T.W. Anderson) were overlain by banded detritus gyttja, and underlain by grey sandy clay. This sample (263–265 cm depth) was submitted by T.W. Anderson as a crosscheck. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (T.W. Anderson): The age of GSC-5302 was checked by the accelerator mass spectrometry (AMS) dating of *Salix* twigs, which were extracted from a depth of 263–265 cm in a separate core. The *Salix* twigs yielded a date of 9540 ± 90 BP (TO-5707). GSC-5302 is therefore too old by up to 3560 years, probably because of hard-water error. The AMS date provides an age for isolation of a small lake from an arm of a larger glacial lake that is believed to have occupied the South Brook valley and the present-day Deer Lake basin (Batterson et al., 1983).

'Woody Hill Brook Pond' series

A series of lake sediment samples was collected by T.W. Anderson on August 01, 1989, from a pond, locally known as 'Woody Hill Brook Pond', alongside Highway 480, about 7 km north of Burgeo, Newfoundland (47°40′45″N, 57°37′40″W), at an elevation of 165 m. These samples were submitted by T.W. Anderson to gain information on deglaciation, the pollen spectra, and the rate of sediment accumulation.

GSC-5315. 'Woody Hill Brook Pond' I

normalized age:	8460 ± 120
$\delta^{13}C$:	-26.1‰
uncorrected age:	8480 ± 120

Lake sediment sample AP-89-2D (87–93 cm depth; 80.6 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (15.8 g) yielded 3.82 L of CO_2 gas. The age estimate is based on two counts for 2070 minutes in the 2 L counter with a mixing ratio of 1.18. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 6.360 ± 0.075, 1.288 ± 0.028, and 18.276 ± 0.111 cpm, respectively.

Comment (T.W. Anderson): GSC-5315 falls within a consistent pollen assemblage dominated by *Betula* with lesser amounts of *Picea, Pinus, Myrica, Alnus*, grasses, heaths, sedges, clubmosses and ferns. The sample provides an early Holocene time horizon to compute sedimentation rates and pollen influx.

GSC-5309. 'Woody Hill Brook Pond' II

normalized age:	9720 ± 110
$\delta^{13}C$:	-23.4‰
uncorrected age:	9690 ± 110

Lake sediment sample AP-89-2C (120–122.5 cm depth; 87.4 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (19.9 g) yielded 3.69 L of CO_2 gas. The age estimate is based on one count for 3770 minutes in the 2 L counter with a mixing ratio of 1.21. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.469 ± 0.058, 1.288 ± 0.028, and 18.276 ± 0.111 cpm, respectively.

Comment (T.W. Anderson): GSC-5309 provides an age for a brief, early Holocene cool interval documented by a peak in *Picea* and corresponding decreases in *Pinus* and *Betula*. The sample provides a time horizon to compute sedimentation rates and estimates of pollen influx.

GSC-5281. 'Woody Hill Brook Pond' III

normalized age:	11 900 ± 140
$\delta^{13}C$:	-25.9‰
uncorrected age:	11 900 ± 140

Lake sediment, basal detrital gyttja sample AP-89-2B (167–170 cm depth; 262.6 g wet weight), enclosed in sandy clay, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (89.7 g) yielded 3.16 L of CO_2 gas. The age estimate is based on one count for 3730 minutes in the 2 L counter with a mixing ratio of 1.44. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.095 ± 0.060, 1.216 ± 0.026, and 18.122 ± 0.101 cpm, respectively.

Comment (T.W. Anderson): GSC-5281 dates a stratified detritus gyttja overlying basal sandy clay and an underlying clay deposited during the Younger Dryas. The date falls within a pollen assemblage dominated by shrub pollen of *Salix* and Ericaceae, and herb pollen such as *Oxyria digyna, Artemisia*, grasses and sedges. The pollen assemblage indicates gradual warming since deglaciation. The gyttja sequence and warming trend are interrupted by a clay unit and corresponding brief cold interval, the Killarney Oscillation of Levesque et al. (1993), which is estimated here at 11 200 BP from rates of sedimentation. Post-Killarney Oscillation warming gave way to the Younger Dryas cool interval, dated at 11 100 and 10 400 BP, respectively, at the base and top of the clay unit (Shaw et al., 2000).

GSC-5268. Aaron Arm

normalized age:	9630 ± 150
$\delta^{13}C$:	-25.6‰
uncorrected age:	9640 ± 150

The lake sediment, basal gyttja was underlain by noncalcareous, blue-grey silty clay and overlain by gyttja. Sample AP-89-1 (635–643 cm depth) was collected by T.W. Anderson on July 30, 1989 from 1500 m north of Burgeo, 250 m off the left side of Highway 480 in the widest part of Aaron Arm, Newfoundland (47°37′11″N, 57°38′23″W), at an elevation of 15.6 m. The sample was submitted by T.W. Anderson to gain information on deglaciation and the rate of sediment accumulation.

The sample (133.0 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (21.5 g) yielded 5.27 L of CO_2 gas. The age estimate is based on two counts for 2565 minutes in the 2 L counter with a mixing ratio of 1.00. The count rate for the sample (net) and monthly backgrounds and standards (net) were 5.684 ± 0.058, 1.224 ± 0.025, 18.875 ± 0.273 cpm, respectively.

Comment (T.W. Anderson): GSC-5268 dates a basal gyttja just above banded light grey and blue-grey clay. The clay is interpreted as glacial in origin and was deposited during a period of high sea level. The gyttja represents sediments of a freshwater lake phase in Aaron Arm. This lake came into existence when sea level lowered and the lake was isolated as a separate basin above the sill connection to Cabot Strait. This freshwater lake existed in the area until well into the late Holocene.

Southwestern Newfoundland series

TO-7454. Middle Brook

normalized age:	13 480 ± 110

Marine shell sample DL-8001-98112 (*Mya*, identified by D. Liverman), enclosed in clay, was collected by D. Liverman on July 04, 1998 from Middle Brook, St. George's Bay, Newfoundland (48.34°N, 58.69°W), at an elevation of 10 to 12 m. The age was normalized to $\delta^{13}C$ = -25‰. This sample was submitted by T. Bell to gain information on deglaciation and sea level change.

Beta-120125. Butter Brook

normalized age:	13 880 ± 80
$\delta^{13}C$:	0.0‰

Marine shell sample KS-8521, enclosed in silt and clay, was collected by K. Sheppard from Butter Brook, St. George's Bay, Newfoundland (48.17°N, 58.93°W), at an elevation of 10 m. The age was normalized to $\delta^{13}C$ = -25‰. This sample was submitted by T. Bell to gain information on deglaciation and sea level change.

TO-7453. Maidstone

normalized age:	13 930 ± 110

Marine shell sample KS-8537-575 (*Hiatella* or *Mya*, identified by T. Bell), enclosed in sandy silt and clay, was collected by K. Sheppard on August 26, 1998 from Maidstone, St. George's Bay, Newfoundland (48.2°N, 58.9°W), at an elevation of 10 m. The age was normalized to $\delta^{13}C$ = -25‰. This sample was submitted by T. Bell to gain information on deglaciation and sea level change.

GSC-6024. Red Brook

normalized age:	14 000 ± 170
corrected age:	13 600 ± 170
$\delta^{13}C$:	0.0‰
uncorrected age:	13 600 ± 170

Marine shell sample RH-06-S-9506 (*Hiatella arctica*, identified by J. Maunder), from a surface collection on silty clay, was collected by T. Bell and D. Liverman on July 6, 1995 from a coastal cliff section around the mouth of Red Brook, 1 km southwest of Heatherton, St. George's Bay, southwest Newfoundland (48°16.7′N, 58°46.3′W), at an elevation of 16 to 19 m. The sample was submitted by T. Bell to gain information on deglaciation and sea level change.

The sample (18.8 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (14.9 g) yielded 3.1 L of CO_2 gas. The age estimate is based on one count for 3750 minutes in the 2 L counter with a mixing ratio of 1.32. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 3.324 ± 0.057, 1.349 ± 0.029, and 18.151 ± 0.150 cpm, respectively.

TO-7455. Fischells

normalized age: 14 020 ± 110

Marine shell sample DL-8009-98172 (*Mya* or *Hiatella*, identified by D. Liverman), enclosed in silty clay, was collected by D. Liverman and D. O'Dell on July 20, 1998 from Fischells, St. George's Bay, Newfoundland (48.32°N, 58.71°W), at an elevation of 15 m. The age was normalized to $\delta^{13}C$ = -25‰. This sample was submitted by T. Bell to gain information on deglaciation and sea level change.

TO-4356. Rattling Brook

normalized age: 14 380 ± 100

Marine shell sample JOURNOIS 1, was enclosed in clay, was collected by D. Liverman and R. Boger on August 15, 1993 from Rattling Brook, Journois, St. George's Bay, Newfoundland (48.29°N, 58.74°W), at an elevation of 10 m. This sample was submitted by D. Liverman to gain information on deglaciation and sea level change. The age was normalized to $\delta^{13}C$ = -25‰.

TO-5717. Jeffrey's

normalized age: 14 330 ± 90

Marine shell sample RH-05-S-9505 (*Portlandia arctica*, identified by D. Maunder), enclosed in clay and silty clay, was collected by T. Bell and D. Liverman on July 05, 1995 from Jeffrey's, St. George's Bay, Newfoundland (48.23°N, 58.84°W), at an elevation of 22 m. The age was normalized to $\delta^{13}C$ = -25‰. This sample was submitted by T. Bell to gain information on deglaciation and sea level change.

Comment (T. Bell): Mud directly overlies basal diamicton and forms a more or less continuous unit, between 1 and 15 m thick, along the coastal exposure of southern St. George's Bay, southwestern Newfoundland. It varies from structureless to rhythmically laminated, moderately to well sorted, silty clay and clayey silt and, in places, is interlaminated with thin beds of very fine sand. Dropstones are very rare. The mud is commonly fossiliferous, with a variety of species including *Hiatella arctica, Portlandia arctica, Macoma calcarea, Mya pseudoarenaria*, and *Balanus* (sp). Twelve shell samples, one of which is GSC-6024, have provided radiocarbon dates ranging between 14 and 13 ka BP. The other samples yielded the following dates: 13 970 ± 100 (TO-4356); 13 920 ± 120 (TO-5717); 13 700 ± 120 (GSC-5700); 13 610 ± 110 (TO-7455); 13 600 ± 190 (GSC-4270); 13 520 ± 110 (TO-7453); 13 500 ± 210 (GSC-1200); 13 500 ± 120 (GSC-4685); 13 470 ± 120 (Beta-120125); 13 420 ± 190 (GSC-598); 13 070 ± 110 (TO-7454).

A sharp, conformable contact between the basal diamicton and the mud suggests an overlap relationship, in which sudden marine inundation and onset of deep-water conditions occurred upon retreat of a glacier grounded in deep water in St. George's Bay. Rare dropstones suggest limited iceberg rafting in the area. Laminated and massive mud deposits resulted from suspension-settling from overflow plumes generated by meltwater discharge from the nearby ice margin. The faunal assemblages closely resemble the mature *Portlandia* association that is found in association with sediments deposited distal to a retreating ice margin, where sedimentation rates are moderate. Radiocarbon dates on marine shells from the mud provide minimum estimates on the timing of deglaciation (cf. Bell et al., 2001); they range from 13 to 14 ka BP along roughly 40 km of coastline. The 1000-year range suggests that ice terminus fluctuations were locally nonsynchronous and likely determined by ice-marginal conditions (e.g. sediment supply and accumulation, bedrock topography).

GSC-5700. Robinsons Head

normalized age: 14 100 ± 120
corrected age: 13 700 ± 120
$\delta^{13}C$: +1.40‰
uncorrected age: 13 600 ± 120

Marine shell sample DL-93-RH1 (*Hiatella arctica*, identified by S. Scott), enclosed in massive silty clay, was collected by D. Liverman on August 14, 1993 from 200 m south of Robinsons Head, 1.2 km north-northeast of the Highway 63 bridge across the Robinsons River, Robinsons, Newfoundland (48°15.55′N, 58°48.87′W), at an elevation of 12 m. The sample was submitted by D. Liverman to gain information on deglaciation and sea level change.

The sample (39.8 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (31.6 g) yielded 7.19 L of CO_2 gas. The age estimate is based on one count for 3910 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.147 ± 0.052, 2.258 ± 0.029, and 28.094 ± 0.130 cpm, respectively.

Comment (D. Liverman): At Robinsons Head, there is intermittent exposure over 1.5 km of coastal cliffs, as well as further exposure along the cliffs south of Robinsons Head. The transect logged by Brookes (1974) is located at the northern end of the coastal cliff. This, and a further section at the

southern margin of the Robinsons Head ridge was described in detail, and the entire exposure examined on a reconnaissance scale. The northern transect shows bedrock at the base, overlain by a compact diamicton. This is in turn overlain by a loose diamicton or pebbly mud with clasts up to 1 m diameter, and then moderately sorted planar-bedded pebble gravel. A 1 m bed of silty clay containing shells (*Hiatella arctica*) is overlain by 1 to 2.5 m of silty sand with rare fossils, and capped by interbedded planar-bedded sand, pebble gravel and cobble gravel, dipping eastward (into the cliff) at approximately 10°.

The southern transect differs from the northern one in several respects. The basal diamicton (directly overlying bedrock) is fossiliferous, contains sand laminae, and has a weak to unoriented clast fabric (two measurements). This is overlain by a thick sequence of interbedded sand, silt and silty clay, generally well sorted. Shells (*Hiatella arctica*) were recovered from a silty clay bed directly overlying the basal diamicton at 12 m a.s.l., and were the subject of this date. The sediments become generally sandier vertically, and show considerable deformation throughout. Faulting, injection structures, and folding and flame structures are commonly seen. The top of this 25 m sequence of finer sediment shows an interbedded contact with gravel. The gravel is dominantly planar bedded, and coarsens upwards from mostly pebble gravel to cobble gravel over 15 m. The uppermost gravel is deformed, with some beds that dip at up to 60°, mostly to the southeast.

Examination of the sediments between the two transects suggests that the southernmost transect is more typical of the section as a whole. Lenses of gravel are found within the thick deformed sand to the north of the described transect, mud is found overlying the basal diamicton, and the coarse upper gravel thickens toward the centre of the exposure. A lateral grain-size transition occurs between the centre of the exposure and the northern transect, with sand being replaced by sandy gravel and gravel, with interbeds of diamicton at the base.

The sediments here suggested deposition close to an ice margin in an outwash fan. No evidence was seen of well developed foresets indicating a delta, and the similarity of dates from shells directly overlying the basal diamicton at 12 m a.s.l. (this date) and material recovered at over 30 m a.s.l. (GSC-1200; 13 500 ± 210) indicate the entire sequence was deposited rapidly. The height of Robinsons Head, well above known sea levels in the area, indicates that the fan built up to well above sea level. The deformation of the upper part of the sequence suggests that the fan was deposited against ice, and subsequent melting caused collapse (see Liverman and Bell, 1996; Bell et al., 1999; Sheppard et al., 2000; Bell et al., 2001).

Prince Edward Island

Figure 7. *Radiocarbon-dated sites in Prince Edward Island.*

Central St. Peters Bay series

A series of shell and peat samples was collected by H. Josenhans on February 08, 2000 from a depth of 12 m in central St. Peters Bay, Prince Edward Island (46.42485°N, 62.62043°W). These samples were submitted by H. Josenhans to gain information on sea level change.

Beta-143105. Central St. Peters Bay I

normalized age:	3990 ± 50
$\delta^{13}C$:	-2.8‰
uncorrected age:	3630 ± 50

Marine shell sample 99-700-01 (160 cm depth) was enclosed in marine silt. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-6468. Central St. Peters Bay II

normalized age:	4090 ± 90
$\delta^{13}C$:	-28.2‰
uncorrected age:	4150 ± 90

Peat sample 99-700-01 (170–173 cm depth; 28.1 g wet weight), with a soil horizon above and marine silt below, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (3.7 g) yielded 1.7 L of CO_2 gas. The age estimate is based on one count for 4940 minutes in the 2 L counter with a mixing ratio of 2.38. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.706 ± 0.094, 1.120 ± 0.021, and 17.939 ± 0.098 cpm, respectively.

Eastern St. Peters Bay series

A series of marine shell and wood samples was collected by H. Josenhans on February 08, 2000, from a depth of 5.48 m in eastern St. Peters Bay, Prince Edward Island (46.42586°N, 62.62034°W). These samples were submitted by H. Josenhans to gain information on sea level change.

Beta-143107. Eastern St. Peters Bay I

normalized age:	2270 ± 40
$\delta^{13}C$:	-0.5‰
uncorrected age:	1870 ± 40

Marine shell sample 99-700-02 (140–144 cm depth) was enclosed in marine silt. The age was normalized to $\delta^{13}C$ = -25‰.

Beta-143106. Eastern St. Peters Bay II

normalized age:	3950 ± 40
$\delta^{13}C$:	-3.9‰
uncorrected age:	3610 ± 40

Marine shell sample 99-700-02 (203–205 cm depth) was enclosed in marine silt. The age was normalized to $\delta^{13}C$ = -25‰.

Beta-142248. Eastern St. Peters Bay III

normalized age:	3990 ± 60
$\delta^{13}C$:	-25.0‰
uncorrected age:	3990 ± 60

Wood sample 99-700-02 (258–259 cm depth) was enclosed in marine silt. The age was normalized to $\delta^{13}C$ = -25‰.

Beta-143108. St. Peters Bay

normalized age:	4000 ± 40
$\delta^{13}C$:	-2.8‰
uncorrected age:	3640 ± 40

Marine shell sample 99-700-03 (160–161 cm depth), enclosed in marine silt, was collected by H. Josenhans on February 08, 2000 from a depth of 6.67 m in central St. Peters Bay, Prince Edward Island (46.42744°N, 62.63277°W). This sample was submitted by H. Josenhans to gain information on sea level change. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (H. Josenhans): These samples define the rate of marine sedimentation within St. Peters Bay and the age of terrestrial conditions when sea level was below the (13 m) sill at the entrance to St. Peters Bay. The dates indicate that marine conditions inundated this former river valley sometime between 3990 ± 60 (normalized age) and 3950 ± 40 (normalized age). This implies that the former shoreline must have been seaward of the present 13 m contour, which is located about 1 km from the present coast. A paleochannel extending from St. Peters Bay suggests the river that drained St. Peters Bay before 3990 extended further seaward to at least 30 m depth.

GSC-6497. Greenwich

normalized age:	9940 ± 110
corrected age:	9540 ± 110
$\delta^{13}C$:	+0.38‰
uncorrected age:	9540 ± 110

The mixed collection of marine shell fragments (*see* analysis below) was on an unconformity on proglacial sediments and overlain by transgressive sand deposits. Sample Hudson 2000-030-0-12 was collected by H. Josenhans on July 27, 2000, from 30 km north of Greenwich, in a 132 m deep basin in the Gulf of St. Lawrence, situated about halfway between Prince Edward Island and Îles-de-la-Madeleine, Quebec (46°43′49″N, 62°00′91″W), at a depth of 132m. The sample was submitted by H. Josenhans to gain information on sea level change, specifically the 80 m RSL (relative sea level) related to submergence.

The sample (23.4 g dry weight) was treated with an acid leach to remove the outer 10%. The treated sample (19.9 g) yielded 3.9 L of CO_2 gas. The age estimate is based on one count for 2285 minutes in the 2 L counter with a mixing ratio of 1.03. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.457 ± 0.060, 1.138 ± 0.025, and 17.890 ± 0.105 cpm, respectively.

Comment (H. Josenhans): The ^{14}C age on this mixed assemblage of shell hash (as described below), which includes intertidal to brackish shell fragments, represents a time when this area was a shallow embayment or estuarine environment. This implies that sea level must have been at or below the sill height (approximately 70 m) of this embayment (isolation basin) and indicates that sea level was low enough over this part of the Magdalen plateau to expose vast areas of land and provide an almost continuous land bridge from New Brunswick to Îles-de-la-Madeleine. It would be sensible to specifically date the intertidal barnacle fragments to establish a precise age for the low-sea level interval.

Analysis of shell 'hash' from core Hudson 2000-030C-12

David Black, Department of Anthropology, University of New Brunswick

Material

The sample consisted of about 55.3 g of marine shell fragments and mineral particles from a core taken 30 km north of Greenwich, Prince Edward Island, in a water depth of 132 m.

Purpose of analysis

To sort the marine shell fragments and to identify the shellfish species represented in the sample.

Methods

The sample was separated into two fractions by screening it using a 1.5 mm plastic mesh. The material that remained on the mesh is referred to as the coarse fraction

(>1.5 mm); the material that passed through the mesh is referred to as the fine fraction (1.5 mm). All of the coarse fraction was examined and sorted using a binocular microscope at 10X magnification, and an unsorted portion of the fine fraction was examined at 10X magnification. Most of the analysis presented below is based on the coarse fraction.

Fractions

Total weight of sample:	55.3 g
Coarse fraction (>1.5 mm):	21.7 g
Fine fraction (1.5 mm):	33.6 g

Analysis of coarse fraction

Material	Amount (g)	Proportion (%)
Echinoid shell	7.3	33.6
Barnacle shell	5.6	25.8
Bivalve clam shell	5.5	25.3
Bivalve mussel shell	0.3	1.0
Mineral particles	0.0	13.8
Unidentified material	trace	-
Totals	21.7	99.5

Shellfish species identifications

Material	Taxonomic identification	Common name
Echinoid shell	Echinarachnius parma (Lamarck)	Common sand dollar
Barnacle shell	Balanus balanus (Linnaeus)	Northern ridged barnacl
Bivalve clam shell	Mya arenaria (Linnaeus)	Soft-shelled clam
Bivalve mussel shell	Mytilus edulis (Linnaeus)	Blue mussel (tentative identification)

Interpretation

These species are consistent with a low intertidal zone or shallow water, sandy substrate habitat.

Detailed descriptions of materials

Coarse fraction

Mineral particles: The mineral particles are angular to subrounded; the largest is 0.5 cm in length. There are some reddish-coloured aggregates of cemented mineral particles; the largest is 0.8 cm in length.

Echinoid shell: Echinoid shell has a porous, granular-looking structure that can readily be distinguished from the lamellar and fibrous structures of bivalve molluscs. Echinoid shell is structurally weaker and, as a result, the pieces in the sample have been more affected by abrasion than the bivalve mollusc shell described below. Most pieces are bleached white, but some are stained a bright reddish-orange colour. All of the echinoid shell in the sample is consistent with that of the common sand dollar, *Echinarachnius parma.* This species lives on sandy substrates from the lower intertidal zone to 165 m depth.

Barnacle shell: The barnacle shell is generally well preserved, but all of the barnacles are fragmented. The pieces are bleached on the outside, but many retain an ashy purple-grey colour in the interior. The largest piece of barnacle shell is 1.2 cm long. The largest individual barnacle with both the base and the rostrum preserved has a height of 0.5 cm. Barnacle shell is difficult to identify to species because of wide variations in form among individuals of the same species. I can confidently identify *Balanus balanus* in this sample, and I believe most of the barnacle shell is consistent with this species. However, I also saw several pieces that are consistent with *Balanus crenatus* (Bruguière), and a few pieces are more consistent with *Balanus balanoides* (Linnaeus). *B. balanus* attaches itself to stones and shells from the lower intertidal zone to 165 m depth. *B. crenatus* attaches itself to overhanging rocks and shells from low water to 90 m depth. *B. balinoides* is an intertidal species.

Bivalve clam shell: The largest piece of bivalve clam shell (1.6 cm length; 1.0 g) is a portion of the apex and chondrophore of a soft-shelled clam, *Mya arenaria*. The other large pieces of bivalve clam shell, which exhibit broad growth bands and traces of brownish periostrachum, also are consistent with this species. *M. arenaria* burrows in sand, mud and gravel substrates from the intertidal zone to 75 m depth. The smaller pieces of bivalve clam shell mostly are bleached to a chalky white. A few pieces are bleached on the exterior surfaces, but retain waxy translucent grey interiors. Some of the latter, including the chondrophore, are riddled with sinuous tunnels. These may result from the dead shell(s) being colonized by a sponge such as *Cliona celata* (Grant), which occurs from the intertidal zone to 40 m depth, that excavates tunnels into calcareous materials.

Bivalve mussel shell: This material consists of 3 small pieces of prismatic shell and 4 pieces of nacreous shell. The prismatic shell pieces retain some mauve-blue colouring; these are more consistent with the blue mussel, *Mytilus edulis*, than with other mussel species in the area. The blue mussel is an intertidal and shallow water species that attaches itself in holdfasts to sand, gravel and rocks.

Unidentified material: A small coiled fragment of white organic-looking material was found. It may represent part of a marine worm.

Fine fraction

Most of this fraction is composed of fine mineral particles. All of the shell fragments examined in it are consistent with species identified in the coarse fraction. Barnacle tergae and scutae were observed in the fine fraction, but not in the coarse fraction. A few small pieces of leathery looking, dark brown organic material probably are fragments of shellfish periostrachum, perhaps from soft-shelled clams or mussels.

Nova Scotia

Figure 8. *Radiocarbon-dated sites in Nova Scotia.*

Ragged Head barrier series

A series of peat samples was collected by J. Shaw and S. Jennings on September 06, 1991 from Ragged Head barrier on the north shore of Chedabucto Bay, 7 km northeast of Guysborough, Nova Scotia (45°25.24′N, 61°23.29′W), at an elevation of 1 m. These samples were submitted by J. Shaw to gain information on spit development, specifically to date the Ragged Head barrier complex in Chedabucto Bay.

GSC-5426. Ragged Head barrier I

age:	modern
$\delta^{13}C$:	-25.30‰

Peat sample RHPS-1-15-17 (211.0 g wet weight), enclosed in peat and gravel, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (16.0 g) yielded 6.04 L of CO_2 gas. The age estimate is based on two counts for 2015 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 19.388 ± 0.104, 1.209 ± 0.024, and 18.316 ± 0.145 cpm, respectively.

Comment (J. Shaw): The sample was taken in an attempt to date the Ragged Head barrier complex in Chedabucto Bay. This sample was from a depth of 15 to 17 cm in organic material 33 cm thick overlying coarse gravel. The organic horizon contained gravel horizons at 2 to 8 cm and 17 to 22 cm. The site is on the lagoon side of a series of prograded beach ridges.

See TO-3171 for additional comments.

GSC-5438. Ragged Head barrier II

age:	modern
$\delta^{13}C$:	-25.8‰
uncorrected age:	20 ± 70

Basal peat sample RHPS-1-31-33 (360.60 g wet weight), enclosed in peat and gravel, was treated with hot base, hot acid, and distilled water rinses (slightly calcareous). The treated sample (24.1 g) yielded 8.2 L of CO_2 gas. The age estimate is based on one count for 1000 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.956 ± 0.175, 2.111 ± 0.026, and 28.013 ± 0.180 cpm, respectively.

Comment (J. Shaw): The sample was taken in an attempt to date the Ragged Head barrier complex in Chedabucto Bay. This sample was from the basal 2 cm of organic material 33 cm thick overlying coarse gravel. The organic horizon contained gravel horizons at 2 to 8 cm and 17 to 22 cm. The site is on the lagoon side of a series of prograded beach ridges.

See TO-3171 for additional comments.

TO-1371. Ragged Head barrier III

normalized age:	1470 ± 50

Clayey peat sample RHPS-1-179-181 (211.0 g wet weight), enclosed in and overlain by an organic-rich clay, was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (16.0 g) yielded 6.04 L of CO_2 gas. The age estimate is based on two counts for 2015 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 19.388 ± 0.104, 1.209 ± 0.024, and 18.316 ± 0.145 cpm, respectively.

Comment (J. Shaw): These samples were taken in an attempt to date the Ragged Head barrier complex in Chedabucto Bay. The site is on the lagoon side of a series of prograded beach ridges. In the swamp, organic-rich clay overlies a peat layer (162–181 cm). This sample was from a depth of 179 to 181 cm in clayey peat. Examination of the airphotos of the Ragged Head barrier complex suggests that the gravel deposits at this site are relatively recent, and formed after migration of a tidal inlet toward the southeast. A radiocarbon date from a swampy depression immediately behind the eastern end of the Ragged Head barrier shows that the barrier probably became established about 1.5 ka.

GSC-5560. Cape Antrim

normalized age:	590 ± 60
$\delta^{13}C$:	-25.9‰
uncorrected age:	600 ± 60

Wood sample 92/1/Antrim (*Abies*, identified by H. Jetté in unpublished GSC Wood Report 93-25), enclosed in peat, was collected by S. Jennings on August 3, 1992 from Cape Antrim at the western entrance to Chezzetcook Inlet, 1.6 km southeast of Grand Desert and 1.6 km northeast of Seaforth, Halifax County, Nova Scotia (44°41′N, 63°14′W), at an elevation of 0 m. The sample was submitted by J. Shaw to gain information on rates of coastal change.

The sample (13.5 g dry weight) was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (8.8 g) yielded 8.4 L of CO_2 gas. The age estimate is based on two counts for 2145 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 26.141 ± 0.127, 2.208 ± 0.053, and 28.186 ± 0.139 cpm, respectively.

Comment (J. Shaw): The wood was in growth position, and was embedded in 20 cm of peat overlying till, together with other tree and shrub remains. This indicates a freshwater to brackish environment behind a barrier attached to Cape Antrim, at a period when relative sea level was approximately 1.5 m lower than today. Thus, the tree grew just above the former high-tide level. The barrier has migrated landward, exposing the peat and wood on the foreshore.

New Brunswick

Figure 9. *Radiocarbon-dated sites in New Brunswick.*

'Lowell Lake' series

A series of lake sediment samples was collected by D.J. Rawlence on June 19, 1992 from 'Lowell Lake', Saint John County, New Brunswick (45°19′01″N, 66°03′33″W). These samples were submitted by D.J. Rawlence to gain information on the rate of organic accumulation and deglaciation.

GSC-5606. 'Lowell Lake' I

normalized age:	3550 ± 110
$\delta^{13}C$:	-26.8‰
uncorrected age:	3580 ± 110

Lake sediment gyttja sample 'Lowell Lake' Core E (107.5–111.5 cm depth; 38.9 g wet weight), enclosed in gyttja, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (4.9 g) yielded 1.65 L of CO_2 gas. The age estimate is based on two counts for 2100 minutes in the 2 L counter with a mixing ratio of 2.61. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.715 ± 0.149, 1.223 ± 0.023, and 18.286 ± 0.110 cpm, respectively.

GSC-5605. 'Lowell Lake' II

normalized age:	11 000 ± 190
$\delta^{13}C$:	-23.8‰
uncorrected age:	11 000 ± 190

Basal lake sediment gyttja sample 'Lowell Lake' Core E (256–260 cm depth; 48.5 g wet weight), enclosed in gyttja, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment omitted. The treated sample (8.2 g) yielded 1.79 L of CO_2 gas. The age estimate is based on one count for 2390 minutes in the 2 L counter with a mixing ratio of 2.44. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.674 ± 0.104, 1.223 ± 0.023, and 18.286 ± 0.110 cpm, respectively.

Crescent Lake series

A series of lake sediment samples was collected by D.J. Rawlence on May 20, 1992 from Crescent Lake, Saint John County, New Brunswick (45°18′30″N, 66°04′32″W), at an elevation of about 55 m. These samples were submitted by D.J. Rawlence to gain information on deglaciation and the interrelationship between biotic parameters.

GSC-5601. Crescent Lake I

normalized age:	3330 ± 140
$\delta^{13}C$:	-28.0‰
uncorrected age:	3370 ± 140

Lake sediment gyttja sample 'Crescent Lake Core A (83.5–87.5 cm)' (23.3 g wet weight), enclosed in gyttja, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment omitted. The treated sample (3.0 g) yielded 1.2 L of CO_2 gas. The age estimate is based on two counts for 2295 minutes in the 2 L counter with a mixing ratio of 3.64. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.922 ± 0.183, 1.227 ± 0.024, and 18.146 ± 0.137 cpm, respectively.

GSC-5599. Crescent Lake II

normalized age:	11 000 ± 190
$\delta^{13}C$:	-27.5‰
uncorrected age:	11 000 ± 190

Lake sediment basal gyttja sample 'Crescent Lake, Core A (223–227 cm)' (44.3 g wet weight), enclosed in gyttja, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (9.8 g) yielded 1.7 L of CO_2 gas. The age estimate is based on one count for 3900 minutes in the 2 L counter with a mixing ratio of 2.65. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.608 ± 0.097, 1.227 ± 0.024, and 18.146 ± 0.137 cpm, respectively.

Comment (R.J. Mott): These cores were taken from Crescent Lake for preliminary studies of diatoms and the relationship between diatom content and organic carbon and pigment analysis. Carbonate in the sediments of the area raises the possibility that the date is anomalous due to hardwater error. Another site nearby, however, has reliable dates older than 11 ka BP and evidence of a late-glacial climatic oscillation correlated with the Younger Dryas that is recorded throughout the Maritimes (Levesque et al., 1993).

Harrigan Lake series

A series of lake sediment samples was collected by A. McAslan, H. Black and D.J. Rawlence on August 15, 1989 from Harrigan Lake, 'Rockwood Park', 5 km southeast of Saint John, Saint John County, New Brunswick (45°19′N, 66°4′W), at an elevation of 51 m. These samples were submitted by D.J. Rawlence to gain information on sediment accumulation rates related to human settlement, land use, and fire frequency.

GSC-5005. Harrigan Lake I

normalized age:	2120 ± 100
$\delta^{13}C$:	-30.8‰
uncorrected age:	2210 ± 100

Lake sediment sample 'H.L.C.1; S.1 215–220cm' (98.8 g wet weight), enclosed in lake sediment mud, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (5.9 g) yielded 2.56 L of CO_2 gas. The age estimate is based on three counts for 3000 minutes in the 2 L counter with a mixing ratio of 1.74. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.669 ± 0.152, 1.013 ± 0.027, and 18.000 ± 0.102 cpm, respectively.

GSC-5007. Harrigan Lake II

normalized age:	4410 ± 100
$\delta^{13}C$:	-34.2‰
uncorrected age:	4560 ± 100

Lake sediment sample 'H.L.C.1; S.2 397–402.5cm' (95.0 g wet weight), enclosed in mud and clay, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (5.3 g) yielded 3.02 L of CO_2 gas. The age estimate is based on two counts for 2000 minutes in the 2 L counter with a mixing ratio of 1.48. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.208 ± 0.101, 1.013 ± 0.027, and 18.000 ± 0.102 cpm, respectively.

GSC-5009. Harrigan Lake III

normalized age:	10 800 ± 130
$\delta^{13}C$:	-33.3‰
uncorrected age:	11 000 ± 130

Lake sediment sample 'H.L.C.1; S.3 670–675cm' (98.0 g wet weight), enclosed in mud and clay, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (10.5 g) yielded 4.83 L of CO_2 gas. The age estimate is based on two counts for 2000 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.605 ± 0.060, 1.013 ± 0.027, and 18.000 ± 0.102 cpm, respectively.

GSC-5011. Harrigan Lake IV

normalized age:	11 700 ± 120
$\delta^{13}C$:	-30.0‰
uncorrected age:	11 800 ± 120

Lake sediment sample 'H.L.C.1; S.4 700–705cm' (89.7 g wet weight), enclosed in mud, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (13.7 g) yielded 3.85 L of CO_2 gas. The age estimate is based on one count for 3900 minutes in the 2 L counter with a mixing ratio of 1.16. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.160 ± 0.051, 1.013 ± 0.027, and 18.000 ± 0.102 cpm, respectively.

Comment (R.J. Mott): Organic carbon content and preliminary diatom and pigment analysis (McAslan and Rawlence, 1991) suggest that the basal sediments record the pre–Younger Dryas warm interval and the Younger Dryas cold interval. Holocene fluctuations in diatoms and pigments may reflect

vegetation changes in the lake catchment or climate changes in the region. The ages 11 700 and 10 800 years BP, however, are somewhat anomalous compared to numerous other ages for these events in the region (Mayle et al., 1993). Carbonate in the bedrock and glacial sediments in the area, as well as carbonate indicators in the lake itself, raise the possibility that the dates are anomalous due to hard water error.

GSC-5013. Connors Lake

normalized age:	5180 ± 70
$\delta^{13}C$:	-29.0‰
uncorrected age:	5250 ± 70

The lake sediment was enclosed in mud. Sample C.L. S1 was collected by R.J. Mott and D.J. Rawlence in August 1986 from Connors Lake, 1 km south of Highway 1, 5 km northwest of Lorneville and 2 km southwest of Ludgate Lake, Saint John County, New Brunswick (45°11′N, 66°14′W), at an elevation of 70 m. The sample was submitted by D.J. Rawlence to gain information on sediment accumulation rates, and related organic carbon, diatoms and plant pigments.

The sample (55.0 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (14.8 g) yielded 6.69 L of CO_2 gas. The age estimate is based on two counts for 2000 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 14.741 ± 0.095, 2.095 ± 0.026, and 28.326 ± 0.128 cpm, respectively.

Comment (R.J. Mott): The complete organic sediment sequence could not be recovered with the Hiller Sampler. Subsamples were taken at 5 cm intervals to a depth of 550 cm for diatom and pigment analyses. A 2 m core was also recovered for analysis. A bulk organic sediment sample from about 550 cm depth below the mud/water interface was used for dating.

Kouchibouguac National Park series

A series of peat and wood samples was collected by A. Poulin in August 1991 from Kouchibouguac National Park, halfway between Sapin Point and Rivière au Portage, New Brunswick (46°56′N, 64°52′W), at an elevation of 0 to 15 m. These samples were submitted by A. Poulin to gain information on dune development and stabilization, and peat development.

GSC-5338. Kouchibouguac National Park I

normalized age:	40 ± 60
$\delta^{13}C$:	-25.9‰
uncorrected age:	50 ± 60

Peat sample 3-K 1991 (81.8 g wet weight), enclosed in peat, was treated with cold base, hot acid (slightly calcareous), and distilled water rinses. The treated sample (8.3 g) yielded 7.42 L of CO_2 gas. The age estimate is based on one count for 3285 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 28.186 ± 0.102, 2.231 ± 0.034, and 28.364 ± 0.176 cpm, respectively.

GSC-5326. Kouchibouguac National Park II

normalized age:	360 ± 50
$\delta^{13}C$:	-25.6‰
uncorrected age:	370 ± 50

Wood sample W 2-K 1991 (18.6 g dry weight; *Larix*, identified by H. Jetté in unpublished GSC Wood Report 91-84), enclosed in dune sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (16.4 g) yielded 8.01 L of CO_2 gas. The age estimate is based on two counts for 2000 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 26.941 ± 0.124, 2.107 ± 0.027, and 28.215 ± 0.129 cpm, respectively.

GSC-5371. Kouchibouguac National Park III

normalized age:	390 ± 70
$\delta^{13}C$:	-24.9‰
uncorrected age:	380 ± 70

Organic peat sample 2-K 1991 (106.4 g wet weight), enclosed in peat, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.7 g) yielded 6.04 L of CO_2 gas. The age estimate is based on two counts for 2020 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.220 ± 0.099, 1.246 ± 0.024, and 18.063 ± 0.123 cpm, respectively.

GSC-5324. Kouchibouguac National Park IV

normalized age:	1200 ± 50
$\delta^{13}C$:	-25.3‰
uncorrected age:	1210 ± 50

Wood sample W 1-K 1991 (20.8 g dry weight; *Larix*, identified by H. Jetté in unpublished GSC Wood Report 91-85), enclosed in dune sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.2 g) yielded 7.83 L of CO_2 gas. The age estimate is based on two counts for 2500 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 24.279 ± 0.106, 2.107 ± 0.027, and 28.215 ± 0.129 cpm, respectively.

Quebec

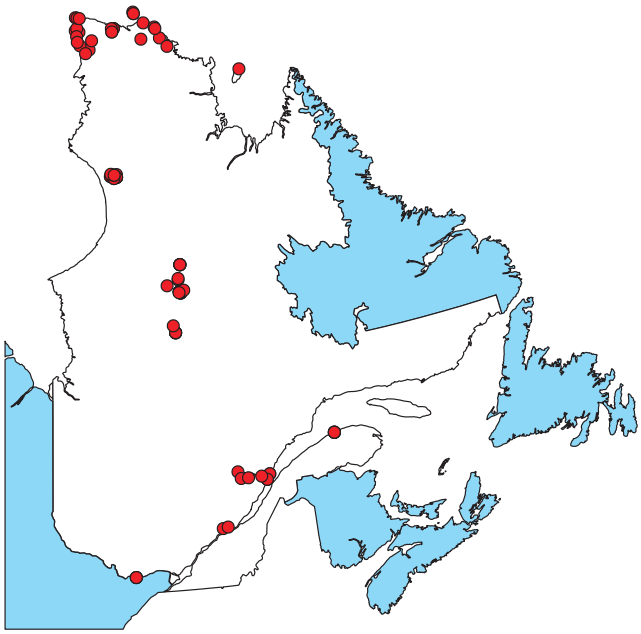


Figure 10. *Radiocarbon-dated sites in Quebec.*

GSC-5400. Baie-Sainte-Catherine

normalized age:	4380 ± 80
$\delta^{13}C$:	-26.9‰
uncorrected age:	4410 ± 80

Wood sample TAD-2-91 (*Abies balsamea*, identified by H. Jetté in unpublished GSC Wood Report 92-27), enclosed in beach sand, was collected by J.C. Dionne in June 1991 from 2 km south of Baie-Sainte-Catherine (village), on the north shore of the St. Lawrence estuary, Saguenay region, Quebec (48°05′N, 69°43′20″W), at an elevation of 5.5 m. The sample was submitted by J.C. Dionne.

The sample (20.2 g dry weight) was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (8.2 g) yielded 8.36 L of CO_2 gas. The age estimate is based on two counts for 1800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 16.150 ± 0.110, 2.185 ± 0.041, and 27.969 ± 0.203 cpm, respectively.

Comment (J.C. Dionne): The age for GSC-5400 is too old for the intertidal unit in which the piece of wood was found, because the median age for this unit, based on 17 dates, is 1.4 ka. A similar age (cf. GSC-5333: 4510 ± 70), however, was obtained on a piece of wood in the overlying sand (beach) unit.

GSC-5440. Grandes-Bergeronnes

age:	modern

Wood sample TAD-10-91 (*Abies balsamea*, identified by H. Jetté in unpublished GSC Wood Report 92-58), enclosed in silty fine sand, was collected by J.C. Dionne in June 1991 from Rivière des Petites Bergeronnes, 2.5 km west of Grandes-Bergeronnes, on the north shore of the St. Lawrence estuary, Saguenay region, Quebec (48°14′10″N, 69°34′45″W), at an elevation of 4.5 m. The sample was submitted by J.C. Dionne to gain information on sea level emergence related to the 6 m terrace.

The sample (17.20 g dry weight) was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (8.3 g) yielded 8.3 L of CO_2 gas. The age estimate is based on one count for 1040 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 31.272 ± 0.178, 1.214 ± 0.025, and 18.357 ± 0.145 cpm, respectively.

Comment (J.C. Dionne): The piece of wood (branch) was found in an eroded river bank (Rivière des Petites Bergeronnes estuary) which exposed a silty sand unit overlying a clay substrate (Goldthwait Sea clay). The surficial material appeared to be a natural deposit but was unfortunately, in fact, buried by the local farmer a few decades ago.

GSC-5472. Pointe aux Alouettes

normalized age:	1160 ± 60
$\delta^{13}C$:	-24.6‰
uncorrected age:	1150 ± 60

Wood sample TAD-5-91 (*Picea*, identified by H. Jetté in unpublished GSC Wood Report 92-81), enclosed in clay, was collected by J.C. Dionne in June 1991 from the Mitis terrace, west of Pointe aux Alouettes, Baie-Sainte-Catherine, Saguenay region, Quebec (48°05′05″N, 69°43′30″W), at an elevation of 8 m. The sample was submitted by J.C. Dionne to gain information on sea level emergence and terrace development.

The sample (17.4 g dry weight) was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (8.3 g) yielded 8.01 L of CO_2 gas. The age estimate is based on two counts for 2200 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 24.297 ± 0.126, 2.201 ± 0.062, and 28.038 ± 0.135 cpm, respectively.

Comment (J.C. Dionne): The date was obtained on a piece of wood from a colluvial deposit at the surface of the Mitis terrace, close to the Micmac cliff. Its age is slightly younger than the emergence of the low terrace at Pointe aux Alouettes (Baie-Sainte-Catherine, Charlevoix; Dionne, 1996).

GSC-5475. Tadoussac

normalized age:	40 ± 50
$\delta^{13}C$:	-25.3‰
uncorrected age:	40 ± 50

Charcoal sample TAD-9-91 (*Thuja occidentalis*, identified by R.J. Mott in unpublished GSC Wood Report 92-84), enclosed in sand, was collected by J.C. Dionne in June 1991 from National Road 138, on a delta to the east of the village of Tadoussac, Quebec (48°09′05″N, 69°43′20″W), at an elevation of 100 m. The sample was submitted by J.C. Dionne to gain information on eolian activity related to a forest fire, and environmental change.

The sample (17.1 g dry weight) was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (8.4 g) yielded 8.36 L of CO_2 gas. The age estimate is based on one count for 2470 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 27.887 ± 0.127, 2.201 ± 0.062, and 28.038 ± 0.135 cpm, respectively.

Comment (J.C. Dionne): This date provides chronological control on a major forest fire that occurred at the beginning of the 20th century at Tadoussac (ca. 1920). Eolian activity following the forest fire deposited a 3 m thick cliff-top deposit that buried the remains of the burned logs. A pine forest presently covers the surface of the 100 m delta terrace.

GSC-5476. Grandes-Bergeronne

normalized age:	6830 ± 80
corrected age:	6430 ± 80
$\delta^{13}C$:	+0.10‰
uncorrected age:	6420 ± 80

Marine shell sample TAD-12-91 (*Clinocardium ciliatum*, identified by J.C. Dionne), enclosed in clay, was collected by J.C. Dionne in June 1991 from the estuary of Rivière des Petites Bergeronnes, Grandes-Bergeronne, Saguenay region, Quebec (48°14′10″N, 69°34′45″W), at an elevation of 2.5 to 3 m. The sample was submitted by J.C. Dionne to gain information on deglaciation and sea level submergence.

The sample (47.2 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (37.9 g) yielded 7.60 L of CO_2 gas. The age estimate is based on one count for 3890 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.601 ± 0.087, 2.201 ± 0.062, and 28.038 ± 0.135 cpm, respectively.

Comment (J.C. Dionne): This date provides chronological control for the mid-Holocene low sea level in the St. Lawrence estuary, which is well documented for the south shore, and is similar to two dates on *Mya arenaria*

± 100; Dionne, 2001).

GSC-5481. Pointe-au-Bouleau

normalized age:	4580 ± 70
$\delta^{13}C$:	-29.4‰
uncorrected age:	4650 ± 70

Peat sample TAD-8-91, enclosed in clay, was collected by J.C. Dionne in June 1991 near Pointe-au-Bouleau, east of the Mitis terrace, Baie-Sainte-Catherine, Saguenay region, Quebec (48°05′00″N, 69°43′35″W), at an elevation of about 9 m. The sample was submitted by J.C. Dionne to gain information on a landslide, and the rate of retreat caused by coastal erosion.

The sample (49.4 g dry weight) was treated with cold base, hot acid, and distilled water rinses (noncalcareous). The treated sample (18.2 g) yielded 8.47 L of CO_2 gas. The age estimate is based on one count for 3700 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 15.713 ± 0.093, 2.201 ± 0.062, and 28.038 ± 0.135 cpm, respectively.

Comment (J.C. Dionne): This date provides a minimum age for a large landslide that occurred in the 30 m terrace bordering the St. Lawrence estuary at Pointe aux Alouettes. The peat formed in a shallow depression of the hummocky topography of the landslide toe. The date for GSC-5481 is close in age to another sample from a nearby site (cf. UL-1039, 4230 ± 90 BP).

GSC-5544. 'Anse Saint-Étienne'

age:	modern
$\delta^{13}C$:	-26.1‰

Wood sample SAG-1-92 (a stump of *Betula*, identified by H. Jetté in unpublished GSC Wood Report 93-18), enclosed in sand over clay in the intertidal zone, was collected by J.C. Dionne in June 1992 from 'Anse Saint-Étienne', Saguenay region, Quebec (48°12′40″N, 70°54′20″W), at an elevation of 0 m. The sample was submitted by J.C. Dionne to gain information on a landslide.

The sample (20.20 g dry weight) was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (9.2 g) yielded 8.8 L of CO_2 gas. The age estimate is based on one count for 3610 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 31.616 ± 0.112, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

Comment (J.C. Dionne): This wood sample was submitted to date a former landslide; however, the modern age obtained indicates that the log was anthropogenic in origin and probably related to sawmill activities at that locality early in the 20th century.

GSC-5550. Saint-Étienne

normalized age:	3800 ± 70
$\delta^{13}C$:	-27.6‰
uncorrected age:	3850 ± 70

Wood sample SAG-2-92 (unidentifiable; H. Jetté in unpublished GSC Wood Report 93-23), enclosed in sand, was collected by J.C. Dionne in June 1992 from Saint-Étienne,

Saguenay region, Quebec (48°12′05″N, 69°57′45″W), at an elevation of 150 m. The sample was submitted by J.C. Dionne.

The sample (20.3 g dry weight) was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (8.5 g) yielded 8.6 L of CO_2 gas. The age estimate is based on two counts for 2010 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.459 ± 0.115, 2.208 ± 0.053, and 28.186 ± 0.139 cpm, respectively.

Comment (J.C. Dionne): Sample GSC-5550 dates late-Holocene alluvial activity on the surface of a wide sand plain close to the Saguenay River. This fluvial activity may possibly relate to a flood caused by the sudden discharge of a small lake ('Lac Fridelin').

GSC-5561. Anse aux Érables

normalized age:	3650 ± 70
$\delta^{13}C$:	-25.0‰
uncorrected age:	3650 ± 70

Wood sample SAG-3-92 (a tree trunk of *Pinus resinosa*, identified by H. Jetté in unpublished GSC Wood Report 93-26), enclosed in sand and clay, was collected by J.C. Dionne in June 1992 from Anse aux Érables, Saguenay region, Quebec (48°12′05″N, 70°34′10″W), at an elevation of 0 m. The sample was submitted by J.C. Dionne.

The sample (14.6 g dry weight) was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (8.0 g) yielded 8.3 L of CO_2 gas. The age estimate is based on two counts for 2040 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.903 ± 0.112, 2.208 ± 0.053, and 28.186 ± 0.139 cpm, respectively.

Comment (J.C. Dionne): This date records a former landslide that occurred in the clay terrace bordering Anse aux Érables in the upper Saguenay River area. The landslide deposit presently outcrops in the intertidal zone.

GSC-5422. Chicoutimi

normalized age:	880 ± 50
$\delta^{13}C$:	-25.8‰
uncorrected age:	890 ± 50

Peat sample 910927, enclosed in peat, was collected by J. Vallée on September 17, 1991 from Lachance Creek, as part of the Ricochet Project, 1 km east of Chicoutimi, Quebec (48°25′25″N, 71°01′00″W), at an elevation of 50 m. The sample was submitted by J. Vallée to gain information on a landslide.

The sample (60.6 g dry weight) was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (18.2 g) yielded 8.29 L of CO_2 gas. The age estimate is based on one count for 3646 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.321 ± 0.090, 2.106 ± 0.025, and 28.293 ± 0.128 cpm, respectively.

GSC-5529. Sainte-Christine

normalized age:	10 700 ± 100
corrected age:	10 300 ± 100
$\delta^{13}C$:	1.69‰
uncorrected age:	10 300 ± 100

Marine shell sample 92BZA3033 (*Hiatella arctica*, identified by M. Gagnon), enclosed in glaciomarine diamicton, was collected by M. Gagnon and D. Harmand on July 11, 1992 from 6 km south of Sainte-Christine, Portneuf, Quebec (46°45′32″N, 71°57′58″W), at an elevation of 115 m. The sample was submitted by A.M. Bolduc to gain information on sea level change, specifically the Saint Narcisse episode of the Champlain Sea.

The sample (29.00 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (23.0 g) yielded 5.1 L of CO_2 gas. The age estimate is based on one count for 3900 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.061 ± 0.047, 1.214 ± 0.024, and 18.146 ± 0.102 cpm, respectively.

Comment (A. Bolduc): This site, located on what was a shoal during Champlain Sea time, could have helped shed some light onto either sedimentation during the Saint-Noclas readvance (LaSalle, 1987; LaSalle et Shilts, 1993), or the extent of glaciomarine sedimentation during the Saint-Narcisse episode. The diamicton itself might be older than the shells, but the young age obtained suggests that the shells (*Hiatella arctica*), mostly found as fragments, were incorporated in the deposit during intense reworking of the shoal by sublittoral currents and tides at or slightly later than 10.3 ka. Thus, they are not associated with either of the older postulated glacial readvances in the area. The date was used in a research report produced for Maîtrise en sciences de l'environnement, UQAM (Gagnon, 1994).

GSC-5536. Pont-Rouge

normalized age:	10 800 ± 120
corrected age:	10 400 ± 120
$\delta^{13}C$:	-2.04‰
uncorrected age:	10 400 ± 120

Marine shell sample 92BZA3034 (*Macoma baltica*, identified by M. Gagnon), enclosed in clay grading upward to silty clay and then sand, was collected by M. Gagnon and T. Lanovara on August 10, 1992 from 4 km northwest of Pont-Rouge, Portneuf, Quebec (46°47′16″N, 71°44′29″W), at an elevation of 90 m. The sample was submitted by A.M. Bolduc to gain information on sea level change, specifically the Champlain Sea regression.

The sample (22.70 g dry weight) was treated with an acid leach to remove the outer 10%. The treated sample (20.5 g) yielded 4.5 L of CO_2 gas. The age estimate is based on one count for 2500 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.947 ± 0.055, 1.214 ± 0.024, and 18.146 ± 0.102 cpm, respectively.

Comment (A. Bolduc): *Macoma balthica* is often associated with intertidal to sublittoral conditions (0–6 m), but it can be found in much deeper waters (Wagner, 1970). In this case, because the shells were well preserved, some still hinged and with traces of periostracum, it is assumed that they have not been reworked very much and therefore must have lived close to this location. They were found in deep-water silt under prodeltaic sediments, suggesting that the delta at Pont-Rouge (Jacques-Cartier River, surface elevation at 115 m a.s.l.) is younger than 10.4 ka. This age also suggests that the glacial activity (10 390 ± 130, QU-447, 2.5 km south of this site) postulated by LaSalle et al., (1977) at Pont-Rouge for a fossiliferous diamicton is better interpreted as intense sublittoral reworking of the till, as proposed by Occhietti and Hillaire-Marcel (1982) and Parent and Occhietti (1988). This date was used in a research report produced for Maîtrise en sciences de l'environnement, UQAM (Gagnon, 1994).

'Breckenridge Creek' series

A series of wood samples was collected by G. Brooks and J. Aylsworth on June 21, 1996 from 1.7 km east-northeast of Highway 144 bridge that crosses 'Breckenridge Creek', Breckenridge, Quebec (45°29.1′N, 75°55.9′W), at an elevation of 70 to 80 m. These samples were submitted by G. Brooks to gain information on a landslide.

GSC-6246. 'Breckenridge Creek' I

normalized age:	6980 ± 80
$\delta^{13}C$:	-25.2‰
uncorrected age:	6990 ± 80

Wood sample 96-06-21-03-No. 1 (12.5 g dry weight), enclosed in landslide debris composed of marine silt-clay, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.2 g) yielded 7.5 L of CO_2 gas. The age estimate is based on one count for 2400 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.960 ± 0.083, 2.141 ± 0.033, and 28.542 ± 0.138 cpm, respectively.

GSC-6243. 'Breckenridge Creek' II

normalized age:	7030 ± 70
$\delta^{13}C$:	-26.1‰
uncorrected age:	7050 ± 70

Wood sample 96-06-21-02-No. 2 (13.4 g dry weight), enclosed in landslide debris composed of marine silt-clay, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.5 g) yielded 7.1 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.869 ± 0.069, 2.141 ± 0.033, and 28.542 ± 0.138 cpm, respectively.

GSC-6233. 'Breckenridge Creek' III

normalized age:	7050 ± 80
$\delta^{13}C$:	-28.0‰
uncorrected age:	7100 ± 80

Wood sample 96-06-21-01-No. 1 (14.1 g dry weight), enclosed in landslide debris composed of marine silt-clay, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.4 g) yielded 9.2 L of CO_2 gas. The age estimate is based on one count for 3760 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.682 ± 0.073, 2.195 ± 0.041, and 28.266 ± 0.154 cpm, respectively.

Comment (G. Brooks): A large number of undated prehistoric and several historic sensitive-clay landslides are present in the Breckenridge valley, Quebec. These three radiocarbon dates (GSC-6233, -6243, -6246) represent maximum ages for one of the prehistoric scars. The close grouping of the radiocarbon ages supports the interpretation that the three sampled logs represent living trees that were incorporate in the landslide debris, since all three dates are based on wood sampled from the outer portion of the logs. The ages indicate that landsliding began in this valley as early as about 7000 years BP.

Perdu Lake series

A series of lake sediment samples was collected by P.J.H. Richard and C. Labelle on April 11, 1980 from Perdu Lake, 1 km due south of Ruisseau du Castor, 11 km east of Sainte-Anne-des-Monts, Gaspésie, Quebec (49°10′15″N,

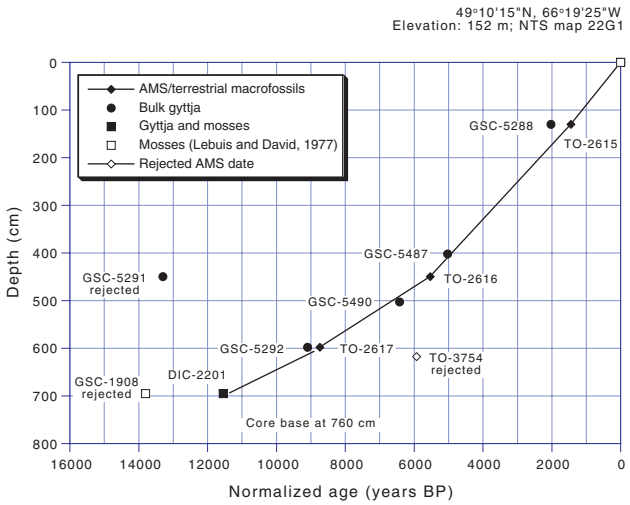


Figure 11a. *Age-depth curve for Lac Perdu, Gaspésie, Quebec.*

66°19′25″W), at an elevation of 152 m. These samples were submitted by P.J.H. Richard to gain information on the pollen accumulation rate and to crosscheck with AMS dates in relation to hardwater error on bulk samples.

GSC-5288. Lake Perdu I

normalized age:	1960 ± 120
$\delta^{13}C$:	-29.4‰
uncorrected age:	2030 ± 120

Lake sediment gyttja sample Perdu-C (128–132 cm depth; 65.9 g wet weight), enclosed in organic lake mud, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (1.7 g) yielded 1.49 L of CO_2 gas. The age estimate is based on two counts for 1906 minutes in the 2 L counter with a mixing ratio of 3.02. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.187 ± 0.191, 1.288 ± 0.028, and 18.276 ± 0.111 cpm, respectively.

GSC-5487. Lake Perdu II

normalized age:	5030 ± 120
$\delta^{13}C$:	-30.9‰
uncorrected age:	5120 ± 120

Lake sediment gyttja sample Perdu-C (400–405 cm depth; 168.1 g wet weight), enclosed in organic mud, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (3.7 g) yielded 1.76 L of CO_2 gas. The age estimate is based on two counts for 2195 minutes in the 2 L counter with a mixing ratio of 2.46. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.686 ± 0.133, 1.200 ± 0.024, and 18.324 ± 0.104 cpm, respectively.

GSC-5291. Lake Perdu III

$\delta^{13}C$:	lost
uncorrected age:	13 300 ± 150

Lake sediment gyttja sample Perdu-C (448–452 cm depth; 144.4 g wet weight), enclosed in organic lake mud, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (4.6 g) yielded 1.76 L of CO_2 gas. The age estimate is based on two counts for 2040 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 3.479 ± 0.055, 1.216 ± 0.026, and 18.122 ± 0.101 cpm, respectively.

GSC-5490. Lake Perdu IV

normalized age:	6420 ± 120
$\delta^{13}C$:	-30.1‰
uncorrected age:	6500 ± 120

Lake sediment gyttja sample Perdu-C (500–505 cm depth; 165.3 g wet weight), enclosed in lake organic mud, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (3.3 g) yielded 2.24 L of CO_2 gas. The age estimate is based on one count for 2540 minutes in the 2 L counter with a mixing ratio of 1.97. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.153 ± 0.102, 1.200 ± 0.024, and 18.324 ± 0.104 cpm, respectively.

GSC-5292. Lake Perdu V

normalized age:	9050 ± 140
$\delta^{13}C$:	-28.3‰
uncorrected age:	9100 ± 140

Lake sediment, silty gyttja sample Perdu-C (596–600 cm depth; 13.6 g wet weight), enclosed in organic lake mud, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (11.9 g) yielded 3.69 L of CO_2 gas. The age estimate is based on one count for 3600 minutes in the 2 L counter with a mixing ratio of 1.21. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.922 ± 0.087, 1.188 ± 0.059, and 18.396 ± 0.155 cpm, respectively.

Comment (P.J.H. Richard): GSC-5291 is anomalous. All of the other dates fall close to the age-depth curve developed by AMS dating. All available dates are shown on 11a (*modified from* Richard et al., 1997).

A basal age on moss (13 800 ± 160 BP; GSC-1908) was first published by Lebuis and David (1977). Subsequently, the (presumably) same moss-rich gyttja layer (690–700 cm) yielded a bulk sediment age of 11 500 ± 220 BP. In addition, the entire core was dated by both conventional (residual radiocarbon activity, GSC-series) and AMS (accelerator mass spectrometry, TO-series) methods. Although a hardwater effect is indicated at depths of 128 to 132 cm and 596 to 600 cm, results for GSC-5291 and TO-3754 are unexplained. The age of DIC-2201 (Dicar Corporation, Radioisotope Laboratory) is acceptable as a minimum age for local ice retreat based on pollen correlation with other lake sediments near Madeleine-Centre (Marcoux and Richard, 1995).

Lake Boisseau series

A series of lake sediment samples was collected by A.C. Larouche on April 30, 1983 from 10 km south of Lake Boisseau, James Bay region, Quebec (52°50′34″N, 73°18′59″W), at an elevation of 534 m. These samples were submitted by P.J.H. Richard to gain information on deglaciation, and pollen accumulation rates.

Core LG4-83-12:

GSC-5657. LG4-83-12: E

normalized age:	2110 ± 80
$\delta^{13}C$:	-29.3‰
uncorrected age:	2180 ± 80

Lake sediment gyttja sample LG4-83-12: E (43–48 cm depth; 39.9 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (5.4 g) yielded 1.65 L of CO_2 gas. The age estimate is based on one count for 3840 minutes in the 2 L counter with a mixing ratio of 2.63. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.895 ± 0.122, 1.284 ± 0.021, and 18.219 ± 0.103 cpm, respectively.

GSC-5644. LG4-83-12: D

normalized age:	2300 ± 100
$\delta^{13}C$:	-29.7‰
uncorrected age:	2380 ± 100

Lake sediment gyttja sample LG4-83-12: D (95–100 cm depth; 44.6 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (6.9 g) yielded 1.67 L of CO_2 gas. The age estimate is based on two counts for 2140 minutes in the 2 L counter with a mixing ratio of 2.65. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.548 ± 0.155, 1.284 ± 0.021, and 18.219 ± 0.103 cpm, respectively.

GSC-5642. LG4-83-12: C

normalized age:	2960 ± 90
$\delta^{13}C$:	-29.6‰
uncorrected age:	3030 ± 90

Lake sediment gyttja sample LG4-83-12: C (145–150 cm depth; 64.7 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (9.5 g) yielded 2.70 L of CO_2 gas. The age estimate is based on two counts for 2150 minutes in the 2 L counter with a mixing ratio of 1.63. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.492 ± 0.110, 1.284 ± 0.021, and 18.219 ± 0.103 cpm, respectively.

GSC-5640. LG4-83-12: B

normalized age:	4230 ± 90
$\delta^{13}C$:	-26.8‰
uncorrected age:	4260 ± 90

Lake sediment gyttja sample LG4-83-12: B (195–200 cm depth; 72.4 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (9.0 g) yielded 3.71 L of CO_2 gas. The age estimate is based on two counts for 2195 minutes in the 2 L counter with a mixing ratio of 1.18. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.647 ± 0.086, 1.266 ± 0.025, and 18.088 ± 0.145 cpm, respectively.

GSC-5385. LG4-83-12: A

normalized age:	5820 ± 180
$\delta^{13}C$:	-28.1‰
uncorrected age:	5870 ± 180

Lake sediment, silty basal gyttja sample LG4-83-12: A (257.5–262.5 cm depth; 12.5 g wet weight), enclosed in silt, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (9.9 g) yielded 1.21 L of CO_2 gas. The age estimate is based on two counts for 2120 minutes in the 2 L counter with a mixing ratio of 3.55. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.739 ± 0.173, 1.249 ± 0.025, and 18.139 ± 0.145 cpm, respectively.

Comment (P.J.H. Richard): This basal sample (GSC-5385) provides a minimum age for local ice retreat. Along with samples GSC-5640, -5642, -5644, and -5657, it helps to define a net deposition rate for the organic lake sediment (*see* Fig. 11b) and allows the calculation of pollen accumulation rates. An increase in the net sediment accumulation rate occurs between about 3 and 2 ka BP, followed by a very low net rate during the last 2 ka BP. Pollen content of the basal sample points to an open spruce woodland with tree cover sparser than at present, shortly after ice retreat.

Core LG4-83-13:

GSC-5798. LG4-83-13: A

normalized age:	5690 ± 130
$\delta^{13}C$:	-25.3‰
uncorrected age:	5700 ± 130

Lake sediment, silty basal gyttja sample LG4-83-13: A (250–255 cm depth), enclosed in lake sediment, was collected by A.C. Larouche in 1983 from 4 km southwest of Lake Jacquelein, near the Sakami River, James Bay region, Quebec (53°03′30″N, 73°24′23″W), at an elevation of 442 m. The sample was submitted by P.J.H. Richard to gain information on the timing of ice retreat.

The sample (1.0 g dry weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (17.9 g) yielded 1.41 L

of CO_2 gas. The age estimate is based on one count for 3320 minutes in the 2 L counter with a mixing ratio of 3.11. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 8.985 ± 0.134, 1.204 ± 0.025, and 18.269 ± 0.117 cpm, respectively.

Comment (P.J.H. Richard): This basal sample provides a minimum age for local ice retreat.

Core LG4-83-14:

GSC-5437. LG4-83-14: A

normalized age:	6170 ± 130
$\delta^{13}C$:	-22.3‰
uncorrected age:	6130 ± 130

Lake sediment, silty basal gyttja sample LG4-83-14: A (250–255 cm depth), enclosed in silt, was collected by A.C. Larouche in May 1983 from 28 km south-southeast from Lac Semonville, James Bay region, Quebec (54°17′32″N, 73°33′03″W), at an elevation of 442 m. The sample was submitted by P.J.H. Richard to gain information on the timing of deglaciation.

The sample (11.7 g dry weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (9.8 g) yielded 1.49 L of CO_2 gas. The age estimate is based on one count for 3940 minutes in the 2 L counter with a mixing ratio of 2.96. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.544 ± 0.118, 1.209 ± 0.024, and 18.316 ± 0.145 cpm, respectively.

Comment (P.J.H. Richard): This basal sample provides a minimum age for local ice retreat.

Eastern Laforge River series

A series of lake sediment samples was collected by A.C. Larouche on April 26, 1983 from the eastern Laforge River area, James Bay region, Quebec. The samples were submitted by P.J.H. Richard to gain information on the vegetational history (pollen and macrofossils) and deglaciation.

Core LG4-83-08:

GSC-5796. LG4-83-08: A

normalized age:	5750 ± 90
$\delta^{13}C$:	-29.6‰
uncorrected age:	5830 ± 90

This site was 12 km northeast of site GaFf-1 (54°06′49″N, 72°42′14″W), at an elevation of 555 m. Lake sediment, basal silty gyttja sample LG4-83-08: A (109–114 cm depth; 39.9 g dry weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (33.4 g) yielded 5.20 L of CO_2 gas. The age estimate is based on two counts for 2110 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.844 ± 0.073, 1.204 ± 0.025, and 18.269 ± 0.117 cpm, respectively.

Comment (P.J.H. Richard): This basal sample provides a minimum age for local ice retreat.

Core LG4-83-01P:

GSC-5780. LG4-83-01P: D

normalized age:	1160 ± 80
$\delta^{13}C$:	-27.7‰
uncorrected age:	1200 ± 80

This and the next three dates are from 3 km south of archeological site GaFf-1 (54°02′09″N, 72°52′22″W), at an elevation of 470 m. Lake sediment gyttja sample LG4-83-01P: D (20–25 cm depth; 49.5 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (5.7 g) yielded 1.79 L of CO_2 gas. The age estimate is based on one count for 3900 minutes in the 2 L counter with a mixing ratio of 2.41. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.035 ± 0.124, 1.218 ± 0.025, and 18.627 ± 0.106 cpm, respectively.

GSC-5772. LG4-83-01P: C

normalized age:	2060 ± 130
$\delta^{13}C$:	-29.4‰
uncorrected age:	2130 ± 130

Lake sediment gyttja sample LG4-83-01P: C (45–50 cm depth; 29.1 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (2.7 g) yielded 0.85 L of CO_2 gas. The age estimate is based on one count for 3500 minutes in the 2 L counter with a mixing ratio of 4.94. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.290 ± 0.209, 1.218 ± 0.025, and 18.627 ± 0.106 cpm, respectively.

GSC-5769. LG4-83-01P: B

normalized age:	3390 ± 110
$\delta^{13}C$:	-31.3‰
uncorrected age:	3500 ± 110

Lake sediment gyttja sample LG4-83-01P: B (95–100 cm depth; 47.7 g dry weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (4.1 g) yielded 1.43 L of CO_2 gas. The age estimate is based on one count for 3280 minutes in the 2 L counter with a mixing ratio of 3.01. The count rates for the sample (net) and for

monthly backgrounds and standards (net) were 11.982 ± 0.141, 1.214 ± 0.025, and 18.515 ± 0.105 cpm, respectively.

GSC-5766. LG4-83-01P: A

normalized age:	6010 ± 90
$\delta^{13}C$:	-26.6‰
uncorrected age:	6040 ± 90

Lake sediment, basal silty gyttja sample LG4-83-01P: A (155–160 cm depth; 35.2 g dry weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (30.2 g) yielded 2.79 L of CO_2 gas. The age estimate is based on one count for 3900 minutes in the 2 L counter with a mixing ratio of 1.56. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.728 ± 0.076, 1.214 ± 0.025, and 18.515 ± 0.105 cpm, respectively.

Comment (P.J.H. Richard): This basal sample (GSC-5766) provides a minimum age for local ice retreat. Along with samples GSC-5769, -5772, and -5780, it helps to define an almost constant net deposition rate for the organic lake sediment (*see* Fig. 11b), and allows the calculation of pollen accumulation rates. Pollen content of the basal sample points to an open spruce woodland with tree cover sparser than at present, shortly after ice retreat.

Core LG4-83-03

GSC-5799. LG4-83-03: A'

normalized age:	5450 ± 150
$\delta^{13}C$:	-28.3‰
uncorrected age:	5500 ± 150

This site was 5.5 km west of archeological site GaFf-1, (54°03′06″N, 72°57′32″W), at an elevation of 350 m. Lake sediment, basal silty gyttja sample LG4-83-03: A' (300–305 cm depth; 26.3 g dry weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (18.5 g) yielded 1.14 L of CO_2 gas. The age estimate is based on one count for 3600 minutes in the 2 L counter with a mixing ratio of 3.80. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.211 ± 0.153, 1.204 ± 0.025, and 18.269 ± 0.117 cpm, respectively.

Comment (P.J.H. Richard): This basal sample provides a minimum age for local ice retreat.

Lake Roz series

A series of lake sediment samples was collected by A.C. Larouche in May 1983 from 7 km northwest from Lake Roz, James Bay region, Quebec (54°54′04″N, 72°46′38″W), at an elevation of 442 m. These samples were submitted by P.J.H. Richard to gain information on the pollen accumulation rate and deglaciation.

Core LG4-83-09

GSC-5636. LG4-83-09: E

normalized age:	1550 ± 130
$\delta^{13}C$:	-26.1‰
uncorrected age:	1570 ± 130

Lake sediment gyttja sample LG4-83-09: E (45–50 cm depth; 29.8 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (3.7 g) yielded 1.21 L of CO_2 gas. The age estimate is based on two counts for 2190 minutes in the 2 L counter with a mixing ratio of 3.61. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.885 ± 0.201, 1.266 ± 0.025, and 18.088 ± 0.145 cpm, respectively.

GSC-5626. LG4-83-09: D

normalized age:	3070 ± 100
$\delta^{13}C$:	-26.6‰
uncorrected age:	3100 ± 100

Lake sediment gyttja sample LG4-83-09: D (95–100 cm depth; 46.0 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (4.6 g) yielded 1.88 L of CO_2 gas. The age estimate is based on one count for 2400 minutes in the 2 L counter with a mixing ratio of 2.29. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.476 ± 0.128, 1.191 ± 0.020, and 18.338 ± 0.103 cpm, respectively.

GSC-5618. LG4-83-09: C

normalized age:	4320 ± 100
$\delta^{13}C$:	-27.2‰
uncorrected age:	4350 ± 100

Lake sediment gyttja sample LG4-83-09: C (145–150 cm depth; 56.4 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (5.3 g) yielded 2.34 L of CO_2 gas. The age estimate is based on two counts for 2285 minutes in the 2 L counter with a

mixing ratio of 1.85. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.637 ± 0.111, 1.223 ± 0.023, and 18.286 ± 0.110 cpm, respectively.

GSC-5613. LG4-83-09: B

normalized age:	5390 ± 80
$\delta^{13}C$:	-28.0‰
uncorrected age:	5440 ± 80

Lake sediment gyttja sample LG4-83-09: B (195–200 cm depth; 66.8 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (5.6 g) yielded 2.98 L of CO_2 gas. The age estimate is based on one count for 3750 minutes in the 2 L counter with a mixing ratio of 1.44. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.291 ± 0.073, 1.223 ± 0.023, and 18.286 ± 0.110 cpm, respectively.

GSC-5384. LG4-83-09: A

normalized age:	5790 ± 160
$\delta^{13}C$:	-26.7‰
uncorrected age:	5820 ± 160

Lake sediment, silty basal gyttja sample LG4-83-09: A (210–215 cm depth; 10.9 g wet weight), enclosed in silt, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (8.8 g) yielded 1.37 L of CO_2 gas. The age estimate is based on two counts for 1950 minutes in the 2 L counter with a mixing ratio of 3.17. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.784 ± 0.169, 1.238 ± 0.028, and 18.133 ± 0.104 cpm, respectively.

Comment (P.J.H. Richard): This basal sample (GSC-5384) provides a minimum age for local ice retreat. Along with samples GSC-5613, -5618, -5626, and -5636, it helps to define an almost constant net deposition rate for the organic lake sediment (*see* Fig. 11b), and allows the calculation of pollen accumulation rates. Pollen content of the basal sample points to an open spruce woodland with tree cover sparser than at present, shortly after ice retreat.

Laforge River series

A series of lake sediment samples was collected by A.C. Larouche on April 27, 1983 from 300 m north of the Laforge River, James Bay region, Quebec (54°03′48″, **72**°54′55″W), at an elevation of 350 m. These samples were submitted by P.J.H. Richard to gain information on the rate of pollen accumulation.

Core LG4-83-05

GSC-5789. LG4-83-05: D

normalized age:	1250 ± 90
$\delta^{13}C$:	-24.3‰
uncorrected age:	1240 ± 90

Lake sediment gyttja sample LG4-83-05: D (45–50 cm depth; 46.5 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (12.5 g) yielded 2.14 L of CO_2 gas. The age estimate is based on two counts for 2080 minutes in the 2 L counter with a mixing ratio of 2.02. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 15.957 ± 0.150, 1.218 ± 0.025, and 18.627 ± 0.106 cpm, respectively.

GSC-5787. LG4-83-05: C

normalized age:	2500 ± 100
$\delta^{13}C$:	-23.5‰
uncorrected age:	2480 ± 100

Lake sediment gyttja sample LG4-83-05: C (95–100 cm depth; 46.3 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (7.2 g) yielded 1.89 L of CO_2 gas. The age estimate is based on two counts for 2080 minutes in the 2 L counter with a mixing ratio of 2.28. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.681 ± 0.146, 1.218 ± 0.025, and 18.627 ± 0.106 cpm, respectively.

GSC-5784. LG4-83-05: B

normalized age:	3770 ± 110
$\delta^{13}C$:	-26.0‰
uncorrected age:	3780 ± 110

Lake sediment gyttja sample LG4-83-05: B (145–150 cm depth; 72.5 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (13.7 g) yielded 4.19 L of CO_2 gas. The age estimate is based on two counts for 2000 minutes in the 2 L counter with a mixing ratio of 1.04. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.629 ± 0.147, 1.218 ± 0.025, and 18.627 ± 0.106 cpm, respectively.

GSC-5425. LG4-83-05: A

normalized age:	4850 ± 80
$\delta^{13}C$:	-30.8‰
uncorrected age:	4940 ± 80

Lake sediment, silty basal gyttja sample LG4-83-05: A (178–183 cm depth; 28.1 g wet weight), enclosed in silt, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (24.0 g) yielded 6.89 L of CO_2 gas. The age estimate is based on one count for 3880 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.899 ± 0.058, 1.209 ± 0.024, and 18.316 ± 0.145 cpm, respectively.

Comment (P.J.H. Richard): This basal sample (GSC-5425) provides a minimum age for local ice retreat. Along with samples GSC-5784, -5787, and -5789, it helps to define an almost constant net deposition rate for the organic lake sediment (*see* Fig. 11b), and allows the calculation of pollen accumulation rates. Pollen content of the basal sample points to an open spruce woodland with tree cover sparser than at present, shortly after ice retreat.

Laforge River area series

A series of lake sediment samples was collected by A.C. Larouche in 1983 from the Laforge River area, James Bay region, Quebec (54°04′30″N, 72°56′31″W), at an elevation of 365 m. These samples were submitted by P.J.H. Richard to gain information on the rate of pollen accumulation.

Core LG4-83-06P

GSC-5749. LG4-83-06P: G

normalized age:	2500 ± 80
$\delta^{13}C$:	-27.2‰
uncorrected age:	2540 ± 80

Lake sediment gyttja sample LG4-83-06P: G (45–50 cm depth; 43.3 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (9.9 g) yielded 1.63 L of CO_2 gas. The age estimate is based on one count for 4910 minutes in the 2 L counter with a mixing ratio of 2.67. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.311 ± 0.114, 1.172 ± 0.024, and 18.250 ± 0.102 cpm, respectively.

GSC-5747. LG4-83-06P: F

normalized age:	2690 ± 80
$\delta^{13}C$:	-28.7‰
uncorrected age:	2750 ± 80

Lake sediment gyttja sample LG4-83-06P: F (95–100 cm depth; 66.3 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (11.2 g) yielded 2.15 L of CO_2 gas. The age estimate is based on one count for 3885 minutes in the 2 L counter with a mixing ratio of 2.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.963 ± 0.101, 1.172 ± 0.024, and 18.250 ± 0.102 cpm, respectively.

GSC-5734. LG4-83-06P: E

normalized age:	3550 ± 120
$\delta^{13}C$:	-27.8‰
uncorrected age:	3600 ± 120

Lake sediment gyttja sample LG4-83-06P: E (145–150 cm depth; 73.1 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (13.9 g) yielded 2.22 L of CO_2 gas. The age estimate is based on two counts for 2140 minutes in the 2 L counter with a mixing ratio of 1.95. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.666 ± 0.123, 1.218 ± 0.025, and 18.260 ± 0.170 cpm, respectively.

GSC-5714. LG4-83-06P: D

normalized age:	4150 ± 100
$\delta^{13}C$:	-26.5‰
uncorrected age:	4170 ± 100

Lake sediment gyttja sample LG4-83-06P: D (195–200 cm depth; 88.1 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (17.3 g) yielded 3.39 L of CO_2 gas. The age estimate is based on three counts for 3165 minutes in the 2 L counter with a mixing ratio of 1.29. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.939 ± 0.115, 1.199 ± 0.028, and 18.393 ± 0.105 cpm, respectively.

GSC-5709. LG4-83-06P: C

normalized age:	4600 ± 100
$\delta^{13}C$:	-28.4‰
uncorrected age:	4650 ± 100

Lake sediment gyttja sample LG4-83-06P: C (240–245 cm depth; 50.4 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (23.2 g) yielded 2.59 L of CO_2 gas. The age estimate is based

on one count for 2570 minutes in the 2 L counter with a mixing ratio of 1.71. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.305 ± 0.102, 1.199 ± 0.028, and 18.393 ± 0.105 cpm, respectively.

GSC-5693. LG4-83-06P: B

normalized age:	5280 ± 150
$\delta^{13}C$:	-26.3‰
uncorrected age:	5310 ± 150

Lake sediment gyttja with clay band, sample LG4-83-06P: B (290–295 cm depth; 86.8 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (43.7 g) yielded 1.40 L of CO_2 gas. The age estimate is based on two counts for 2060 minutes in the 2 L counter with a mixing ratio of 3.12. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.520 ± 0.161, 1.217 ± 0.025, and 18.431 ± 0.104 cpm, respectively.

GSC-5683. LG4-83-06P: A'

normalized age:	6360 ± 140
$\delta^{13}C$:	-28.1‰
uncorrected age:	6410 ± 140

Lake sediment, basal silty gyttja sample LG4-83-06P: A' (327–332 cm depth; 89.5 g wet weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (51.2 g) yielded 1.26 L of CO_2 gas. The age estimate is based on one count for 3715 minutes in the 2 L counter with a mixing ratio of 3.39. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.302 ± 0.135, 1.217 ± 0.025, and 18.431 ± 0.104 cpm, respectively.

Comment (P.J.H. Richard): This basal sample (GSC-5683) provides a minimum age for local ice retreat. Along with samples GSC-5693, -5709, -5714, -5734, -5747 and -5749, it helps to define a varying deposition rate for the organic lake sediment (*see* Fig. 11b), and allows the calculation of pollen accumulation rates. Pollen content of the basal sample points to an open spruce woodland with tree cover sparser than at present, shortly after ice retreat. An additional core was taken in the marginal part of the lake, facing the inlet, and five samples were dated at Beta Analytic Inc. More sediments were present there and accumulated at a quite different rate, especially during the last 2500 years (*see* Fig. 11b).

Core LG4-83-06 M

The next five gyttja samples were taken from the same lake as LG4-83-06P but from a lateral core facing an inlet stream. They were dated by Beta Analytic Inc. (report dated June 14, 1984). The samples were given an acid leach only, and an extended counting time (four times the standard) was applied to all samples except Beta-9515.

Beta-9512. LG4-83-06M: E

normalized age:	260 ± 90
$\delta^{13}C$:	-28.10‰
uncorrected age:	310 ± 90

Organic lake sediment from 95 to 100 cm depth.

Beta-9513. LG4-83-06M: D

normalized age:	1490 ± 110
$\delta^{13}C$:	-28.62‰
uncorrected age:	1550 ± 110

Organic lake sediment from 195 to 200 cm depth.

Beta-9514. LG4-83-06M: C

normalized age:	3630 ± 110
$\delta^{13}C$:	-29.87‰
uncorrected age:	3710 ± 110

Organic lake sediment from 295 to 300 cm depth.

Beta-9515. LG4-83-06M: B

normalized age:	4140 ± 90
$\delta^{13}C$:	-28.87‰
uncorrected age:	4200 ± 90

Organic lake sediment from 395 to 400 cm depth.

Beta-9516. LG4-83-06M: A

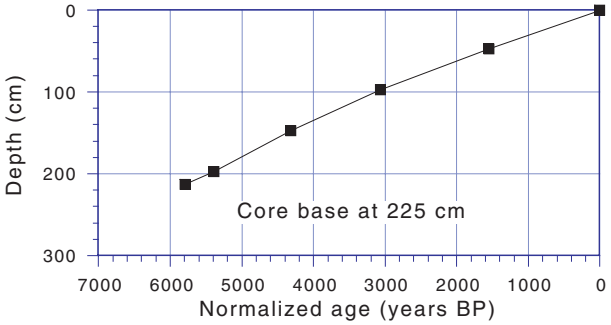
normalized age:	6600 ± 100
$\delta^{13}C$:	-28.73‰
uncorrected age:	6660 ± 100

Organic lake sediment from 495 to 500 cm depth.

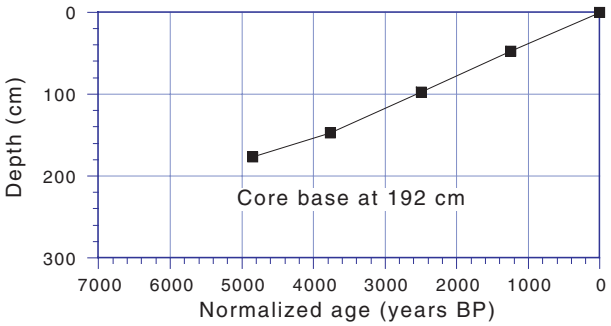
See GSC-5683 (LG4-83-06P, above) for comments.

(top of cores = 0 BP)

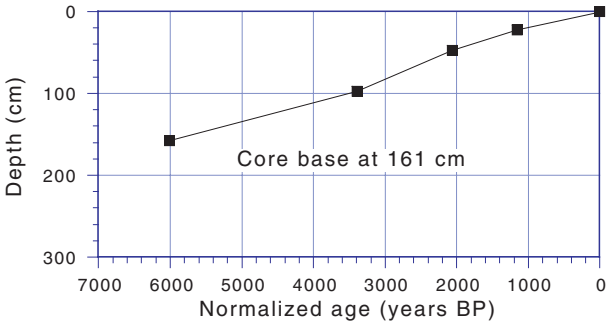
LG4-83-09 (Lake Roz) 442 m, 5,3 ha, 3,95 m
54°54'04"N, 72°46'38"W



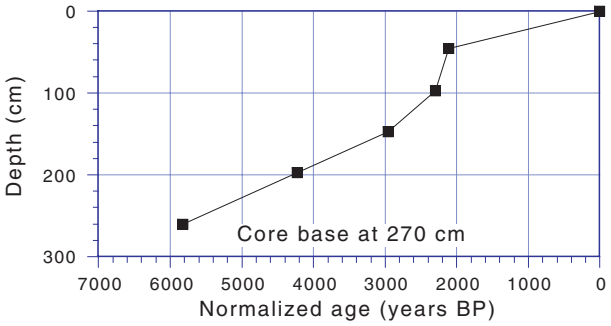
LG4-83-05 (Laforge River) 350 m, 1 ha, 3,75 m
54°03'48"N, 72°54'55"W



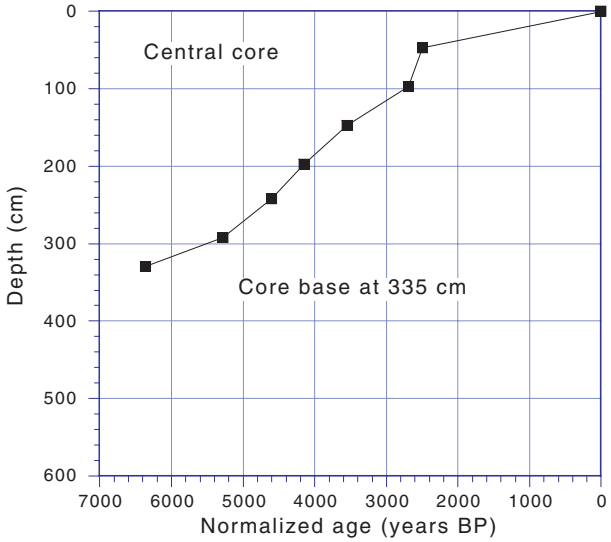
LG4-83-01P (Laforge River eastern) 470 m, 3 ha, 3,6 m
54°02'09"N, 72°52'22"W



LG4-83-12 (Boisseau Lake) 534 m, 3,75 ha, 2,6 m
52°50'34"N, 73°18'59"W



LG4-83-06P (Laforge River) 365 m, 7,1 ha, 1,15 m
54°04'30"N, 72°56'31"W



Caption: Altitude, size and water depth are given for each lake. Core base corresponds to depth of inorganic, sandy sediments (no more penetration). Except LG4-83-06, all lakes have no major inlets.

Left column: Central cores sorted by latitude. Note the elevated accumulation rate in LG4-83-12 before 2000 BP.

Right column: Central (above) and lateral (below; dates from Beta Analytic) cores from the same lake, illustrating varied accumulation rates and dissymetric lake sediment accumulation. The lateral core faces an inlet.

LG4-83-06M (Laforge River) 365 m, 7,1 ha, 0,6 m
54°04'30"N, 72°56'31"W

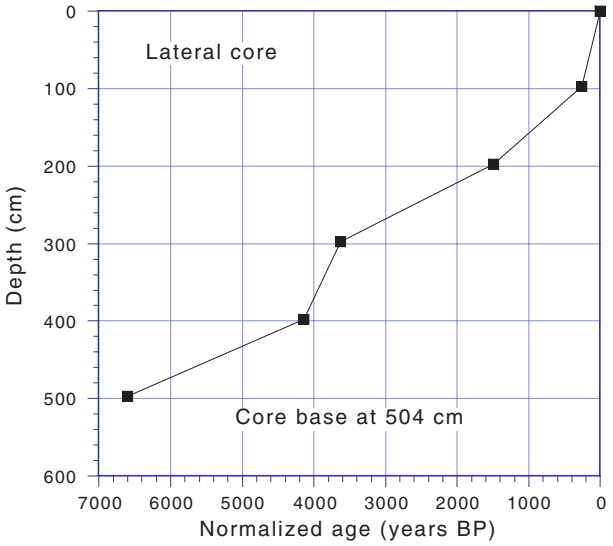


Figure 11b. *Age-depth curves for the five lakes in La Grande 4 Dam area, Quebec.*

'Lac de Forsan' series

A series of lake sediment samples was collected by A.C. Larouche on April 29, 1983 and in May 1983 from the 'Lac de Forsan area', James Bay region. These samples were submitted by P.J.H. Richard to gain information on the timing of deglaciation.

Core LG4-83-10

GSC-5797. LG4-83-10: A

normalized age:	5720 ± 110
$\delta^{13}C$:	-18.0‰
uncorrected age:	5600 ± 110

This site is situated 22 km west of 'Lac de Forsan', (54°29′01″N, 72°56′26″W), at an elevation of 465 m. Lake sediment, basal silty gyttja sample LG4-83-10: A (268–273 cm depth; 10.0 g dry weight), enclosed in lake sediment, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (7.5 g) yielded 2.00 L of CO_2 gas. The age estimate is based on one count for 3780 minutes in the 2 L counter with a mixing ratio of 2.19. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.093 ± 0.099, 1.204 ± 0.025, and 18.269 ± 0.117 cpm, respectively.

Comment (P.J.H. Richard): This basal sample provides a minimum age for local ice retreat.

Core LG4-83-11

GSC-5445. LG4-83-11: A

normalized age:	5700 ± 160
$\delta^{13}C$:	-23.9‰
uncorrected age:	5680 ± 160

This site is situated 21 km due west of 'Lac de Forsan', (54°26′35″N, 72°56′48″W), at an elevation of 465 m. Lake sediment, silty basal gyttja sample LG4-83-11: A (273–278 cm depth; 16.40 g dry weight), enclosed in silt, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (14.0 g) yielded 1.26 L of CO_2 gas. The age estimate is based on one count for 2200 minutes in the 2 L counter with a mixing ratio of 3.48. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.048 ± 0.168, 1.214 ± 0.025, and 18.357 ± 0.145 cpm, respectively.

Comment (P.J.H. Richard): This basal sample provides a minimum age for local ice retreat.

Boniface River series

A series of wood samples was collected from the Boniface River area, about 130 km southeast of Inukjuak, Quebec. These samples were submitted by C. Lavoie and S. Payette to gain information on the paleobotany of the region, specifically the spruce maximum.

GSC-5591. Boniface River I

normalized age:	1650 ± 60
$\delta^{13}C$:	-24.3‰
uncorrected age:	1640 ± 60

Wood sample EW10-A1 (11.2 g dry weight; *Picea mariana*, identified by C. Lavoie), enclosed in peat, was collected by C. Lavoie on July 15, 1992 at latitude 57°48′N, longitude 76°14′W, and an elevation of 110 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.5 g) yielded 8.4 L of CO_2 gas. The age estimate is based on two counts for 2145 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 22.922 ± 0.113, 2.197 ± 0.031, and 28.117 ± 0.130 cpm, respectively.

GSC-5532. Boniface River II

normalized age:	1710 ± 60
$\delta^{13}C$:	-26.0‰
uncorrected age:	1730 ± 60

Wood sample EW13-A1 (13.10 g dry weight; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 93-15) was collected by C. Lavoie and S. Payette on July 15, 1992, from a depth of 56 cm in sedge peat, at latitude 57°45′N, longitude 76°04′W, and an elevation of 120 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 8.3 L of CO_2 gas. The age estimate is based on one count for 2500 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 22.857 ± 0.115, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

GSC-5421. Boniface River III

normalized age:	1910 ± 70
$\delta^{13}C$:	-24.5‰
uncorrected age:	1900 ± 70

Wood sample EW6-A1 (17.1 g dry weight; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 92-50) was collected by C. Lavoie, E. Marcoux, and M. Lévesque on July 30, 1991 from a depth of 60 cm, at latitude 57°44′N, longitude 76°16′W, and an elevation of 120 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 8.15 L of CO_2 gas. The age estimate is based on two counts for 2060 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 22.326 ± 0.149, 2.106 ± 0.025, and 28.293 ± 0.128 cpm, respectively.

GSC-5533. Boniface River IV

normalized age:	2060 ± 70
$\delta^{13}C$:	-23.5‰
uncorrected age:	2040 ± 70

Wood sample EW14-A1 (*Picea*, identified by H. Jetté in unpublished GSC Wood Report 93-16), enclosed in peat, was collected by C. Lavoie and S. Payette on July 15, 1992, at latitude 57°40′N, longitude 76°04′W, and an elevation of 125 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 6.7 L of CO_2 gas. The age estimate is based on two counts for 3610 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.084 ± 0.084, 1.214 ± 0.024, and 18.146 ± 0.102 cpm, respectively.

GSC-5565. Boniface River V

normalized age:	2170 ± 60
$\delta^{13}C$:	-25.9‰
uncorrected age:	2180 ± 60

Wood sample EW6-A21 (10.8 g dry weight; *Picea mariana*, identified by C. Lavoie), enclosed in peat, was collected by C. Lavoie on July 15, 1992 at latitude 57°44′N, longitude 76°16′W, and an elevation of 120 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9 g) yielded 9.2 L of CO_2 gas. The age estimate is based on two counts for 1910 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.456 ± 0.117, 2.168 ± 0.035, and 28.159 ± 0.131 cpm, respectively.

GSC-5574. Boniface River VI

normalized age:	2230 ± 60
$\delta^{13}C$:	-23.3‰
uncorrected age:	2200 ± 60

Wood sample EW11-A2 (11.0 g dry weight; *Picea mariana*, identified by C. Lavoie), enclosed in peat, was collected by C. Lavoie on July 15, 1992 at latitude 57°40′N, longitude 76°04′W, and an elevation of 128 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (10 g) yielded 9.6 L of CO_2 gas. The age estimate is based on two counts for 1985 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.416 ± 0.115, 2.168 ± 0.035, and 28.159 ± 0.131 cpm, respectively.

GSC-5568. Boniface River VII

normalized age:	2390 ± 60
$\delta^{13}C$:	-25.0‰
uncorrected age:	2390 ± 60

Wood sample EW7-A10 (15.8 g dry weight; *Picea mariana*, identified by C. Lavoie), enclosed in peat, was collected by C. Lavoie on July 15, 1992 at latitude 57°45′N, longitude 76°10′W, and an elevation of 110 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9 g) yielded 9.0 L of CO_2 gas. The age estimate is based on two counts for 2055 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 20.904 ± 0.111, 2.168 ± 0.035, and 28.159 ± 0.131 cpm, respectively.

GSC-5530. Boniface River VIII

normalized age:	2540 ± 60
$\delta^{13}C$:	-23.7‰
uncorrected age:	2520 ± 60

This palsa bog, at latitude 57°45′N, longitude 76°10′W, and an elevation of 110 m, was sampled by C. Lavoie and S. Payette on July 15, 1992. Wood sample EW7-A8 (12.80 g dry weight; , identified by C. Lavoie in unpublished GSC Wood Report 93-11), from a depth of 110 cm in sedge peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 8.3 L of CO_2 gas. The age estimate is based on two counts for 2100 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 20.706 ± 0.119, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

GSC-5546. Boniface River IX

normalized age:	2760 ± 70
$\delta^{13}C$:	-25.9‰
uncorrected age:	2770 ± 70

Wood sample EW2-A21 (18.40 g dry weight; *Picea mariana*, identified by C. Lavoie), enclosed in peat, was collected by C. Lavoie on July 15, 1992 at latitude 57°44′N, longitude 76°10′W, and an elevation of 115 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.5 g) yielded 8.2 L of CO_2 gas. The age estimate is based on two counts for 2200 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 20.047 ± 0.113, 2.176 ± 0.051, and 28.307 ± 0.186 cpm, respectively.

GSC-5579. Boniface River X

normalized age:	2880 ± 60
$\delta^{13}C$:	-23.7‰
uncorrected age:	2860 ± 60

Wood sample EW9-A1 (9.0 g dry weight; *Picea mariana*, identified by C. Lavoie), enclosed in peat, was collected by C. Lavoie on July 15, 1992 at latitude 57°46′N, longitude 76°03′W, and an elevation of 135 m. The sample was treated

with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8 g) yielded 7.8 L of CO_2 gas. The age estimate is based on two counts for 2060 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 19.719 ± 0.109, 2.168 ± 0.035, and 28.159 ± 0.131 cpm, respectively.

GSC-5598. Boniface River XI

normalized age:	2980 ± 60
$\delta^{13}C$:	-25.5‰
uncorrected age:	2980 ± 60

Wood sample EW9-A3 (12.8 g dry weight; *Picea mariana*, identified by C. Lavoie), at a depth of 75 cm in peat, was collected by C. Lavoie on July 15, 1992 at latitude 57°46′N, longitude 76°03′W, and an elevation of 135 m. The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.7 g) yielded 8.5 L of CO_2 gas. The age estimate is based on two counts for 2160 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 19.390 ± 0.105, 2.197 ± 0.031, and 28.117 ± 0.130 cpm, respectively.

Comment (S. Payette): These samples were collected to date the maximum establishment of spruce during the forest optimum, at tree line, in subarctic Quebec. The dimensions of the logs found in the peat and the width of the growth rings suggest that the climate was milder in the past because the radial growth of the log is greater than for spruce in modern forest-tundra of the Boniface River area.

Inukjuak series

A series of wood samples was collected by M.C. Penalba on August 17, 1992 from 155 km southeast of Inukjuak, northern Quebec (57°42′N, 75°55′W), at an elevation of 140 m. These samples were submitted by M.C. Penalba to gain information on the paleobiology of the region.

GSC-5534. Inukjuak I

normalized age:	2180 ± 50
$\delta^{13}C$:	-27.5‰
uncorrected age:	2220 ± 50

This sample was dated to gain information on the initial occurrence of *Larix laricina* in the area. Wood sample 2/60 (9.50 g dry weight; *Salix*< identified by H. Jetté in unnublished GSC Wood Report 93-13), enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.2 g) yielded 8.4 L of CO_2 gas. The age estimate is based on one count for 3910 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.513 ± 0.096, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

GSC-5513. Inukjuak II

normalized age:	2740 ± 70
$\delta^{13}C$:	-28.1‰
uncorrected age:	2790 ± 70

This sample was dated to gain information on a pollen profile and peat transition from *Sphagnum* above to Cyperaceae below. Peat sample 2/100 (102.0 g wet weight; *Musci, Sphagnum, Picea*, and Cyperaceae, identified by M.C. Penalba), enclosed in peat, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (10.2 g) yielded 7.37 L of CO_2 gas. The age estimate is based on two counts for 2400 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 20.056 ± 0.103, 2.148 ± 0.033, and 28.377 ± 0.182 cpm, respectively.

GSC-5506. Inukjuak III

normalized age:	3300 ± 70
$\delta^{13}C$:	-29.1‰
uncorrected age:	3360 ± 70

This sample was dated to gain information on a pollen profile and major vegetation changes. Peat sample 2 (150 cm depth; 121.1 g wet weight; *Musci* and Cyperaceae, identified by M.C. Penalba), enclosed in peat, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (19.4 g) yielded 4.65 L of CO_2 gas. The age estimate is based on two counts for 2205 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.050 ± 0.081, 1.213 ± 0.025, and 18.316 ± 0.104 cpm, respectively.

GSC-5502. Inukjuak IV

normalized age:	3680 ± 80
$\delta^{13}C$:	-27.9‰
uncorrected age:	3730 ± 80

This sample was dated to gain information on the initial occurrence of *Larix laricina* in the area. Peat sample 2/190 (122.5 g wet weight; *Musci* and Cyperaceae, identified by M.C. Penalba), enclosed in peat, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (13.5 g) yielded 5.86 L of CO_2 gas. The age estimate is based on two counts for 2230 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.518 ± 0.079, 1.213 ± 0.025, and 18.316 ± 0.104 cpm, respectively.

GSC-5473. Inukjuak V

normalized age:	3830 ± 60
$\delta^{13}C$:	-28.3‰
uncorrected age:	3890 ± 60

This sample was dated to gain information on deglaciation and peat development. Basal peaty clay sample 2/220 (57.1 g dry weight), overlying clay, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (37.6 g) yielded 7.12 L of CO_2 gas. The age estimate is based on one count for 3965 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.284 ± 0.094, 2.201 ± 0.062, and 28.038 ± 0.135 cpm, respectively.

GSC-5518. Inukjuak VI

normalized age:	970 ± 60
$\delta^{13}C$:	-27.7‰
uncorrected age:	1010 ± 60

Peat sample 2/30 (Cyperaceae, identified by M.C. Penalba), enclosed in peat, was collected by M.C. Penalba on August 17, 1992 from 155 km southeast of Inukjuak, northern Quebec (57°47′N, 75°55′W), at an elevation of 140 m. The sample was submitted by M.C. Penalba to gain information on the initial presence of *Larix laricina*.

The sample was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.2 g) yielded 7.30 L of CO_2 gas. The age estimate is based on one count for 3682 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 25.011 ± 0.092, 2.148 ± 0.033, and 28.377 ± 0.182 cpm, respectively.

GSC-5678. Akpatok Island

normalized age:	3760 ± 60
$\delta^{13}C$:	-25.4‰
uncorrected age:	3770 ± 60

Moss peat sample '1993/2' was collected by G. Donaldson on September 01, 1993 from the northern tip of Akpatok Island, Ungava Bay, Baffin region, Nunavut (60°35′N, 68°00′W), at an elevation of 300 m. The sample was submitted by A.J. Gaston to gain information on peat development in response to an avian community.

The sample (22.2 g dry weight) was treated with hot base, hot acid (moderately calcareous), and distilled water rinses. The treated sample (11.0 g) yielded 6.98 L of CO_2 gas. The age estimate is based on two counts for 2065 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 17.577 ± 0.102, 2.258 ± 0.029, and 28.094 ± 0.130 cpm, respectively.

Refer to Gaston and Donaldson (1995) for comments.

GSC-5581. Rivière Jacquere

normalized age:	4180 ± 70
corrected age:	3780 ± 70
$\delta^{13}C$:	+1.62‰
uncorrected age:	3760 ± 70

Marine shell sample RJ-1A (*Mya truncata*, identified by D. Bruneau), enclosed in sand and silt, was collected by D. Bruneau on August 07, 1989 from first major tributary of Rivière Jacquere, about 1 km upstream of the river mouth on Hudson Strait (Foul Bay), Ungava Peninsula, Quebec (62°07′N, 72°57′W), at an elevation of 3.0 m. The sample was submitted by J.T. Gray to gain information on sea level change.

The sample (41.9 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (32 g) yielded 7.3 L of CO_2 gas. The age estimate is based on two counts for 2065 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.640 ± 0.121, 2.168 ± 0.035, and 28.159 ± 0.131 cpm, respectively.

Charles Island series

A series of peat samples was collected by J.T. Gray and B. Lauriol on July 8, 1988 from the south coast of Charles Island, Hudson Strait, Baffin region, Nunavut (62°37′18″N, 74°16′30″W), at an elevation of 0.4 m. These samples were submitted by J.T. Gray to gain information on the development of peat.

GSC-5597. Charles Island I

age:	modern
$\delta^{13}C$:	-24.5‰

Peat sample 'CHA 25C' (134.0 g wet weight), the top of the peat layer, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (21.8 g) yielded 11.8 L of CO_2 gas. The age estimate is based on one count for 1105 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 28.931 ± 0.171, 2.197 ± 0.031, and 28.117 ± 0.130 cpm, respectively.

GSC-5595. Charles Island II

normalized age:	520 ± 50
$\delta^{13}C$:	-20.4‰
uncorrected age:	450 ± 50

Basal peat sample 'CHA 25A' (486.0 g wet weight) was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (18.8 g) yielded 7.2 L of CO_2 gas. The age estimate is based on two counts for 2290 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 26.586 ± 0.116, 2.197 ± 0.031, and 28.117 ± 0.130 cpm, respectively.

GSC-5593. Charles Island III

normalized age:	2980 ± 100
corrected age:	2580 ± 100
$\delta^{13}C$:	+3.69‰
uncorrected age:	2520 ± 100

Marine shell fragment sample CHA 29 (*Balanus*, identified by J.T. Gray), enclosed in sand and gravel, was collected by J.T. Gray and B. Lauriol on July 08, 1988 from the north coast of Charles Island, Hudson Strait, Baffin region, Nunavut (62°40′00″N, 74°18′00″W), at an elevation of 7 m. The sample was submitted by J.T. Gray to gain information on sea level change.

The sample (12.0 g dry weight) was treated with an acid leach to remove the outer 5%. The treated sample (11.1 g) yielded 2.5 L of CO_2 gas. The age estimate is based on two counts for 2145 minutes in the 2 L counter with a mixing ratio of 1.74. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.258 ± 0.119, 1.227 ± 0.024, and 18.146 ± 0.137 cpm, respectively.

'Salluit village' series

A series of marine shells samples, in biocenosis, was collected by J.T. Gray and B. Lauriol on August 13, 1984 from 'Salluit village', Ungava, Quebec (62°12′34″N, 75°38′22″W), at an elevation of 3.4 m. These samples were submitted by J.T. Gray to gain information on sea level change.

GSC-5584. 'Salluit Village' I

normalized age:	5210 ± 80
corrected age:	4810 ± 80
$\delta^{13}C$:	+2.72‰
uncorrected age:	4770 ± 80

Marine shell sample SU 1-6 (21.8 g dry weight; *Mya truncata* and *M. pseudoarenaria*, identified by J.T. Gray and B. Lauriol), enclosed in sandy silt, was treated with an acid leach to remove the outer 20%. The treated sample (17 g) yielded 4.1 L of CO_2 gas. The age estimate is based on two counts for 2040 minutes in the 2 L counter with a mixing ratio of 1.06. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.138 ± 0.080, 1.179 ± 0.020, and 18.355 ± 0.109 cpm, respectively.

GSC-5583. 'Salluit Village' II

normalized age:	5350 ± 80
corrected age:	4950 ± 80
$\delta^{13}C$:	+1.66‰
uncorrected age:	4920 ± 80

Marine shell sample SU 1-5 (29.0 g dry weight; *Balanus*, identified by J.T. Gray and B. Lauriol), enclosed in littoral gravel and cobbles, was treated with an acid leach to remove the outer 20%. The treated sample (21 g) yielded 4.7 L of CO_2 gas. The age estimate is based on two counts for 1910 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.949 ± 0.079, 1.179 ± 0.020, and 18.355 ± 0.109 cpm, respectively.

GSC-5582. 'Salluit Village' III

normalized age:	6450 ± 70
corrected age:	6050 ± 70
$\delta^{13}C$:	+2.91‰
uncorrected age:	6000 ± 70

Marine shell sample SU 1-2 (53.0 g dry weight; *Mya truncata* and *M. pseudoarenaria*, identified by J.T. Gray and B. Lauriol), enclosed in sandy clayey silt, was treated with an acid leach to remove the outer 30%. The treated sample (37 g) yielded 8.2 L of CO_2 gas. The age estimate is based on one count for 3770 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.336 ± 0.073, 2.168 ± 0.035, and 28.159 ± 0.131 cpm, respectively.

'Rivière des Fossiles' series

A series of wood and shell samples was collected by J.T. Gray and B. Lauriol on June 29, 1988 from 'Rivière des Fossiles' at the head of Fjord de Salluit, Ungava, Quebec (62°06′37″N, 75°45′00″W). These samples were submitted by J.T. Gray to gain information on sea level change.

GSC-5592. 'Rivière des Fossiles' I

normalized age:	800 ± 40
$\delta^{13}C$:	-28.1‰
uncorrected age:	850 ± 40

Wood sample SAL 3D (10.2 g dry weight; *Populus balsamii*, identified by A. Larouche), enclosed in eolian sand at an elevation of 21.5 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.3 g) yielded 9.3 L of CO_2 gas. The age estimate is based on one count for 6285 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.291 ± 0.073, 2.197 ± 0.031, and 28.117 ± 0.130 cpm, respectively.

GSC-5588. 'Rivière des Fossiles' II

normalized age:	5590 ± 100
corrected age:	5190 ± 100
$\delta^{13}C$:	+2.55‰
uncorrected age:	5150 ± 100

Marine shell sample SAL 3A (17.4 g dry weight; *Mya pseudoarenaria*, identified by J.T. Gray), enclosed in organic-rich silt at an elevation of 15 m, was treated with an acid leach to remove the outer 20%. The treated sample (13.6 g) yielded 3.1 L of CO_2 gas. The age estimate is based on two counts for 2160 minutes in the 2 L counter with a mixing ratio of 1.41.

The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.557 ± 0.092, 1.227 ± 0.024, and 18.146 ± 0.137 cpm, respectively.

GSC-5590. 'Rivière des Caribous'

normalized age:	5770 ± 60
corrected age:	5370 ± 60
$\delta^{13}C$:	+1.85‰
uncorrected age:	5340 ± 60

Marine shell sample SAL 7B (*Mya truncata* and *M. pseudoarenaria*, identified by J.T. Gray and B. Lauriol), enclosed in sand and an algal bed, was collected by J.T. Gray and B. Lauriol on June 30, 1988 from on the west bank of the 'Rivière des Caribous', 2 km above its junction with the 'Rivière des Fossiles', 15 km south-southwest of the village of 'Alluit', Ungava, Quebec (62°12′35″N, 75°46′02″W), at an elevation of 32 m. The sample was submitted by J.T. Gray to gain information on sea level change.

The sample (46.0 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (36.6 g) yielded 7.8 L of CO_2 gas. The age estimate is based on one count for 3900 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.460 ± 0.072, 2.197 ± 0.031, and 28.117 ± 0.130 cpm, respectively.

GSC-5509. Ivujivik

normalized age:	1580 ± 60
$\delta^{13}C$:	-24.2‰
uncorrected age:	1560 ± 60

Moss peat sample 92/2 was collected by A.J. Gaston on August 22, 1922 from Digges Islands, 25 km north of Ivujivik, off the shore of Quebec, Baffin region, Nunavut (62°33′N, 77°50′W), at an elevation of 150 m. The sample was submitted by A.J. Gaston to gain information on peat development in response to a seabird colony.

The sample (29.8 g dry weight) was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 7.81 L of CO_2 gas. The age estimate is based on one count for 3833 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 23.357 ± 0.088, 2.148 ± 0.033, and 28.377 ± 0.182 cpm, respectively.

Refer to Gaston and Donaldson (1995) for comments.

GSC-5420. Kovik Bay

normalized age:	6570 ± 90
corrected age:	6170 ± 90
$\delta^{13}C$:	+1.79‰
uncorrected age:	6140 ± 90

Marine shell sample 91-DKA-170 (*Hiatella arctica*, identified by R.A. Daigneault), enclosed in sandy silt, was collected by R.A. Daigneault on July 19, 1991 from 10 km southeast of Kovik Bay, Nouveau-Québec (61°29′14″N, 77°29′08″W), at an elevation of 38 m. The sample was submitted by R.A. Daigneault to gain information on sea level change, and deglaciation.

The sample (38.4 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (30.7 g) yielded 6.87 L of CO_2 gas. The age estimate is based on one count for 3680 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.532 ± 0.057, 1.209 ± 0.024, and 18.316 ± 0.145 cpm, respectively.

GSC-5423. 'Lake Nalljuaq'

normalized age:	4390 ± 90
corrected age:	3990 ± 90
$\delta^{13}C$:	+2.03‰
uncorrected age:	3950 ± 90

Marine shell sample 91-DKA-59 (*Mya pseudoarenaria*, identified by R.A. Daigneault), enclosed in sand, was collected by R.A. Daigneault on June 29, 1991 on the north shore of the river that flows west, 5 km southwest of 'Lake Nalljuaq', Nouveau-Québec (61°50′06″N, 78°00′00″W), at an elevation of 26 m. The sample was submitted by R.A. Daigneault to gain information on sea level change, and a delta construction.

The sample (28.5 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (22.7 g) yielded 5.04 L of CO_2 gas. The age estimate is based on two counts for 2005 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.196 ± 0.082, 1.209 ± 0.024, and 18.316 ± 0.145 cpm, respectively.

GSC-5409. Pointe de Sainte Hélène

normalized age:	7360 ± 80
corrected age:	6960 ± 80
$\delta^{13}C$:	+1.74‰
uncorrected age:	6930 ± 80

Marine shell sample 91-DKA-26 (*Hiatella arctica*, identified by R.A. Daigneault), enclosed in muddy silt, was collected by R.A. Daigneault on June 26, 1991 from 10 km northeast of Pointe de Sainte Hélène, Nouveau-Québec (62°14′58″N, 78°00′35″W), at an elevation of 75 m. The sample was submitted by R.A. Daigneault to gain information on sea level change, and deglaciation.

The sample (37.5 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (29.7 g) yielded 6.80 L of CO_2 gas. The age estimate is based on one count for 3730 minutes in the 5 L counter with a mixing ratio of 1.00.

The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.934 ± 0.072, 2.197 ± 0.037, and 28.267 ± 0.155 cpm, respectively.

GSC-5412. Ice Harbour

normalized age:	2880 ± 60
corrected age:	2480 ± 60
$\delta^{13}C$:	+0.54‰
uncorrected age:	2470 ± 60

Marine shell sample 91-DKA-27 (*Mytilus edulis*, identified by R.A. Daigneault), enclosed in sand, was collected by R.A. Daigneault on June 24, 1991 from 4 km northeast of Ice Harbour, Nouveau-Québec (62°00′19″N, 78°02′02″W), at an elevation of 22 m. The sample was submitted by R.A. Daigneault to gain information on sea level change, specifically the 22 m RSL.

The sample (50.5 g dry weight) was treated with an acid leach to remove the outer 10%. The treated sample (35.1 g) yielded 8.01 L of CO_2 gas. The age estimate is based on one count for 4125 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 20.782 ± 0.083, 2.197 ± 0.037, and 28.267 ± 0.155 cpm, respectively.

Ontario

Figure 12. *Radiocarbon-dated sites in Ontario.*

Plate Lake series

A series of lake sediment samples was collected by T.W. Anderson on October 14, 1988 from Plate Lake, 9.5 km east of Parry Sound, Ontario (45°20′50″N, 79°55′10″W), at an elevation of 251 m. These samples were submitted by T.W. Anderson to gain information on the pollen spectra influx.

GSC-5596. Plate Lake I

normalized age:	9450 ± 160
$\delta^{13}C$:	-25.8‰
uncorrected age:	9470 ± 160

Lake sediment gyttja sample AP-88-9 (579–581 cm depth; 50.6 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (5.8 g) yielded 2.0 L of CO_2 gas. The age estimate is based on two counts for 2500 minutes in the 2 L counter with a mixing ratio of 2.16. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.583 ± 0.100, 1.227 ± 0.024, and 18.146 ± 0.137 cpm, respectively.

GSC-5600. Plate Lake II

normalized age:	9720 ± 140
$\delta^{13}C$:	-26.5‰
uncorrected age:	9740 ± 140

Lake sediment gyttja sample AP-88-9 A (591–593.3 cm depth; 66.7 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment omitted. The treated sample (13.1 g) yielded 2.7 L of CO_2 gas. The age estimate is based on one count for 2570 minutes in the 2 L counter with a mixing ratio of 1.64. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.395 ± 0.079, 1.227 ± 0.024, and 18.146 ± 0.137 cpm, respectively.

Comment (T.W. Anderson): Sample GSC-5596 falls at the upper limit of the spruce pollen recurrence in the eastern Georgian Bay area. Sample GSC-5600 falls at the lower limit of the spruce recurrence in the same lake. Samples GSC-5600 and -5596 bracket a regional climate reversal in the eastern extremity of the upper Great Lakes that is indicated by the *Picea* pollen recurrence and corresponding *Pinus* minimum (Anderson and Lewis, 2002).

Strain Lake series

A series of lake sediment samples was collected by T.W. Anderson on October 13, 1988 from Strain Lake, about 0.5 km west of the junction of Highways 69 and 69B, on the northwest edge of Parry Sound, Ontario (45°21′33″N, 80°02′48″W), at an elevation of 206 m. These samples were submitted by T.W. Anderson to gain information on the pollen sequence and climate change.

GSC-5594. Strain Lake I

normalized age:	9430 ± 150
$\delta^{13}C$:	-25.9‰
uncorrected age:	9450 ± 150

Lake sediment gyttja sample AP-88-8 (548.3–550 cm depth; 106.4 g wet weight), enclosed in gyttja, was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (11.0 g) yielded 2.6 L of CO_2 gas. The age estimate is based on two counts for 2190 minutes in the 2 L counter with a mixing ratio of 1.69. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.599 ± 0.087, 1.227 ± 0.024, and 18.146 ± 0.137 cpm, respectively.

GSC-5297. Strain Lake II

normalized age:	9720 ± 120
$\delta^{13}C$:	-27.9‰
uncorrected age:	9760 ± 120

Lake sediment, basal gyttja sample AP-88-8A (556.5–560 cm depth; 162.1 g wet weight) was treated with hot acid (noncalcareous), and distilled water rinses. The base treatment was omitted. The treated sample (43.1 g) yielded 4.19 L of CO_2 gas. The age estimate is based on one count for 3840 minutes in the 2 L counter with a mixing ratio of 1.08. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.500 ± 0.057, 1.261 ± 0.033, and 18.546 ± 0.156 cpm, respectively.

Comment (T.W. Anderson): Sample GSC-5594 dates the upper limit of the spruce pollen recurrence in the eastern Georgian Bay area. Sample GSC-5297 dates the lower limit of the spruce recurrence in the same lake. Samples GSC-5297 and -5594 bracket a regional climate reversal in the eastern extremity of the upper Great Lakes region that is indicated by the *Picea* pollen recurrence and corresponding *Pinus* minimum (Anderson and Lewis, 1992, 2002).

'Ballycroy Bog' series

A series of woody peat samples was collected by T.W. Anderson and P.F. Karrow in 1968, and by T.W. Anderson on September 29, 1993, from 'Ballycroy Bog', located in a kettle hole in the Oak Ridges Moraine, 1.6 km south of Ballycroy and about 5 km west of Palgrave, Ontario (43°57′15″N, 79°52′20″W), at an elevation of 290 m. These samples were submitted by T.W. Anderson to gain information on the pollen spectrum in the bog.

GSC-5759. 'Ballycroy Bog' I

normalized age:	3730 ± 60
$\delta^{13}C$:	-25.7‰
uncorrected age:	3740 ± 60

Woody peat sample AP-93-10A (71–77 cm depth; 91.7 g wet weight), enclosed in black woody peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (12.4 g) yielded 12.72 L of CO_2 gas. The age estimate is based on two counts for 3465 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.841 ± 0.089, 2.137 ± 0.035, and 28.437 ± 0.131 cpm, respectively. This sample was submitted by T.W. Anderson to gain information on the pollen zone, related to the second *Tsuga* maximum.

GSC-5754. 'Ballycroy Bog' II

normalized age:	6060 ± 70
$\delta^{13}C$:	-27.3‰
uncorrected age:	6100 ± 70

Peat sample AP-93-10 (132–138 cm depth; 90.6 g wet weight), enclosed in brown fibrous peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.9 g) yielded 7.56 L of CO_2 gas. The age estimate is based on two counts for 2170 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.300 ± 0.090, 2.107 ± 0.032, and 28.412 ± 0.128 cpm, respectively.

Comment (T.W. Anderson): Sample GSC-5754 was intended to date the boundary between the *Tsuga* minimum and the second *Tsuga* maximum in the surface peat in 'Ballycroy Bog'. The date is about 2600 years too old, based on a previous date of 4220 ± 130 BP (GSC-1146) near the base of the *Tsuga* minimum (Anderson, 1971). It is likely that the 1993 sample location was not the same as that in 1968 and bog growth was higher than expected. Sample GSC-5759 was intended to date the midpoint of the second *Tsuga* maximum. The date is about 2000 years too old for the same reasons.

GSC-1146. 'Ballycroy Bog' III

normalized age:	4220 ± 130
$\delta^{13}C$:	-25.5‰
uncorrected age:	4220 ± 130

Fibrous peat sample A-3 (230–235 cm depth) was above the shelly marl in a sequence of woody peat, shelly marl, and detrital gyttja.

GSC-1143. 'Ballycroy Bog' IV

uncorrected age: 10 900 ± 200

Lake sediment, basal gyttja sample A-2 (604–609 cm depth), underlain by silty clay and overlain by shelly marl, was collected by T.W. Anderson and P.F. Karrow in 1968. This sample was submitted by T.W. Anderson to gain information on the *Picea-Pinus* zone boundary.

Comment (P.F. Karrow and T.W. Anderson in Lowdon et al., 1977): The age determinations provide a dated pollen sequence from an upland bog with which to compare the pollen record and radiocarbon date from the 'Cookstown Bog' (cf. GSC-1111, Lowdon et al., 1977) and the pollen record at Alliston on the Lake Algonquin plain. Sample GSC-1143 dates the spruce-pine transition, which occurs within the Algonquin sediments at Alliston (cf. Anderson, 1971; Karrow et al., 1975) and sample GSC-1146 dates the hemlock pollen minimum. Sample GSC-1143 seems slightly old when compared to regional information.

WESTERN CANADA

Manitoba

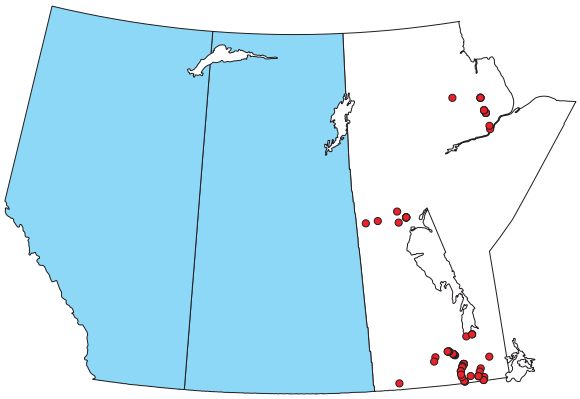


Figure 13. *Radiocarbon-dated sites in Manitoba.*

GSC-5686. Hazel Creek

normalized age: 2010 ± 50
$\delta^{13}C$: -25.6‰
uncorrected age: 2020 ± 50

Wood sample '93 M74 0819 (1.2 m)' (*Larix*, identified by H. Jetté in unpublished GSC Wood Report 92-06), enclosed in the base of 1.2 m of interbedded medium to coarse sand and silty fine sand, was collected by G. Matile and H. Thorleifson on August 18, 1993 from the abandoned upper reaches of Hazel Creek, 3 km north-northwest of Hadashville, southeastern Manitoba (49°42′02″N, 95°55′49″W), at an elevation of 295 m. This sample was submitted by G. Matile to gain information on alluviation.

Comment (G. Matile): The wood was collected from the base a 1.2 m shovel hole at the edge of a cultivated field. The water table was at 0.9 m. The enclosing material contained abundant Paleozoic carbonate clasts, shells and charcoal, which may or may not be of the same age. There was a buried 'A horizon' at 0.2 m. In addition to the log, the sediment contained disseminated charcoal and numerous bivalves. The sediment is interpreted as alluvium. A wood sample from a river terrace 8 km up stream on the Whitemouth River was dated at 7.1 ka BP (Morlan et al. 2000, BGS-1424 in the section on the Moorhead Phase of Lake Agassiz).

This date was previously reported in Morlan et al. (2000).

GSC-5430. Sundown

normalized age: 10 200 ± 110
$\delta^{13}C$: -26.0‰
uncorrected age: 10 200 ± 110

Wood sample L-003 (2.5 m depth; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 92-52), enclosed in sand, was collected by G. Matile and H. Thorleifson on August 13, 1991 from 2.5 km northwest of Sundown, southeastern Manitoba (49°06′51″N, 96°17′31″W), at an elevation of 322 m. This sample was submitted by G. Matile to gain information on the Moorhead Phase of Lake Agassiz.

Comment (G. Matile): A backhoe test site was excavated on August 13, 1991. The sample was collected from below the water table in unoxidized, saturated sediment. Pieces of wood were removed from the enclosing sediment after the sample was dry. The enclosing sediment contained abundant Paleozoic carbonate. Lignite was collected from enclosing material. The sediment enclosing and overlying the organic materials is interpreted to be an Emerson Phase (Lake Agassiz) sequence. The wood was abraded, which suggests that it was reworked Moorhead Phase wood.

This date was previously reported in Morlan et al. (2000).

GSC-5697. Somme I

normalized age: 9950 ± 100
$\delta^{13}C$: -25.8‰
uncorrected age: 9970 ± 100

Wood sample LM 537 (1.7 m depth; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 94-63), enclosed in sand, was collected by G. Matile on August 13, 1991 from 1 km southwest of Somme, southeastern Manitoba (49°01′35″N, 96°20′13″W), at an elevation of 322 m. This sample was submitted by G. Matile to gain information on the Moorhead Phase of Lake Agassiz.

Comment (G. Matile): A backhoe test site was excavated on August 16, 1991. The sample was collected from below the water table in unoxidized saturated sediment. The enclosing sediment contains abundant Paleozoic carbonate and disseminated organic material, which could contain pre-Quaternary organic material such as lignite. The sediment enclosing and overlying the organic material is believed to be a Moorhead Phase (Lake Agassiz) sequence, possibly a beach berm that has been subdued by Emerson Phase wave erosion.

This date was previously reported in Morlan et al. (2000).

GSC-5330. Somme II

normalized age:	9940 ± 90
$\delta^{13}C$:	-26.7‰
uncorrected age:	9960 ± 90

Wood sample LM-535 (2.3 m depth; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 92-01), enclosed in glaciolacustrine sand of a beach berm, was collected by G. Matile on August 12, 1991 from 1 km southwest of Somme, southeastern Manitoba (49°01′38″N, 96°20′13″W), at an elevation of 322 m. This sample was submitted by G. Matile to gain information on the Moorhead Phase of Lake Agassiz.

Comment (G. Matile): This sample dates a drowned beach berm of Lake Agassiz, from the end of the Moorhead Phase. This site is very similar in landform, strandline correlation, and age to sample GSC-4732 (above). Although it is similar in elevation to the lower Campbell strandline, it predates the strandline. The strandline, which has been correlated with the lower Campbell in southeastern Manitoba, has not been drowned.

This date was previously reported in Morlan et al. (2000).

GSC-5710. Marchand

normalized age:	10 100 ± 140
$\delta^{13}C$:	-27.9‰
uncorrected age:	10 200 ± 140

Wood fragment sample LM 567 (1.0–2.5 m depth; unidentifiable, according to H. Jetté in unpublished GSC Wood Report 94-69), enclosed in sand, was collected by G. Matile on August 16, 1991 from 6.5 km south of Marchand, southeastern Manitoba (49°23′06″N, 96°23′50″W), at an elevation of 311 m. This sample was submitted by G. Matile to gain information on the Moorhead Phase of Lake Agassiz.

Comment (G. Matile): A backhoe test site was excavated on August 16, 1991 and the sample was collected near the water table; consequently, the enclosing sediment is oxidized and wet. White mould was formed on wood fragments at time of collection. The enclosing sediment contains abundant Paleozoic carbonate. The sediment enclosing and overlying the organic materials is interpreted to be an Emerson Phase (Lake Agassiz) sequence, but the wood is believed to be reworked from the Moorhead Phase.

This date was previously reported in Morlan et al. (2000).

GSC-5357. Zhoda

normalized age:	10 100 ± 90
$\delta^{13}C$:	-28.0‰
uncorrected age:	10 200 ± 90

Wood sample L021 (2.5–3.5 m depth; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 92-05), enclosed in sand, was collected by G. Matile on August 12, 1991 from 3.5 km southeast of Zhoda, southeastern Manitoba (49°17′41″N, 96°27′50″W), at an elevation of 311 m. This sample was submitted by G. Matile to gain information on the Moorhead Phase of Lake Agassiz.

Comment (G. Matile): The date confirms a Moorhead Phase origin for wood (flotsam). The enclosing sediment is believed to be littoral sand resulting from the formation of the landforms associated with the upper Campbell strandline, at the beginning of the Emerson Phase of Lake Agassiz.

This date was previously reported in Morlan et al. (2000).

GSC-5731. Vita

normalized age:	9960 ± 190
$\delta^{13}C$:	-25.1‰
uncorrected age:	9960 ± 190

The wood sample (1.8 m depth; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 94-17), enclosed in silt and sand, was collected by G. Matile on August 8, 1991 from 3.5 km northeast of Vita, southeastern Manitoba (49°09′48″N, 96°32′46″W), at an elevation of 303 m. This sample was submitted by G. Matile to gain information on the Moorhead Phase of Lake Agassiz.

Comment (G. Matile): A backhoe test pit was excavated on August, 8, 1991. A sample was collected from below the water table in unoxidized saturated sediment. The enclosing sediment contained abundant Paleozoic carbonate. There was some evidence of modern rootlets down to 2 m depth. Three samples were taken for ^{14}C dating: two containing pieces of wood from 1.8 m (GSC-5731) and 2.4 m (base of organics), and one containing fragments of several large bivalve molluscs. The sediment containing the organic material underlies and grades up into a suspected Emerson Phase (Lake Agassiz) sequence that has infilled a minor (?) Moorhead Phase channel. This wood sample is believed to be reworked from the basal organic mud unit and therefore dates the Moorhead Phase of Lake Agassiz.

This date was previously reported in Morlan et al. (2000).

Vita series

A series of samples was collected by G. Matile on August 8, 1991 from 3.5 km northeast of Vita, southeastern Manitoba (49°09′48″N, 96°32′46″W), at an elevation of 303 m. These samples were submitted by G. Matile to gain information on the Emerson Phase of Lake Agassiz.

GSC-5296. Vita I

normalized age:	10 000 ± 90
$\delta^{13}C$:	-28.7‰
uncorrected age:	10 100 ± 90

Wood sample G-983 (2.4 m depth; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 91-62) was enclosed in terrestrial plant remains in silt (organic mud).

GSC-5363. Vita II

normalized age:	10 900 ± 100
$\delta^{13}C$:	-5.61‰
uncorrected age:	10 600 ± 100

Freshwater bivalve shell sample G-983 was enclosed in a sand-clay rhythmite unit.

Comment (G. Matile): Wood (GSC-5296 and -5731) and shells (GSC-5363) were collected from a backhoe pit dug within a drowned Moorhead Phase river channel. The wood was enclosed by terrestrial plant remains associated with the river channel, whereas the shells were from an overlying sand-clay rhythmite unit associated with the initial inundation of the channel by the rising water of the Emerson Phase of Lake Agassiz.

These dates were previously reported in Morlan et al. (2000).

GSC-5837 HP. Senkiw

age:	>49 000

Wood sample '91 TCA 282.9 Grape Section' (*Picea*, identified by H. Jetté in unpublished GSC Wood Report 94-87), a surface collection on riverbank silt-diamicton, was collected by G. Matile and H. Thorleifson on August 27, 1991 from 4.5 km west of Senkiw, on the Roseau River, southeastern Manitoba (49°11′54″N, 96°54′09″W), at an elevation of 259 m. This sample was submitted by L.H. Thorleifson to gain information on the Wisconsin deposits.

Comment (G. Matile): Collected from the surface of a natural river bank, 10.5 m below prairie level. Enclosing sediment had been 'baked' by the sun. The Big Bend section, 0.5 km west of the Grape section, was described by Fenton (1974). Preliminary correlation suggests that these two sections are stratigraphic equivalents. The upper sand unit is correlated with the Upper Hazel Formation, and the diamicton unit is correlated with the Senkiw Formation. Sub–Senkiw Formation ^{14}C dates from southeastern Manitoba and vicinity range from 32.8 to >43 ka BP. This is the first time that wood has been collected from the Senkiw Formation.

This date was previously reported in Morlan et al. (2000).

GSC-6268. Ste. Agathe

normalized age:	2190 ± 50
$\delta^{13}C$:	-23.29‰
uncorrected age:	2160 ± 50

Wood charcoal sample RR-97-26 (about 4.5 m depth; probably *Fraxinus*, identified by C. Keith), enclosed in clay and silty clay alluvium, was collected by E. Nielsen and G. Matile on December 3, 1997 from about 5 km south of Ste. Agathe, about 40 km south of Winnipeg in the Red River valley, southern Manitoba (49°31′40″N, 97°13′05″W), at an elevation of about 223 m. This sample was submitted by E. Nielsen to gain information on the fluvial terrace and flood history.

This date was previously reported in Morlan et al. (2000).

Ste. Agathe series

A series of samples was collected by E. Nielsen and G. Matile on September 30, 1997 from a borrow pit along the shore of the Red River, 3 km northeast of Ste. Agathe, southern Manitoba (49°35′05″N, 97°08′45″W), at an elevation of 234 m. These samples were submitted by E. Nielsen to gain information on fluvial processes and flood history.

TO-6983. Ste. Agathe I

normalized age:	3280 ± 80

Charcoal sample RR-97-01 (0.70 m depth) was enclosed in silty clay and clay. The age was normalized to a $\delta^{13}C$ of -25‰.

TO-6984. Ste. Agathe II

normalized age:	4360 ± 100

Charcoal sample RR-97-02 (1.05 m depth) was enclosed in silty clay and clay. The age was normalized to a $\delta^{13}C$ of -25‰.

TO-6985. Ste. Agathe III

normalized age:	4640 ± 90

Charcoal sample RR-97-03 (1.65 m depth) was enclosed in silty clay and clay. The age was normalized to a $\delta^{13}C$ of -25‰.

TO-6987. Ste. Agathe IV

normalized age:

4850 ± 70

Charcoal sample RR-97-05 (2.00 m depth) was enclosed in silty clay and clay. The age was normalized to a $\delta^{13}C$ of -25‰.

TO-6986. Ste. Agathe V

normalized age:	4860 ± 70

Charcoal sample RR-97-04 (1.85 m depth) was enclosed in silty clay and clay. The age was normalized to a $\delta^{13}C$ of -25‰.

TO-6989. Ste. Agathe VI

normalized age:	5590 ± 70

Charcoal sample RR-97-08 (3.50 m depth) was enclosed in silty clay and clay. The age was normalized to a $\delta^{13}C$ of -25‰.

TO-6988. Ste. Agathe VII

normalized age: 5900 ± 70

Charcoal sample RR-97-07 (3.20 m depth) was enclosed in silty clay and clay. The age was normalized to a $\delta^{13}C$ of -25‰.

GSC-6254. Ste. Agathe VIII

normalized age: 5570 ± 80
$\delta^{13}C$: -24.88‰
uncorrected age: 5570 ± 80

Charcoal sample RR-97-06 (3.00 m depth) was enclosed in silty clay and clay.

Lab comment: Because some rootlets may have been present in the samples from shallow depths, all samples were inspected under binocular microscope (6x) and all modern rootlets were removed by M. Pyne. Only cohesive chunks of charcoal were submitted for dating.

The samples that were collected from the upper Red River terrace were from the following depths:

Sample no.	Depth	Lab no.	Age
RR-97-01	0.70m	TO-6983	3280 ± 80
RR-97-02	1.05m	TO-6984	4360 ± 100
RR-97-03	1.65m	TO-6985	4640 ± 90
RR-97-04	1.85m	TO-6986	4860 ± 70
RR-97-05	2.00m	TO-6987	4850 ± 70
RR-97-06	3.00m	GSC-6254	5570 ± 80
RR-97-07	3.20m	TO-6988	5900 ± 70
RR-97-08	3.50m	TO-6989	5590 ± 70

These dates were previously reported in Morlan et al. (2000).

Emerson series

A series of samples was collected by E. Nielsen and G. Matile on October 1, 1997 from a section along the Red River, 5 km north of Emerson, southern Manitoba (49°03′10″N, 97°11′45″W), at an elevation of 234 m. These samples were submitted by E. Nielsen to gain information on the flood history of the Red River.

GX-23489. Emerson I

normalized age: 3490 ± 135

The charcoal sample RR-97-10 (4.4 m depth) was enclosed in brown clay.

GSC-6256. Emerson II

normalized age: 2170 ± 70
$\delta^{13}C$: -22.79‰
uncorrected age: 2140 ± 70

Charcoal sample RR-97-09 (2.1 m depth) was enclosed in brown clay.

GSC-6258. Emerson

normalized age: 100 ± 60
$\delta^{13}C$: -28.07‰
uncorrected age: 150 ± 60

Charcoal sample RR-97-11 (1.1 m depth; probably *Fraxinus*, identified by C. Keith), enclosed in silty calcareous sand alluvium, was collected by E. Nielsen and G. Matile on October 1, 1997 from 6.5 km north of Emerson, about 90 km south of Winnipeg in the Red River valley, southern Manitoba (49°04′20″N, 97°13′10″W), at an elevation of 225 m. This sample was submitted by E. Nielsen to gain information on the flood history of the Red River.

Comment (E. Nielsen): Sample was collected 1.1 m down in a fresh 3 m high exposure at the top of a terrace (floodplain) of the Red River that was about 8 m high. Young ash trees on the top of the section suggest that these sediments are young.

This date was previously reported in Morlan et al. (2000).

Aubigny series

A series of samples was collected by E. Nielsen and G. Matile on October 3, 1997 from about 4 km north of Aubigny, about 45 km south of Winnipeg in the Red River valley, southern Manitoba (49°29′40″N, 97°13′45″W), at an elevation of about 228 m. These samples were submitted by E. Nielsen to gain information on the fluvial terrace and flood history.

GSC-6266. Aubigny I

normalized age: 4050 ± 80
$\delta^{13}C$: -26.44‰
uncorrected age: 4080 ± 80

The rounded fragments of wood charcoal in sample RR-97-21(a) (4.4 m depth; probably *Fraxinus*, identified by C. Keith) were enclosed in silty calcareous clay. When compared with sample RR-97-21(b) (GSC-6253), this date will provide the 'hardwater' correction for the Red River and Lake Winnipeg. This sample was submitted by E. Nielsen as a crosscheck date.

GSC-6253. Aubigny II

normalized age:	4320 ± 70
$\delta^{13}C$:	-8.16‰
uncorrected age:	4040 ± 70

Freshwater shell sample RR-97-21(b) (4.4 m depth; whole valves of *Sphaerium simile* and/or striatinum), identified by J-M. Gagnon) was enclosed in silty calcareous clay. When compared with sample RR-97-21(a) (GSC-6266), this date will provide the 'hardwater' correction for the Red River and Lake Winnipeg.

Comments (E. Nielsen): The 'hardwater' error in this area is about 270 years, as defined by GSC-6266 and -6253.

This date was previously reported in Morlan et al. (2000).

GSC-6260. Letellier

normalized age:	2460 ± 70
$\delta^{13}C$:	-24.50‰
uncorrected age:	2450 ± 70

Charcoal sample RR-97-12 (1.60 m depth; probably *Fraxinus*, identified by C. Keith), enclosed in silty clay and clay, was collected by E. Nielsen and G. Matile on October 1, 1997 from 9 km north of Letellier, in the Red River valley, southern Manitoba (49°11′50″N, 97°18′20″W), at an elevation of 234 m. This sample was submitted by E. Nielsen to gain information on the flood history.

This date was previously reported in Morlan et al. (2000).

Morris series

A series of samples was collected by E. Nielsen and G. Matile on October 3, 1997 from about 3 km northeast of Morris, about 55 km south of Winnipeg in the Red River valley, southern Manitoba (49°22′45″N, 97°19′15″W), at an elevation of about 228 m. These samples were submitted by E. Nielsen to gain information on the fluvial terrace and flood history.

GSC-6264. Morris I

normalized age:	80 ± 60
$\delta^{13}C$:	-28.91‰
uncorrected age:	140 ± 60

Wood sample RR-97-16 (2.0 m depth; Populus, identified by C. Keith), enclosed in silt and silty clay alluvium, was collected from the modern floodplain where the total height of the section was 3 m.

S-3663. Morris II

normalized age:	350 ± 70
$\delta^{13}C$:	-15.67‰
uncorrected age:	200 ± 70

Bone sample RR-97-17 (2.3 m depth; left tibia of a *Bison*, identified by R.E. Morlan) was enclosed in silt and silty clay alluvium of a fresh exposure, 0.3 m below GSC-6264 (RR-97-16) in the modern floodplain.

Comments (R.E. Morlan): This sample was a left tibia bison bone, wholly intact, with proximal and distal ends completely fused. The measurements of the distal end (breadth 7.2 cm, depth 5.1 cm) suggest that this bison was probably a relatively small adult bull. These measurements are near the lower end of the size range for modern Plains bison bulls and are smaller than the largest adult cow tibia in Morlan's comparative data (R.E. Morlan, pers. comm., 2001). There is no evidence bearing upon the cause of death of this bison. The bone lay on the surface for a brief period (a few months?) prior to burial and is weathered to Behrensmeyer's stage 1 (Behrensmeyer and Hill, 1980). During this period on the surface, a rodent gnawed on a small area of the anterior crest. The bone may have entered into a relatively deep burial environment rather quickly, because there is no evidence of root-etching.

These dates were previously reported in Morlan et al. (2000).

GSC-6262. Morris

normalized age:	310 ± 50
$\delta^{13}C$:	-27.72‰
uncorrected age:	360 ± 50

Wood sample RR-97-13 (3.8 m depth; unidentifiable according to C. Keith), enclosed in laminated clay alluvium, was collected by E. Nielsen and G. Matile on October 1, 1997 from about 9 km south of Morris, about 70 km south of Winnipeg in the Red River valley, southern Manitoba (49°16′30″N, 97°19′40″W), at an elevation of about 228 m. This sample was submitted by E. Nielsen to gain information on the fluvial terrace and flood history.

Comment (E. Nielsen): A stump was removed from a clean, fresh section at a depth of 3.8 m in a 5.3 m high terrace. The upper 1.6 m was vertical and the lower 3.7 m sloped slightly toward the river. Good soil development at the top of the section suggests that this site is old and sedimentation has ceased on the upper surface.

This date was previously reported in Morlan et al. (2000).

GSC-5864. Zetterstrom Creek

age:	modern
$\delta^{13}C$:	-28.3‰

Wood sample 94-FI-017 (100 cm depth; *Ulmus* cf. U. americana, identified by R.J. Mott in unpublished GSC Wood Report 96-61), enclosed in poorly stratified silty sand beneath 75 cm of organic-rich mucky sandy silt, was collected by R.J. Fulton on June 9, 1994 from Zetterstrom Creek, 5 km south of Whitewater Lake and 10 km south of Boissevain, southwestern Manitoba (49°11′30″N, 100°10′30″W), at an

elevation of 512 m. This sample was submitted by R.J. Fulton to gain information on climate change and paleohydrology, specifically to provide a maximum age for the terrace.

The sample (6.5 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (5.6 g) yielded 5.52 L of CO_2 gas. The age estimate is based on one count for 1080 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 19.156 ± 0.140, 1.243 ± 0.025, and 18.474 ± 0.105 cpm, respectively.

Comment (R.J. Fulton): The enclosing and overlying sediments underlie a plain, interpreted as a Holocene terrace, standing about 1 m above the channel floor. Given the modern age of the wood, what was interpreted as a terrace must instead be the present stream floodplain.

This date was previously reported in Morlan et al. (2000).

GSC-5244. Assiniboine River I

(26 km) normalized age:	870 ± 60
$\delta^{13}C$:	-26.4‰
uncorrected age:	900 ± 60

Wood sample B.P.-90-5(b) (*Quercus macrocarpa*, identified by R.J. Mott in unpublished GSC Wood Report 91-38), enclosed in alluvial silt, was collected by E. Nielsen on May 31, 1990 from 1 km south of the Trans-Canada Highway in 'Beaudry Park' on the Assiniboine River, 26 km west of its junction with the Red River, southern Manitoba (49°52′30″N, 97°29′30″W), at an elevation of 238 m. The sample was submitted by E. Nielsen.

GSC-5212. Assiniboine River II

(29 km) normalized age:	1120 ± 60
$\delta^{13}C$:	-27.1‰
uncorrected age:	1150 ± 60

Wood sample Assin-91-1 (*Quercus macrocarpa*, identified by E. Nielsen), enclosed in water, was collected by E. Nielsen on May 23, 1991 from 0.5 km north of the Trans-Canada Highway in the Assiniboine River, 29 km west of its junction with the Red River, southern Manitoba (49°53′30″N, 97°32′00″W), at an elevation of 239 m. The sample was submitted by E. Nielsen.

GSC-5323. Assiniboine River III

(29.5 km) normalized age:	200 ± 60
$\delta^{13}C$:	-25.2‰
uncorrected age:	200 ± 60

Wood sample Assin-91-6 (*Quercus macrocarpa*, identified by H. Jetté in unpublished GSC Wood Report 91-86), on the river bottom, was collected by E. Nielsen on September 24, 1991 from the Assiniboine River, 1.25 km north of the Trans-Canada Highway and 29.5 km west of its junction with the Red River, southern Manitoba (49°53′35″N, 97°32′10″W), at an elevation of 239 m. The sample was submitted by E. Nielsen.

GSC-5217. Assiniboine River IV

(30.5 km) normalized age:	1570 ± 60
$\delta^{13}C$:	-25.7‰
uncorrected age:	1580 ± 60

Wood sample Assin-91-2 (*Quercus macrocarpa*, identified by H. Jetté in unpublished GSC Wood Report 91-30), enclosed in surface collection on river bed, was collected by E. Nielsen on May 23, 1991, from 2 km north of the Trans-Canada Highway in the Assiniboine River, 30.5 km west of its junction with the Red River, southern Manitoba (49°54′30″N, 97°33′20″W), at an elevation of 239 m. The sample was submitted by E. Nielsen.

GSC-5220. Assiniboine River VI

(30.5 km) normalized age:	90 ± 80
$\delta^{13}C$:	-27.4‰
uncorrected age:	130 ± 80

Wood sample Assin-91-3 (*Quercus macrocarpa*, identified by H. Jetté in unpublished GSC Wood Report 91-32), enclosed in water, was collected by E. Nielsen on May 23, 1991 from 3.50 km north of the Trans-Canada Highway in the Assiniboine River, 30.5 km west of its junction with the Red River, southern Manitoba (49°55′10″N, 97°34′25″W), at an elevation of 239 m. The sample was submitted by E. Nielsen.

GSC-5303. Assiniboine River V

(31.2 km) normalized age:	180 ± 50
$\delta^{13}C$:	-25.1‰
uncorrected age:	180 ± 50

Wood sample Assin-91-5 (*Quercus macrocarpa*, identified by H. Jetté in unpublished GSC Wood Report 91-60), enclosed in water, was collected by E. Nielsen on September 24, 1991 from 3.5 km north of the Trans-Canada Highway in the Assiniboine River, 31.2 km west of its junction with the Red River, southern Manitoba (49°55′15″N, 97°33′45″W), at an elevation of 239 m. The sample was submitted by E. Nielsen.

GSC-5238. Assiniboine River VII

(32.7 km) normalized age:	430 ± 60
$\delta^{13}C$:	-26.2‰
uncorrected age:	450 ± 60

Wood sample Assin-91-4 (*Quercus macrocarpa*, identified by H. Jetté in unpublished GSC Wood Report 91-36), enclosed in water, was collected by E. Nielsen on May 23, 1991 from 4.75 km north of the Trans-Canada Highway in the

Assiniboine River, 32.7 km west of its junction with the Red River, southern Manitoba (49°55′40″N, 97°35′00″W), at an elevation of 239 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5479. Marquette I

normalized age:	520 ± 60
$\delta^{13}C$:	-24.8‰
uncorrected age:	520 ± 60

Wood sample Assin-92-4 (*Quercus* probably macrocarpa, identified by H. Jetté in unpublished GSC Wood Report 92-85), enclosed in silty clay, was collected by E. Nielsen on May 12, 1992 from 6 km south of Marquette along the north shore of Assiniboine River, south-central Manitoba (50°00′40″N, 97°44′40″W), at an elevation of 241 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5503. Marquette II

normalized age:	70 ± 60
$\delta^{13}C$:	-26.7‰
uncorrected age:	100 ± 60

Wood sample Assin-92-6 (*Quercus* probably macrocarpa, identified by H. Jetté in unpublished GSC Wood Report 92-87), a surface collection on fluvial silt, was collected by E. Nielsen on May 13, 1992 from 6 km south-southwest of Marquette along the south shore of the Assinboine River in south-central Manitoba (50°00′59″N, 97°45′25″W), at an elevation of 241 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5489. Marquette III

normalized age:	260 ± 50
$\delta^{13}C$:	-24.4‰
uncorrected age:	250 ± 50

Wood sample Assin-92-5 (*Quercus* probably macrocarpa, identified by H. Jetté in unpublished GSC Wood Report 92-86), a large log sticking out of the water, was collected by E. Nielsen on May 13, 1992 from 7.5 km southeast of Marquette along the north shore of the Assiniboine River, south-central Manitoba (50°00′20″N, 97°46′50″W), at an elevation of 242 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5477. Poplar Point I

normalized age:	90 ± 60
$\delta^{13}C$:	-23.5‰
uncorrected age:	60 ± 60

Wood sample Assin-92-3 (*Quercus* probably macrocarpa, identified by H. Jetté in unpublished GSC Wood Report 92-83), a surface collection on shore, was collected by E. Nielsen on May 12, 1992 from 13.5 km southeast of Poplar Point along the Assiniboine River, about halfway between Winnipeg and Portage la Prairie, south-central Manitoba (50°00′30″N, 97°48′15″W), at an elevation of 242 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5474. Poplar Point II

age:	modern
$\delta^{13}C$:	-26.5‰
uncorrected age:	20 ± 60

Wood sample Assin-92-2 (*Populus*, identified by H. Jetté in unpublished GSC Wood Report 92-82), enclosed in water, was collected by E. Nielsen on May 12, 1992 from 12 km southeast of Poplar Point along Assiniboine River, south-central Manitoba (50°00′59″N, 97°49′10″W), at an elevation of 242 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5507. Portage la Prairie I

normalized age:	90 ± 60
$\delta^{13}C$:	-27.3‰
uncorrected age:	130 ± 60

Wood sample Assin-92-9 (Quercus probably macrocarpa, identified by H. Jetté in unpublished GSC Wood Report 92-88), enclosed in silty clay beneath 1 m of silty clay, was collected by E. Nielsen on May 14, 1992 from the bank of the Assiniboine River, 13 km southwest of Portage la Prairie City Hall, south-central Manitoba (49°53′00″N, 98°24′50″W), at an elevation of about 265 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5510. Portage la Prairie II

normalized age:	190 ± 60
$\delta^{13}C$:	-25.0‰
uncorrected age:	190 ± 60

Wood sample Assin-92-10 (*Quercus* probably macrocarpa, identified by H. Jetté in unpublished GSC Wood Report 93-01), enclosed in silty clay at the base of homogeneous alluvial silt and clay about 2 m thick, was collected by E. Nielsen on May 14, 1992 from the north bank of the Assinboine River, 28 km southwest of Portage la Prairie City Hall, south-central Manitoba (49°45′20″N, 98°29′30″W), at an elevation of about 270 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5264. Beaconia Beach

normalized age:	590 ± 50
$\delta^{13}C$:	-26.2‰
uncorrected age:	610 ± 50

Wood sample NB-90-8 (*Larix*, identified by H. Jetté in unpublished GSC Wood Report 91-45), enclosed in sand and clay, was collected by E. Nielsen on October 25, 1990 from Beaconia Beach on the southeastern shore of the south basin of Lake Winnipeg, Manitoba (50°26′50″N, 96°34′35″W), at an elevation of 217 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5269. 'Patricia Beach'

age:	modern
$\delta^{13}C$:	-27.6‰
uncorrected age:	90 ± 50

Wood sample NB-90-5 (*Salix*, identified by H. Jetté in unpublished GSC Wood Report 91-48), enclosed in sand, was collected by E. Nielsen on October 25, 1990 from 'Patricia Beach', on the southeastern shore of the south basin of Lake Winnipeg, Manitoba (50°26′10″N, 96°35′20″W), at an elevation of 217.4 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-5258. Red River mouth

age:	modern
$\delta^{13}C$:	-25.9‰
uncorrected age:	20 ± 60

Wood sample NB-90-2(c) (*Ulmus americana*, identified by H. Jetté in unpublished GSC Wood Report 91-41), enclosed in silty clay, was collected by E. Nielsen on June 25, 1990 from 4 km west of the main channel of the Red River on the southern shore of the south basin of Lake Winnipeg, Manitoba (50°24′10″N, 96°51′55″W), at an elevation of 217 m. The sample was submitted by E. Nielsen.

This date was previously reported in Morlan et al. (2000).

GSC-6052. Wigle Lake

normalized age:	4140 ± 90
$\delta^{13}C$:	-30.50‰
uncorrected age:	4230 ± 90

Basal fen peat sample 95-MOB-0042 (2.21–2.23 m depth; unit A), enclosed in fen peat immediately above limnic peat (unit B), was collected by I. McMartin and S. Phaneuf on June 15, 1995 from 50 m west of Highway 6 and 150 m east of Wigle Lake, about 1 km north of the Minago River in the northern arm of the Minago River channel, north-central Manitoba (54°12′30″N, 99°10′10″W), at an elevation of 228 m. This sample was submitted by I. McMartin to gain information on peat accumulation.

Comment (I. McMartin): The date provides an estimate for the timing of a major change in the depositional environment from lacustrine to a sedge peat bog, after the diversion of the Saskatchewan River.

This date was previously reported in Morlan et al. (2000).

TO-4910. Minago River

normalized age:	5860 ± 60

Freshwater shell sample 92-MOB-0011 (*Pisidium*, identified by J-M. Gagnon), enclosed in calcareous alluvial sediment, was collected by I. McMartin on July 5, 1992 from Minago River channel, 400 m north of the Minago River, 100 km north of Grand Rapids, north-central Manitoba (54°12′05″N, 99°10′04″W), at an elevation of 235 m. This sample was submitted by I. McMartin to gain information on alluviation and the diversion of the Saskatchewan River. The age was normalized to a $\delta^{13}C$ of -25‰.

Comment (I. McMartin): This date is probably not significant in terms of a minimum age for channel abandonment. This site is 5 m above the bottom of the channel, and was therefore abandoned earlier than the rest of the channel.

This date was previously reported in Morlan et al. (2000).

Minago River series

A series of samples was collected by I. McMartin and S. Phaneuf on June 15, 1995 from 50 m west of Highway 6 and 150 m east of Wigle Lake, about 1 km north of the Minago River in the northern arm of the Minago River channel, north-central Manitoba (54°12′30″N, 99°10′10″W), at an elevation of 227 m. This sample was submitted by I. McMartin to gain information on alluviation, fluvial processes, and channel abandonment.

GSC-6077. Minago River I

normalized age:	4650 ± 90
$\delta^{13}C$:	-25.56‰
uncorrected age:	4660 ± 90

Limnic peat sample 95-MOB-0043 (2.34–2.36 m depth; unit B1) was enclosed in limnic peat immediately above fossiliferous limnic peat (unit B2). Duplicate McCaulley peat cores taken in a fen bog (Minago River channel) were fairly uniform with well preserved sedges. The surrounding vegetation is *Carex, Salix,* and *Larix*.

Comment (I. McMartin): The date provides an approximate age for a major change in depositional environment, from alluvial to shallow lacustrine, when limnic peat started to accumulate following the diversion of the Saskatchewan River.

GSC-6087. Minago River II

normalized age:	4500 ± 130
$\delta^{13}C$:	-27.13‰
uncorrected age:	4540 ± 130

Limnic peat sample 95-MOB-0044 (2.36–2.40 m depth; unit B2) was enclosed in limnic peat with freshwater shells immediately overlying alluvial sediment (unit C). Duplicate McCaulley peat cores taken in a fen bog (Minago River channel) were fairly uniform with well preserved sedges. The surrounding vegetation is *Carex, Salix,* and *Larix*.

Comment (I. McMartin): This date can be compared with an AMS radiocarbon age of 4880 ± 60 14C years BP (TO-5699) obtained on freshwater mollusc shells from the same layer. Therefore, about 380 years must be subtracted from mollusc dates in the area to make them comparable to other terrestrial materials. This date provides a minimum age for channel abandonment by the Saskatchewan River.

TO-5699. Minago River III

normalized age:	4880 ± 60

Freshwater gastropod shell sample 95-MOB-0045 (2.36–2.40 m depth; unit B2; *Gyraulus*, identified by J-M. Gagnon) was enclosed in limnic peat. The age was normalized to a $\delta^{13}C$ of -25‰.

Comment (I. McMartin): The sample is immediately above a unit composed of alluvial sediment (unit C) and enclosed in a unit of dark brown organic limnic sediment (unit B2). When compared with a conventional radiocarbon date (GSC-6087) of 4500 ± 130 14C years BP on the limnic peat enclosing these shells, a correction factor of about 380 years should be applied to mollusc dates from this region. This would compensate for the 'hardwater error' related to the calcareous sediments of the area and make the freshwater shell dates comparable with the peat dates.

TO-5700. Minago River IV

normalized age:	5210 ± 60

Freshwater gastropod shell sample 95-MOB-0046 (2.40–2.46 m depth; unit C; *Gyraulus*, identified by J-M. Gagnon) was enclosed in alluvial silt. The age was normalized to a $\delta^{13}C$ of -25‰.

Comment (I. McMartin): The sample was enclosed in grey, calcareous (20% carbonate), sandy silt with aquatic organic fragments. This unit (unit C) is interpreted as alluvium deposited by slow-moving waters of the Saskatchewan River before the final abandonment of the channel. By applying a 'hardwater' correction of about 380 years (cf. TO-5699 and GSC-6087), an approximate age of 4830 ^{14}C years BP is obtained for this sample, thus providing a maximum age for channel abandonment by the Saskatchewan River. The surrounding vegetation is composed of *Carex, Salix,* and *Larix*.

These dates were previously reported in Morlan et al. (2000).

GSC-5880. Minago River

normalized age:	2530 ± 70
$\delta^{13}C$:	-29.0‰
uncorrected age:	2590 ± 70

Basal sedge and moss peat sample 93-MOB-0061 (72–75 cm depth), enclosed in the lowermost 3 cm of peat directly overlying dolomitic bedrock, was collected by I. McMartin and R. Boucher on June 15, 1993 from the Minago River channel, 3 km northeast of South Moose Lake, 100 km north-northwest of Grand Rapids, north-central Manitoba (54°04′09″N, 99°34′54″W), at an elevation of 259 m. This sample was submitted by I. McMartin to gain information on fluvial processes and provide a minimum age for channel abandonment.

Comment (I. McMartin): This basal fen peat age in the abandoned Minago River channel is anomalously young compared to dates from the same context in the region (GSC-6052, and TO-4910 and -5700). The sample was collected at the highest elevation of the bedrock channel (259 m), directly on the present-day drainage divide between waters flowing into the Saskatchewan River and those flowing into the Minago River, thus providing a minimum age for channel abandonment. This site was probably not the most favourable for peat accumulation, however, and the age obtained on limnic peat at the bottom of the channel (GSC-6087) is favoured for a minimum age of channel abandonment.

This date was previously reported in Morlan et al. (2000).

GSC-5931. Hargrave Lake

normalized age:	4930 ± 80
$\delta^{13}C$:	-28.6‰
uncorrected age:	4980 ± 80

Basal fen peat sample 92-MOB-0402 (350–370 cm depth), underlain by glaciolacustrine clay, was collected by I. McMartin and S. Gautrey on August 7, 1992 from 4.25 km southeast of Hargrave Lake, 14 km southeast of Wekusko, north-central Manitoba (54°24′41″N, 99°36′42″W), at an elevation of 270 m. This sample was submitted by I. McMartin to gain information on the initiation of peat deposition.

Comment (I. McMartin): Several basal fen peat samples located in the surrounding peatlands have been radiocarbon dated between 4.6 and 5.0 ka BP (BGS-868, and GSC-410 and -1958), including this radiocarbon date at 4930 ± 80. These dates suggest a delay between the final drainage of Lake Agassiz and the establishment of fen peat–forming vegetation over mineral soil, as discussed by Zoltai and Vitt (1990).

This date was previously reported in Morlan et al. (2000).

GSC-5890. Cormorant Lake

normalized age:	1400 ± 120
$\delta^{13}C$:	-29.8‰
uncorrected age:	1470 ± 120

The basal fen peat was irregularly overlying fossiliferous alluvial silt. Sample 93-MOB-0062 (160–180 cm depth) was collected by I. McMartin and R. Boucher on June 15, 1993 from the southeast shore of Cormorant Lake, 200 m east of Cormorant Road (Highway 287), 7.25 km southwest of Cormorant, north-central Manitoba (54°09′52″N, 100°39′07″W), at an elevation of 257 m. This sample was submitted by I. McMartin to gain information on the initiation of peat deposition.

Comment (I. McMartin): This basal fen peat age is surprisingly young and it would indicate a young age for the cessation of the overflowing of the Saskatchewan River in this part of the alluvial plain. Since the sample was taken in the old alluvial plain, this date should not be compared with other dates obtained on basal peat from the general area.

This date was previously reported in Morlan et al. (2000).

GSC-5911. The Pas Moraine

normalized age:	1920 ± 60
$\delta^{13}C$:	-27.6‰
uncorrected age:	1960 ± 60

The basal fen peat was overlying medium- to fine-grained and reduced glaciolacustrine sand. Sample 93-MOB-0064 (143–145 cm depth) was collected by I. McMartin and R. Bouchard on June 16, 1993 about 200 m in front of The Pas Moraine, west of the gravel road running along the northwest-trending crest of the moraine, 9 km southeast of Wanless, north-central Manitoba (54°07′05″N, 101°16′44″W), at an elevation of 287 m. This sample was submitted by I. McMartin to gain information on the initiation of peat deposition.

Comment (I. McMartin): This basal bog peat age, in front of The Pas Moraine, is anomalously young compared to dates from the same area obtained on fen peat (BGS-852, -856, and -864), although it is similar to a date obtained from similar material in the same peat bog (WIS-1).

These dates were previously reported in Morlan et al. (2000).

GSC-6011. Limestone Dam

age:	>37 000
$\delta^{13}C$:	-26.32‰

Wood sample ‘95 MOON 008’, enclosed in slightly deformed peat capping oxidized fluvial sand and gravel, overlain by clay, was collected by M. Roy on June 19, 1995 from the south shore of the Nelson River, near the Limestone Dam, 50 km northeast of Gillam, Hudson Bay Lowlands, northeastern Manitoba (56°33′50″N, 94°04′55″W), at an elevation of 185 m. This sample was submitted by J. Veillette to gain information on the nonglacial deposits and provide a comparison date for thermoluminescence and optical-stimulation luminescence dating.

Comment (M. Roy): The sample was collected from a river-bank section. The collection site was 16 m above the river level. The wood fragments were collected from a slightly deformed peat layer. The wood retrieved from the peat was compressed and humid. All wood fragments taken from the peat were in excellent condition. The peat was also sampled for paleoecological analysis, and the results show a pollen spectrum reflecting a black spruce forest, with a high abundance of herb pollen that suggests a local open forest. The wood fragments were enclosed in a massive peat layer that was found in a nonglacial unit composed mainly of oxidized sand and gravel with few clay beds. This nonglacial unit overlies the Amery and Sundance tills, the surface of the latter being deeply weathered. Both tills are presumably older than the last interglacial. The overlying Long Spruce Till might represent the onset of the Wisconsinan glaciation. The nonglacial unit is correlated with the Nelson River sediments (Nielsen et al., 1986). The original type-section of this facies is now flooded, so a new radiocarbon date should be obtained on the unit. This section is an important new locality in northern Manitoba, and is one of the rare sites, accessible by road, where subtill organic-bearing sediments are exposed in the Hudson Bay Lowlands. The local stratigraphy is key in developing glaciological models, including the evolution of the Laurentide Ice Sheet. A controversy exists as whether or not the thermoluminescence dates of about 40 ka obtained from a nearby section are reliable (Berger and Nielsen, 1991). Samples for optical dating were collected above and below the peat layer. Optical dating on the clay overlying the peat yielded an apparent infrared-stimulated luminescence age of 121 ± 16 ka.

This date was previously reported in Morlan et al. (2000).

GSC-2760. Gillam

uncorrected age:	6280 ± 80

The basal peat was enclosed in peat overlying 0.6 m of gravelly silty sand, which in turn overlay 4 m of clay. Sample R69-2-8 from (2.15–2.4 m depth) was collected by E. Fraser on April 9, 1977 from a bog located 3 km south of CNR siding at Charlebois, 52 km northeast of Gillam, Manitoba (56°40′N, 94°05′W), at an elevation of about 122 m. This sample was submitted by D.W. Roggensack to gain information on the initiation of peat deposition.

Comment (D.W. Roggensack): The date represents the beginning of peat accumulation following the marine offlap of the Tyrrell Sea in the Hudson Bay Lowlands.

Comment (J.V. Matthews, Jr.): The plant fossils and fossil arthropods in this peat represent taxa that are found in and around the lakes of this region today.

These dates were previously reported in Morlan et al. (2000).

Thibaudeau station series

A series of peat samples was collected by Manitoba Hydro in 1985 from Thibaudeau station along the Hudson Bay Railway, 190 km south of Churchill, Manitoba (57°04.5′N, 94°09.5′W), at an elevation of 125 m. These samples were submitted by L.A. Dredge to gain information on peat accumulation and climate change.

GSC-5282. Thibaudeau station I

age:	modern
$\delta^{13}C$:	-26.7‰

Peat sample DU-91-1271 (15–20 cm depth) was enclosed in peat.

Comment (L.A. Dredge): The sample was from the 15–20 cm depth dates a 'Graminae level'.

GSC-5219. Thibaudeau station II

normalized age:	1140 ± 80
$\delta^{13}C$:	-25.3‰
uncorrected age:	1140 ± 80

Peat sample DU-91-1272 (38–43 cm depth) was enclosed in peat.

Comment (L.A. Dredge): The sample from the 38–43 cm depth dates a change from spruce to sphagnum peat.

GSC-5285. Thibaudeau station III

normalized age:	4560 ± 110
$\delta^{13}C$:	-25.2‰
uncorrected age:	4560 ± 110

Wood sample DU-91-1274 (65 cm depth; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 91-56) was enclosed in peat.

Comment (L.A. Dredge): This wood sample was from 65 cm depth and indicates a forest interval.

GSC-5213. Thibaudeau station IV

normalized age:	6240 ± 80
$\delta^{13}C$:	-29.4‰
uncorrected age:	6310 ± 80

Peat sample DU-91-1273 (150–160 cm depth) was enclosed in peat.

Comment (L.A. Dredge): This basal date, from 150–160 cm below the surface, documents the initiation of organic accumulation at this site.

These dates were previously reported in Morlan et al. (2000).

Silcox station series

A series of peat samples was collected by Manitoba Hydro in 1985 from 5 km northwest of Silcox station along the Hudson Bay Railway, 175 km south of Churchill, Manitoba (57°10.0′N, 94°14.2′W), at an elevation of 135 m. These samples were submitted by L.A. Dredge to gain information on peat accumulation and climate change.

GSC-5265. Silcox station I

normalized age:	550 ± 50
$\delta^{13}C$:	-27.0‰
uncorrected age:	580 ± 50

Peat sample DU-91-521 (20–25 cm depth) was enclosed in peat.

Comment (L.A. Dredge): This sample from 20–25 cm depth dates the end of a 'Cyperaceae interval'.

GSC-5266. Silcox station II

normalized age:	1010 ± 60
$\delta^{13}C$:	-28.3‰
uncorrected age:	1060 ± 60

Peat sample DU-91-522 (38–43 cm depth) was enclosed in peat.

Comment (L.A. Dredge): This sample from a depth of 38–45 cm dates the beginning of a 'Cyperaceae interval'.

GSC-5245. Silcox station III

normalized age:	3120 ± 60
$\delta^{13}C$:	-25.9‰
uncorrected age:	3140 ± 60

Basal peat sample DU-91-523 (70–75 cm depth) was enclosed in peat.

Comment (L.A. Dredge): This basal sample from a depth of 70–75 cm was underlain by thin marine deposits and a silty stony till, and thus dates the initiation of peat accumulation at this site.

These dates were previously reported in Morlan et al. (2000).

O'Day station series

A series of peat samples was collected by Manitoba Hydro in 1985 from 6 km west of O'Day station ('Lost Moose') along the Hudson Bay Railway, 130 km south of Churchill, Manitoba (57°33.9′N, 94°19.0′W), at an elevation of 110 m. These samples were submitted by L.A. Dredge to gain information on peat accumulation and climate change.

GSC-5231. O'Day station I

normalized age:	290 ± 80
$\delta^{13}C$:	-25.8‰
uncorrected age:	300 ± 80

Peat sample DU-91-1281 (40–45 cm depth) was enclosed in peat.

Comment (L.A. Dredge): This sample from 40–45 cm depth dates a change from spruce to sphagnum peat.

GSC-5226. O'Day station II

normalized age:	420 ± 90
$\delta^{13}C$:	-26.9‰
uncorrected age:	460 ± 90

Peat sample DU-91-1282 (50–55 cm depth) was enclosed in peat.

Comment (L.A. Dredge): This sample from 50–55 cm depth dates the initiation of Ericaceae in the bog.

GSC-5284. O'Day station III

normalized age:	1980 ± 70
$\delta^{13}C$:	-25.7‰
uncorrected age:	1990 ± 70

Peat sample DU-91-1283 (68–73 cm depth) was enclosed in peat.

Comment (L.A. Dredge): This sample from 68–73 cm depth dates the Cyperaceae zone.

GSC-5221. O'Day station IV

normalized age:	4270 ± 70
$\delta^{13}C$:	-28.5‰
uncorrected age:	4320 ± 70

Peat sample DU-91-1284 (125–135 cm depth) was enclosed in peat.

Comment (L.A. Dredge): This basal sample from a depth of 125–135 cm dates the initiation of peat accumulation at this site.

Comments on the Hudson Bay Lowlands series (L.A. Dredge and R.J. Mott): Peat cores were extracted from three tundra sites overlying raised marine deposits along the Hudson Bay Railway south of Churchill, and from the base of a 4 m forested peat section overlying Lake Agassiz clays at Bradshaw Lake (cf. GSC-5240, below). The peat sections reflect the Holocene migration of the treeline, and vegetation and climate changes. The basal Thibaudeau site age of 6310 BP at 160 cm depth is virtually the same as the basal age of 6280 BP at 350 cm at Bradshaw site. Both of these ages are considerably younger than minimum ages for disappearance of Glacial Lake Agassiz and maximum limit of Tyrrell Sea at about 7800 yr. The pollen profiles show that spruce trees were abundant in the region 6300 years ago and remained so to the present. Plant communities similar to those at present also characterized the region throughout the entire time interval represented, with areas of bog and fen shifting as conditions changed locally. Areas covered by organic deposits must have increased as paludification continued over time. Except for a change to bog from fen conditions in the last several hundred years at some sites, there are no discernable trends at the sites studied. No changes in treeline, expected due to Nichols' conclusions based on sites farther north at Ennadai Lake (Nichols, 1967, Fig. 1), are apparent from the profiles, even though the treeline presently passes through the region. This might be because the vegetation zonation from tundra to boreal forest in this region could be controlled by proximity to Hudson Bay and not by regional continental Arctic air mass movements, as suggested for the treeline changes farther north and inland.

These dates were previously reported in Morlan et al. (2000).

GSC-5240. Bradshaw Lake

normalized age:	6280 ± 90
$\delta^{13}C$:	-24.4‰

Basal peat sample DU-78-193 (350 cm depth), enclosed in peat, was collected by L.A. Dredge and M. Nixon on July 19, 1978, from a forested bog along Bradshaw Lake, 130 km southwest of Churchill, Manitoba (57°41.8′N, 95°54.0′W), at an elevation of 215 m. This sample was submitted by L.A. Dredge to gain information on peat accumulation and climate change.

Comment (L.A. Dredge): This basal sample was from a depth of 350 cm at a site that lies within the boreal forest. The spruce forest is underlain by peat that has accumulated on the clay of Glacial Lake Agassiz. See GSC-5221 (above) for additional comments.

This date was previously reported in Morlan et al., 2000.

Saskatchewan

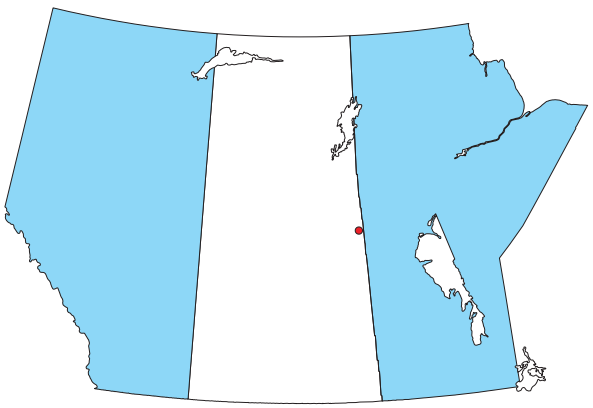


Figure 14. *Radiocarbon-dated sites in Saskatchewan.*

GSC-5950. Cross Bay

normalized age:	modern
$\delta^{13}C$:	-26.8‰
uncorrected age:	40 ± 60

The silty organic detritus was overlain by pebbly sand and underlain by a calcareous sandy silty till. Sample 94-JEC-0080 (17–20 cm depth) was collected by J. Campbell on July 26, 1994 from 75 m west of the southwest shore of Cross Bay, Namew Lake, 23.25 km northeast of Cumberland House, north-central Saskatchewan (54°06′33″N, 102°00′47″W), at an elevation of 267 m. The sample was submitted by I. McMartin to gain information on deglaciation.

The sample (125.3 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (25.7 g) yielded 4.75 L of CO_2 gas. The age estimate is based on two counts for 2000 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 18.253 ± 0.102, 1.212 ± 0.025, and 18.348 ± 0.104 cpm, respectively.

Comment (I. McMartin): The age is modern; therefore, this radiocarbon date is insignificant.

This date was published in Morlan et al. (2001).

Alberta

Jenner site series

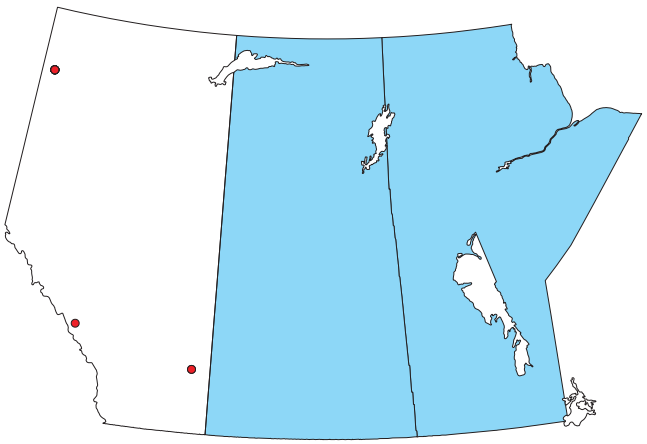


Figure 15. *Radiocarbon-dated sites in Alberta.*

Two radiocarbon dates have been obtained on wood from the Jenner site, which is located in a community pasture about 9 km south of the highway, 27 km east of the small community of Jenner, eastern Alberta (50°44′N, 110°47′30″W), at an elevation of 800 m. The wood was recovered from about 4 m depth at the dugout during excavation by the backhoe operator and subsequently collected from the pile of excavated dirt by D.S. Lemmen in June 1992. These samples were submitted by A.B. Beaudoin to gain information on the timing of the paleoenvironmental transition from woodland to prairie in support of macrofossil analyses.

GSC-5515. Jenner I

normalized age:	9760 ± 100
$\delta^{13}C$:	-24.9‰
uncorrected age:	9760 ± 100

Wood sample 92-LJA-JW1 (file reference D92-33; 20.00 g dry weight; *Salix*, identified by H. Jetté in unpublished GSC Wood Report 93-08) was enclosed in 50 cm of organic-rich sediment underlain by light grey silty clay and overlain by 3.5 m of silty sediment.

The sample was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.5 g) yielded 8.4 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.411 ± 0.077, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

AECV-1666C. Jenner II

normalized age:	10 050 ± 110
$\delta^{13}C$:	-24.8‰
uncorrected age:	10 050 ± 110

A duplicate sample (file reference D92-32) of the same piece of wood that formed sample GSC-5515 was dated, as a crosscheck, at the Alberta Environmental Centre, Vegreville. The wood was identified as *Salix* sp. by both H. Jetté (unpublished GSC Wood Report 93-08) and A. Gottesfeld (Gottesfeld Consulting). The AECV date and some comments on the macroremains were reported in Beaudoin (1992), and the site was briefly discussed in Beaudoin (1999).

Comment (A.B. Beaudoin): Organic-rich sediment was encountered in the base of a dugout excavated for cattle watering. This sediment (around 50 cm thick) overlies light grey silty clay and is overlain by at least 3.5 m of silty sediment with no obvious stratigraphy. The organic layer is wood-rich toward its base. The matrix has yielded a rich and diverse assemblage of macroremains. These include seeds from about twenty taxa, mainly of wetland and aquatic plants such as *Ceratophyllum, Potamogeton, Typha, Zannichellia, Ranunculus, Mentha*, and *Scirpus*, and six types of mollusc shells, mainly from wetland and aquatic taxa such as *Physa, Armiger crista, Promenetus*, and *Gyraulus*.

The evidence available so far suggests the existence, in the early Holocene, of a productive lake or slough fringed with emergent vegetation. This was probably fairly short lived. Evidence from similar sites (e.g., Andrews in southern Saskatchewan; cf. Yansa and Basinger, 1999) would suggest that it probably dried up by the mid-Holocene. This desiccation may be related to the Hypsithermal interval. Subsequent moister conditions in the late Holocene have been insufficient to allow the formation of a permanent water body.

This site is one of several yielding similar dates and assemblages from across the southern interior of Canada and adjacent United States. They all concur in showing a late Pleistocene–early Holocene interval of wetter conditions, before the aridity that characterizes the present landscape. This moister landscape probably does not reflect greater precipitation, which is contraindicated by reconstructions based on orbital parameters (e.g., Schweger and Hickman, 1989). Rather, it may reflect residual moisture and drying of the landscape following deglaciation (Beaudoin et al., 1998).

GSC-5415. Drummond Glacier

normalized age:	180 ± 50
$\delta^{13}C$:	-24.5‰
uncorrected age:	170 ± 50

Tree trunk wood sample DR-2 (*Picea*, identified by H. Jetté in unpublished GSC Wood Report 92-04), enclosed in morainal gravel at the base of a bedrock step, was collected by G. Osborn on August 25, 1991 from 6.2 km northeast of Skoki Lodge in the forefield of the Drummond Glacier, southwestern Alberta (51°34′N, 116°01′W), at an elevation of 2045 m. The sample was submitted by G. Holdsworth to gain information on a Neoglacial glacial advance.

The sample (9.9 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.5 g) yielded 8.59 L of CO_2 gas. The age estimate is based on two counts for 2005 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.691 ± 0.127, 2.106 ± 0.025, and 28.293 ± 0.128 cpm, respectively.

Comment (G. Holdsworth): The tree trunk was in morainal gravel at the base of a bedrock step. No original moraine relief remains, but curving lateral moraines project onto the site. The tree was apparently very near the glacier terminus at its maximum extent. The tilted trunk offers a rare opportunity to narrowly bracket the time of maximum Neoglacial extent of a glacier in the Rocky Mountains. Ring analysis, combined with the ^{14}C date, may allow a precise calendar age to be estimated.

Rainbow Lake series

A series of basal peat samples was collected by I. Bauer between July 5 and 8, 1996 (cores 1 to 7) and August 11 and 13, 1998 (cores 8 to 11) from sites within a 6.5 km^2 peatland complex, 22 km due south of Rainbow Lake, northwestern Alberta (58°17′30″N, 119°22′W), at an elevation of about 500 m. These samples were submitted by I. Bauer to gain information on the initiation of peat and on the paleoenvironment.

GSC-6151. Rainbow Lake I

normalized age:	5000 ± 60
$\delta^{13}C$:	-29.15‰
uncorrected age:	5060 ± 60

The basal peat from a shrubby fen area, sample S4-C1 (111–118 cm depth; 27.4 g dry weight of herbaceous/moss peat with wood), enclosed in peat with mineral below, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (14.9 g) yielded 10.8 L of CO_2 gas. The age estimate is based on one count for 5000 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 15.112 ± 0.067, 2.163 ± 0.032, and 28.387 ± 0.135 cpm, respectively.

GSC-6153. Rainbow Lake II

normalized age:	5410 ± 80
$\delta^{13}C$:	-27.20‰
uncorrected age:	5450 ± 80

The basal peat from a poor fen area, sample S4-C2 (183–187 cm depth; 5.1 g dry weight of woody/herbaceous peat), enclosed in peat with organic and mineral mix below, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (3.7 g) yielded 2.7 L of CO_2 gas. The age estimate is based on one count for 5600 minutes in the 2 L counter with a mixing ratio of 1.51. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.177 ± 0.060, 1.180 ± 0.017, and 18.078 ± 0.106 cpm, respectively.

GSC-6157. Rainbow Lake III

normalized age:	7200 ± 90
$\delta^{13}C$:	-29.78‰
uncorrected age:	7280 ± 90

The basal peat sample S4-C3 (252–256 cm depth; 8.2 g dry weight of woody herbaceous peat), enclosed in peat with mineral below, was collected from a collapse scar in a tall black spruce stand. It was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (5.4 g) yielded 4.3 L of CO_2 gas. The age estimate is based on one count for 3715 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.325 ± 0.054, 1.162 ± 0.025, and 18.124 ± 0.109 cpm, respectively.

GSC-6160. Rainbow Lake IV

normalized age:	3940 ± 60
$\delta^{13}C$:	-29.02‰
uncorrected age:	4010 ± 60

Basal peat sample S4-C4 (29–33 cm depth; 21.9 g dry weight of woody herbaceous peat), enclosed in peat with organic and mineral mix below, was from a marginal willow and alder shrub area. It treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (11.8 g) yielded 11.0 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.070 ± 0.079, 2.172 ± 0.034, and 28.110 ± 0.147 cpm, respectively.

GSC-6163. Rainbow Lake V

normalized age:	3770 ± 60
$\delta^{13}C$:	-27.15‰
uncorrected age:	3810 ± 60

Basal peat sample S4-C5 (68–72 cm depth; 15.6 g dry weight of *Sphagnum* peat), enclosed in peat with organic and mineral mix below, was from a bog or poor fen about 100 m from the upland edge in a peatland complex. It was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.3 g) yielded 8.1 L of CO_2 gas. The age estimate is based on one count for 3750 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.498 ± 0.080, 2.172 ± 0.034, and 28.110 ± 0.147 cpm, respectively.

GSC-6167. Rainbow Lake VI

normalized age:	4270 ± 70
$\delta^{13}C$:	-27.36‰
uncorrected age:	4310 ± 70

Basal peat sample S4-C6 (79–83 cm depth; 20.4 g dry weight of woody herbaceous peat), enclosed in peat with mineral below, was from a bog site. It was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (11.0 g) yielded 7.9 L of CO_2 gas. The age estimate is based on one count for 3715 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.660 ± 0.079, 2.170 ± 0.034, and 28.489 ± 0.208 cpm, respectively.

GSC-6169. Rainbow Lake VII

normalized age:	6230 ± 80
$\delta^{13}C$:	-27.47‰
uncorrected age:	6270 ± 80

Basal peat sample S4-C7 (100–104 cm depth; 14.3 g dry weight of *Sphagnum* peat with wood), enclosed in peat with organic and mineral mix below, was from a bog site. It was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.6 g) yielded 6.8 L of CO_2 gas. The age estimate is based on one count for 3720 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.054 ± 0.073, 2.170 ± 0.034, and 28.489 ± 0.208 cpm, respectively.

BGS-2114. Rainbow Lake VIII

normalized age:	9065 ± 115
$\delta^{13}C$:	-30.04‰
uncorrected age:	9145 ± 115

Basal peat sample S4-C8 (310–314 cm depth; 8.2 g dry weight of herbaceous/*Sphagnum* peat), enclosed in peat with organic and mineral mix below, was from a bog site. It was treated with acid and base to yield 7.3 g of treated material. The age estimate is based on one count for 3000 minutes.

BGS-2115. Rainbow Lake IX

normalized age:	2136 ± 70
$\delta^{13}C$:	-26.82‰
uncorrected age:	2166 ± 70

Basal peat sample S4-C9 (45–49 cm depth; 8.4 g dry weight of woody peat), enclosed in peat with mineral material below, was from a marginal swamp area. It was treated with acid and base to yield 4.6 g of treated material. The age estimate is based on one count for 4000 minutes.

BGS-2116. Rainbow Lake X

normalized age:	8175 ± 90
$\delta^{13}C$:	-28.86‰
uncorrected age:	8237 ± 90

Basal peat sample S4-C10 (295–299 cm depth; 9.9 g dry weight of herbaceous peat with *Sphagnum*), enclosed in peat with organic and mineral mix below, was from a bog area. It was treated with acid and base to yield 7.0 g of treated material. The age estimate is based on one count for 4000 minutes.

BGS-2117. Rainbow Lake XI

normalized age:	5600 ± 80
$\delta^{13}C$:	-29.72‰
uncorrected age:	5675 ± 80

Basal peat sample S4-C11 (153–157 cm depth; 9.3 g dry weight of woody peat), enclosed in peat with organic and mineral mix below, was from a small fen channel. It was treated with acid and base to yield 5.9 g of treated material. The age estimate is based on one count for 4000 minutes.

Comment (I. Bauer): Stratigraphic evidence and aerial photography indicate that most sites classified as bog or poor fen represent former (permafrost) peat plateaus. None of the coring sites contained permafrost at the time of sampling. See Bauer (2002) for additional details.

British Columbia

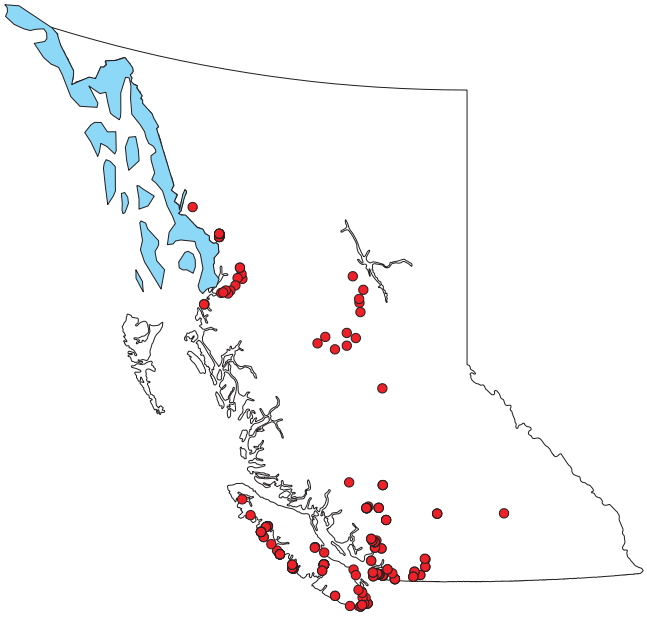


Figure 16. *Radiocarbon-dated sites in British Columbia.*

Mainland

GSC-6300. Mabel Lake

normalized age:	18 900 ± 180
$\delta^{13}C$:	-23.5‰
uncorrected age:	18 900 ± 180

Wood sample 'BH103: 10.2-10.4' (*Picea* possibly sitka, identified by C. Keith) was collected by K.P. Turner on October 13, 1998 from glaciolacustrine or lacustrine clayey silt recovered from a borehole at the intersection of Mabel Lake Forest Service Road and South Cascades Road on the east side of Mabel Lake, 30 km east of Enderby, southeastern British Columbia (50°29.8′N, 118°43.0′W), at an elevation of about 434 m. The sample was submitted by J.J. Clague to gain information on deglaciation.

The sample (9.0 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 7.8 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 2.710 ± 0.050, 2.230 ± 0.035, and 28.420 ± 0.140 cpm, respectively.

Comment (J.J. Clague): The dated glaciolacustrine sediment was deposited during the early, growth phase of the Late Wisconsinan Fraser Glaciation. At that time, the regional drainage was blocked by advancing glaciers, and an ice-dammed lake developed.

Silver Lake series

A series of wood samples was collected by J.J. Clague on September 29, 1990 and June 19, 1991, and by J.J. Clague and W.W. Shilts on October 10, 1991 from Silver Lake, 7 km south-southeast of Hope, southwestern British Columbia, at an elevation of about 343 m. These samples were submitted by J.J. Clague to gain information on the damming of a lake by a landslide.

GSC-5236. Silver Lake I

normalized age:	100 ± 50
$\delta^{13}C$:	-23.5‰
uncorrected age:	80 ± 50

Wood sample CIA-91-105 (49°18.9′N, 121°24.8′W; 18.2 g dry weight; Pseudotsuga menziesii, identified by H. Jetté in unpublished GSC Wood Report 91-35), from a tree rooted on the lake bottom 13.5 m below the surface, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.7 g) yielded 8.08 L of CO_2 gas. The age estimate is based on two counts for 1920 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 28.053 ± 0.128, 2.055 ± 0.028, and 28.334 ± 0.123 cpm, respectively.

Comment (J.J. Clague): Sample GSC-5236 was collected from what was thought to be an in situ tree, drowned when Silver Lake was impounded by a landslide. Sample GSC-5204 (below) indicates that this event occurred 800 to 1100 cal. years BP. The near- modern age for GSC-5236 suggests that the dated tree is, in fact, a piling emplaced during logging operations earlier in the twentieth century.

GSC-5444. Silver Lake II

normalized age:	890 ± 60
$\delta^{13}C$:	-22.9‰
uncorrected age:	850 ± 60

Wood sample CIA-91-176 (49°18.6′N, 121°24.4′W; 18.20 g dry weight; Pseudotsuga menziesii, identified by H. Jetté in unpublished GSC Wood Report 92-61), an in situ stump in a lake, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 8.08 L of CO_2 gas. The age estimate is based on one count for 2126 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.187 ± 0.116, 2.111 ± 0.026, and 28.013 ± 0.180 cpm, respectively.

Comments (J.J. Clague): The dated sample consisted of the outermost rings of a tree stump rooted on the floor of Silver Lake, a landslide-dammed lake in the Cascade Mountains of southwestern British Columbia. The tree was inundated and killed when a rockslide blocked Silverhope Creek and either impounded or raised the level of Silver Lake. Sample GSC-5204 (below) indicates that this happened about 900 radiocarbon years ago.

GSC-5204. Silver Lake III

normalized age:	1020 ± 100
$\delta^{13}C$:	-25.2‰
uncorrected age:	1030 ± 100

Wood sample CIA-90-167 (49°18.8′N, 121°24.8′W; 7.2 g dry weight; outermost 10 rings of a stump of *Pseudotsuga menziesii*, identified by R.J. Mott in unpublished GSC Wood Report 90-53), from a tree rooted on the floor of a lake, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.5 g) yielded 5.92 L of CO_2 gas. The age estimate is based on two counts for 2100 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.085 ± 0.094, 1.065 ± 0.026, and 18.277 ± 0.188 cpm, respectively.

Comment (J.J. Clague): The dated tree is one of many that were drowned when a landslide created Silver Lake or substantially raised its level (Clague and Shilts, 1993). Sample GSC-5204, measured on the outermost exposed rings of the tree, is probably close to the age of the landslide (800-1100 cal. years BP).

TO-5969. Squeah Lake

normalized age:	9360 ± 80

Sample CIA-96-2-1 (6.31 m depth), the conifer needles of *Pinus contorta* (identified by R.W. Mathewes), from the base of an organic-rich mud sequence, was collected by J.J. Clague on May 24, 1996 from a sediment core taken in the marsh at the edge of Squeah Lake, southwestern British Columbia (49°28.8′N, 121°24.3′W), at an elevation of about 205 m. This sample was submitted by J.J. Clague to gain information on deglaciation.

The age was normalized to $\delta^{13}C$ = -25‰. The calibrated age is 8405 BC, with a 1σ range of 8485 to 8340 BC.

Comment (J.J. Clague): Sample TO-5969 provides a minimum age for deglaciation of the Fraser River canyon.

TO-6547. 'Pinecrest Lake'

normalized age:	8350 ± 160
$\delta^{13}C$:	-25 ‰

Wood sample CIA-97-1, a twig from gyttja near the base of the postglacial sequence, was collected by R.W. Mathewes on September 25, 1971 from a sediment core taken in 'Pinecrest Lake', 12 km north of Hope, southwestern British Columbia (49°29.5′N, 121°25.9′W), at an elevation of about 320 m. This sample was submitted by J.J. Clague to gain information on the time of deglaciation.

The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated age is 9375 BP, with a 1σ range of 9195 to 9485 BP and a 2σ range of 8955 to 9585 BP.

Comment (J.J. Clague): It was thought that this sample would provide a closely limiting age on deglaciation. The sample is younger than expected.

Foley Lake series

A series of wood samples was collected by J.J. Clague on April 21 and June 18, 1991 from Foley Lake, 28 km east of Vedder Crossing, southwestern British Columbia (49°7.7′N, 121°34.3′W), at an elevation of 560 m. These samples were submitted by J.J. Clague to gain information on a landslide.

GSC-5239. Foley Lake I

normalized age:	modern
$\delta^{13}C$:	-26.1‰
uncorrected age:	50 ± 60

Wood sample CIA-91-106 (19.3 g dry weight; *Abies*, identified by H. Jetté in unpublished GSC Wood Report 91-37), from a tree rooted on the lake bottom 14 m below the surface, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.5 g) yielded 8.24 L of CO_2 gas. The age estimate is based on two counts for 1960 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 28.002 ± 0.129, 2.186 ± 0.033, and 28.173 ± 0.146 cpm, respectively.

GSC-5260. Foley Lake II

normalized age:	150 ± 50
$\delta^{13}C$:	-27.7‰
uncorrected age:	200 ± 50

Wood sample CIA-91-102 (18.9 g dry weight; *Abies*, identified by H. Jetté in unpublished GSC Wood Report 91-44), from a tree rooted on the lake bottom 1.5 m below surface, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 8.17 L of CO_2 gas. The age estimate is based on two counts for 2240 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.494 ± 0.120, 2.186 ± 0.033, and 28.173 ± 0.146 cpm, respectively.

Comment (J.J. Clague): The two dated trees were drowned when a landslide impounded Foley Lake. The outer rings of the trees were dated in order to determine, as closely as possible, the time the trees were killed. The radiocarbon ages indicate that the landslide occurred no more than 310 cal. years BP. Other evidence (Clague and Shilts, 1993) demonstrates that the event occurred before AD 1840.

Cheam Indian Reserve series

A series of wood samples was collected by J.J. Clague and R. Gerath on October 31, 1993 from a gravel pit on Cheam Indian Reserve 1, 13 km east-northeast of Chilliwack, southwestern British Columbia (49°12.0′N, 121°46.2′W), at an elevation of about 41 m. These samples were submitted by J.J. Clague to gain information on the Cheam landslide.

GSC-6222. Cheam Indian Reserve I

normalized age:	4720 ± 80
$\delta^{13}C$:	-22.9‰
uncorrected age:	4690 ± 80

Wood sample CIA-93-136-1 (3.7 g dry weight; probably *Sequoia sempervirons*, identified by C. Keith), a branch enclosed in silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (3.3 g) yielded 2.9 L of CO_2 gas. The age estimate is based on one count for 3710 minutes in the 2 L counter with a mixing ratio of 1.39. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.110 ± 0.075, 1.214 ± 0.025, and 18.117 ± 0.109 cpm, respectively.

GSC-5781. Cheam Indian Reserve II

normalized age:	4830 ± 90
$\delta^{13}C$:	-22.8‰
uncorrected age:	4800 ± 90

Wood sample CIA-93-134-1 (Gerath Cheam 93-2-3; 4.3 g dry weight), a root or branch enclosed in sandy silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (5.7 g) yielded 3.38 L of CO_2 gas. The age estimate is based on two counts for 1880 minutes in the 2 L counter with a mixing ratio of 1.28. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.248 ± 0.095, 1.218 ± 0.025, and 18.627 ± 0.106 cpm, respectively.

Comment (J.J. Clague): Sample GSC-6222 was from a thin, organic-rich silt that is capped by a 1 to 2 cm thick peat bed. The peat bed is abruptly overlain by debris of the Cheam landslide. Previous dating of wood, including GSC-5781, from the silt and the overlying landslide debris, suggests that the landslide occurred about 4500 to 5000 BP (cf. GSC-4004, 5010 ± 70 BP [McNeely and McCuaig, 1991] and SFU W-04, 4360 ± 90 BP and SFU W-03, 4690 ± 80 BP [Naumann, 1990]). This interpretation is supported by these new dates.

Vedder Crossing series

A series of wood samples was collected by J.J. Clague on May 13, 1999 from a landslide scarp 12 km east of Vedder Crossing, Chilliwack River valley, southwestern British Columbia (49°05.2′N, 121°48.2′W), at an elevation of 250 m. These samples were submitted by J.J. Clague to gain information on a landslide.

GSC-6403. Vedder Crossing I

normalized age:	8690 ± 80
$\delta^{13}C$:	-23.9‰
uncorrected age:	8680 ± 80

Wood sample CIA-99-2-3 (10.4 g dry weight), a branch enclosed in diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 7.0 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.672 ± 0.065, 2.080 ± 0.033, and 28.482 ± 0.131 cpm, respectively.

GSC-6401. Vedder Crossing II

normalized age:	8710 ± 100
$\delta^{13}C$:	-25.1‰
uncorrected age:	8720 ± 100

Wood sample CIA-99-2-1 (10.4 g dry weight), enclosed in diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.0 g) yielded 6.8 L of CO_2 gas. The age estimate is based on one count for 2575 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 6.089 ± 0.056, 1.128 ± 0.017, and 18.019 ± 0.103 cpm, respectively.

Comment (J.J. Clague): The diamicton containing the wood samples is landslide debris. This diamicton occurs in an area of chronic landsliding in the Chilliwack River valley. Samples GSC-6401 and -6403 show that the valley slope at this site failed about 8700 14C years BP, in early Holocene time.

SFU-406. Chilliwack River

uncorrected age:	20 190 ± 1000

Coniferous wood sample CIA-85-169 (identified by R.J. Mott in unpublished GSC Wood Report 85-81), enclosed in sand and silt that is underlain by laminated to massive mud and overlain by laminated mud, was collected by J.J. Clague and I. Saunders on October 24, 1985 from the bank at the meander bend on the Chilliwack River, 12 km east of Vedder Crossing, southwestern British Columbia (49°05′06″N, 121°48′12″W), at an elevation of about 168 m. The sample was submitted by J.J. Clague to gain information on the time of glaciation.

Comment (J.J. Clague): Sample SFU-406 comprised several fragments of wood recovered from glaciolacustrine sediment inferred to have been deposited during the advance phase of the last (Fraser) glaciation. The sample provides chronological control on the glacial lake and on the Fraser Glaciation maximum. Younger radiocarbon ages, however, have been obtained from other wood samples collected from the same unit at this site (Clague et al., 1988). The younger

ages show that trees continued to grow in the Chilliwack River Valley as late as about 16 000 BP, and that the Fraser Glaciation maximum occurred after this time.

Bradner Road series

A series of wood samples was collected by J.J. Clague on December 10, 2000 from a gravel pit east of Bradner Road, 4 km southeast of Aldergrove, southwestern British Columbia (49°01.3′N, 122°25.1′W), at an elevation of 78 m. These samples were submitted by J.J. Clague to gain information on a glacial readvance and marine reservoir.

GSC-6568. Bradner Road I

normalized age:	11 600 ± 110
$\delta^{13}C$:	-26.3‰
uncorrected age:	11 600 ± 110

Wood sample CIA-00-106-7 (5.0 g dry weight), a twig or root enclosed in diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.5 g) yielded 4.2 L of CO_2 gas. The age estimate is based on one count for 3965 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.263 ± 0.042, 1.131 ± 0.020, and 18.092 ± 0.107 cpm, respectively.

GSC-6571. Bradner Road II

normalized age:	11 600 ± 120
$\delta^{13}C$:	-28.7‰
uncorrected age:	11 600 ± 120

Wood sample CIA-00-106-8 (13.1 g dry weight), a log enclosed in diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.1 g) yielded 7.1 L of CO_2 gas. The age estimate is based on one count for 2375 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.255 ± 0.052, 1.131 ± 0.020, and 18.092 ± 0.107 cpm, respectively.

GSC-6541. Bradner Road III

normalized age:	11 700 ± 100
$\delta^{13}C$:	-26.5‰
uncorrected age:	11 700 ± 100

Wood sample CIA-00-106-1 (11.2 g dry weight), a branch enclosed in diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 8.2 L of CO_2 gas. The age estimate is based on one count for 3795 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 6.634 ± 0.056, 2.120 ± 0.028, and 28.420 ± 0.157 cpm, respectively.

GSC-6570. Bradner Road IV

normalized age:	11 700 ± 110
$\delta^{13}C$:	-28.3‰
uncorrected age:	11 800 ± 110

Wood sample CIA-00-106-9 (14.9 g dry weight), a log enclosed in diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 7.8 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.184 ± 0.042, 1.131 ± 0.020, and 18.092 ± 0.107 cpm, respectively.

GSC-6572. Bradner Road V

normalized age:	11 800 ± 120
$\delta^{13}C$:	-29.1‰
uncorrected age:	11 900 ± 120

Wood sample CIA-00-106-13 (9.8 g dry weight), a small log enclosed in diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.1 g) yielded 7.3 L of CO_2 gas. The age estimate is based on one count for 2800 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.121 ± 0.048, 1.131 ± 0.020, and 18.092 ± 0.107 cpm, respectively.

GSC-6565. Bradner Road VI

normalized age:	11 900 ± 170
$\delta^{13}C$:	-26.9‰
uncorrected age:	11 900 ± 170

Wood sample CIA-00-106-3 (2.4 g dry weight), a twig enclosed in diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.2 g) yielded 1.9 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 2.18. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.090 ± 0.075, 1.131 ± 0.020, and 18.092 ± 0.107 cpm, respectively.

Comment (J.J. Clague): The six radiocarbon ages in the Bradner Road series (GSC-6541, -6565, -6568, -6570, -6571, -6572) are from samples of wood (twigs, branches, logs, and a possible root) collected from a stony mud unit in a gravel pit southeast of Aldergrove, southwestern British Columbia (Clague et al., 1997). The stony mud, which is either glaciolacustrine or glaciomarine in origin, is overlain by outwash gravel and till deposited during the Sumas event. The radiocarbon ages range from 11 600 ± 110 BP to 11 900 ± 70 BP, indicating that the advance that deposited the till occurred shortly after

11 600 14C BP. This is also a minimum age for an earlier Sumas advance, which is recorded by a till underlying the dated sediment.

TO-932. Fort Langley

corrected age: 11 820 ± 70

Marine shell sample CIA-80-16-4, valves and fragments of *Nuculana* enclosed in stony mud, was collected by J.J. Clague on August 28, 1987 from a gravel pit on the east side of 256th Street, 0.6 km south of 84th Avenue, 5 km east-southeast of Fort Langley, southwestern British Columbia (49°08.9′N, 122°30.7′W), at an elevation of 55 to 57 m. This sample was submitted by J.J. Clague to gain information on sea level change. The age was age corrected to δ13C = 0‰.

Comments (J.J. Clague): Sea level was at least 55 to 57 m higher relative to the land 11.8 ka BP than at present. A *Macoma calcarea* valve lower in the sequence yielded an age of 12 700 ± 70 BP.

Pitt Meadows series

A series of wood samples was collected by J.J. Clague and T. Spurgeon on October 05, 1996 from backhoe trenches at Pitt Meadows, just north of Lougheed Highway, south of Katzie Slough, southwestern British Columbia (49°13.8′N, 122°40.9′W), at an elevation of 0 to 1 m. These samples were submitted by J.J. Clague to gain information on sea level change and fluvial sedimentation.

GSC-6207. Pitt Meadows I

normalized age: 4030 ± 80
$\delta^{13}C$: -26.1‰
uncorrected age: 4050 ± 80

Wood sample CIA-96-105 (10.1 g dry weight; probably *Tsuga heterophylla*, identified by C. Keith), a branch enclosed in sandy silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.9 g) yielded 7.1 L of CO_2 gas. The age estimate is based on one count for 3600 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.855 ± 0.064, 1.215 ± 0.027, and 17.975 ± 0.149 cpm, respectively.

GSC-6209. Pitt Meadows II

normalized age: 5560 ± 90
$\delta^{13}C$: -26.5‰
uncorrected age: 5580 ± 90

Wood sample CIA-96-106 (6.6 g dry weight; possibly *Pinus*, identified by C. Keith), a branch enclosed in sandy mud, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (5.8 g) yielded 5.3 L of CO_2 gas. The age estimate is based on one count for 3600 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.975 ± 0.060, 1.215 ± 0.027, and 17.975 ± 0.149 cpm, respectively.

Comments (J.J. Clague and T. Spurgeon): Samples GSC-6207 and -6209 were collected from adjacent backhoe trenches on the floodplain of the Pitt and Alouette rivers. The site is adjacent to the 'Park Farm' archeological site (DhRq 22), which contains prehistoric cultural materials spanning the period from 4170 ± 120 BP (SFU-405) to 300 ± 50 BP (Beta-80773), and representing the Charles, Locarno, Marpole, and Developed Coast Salish phases (*see* Spurgeon, 1984).

The dated material in both trenches was collected from the base of the Holocene sedimentary sequence, just above (?) late Pleistocene deltaic sand (part of the Sumas Drift). The depth of the younger radiocarbon sample was 1 m (i.e. at an elevation about 1 m), whereas the depth of the older sample was 2.2 m (i.e. elevation about 0 m). The two ages record progressive aggradation of the Pitt River floodplain as sea level rose relative to the land during late Holocene time. Alluvial or estuarine mud built up against the buried Pleistocene high at this site as the sea rose. The sea was probably about 2 to 3 m below its present level 5500 ^{14}C years BP and 1 m below its present level 4000 ^{14}C years BP.

Serpentine River A series

A series of organic samples was collected by J.J. Clague on June 15 and July 15, 1993, and by J.J. Clague and R.W. Mathewes on July 28, 1994 from the banks of the Serpentine River, 15 km south-southeast of New Westminister, southwestern British Columbia (49°05.3′N, 122°49.3′W), at an elevation of about 1 m. These samples were submitted by J.J. Clague to gain information on sea level change, and on prehistoric earthquakes and a tsunami.

TO-4698. Serpentine River I

normalized age: 330 ± 50

Seed sample CIA-93-15 (18–20 cm depth; *Scirpus*, identified by R.W. Mathewes) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-4058. Serpentine River II

normalized age: 2400 ± 60

Wood sample CIA-93-16 was part of an in situ root enclosed in peat with mud above. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5671. Serpentine River III

normalized age: 4380 ± 80
$\delta^{13}C$: -27.4‰
uncorrected age: 4420 ± 80

Wood sample CIA-93-15-3 (11.9 g dry weight; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 94-09), a piece of a branch enclosed in peaty mud, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.1 g) yielded 9.27 L of CO_2 gas. The age estimate is based on two counts for 2130 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.349 ± 0.099, 2.238 ± 0.033, and 28.354 ± 0.189 cpm, respectively.

Comment (J.J. Clague): These dates provide chronological control on a late Holocene peat sequence that has provided evidence for relative sea level change attributed to a large earthquake (*see* Mathewes and Clague, 1994).

Serpentine River B series

A series of wood samples was collected by J.J. Clague and R.W. Mathewes on August 20 and 24, 1990 and July 27, 1994 from the Serpentine River, 14 km south-southeast of New Westminister, southwestern British Columbia (49°05.3′N, 122°50.3′W), at an elevation of 0 m. These samples were submitted by J.J. Clague to gain information on sea level change, and on prehistoric earthquakes, related tsunamis, and liquefaction events.

TO-4951. Serpentine River I

normalized age: modern
$\delta^{13}C$: -25 ‰

Wood fragment sample CIA-94-153 (52–53 cm depth), was enclosed in peat. The age was normalized assuming $\delta^{13}C$ = -25‰.

TO-4694. Serpentine River II

normalized age: 450 ± 60

Seed sample CIA-90-153 (23–24 cm depth; Chenopodiaceae, identified by R.W. Mathewes) was enclosed in peaty mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2132. Serpentine River III

normalized age: 1090 ± 50

Seed sample CIA-90-153-39 (0.5 m depth; *Scirpus*) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5254. Serpentine River IV

normalized age: 1940 ± 80
$\delta^{13}C$: -24.7‰
uncorrected age: 1930 ± 80

Wood sample CIA-90-153-38 (5.3 g dry weight; *Picea*, identified by R.J. Mott in unpublished GSC Wood Report 90-71), a single piece enclosed in mud with peat below, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.3 g) yielded 4.28 L of CO_2 gas. The age estimate is based on two counts for 1970 minutes in the 2 L counter with a mixing ratio of 1.06. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.450 ± 0.095, 1.213 ± 0.021, and 18.379 ± 0.137 cpm, respectively.

TO-4695. Serpentine River V

normalized age: 3960 ± 70

Wood fragment sample CIA-90-153 (52–53 cm depth) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (J.J. Clague): The wood that yielded GSC-5254 was collected from the top of a peat bed underlying intertidal mud. The mud appears to have been deposited on a shrubland that subsided suddenly, probably as a result of a large earthquake. Sample GSC-5254 indicates that this earthquake occurred after 2000 cal. years BP. Contemporaneous sudden subsidence has been documented at several other sites on southern Vancouver Island and adjacent mainland British Columbia. The other dates from this site provide chronological control on the deposition of the late Holocene sediment sequence at the Serpentine River.

Colebrook Road series

A series of peat samples was collected by J.J. Clague, R.W. Mathewes, and R.J. Hebda on June 22, 1989 from sediment cores on the Serpentine River floodplain, 130 m north of 14019 Colebrook Road, Delta, southwestern British Columbia (49°05.9′N, 122°49.9′W). These samples were submitted by J.J. Clague to gain information on sea level change, and on vertical crustal movements related to paleoseismicity.

S-3187. Colebrook Road I

uncorrected age: 1930 ± 100

Peat sample CIA-89-205-20 was enclosed in peat at an elevation of about 1 m.

S-3188. Colebrook Road II

uncorrected age: 4460 ± 110

Peat sample CIA-89-205-59 was enclosed in peat at an elevation of about 1 m.

TO-1542. Colebrook Road III

normalized age: 4830 ± 80

Wood sample CIA-89-205-41 was enclosed in peat at a depth of about 1 m. The age was normalized to $\delta^{13}C$ = -25‰.

TO-1541. Colebrook Road IV

normalized age: 4900 ± 80

Wood sample CIA-89-205-35 was enclosed in peat at a depth of about 1 m. The age was normalized to $\delta^{13}C$ = -25‰.

Comments (J.J. Clague): The Colebrook Road dates (S-3187, -3188, and TO-1541, -1542) provide information on sea-level change and, by inference, vertical crustal movements near Vancouver during the Holocene (*see* Mathewes and Clague, 1994; Clague et al., 1998).

'Burns Bog' series

A series of wood, seed, and other organic samples was collected by J.J. Clague, R.W. Mathewes, and P.T. Bobrowsky on June 30, 1989, by J.J. Clague and R.W. Mathewes on June 20, 1990, and by J.J. Clague on May 28, 29, and 30, and July 03, 1990 from core sites in 'Burns Bog', about 1.5 km north-northeast of the intersection of Highway 99 and 72nd Street, Delta, southwestern British Columbia (49°06.5′N, 122°57.3′W; 49°06.8′N, 122°56.3′W; 49°06.9′N, 122°57.5′W; 49°07.6′N, 123°01.1′W). These samples were submitted by J.J. Clague to gain information on sea level change, vegetation change, and vertical crustal movements.

TO-2130. 'Burns Bog' I

normalized age: 3430 ± 60

Wood sample CIA-90-104-3 (1.7 m depth) was enclosed in mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2129. 'Burns Bog' II

normalized age: 3750 ± 60

Wood sample CIA-90-104-2 (4.5 m depth) was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2122. 'Burns Bog' III

normalized age: 6350 ± 70

Wood sample CIA-90-100-7 (4.0 m depth) was enclosed in sand above and peat below. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2127. 'Burns Bog' IV

normalized age: 4360 ± 70

Wood sample CIA-90-102-2 (1.4 m depth) was enclosed in mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2128. 'Burns Bog' V

normalized age: 5610 ± 70

Plant material, stem or rhizome sample CIA-90-102-13 (3.5 m depth) was enclosed in mud and sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2126. 'Burns Bog' VI

normalized age: 1580 ± 60

Wood sample CIA-90-101-28, collected at an elevation of 1.3 m, was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2124. 'Burns Bog' VII

normalized age: 3940 ± 70

Wood sample CIA-90-101-6, collected at an elevation of 0 m, was enclosed in organic rich mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2123. 'Burns Bog' VIII

normalized age: 4840 ± 70

Wood sample CIA-90-101-2 (1.2 m depth) was enclosed in sand (above) and peat (below). The age was normalized to $\delta^{13}C$ = -25‰.

TO-2125. 'Burns Bog' IX

normalized age: 5330 ± 70

Plant stem sample CIA-90-101-15 (2.3 m depth) was enclosed in mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2635. 'Burns Bog' X

normalized age: low yield

Leaf sample CIA-89-207-128 (Ericaceae), collected at an elevation of 0.5 m, was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2634. 'Burns Bog' XI

normalized age: 1160 ± 120

Leaf sample CIA-89-207-110 (Ericaceae), collected at an elevation of 1.5 m, was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰

TO-2632. 'Burns Bog' XII

normalized age: 2340 ± 170

Seed sample CIA-89-207-63 (*Scirpus*), collected at an elevation of 0 m, was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2633. 'Burns Bog' XIII

normalized age: 3840 ± 70

Seed sample CIA-89-207-88 (1.0 m; *Scirpus*) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2119. 'Burns Bog' XIV

normalized age: 4210 ± 90

Plant remains sample CIA-89-207-14 (1.5 m depth; seeds of *Scirpus*) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2120. 'Burns Bog' XV

normalized age: 5050 ± 340

Plant remains sample CIA-89-207-22 (1.3 m depth; seeds of *Scirpus*) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰. Sample S-3189 (>33 ka BP; Hebda, 1977) was from the same peat bed.

TO-1543. 'Burns Bog' XVI

normalized age: 7630 ± 140

Wood sample CIA-89-207-27 (1 m depth) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

Comments (J.J. Clague): These dates provide chronological control on the development of 'Burns Bog', a large domed peat bog on the Fraser River delta south of Vancouver. Other radiocarbon dates from 'Burns Bog' are reported in (Hebda, 1977).

Tsawwassen series

A series of organic samples was collected by J.J. Clague on May 20, 1996 from a backhoe trench 7 km northwest of Tsawwassen, south of Canoe Passage in the Fraser River delta, southwestern British Columbia (49°03.8′N, 123°08.9′W), at an elevation of about 1 m. These samples were submitted by J.J. Clague to gain information on fluvial activity and delta aggradation.

GSC-6130. Tsawwassen I

normalized age: 330 ± 60
$\delta^{13}C$: -27.9‰
uncorrected age: 380 ± 60

Rhizome sample C1A-96-1-1 (35.7 g wet weight; *Triglochin maritimum*, identified by J.J. Clague), enclosed in clayey silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.5 g) yielded 3.7 L of CO_2 gas. The age estimate is based on one count for 2315 minutes in the 2 L counter with a mixing ratio of 1.10. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.396 ± 0.098, 1.225 ± 0.024, and 18.240 ± 0.103 cpm, respectively.

GSC-6131. Tsawwassen II

normalized age: 400 ± 60
$\delta^{13}C$: -27.7‰
uncorrected age: 440 ± 60

Wood sample C.a.-96-1-3 (22.4 g dry weight), part of a branch enclosed in clayey silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (10.8 g) yielded 9.6 L of CO_2 gas. The age estimate is based on one count for 2200 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.260 ± 0.095, 1.225 ± 0.024, and 18.240 ± 0.103 cpm, respectively.

Comment (J.J. Clague): Samples GSC-6130 and -6131 provide chronological control on the intertidal sediment about 1.5 m below the Fraser River delta plain near the dyked delta margin. Distributary channel sand overlies the dated sediment, indicating that an arm of the Fraser River occupied the site sometime after about 330 ^{14}C years BP.

Francis Road series

A series of marine shell fragments and wood samples was collected by J.L. Luternauer on October 16, 1990 from drillcores in the Fraser River delta, at the intersection of Francis Road and Railway Avenue, Richmond, southwestern British Columbia (49°08.9′N, 123°10.1′W). These samples were submitted by J.J. Clague to gain information on sea level change and the progradation of the Fraser River delta.

TO-2434. Francis Road I

normalized age: 3860 ± 50
corrected age: 3450 ± 50

Marine mollusc shell fragment sample 'FD-90B (15')', from a depth of 4.5 m, was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰, and corrected to $\delta^{13}C$ = 0‰.

TO-2436. Francis Road II

normalized age: 6220 ± 60

Wood sample 'FD-90B (144′2")', a single piece from a depth of about 44 m, was enclosed in silty clay. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2435. Francis Road III

normalized age:	6870 ± 60
corrected age:	6460 ± 60

Marine pelecypod shell sample 'FD-90B (63′7")', from a depth of about 19 m, was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰, and corrected to $\delta^{13}C$ = 0‰.

Comment (J.J. Clague): Samples TO-2434, -2435, and -2436 define the time of deltaic deposition and progradation at this site (*see* Clague et al., 1998).

Sunset Beach series

A series of wood samples was collected by P. Friele and F. Baumann on April 1, 2001 from the east side of the highway, 4 km northeast of Horseshoe Bay at Sunset Beach, southwestern British Columbia (49°24′13″N, 123°14′33″W), at an elevation of 99 m. These samples were submitted by J.J. Clague to gain information on a landslide.

GSC-6573. Sunset Beach I

normalized age:	1060 ± 50
$\delta^{13}C$:	-24.5‰
uncorrected age:	1060 ± 50

Wood sample 'CIA-01-SB#2 Sunset Beach #2' (10.1 g dry weight), enclosed in a debris flow diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.2 g) yielded 6.4 L of CO_2 gas. The age estimate is based on one count for 2800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 24.911 ± 0.109, 2.039 ± 0.048, and 28.411 ± 0.140 cpm, respectively.

GSC-6574. Sunset Beach II

normalized age:	1090 ± 50
$\delta^{13}C$:	-25.3‰
uncorrected age:	1100 ± 50

Wood sample 'CIA-01-SB#1 Sunset Beach #1' (11.8 g dry weight; *Pseudotsuga*, identified by P. Friele), enclosed in a debris-flow diamicton, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.8 g) yielded 6.9 L of CO_2 gas. The age estimate is based on one count for 3875 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 24.790 ± 0.096, 2.039 ± 0.048, and 28.411 ± 0.140 cpm, respectively.

Comment (J.J. Clague): The wood samples that yielded GSC-6573 and -6574 were collected from debris-flow deposits on the Sunset Creek colluvial fan. The dated debris flow deposits probably underlie, and are therefore older than, a rockslide that forms the fan surface. The dates indicate that the fan has experienced large landslides in the recent past.

Mamquam River series

A series of wood samples was collected by P.A. Friele on June 10, 1996 and by J.J. Clague and P. Friele on August 12, 1997 from a roadcut east of the Mamquam River, about 0.1 km south of Crawford Creek, southwestern British Columbia (49°41.1′N, 122°54.8′W), at an elevation of about 622 m. The samples were submitted by J.J. Clague to gain information on deglaciation.

TO-6838.

Mamquam River I

normalized age:	11 550 ± 110
$\delta^{13}C$:	-25 ‰

Twig sample CIA-97-111-1 was enclosed in silt and sand. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated age is 11 525 BC with a 1σ range of 11 680 to 11 385 BC and a 2σ range of 11 850 to 11 265 BC.

GSC-6140. Mamquam River II

normalized age:	11 900 ± 100
$\delta^{13}C$:	-26.1‰
uncorrected age:	11 900 ± 100

Wood sample CIA-96-17 (11.4 g dry weight; *Pinus* cf. *P. contorta*, identified by R.J. Mott in unpublished GSC Wood Report 97-01), a piece of a log enclosed in stony mud, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.2 g) yielded 7.0 L of CO_2 gas. The age estimate is based on one count for 5275 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 6.450 ± 0.052, 2.163 ± 0.032, and 28.387 ± 0.135 cpm, respectively.

Comment (J.J. Clague): These dates are minima for the deglaciation of the upper Mamquam River valley in the southern Coast Mountains (*see* Friele and Clague, 2002). The dated material was enclosed in sediment deposited in a lake that was dammed by ice in the Ring and Skookum creeks valley to the north. This ice later readvanced into the upper Mamquam River valley.

Squamish series

A series of wood samples was collected by P. Friele and F. Baumann on December 04, 1997 and by J.J. Clague, P. Friele, and F. Baumann on December 13, 1997 from an excavation at Squamish, southwestern British Columbia (49°41.7′N, 123°08.4′W), at an elevation of 13 m. These samples were submitted by J.J. Clague to gain information on deglaciation and sea level change.

GSC-6236. Squamish I

normalized age:	10 200 ± 100
$\delta^{13}C$:	-24.8‰
uncorrected age:	10 200 ± 100

Wood sample CIA-97-143-1 (9.1 g dry weight; *Picea*, identified by C. Keith), one branch enclosed in deltaic sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 7.4 L of CO_2 gas. The age estimate is based on one count for 3780 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.929 ± 0.066, 2.195 ± 0.041, and 28.266 ± 0.154 cpm, respectively.

GSC-6240. Squamish II

normalized age:	10 600 ± 110
$\delta^{13}C$:	-23.4‰
uncorrected age:	10 500 ± 110

Wood sample CIA-97-143-2 (5.2 g dry weight; *Abies*, identified by C. Keith), one branch enclosed in deltaic sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.6 g) yielded 4.1 L of CO_2 gas. The age estimate is based on one count for 3780 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 4.880 ± 0.048, 1.214 ± 0.025, and 18.117 ± 0.109 cpm, respectively.

Comment (J.J. Clague): The two dated samples were recovered from a sequence of marine deltaic deposits at the head of Howe Sound, a fiord extending into the Coast Mountains. Sea level at this site must have been higher than 13 m a.s.l. (the elevation of the samples) when the sediment was deposited, about 10 200 ^{14}C years BP. The top of the delta, however, is 45 m a.s.l., and the sea probably stood at this level 10 200 ^{14}C years BP. Sample GSC-6240 is a minimum age for deglaciation of the lower Squamish River valley, an area near the existing ice fields of the Mount Garibaldi area.

Cheakamus River valley series

A series of wood samples was collected by J.J. Clague on July 06 and 15, 1999 and J.J. Clague and R.J.W. Turner on September 20, 2000 from a trench in the Cheakamus River valley at North Vancouver Outdoor School, 5 km north of Brackendale, southwestern British Columbia (49°49.0′N, 123°09.3′W), at an elevation of 50 m. These samples were submitted by J.J. Clague to gain information on a paleosol and the fluvial history.

GSC-6397. Cheakamus River valley I

normalized age:	modern (30 ± 60)
$\delta^{13}C$:	-24.7‰
uncorrected age:	20 ± 60

Wood sample CIA-99-20 (12.2 g dry weight; *Thuja plicata*, identified by R.J. Mott in unpublished GSC Wood Report 2001-19), a root enclosed in silt and sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 7.5 L of CO_2 gas. The age estimate is based on one count for 3775 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.967 ± 0.073, 1.128 ± 0.017, and 18.019 ± 0.103 cpm, respectively.

GSC-6395. Cheakamus River valley II

normalized age:	100 ± 50
$\delta^{13}C$:	-23.4‰
uncorrected age:	70 ± 50

Wood sample CIA-99-18 (8.8 g dry weight; *Thuja plicata*, identified by R.J. Mott in unpublished GSC Wood Report 2001-18), a root enclosed in silt and sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.9 g) yielded 6.9 L of CO_2 gas. The age estimate is based on one count for 2575 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 28.075 ± 0.112, 2.126 ± 0.027, and 28.325 ± 0.130 cpm, respectively.

GSC-6393. Cheakamus River valley III

normalized age:	110 ± 60
$\delta^{13}C$:	-23.0‰
uncorrected age:	80 ± 60

Wood sample CIA-99-17-1 (10.7 g dry weight; *Thuja plicata*, identified by R.J. Mott in unpublished GSC Wood Repor 2001-17), a root enclosed in silt and sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (5.1 g) yielded 4.58 L of CO_2 gas. The age estimate is based on one count for 3860 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.848 ± 0.072, 1.128 ± 0.017, and 18.019 ± 0.103 cpm, respectively.

Comment (J.J. Clague): Samples GSC-6393, -6395, and -6397 were obtained from the outermost rings of roots of three conifer snags rooted in a buried soil that underlies the floodplain of Cheakamus River. The soil and the snags are buried by about 1 m of silt and sand, deposited during at least two phases of aggradation. The aggradation was probably caused by an increase in the supply of sediment to the Cheakamus River, perhaps due to landslides on the west flank of the Mount Garibaldi volcanic massif. The radiocarbon ages are maximum dates for the initiation of aggradation. Calibration of sample GSC-6397 indicates that aggradation commenced sometime after AD 1800.

GSC-6504. Cheakamus River valley IV

normalized age:	170 ± 60
$\delta^{13}C$:	-23.6‰
uncorrected age:	160 ± 60

Wood sample CIA-00-100-2 (9.0 g dry weight), a charred, decaying tree in growth position at an elevation of 53 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.0 g) yielded 6.2 L of CO_2 gas. The age estimate is based on one count for 2370 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.545 ± 0.092, 1.138 ± 0.025, and 17.890 ± 0.105 cpm, respectively.

Comment (J.J. Clague): Sample GSC-6504 dates the outer preserved rings of a charred tree in growth position in the Cheakamus River valley at North Vancouver Outdoor School. The tree is rooted in a paleosol about 1 m below the surface of the forested Cheakamus River floodplain. The paleosol is abruptly overlain by silty and sandy overbank deposits. Living conifers on the floodplain in the immediate vicinity of the date site are as old as 130 years, so tree burial occurred before about AD 1870. This sample, together with other radiocarbon dates from buried trees at North Vancouver Outdoor School, indicates that a forest was buried beneath alluvium sometime between about AD 1800 and 1870.

GSC-6562. Cheakamus River valley V

normalized age:	650 ± 60
$\delta^{13}C$:	-25.5‰
uncorrected age:	660 ± 60

Wood bark sample CIA-00-100-1 (7.1 g dry weight), enclosed in clayey silt at an elevation of 50 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.0 g) yielded 5.3 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.666 ± 0.072, 1.105 ± 0.023, and 18.091 ± 0.108 cpm, respectively.

Comment (J.J. Clague): Sample GSC-6562 dates overbank deposits that underlie, and are therefore older than, the soil on which the tree that yielded sample GSC-6504 is rooted.

GSC-6560. Brohm Lake

normalized age:	10 600 ± 110
$\delta^{13}C$:	-23.9‰
uncorrected age:	10 600 ± 110

Wood sample CIA-00-Brohm-1 (*Abies*, identified by R.J. Mott in unpublished GSC Wood Report 2001-29), enclosed in diamicton (till), was collected by P.A. Friele on September 11, 2000 from 3 km northeast of Brohm Lake, Squamish, southwestern British Columbia (49°51′15″N, 123°06′04″W), at an elevation of 870 m. The sample was submitted by J.J. Clague to gain information on deglaciation.

The sample (11.8 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.3 g) yielded 6.3 L of CO_2 gas. The age estimate is based on one count for 3815 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 4.829 ± 0.046, 1.105 ± 0.023, and 18.091 ± 0.108 cpm, respectively.

Comment (P.A. Friele): The site is adjacent to a kame terrace located on the northwest flank of Mount Garibaldi in upper Brohm River. The dated sample was collected from compact, matrix-supported diamicton, interpreted to be till. The glacier that deposited the till was also responsible for forming the kame terrace. Sample GSC-6560 is consistent with the age of the last glacier advance in Howe Sound (Friele and Clague, 2002). A line connecting the surface of the kame terrace at this site (1100 m a.s.l.) with an ice margin of the same age near the head of Howe Sound has a slope of about 9%, a value consistent with the surface slope of the terminal zone of a large valley glacier. This date delineates the exact time and position of the last glacier tongue to occupy the head of Howe Sound.

Squamish River series

A series of wood samples was collected by J.J. Clague and R.J. Turner on March 6 and 13, 1998 from the banks of the Squamish River, 22 and 17 km north-northeast of Squamish, southwestern British Columbia (49°53.2′N, 123°16.9′W and 49°50.8′N, 123°14.3′W), at elevations of about 30 and 21 m. These samples were submitted by J.J. Clague to gain information on a lake ponded behind the Cheakamus and Cheekye fans.

GSC-6275 5L. Squamish River I

normalized age:	1230 ± 80
$\delta^{13}C$:	-31.3‰
uncorrected age:	1330 ± 80

GSC-6275 2L.

normalized age:	1230 ± 60
$\delta^{13}C$:	-31.3‰
uncorrected age:	1330 ± 60

Wood sample CIA-98-2 (10.1 g dry weight; probably *Picea*, identified by C. Keith), enclosed in silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 7.0 L of CO_2 gas. The 2L-age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 15.342 ± 0.070, 1.227 ± 0.024, and 18.101 ± 0.150 cpm, respectively.

The 5L-age estimate is based on one count for 3770 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 24.157 ± 0.090, 2.270 ± 0.033, and 28.501 ± 0.190 cpm, respectively.

GSC-6267. Squamish River II

normalized age:	2210 ± 60
$\delta^{13}C$:	-24.8‰
uncorrected age:	2200 ± 60

Wood sample CIA-98-1-2 (11.6 g dry weight; probably *Picea sitchensis*, identified by C. Keith), enclosed in silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 7.0 L of CO_2 gas. The age estimate is based on one count for 3740 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.659 ± 0.087, 2.270 ± 0.033, and 28.501 ± 0.190 cpm, respectively.

GSC-6274. Squamish River III

normalized age:	2620 ± 80
$\delta^{13}C$:	-26.8‰
uncorrected age:	2650 ± 80

Wood sample CIA-98-1-1 (7.1 g dry weight; probably *Populus*, identified by C. Keith), enclosed in silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.8 g) yielded 6.0 L of CO_2 gas. The age estimate is based on one count for 3770 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.022 ± 0.066, 1.227 ± 0.024, and 18.101 ± 0.150 cpm, respectively.

Comment (J.J. Clague): The three dated samples were collected from the banks of the Squamish River at two sites. The deposits at the two date sites comprise two units: a lower unit of stratified silt and an upper unit of sand. The silt unit contains abundant woody plant detritus and, at one of the two date sites, peaty mud horizons. The silty sediment accumulated in a quiet-water environment, probably a shallow lake. The sand is fluvial in origin. Deposits similar to those at the two date sites are common along the Squamish River upstream from the mouth of Cheakamus River.

Samples GSC-6267, -6274, and -6275 indicate that a shallow lake, flanked by marshes and swamps, occupied at least 12 km of the Squamish River valley, upstream of the Cheakamus River fan, from before 2600 ^{14}C years BP until after 2200 ^{14}C years BP, perhaps until after 1300 ^{14}C years BP. Today, the supply of sediment to the Cheakamus fan is insufficient to impound such a lake, and the Squamish River, over the last 1000 years, has eroded the upper part of the dated lake fill.

Signal Hill series

A series of wood samples was collected by P. Friele on January 10, 2000 and P. Friele and J.J. Clague on March 15, 2001 from drillcores at Signal Hill Elementary School, Pemberton, southwestern British Columbia (50°19′08″N, 122°48′07″W), at elevations of 198 to 212 m. These samples were submitted by J.J. Clague to gain information on fluvial activity on a paleofloodplain, specifically aggradation and delta progradation.

Beta-139037. Signal Hill I

normalized age:	1860 ± 70

Wood sample CIA-00-AH.1 (7 m depth; *Abies*, identified by R.J. Mott in unpublished GSC Wood Report 2001-28), was enclosed in silt and sand. The age was normalized to $\delta^{13}C$ = -25‰.

GSC Laboratory comment: Some of the material was black, indicating either mould or charring (lignitic). There was some orange-brown mould on the wood, which was removed. Most of material was too hard to split, so it was chopped into pieces prior to submission to Beta Analytic Inc.

GSC-6546. Signal Hill II

normalized age:	2680 ± 60
$\delta^{13}C$:	-25.5‰
uncorrected age:	2690 ± 60

Wood sample CIA-00-AH.1 (12 m depth; 13.7 g dry weight; *Abies*, identified by R.J. Mott in unpublished GSC Wood Report 2001-28), enclosed in silt and sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 6.8 L of CO_2 gas. The age estimate is based on one count for 4000 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.940 ± 0.064, 1.105 ± 0.023, and 18.091 ± 0.108 cpm, respectively.

GSC-6575. Signal Hill III

normalized age:	3100 ± 80
$\delta^{13}C$:	-25.9‰
uncorrected age:	3120 ± 80

Wood sample 'CIA-01-H#3 Signal Hill #3' (17 m depth; 3.2 g dry weight; *Thuja plicata*, identified by R.J. Mott in unpublished GSC Wood Report 2001-30), enclosed in silty and clay, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.9 g) yielded 2.3 L of CO_2 gas. The age estimate is based on one count for 3875 minutes in the 2 L counter with a mixing ratio of 1.78. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.274 ± 0.088, 1.131 ± 0.020, and 18.092 ± 0.107 cpm, respectively.

Comment (P.A. Friele): The dated wood samples were recovered from a drillcore collected at Signal Hill Elementary School, Pemberton, British Columbia. The site is on the Lillooet River floodplain about 13.5 km upstream from the modern Lillooet River delta. The uppermost 12 to 15 m of the sedimentary sequence at this site consists of floodplain deposits, which can be used to estimate the long-term rate of progradation of the Lillooet delta.

Samples GSC-6546 and Beta-139037 date sediment at depths of 12 and 7 m, respectively. The two dates bracket the surface elevation of Lillooet Lake (about 200 m a.s.l.) and indicate that the delta front stood near the Signal Hill school site at about 2350 BP. The average, late Holocene delta-progradation rate, calculated from these dates and from sample GSC-6575 (17 m depth), is about 4.5 m/year.

Highland Valley series

A series of wood samples was collected by R.J. Fulton and D. Kerr on July 29 and 30, 1992 from a borrow pit of the Highland Valley Copper Company in Highland Valley, 30 km southeast of Ashcroft, southwestern British Columbia (50°29′30″N, 121°02′20″W), at an elevation of 1150 m. These samples were submitted by R.J. Fulton in an attempt to date subtill nonglacial sediments.

GSC-5531. Highland Valley I

age: >39 000
$\delta^{13}C$: -25.3‰

Wood sample FI 92-1 (28.50 g dry weight; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 93-12), enclosed in sand and organic detritus beneath a diamicton and gravel and over bedrock, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.3 g) yielded 8.2 L of CO_2 gas. The age estimate is based on one count for 3715 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were -0.043 ± 0.061, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

GSC-6013 HP. Highland Valley II

age: >47 000
$\delta^{13}C$: -23.8‰

Wood sample FI 92-2C (58.2 g dry weight; possibly *Picea* or *Larix*, identified by R.J. Mott in unpublished GSC Wood Report 96-08), enclosed in gravel, sand, and organic detritus, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (30.3 g) yielded 29.2 L of CO_2 gas. The age estimate is based on one count for 5775 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 0.049 ± 0.056, 2.668 ± 0.052, and 100.987 ± 0.341 cpm, respectively.

GSC-5838 HP. Highland Valley III

age: >48 000

Wood sample FI 92-1 (31.4 g dry weight; unidentifiable, according to H. Jetté in unpublished GSC Wood Report 95-25), enclosed in paleosol Ah-horizon within a gravel facies below diamicton and gravel, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (29.5 g) yielded 28.88 L of CO_2 gas. The age estimate is based on two counts for 1095 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 0.087 ± 0.041, 2.776 ± 0.037, and 100.847 ± 0.294 cpm, respectively.

Comment (R.J. Fulton): These samples are from an exceptional sequence of <75 m of nonglacial lacustrine and deltaic sediments that overlie till and underlie the deposits of at least one glaciation. In addition to wood, these sediments include mollusc shells, cones (dominantly spruce), peat, miscellaneous organic detritus, and paleosols (Fulton, 1995). The deposits have a normal paleomagnetic signature. Five of the previous six radiometric radiocarbon ages (*see* Fulton, 1995) from these beds provided 'greater than' ages (i.e. ages beyond the detection limit of the radiocarbon method). Based on the earlier dates and samples GSC-5531, -5838 HP, and -6013 HP, these deposits should be considered to have ages greater than the method's detection limit. The minimum possible age of the materials is >48 000 BP, so it is still possible the deposits are of Middle Wisconsinan age.

Railroad Pass series

A series of plant detritus samples was collected by J.J. Clague and S.G. Evans on September 2, 1997 from sediment cores southwest of Railroad Pass, 35 km northwest of Pemberton, southwestern British Columbia (50°34.7′N, 123°04.5′W and 50°34.8′N, 123°04.6′W), at an elevation of about 1980 m. These samples were submitted by J.J. Clague to gain information on neotectonics, specifically the chronological control on displacement of a fault scarp.

TO-6839. Railroad Pass I

normalized age: 7620 ± 160
$\delta^{13}C$: -25 ‰

Plant detritus sample CIA-97-123-3 was enclosed in silt. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated age is 6425 BC with a 1σ range of 6555 to 6340 BC and a 2σ range of 6725 to 6155 BC.

TO-6840. Railroad Pass II

normalized age: 7250 ± 90
$\delta^{13}C$: -25 ‰

Plant leaf sample CIA-97-137-1 was enclosed in peat. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated ages are 6105 BC with a 1σ range of 6175 to 5980 BC and a

2σ range of 6220 to 5945 BC; 6100 BC with a 1σ range of 6175 to 5980 BC and a 2σ range of 6220 to 5945 BC; and 6045 BC with a 1σ range of 6175 to 5980 BC, and a 2σ range of 6220 to 5945 BC.

TO-6841. Railroad Pass III

normalized age:	8020 ± 80
$\delta^{13}C$:	-25 ‰

Plant detritus sample CIA-97-137-6 was enclosed in silt. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated ages are 7005 BC with a 1σ range of 7040 to 6760 BP and a 2σ range of 7095 to 6610 BC; and 6830 BC with a 1σ range of 7040 to 6760 BC and a 2 σ range of 7095 to 6610 BC.

Comment (J.J. Clague): These dates provide chronological control on displacement of a fault scarp. Movement on the fault created a depression in which silt and sand began to accumulate about 8000 ^{14}C years ago.

Meager Creek series

A series of wood samples was collected by J.J. Clague and P. Friele on September 25, 1999 and August 26, 2000 from bluffs along Meager Creek, about 2.5 km upstream of its confluence with Hot Springs Creek, southwestern British Columbia. These samples were submitted by J.J. Clague to gain information on a landslide, debris flow related to a volcanic collapse, and Cordilleran deglaciation.

GSC-6515. Meager Creek I

normalized age:	60 ± 50
$\delta^{13}C$:	-23.7‰
uncorrected age:	40 ± 50

Wood sample CIA-MC-8 (9.0 g dry weight; *Abies*, identified by R.J. Mott in unpublished GSC Wood Report 2001-26), a branch enclosed in a diamicton at an elevation of 665 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 6.8 L of CO_2 gas. The age estimate is based on one count for 2365 minutes in the 5 L counter with a mixing ratio of 1.00.The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.943 ± 0.118, 2.136 ± 0.034, and 28.079 ± 0.132 cpm, respectively.

Comment (J.J. Clague): Sample GSC-6515 (50°33.6′N, 123°29.2′W) is anomalously young and not part of the Meager Creek debris-flow series.

GSC-6511. Meager Creek II

normalized age:	7940 ± 100
$\delta^{13}C$:	-23.7‰
uncorrected age:	7920 ± 100

Wood sample CIA-MC3-1 (9.9 g dry weight; Pseudotsuga menziesii, identified by R.J. Mott in unpublished GSC Wood Report 2001-25), enclosed in a diamicton at an elevation of 635 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 7.2 L of CO_2 gas. The age estimate is based on one count for 2370 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 6.718 ± 0.062, 1.112 ± 0.024, and 18.004 ± 0.104 cpm, respectively.

TO-8837. Meager Creek III

normalized age:	8020 ± 70

Wood sample MC-5 (the outermost 30 preserved rings of a log of *Pseudotsuga menziesii*, identified by R.J. Mott in unpublished GSC Wood Report 2001-23), was enclosed in a diamicton at an elevation of 645 m. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-6474. Meager Creek IV

normalized age:	8120 ± 70
$\delta^{13}C$:	-21.6‰
uncorrected age:	8070 ± 70

Wood sample MC-5 (9.3 g dry weight; *Pseudotsuga menziesii*, identified by R.J. Mott in unpublished GSC Wood Report 2001-23), enclosed in a diamicton at an elevation of 645 m , was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 6.8 L of CO_2 gas. The age estimate is based on one count for 3710 minutes in the 5 L counter with a mixing ratio of 1.00.The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.445 ± 0.061, 2.054 ± 0.019, and 28.530 ± 0.135 cpm, respectively.

Comment (J.J. Clague): GSC-6511 (50°33.7′N, 123°28.7′W), TO-8837, and GSC-6474 (50°33.6′N, 123°30.0′W) date a large landslide from Pylon Peak, which is part of the Meager Creek volcanic massif. They are associated with an early Pylon Peak flank collapse and accompanying debris flow.

GSC-6453. Meager Creek V

normalized age:	4120 ± 80
$\delta^{13}C$:	-25.6‰
uncorrected age:	4140 ± 80

Wood fragment sample SMC-3 (8.9 g dry weight), enclosed in silt and sand at an elevation of 672 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.7 g) yielded7.3 L of CO_2 gas. The age estimate is based on one count for 2400 minutes in the 2 L counter with a mixing ratio of 1.00.The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.812 ± 0.074, 1.105 ± 0.023, and 18.091 ± 0.108 cpm, respectively.

GSC-6445. Meager Creek VI

normalized age: 4160 ± 50
$\delta^{13}C$: -25.6‰
uncorrected age: 4170 ± 50

Wood sample SMC-4 (11.5 g dry weight; *Taxus* cf. *Brevifolia,* identified by R.J. Mott in an unpublis hed GSC Wood Report 2001-20), a branch enclosed in silt at an elevation of 674 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 6.9 L of CO_2 gas. The age estimate is based on one count for 5285 minutes in the 5 L counter with a mixing ratio of 1.00.The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.935 ± 0.065, 2.103 ± 0.024, and 28.472 ± 0.132 cpm, respectively.

GSC-6466. Meager Creek VII

normalized age: 4080 ± 60
$\delta^{13}C$: -22.1‰
uncorrected age: 4040 ± 60

Wood sample MC-7-1 (8.6 g dry weight; *Taxus* cf. *brevifolia*, identified by R.J. Mott in unpublished GSC Wood Report 2001-21), a branch or root enclosed in a diamicton at an elevation of 701 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 6.7 L of CO_2 gas. The age estimate is based on one count for 3770 minutes in the 5 L counter with a mixing ratio of 1.00.The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.259 ± 0.074, 2.054 ± 0.019, and 28.530 ± 0.135 cpm, respectively.

GSC-6476. Meager Creek VIII

normalized age: 4090 ± 60
$\delta^{13}C$: -26.6‰
uncorrected age: 4120 ± 60

Wood sample MC-7-2 (9.6 g dry weight; poorly preserved deciduous, according to R.J. Mott in unpublished GSC Wood Report 2001-24), a branch or outer trunk enclosed in a diamicton at an elevation of 693 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 7.9 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00.The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.899 ± 0.078, 2.066 ± 0.034, and 28.207 ± 0.135 cpm, respectively.

GSC-6467. Meager Creek IX

normalized age: 4050 ± 70
$\delta^{13}C$: -24.2‰
uncorrected age: 4040 ± 70

Wood sample MC-1A-2, (10.6 g dry weight), the outermost 50 rings of a log of *Picea* cf. *sitchensis* (identified by R.J. Mott in unpublished GSC Wood Report 2001-22), enclosed in a diamicton at an elevation of 500 m, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 7.5 L of CO_2 gas. The age estimate is based on one count for 3770 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.856 ± 0.060, 1.120 ± 0.021, and 17.939 ± 0.098 cpm, respectively.

Comment (J.J. Clague): The five samples (GSC-6453 from 50°33.4′N, 123°29.0′W; GSC-6445 from 50°33.5′N, 123°30.1′W; GSC-6466, and -6476 from 50°33.6′N, 123°30.3′W; and GSC-6467 from 50°35.8′N, 123°26.2′W) were collected at four sites from a matrix-supported diamicton unit. The diamicton unit is interpreted to be the deposit of an extremely large volcanic debris flow (lahar). It underlies discontinuous terraces over a distance of 7 km along Meager Creek. The lahar was generated by one or more large landslides from the south flank of the Mount Meager volcanic massif. The failure occurred about 4000 to 4100 ^{14}C years ago.

Paradise Creek series

A series of wood samples was collected by J.J. Clague and R.W. Mathewes on August 31, 1989 from a section at the head of Paradise Creek valley, near Castle Peak, southwestern British Columbia (51°05.3′N, 122°58.2′W), at an elevation of 2090 m. These samples were submitted by J.J. Clague to gain information on Holocene climate change.

TO-1551. Paradise Creek I

normalized age: 8100 ± 90

Wood sample CIA-87-CP21 was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-1549. Paradise Creek II

normalized age: 8340 ± 80

Wood sample CIA-87-CP18 was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-1550. Paradise Creek III

normalized age: 8350 ± 90

Wood sample CIA-87-CP20 was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

Comments (J.J. Clague): This site is above the present-day treeline. The dated wood is from trees that grew at a time when the climate was warmer than today. Other radiocarbon dates from the Castle Peak cirque are summarized and discussed in Clague and Mathewes (1989).

GSC-6046. Farrow Creek

normalized age: 4120 ± 60
$\delta^{13}C$: -24.0‰
uncorrected age: 4100 ± 60

Wood sample C1A-95-71 (*Abies* cf. *lasiocarpa*, identified by R.J. Mott in unpublished GSC Wood Report 96-15), enclosed in gravel and a diamicton, was collected by J.J. Clague and S.G. Evans on August 20, 1995 from a streamcut along Farrow Creek, near the toe of Goddard Glacier, 8 km west of Chilko Lake, British Columbia (51°06.3′N, 124°09.7′W), at an elevation of 1430 m. The sample was submitted by J.J. Clague to gain information on a Neoglacial advance.

The sample (10.9 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 7.0 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.045 ± 0.075, 2.277 ± 0.024, and 28.415 ± 0.135 cpm, respectively.

Comment (J.J. Clague): The dated log was one of many that were enclosed in gravel and diamicton downstream of the toe of the Goddard Glacier. The forest from which these logs came was overridden during an advance of the glacier beyond its present limit about 4100 ^{14}C years ago.

TO-192. Pantage Lake

normalized age: 5800 ± 70

Basal wood fragment sample CIA-85-82-2 (2.45–2.5 m depth; deciduous, identified by R.J. Mott in unpublished GSC Wood Report 85-77), enclosed in gyttja just above (0–5 cm) inorganic lacustrine mud, were collected by J.J. Clague, R.J. Hebda, and R. Powell on June 12, 1985 from a sediment core taken in a peat bog 3 km northwest of the northwest end of Pantage Lake, 52 km northwest of Quesnel, southwestern British Columbia (53°14.4′N, 123°09.3′W), at an elevation of about 795 m, This sample was submitted by J.J. Clague to gain information on the time of deglaciation. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (J.J. Clague): Sample TO-192 is younger than expected. The peat bog may have been dry and not accumulating sediment during the early Holocene xerothermic interval.

North-central British Columbia series

To establish a possible link between the time of deglaciation and the onset of peat accumulation (paludification) in central British Columbia, bulk samples of basal peat were collected at ten sites by A. Plouffe in July and August 1994 and dated by the radiometric method at the GSC Radiocarbon Laboratory. The samples consisted of the lowest 3 cm of peat directly above clay or till, at depths varying between 1.1 and 4.0 m.

GSC-5989. François Lake

normalized age: 8320 ± 80
$\delta^{13}C$: -30.6‰
uncorrected age: 8410 ± 80

Sample 94-PMA-073-2 was collected by A. Plouffe on August 6, 1994 from east side of the road to François Lake, 0.9 km south of the road to the Endako mine, 5 km south of the town of Endako, north-central British Columbia (54°02′30″N, 125°01′51″W), at an elevation of 915 m.

The sample (158.9 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (59.4 g) yielded 5.6 L of CO_2 gas. The age estimate is based on one count for 5125 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 6.451 ± 0.045, 1.250 ± 0.022, and 18.382 ± 0.101 cpm, respectively.

GSC-5993. Burns Lake

normalized age: 8070 ± 100
$\delta^{13}C$: -29.5‰
uncorrected age: 8150 ± 100

Sample 94-PMA-061-2 was collected by A. Plouffe on August 5, 1994 from about 200 m south of the forestry road and about 4 km east of the Augier and Lords forestry service roads, about 23 km northeast of Burns Lake, north-central British Columbia (54°18′10″N, 125°26′06″W), at an elevation of 1136 m.

The sample (90.1 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (10.5 g) yielded 3.2 L of CO_2 gas. The age estimate is based on one count for 4900 minutes in the 2 L counter with a mixing ratio of 1.28. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 6.704 ± 0.054, 1.244 ± 0.021, and 18.482 ± 0.130 cpm, respectively.

GSC-5891. Nautley River

normalized age: 9830 ± 130
$\delta^{13}C$: -24.7‰
uncorrected age: 9830 ± 130

Sample 94-PMA-075-2 was collected by A. Plouffe on August 7, 1994 from east side of the Sutherland Forestry Service Road, 9 km north of the bridge on Nautley River and about 19 km northeast of the town of Fraser Lake, north-central British Columbia (54°08′32″N, 124°35′25″W), at an elevation of 815 m.

The sample (95.3 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (12.1 g) yielded 3.37 L of CO_2 gas. The age estimate is based on two counts for 2070 minutes in the 2 L counter with a mixing ratio of 1.29. The count rates for the

sample (net) and for monthly backgrounds and standards (net) were 5.397 ± 0.074, 1.206 ± 0.026, and 18.348 ± 0.107 cpm, respectively.

GSC-6002. Burns Lake

normalized age:	3640 ± 90
$\delta^{13}C$:	-28.8‰
uncorrected age:	3700 ± 90

Basal peat sample 94-PMA-071-2, abruptly overlying a sandy diamicton (?till), was collected by A. Plouffe on August 6, 1994 from 1 km east of Highway 35 and the Seven Mile Forestry Service Road, about 12 km south of the town of Burns Lake, north-central British Columbia (54°08′32″N, 125°42′34″W), at an elevation of 845 m.

The sample (104.5 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (21.2 g) yielded 2.4 L of CO_2 gas. The age estimate is based on one count for 3720 minutes in the 2 L counter with a mixing ratio of 1.73. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.643 ± 0.087, 1.348 ± 0.018, and 18.461 ± 0.145 cpm, respectively.

GSC-6003. Karena Lake

normalized age:	6180 ± 140
$\delta^{13}C$:	-29.3‰
uncorrected age:	6240 ± 140

Sample 94-PMA-003-1 was collected by A. Plouffe on July 21, 1994 from the north side of the road, 1 km north of Karena Lake and about 5 km west of Fort St. James, north-central British Columbia (54°25′44″N, 124°37′37″W), at an elevation of 871 m.

The sample (78.2 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (17.3 g) yielded 2.5 L of CO_2 gas. The age estimate is based on one count for 1400 minutes in the 2 L counter with a mixing ratio of 1.59. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.343 ± 0.118, 1.349 ± 0.029, and 18.151 ± 0.150 cpm, respectively.

Comment (A. Plouffe): It is thought that central British Columbia was ice free by 10 to 9.5 ka BP (Clague, 1981; Ryder and Clague, 1989). Consequently, basal peat samples yielded radiocarbon ages that are much younger than deglaciation. There are three possible reasons for this discrepancy: 1) accumulation of organic matter may have been delayed by buried ice in sediments (i.e. the depression in which the peat accumulated formed sometime after the ice melted); 2) the peat samples, which are 3 cm thick, encompassed too much time; and 3) a dry and/or warm climate may have retarded paludification in early Holocene time (cf. Plouffe, 2000).

GSC-5692. Fort St. James

normalized age:	5400 ± 80
$\delta^{13}C$:	-28.1‰
uncorrected age:	5450 ± 80

Sample 93-PMA-267-2 (3.94–4.12 m depth) was collected by A. Plouffe on July 25, 1993 about 200 m from the road in the central part of a fen on the east side of Highway 27, about 12 km south of the town of Fort St. James, north-central British Columbia (54.327227°N, 124.267640°W), at an elevation of 710 m.

The sample (407.9 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (84.7 g) yielded 13.60 L of CO_2 gas. The age estimate is based on two counts for 2150 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.350 ± 0.074, 1.217 ± 0.025, and 18.431 ± 0.104 cpm, respectively.

Comment (A. Plouffe): The sample, which was collected at a depth of 4.1 m above a laminated grey clay, presents a minimum age for the local deglaciation of the area. According to previous studies (e.g. Clague, 1981; Ryder and Clague, 1989), however, the interior of British Columbia was completely deglaciated by 10.0 to 9.5 ka BP. Therefore, there might be a large time gap represented by the grey clay that underlies the peat.

GSC-5995. Cripple Lake

normalized age:	6180 ± 80
$\delta^{13}C$:	-27.7‰
uncorrected age:	6220 ± 80

Sample 94-PMA-032-2 was collected by A. Plouffe on July 30, 1994 along the North Road, 4.2 km north of the intersection to Cripple Lake, about 70 km north of Fort St. James, north-central British Columbia (54°54′58″N, 124°09′20″W), at an elevation of 930 m.

The sample (120.1 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (34.4 g) yielded 15.3 L of CO_2 gas. The age estimate is based on one count for 3780 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.516 ± 0.055, 1.244 ± 0.021, and 18.482 ± 0.130 cpm, respectively.

GSC-5932. Suschua Creek

normalized age:	8270 ± 90
$\delta^{13}C$:	-28.5‰
uncorrected age:	8320 ± 90

Sample 94-PMA-026-2 was collected by A. Plouffe on July 27, 1994 from 1.1 km north of Suschua Creek along the North Road, about 100 km north of Fort St. James, north-central British Columbia (55°07′27″N, 124°12′56″W), at an elevation of 940 m.

The sample (127.4 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (21.4 g) yielded 5.77 L of CO_2 gas. The age estimate is based on two counts for 2160 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.997 ± 0.082, 2.228 ± 0.033, and 28.171 ± 0.176 cpm, respectively.

GSC-5298. Nation River

normalized age:	700 ± 80
$\delta^{13}C$:	-27.4‰
uncorrected age:	740 ± 80

Wood charcoal sample 91-PMA-222 (*Pinus albicaulis, P. flexlis, P. monticola*, identified by H. Jetté in unpublished GSC Wood Report 91-81), enclosed in poorly sorted alluvial sand, was collected by A. Plouffe on June 20, 1991 from about 600 m north of the bridge crossing the Nation River on the Germansen Road, about 100 km north of Fort St. James, north-central British Columbia (55°12′30″N, 124°14′20″W), at an elevation of 850 m. The sample was submitted by A. Plouffe to gain information on fluvial aggradation, and terrace incision.

The sample (5.7 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.9 g) yielded 5.47 L of CO_2 gas. The age estimate is based on two counts for 2180 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.919 ± 0.097, 1.261 ± 0.033, and 18.546 ± 0.156 cpm, respectively.

Comment (A. Plouffe): The sample was collected 80 cm below the top surface of the alluvial terrace of an unnamed creek. The radiocarbon age indicates that a minimum of 80 cm of sediment aggradation occurred after 700 BP in the small valley. The sediment may have been deposited during one or more floods. Aggradation appears to coincide with the Little Ice Age (Ryder and Thompson, 1986).

GSC-5869. Skunk Lake

normalized age:	9420 ± 110
$\delta^{13}C$:	-26.2‰
uncorrected age:	9440 ± 110

Sample 94-PMA-031-2 was collected by A. Plouffe on July 30, 1994 from 1.7 km north of Skunk Lake on the North Road, about 70 to 80 km south of Germansen Landing, north-central British Columbia (55°25′08″N, 124°06′03″W), at an elevation of 990 m.

The sample (101.3 g wet weight) was treated with hot acid (slightly calcareous), and distilled water rinses. The base treatment was omitted. The treated sample (32.6 g) yielded 4.79 L of CO_2 gas. The age estimate is based on two counts for 2150 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 5.698 ± 0.062, 1.217 ± 0.026, and 18.461 ± 0.106 cpm, respectively.

GSC-5912. Jackfish Creek

normalized age:	7480 ± 90
$\delta^{13}C$:	-27.5‰
uncorrected age:	7520 ± 90

Sample 94-PMA-030-2 was collected by A. Plouffe on July 29, 1994 from 1 km west of Jackfish Creek, about 15 km south of Germansen Landing, north-central British Columbia (55°42′26″N, 124°33′11″W), at an elevation of 980 m.

The sample (131.5 g wet weight) was treated with hot base, hot acid (very calcareous), and distilled water rinses. The treated sample (21.0 g) yielded 10.42 L of CO_2 gas. The age estimate is based on one count for 2350 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.052 ± 0.082, 2.228 ± 0.033, and 28.171 ± 0.176 cpm, respectively.

GSC-5587. Crow Lagoon I

normalized age:	7020 ± 70
$\delta^{13}C$:	-24.5‰
uncorrected age:	7010 ± 70

Carbonized wood sample SECL-10 (charcoal; coniferous according to R.J. Mott in unpublished GSC Wood Report 93-38), enclosed in sandy marine clay, was collected by J.G. Souther on September 8, 1992 from 1 km southeast of Crow Lagoon, 45 km north of Prince Rupert, west-central British Columbia (54°41.7′N, 130°12.6′W), at an elevation of 120 m. The sample was submitted by J.G. Souther.

The sample (54.4 g dry weight) was treated with hot base, hot acid (slightly calcareous), and distilled water rinses. The treated sample (8.1 g) yielded 8.7 L of CO_2 gas. The age estimate is based on one count for 3660 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.744 ± 0.069, 2.197 ± 0.031, and 28.117 ± 0.130 cpm, respectively.

GSC-5514. Crow Lagoon II

normalized age:	7340 ± 90
$\delta^{13}C$:	-25.6‰
uncorrected age:	7350 ± 90

Wood sample SECL-9 (coniferous, according to H. Jetté in unpublished GSC Wood Report 93-07), enclosed in sandy marine clay about 2 m below tephra, was collected by J.G. Souther on September 8, 1992 from 1.1 km southeast of Crow Lagoon, 45 km north of Prince Rupert, west-central British Columbia (54°41.8′N, 130°12.8′W), at an elevation of 140 m. The sample was submitted by J.G. Souther to gain information on sea level change and a maximum age for a tephra.

The sample (17.20 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (10.4 g) yielded 11.7 L of CO_2 gas. The age estimate is based on two counts for 2200 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.349 ± 0.097, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

GSC-5505. Crow Lagoon III

normalized age:	7100 ± 100
$\delta^{13}C$:	-23.7‰
uncorrected age:	7080 ± 100

Carbonized wood sample SECL-8 (coniferous, according to H. Jetté in unpublished GSC Wood Report 93-04), enclosed in basaltic tephra over sandy marine clay, was collected by J.G. Souther on September 8, 1992 from 1 km south of Crow Lagoon, 45 km north of Prince Rupert, west-central British Columbia (54°41.5′N, 130°13.5′W), at an elevation of 140 m. The sample was submitted by J.G. Souther to gain information on a tephra.

The sample (19.90 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (14.9 g) yielded 5.8 L of CO_2 gas. The age estimate is based on two counts for 2225 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.583 ± 0.067, 1.214 ± 0.024, and 18.297 ± 0.145 cpm, respectively.

GSC-6158. Nass River

normalized age:	2520 ± 60
$\delta^{13}C$:	-27.76‰
uncorrected age:	2560 ± 60

Plant fragment sample JJS-R09 (1.3 m depth), enclosed in clay and clayey silt, was collected by S.J. McCuaig on July 17, 1996 on the bank of the Nass River, 4 km southwest of 'Greenville', west-central British Columbia (55°00.27′N, 129°37.95′W), at an elevation of 20 m. The sample was submitted by S.J. McCuaig to gain information on deglaciation.

The sample (165.8 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.7 g) yielded 5.3 L of CO_2 gas. The age estimate is based on one count for 3785 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.174 ± 0.066, 1.162 ± 0.025, and 18.124 ± 0.109 cpm, respectively.

Comment (S.J. McCuaig): The woody debris was found in horizontally laminated clay and clayey silt. The sediment could be either fluvial or glaciomarine, as one dropstone was present. The young age indicates that it is fluvial.

GSC-6308. Kwinatahl I

age:	modern
$\delta^{13}C$:	-29.25‰

Forest floor litter sample 981105-02 (organic debris), enclosed in silty clay of unweathered C horizon, was collected by M. Geertsema and S.J. McCuaig on November 5, 1998 along a logging road east of Kwinatahl logging road, Nass River valley, west-central British Columbia (55°23′30″N, 129°05′00″W), at an elevation of about 140 m. The sample was submitted by S.J. McCuaig to gain information on a landslide.

The sample (26.1 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.8 g) yielded 2.0 L of CO_2 gas. The age estimate is based on one count for 1200 minutes in the 2 L counter with a mixing ratio of 2.07. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 20.944 ± 0.210, 1.285 ± 0.027, and 17.842 ± 0.107 cpm, respectively.

Comment (S.J. McCuaig): This sample was taken from a buried soil horizon in an earth-flow scar. The modern age indicates that this part of the slump feature is young. The rest of the earth flow probably occurred some time ago, however, as it was vegetated prior to logging.

GSC-6328. Kwinatahl II

normalized age:	6810 ± 100
$\delta^{13}C$:	-29.60‰
uncorrected age:	6890 ± 100

Peat sample 981106-02, overlain by peat and underlain by massive silty clay, was collected by M. Geertsema and S.J. McCuaig on November 6, 1998 from a logging road east of Kwinatahl logging road, west of Nass River in Nass Valley, west-central British Columbia (55°29′30″N, 129°57′W), at an elevation of 175 m. The sample was submitted by S.J. McCuaig to gain information on a landslide.

The sample (343.0 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (83.4 g) yielded 13.9 L of CO_2 gas. The age estimate is based on one count for 2400 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.650 ± 0.066, 1.267 ± 0.024, and 18.031 ± 0.134 cpm, respectively.

Comment (S.J. McCuaig): The sample is from an earth-flow scar. There are no stumps in this bog, indicating that the bog formed at the same time as the earth flow. The sample, excavated by backhoe, was taken from the bottom of the bog immediately above the contact with glaciomarine silty clay, which is the sediment in which the failure occurred. The date indicates that the earth flow occurred at 6.8 ka BP.

GSC-6147. Nass River

normalized age:	590 ± 60
$\delta^{13}C$:	-28.23‰
uncorrected age:	640 ± 60

The deciduous wood (possibly *Salix*, identified by R.J. Mott in unpublished GSC Wood Report 97-04) was enclosed in clay, underlain and overlain by massive grey clay and overlain by fluvial gravel. Sample JJS-R08 was collected by S.J. McCuaig on July 17, 1996 from a bank of the Nass River, 1 km southeast of 'Greenville', west-central British Columbia (55°01.364′N, 129°33.728′W), at an elevation of 25 m. The sample was submitted by S.J. McCuaig to gain information on fluvial geomorphic processes.

The sample (5.6 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.5 g) yielded 4.1 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.693 ± 0.071, 1.180 ± 0.017, and 18.078 ± 0.106 cpm, respectively.

Comment (S.J. McCuaig): Sample GSC-6147 is a date on a large wood sample from a bank of the Nass River. It was overlain by 1.1 m and underlain by 0.4 m of massive grey clay, and overlain, at the surface, by 40 cm of horizontally bedded, imbricate pebble-cobble (fluvial) gravel. It was thought that the clay might be glaciomarine, but the young age indicates that this is a fluvial deposit of the Nass River, possibly an abandoned channel.

GSC-6150. New Aiyansh

normalized age:	280 ± 50
$\delta^{13}C$:	-26.78‰
uncorrected age:	310 ± 50

Wood sample JJS-R12 (deciduous, according to R.J. Mott in unpublished GSC Wood Report 97-05), enclosed in basalt, was collected by S.J. McCuaig on August 17, 1996 near the edge of the Aiyansh lava flow, 2 km northwest of New Aiyansh, west-central British Columbia (55°13.139′N, 129°07.509′W), at an elevation of 160 m. The sample was submitted by S.J. McCuaig to gain information on the geomorphic processes of a volcanic flow, and as a crosscheck on GSC-1124 (250 ± 130; Lowdon et al., 1971).

The sample (9.4 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.4 g) yielded 6.8 L of CO_2 gas. The age estimate is based on one count for 3600 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.304 ± 0.096, 2.163 ± 0.032, and 28.387 ± 0.135 cpm, respectively.

Comment (S.J. McCuaig): Sample R12 (GSC-6150) was a sample of wood from the Aiyansh lava flow. It came from a lava-encased tree trunk in growth position. Moss growing on the top of the stump was avoided when sampling. Since 8 cm of trunk was missing at the edge of the tree-mould and there was an average of 5 rings/cm in the sample collected, the date is about 40 years too old. As this was a bulk date (several rings were pulverized), it is probably another 10 years older. The calendar dates for the 280 ± 50 14C years BP date are AD 1526 to 1557 or 1629 to 1663. Subtracting 50 years, the new calendar ages are AD 1576 to 1607 or 1679 to 1713.

GSC-6161. 'Greenville'

age:	modern
$\delta^{13}C$:	-28.61‰
uncorrected age:	0 ± 50

The deciduous bark (according to R.J. Mott in unpublished GSC Wood Report 97-06) was overlain by well sorted, very fine to medium-grained, horizontally bedded and crossbedded sand and cobble gravel. Sample JJS-R01 (1 m depth) was collected by S.J. McCuaig on July 14, 1996 from a stream-cut section in an alluvial fan, 1 km north of the Nass River, about 7 km northeast of 'Greenville', west-central British Columbia (55°04.546′N, 129°28.447′W), at an elevation of 50 m. The sample was submitted by S.J. McCuaig to gain information on an alluvial fan, and on stream aggradation and incision.

The sample (86.8 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (15.1 g) yielded 11.9 L of CO_2 gas. The age estimate is based on one count for 3755 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 28.099 ± 0.096, 2.172 ± 0.034, and 28.110 ± 0.147 cpm, respectively.

Comment (S.J. McCuaig): The alluvial fan sample (GSC-6161) was overlain by 50 cm of horizontally and crosslaminated, very fine to medium-grained sand, and another 50 cm of cobble gravel. The section was incised down to 4.5 m by the modern stream channel. Evidently, the aggradation and incision all occurred in recent times.

GSC-6164. 'Gitwinksilkw'

normalized age:	1960 ± 50
$\delta^{13}C$:	-28.21‰
uncorrected age:	2010 ± 50

Woody detritus sample JJS-R05 (about 30 cm depth), enclosed in an organic mat overlying clayey silt (till) and underlying silty clay, was collected by S.J. McCuaig on July 01, 1996 from a bog 7 km east of Nisga'a Highway, 12 km south-southwest of 'Gitwinksilkw' ('Canyon City'), west-central British Columbia (55°05.104′N, 129°17.596′W), at an elevation of 640 m. The sample was submitted by S.J. McCuaig to gain information on the timing of the development of the peat bog.

The sample (10.8 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.49 g) yielded 8.15 L of CO_2 gas. The age estimate is based on one count for 3750 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.885 ± 0.087, 2.172 ± 0.034, and 28.110 ± 0.147 cpm, respectively.

Comment (S.J. McCuaig): Sample for GSC-6164 was from a high-elevation (640 m) organic mat overlying till that was formerly a bog. The bog is of late Holocene age and it developed sometime after 2000 years ago.

TO-6352. 'Greenville'

age: modern

The leaf fragment was enclosed in clay, which was underlain and overlain by glaciofluvial gravel sand and silt. Sample JJS-R02 was collected by S.J. McCuaig on June 15,1996 from 1 km north of the Nass River, about 7 km northeast of 'Greenville', west-central British Columbia (55°01.005′N, 129°22.037′W), at an elevation of 350 m. This sample was submitted by S.J. McCuaig.

Comment (S.J. McCuaig): The glaciolacustrine sample (TO-6352) was found at an elevation of 350 m, was enclosed in clay, and was overlain and underlain by glaciofluvial gravel, sand and silt. This deposit cannot be modern, so the leaf fragment must have been a contaminant introduced into the sample. It is not known how this happened, because only the horizontally bedded clay was sampled, after removal of the slumped outer surface of the section.

Beta-130442. Nass River

normalized age: 2830 ± 40

Basal peat sample JJS-R13, overlain by peat, was collected by S.J. McCuaig on November 6, 1998 from a peat bog on the Aiyansh braidplain of the Nass River, west-central British Columbia (55°23.275′N, 128°53.456′W), at an elevation of about 350 m. This sample was submitted by S.J. McCuaig to gain information on deglaciation and peat development. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (S.J. McCuaig): Sample R13 (Beta-130442) was a bog bottom sample from a large bog on the Aiyansh braidplain. It was hoped that a limiting age for deglaciation could be obtained from this sample. Unfortunately, the bog appears to have formed in late Holocene time. In conclusion, no limiting ages for deglaciation were acquired from these dates.

'Kinskuch valley' series

A series of organic samples was collected by S.J. McCuaig on July 23, 1997 from a road cut in the Kinskuch River valley, British Columbia (55°37.645′N, 129°02.978′W), at an elevation of 148 m. These samples were submitted by S.J. McCuaig to gain information on an interglacial deposit.

TO-6354. 'Kinskuch valley' I

normalized age: 27 130 ± 280

The terrestrial moss (according to R.W. Mathewes), sample JJS-R07, was enclosed in an in situ organic mat. The age was normalized to $\delta^{13}C$ = -25‰.

Beta-124778. 'Kinskuch valley' II

normalized age: 30 080 ± 170

Plant fragment sample JJS-R07 (Equisetum, identified by R.W. Mathewes) was enclosed in a compressed organic mat. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (S.J. McCuaig): Sample R7 (TO-6354 and Beta-124778) was taken from a road cut in the Kinskuch valley. It is the same sample as 97723-31, 'Kinskuch valley' section (McCuaig, 2000, Figure 5.7). The organic sample was actually taken a year before the section was described, hence the different sample number. Terrestrial moss (identified by R.W. Mathewes, Biological Sciences Department, Simon Fraser University) was initially dated by AMS (TO-6354). It was considered in situ, as it formed mats of a single species. When this age turned out to be interstadial, a second age was obtained from flattened stems of Equisetum sp. in the same sample (Beta-124778). The 'Beta age' is slightly older, possibly due to the different laboratories at which the samples were dated. The site is interglacial, correlative to the Olympia Nonglacial Interval of southern British Columbia.

Berendon Glacier series

A series of seeds, plant detritus, and wood samples was collected by J.J. Clague on August 25, 1991, J.J. Clague and R.W. Mathewes on August 14, 1992, and J.J. Clague and O. Lian on July 31, 1993 from pits dug 2 km east of Berendon Glacier, 33 km north of Stewart, west-central British Columbia, at elevations of 785 to 790 m. These samples were submitted by J.J. Clague to gain information on a Neoglacial advance, and provide chronological control for a pollen profile, lake level change in Summit and 'Tide' lakes, and Holocene climate change.

TO-4153. Berendon Glacier I

age: modern

The seeds of Cyperaceae and plant detritus, sample CIA-93-110-2 (56°14.4′N, 130°03.0′W), were overlain by peat and underlain by mud. The age was normalized to $\delta^{13}C = -25‰$.

Comment (J.J. Clague): This date provides chronological control on Holocene fluctuations of the Berendon and Frank Mackie glaciers, and recent climate change.

TO-3514. Berendon Glacier II

age: modern

The needles of *Abies* and a twig of Ericaceae, sample CIA-91-159 (56°14.5′N, 130°03.1′W), were enclosed in peat. The age was normalized to $\delta^{13}C = -25‰$.

TO-3524. Berendon Glacier III

normalized age: 1410 ± 130

The needles of *Abies* and seeds of *Carex*, sample CIA-92-37-1 (56°14.5′N, 130°03.2′W), were enclosed in peat. The age was normalized to $\delta^{13}C = -25‰$.

TO-3525. Berendon Glacier IV

normalized age: 1670 ± 60

The needles of *Abies* and seeds of *Carex*, sample CIA-92-37-1 (56°14.5′N, 130°03.2′W), were enclosed in peat. The age was normalized to $\delta^{13}C = -25‰$.

Comment (J.J. Clague): Samples TO-3514, -3524, and -3525 provide chronological control for a pollen diagram, and date the maximum phases of Summit and 'Tide' lakes and therefore, indirectly, major Neoglacial advances of the Salmon and Frank Mackie glaciers.

GSC-5407. Berendon Glacier V

normalized age: 1700 ± 70
$\delta^{13}C$: -27.6‰
uncorrected age: 1740 ± 70

Peat sample CIA-91-159-63 (56°14.5′N, 130°03.6′W; 315 g wet weight), underlain by peat and overlain by mud, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (12.0 g) yielded 11.10 L of CO_2 gas. The age estimate is based on one count for 2340 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 22.520 ± 0.111, 2.185 ± 0.041, and 27.969 ± 0.203 cpm, respectively.

GSC-5406. Berendon Glacier VI

normalized age: 6600 ± 80
$\delta^{13}C$: -26.7‰
uncorrected age: 6630 ± 80

Wood sample CIA-91-159-26 (56°14.5′N, 130°03.6′W; 7.0 g dry weight; *Salix*, identified by H. Jetté in unpublished GSC Wood Report 92-32), a single piece of wood enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.4 g) yielded 6.96 L of CO_2 gas. The age estimate is based on one count for 4125 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.911 ± 0.053, 1.246 ± 0.024, and 18.063 ± 0.123 cpm, respectively.

GSC-5524. Berendon Glacier VII

normalized age: 7060 ± 90
$\delta^{13}C$: -27.2‰
uncorrected age: 7100 ± 90

Wood sample CIA-92-38-1 (56°14.5′N, 130°03.1′W; 7.50 g dry weight), a branch overlain by peat and underlain by silt, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.9 g) yielded 6.3 L of CO_2 gas. The age estimate is based on one count for 2190 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.502 ± 0.068, 1.214 ± 0.024, and 18.146 ± 0.102 cpm, respectively.

Comments (J.J. Clague): Peat and wood samples GSC-5406, -5407, and -5524 were collected from shovel pits at Berendon fen to date incursions of glacier-dammed 'Tide Lake' into the fen. 'Tide Lake' formed repeatedly in the Neoglacial period when Frank Mackie Glacier advanced across Bowser River and blocked its flow. The fen is located just below the highest shoreline of 'Tide Lake'. Some of the silt layers in the dominantly peaty fen sequence were probably deposited in the lake. Sample GSC-5407 indicates that the lake may have filled to near its limit some time after 1700 ^{14}C years ago. Sample GSC-5406, a piece of wood collected from the lowest 15 cm of the peat sequence, indicates that the fen began to develop prior to 6600 ^{14}C years ago. GSC-5524 gave a minimum age for a thick silt layer in the lower part of the peat sequence in the fen.

'Tide Lake' series

A series of wood samples was collected by J.J. Clague on September 20 and 21, 1990 and August 08 and 24, 1991 from drillcores and river bluffs at 'Tide Lake', 2 km south of the toe of the Frank Mackie Glacier in the Bowser River valley, 41 km north of Stewart, east-central British Columbia (between 56°16.2′N, 130°03.3′W and 56°18.7′N, 130°04.5′W), at elevations between 595 and 639 m. These samples were submitted by J.J. Clague to gain information on climate change, Neoglacial fluctuations, and lake level change.

TO-2203. 'Tide Lake' I

normalized age: 520 ± 60

Conifer wood sample CIA-90-162-3 was enclosed in sand. The age was normalized to $\delta^{13}C = -25‰$. The calibrated age is AD 1413, with a 1σ range of AD 1395 to 1437 and a 2σ range of AD 1292 to 1460.

TO-2204. 'Tide Lake' II

normalized age: 2650 ± 60
$\delta^{13}C$: -25 ‰

Conifer wood sample CIA-90-162-4 was enclosed in sand and silt. The age was normalized assuming $\delta^{13}C = -25‰$. The calibrated age is 812 BC, with a 1σ range of 842 to 799 BC and a 2σ range of 916 to 776 BC.

TO-2205. 'Tide Lake' III

normalized age: 2700 ± 60
$\delta^{13}C$: -25 ‰

Conifer wood sample CIA-90-162-9 was enclosed in silt and sand. The age was normalized assuming $\delta^{13}C = -25‰$. The calibrated age is 837 BC, with a 1σ range of 910 to 809 BC and a 2σ range of 994 to 797 BC.

Comment (J.J. Clague): Samples TO-2203, -2204, and -2205 were obtained on conifer needles and wood fragments recovered from lacustrine sediments underlying the floor of Neoglacial 'Tide Lake'. The samples date two phases of 'Tide Lake', when the Frank Mackie Glacier was more advanced than it is today.

TO-2897. 'Tide Lake' IV

normalized age: 1440 ± 40

Wood sample CIA-91-158-1 was enclosed in mud. The age was normalized to $\delta^{13}C = -25‰$.

TO-2898. 'Tide Lake' V

normalized age: 1600 ± 40

Conifer needle sample CIA-91-158-5 (*Abies lasiocarpa*, identified by J.J. Clague) was enclosed in sand. The age was normalized to $\delta^{13}C = -25‰$.

Comment (J.J. Clague): Samples TO-2897 and -2898 date a phase of 'Tide Lake' and an advanced position of the Frank Mackie Glacier.

GSC-5336. 'Tide Lake' VI

normalized age: 520 ± 60
$\delta^{13}C$: -25.8‰
uncorrected age: 540 ± 60

Wood sample CIA-91-156-2 (17.2 g dry weight; *Abies*, identified by H. Jetté in unpublished GSC Wood Report 91-90), part of a branch enclosed in glaciolacustine sediment (mud), was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 7.90 L of CO_2 gas. The age estimate is based on two counts for 2220 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 26.528 ± 0.119, 2.231 ± 0.034, and 28.364 ± 0.176 cpm, respectively.

GSC-5305. 'Tide Lake' VII

normalized age: 990 ± 60
$\delta^{13}C$: -23.6‰
uncorrected age: 970 ± 60

Wood sample CIA-91-158-3 (195 g dry weight; *Abies*, identified by H. Jetté in unpublished GSC Wood Report 91-64), a piece of a log enclosed in glaciolacustine sediment (mud), was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.6 g) yielded 8.33 L of CO_2 gas. The age estimate is based on two counts for 2020 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.125 ± 0.162, 2.287 ± 0.039, and 28.354 ± 0.135 cpm, respectively.

GSC-5386. 'Tide Lake' VIII

normalized age: 1520 ± 50
$\delta^{13}C$: -24.3‰
uncorrected age: 1510 ± 50

Wood sample CIA-91-156-1 (18.5 g dry weight; *Abies*, identified by H. Jetté in unpublished GSC Wood Report 92-31), a single piece of wood enclosed in glaciolacustine sediment (mud), was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 7.94 L of CO_2 gas. The age estimate is based on two counts for 2150 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 23.548 ± 0.113, 2.234 ± 0.029, and 28.421 ± 0.132 cpm, respectively.

GSC-5349. 'Tide Lake' IX

normalized age:	1640 ± 60
$\delta^{13}C$:	-22.3‰
uncorrected age:	1590 ± 60

Wood sample CIA-91-158-2 (10.2 g dry weight; *Tsuga heterophylla*, identified by H. Jetté in unpublished GSC Wood Report 91-87), a piece of a log enclosed in gravelly sand (fluvial), was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.2 g) yielded 8.10 L of CO_2 gas. The age estimate is based on two counts for 2510 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 23.265 ± 0.107, 2.231 ± 0.034, and 28.364 ± 0.176 cpm, respectively.

Comment (J.J. Clague): Samples GSC-5336, -5305, -5386, and -5349 were collected from two sections along the Bowser River, 2 km south of the toe of the Frank Mackie Glacier. The sections provide a record of the recent history of 'Tide Lake', which, until recently, was dammed by the Frank Mackie Glacier and its Neoglacial end moraine (Clague and Mathews, 1992). One of the dated samples (GSC-5386) was collected from glaciolacustrine mud deposited during a minor phase of 'Tide Lake' (about 1400 cal. years BP). The lake subsequently drained and fluvial gravel was deposited on the exposed lake floor. Sample GSC-5349 pertains to this gravel unit. Two samples (GSC-5336 and -5305) are from glaciolacustrine mud overlying the gravel. They indicate that the major Little Ice Age phase of 'Tide Lake' may have begun as early as 1000 cal. yr BP.

GSC-5868. Hoodoo River

normalized age:	670 ± 50
$\delta^{13}C$:	-23.7‰
uncorrected age:	650 ± 50

Wood sample 94-BRE-71 (a piece of a large branch of *Abies*, identified by H. Jetté in unpublished GSC Wood Report 94-95), enclosed in gravelly sand, was collected by B.R. Edwards on July 29, 1994 from a streamcut along the north fork of the upper Hoodoo River, near Hoodoo Glacier, 130 km north-northwest of Stewart, northwestern British Columbia (56°48.3′N, 131°19.6′W), at an elevation of about 770 m The sample was submitted by J.J. Clague to gain information on a Little Ice Age advance and the initiation of lake level change.

The sample (9.9 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 7.95 L of CO_2 gas. The age estimate is based on two counts for 2150 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 26.104 ± 0.120, 2.277 ± 0.033, and 28.303 ± 0.131 cpm, respectively.

Comments (B.R. Edwards): Sample GSC-5868 was collected from a cobble gravel layer at the base of a sequence of rhythmically layered sand and silt beds that are part of one of the lacustrine sediment sequences in the Hoodoo Mountain volcanic complex (in unit Qs2 of Edwards et al., 1996). Sample GSC-5868 places an upper limit on the depositional ages of basalt breccia from the 'Little Bear Mountain' volcano (unit Qvbb of Edwards et al., 1996) and porphyritic lavas from the Hoodoo Mountain volcano (unit Qvpp of Edwards et al., 1996) because it overlies both. The glaciolacustrine sediment was deposited during the Little Ice Age in a glacier-dammed lake when Hoodoo Glacier was at a much higher level than it is today.

Vancouver Island

'Gyro park' series

A series of seeds and wood samples was collected by P.T. Bobrowsky on March 17, 1989, J.J. Clague and P.T. Bobrowsky on September 04 1991, and J.J. Clague and R.W. Mathewes on June 03, 1993 and May 18, 1995 from two sites at 'Gyro park', Cadboro Bay, Victoria, Vancouver Island, British Columbia (48°27.6′N, 123°17.5′W; 48°27.5′N, 123°17.6′W; 48°27.6′N, 123°17.6′W). These samples were submitted by J.J. Clague to gain information on sea level change and vertical crustal movements related to earthquakes and tsunami.

TO-5312. 'Gyro park' I

normalized age:	600 ± 70
$\delta^{13}C$:	-25 ‰

Seed sample CIA-95-1-2 (*Potentilla)*, was enclosed in peat in the intertidal marsh at 'Gyro park', at an elevation of about 2 m. The age was normalized assuming $\delta^{13}C = -25‰$. The calibrated ages are AD 1325, with a 1σ range of AD 1300 to 1415 and a 2σ range of AD 1285 to 1440; AD 1335, with a 1σ range of AD 1300 to 1415 and a 2σ AD 1285 to 1440; and AD 1395, with a 1σ range of AD 1300 to 1415 and 2σ range of AD 1285 to 1440.

TO-4697. 'Gyro park' II

normalized age:	1070 ± 80

Seed sample CIA-93-8 was enclosed in peat. The age was normalized to $\delta^{13}C = -25‰$.

Comment (J.J. Clague): Samples TO-4697 and -5312 date possible tsunamis.

TO-1544. 'Gyro park' III

normalized age:	2980 ± 70

Wood sample PTB-89-3-2 (6 m depth) was enclosed in peat. The age was normalized to $\delta^{13}C = -25‰$.

GSC-5463. 'Gyro park' IV

normalized age:	5230 ± 70
$\delta^{13}C$:	-25.9‰
uncorrected age:	5240 ± 70

Wood sample CIA-91-172-1 (about 5 m depth; 10.20 g dry weight; unidentifiable, according to H. Jetté in unpublished GSC Wood Report 92-76), a single piece enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.7 g) yielded 6.4 L of CO_2 gas. The age estimate is based on one count for 2100 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.777 ± 0.098, 2.122 ± 0.040, and 28.386 ± 0.132 cpm, respectively.

Comments (J.J. Clague): The peat containing the dated sample is a terrestrial or brackish water deposit. The elevation of the dated sample is -5 m (mean sea level datum); thus, the level of the sea relative to the land 5200 14C years ago was more than 5 m lower than at present. Clastic sediment overlying the peat was deposited during a late Holocene marine transgression.

GSC-5461. 'Gyro park' VI

normalized age:	13 200 ± 150
$\delta^{13}C$:	-3.8‰
uncorrected age:	12 800 ± 150

Calcareous worm tube sample CIA-91-173-10 (12 m depth; 14.8 g dry weight; *Serpula*, identified by J.J. Clague), enclosed in silty marine clay, was treated with an acid leach to remove the outer 10%. The treated sample (13.4 g) yielded 2.84 L of CO_2 gas. The age estimate is based on one count for 3890 minutes in the 2 L counter with a mixing ratio of 1.53. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 3.691 ± 0.058, 1.207 ± 0.022, and 18.234 ± 0.101 cpm, respectively.

Comment (J.J. Clague): Sample GSC-5461 is a minimum age for deglaciation of southern Vancouver Island.

Dates from the 'Gyro park' site:

Sample	Age	Stratigraphic level
TO-1540	1250 ± 70	160 cm above GSC-4896
GSC-4895	1520 ± 70	140 cm above GSC-4896
GSC-4902	1960 ± 70	120 cm above GSC-4896
S-3195	3390 ± 90	55 cm above GSC-4896
S-3197	3730 ± 90	45 cm above GSC-4896
GSC-4896	3920 ± 70)	base of the sequence
S-3196	4070 ± 90	base of the sequence

See McNeely and Jorgensen (1993) for comments on GSC-4896.

Other dates from a related site include:

Sample	Age	Stratigraphic level
TO-2628	2000 ± 60	205 cm above GSC-4869
TO-2629	2870 ± 70	125 cm above GSC-4869
TO-2630	3380 ± 60	100 cm above GSC-4869
GSC-4883	3320 ± 80	90 cm above GSC-4869
GSC-4869	4060 ± 70	

See McNeely and Jorgensen (1993) for comments on GSC-4869.

Esquimalt Lagoon series

A series of wood samples was collected by J.J. Clague on July 28, 1990 and on September 04, 1991 from a natural exposure at Esquimalt Lagoon, 2 km southeast of Colwood, Vancouver Island, British Columbia (48°25.1′N, 123°28.2′W), at an elevation of 0 to 1 m. These samples were submitted by J.J. Clague to gain information on sea level change.

GSC-5404. Esquimalt Lagoon I

normalized age:	190 ± 80
$\delta^{13}C$:	-25.3‰
uncorrected age:	200 ± 80

Twig sample CIA-90-131-33 (4.2 g dry weight; *Taxus brevifolia*, identified by H. Jetté in unpublished GSC Wood Report 92-29), enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (3.6 g) yielded 3.43 L of CO_2 gas. The age estimate is based on two counts for 2100 minutes in the 2 L counter with a mixing ratio of 1.29. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.867 ± 0.113, 1.209 ± 0.024, and 18.316 ± 0.145 cpm, respectively.

TO-2896. Esquimalt Lagoon II

normalized age:	430 ± 40

Twig sample CIA-90-131-32 was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5159. Esquimalt Lagoon III

normalized age:	780 ± 60
$\delta^{13}C$:	-23.4‰
uncorrected age:	760 ± 60

Wood sample CIA-90-131-16 (9.7 g dry weight; *Thuja plicata*, identified by R.J. Mott in unpublished GSC Wood Report 90-54), a single piece enclosed in muddy peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 8.70 L of CO_2 gas. The age

estimate is based on one count for 2000 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.996 ± 0.124, 2.255 ± 0.036, and 28.572 ± 0.180 cpm, respectively.

TO-2131. Esquimalt Lagoon IV

normalized age: 3730 ± 60

Wood sample CIA-90-131-15 (1 m depth) was enclosed in peat near the base of the peat unit and 40 cm below sample GSC-5159 (*see* above).

Comments (J.J. Clague): The peat containing the dated samples is a brackish-water deposit. It accumulated near its present elevation of 0 to 1 m (mean sea level datum) when Esquimalt Lagoon extended slightly farther seaward than it does today. The peat is overlain by fill and by gravel of Esquimalt spit. The gravel was deposited on the peat as the spit migrated northward into the lagoon. Samples GSC-5159 and TO-2131 were reported previously (*see* McNeely and Atkinson, 1996).

Witty's Lagoon series

A series of wood samples was collected by J.J. Clague and R.J. Hebda on June 27, 1989 from a pit dug at Witty's Lagoon, about 15 km west-southwest of Victoria, Vancouver Island, British Columbia (48°23.1′N, 123°31.0′W), at a depth of 1 to 2 m. This sample was submitted by J.J. Clague to gain information on sea level change.

TO-1548. Witty's Lagoon I

normalized age: 5740 ± 70

Wood sample CIA-88-199-37 was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-1547. Witty's Lagoon II

normalized age: 5840 ± 70

Wood sample CIA-88-199-34 was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-1546. Witty's Lagoon III

normalized age: 6360 ± 80

Wood sample CIA-88-199-23 was enclosed in mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-1545. Witty's Lagoon IV

normalized age: 6750 ± 110

Wood sample CIA-88-199-22 was enclosed in organic-rich mud. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (J.J. Clague): The dated samples are about 1 to 2 m below sea level. The dates indicate that sea level was lower, relative to the land, 5700 to 6800 ^{14}C years BP.

GSC-5610. Muir Creek

normalized age: 3280 ± 50
$\delta^{13}C$: -23.0‰
uncorrected age: 3250 ± 50

Wood sample CIA-93-1 (the outermost 12 rings of a log of *Thuja plicata*, identified by H. Jetté in unpublished GSC Wood Report 93-37), enclosed in gravel, sand, and silt, was collected by R.W. Mathewes on April 21, 1993 from the mouth of Muir Creek, 0.2 km south of Highway 14, 10 km west of Sooke, British Columbia (48°22.9′N, 123°51.9′W), at an elevation of 0 m (msl). The sample was submitted by J.J. Clague to gain information on sea level change.

The sample (11.8 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.0 g) yielded 8.88 L of CO_2 gas. The age estimate is based on one count for 3925 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 18.755 ± 0.078, 2.193 ± 0.027, and 28.110 ± 0.129 cpm, respectively.

Comment (J.J. Clague): The dated log is from a peat bed outcropping in the intertidal zone at the mouth of Muir Creek on southern Vancouver Island. The peat also contains tree stumps in growth position. The sea has risen relative to the land since the peat was deposited. The relative sea level rise may be the result of sudden subsidence of the land during an earthquake about 3300 ^{14}C years BP (Mathewes and Clague, 1994).

See sample GSC-4787 in McNeely and Jorgensen (1992) for additional comments.

TO-1347. Colquitz River park

normalized age: 270 ± 80
$\delta^{13}C$: -25 ‰

Wood sample CIA-88-198-5, a twig enclosed in woody, silty sand over glaciomarine clay, was collected by J.J. Clague and P. Bobrowsky on October 20, 1988 from a pit dug at Colquitz River park, 1 km east of Portage Inlet, 0.3 km south of Highway 1, Victoria, Vancouver Island, British Columbia (48°27.3′N, 123°24.0′W), at an elevation of about 0 m. This sample was submitted by J.J. Clague to gain information on sea level change. The age was normalized assuming $\delta^{13}C$ = -25‰.

Comment (J.J. Clague): Sample TO-1347 dates the base of a thick (approximately 0.8 m) unit of woody, silty sand in a tidal channel in Victoria, British Columbia. The unexpectedly young age suggests that the dated sediment may be fill or fill that has been reworked by tidal currents.

See GSC-4891 in McNeely and Jorgensen (1993) for additional comments.

S-3198. Island View Beach

uncorrected age: 830 ± 80

Wood sample CIA-89-206 was collected by J.J. Clague and R.J. Hebda from Island View Beach, 8 km south-southeast of Sidney, Vancouver Island, British Columbia (48°34.8′N, 123°22.1′W), at an elevation of 0 m. This sample was submitted by J.J. Clague to gain information on sea level change.

Comment (J.J. Clague): Sample S-3198 dates the contact between beach gravel and sand, exposed in the eroding face of a beach ridge. Relative sea level at the site about 800 BP differed little from that of today.

Saanich Inlet series

A series of marine shell samples was collected by A. Blais on June 24 and 26, 1992 and by A. Blais and W. Stevens on September 1, 1992 from Saanich Inlet, about 30 km north of Victoria, Vancouver Island, British Columbia. These samples were submitted by J.J. Clague to gain information on the post-bomb marine reservoir age.

GSC-5499. Saanich Inlet I

age: modern
$\delta^{13}C$: +1.63‰
pMC: 97.89 ± 0.85

Marine shell sample 92GS044 (48°35.02′N, 123°28.03′W; 10.4 g dry weight), an entire valve from a live collection on marine mud at a water depth of 52 m, was treated with an acid leach to remove the outer 10%. The treated sample (9.8 g) yielded 2.08 L of CO_2 gas. The age estimate is based on one count for 3600 minutes in the 2 L counter with a mixing ratio of 2.08. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 18.960 ± 0.123, 1.213 ± 0.025, and 18.316 ± 0.104 cpm, respectively.

GSC-5519. Saanich Inlet II

age: modern
$\delta^{13}C$: -1.23‰
pMC: 101.46 ± 0.70

Marine shell sample 92GS060 (48°41.275′N, 123°29.075′W; 68.50 g dry weight), an entire valve from a live collection on marine sand and gravel at a water depth of 1 m, was treated with an acid leach to remove the outer 30%. The treated sample (35.7 g) yielded 7.9 L of CO_2 gas. The age estimate is based on two counts for 2100 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 30.229 ± 0.149, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

GSC-5520. Saanich Inlet III

age: modern
$\delta^{13}C$: +1.00‰
pMC: 99.44 ± 0.77

Marine shell sample 92GS021 (48°44.775′N, 123°37.056′W; 22.5 g dry weight), an entire valve from a live collection on the surface of marine mud at a water depth of 40 m, was treated with an acid leach to remove the outer 20%. The treated sample (19.3 g) yielded 4.10 L of CO_2 gas. The age estimate is based on two counts for 2290 minutes in the 2 L counter with a mixing ratio of 1.07. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 19.234 ± 0.101, 1.213 ± 0.025, and 18.316 ± 0.104 cpm, respectively.

Comments (J.J. Clague): Three valves of live molluscs were radiocarbon dated to obtain information on the marine reservoir age of Saanich Inlet waters. All three samples yielded modern ages (98.0, 101.6, and 99.6% modern carbon), indicating that present-day concentrations of radiocarbon in waters of Saanich Inlet are elevated (anomalously high) as a result of atmospheric bomb testing in the 1960s. The pre-bomb marine residence time (apparent age) for the Canadian Pacific coast is about 800 years (unpublished data, Geological Survey of Canada Laboratory).

San Juan River valley series

A series of wood samples was collected by J.J. Clague and I. Hutchinson on August 19, 1997 from the San Juan River valley, 4 and 4.5 km northeast of Port Renfrew, British Columbia, at an elevation of 1 m. These samples were submitted by J.J. Clague to gain information on an earthquake and on river-channel abandonment.

GSC-6205. San Juan River valley I

normalized age: 80 ± 80
$\delta^{13}C$: -25.7‰
uncorrected age: 90 ± 80

Wood sample ‘CIA-97-115’ (11.1 g dry weight; a branch of *Pseudotsuga menziesii*, identified by C. Keith), enclosed in underlying sandy mud and overlying muddy peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.8 g) yielded 8.4 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for

the sample (net) and for monthly backgrounds and standards (net) were 17.776 ± 0.076, 1.215 ± 0.027, and 17.975 ± 0.149 cpm, respectively.

Comment (J.J. Clague): The dated sample (GSC-6205: 48°34.9′N, 124°22.8′W) is from the top of a muddy peat layer, which is sharply overlain by surface sandy mud. A similar stratigraphy has been found at many sites in the San Juan River estuary and is interpreted to record an episode of coseismic subsidence. The peat delineates an old tidal marsh surface that subsided during a large earthquake and was covered by tidal mud. Sample GSC-6205 indicates that the earthquake occurred sometime after the late seventeenth century; the age is consistent with the event being the last great earthquake at the Cascadia subduction zone (AD 1700).

GSC-6206. San Juan River valley II

normalized age:	2150 ± 60
$\delta^{13}C$:	-25.8‰
uncorrected age:	2160 ± 60

Wood sample CIA-97-118 (11.6 g dry weight; *Tsuga heterophylla*, identified by C. Keith), enclosed in underlying organic-rich mud and overlying gravel, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 7.2 L of CO_2 gas. The age estimate is based on one count for 3600 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.700 ± 0.094, 2.216 ± 0.048, and 28.397 ± 0.191 cpm, respectively.

Comment (J.J. Clague): Sample GSC-6206 (48°35.0′N, 124°22.8′W) was obtained on the outermost 10 rings of a log recovered from fine channel gravel deposited by the San Juan River. The gravel is overlain by 85 cm of tidal mud and peat. The San Juan River abandoned its old channel at this site about 2100 ^{14}C years BP; it probably shifted to a location farther south. The old channel slowly filled with mud and then peat, culminating in the establishment of the present tidal marsh.

GSC-6405. 'Boultons' pit'

normalized age:	12 900 ± 160
corrected age:	12 500 ± 160
$\delta^{13}C$:	-1.5‰
uncorrected age:	12 500 ± 160

Marine pelecypod shell sample CIA-99-22 (*Saxidomus gigantea*, identified by A.S. Dyke), enclosed in sand, was collected by C.S. Churcher in August 1999 from a sand and gravel pit ('Boultons' pit') at the west end of Dorby Road, Gabriola Island, British Columbia (49°04.07′N, 123°43.97′W), at an elevation of 45 m. The sample was submitted by J.J. Clague to gain information on sea level change and the time of deglaciation.

The sample (39.4 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (31.2 g) yielded 6.7 L of CO_2 gas. The age estimate is based on one count for 2186 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.949 ± 0.098, 2.140 ± 0.076, and 28.328 ± 0.196 cpm, respectively.

Comment (J.J. Clague): This date is a minimum for deglaciation of the southern Strait of Georgia. At the time, relative sea level on Gabriola Island was at least 45 m higher than at present.

GSC-6060. Lock Bay

normalized age:	4160 ± 60
$\delta^{13}C$:	-23.4‰
uncorrected age:	4130 ± 60

Wood sample CIA-95-4-2 (a branch of *Pseudotsuga menziesii*, identified by R.J. Mott in unpublished GSC Wood Report 96-20), underlain by peat and overlain by mud, was collected by J.J. Clague and I. Hutchinson on June 8, 1995 from Lock Bay, Gabriola Island, British Columbia (49°11.3′N, 123°49.3′W), at an elevation of 2 m. The sample was submitted by J.J. Clague to gain information on sea level fluctuations and possible tsunami deposits.

The sample (10.2 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 7.0 L of CO_2 gas. The age estimate is based on one count for 3330 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.882 ± 0.083, 2.293 ± 0.035, and 28.244 ± 0.136 cpm, respectively.

Comment (J.J. Clague): The dated sample was from a pit dug in a tidal marsh bordering the Strait of Georgia. Peat underlying the dated horizon is a fresh- or brackish-water deposit. The mud overlying the peat is intertidal. Sample GSC-6060 indicates that the sea, relative to the land, was lower about 4200 ^{14}C years BP than today, and was near its present level sometime after 4200 years BP.

Macktush Creek series

A series of wood samples was collected by M. Miles on May 14, 1996 from the river bank on the north side of Macktush Creek, 14 km south-southwest of Port Alberni, Vancouver Island, British Columbia (49°06.9′N, 124°52.2′W), at an elevation of about 165 m. These samples were submitted by J.J. Clague to gain information on a landslide.

GSC-6220. Macktush Creek I

normalized age:	6010 ± 70
$\delta^{13}C$:	-26.3‰
uncorrected age:	6030 ± 70

Wood sample 'Macktush no. 2' (10.3 g dry weight; coniferous, identified by C. Keith), a branch enclosed in woody organic detritus, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.6 g) yielded 7.5 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.345 ± 0.076, 2.195 ± 0.041, and 28.266 ± 0.154 cpm, respectively.

GSC-6216. Macktush Creek II

normalized age:	6080 ± 70
$\delta^{13}C$:	-25.38‰
uncorrected age:	6090 ± 70

Wood sample 'Macktush no. 1' (9.6 g dry weight; a branch of *Pseudotsuga menziesii*, identified by C. Keith), enclosed in woody organic detritus, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 7.5 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.285 ± 0.073, 2.260 ± 0.035, and 28.346 ± 0.136 cpm, respectively.

Comment (J.J. Clague): The two dated branches were collected from a 1.5 to 2 m thick layer of coarse woody detritus that sharply overlies laminated to thin-bedded lacustrine sediment. The detrital wood layer, in turn, is overlain by fluvial terrace gravel. The date site is directly upstream of a large landslide, and the lacustrine sediment was probably deposited in a lake that was impounded by this landslide. If the detrital wood layer accumulated in the lake (or, alternatively, on the floor of the lake shortly after drainage), the two radiocarbon ages closely date the landslide.

'Shoemaker Bay' series

A series of wood and marine shell samples was collected by J.J. Clague and P.T. Bobrowsky on June 5, 1991 and by J.J. Clague on September 05, 1991 from 'Shoemaker Bay', 2 km west-southwest of Port Alberni, Vancouver Island, British Columbia (49°15.1′N, 124°50.0′W), at an elevation of about 0 m. These samples were submitted by J.J. Clague to gain information on tsunami deposits related to prehistoric earthquakes.

GSC-5449. 'Shoemaker Bay' I

normalized age:	390 ± 80
$\delta^{13}C$:	-22.0‰
uncorrected age:	350 ± 80

Wood sample CIA-91-132-1 (2.6 g dry weight; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 92-64), enclosed in sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.1 g) yielded 2.06 L of CO_2 gas. The age estimate is based on two counts for 2200 minutes in the 2 L counter with a mixing ratio of 2.11. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.464 ± 0.147, 1.207 ± 0.022, and 18.234 ± 0.101 cpm, respectively.

TO-3326. 'Shoemaker Bay' II

normalized age:	3330 ± 60

Wood sample CIA-91-175-6 consisted of twigs enclosed in woody muddy silt, directly overlying a sand bed. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5442. 'Shoemaker Bay' III

normalized age:	4140 ± 90
$\delta^{13}C$:	-24.8‰
uncorrected age:	4140 ± 90

Wood sample CIA-91-132-4 (about 0.5 m; 5.80 g dry weight; *Pseudotsuga menziesii*, identified by H. Jetté in unpublished GSC Wood Report 92-60), a piece of a large log enclosed in sand above and muddy silt below, was treated with hot base, hot acid (slightly calcareous), and distilled water rinses. The treated sample (4.8 g) yielded 5.2 L of CO_2 gas. The age estimate is based on one count for 2190 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.968 ± 0.079, 1.214 ± 0.025, and 18.357 ± 0.145 cpm, respectively.

TO-2899. 'Shoemaker Bay' IV

normalized age:	4410 ± 50
corrected age:	4000 ± 50

Marine shell sample CIA-91-175-7 (7 m depth) consisted of two valves enclosed in muddy silt. The age was normalized to $\delta^{13}C$ = -25‰, and corrected to $\delta^{13}C$ = 0‰.

Comment (J.J. Clague): Samples GSC-5442 and -5449 are from a natural bank at the edge of a tidal marsh at Port Alberni, British Columbia. Sample GSC-5549 is a maximum age for the tsunami triggered by the most recent large plate-boundary earthquake at the Cascadia subduction zone (determined elsewhere to have occurred in AD 1700). It is also a minimum age for a tsunami that predates the AD 1700 event. Sample GSC-5542 is a date on a piece of wood collected from the base of the lowest tsunami sand at this exposure. The wood may have been reworked by the tsunami from older sediment, in which case it could be significantly older than the tsunami itself. Samples TO-2899 and -3326 are from a core collected adjacent to the natural bank exposure. Sample TO-3326 is a minimum age for a tsunami.

Port Alberni series

A series of wood samples and *Triglochin* fragments was collected by J.J. Clague and P.T. Bobrowsky on June 3, 4 and 5, 1991 and by J.J. Clague, P.T. Bobrowsky, and B. Atwater on August 10, 1992 from dug pits and tidal channel banks near Port Alberni, Vancouver Island, British Columbia, at elevations of 0 to 1 m. These samples were submitted by J.J. Clague to gain information on the tsunami deposits related to prehistoric earthquakes.

Core CIA-91-141 (49°15.3′N, 124°49.3′W):

TO-2643. Port Alberni I

normalized age: 1560 ± 60

Wood sample CIA-91-141-1 was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5458. Port Alberni II

normalized age:	1770 ± 60
$\delta^{13}C$:	-27.3‰
uncorrected age:	1810 ± 60

Wood sample CIA-91-141-2 (8.70 g dry weight; a single piece of *Abies* identified by H. Jetté in unpublished GSC Wood Report 92-73), enclosed in sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.8 g) yielded 7.8 L of CO_2 gas. The age estimate is based on two counts for 2195 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 22.666 ± 0.114, 2.122 ± 0.040, and 28.386 ± 0.132 cpm, respectively.

Core CIA-91-129 (49°15.1′N, 124°49.4′W):

GSC-5453. Port Alberni III

normalized age:	980 ± 60
$\delta^{13}C$:	-23.6‰
uncorrected age:	960 ± 60

Wood sample CIA-91-129 (5.80 g dry weight; two pieces of *Pseudotsuga menziesii*, identified by H. Jetté in unpublished GSC Wood Report 92-67), overlain by organic-rich mud and underlain by sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.9 g) yielded 4.9 L of CO_2 gas. The age estimate is based on two counts for 2230 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.389 ± 0.092, 1.198 ± 0.024, and 18.457 ± 0.104 cpm, respectively.

Core CIA-91-121 (49°15.1′N, 124°49.5′W):

TO-2642. Port Alberni IV

normalized age: 270 ± 60

Wood sample CIA-91-121-4 was overlain by peaty mud above and underlain by sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-3325. Port Alberni V

normalized age: 270 ± 50

Twig sample CIA-91-121-2 was enclosed in organic-rich mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2641. Port Alberni VI

normalized age: 1010 ± 60

Wood sample CIA-91-121-1 was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5439. Port Alberni VII

normalized age:	1160 ± 90
$\delta^{13}C$:	-23.9‰
uncorrected age:	1140 ± 90

Wood sample CIA-91-121-3 (2.60 g dry weight; a twig of *Pinus monticola,*(identified by H. Jetté in unpublished GSC Wood Report 92-57), overlain by peaty mud and underlain by sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.3 g) yielded 2.4 L of CO_2 gas. The age estimate is based on one count for 2070 minutes in the 2 L counter with a mixing ratio of 1.88. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 15.931 ± 0.137, 1.214 ± 0.025, and 18.357 ± 0.145 cpm, respectively.

Core CIA-91-131 (49°15.2′N, 124°49.5′W):

GSC-5447. Port Alberni VIII

normalized age:	880 ± 90
$\delta^{13}C$:	-22.0‰
uncorrected age:	830 ± 90

Organic material sample CIA-91-131-2 (3.10 g dry weight; a cone of *Pseudotsuga menziesii*, identified by H. Jetté in unpublished GSC Wood Report 92-62), overlain by sand and underlain by mud, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.1 g) yielded 2.0 L of CO_2 gas. The age estimate is based on two counts for 2120 minutes in the 2 L counter with a mixing ratio of 2.19. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.643 ± 0.151, 1.198 ± 0.024, and 18.457 ± 0.104 cpm, respectively.

GSC-5455. Port Alberni IX

normalized age:	1600 ± 70
$\delta^{13}C$:	-26.0‰
uncorrected age:	1620 ± 70

Wood sample CIA-91-131-1 (11.00 g dry weight; a piece of a large log of *Abies,* identified by H. Jetté in unpublished GSC Wood Report 92-69), overlain by sandy mud and underlain by sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (5.9 g) yielded 5.7 L of CO_2 gas. The age estimate is based on two counts for 2245 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 15.088 ± 0.089, 1.198 ± 0.024, and 18.457 ± 0.104 cpm, respectively.

Core CIA-92-36 (49°15.2′N, 124°49.6′W):

TO-3523. Port Alberni X

normalized age:	400 ± 50

Organic fragment sample CIA-92-36-1 (*Triglochin*), was enclosed in mud. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5523. Port Alberni XI

normalized age:	3600 ± 70
$\delta^{13}C$:	-22.2‰
uncorrected age:	3550 ± 70

Wood sample CIA-92-36-2 (4.50 g dry weight; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 93-03), a twig enclosed in muddy sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.2 g) yielded 4.2 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.04. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.659 ± 0.065, 1.214 ± 0.024, and 18.146 ± 0.102 cpm, respectively.

Core CIA-01-122 (49°15.2′N, 124°49.6′W):

GSC-5405. Port Alberni XII

normalized age:	790 ± 70
$\delta^{13}C$:	-26.2‰
uncorrected age:	810 ± 70

Wood sample CIA-91-122 (19.3 g dry weight; a branch of *Abies*, identified by H. Jetté in unpublished GSC Wood Report 92-30), overlain by peaty mud and underlain by muddy sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 8.29 L of CO_2 gas. The age estimate is based on three counts for 3730 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.279 ± 0.115, 2.185 ± 0.041, and 27.969 ± 0.203 cpm, respectively.

Core CIA-91-174 (49°15.2′N, 124°49.6′W):

GSC-5397. Port Alberni XIII

normalized age:	2090 ± 90
$\delta^{13}C$:	-24.8‰
uncorrected age:	2090 ± 90

Wood sample CIA-91-174-6 (10.4 g dry weight; *Thuja plicata, i*dentified by H. Jetté in unpublished GSC Wood Report 92-26), a single piece enclosed in muddy silt above and sand below, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 8.45 L of CO_2 gas. The age estimate is based on two counts for 2300 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.570 ± 0.176, 2.185 ± 0.041, and 27.969 ± 0.203 cpm, respectively.

Core CIA-91-108 (49°15.1′N, 124°50.0′W):

TO-2639. Port Alberni XIV

normalized age:	410 ± 60

Wood sample CIA-91-108-11 was enclosed in peaty mud. The age was normalized to $\delta^{13}C$ = -25‰.

Beta-56652. (CAMS-4249) Port Alberni XV

normalized age:	570 ± 70

Wood bark sample CIA-91-108-12 was enclosed in organic-rich mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-3324. Port Alberni XVI

normalized age:	840 ± 50

Wood sample CIA-91-108-10 was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2638. Port Alberni XVII

normalized age:	1280 ± 70

Wood sample CIA-91-108-1 was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2640. Port Alberni XVIII

normalized age:	1850 ± 60

Wood sample CIA-91-108-13 was overlain by sand and underlain by organic-rich mud. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (J.J. Clague): The dates delimit the ages of thin layers of clean sand in the Port Alberni marsh. These sand layers are possible tsunami deposits (*see* Clague and Bobrowsky, 1994). Samples GSC-5405, -5439, -5447, -5453, -5455, -5458, and -5523 are wood and a conifer cone collected from sand and mud underlying a tidal marsh at Port Alberni, British Columbia. The samples were dated to determine times of marsh establishment, river channel abandonment, and large tsunamis on the west coast of Vancouver Island. Samples GSC-5439 (1160 ± 90 BP) and GSC-5447 (880 ± 90 BP) are maximum ages for one tsunami; GSC-5405 (790 ± 70 BP) and GSC-5453 (980 ± 60 BP) are a minimum ages for this event. Sample GSC-5455 (1600 ± 70 BP) is a minimum age for abandonment of a Somass River distributary channel. Sample GSC-5458 (1770 ± 60 BP) dates material reworked by, and thus older than, one of the tsunamis. Sample GSC-5523 (3600 ± 70 BP) is the minimum age for the inception of the marsh in this area.

Esowista Peninsula series

A series of wood, charcoal, and *Triglochin* rhizome samples was collected by J.J. Clague and P.T. Bobrowsky on August 1 and 4, 1992 and by J.J. Clague on June 25, 28 and 29, 1993 from pits dug on the Esowista Peninsula, between 4 and 8 km southeast of Tofino, Vancouver Island, British Columbia, at elevations of about 2 to 4 m. These samples were submitted by J.J. Clague to gain information on the tsunami deposits related to prehistoric earthquakes.

TO-3515. Esowista Peninsula I

normalized age: 130 ± 50

Coniferous cone fragment sample CIA-92-16-2 (49°06.8′N, 125°52.6′W) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-4061. Esowista Peninsula II

normalized age: 160 ± 60

Rhizome sample CIA-93-74-2 (49°07.3′N, 125°52.5′W; Triglochin, identified by J.J. Clague) was enclosed in muddy peat. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5521. Esowista Peninsula III

normalized age:	190 ± 60
$\delta^{13}C$:	-24.9‰
uncorrected age:	180 ± 60

Wood sample CIA-92-6 (49°06.1′N, 125°49.5′W; 17.7 g dry weight; a branch of Abies, identified by H. Jetté in unpublished GSC Wood Report 93-06), from), overlain by peaty mud, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 8.26 L of CO_2 gas. The age estimate is based on two counts for 2220 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.734 ± 0.121, 2.148 ± 0.033, and 28.377 ± 0.182 cpm, respectively.

TO-4059. Esowista Peninsula IV

normalized age: 310 ± 60

Rrhizome sample CIA-93-40 (49°06.8′N, 125°52.5′W; Triglochin, identified by J.J. Clague) was overlain by peaty mud and underlain by sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-4062. Esowista Peninsula V

normalized age: 620 ± 50

Charcoal sample CIA-93-78-1 (49°06.8′N, 125°52.5′W) was enclosed in organic-rich mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-4060. Esowista Peninsula VI

normalized age: 800 ± 60

Charcoal sample CIA-93-58-2 (49°06.8′N, 125°52.5′W) was enclosed in organic-rich sandy silt. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5508. Esowista Peninsula VII

normalized age:	6060 ± 70
$\delta^{13}C$:	-24.3‰
uncorrected age:	6040 ± 70

Wood sample CIA-92-16-1 (49°06.8′N, 125°52.6′W; 19.5 g dry weight; a log of Pseudotsuga menziesii, identified by H. Jetté in unpublished GSC Wood Report 92-89), enclosed in sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.2 g) yielded 7.67 L of CO_2 gas. The age estimate is based on one count for 6200 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.271 ± 0.065, 2.193 ± 0.042, and 28.163 ± 0.147 cpm, respectively.

GSC-5773. Esowista Peninsula VIII

normalized age:	6440 ± 100
$\delta^{13}C$:	-25.2‰
uncorrected age:	6450 ± 100

Wood sample C1A-93-71-2 (49°07.1′N, 125°53.0′W; 55–56 cm; 4.8 g dry weight; unidentifiable, according to H. Jetté in unpublished GSC Wood Report 94-47), overlain by fine sand and underlain by clay, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.2 g) yielded 4.38 L of CO_2 gas. The age estimate is based on two counts for 3335 minutes in the 2 L counter with

a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.295 ± 0.081, 1.214 ± 0.025, and 18.515 ± 0.105 cpm, respectively.

Comment (J.J. Clague): These dates provide chronological control on a succession of tsunami deposits related to large earthquakes. Sample GSC-5521 was collected from tidal mud directly overlying a tsunami sand, which in turn rests on a peat interpreted to be a coseismically subsided, tidal marsh deposit. It dates the earthquake and accompanying tsunami, which probably occurred in AD 1700. The log that yielded sample GSC-5508 was in tsunami sand, which has been dated elsewhere in the area as being less than 500 years old. The tsunami probably occurred in AD 1700. The log was eroded by the tsunami from much older sediment and redeposited in the tidal marsh.

Meares Island series

A series of organic samples was collected by J.J. Clague and P.T. Bobrowsky on August 8, 1992 and by J.J. Clague, P.T. Bobrowsky, and B. Atwater on August 9, 1992 from pits dug on Meares Island, 3 km east of Tofino, Vancouver Island, British Columbia (49°08.9′N, 125°51.4′W), at an elevation of 1 m. These samples were submitted by J.J. Clague to gain information on tsunamis related to earthquakes.

TO-3518. Meares Island I

normalized age: 180 ± 50

Conifer needle and cedar scale sample CIA-92-28-5 was underlain by peat and overlain by sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-3517. Meares Island II

normalized age: 340 ± 50

Twig fragment sample CIA-92-28-3 was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-3519. Meares Island III

normalized age: 440 ± 60

Organic fragment sample CIA-92-28-7 (*Juncus*) was enclosed in peat and sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-3520. Meares Island IV

normalized age: 630 ± 50

Conifer cone fragment sample CIA-92-28-8 was enclosed in peaty mud and muddy peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-3521. Meares Island V

normalized age: 680 ± 50

Twig fragment sample CIA-92-28-9 was enclosed in peaty mud and muddy peat. The age was normalized to $\delta^{13}C$ = -25‰.

GSC-5522. Meares Island VI

normalized age: 700 ± 60
$\delta^{13}C$: -24.9‰
uncorrected age: 700 ± 60

Wood sample CIA-92-28-1 (18.2 g dry weight; a branch of *Picea*, identified by H. Jetté in unpublished GSC Wood Report 93-10), overlain by peaty mud and underlain by sandy gravel, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.7 g) yielded 8.77 L of CO_2 gas. The age estimate is based on two counts for 2220 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 26.015 ± 0.117, 2.148 ± 0.033, and 28.377 ± 0.182 cpm, respectively.

TO-3516. Meares Island VII

normalized age: 1140 ± 50

Coniferous cone fragment sample CIA-92-28-2 was underlain by peat and overlain by sand. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (J.J. Clague): The dates provide chronological control on a large earthquake and tsunami on western Vancouver Island. Sample GSC-5522 is a minimum age for the establishment of the tidal marsh flanking Meares Island.

'Kakawis Lake' series

A series of wood and shell samples was collected by J.J. Clague, I. Hutchinson, and P.T. Bobrowsky on October 9, 1998 from sediment cores taken in 'Kakawis Lake' on western Meares Island, 4 km west of Tofino, Vancouver Island, British Columbia (49°11.5′N, 125°53.6′W), at a depth of about 1 m. These samples were submitted by J.J. Clague to gain information on tsunami deposits and coseismic subsidence.

GSC-6295. 'Kakawis Lake' I

normalized age: 2680 ± 120
$\delta^{13}C$: -24.9‰
uncorrected age: 2680 ± 120

Wood sample 'Kakawis 5: 186-191 cm' (2.1 g dry weight; a twig of *Thuja plicata,* identified by C. Keith), enclosed in organic mud, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (1.5 g) yielded 1.3 L of CO_2 gas. The age estimate is based on one count for 3550 minutes in the 2 L counter with a mixing

ratio of 3.23. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.919 ± 0.151, 1.236 ± 0.027, and 18.030 ± 0.148 cpm, respectively.

Comment (J.J. Clague): The dated twig was collected from organic mud overlying a layer of shelly gravelly sand within Kakawis core 5. Sample GSC-6295 provides a minimum age for deposition of the shelly gravelly sand, which is interpreted as a tsunami deposit.

GSC-6303. 'Kakawis Lake' II

normalized age:	3490 ± 90
$\delta^{13}C$:	-27.0‰
uncorrected age:	3520 ± 90

Bark sample 'Kakawis 5: 229-230 cm' (2.9 g dry weight), enclosed in a shelly woody layer, was treated with hot base, hot acid, and distilled water rinses (noncalcareous). The treated sample (2.3 g) yielded 2.0 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 2.10. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.682 ± 0.104, 1.275 ± 0.026, and 18.118 ± 0.111 cpm, respectively.

Comment (J.J. Clague): The dated bark fragment was collected from a layer of coarse plant detritus, shell fragments, mud, and minor sand in Kakawis core 5. This layer and two other similar, thin layers of coarse sediment occur within a dominantly fine-grained (gyttja, mud) Holocene sequence. The Holocene sediments overlie late Pleistocene glaciomarine mud. The coarse Holocene sediment layers may be deposits of tsunamis triggered by great earthquakes at the Cascadia subduction zone.

GSC-6281. 'Kakawis Lake' III

normalized age:	4150 ± 80
corrected age:	3750 ± 80
$\delta^{13}C$:	-0.6‰
uncorrected age:	3760 ± 80

Marine pelecypod shell sample 'Kakawis 1: 164-168 cm' (12.2 g dry weight), enclosed in a shelly gravelly sand, was treated with an acid leach to remove the outer 5%. The treated sample (11.5 g) yielded 2.4 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.68. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 11.344 ± 0.089, 1.275 ± 0.026, and 18.118 ± 0.111 cpm, respectively.

Comment (J.J. Clague): The dated shells were collected from a layer of shelly gravelly sand occurring within a sequence of gyttja and peat in Kakawis core 1. 'Kakawis Lake' is a low-elevation lake on Meares Island, located on the west coast of Vancouver Island. The lake sill is about 1 to 2 m above the upper limit of tides. The gravelly sand layer thins and fines landward, away from the outlet of the lake, and is interpreted as a tsunami deposit. The tsunami may have been generated by a great earthquake at the Cascadia subduction zone. Sample GSC-6281 and other radiocarbon ages from 'Kakawis Lake' cores (e.g., GSC-6303, above) suggest that the earthquake occurred about 3500 14C years ago.

Kanim Lake series

A series of organic sediment cores was collected by J.J. Clague, R.W. Mathewes, and I. Hutchinson on September 4, 1993 and September 04, 1994 from Kanim Lake, 10 km east of Hesquiat, western Vancouver Island, British Columbia, at an elevation of about 2 to 4 m,. These samples were submitted by J.J. Clague to gain information on sea level emergence and tsunami deposits related to earthquakes.

TO-4705. Kanim Lake I

age:	modern
(109.1 pMC)	

Needle sample CIA-94-45-2 (49°23.6′N, 126°20.3′W; Tsuga identified by R.W. Mathewes) was enclosed in gyttja.

TO-4913. Kanim Lake II

age:	modern
(102.9 pMC)	

Plant leaf sample CIA-94-45-3 (49°23.6′N, 126°20.3′W; 35–38 cm depth) was enclosed in gyttja.

TO-4952. Kanim Lake III

normalized age:	210 ± 50
$\delta^{13}C$:	-25 ‰

Lake sediment gyttja sample CIA-94-51-3 (49°23.5′N, 126°20.2′W; 33–36 cm depth) was enclosed in gyttja. The age was normalized assuming $\delta^{13}C$ = -25‰.

The calibrated ages are AD 1670, with a 1σ range of AD 1655 to 1685 and a 2σ range of AD 1640 to 1710; AD 1785, with a 1σ range of AD 1745 to 1805 and a 2σ range of AD 1710 to 1820; AD 1795, with a 1σ range of AD 1745 to 1805 and a 2σ range of AD 1710 to 1820; AD 1950, with a 1σ range of AD 1935 to 1954 and a 2σ range of AD 1915 to 1955; and AD 1953, with a 1σ range of AD 1935 to 1954 and a 2σ range of AD 1915 to 1955.

Comment (J.J. Clague): Sample TO-4952 dates a possible tsunami deposit.

TO-4708. Kanim Lake IV

normalized age: 2130 ± 60

Lake sediment gyttja sample CIA-94-51-2 (49°23.5′N, 126°20.2′W) was enclosed in gyttja. There was an anomalous clastic layer in the gyttja sequence. The age was normalized to $\delta^{13}C$ = -25‰.

TO-5310. Kanim Lake V

normalized age: 2650 ± 50
$\delta^{13}C$: -25 ‰

Wood sample CIA-94-47-4 (49°27.7′N, 126°20.2′W; twigs of Myrica, identified by R.W. Mathewes) was enclosed in a sandy wood layer in gyttja. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated age is 805 BC, with a 1σ range of 825 to 795 BC and 2σ range of 900 to 775 BC.

Comment (J.J. Clague): Sample TO-5310 dates a possible tsunami deposit.

TO-5309. Kanim Lake VI

normalized age: 2700 ± 50
$\delta^{13}C$: -25 ‰

Cone sample CIA-94-46 (49°23.7′N, 126°20.2′W; Tsuga heterophylla, identified by R.W. Mathewes) was enclosed in a sandy, woody layer in gyttja. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated age is 825 BC, with a 1σ range of 900 to 805 BC and a 2σ range of 925 to 795 BC.

Comment (J.J. Clague): Sample TO-5309 dates a possible tsunami deposit.

TO-4914. Kanim Lake VII

normalized age: 2750 ± 60

Seed cone sample CIA-94-47-2 (49°23.6′N, 126°20.3′W; Thuja plicata, identified by R.W. Mathewes) was enclosed in gyttja. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated ages are 900 BC, with a 1σ range of 930 to 820 BC and a 2σ range of 1010 to 805 BC; 870 BC, with a 1σ range of 930 to 820 BC and a 2σ range of 1010 to 805 BC; and 860 BC, with a 1σ range of 930 to 820 BC and a 2σ range of 1010 to 805 BC.

TO-5311. Kanim Lake VIII

normalized age: 2800 ± 50
$\delta^{13}C$: -25 ‰

Wood sample CIA-94-47-5 (49°23.7′N, 126°20.2′W; twig of Picea, identified by R.W. Mathewes) was enclosed in a sandy woody layer in gyttja. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated age is 920 BC, with a 1σ range of 1000 to 900 BC and a 2σ range of 1045 to 825 BC.

Comment (J.J. Clague): Sample TO-5311 dates a possible tsunami deposit.

TO-4706. Kanim Lake IX

normalized age: 3100 ± 70

Wood sample CIA-94-47 (49°23.7′N, 126°20.2′W; twig of Picea, identified by R.W. Mathewes) was enclosed in gyttja. The age was normalized to $\delta^{13}C$ = -25‰.

TO-4704. Kanim Lake X

normalized age: 4440 ± 60

Marine shell fragment sample CIA-94-45-1 (49°23.6′N, 126°20.3′W) was enclosed in silty sand. The age was normalized to $\delta^{13}C$ = -25‰.

TO-4707. Kanim Lake XI

corrected age: 4170 ± 70

Marine shell fragment sample CIA-94-51-1 (49°23.5′N, 126°20.2′W) was enclosed in sandy mud. The age was normalized to δ13C = -25‰.

Comment (J.J. Clague): These samples date the uplift of western Vancouver Island.

TO-4063. Hesquiat Harbour

normalized age: 2160 ± 50
corrected age: 1750 ± 50

Marine shell sample CIA-93-90-3, enclosed in cultural deposits (midden), was collected by J.J. Clague and P.T. Bobrowsky on July 7, 1993 from a core at Hesquiat Harbour, 8 km north-northeast of Hesquiat, Vancouver Island, British Columbia (49°28.2′N, 126°26.8′W), at an elevation of about 6 m. This sample was submitted by J.J. Clague to gain information on a tsunami related to a prehistoric earthquake. The age was normalized to $\delta^{13}C$ = -25‰, and corrected to $\delta^{13}C$ = 0‰.

Comment (J.J. Clague): Sample TO-4063 provides chronological control on a possible tsunami deposit.

GSC-6496. Tsable River

normalized age:	12 600 ± 120
corrected age:	12 200 ± 120
$\delta^{13}C$:	-1.1‰
uncorrected age:	12 200 ± 120

Marine shell sample CIA-00-102 (*Saxidomus gigantea*, identified by T. Cockburn), enclosed in sand, was collected by R. Graham in April 1998 from a roadcut on the west side of Island Highway, about 200 to 300 m north of the bridge across the Tsable River, near Buckley Bay, Vancouver Island, British Columbia (49°31′N, 124°51′W), at an elevation of 65 m. The sample was submitted by J.J. Clague to gain information on sea level change and the time of deglaciation.

The sample (27.8 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (22.2 g) yielded 4.8 L of CO_2 gas. The age estimate is based on one count for 4200 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 3.906 ± 0.042, 1.138 ± 0.025, and 17.890 ± 0.105 cpm, respectively.

Comment (J.J. Clague): Sample GSC-6496 is a minimum age for deglaciation of the central Strait of Georgia. At the time, sea level was at least 65 m higher, relative to the land, than at present. This is one of a suite of radiocarbon dates from the lowlands bordering the Strait of Georgia that constrain the age of deglaciation and glacio-isostatic rebound in the region (Clague, 1981).

Comox Lake series

A series of organic samples was collected by R.H. Linden in August 1991 from sediment cores taken in Comox Lake, Vancouver Island, British Columbia (49°37.2′N, 125°10.4′W; 49°36.4′N, 125°11.0′W), at an elevation of about 12 m. The water depth at the core site was about 120 m. These samples were submitted by J.J. Clague to gain information on a landslide events related to neotectonics.

TO-3328. Comox Lake I

normalized age:	1050 ± 60

Wood sample COMOX-91-2-216 consisted of a single piece enclosed in silty mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-3329. Comox Lake II

normalized age:	1170 ± 50

Coniferous cone bract sample COMOX-91-2-352 was enclosed in mud. The age was normalized to $\delta^{13}C$ = -25‰.

TO-3327. Comox Lake III

normalized age:	2960 ± 60

Wood sample COMOX-91-1-608 consisted of a single piece enclosed in mud. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (J.J. Clague): These samples date a subaqueous landslide deposit that may have been emplaced during a large earthquake.

GSC-6129. Friendly Cove

normalized age:	1040 ± 60
$\delta^{13}C$:	-23.6‰
uncorrected age:	1010 ± 60

Wood sample C1A-96-12, enclosed in pebbly sand, was collected by P.T. Bobrowsky and I. Hutchinson on June 16, 1996 from a pit dug on a marsh adjacent to a unnamed tidal lake, about 3 km west of Friendly Cove, Vancouver Island, British Columbia (49°35.8′N, 126°39.8′W), at an elevation of about 3 m. The sample was submitted by J.J. Clague to gain information on a prehistoric earthquake and tsunami.

The sample (8.3 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (5.6 g) yielded 4.8 L of CO_2 gas. The age estimate is based on one count for 3350 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 16.078 ± 0.076, 1.225 ± 0.024, and 18.240 ± 0.103 cpm, respectively.

Comment (J.J. Clague): The dated sample was collected from the base of a thick unit of pebbly sand within a peat and silt sequence. The pebbly sand is a storm or tsunami deposit. The penultimate great earthquake at the Cascadia subduction zone happened about 1000 years ago, indicating that the dated sand layer may record the tsunami of that event.

GSC-6142. Louie Bay I

normalized age:	130 ± 50
$\delta^{13}C$:	-25.3‰
uncorrected age:	140 ± 50

GSC-6142 2. Louie Bay II

normalized age:	180 ± 60
$\delta^{13}C$:	-25.3‰
uncorrected age:	190 ± 60

Wood sample CIA-96-103 (a branch of *Picea* cf. *P. sitchensis*, identified by R.J. Mott in unpublished GSC Wood Report 97-03), enclosed in sand, was collected by J.J. Clague on September 12, 1996 from a tidal marsh at Louie Bay,

Vancouver Island, British Columbia (49°44.0′N, 126°56.8′W), at an elevation of 1 m. The sample was submitted by J.J. Clague to gain information on a tsunami deposit.

The sample (12.9 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.2 g) yielded 7.1 L of CO_2 gas. The age estimate is based on one count for 3750 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.915 ± 0.095, 2.163 ± 0.032, and 28.387 ± 0.135 cpm, respectively.

Comment (J.J. Clague): The dated sand was deposited by the tsunami that accompanied the last great earthquake at the Cascadia subduction zone in AD 1700 (Clague and Bobrowsky, 1994).

Catala Island series

A series of wood and shell samples was collected by J.J. Clague, I. Hutchinson, and R.T. Patterson on June 16, 1995 and by J.J. Clague and R.W. Mathewes on September 07, 1995 from sediment cores on Catala Island, west coast of Vancouver Island, British Columbia (49°50.5′N, 127°03.3′W), at elevations of about 0 to 2 m. The samples were submitted by J.J. Clague to gain information on tsunami deposits related to prehistoric earthquakes.

Core CIA-95-106:

TO-5420. Catala Island I

normalized age: 170 ± 40
$\delta^{13}C$: -25 ‰

Twig sample CIA-95-106-3 (0.34 m depth) was enclosed in lake sediment at the upper contact of a sandy unit. The age was normalized assuming $\delta^{13}C$ = -25‰.

TO-5891. Catala Island II

normalized age: 460 ± 80

Twig sample CIA-95-106-2B (0.34 m depth) was enclosed in lake sediment at the upper contact of a sandy unit. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated age is AD 1440, with a 1σ range of AD 1410 to 1485.

TO-5890. Catala Island III

normalized age: 580 ± 80

Spruce needle sample CIA-95-106-2A (0.34 m depth; *Picea*, identified by R.W. Mathewes) was enclosed in lake sediment at the upper contact of a sandy unit. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated age is AD 1400, with a 1σ range of AD 1300 to 1430.

TO-6544. Catala Island IV

normalized age: 1250 ± 100

Conifer needle sample CIA-95-106-13 (spruce and hemlock, identified by R.W. Mathewes) was enclosed in shelly sand, underlain and overlain by organic mud. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated age is AD 780, with a 1σ range of AD 690 to 890 and a 2σ range of AD 625 to 1305.

TO-5893. Catala Island V

normalized age: 1400 ± 60

Twig sample CIA-95-106-14 (0.69 m depth) was at the top of a sandy unit in lake sediment. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated age is AD 655, with a 1σ range of AD 615 to 670.

TO-6545. Catala Island VI

normalized age: 1690 ± 60
$\delta^{13}C$: -25 ‰

Marine pelecypod shell sample CIA-95-106-15 (0.69 m depth; a single valve of *Mytilus,* identified by J.J. Clague), was enclosed in shelly sand, underlain and overlain by organic mud in lake sediment. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated age is AD 1105, with a 1σ range of AD 1040 to 1195 and a 2σ range of AD 995 to 1265. A Delta R reservoir correction of 390 ± 25 years was used in the calibration.

TO-6229. Catala Island VII

normalized age: 1350 ± 70

Leaf and needle sample CIA-96-106-17 (0.71-0.72 m depth; leaves of *Thuja* and needles of Picea, identified by R.W. Mathewes), was enclosed in lake sediment, an organic mud below a sand layer. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated age is AD 670, with a 1σ range of AD 645 to 720.

TO-5892. Catala Island VIII

normalized age: 2080 ± 60

Marine pelecypod shell sample CIA-95-106-12 (0.70 m depth; a single valve) was enclosed in a sandy unit in lake sediment. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated age is AD 705, with a 1σ range of AD 665 to 780.

Core CIA-95-110:

TO-5957. Catala Island IX

normalized age: 330 ± 60

Unidentified plant tissue sample CIA-95-110-1 (0.32–0.33 m depth) was enclosed in a sandy unit in lake sediment. The age was normalized to $\delta^{13}C = -25‰$. The calibrated ages are AD 1525, with a 1σ range of AD 1475 to 1650 and a 2σ range of AD 1440 to 1670; AD 1560, with a 1σ range of AD 1475 to 1650 and a 2σ range of AD 1440 to 1670; and AD 1630, with a 1σ range of AD 1475 to 1650 and a 2σ range of AD 1440 to 1670.

TO-5958. Catala Island X

normalized age: 330 ± 50

Twig sample CIA-95-110-3 (0.40–0.41 m depth; unidentified) was enclosed in a plant detrital layer. The age was normalized to $\delta^{13}C = -25‰$. The calibrated ages are AD 1525, with a 1σ range of AD 1480 to 1650 and a 2σ range of AD 1445 to 1665; AD 1560, with a 1σ range of AD 1480 to 1650 and a 2σ range of AD 1445 to 1665; and AD 1630, with a 1σ range of AD 1480 to 1650 and a 2σ range of AD 1445 to 1665.

TO-5959. Catala Island XI

normalized age: 420 ± 50

Wood bark sample CIA-95-110-4 (0.40–0.41 m depth; unidentified) was enclosed in sandy plant detritus in lake sediment. The age was normalized to $\delta^{13}C = -25‰$. The calibrated age is AD 1455, with a 1σ range of AD 1490 to 1435.

TO-6546. Catala Island XII

normalized age: 500 ± 70

Bark sample CIA-95-110-5 was enclosed in sandy mud. The age was normalized to $\delta^{13}C = -25‰$. The calibrated age is AD 1430, with a 1σ range of AD 1400 to 1450 and a 2σ range of AD 1380 to 1510.

TO-5318. Catala Island XIII

normalized age: 1000 ± 60

Wood or bark fragment sample CIA-95-10 was enclosed in the peat of a marsh bordering a lake. The age was normalized to $\delta^{13}C = -25‰$. The calibrated age is AD 1025, with a 1σ range of AD 995 to 1045 and a 2σ range of AD 960 to 1175.

Comment (J.J. Clague): The Catala Island radiocarbon dates were obtained on marine shell and plant detritus recovered from lake and marsh cores. The dates are closely limiting ages on a series of sand layers, interpreted to be tsunami deposits. Two of the sand layers were probably emplaced by the tsunamis of the last two great earthquakes at the Cascadia subduction zone, about 300 and 1000 years ago (Clague et al., 1999).

Little Espinosa Inlet series

A series of organic samples was collected by J.J. Clague, P.T. Bobrowsky, and D. Huntley on August 4, 1994 from pits dug on a tidal marsh at Little Espinosa Inlet, 5 km southwest of Zeballos, Vancouver Island, British Columbia (49°57.5′N, 126°54.6′W), at an elevation of about 1 m. These samples were submitted by J.J. Clague to gain information on sea level change.

TO-4701. Little Espinosa Inlet I

normalized age: 200 ± 50

Rhizome sample CIA-94-21-2 (*Triglochin*, identified by J.J. Clague) was enclosed in muddy peat. The age was normalized to $\delta^{13}C = -25‰$.

TO-4702. Little Espinosa Inlet II

normalized age: 270 ± 50

Bark sample CIA-94-21-3 was enclosed in muddy peat. The age was normalized to $\delta^{13}C = -25‰$.

TO-4700. Little Espinosa Inlet III

normalized age: 330 ± 60

Rhizome sample CIA-94-21-1 (*Triglochin,* identified by J.J. Clague) was enclosed in muddy peat. The age was normalized to $\delta^{13}C = -25‰$.

Comment (J.J. Clague): These samples date a dark peat that may have subsided slightly during a large earthquake, perhaps the last great earthquake at the Cascadia subduction zone (AD 1700).

Zeballos series

A series of wood samples was collected by P.T. Bobrowsky and J.J. Clague on August 1, 1994, by J.J. Clague, P.T. Bobrowsky and D. Huntley on August 4, 1994, and by J.J. Clague and J. Gutsell on June 22, 2000 from an intertidal marsh that has developed on an ancient floodplain, 50 m west of the village of Zeballos, Vancouver Island British Columbia (49°59.0′N, 126°51.3′W; 49°59.1′N, 126°50.5′W), at an elevation of about 1 m. These samples were submitted by J.J. Clague to gain information on fluvial activity, deltaic progradation, and marsh evolution.

TO-4988. Zeballos I

normalized age: 130 ± 40
$\delta^{13}C$: -25 ‰

Twig sample PTB-94-1002-18 was enclosed in peat and sand. The age was normalized assuming $\delta^{13}C$ = -25‰. The calibrated ages are AD 1695, with a 1σ range of AD 1680 to 1755 and a 2σ range of AD 1670 to 1785; AD 1725, with a 1σ range of AD 1680 to 1755 and a 2σ range of AD 1670 to 1785; AD 1815, with a 1σ range of AD 1805 to 1895 and a 2σ range of AD 1795-1950; AD 1920, with a 1σ range of AD 1905 to 1935 and a 2σ range of AD 1795 to 1950; and AD 1955, with a 1σ range of AD 1954 to 1955 and a 2σ range of AD 1952 to 1955.

TO-4703. Zeballos II

normalized age: 190 ± 70

Wood fragments sample CIA-94-25 was enclosed in muddy peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-4807. Zeballos III

normalized age: 210 ± 40

Twig sample PTB-94-1002-21 was enclosed in olive brown muddy peat of a coastal marsh. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated ages are AD 1670, with a 1σ range of AD 1665 to 1680 and a 2σ range of AD 1645 to 1695; AD 1785, with a 1σ range of AD 1750 to 1805 and a 2σ range of AD 1725 to 1815; AD 1795, with a 1σ range of AD 1750 to 1805 and a 2σ range of AD 1725 to 1815; AD 1950, with a 1σ range of AD 1935 to 1954 and a 2σ range of AD 1920 to 1955; and AD 1953, with a 1σ range of AD 1935 to 1954 and a 2σ range of AD 1920 to 1955.

GSC-6543. Zeballos IV

normalized age: 830 ± 50
$\delta^{13}C$: -27.0‰
uncorrected age: 860 ± 50

Wood sample CIA-00-ZMP3-B2-98 (98 cm depth; 11.8 g dry weight; *Abies*, identified by R.J. Mott in unpublished GSC Wood Report 2001-27), enclosed in medium sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 7.4 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.529 ± 0.090, 2.120 ± 0.028, and 28.420 ± 0.157 cpm, respectively.

Comment (J.J. Clague): Sample GSC-6543 dates stabilization of the Zeballos River delta top and the inception of the tidal marsh at the present delta front. Samples TO-4988, -4807, and -4703 constrain the age of an anomalous unit of silt and sand, now known to be reworked mine tailings.

GSC-6144. Ououkinsh Inlet

normalized age: 320 ± 50
$\delta^{13}C$: -26.3‰
uncorrected age: 340 ± 50

Wood sample CIA-96-16-1 (a branch of *Abies*, identified by R.J. Mott in unpublished GSC Wood Report 97-02), underlain by sand and overlain by peat, was collected by J.J. Clague on July 17, 1996 from a tidal marsh near the head of Ououkinsh Inlet, 0.7 km south of the outlet of Power Lake, Vancouver Island, British Columbia (50°10.9′N, 127°28.7′W), at an elevation of 2 m. The sample was submitted by J.J. Clague to gain information on a tsunami.

The sample (20.4 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.7 g) yielded 7.7 L of CO_2 gas. The age estimate is based on one count for 3715 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.192 ± 0.095, 2.163 ± 0.032, and 28.387 ± 0.135 cpm, respectively.

Comment (J.J. Clague): The peat sequence in the tidal marsh at the head of Ououkinsh Inlet contains two anomalous sand layers. The lower sand layer, dated by sample GSC-6144, was deposited by the tsunami of the AD 1700 earthquake. The upper sand layer, near the top of the sequence, probably records the tsunami of the 1964 Alaska earthquake.

TO-5970. Koprino Harbour

normalized age: 500 ± 50

Rhizome sample KH300 R35 (0.8 m depth; *Triglochin,* identified by J.J. Clague), enclosed in tidal marsh sediment, was collected by B.E. Benson on July 20, 1995 from a tidal channel bank at Koprino Harbour, Vancouver Island, British Columbia (50°30.4′N, 127°49.9′W), at an elevation of 0 m. This sample was submitted by J.J. Clague to gain information on the initiation of the marsh. The age was normalized to $\delta^{13}C$ = -25‰. The calibrated age is AD 1430, with a 1σ range of AD 1445 to 1405.

Comment (J.J. Clague): Sample TO-5970 indicates that the modern marsh at Koprino Harbour became established about 500 years ago.

NORTHERN CANADA

Yukon Territory

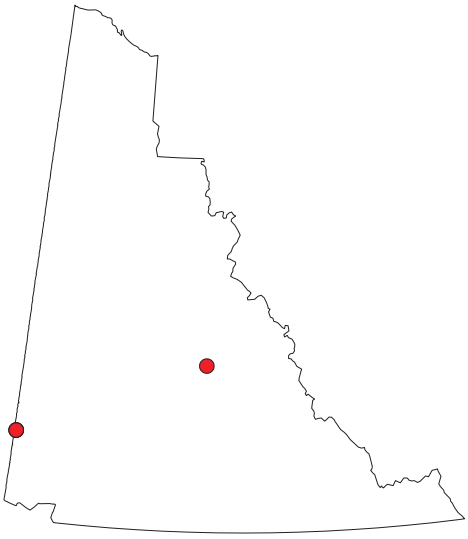


Figure 17. *Radiocarbon-dated sites in the Yukon Territory.*

GSC-6563. Yukon River

normalized age:	9050 ± 110
$\delta^{13}C$:	-27.7‰
uncorrected age:	9090 ± 110

Wood bark sample CIA-00-JJP-0055, enclosed in laminated medium to fine sand and humic-rich silt, was collected by A. Miskovic and P.A. Friele on July 11, 2000 from beneath a fluvial terrace on the right bank of the Yukon River, about 7 km upstream from the confluence with the White River, Yukon Territory (63°07.16′N, 133°30.29′W), at an elevation of 374 m. The sample was submitted by J.J. Clague to gain information on fluvial aggradation.

The sample (6.5 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (3.7 g) yielded 2.8 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.50. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.832 ± 0.065, 1.105 ± 0.023, and 18.091 ± 0.108 cpm, respectively.

Comment (J.J. Clague): The dated sediment underlies a terrace adjacent to the Yukon River, 7 km upstream of the mouth of the White River. The terrace is underlain by laminated sand and organic-rich silt, which are interpreted to be reworked loess, derived primarily from the White River floodplain during early Holocene time. The sediment records a short-lived period of aggradation of the Yukon River floodplain 2200 to 3000 years after deglaciation was complete.

White River series

A series of wood samples was collected by V.N. Rampton on June 6, 1966 from the upstream edge of an island in the channel of Little Boundary Creek, 17.5 km from its confluence with the White River, Saint Elias Mountains, Yukon Territory (61°38′N, 140°55′W), at an elevation of about 1250 m. These samples were submitted by J.J. Clague to gain information on volcanic activity, specifically the White River tephra, and to provide a crosscheck on previous dates.

GSC-748. White River I

normalized age:	1210 ± 130
$\delta^{13}C$:	-21.9‰
uncorrected age:	1160 ± 130

Wood sample 37 ROS-A (8.5 g dry weight), the outer portion of in situ tree buried by 0.6 m of White River tephra (east lobe), was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The age estimate is based on two 1-day counts in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.051 ± 0.109, 2.135 ± 0.030, and 28.951 ± 0.123 cpm, respectively.

GSC-5619. White River II

normalized age:	1260 ± 50
$\delta^{13}C$:	-21.9‰
uncorrected age:	1210 ± 50

Wood sample CIA-93-3 (9.0 g dry weight; rings 23 to 37 from the outermost of an in situ tree of *Picea*, identified by H. Jetté in unpublished GSC Wood Report 93-32), enclosed in lapilli tephra, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.1 g) yielded 7.85 L of CO_2 gas. The age estimate is based on one count for 2190 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 24.178 ± 0.113, 2.193 ± 0.027, and 28.110 ± 0.129 cpm, respectively.

Laboratory comment: Chiselled and cut out the outer set of rings (23–37), as requested by Dr. J.J. Clague. Cut off all patina; cut off about 2 cm of epoxy from the base; cut out any epoxy along 'checks' and inspected slivers under the microscope.

GSC-5617. White River III

normalized age:	1430 ± 70
$\delta^{13}C$:	-23.6‰
uncorrected age:	1410 ± 70

Wood sample CIA-93-2 (6.3 g dry weight; inner core [rings 166 to 193] of an in situ tree of *Picea*, identified by H. Jetté in published GSC Wood Report 93-32), enclosed in lapilli tephra, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (5.0 g) yielded 4.65 L of CO_2 gas. The age estimate is based on one count for

2490 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 15.344 ± 0.085, 1.223 ± 0.023, and 18.286 ± 0.110 cpm, respectively.

Laboratory comment: Chiselled and punched out the central core of the slab. Cut off all patina; cut off about 1 cm of epoxy (base) and then cut out epoxy in the 'checks'. All slivers were checked for contamination under microscope and any epoxy was excluded from the sample processed.

Comment (J.J. Clague): The tree from which the samples were collected was killed by the White River tephra fall. The original age on outer rings from this sample (GSC-748) has a large error term; the stump was redated to provide an age with a smaller error term and a more precise calendar calibration (Clague et al., 1995). Several radiocarbon ages pertaining to the White River tephra are summarized in Hughes et al. (1972).

Arctic Mainland

Figure 18. *Radiocarbon-dated sites on the Arctic mainland, Nunavut and Northwest Territories.*

Nunavut, 'Keewatin region'

Coats Island

GSC-5500. Coats Island I

normalized age:	2160 ± 120
$\delta^{13}C$:	-21.0‰
uncorrected age:	2100 ± 120

Moss peat sample 92/1, enclosed in peat, was collected by A.J. Gaston on August 22, 1992 from Coats Island, 5 km west of Cape Pembroke, Keewatin region, Nunavut (63°00′N, 82°00′W), at an elevation of 100 m. The sample was submitted by A.J. Gaston to gain information on peat development in response to an avian community.

The sample (15.0 g wet weight) was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.0 g) yielded 1.72 L of CO_2 gas. The age estimate is based on two counts for 2015 minutes in the 2 L counter with a mixing ratio of 2.55. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.110 ± 0.197, 1.200 ± 0.024, and 18.324 ± 0.104 cpm, respectively.

Refer to Gaston and Donaldson (1995) for comments.

GSC-5687. Coats Island II

normalized age:	2070 ± 60
$\delta^{13}C$:	-22.4‰
uncorrected age:	2030 ± 60

Moss peat sample 1993/1 (*Dicranum groenlandicum*, identified by R.T. Ireland) was collected by A.J. Gaston on August 20, 1993 from Coats Island, northern Hudson Bay, Keewatin region, Nunavut (62°50′N, 82°00′W), at an elevation of 100 m. The sample was submitted by A.J. Gaston to gain information on peat development in response to an avian community.

The sample (29.2 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.4 g) yielded 7.74 L of CO_2 gas. The age estimate is based on two counts for 2160 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.986 ± 0.111, 2.235 ± 0.033, and 28.299 ± 0.131 cpm, respectively.

Refer to Gaston and Donaldson (1995) for comments.

Nunavut, 'Kitikmeot region'

GSC-6399. Coppermine River

normalized age:	8670 ± 110
corrected age:	8270 ± 110
$\delta^{13}C$:	-1.0‰
uncorrected age:	8290 ± 110

Marine shell sample 99-DU-S-1 (*Macoma brota*, identified by J-M. Gagnon), from a river bank exposure of silty marine clay underlying littoral marine sand, was collected by L.A. Dredge on July 18, 1999 from a small gully entering the west bank of the Coppermine River, 8.0 km upstream from the river mouth, Kitikmeot region, Nunavut (67°46′31″N, 115°13′23″W), at an elevation of 20 m. The sample was submitted by L.A. Dredge to gain information on sea level change.

The sample (42.2 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (33.8 g) yielded 7.3 L of CO_2 gas. The age estimate is based on one count for 2400 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net), and for monthly backgrounds and standards (net) were 10.093 ± 0.105, 2.140 ± 0.076, and 28.328 ± 0.196 cpm, respectively.

Comments (L.A. Dredge): These shells, together with those of *Clinocardium cilatum*, are most abundant near the top of the silt unit that underlies the terrace sand, but are found in lower concentrations throughout the silt. Although the enclosing sediments may relate to the base level of the terrace sand at 30 m above present, they more likely are deep water deposits associated with a major delta at 80 m that lies 5 km upriver. The shells are the first reported occurrence of *Macoma brota* in the western Arctic. The species is presently found along the west coast of Canada.

Northwest Territories, District of Mackenzie

Fort Simpson series

A series of peat samples was collected by M. Burgess in March 1985 from the Mackenzie Highway, Fort Simpson area, District of Mackenzie, Northwest Territories (61°21.31′N, 120°52.04′W), at an elevation of 244 m. These samples were submitted by H. Jetté to gain information on the rate of peat development.

GSC-5564. Fort Simpson I

normalized age:	180 ± 80
$\delta^{13}C$:	-24.2‰
uncorrected age:	170 ± 80

Compressed peat sample 'PL-91-86 25 cm' (46.0 g wet weight), enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (3.0 g) yielded 2.8 L of CO_2 gas. The age estimate is based on two counts for 1940 minutes in the 2 L counter with a mixing ratio of 1.63. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.753 ± 0.141, 1.216 ± 0.035, and 18.123 ± 0.108 cpm, respectively.

GSC-5555. Fort Simpson II

normalized age:	3650 ± 100
$\delta^{13}C$:	-26.1‰
uncorrected age:	3670 ± 100

Compressed peat sample 'PL-91-86 100 cm' (78.0 g wet weight), enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8 g) yielded 8.5 L of CO_2 gas. The age estimate is based on two counts for 1900 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.829 ± 0.214, 2.168 ± 0.035, and 28.159 ± 0.131 cpm, respectively.

GSC-5553. Fort Simpson III

normalized age:	4490 ± 90
$\delta^{13}C$:	-26.6‰
uncorrected age:	4520 ± 90

Compressed peat sample 'PL-91-86 150 cm' (82.1 g wet weight), enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.7 g) yielded 4.0 L of CO_2 gas. The age estimate is based on one count for 2110 minutes in the 2 L counter with a mixing ratio of 1.09. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.326 ± 0.087, 1.216 ± 0.035, and 18.123 ± 0.108 cpm, respectively.

GSC-5624. Fort Simpson IV

normalized age:	4510 ± 70
$\delta^{13}C$:	-27.1‰
uncorrected age:	4540 ± 70

Compressed peat sample 'PL-91-86 160 cm' (83.3 g wet weight), enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.6 g) yielded 9.25 L of CO_2 gas. The age estimate is based on two counts for 2545 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 15.986 ± 0.100, 2.165 ± 0.052, and 28.136 ± 0.136 cpm, respectively.

GSC-5154. Fort Simpson area

$\delta^{13}C$:	lost
uncorrected age:	270 ± 60

Sandy peat sample FS-1, enclosed in dune sand, was collected by C. Bégin and Y. Michaud on July 31, 1990 from 10 km west of Fort Simpson, District of Mackenzie, Northwest Territories (61°53′N, 121°30′W), at an elevation of 159 m. The sample was submitted by C. Bégin to gain information on dune activity.

The sample (28.8 g dry weight) was treated with cold base, hot acid (slightly calcareous), and distilled water rinses. The treated sample (9.6 g) yielded 3.80 L of CO_2 gas. The age estimate is based on two counts for 5370 minutes in the 2 L counter with a mixing ratio of 1.18. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.870 ± 0.079, 1.099 ± 0.023, and 18.484 ± 0.104 cpm, respectively.

See Michaud and Begin (2000) for additional information.

Mountain River series

A series of wood and peat samples was collected by C. Bégin and Y. Michaud on August 17, 23, and 26, 1991 near Mountain River, 80 km west of Norman Wells, District of Mackenzie, Northwest Territories (65°14′N, 128°33′W), at an elevation of 400 m. These samples were submitted by C. Bégin to gain information on dune stabilization and paleosol development.

GSC-5332. Mountain River I

normalized age:	910 ± 60
$\delta^{13}C$:	-24.7‰
uncorrected age:	900 ± 60

Wood sample E-12-8 (18.0 g dry weight; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 91-88), was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.7 g) yielded 8.17 L of CO_2 gas. The age estimate is based on two counts for 2090 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.354 ± 0.120, 2.231 ± 0.034, and 28.364 ± 0.176 cpm, respectively.

GSC-5365. Mountain River II

normalized age:	890 ± 50
$\delta^{13}C$:	-26.6‰
uncorrected age:	910 ± 50

Wood sample D-12-4 (11.0 g dry weight; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 92-22), was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 8.22 L of CO_2 gas. The age estimate is based on two counts for 2080 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.106 ± 0.119, 2.215 ± 0.033, and 28.129 ± 0.131 cpm, respectively.

GSC-5348. Mountain River III

normalized age:	1850 ± 100
$\delta^{13}C$:	-24.6‰
uncorrected age:	1840 ± 100

Peat sample H-12-10-A (95.2 g wet weight; organic fragments), enclosed in sand, was treated with cold base, hot acid (very calcareous), and distilled water rinses. The treated sample (67.3 g) yielded 1.92 L of CO_2 gas. The age estimate is based on two counts for 1845 minutes in the 2 L counter with a mixing ratio of 2.30. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.412 ± 0.160, 1.238 ± 0.028, and 18.133 ± 0.104 cpm, respectively.

GSC-5358. Mountain River IV

normalized age:	2060 ± 70
$\delta^{13}C$:	-25.7‰
uncorrected age:	2080 ± 70

Peat sample E-13-15-A (61.9 g dry weight; forest litter), enclosed in sand, was treated with cold base, hot acid (slightly calcareous), and distilled water rinses. The treated sample (43.7 g) yielded 4.35 L of CO_2 gas. The age estimate is based on one count for 2310 minutes in the 2 L counter with a mixing ratio of 1.02. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 14.004 ± 0.087, 1.238 ± 0.028, and 18.133 ± 0.104 cpm, respectively.

GSC-5446. Mountain River V

normalized age:	310 ± 80
$\delta^{13}C$:	-26.7‰
uncorrected age:	340 ± 80

Peat sample L-10-1A (32.20 g dry weight), enclosed in forest paleosol in sand about 20 m above fluvioglacial deposits, was treated with cold base, hot acid (moderately calcareous), and distilled water rinses. The treated sample (20.6 g) yielded 5.77 L of CO_2 gas. The age estimate is based on one count for 2126 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.603 ± 0.097, 1.214 ± 0.025, and 18.357 ± 0.145 cpm, respectively.

GSC-5443. Mountain River VI

normalized age:	3200 ± 110
$\delta^{13}C$:	-24.2‰
uncorrected age:	3190 ± 110

Peat sample H-10-5 (191.40 g dry weight), enclosed in forest paleosol in sand about 18 m above glaciofluvial deposits, was treated with cold base, hot acid (very calcareous), and distilled water rinses. The treated sample (75.3 g) yielded 2.13 L of CO_2 gas. The age estimate is based on one count for 1790 minutes in the 2 L counter with a mixing ratio of 2.04. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.337 ± 0.139, 1.214 ± 0.025, and 18.357 ± 0.145 cpm, respectively.

See Michaud and Begin (2000) for additional information.

GSC-5256. Inuvik I

normalized age:	7970 ± 90
$\delta^{13}C$:	-24.4‰
uncorrected age:	7960 ± 90

Wood sample EL-1 (2.5 m depth; *Picea*, identified by H. Jetté in unpublished GSC Wood Report 91-40), enclosed in peat, was collected by C. Bégin and Y. Michaud on August 9, 1990 from 55 km north of Inuvik, District of Mackenzie, Northwest Territories (68°50′N, 133°26′W), at an elevation of 50 m. The sample was submitted by C. Bégin.

The sample (20.1 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (9.1 g) yielded 8.56 L of CO_2 gas. The age

estimate is based on two counts for 1995 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.461 ± 0.086, 2.186 ± 0.033, and 28.173 ± 0.146 cpm, respectively.

GSC-5136. Inuvik II

normalized age:	3430 ± 100
$\delta^{13}C$:	-27.6‰
uncorrected age:	3440 ± 100

Peat with twigs sample EL-3, enclosed in peat, was collected by C. Bégin and Y. Michaud on August 9, 1990 from 55 km north of Inuvik, District of Mackenzie, Northwest Territories (68°50′N, 133°26′W), at an elevation of 50 m. The sample was submitted by C. Bégin.

The sample (57.1 g dry weight) was treated with cold base, hot acid, and distilled water rinses. The treated sample (11.9 g) yielded 8.36 L of CO_2 gas. The age estimate is based on two counts for 3200 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 12.084 ± 0.122, 1.094 ± 0.019, and 18.531 ± 0.106 cpm, respectively.

See Michaud and Begin (2000) for additional information.

GSC-6305. Cliff Point

normalized age:	100 ± 60
$\delta^{13}C$:	-29.1‰
uncorrected age:	160 ± 60

Wood sample 98-56 (*Salix*, identified by C. Keith), enclosed in a thin, grey, pebbly sand unit truncating brown Kittigazuit Formation sand foresets, was collected by J.B. Murton on July 19, 1998 about 2 km southwest of Cliff Point, south side of Liverpool Bay, Tuktoyaktuk coastlands, District of Mackenzie, Northwest Territories (69°48′N, 129°34′W), at an elevation of about 3 m. The sample was submitted by J.B. Murton to gain information on geomorphic processes related to alluvial and eolian activity.

The sample (9.9 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.0 g) yielded 6.8 L of CO_2 gas. The age estimate is based on one count for 920 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 27.844 ± 0.184, 2.201 ± 0.033, and 28.419 ± 0.132 cpm, respectively.

Comment (J.B. Murton): The age estimate of 100 ± 60 years BP obtained from the willow fragment in the grey pebbly sand is unexpectedly young. This estimate cannot reflect the depositional age of the host grey pebbly sand layer, which occurs intraformationally in the Kittigazuit Formation of preglacial, probably Wisconsinan, age. Since no evidence was observed for the willow having grown horizontally inward into the pebbly sand layer from the gully side, two possible explanations for the essentially modern age estimate are that the sample has been contaminated with modern carbon or that the sample number was confused after submission to the radiocarbon laboratory. Sample confusion in the field is impossible because only one sample of organic material was collected, the sample submitted.

Four samples of brown (Kittigazuit) sand, two above and two below the grey pebbly sand layer, have been submitted for luminescence dating. An additional vertical sequence of seven Kittigazuit sand samples from an adjacent section have also been submitted for dating.

A brief description and interpretation of the stratigraphy, sedimentology, and existing geochronology is given below:

Stratigraphy:

The main stratigraphic unit at the sample site is brown sand of the Pleistocene Kittigazuit Formation (Rampton, 1988). At least 6 m of brown sand is exposed here, to an elevation of about 7 m a.s.l., several metres below the highest part of the Kittigazuit Formation observed in adjacent bluffs. Within the brown sand at the sample site is a discontinuous grey pebbly sand layer (up to 0.33 m thick) about 3 m a.s.l. This layer is intraformational: its base truncates foresets in the underlying brown sand; its top is overlain by similar foresets; and stratigraphic relationships between foresets and a stratigraphically higher, offset top to the layer indicate alternating deposition of brown and grey sand (discussed below). Two additional grey sandy to silty units occur stratigraphically above the grey pebbly sand layer and within the brown sand. The lower of these units (small depression fill) is 9–14 cm above the top of the grey pebbly sand layer, and the higher unit is about 4 m above the top. The sample of willow submitted for ^{14}C dating is within the grey pebbly sand layer. The sample was not observed to extend into the over- or underlying brown sand, nor laterally outwards toward the slope surface, a gully side. Fine rootlets attached to the wood sample suggest that sample reworking is unlikely and that the wood may have grown more or less contemporaneously with deposition of the grey pebbly sand. For this reason it was submitted for ^{14}C dating.

Sedimentology:

The brown sand near Cliff Point is typical of that in the Kittigazuit Formation along the southern shore of Liverpool Bay and in the northeast Richards Island area. It comprises cross-stratified fine sand and silty sand. The dominant crossbeds are large (at least 8 m thick), with measured foresets steeply dipping to the

northeast, east, or southeast. A few small crossbeds (up to 0.21 m thick) were observed with foresets steeply dipping to the northeast. One major angular unconformity, traced laterally for a few hundred metres, truncated large foresets and was overlain by a thin layer of clayey silty sand (a few millimetres to 2 cm thick). This unconformity records a significant phase of erosion of a large, steeply dipping bedform (?dune), followed by low-energy deposition of fine sediment. Strata inversely grading from silty sand upward into fine sand are common within the brown sand, and are interpreted as wind ripples developed on dune slipfaces.

At the sample site, large foresets in the brown sand below the grey pebbly sand layer dip steeply (av. 28°) to the east-northeast, and very similar foresets above the grey pebbly sand dip steeply (av. 24°) to the east. However, the toes of some large foresets directly above the pebbly sand are locally deformed, comprising small, low-angle reverse faults, and wavy, irregular strata suggestive of minor slumping. This deformation is syndepositional: it does not extend up above the toes of the foresets nor within the underlying grey pebbly sand. Inversely graded foresets (wind ripples) are common in the brown sand.

The grey pebbly sand layer is texturally variable, including fine sand, granule-pebble sand, sandy silty clay, and cobbles #13 cm. Clasts are generally rounded to subangular and include granule to small-pebble-size rounded fragments of dark grey silty clay (rip-up clasts). Disc-shaped clasts tend to be flat lying, and quartzose pebbles are common. Parts of the layer are massive (e.g. granule-pebble sand), others crudely to well stratified. Stratification types include a) lenticular and b) wavy, horizontal. Some lenses of granule sand within medium-fine sand contain small, crudely defined foresets. Concave-upward scour surfaces, several to a few tens of centimetres wide and one to a few centimetres high, are common. In places, there is an overall fining-upward sequence, with granule-pebble sand concentrated in the lower few to several centimetres. The lower contact is sharp and irregular (#9 cm relief), truncating underlying foresets; excavation of 110 cm of sediment into the bluff indicated that this contact is more or less horizontal. The upper contact is sharp and irregular to curved. The grey pebbly sand layer is discontinuous, being traced 12.3 m laterally through the Kittigazuit Formation sand before feathering out into an angular unconformity within brown sand.

The stratigraphically higher, offset top to the pebbly sand layer contains lenses of granule sand within wavy horizontal laminae, 1–10 mm thick, of fine sand. The offset feathers out above the toe of a large foreset in the brown sand and is overlain by stratigraphically younger, large foresets. Clearly, eastward progradation of the large bedform (dune) that deposited the brown sand was temporarily interrupted by deposition of grey pebbly sand. The main, lower part of the pebbly sand layer represents a similar, previous interruption.

The grey pebbly sand layer is tentatively attributed to alluvial and/or colluvial deposition following erosion of Kittigazuit sand. Erosion is indicated by truncated foresets along the lower contact of the pebbly sand layer. Deposition by flowing water is tentatively inferred from 1) the granule sand lenses containing small foresets, 2) scour structures, and 3) rounded clasts of silty clay interpreted as abraded rip-ups. The absence of pebbles and cobbles in the under- and overlying brown sand indicates that the clasts in the pebbly sand layer were transported to the site, probably by colluvial and/or alluvial processes. No clear channel structures were observed, although it is possible that the discontinuous pebbly sand layer itself is a shallow channel fill, in places overlain by a pebbly to cobbly lag.

Additional evidence for subaqueous deposition is provided by the deposits of the small depression fill 9 to 14 cm above the top of the grey pebbly sand layer and stratigraphically older than the offset top to the pebbly sand layer. These deposits comprise laminated sand and clayey silt, the laminae concave-upward and some interdigitating with foresets in a small crossbed. The foresets consist of fine sand with subsidiary silty fine sand and clayey silt, and are thought to have been deposited by a ripple about 5 cm high migrating into a small pond. The clayey silt foresets and concave-upward laminae are probably muddy drapes formed by suspension settling.

In summary, the sediments examined are attributed to deposition mainly by large, prograding eolian dunes. Dune progradation was interrupted on at least four occasions by alluvial and possibly colluvial processes, including suspension settling in a small pond. Two of these interruptions were preceded by significant erosion of the dunes. The grey pebbly sand has some similarities (colour, texture, pebbles, stratification) with grey sand of the Kidluit Formation that underlies the Kittigazuit Formation and is attributed to fluvial deposition (Rampton, 1988). This raises the possibility that the grey pebbly sand records intermittent, and very local, small-scale return of alluvial depositional conditions in the lower exposed part of the Kittigazuit Formation near Cliff Point.

Existing geochronology:

Two finite AMS ^{14}C age estimates have been obtained from *Corispermum* seeds and moss fragments within the Kittigazuit Formation sand beside Mason Bay, northeastern Richards Island (Dallimore et al., 1997). These estimates, 33 710 ± 460 years BP (CAMS-14837) and 37 400 ± 810 years BP (CAMS-14839), are thought to indicate a mid-Wisconsinan age for the deposition of the Kittigazuit Formation (Dallimore et al., 1997).

McKinley Bay series

A series of peat samples was collected by C. Bégin on July 10 and 14, 1992 from the eastern shore of McKinley Bay, 90 km northeast of Tuktoyaktuk, District of Mackenzie, Northwest Territories (69°56′N, 131°05′W at an elevation of 3 to 4 m; 69°56′30″N, 131°05′W at an elevation of 2 to 3 m). These samples were submitted by C. Bégin to gain information on eolian activity and the initiation of the dune field.

GSC-5585. McKinley Bay I

normalized age:	3940 ± 60
$\delta^{13}C$:	-28.0‰
uncorrected age:	3990 ± 60

Peat sample MK-2-92-8 (31.6 g dry weight), enclosed in sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (13.1 g) yielded 12.0 L of CO_2 gas. The age estimate is based on two counts for 2115 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.103 ± 0.100, 2.197 ± 0.031, and 28.117 ± 0.130 cpm, respectively.

GSC-5578. McKinley Bay II

normalized age:	4820 ± 90
$\delta^{13}C$:	-26.5‰
uncorrected age:	4850 ± 90

Peat sample MK-1-92-3 (44.4 g dry weight), enclosed in sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.3 g) yielded 3.3 L of CO_2 gas. The age estimate is based on one count for 3480 minutes in the 2 L counter with a mixing ratio of 1.32. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.926 ± 0.074, 1.227 ± 0.024, and 18.146 ± 0.137 cpm, respectively.

GSC-5573. McKinley Bay III

normalized age:	70 ± 80
$\delta^{13}C$:	-26.9‰
uncorrected age:	100 ± 80

Peat sample MK-3-92-16 (26.7 g dry weight), enclosed in sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (10 g) yielded 6.5 L of CO_2 gas. The age estimate is based on one count for 920 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 18.134 ± 0.146, 1.179 ± 0.020, and 18.355 ± 0.109 cpm, respectively.

GSC-5563. McKinley Bay IV

normalized age:	380 ± 70
$\delta^{13}C$:	-27.0‰
uncorrected age:	410 ± 70

Peat sample MK-3-92-14 (28.9 g dry weight), enclosed in sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (10 g) yielded 5.5 L of CO_2 gas. The age estimate is based on two counts for 1900 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.435 ± 0.101, 1.179 ± 0.020, and 18.355 ± 0.109 cpm, respectively.

GSC-5551. McKinley Bay V

normalized age:	690 ± 60
$\delta^{13}C$:	-27.1‰
uncorrected age:	720 ± 60

Peat sample MK-3-92-12 (31.0 g dry weight), enclosed in sand, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (16.0 g) yielded 6.4 L of CO_2 gas. The age estimate is based on two counts for 1915 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 25.765 ± 0.133, 2.208 ± 0.053, and 28.186 ± 0.139 cpm, respectively.

GSC-5545. McKinley Bay VI

normalized age:	1450 ± 70
$\delta^{13}C$:	-27.9‰
uncorrected age:	1490 ± 70

Peat sample MK-3-92-9 (29.10 g dry weight), enclosed in sand, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (11.8 g) yielded 7.8 L of CO_2 gas. The age estimate is based on two counts for 2125 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 23.503 ± 0.121, 2.176 ± 0.051, and 28.307 ± 0.186 cpm, respectively.

GSC-5537. McKinley Bay VII

normalized age:	2240 ± 80
$\delta^{13}C$:	-28.8‰
uncorrected age:	2300 ± 80

Peat sample MK-3-92-6 (23.90 g dry weight), enclosed in sand, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.9 g) yielded 5.5 L of CO_2 gas. The age estimate is based on two counts for 2200 minutes in the 2 L counter with a mixing ratio of 1.00.

The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.748 ± 0.086, 1.214 ± 0.024, and 18.297 ± 0.145 cpm, respectively.

GSC-5525. McKinley Bay VIII

normalized age:	2310 ± 70
$\delta^{13}C$:	-28.9‰
uncorrected age:	2380 ± 70

Peat sample MK-3-92-5 (29.2 g dry weight), enclosed in sand, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (8.5 g) yielded 7.72 L of CO_2 gas. The age estimate is based on two counts for 2290 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 21.111 ± 0.106, 2.148 ± 0.033, and 28.377 ± 0.182 cpm, respectively.

See Michaud and Begin (2000) for additional information.

Arctic Archipelago

Figure 19. *Radiocarbon-dated sites in the Arctic Archipelago, Queen Elizabeth Islands, Nunavut and Northwest Territories.*

Nunavut, 'Baffin region'

Devon Island

GSC-5569. 'Jason's Creek'

normalized age:	430 ± 90
$\delta^{13}C$:	-24.5‰
uncorrected age:	420 ± 90

Plant detritus and wood fragment sample 9208008a (*Picea,* identified by H. Jetté in unpublished GSC Wood Report 93-27), enclosed in plant detritus, was collected by R.B. Taylor and P. White on August 24, 1992 from an eroded bank of 'Jason's Creek', just north of Cape Liddon on the west shore of Radstock Bay, southwestern Devon Island, Baffin region, Nunavut (74°39′N, 91°07.80′W), at an elevation of 3.0 m above high tide. The sample was submitted by R.B. Taylor to determine the age of the most recent raised beach ridge and the subsequent rate of beach progradation.

The sample (2.2 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.0 g) yielded 2.0 L of CO_2 gas. The age estimate is based on two counts for 1915 minutes in the 2 L counter with a mixing ratio of 2.18. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.195 ± 0.169, 1.216 ± 0.035, and 18.123 ± 0.108 cpm, respectively.

Comment (R.B. Taylor): The plant and wood fragments were mixed together in a thin layer 0.5 m below the ground surface of a beach swale that existed landward of the most recent raised beach ridge (surface pebbles discoloured and weathered; Taylor, 1987). Another major beach ridge exists farther seaward at 3 m elevation (all elevations are relative to high tide level), but is reworked by waves during infrequent high-water storm events.

The sample was collected 30 m landward of present high tide at 3 m elevation (Wallace and Tiernan precise surveying barometric altimeter). The sample lay beneath continuous beds of pebble, which were interpreted as wave overwash or stream-flood deposits that accumulated during or after the most recent raised beach ridge was built. The rate of beach progradation since the sample was laid down is estimated at 6 to 7 m/century. Farther alongshore to the north, however, the same raised beach ridge is slightly higher and farther landward, suggesting a higher rate of beach progradation. This is a drift-aligned shore, where waves strike at an oblique angle to the shoreline and beach ridges are fewer than along swash-aligned shores, where wave direction is more onshore than offshore. Sediment availability for beach development is low along the central Arctic islands shores. Therefore, it takes substantial periods of time for the larger primary beach ridges to develop. Taylor (1987) reported that elapsed time between the formation of primary ridges across more swash-aligned raised beach sequences on Devon and Lowther islands varied from 225 to 300 years during the past 4200 years.

Dyke et al. (1991) provided an emergence curve for the Radstock Bay area. The lowest wood sample, at 4.7 m elevation, was GSC-1456, dated at 2030 ± 130 BP. The present sample suggests a slightly higher shoreline emergence rate of 0.7 m/century.

It should be noted that Inuit stone circles existed on the present ground surface within the same beach swale where the wood sample was collected. The circles also existed on the adjacent raised beach ridges on both sides of the stream. Other samples of charcoal residue and bird bones were collected from apparent subsurface fire pits beneath the same beach swale, and artifacts of Inuit tools were discovered at the base of the eroded stream bank. The Inuit camp was probably established because of the source of water at the stream and

the huge bird nesting colonies on the shore cliffs of Cape Liddon, just south of the camp. The artifacts were submitted to Dr. C. Arnold of the Prince of Wales Northern Heritage Centre, Yellowknife, Northwest Territories for identification and possible dating. It is assumed the dated wood sample predates the Inuit structures because dwellings would have been established above the limit of wave attack, presumably after the raised beach ridge was built. Nevertheless, it would be very useful to obtain dates on the artifacts to confirm their age and the timing of Inuit occupancy.

GSC-5556. Cape Ricketts I

age:	>34 000
$\delta^{13}C$:	+1.15‰

Marine shell sample 9208010 (*Mya truncata*, identified by F. Cole), enclosed in damp compressed brown silty fine sand, was collected by R.B. Taylor and P. White on August 25, 1992 from Cape Ricketts, projecting into Barrow Strait, southwestern Devon Island, Baffin region, Nunavut (74°37.68′N, 91°16.50′W), at an elevation of 6.5 m. The sample was submitted by R.B. Taylor to determine the age and rate of progradation of the coastal foreland.

The sample (44.3 g dry weight) was treated with an acid leach to remove the outer 30%. The treated sample (30.0 g) yielded 7.2 L of CO_2 gas. The age estimate is based on one count for 3645 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 0.130 ± 0.059, 2.208 ± 0.053, and 28.186 ± 0.139 cpm, respectively.

GSC-5548. Cape Ricketts II

normalized age:	9000 ± 90
corrected age:	8600 ± 90
$\delta^{13}C$:	+1.62‰
uncorrected age:	8570 ± 90

Marine shell sample 9208009 (*Hiatella arctica*, identified by F. Cole), enclosed in a silty sand bed, was collected by R.B. Taylor and P. White on August 25, 1992 from Cape Ricketts, projecting into Barrow Strait, southwestern Devon Island, Baffin region, Nunavut (74°37.65′N, 91°16.65′W), at an elevation of 14.5 m. The sample was submitted by R.B. Taylor to determine the age and rate of progradation of the coastal foreland.

The sample (47.30 g dry weight) was treated with an acid leach to remove the outer 30%. The treated sample (33.3 g) yielded 7.6 L of CO_2 gas. The age estimate is based on one count for 3880 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.738 ± 0.075, 2.176 ± 0.051, and 28.307 ± 0.186 cpm, respectively.

Comment (R.B. Taylor): Cape Ricketts is a large coastal foreland that extends over 500 m seaward of the plateau separating Radstock Bay and Gascoyne Inlet, Devon Island. The foreland is covered by a series of well defined raised beach ridges that reach 35 to 40 m elevation (all elevations above high tide level). Higher marine terraces exist but are devoid of beach ridges. A number of similar forelands was observed along the north coast of Barrow Strait, including Cape Dungeness on Cornwallis Island. Sediment abundance for beach development is generally scarce in this part of the central Arctic islands, and these forelands are much thicker than most Holocene beach deposits. A series of subparallel, moderately dipping sand and gravel beds was observed along the southeast erosional face of these forelands. The shell bed at sample location GSC-5548 dips at an estimated 5 to 6°. The surface slope of the beach ridges is only 2°. The beach ridges were merely the product of waves reworking the underlying material. Shell samples (GSC-5548 and -5556) were collected from the middle (14.5 m) and lower (6.5 m) sandy silt beds at Cape Ricketts to determine the rate of progradation and age of the subsurface deposits. No shells were observed at Cape Dungeness, but only the upper part of the cape was exposed above a semipermanent snow patch.

Sample GSC-5556 was from a 0.5 m thick shell bed (*Mya truncata)* overlying a 5.5 cm thick oxidized layer, and sample GSC-5548 was from a 1.5 to 1.7 m thick shell horizon (*Hiatella arctica*). The age of >34 000 for GSC-5556 is one of only three samples reported by Dyke (1999) that predate the last glacial maximum on Devon Island. Dyke also suggested that the shell bed, based on the occurrence of the oxidized layer, may record a marine transgression following a nonglacial interval. The age of 8600 ± 90 BP for GSC-5548 suggests that the bulk of the foreland developed during the Holocene, but there is no apparent large source of sediment farther alongshore or offshore, except possibly erosion of the older deposit indicated by GSC-5556. Using the sea level curve published by Dyke et al. (1991), the shells from sample GSC-5548 would have been deposited when sea level was roughly 60 m higher, which corresponds closely to the eroded slope of a terrace at the base of the plateau. Once the foreland began to form, it continued its progradation by cannibalizing sediment from itself as sea level fell. The elevation of the raised beach surface above GSC-5548 was 31 m. Using the sea level curve published by Dyke et al. (1991) to date the higher raised beaches, the rate of progradation works out to be 7 to 9 m/century, which is slightly faster than the rate indicated by the beach ridges built at 'Jason's Creek' in Radstock Bay (see GSC-5569). The more rapid progradation is attributed to the more abundant sediment and greater wave exposure at Cape Ricketts. Further research is encouraged to determine the initial source(s) of sediment for building the larger coastal forelands along the north shore of Barrow Strait.

GSC-5562. Gascoyne Inlet I

normalized age:	8950 ± 90
corrected age:	8550 ± 90
$\delta^{13}C$:	+1.69‰
uncorrected age:	8530 ± 90

Marine shell sample 9208014 (*Hiatella arctica*, identified by F. Cole), enclosed in slope debris, was collected by R.B. Taylor and P. White on August 27, 1992 from the base of a narrow coastal foreland at the east side of the entrance to Gascoyne Inlet, southwestern Devon Island, Baffin region, Nunavut (74°39.46′N, 91°18.75′W), at an elevation of 2.0 m above high tide level. The sample was submitted by R.B. Taylor to gain information about the age of the narrow foreland/spit.

The sample (43.5 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (35.0 g) yielded 8.1 L of CO_2 gas. The age estimate is based on one count for 3670 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 9.750 ± 0.078, 2.208 ± 0.053, and 28.186 ± 0.139 cpm, respectively.

Comment (R.B. Taylor): The shell horizon was partially exposed in slope deposits along the base of a narrow, steep, coastal foreland. Although the shell bed was not as exposed as those at Cape Ricketts, the type of shells (*Hiatella arctica*) and enclosing sediment were similar to those of GSC-5548. The intention was to use this sample to confirm the age of the two coastal forelands. The age of the sample is slightly younger than the shells collected at Cape Ricketts, but it confirms they were both developed during the Holocene. The elevation of the raised beaches above the sample was 56 m, which fits closely with the sea level curve of Dyke et al. (1991). Despite similar ages and general agreement with the published sea level curve, more confidence is placed on the age and associated stratigraphic information collected for sample GSC-5548 than this sample because the former was much less exposed.

GSC-5940. Gascoyne Inlet II

normalized age:	9870 ± 90
corrected age:	9470 ± 90
$\delta^{13}C$:	+0.94‰
uncorrected age:	9460 ± 90

Marine shell sample 9208015 (*Hiatella arctica*, identified by F. Cole), a surface collection in silty pebble material on a small terrace, was collected by R.B. Taylor and P. White on August 27, 1992 on the west shore of Gascoyne Inlet, southwestern Devon Island, Northwest Territories (74°39.3′N, 91°17.9′W), at an elevation of 115 m. The sample was submitted by R.B. Taylor to confirm previously published dates related to the marine limit in this area.

The sample (40.2 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (31.8 g) yielded 6.68 L of CO_2 gas. The age estimate is based on one count for 6360 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.751 ± 0.046, 1.253 ± 0.031, and 18.665 ± 0.106 cpm, respectively.

Comment (R.B. Taylor): The sample represents the highest occurrence of shells at this location. Shells were scattered across the surface of the highest terrace, which was situated below a perennial snow patch, felsenmeer and rock outcrop. Well defined raised beach ridges only extended to about 95 m elevation. Altimeter readings at the shell sample site varied from 115 to 112 m above high tide level. These shells are similar in age to a previous shell sample (GSC-1502), collected at 107 m elevation and dated at 9260 ± 150 BP, thus providing further confidence in the sea level curve published by (Dyke et al., 1991).

Ellesmere Island

GSC-5482. Parrish Glacier

normalized age:	6940 ± 80
corrected age:	6540 ± 80
$\delta^{13}C$:	+3.74‰
uncorrected age:	6480 ± 80

Marine shell sample 89-BS-24 (*Mya truncata*, identified by W. Blake, Jr.), enclosed in silt and fine sand as much as 1 m below the surface, was collected by W. Blake, Jr. on May 25, 1989 from a stream-cut exposure about 2.5 km north of the front of the Parrish Glacier, innermost Copes Bay, Ellesmere Island, Nunavut (79°34.1′N, 77°04.0′W), at an elevation of 50 m. The sample was submitted by W. Blake, Jr. to confirm the age of the Holocene marine incursion.

The sample (26.8 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (21.4 g) yielded 4.73 L of CO_2 gas. The age estimate is based on one count for 3925 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 8.142 ± 0.054, 1.207 ± 0.022, and 18.234 ± 0.101 cpm, respectively.

Comment (W. Blake, Jr.): This result is virtually identical to the corrected age of 6490 ± 90 years for GSC-4876 (McNeely and Jorgensen, 1993; Blake, 1995), obtained on *Hiatella arctica* shells from the same collection. Both determinations indicate that the front of Parrish Glacier 6500 years ago was more than 2.5 km behind the position that it occupied in 1959.

GSC-5470. Stygge Glacier

normalized age:	480 ± 60
$\delta^{13}C$:	-26.9‰
uncorrected age:	510 ± 60

Wood sample 88-BS-52 (*Salix*, identified by H. Jetté in unpublished GSC Wood Report 92-79), a surface collection, was collected by W. Blake Jr. on August 5, 1988 from a nunatak about 5.5 km southwest of the front of the Stygge Glacier at the head of Jokel Fiord, Ellesmere Island, Nunavut (78°44.3′N, 78°29.0′W), at an elevation of 330 m. The sample was submitted by W. Blake, Jr. to gain information on deglaciation chronology.

The sample (5.3 g dry weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (4.6 g) yielded 4.30 L of CO_2 gas. The age estimate is based on one count for 2470 minutes in the 2 L

counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.113 ± 0.089, 1.207 ± 0.022, and 18.234 ± 0.101 cpm, respectively.

Comment (W. Blake, Jr.): The age shows that the nunatak has not been overridden by glacier ice during the last few hundred years (cf. Blake et al., 1997).

Hot Weather Creek series

A series of peat samples was collected by C. Bégin and Y. Michaud on July 23 and 25, 1990 from 5 km north of Hot Weather Creek campsite, Fosheim Peninsula, Ellesmere Island, Baffin region, Nunavut. These samples were submitted by C. Bégin to gain information on peatland development and drainage.

GSC-5280. Hot Weather Creek I

normalized age:	1910 ± 60
$\delta^{13}C$:	-27.9‰
uncorrected age:	1960 ± 60

Peat sample FP-23.07.90-01 (79°59′N, 84°08′W; 122 m elevation; 121.8 g dry weight), enclosed in sand, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (34.1 g) yielded 8.12 L of CO_2 gas. The age estimate is based on two counts for 2100 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 22.216 ± 0.130, 2.287 ± 0.039, and 28.354 ± 0.135 cpm, respectively.

GSC-5180. Hot Weather Creek II

normalized age:	7120 ± 80
$\delta^{13}C$:	-27.0‰
uncorrected age:	7150 ± 80

Basal peat sample FP-23.07.90-05 (79°59′N, 84°08′W; 122 m elevation; 2.8 cm depth; 124.4 g dry weight), enclosed in sand below and peat above, was treated with cold base, hot acid (slightly calcareous), and distilled water rinses. The treated sample (38.1 g) yielded 4.62 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.563 ± 0.052, 1.057 ± 0.020, and 18.411 ± 0.103 cpm, respectively.

GSC-5137. Hot Weather Creek III

normalized age:	2640 ± 70
$\delta^{13}C$:	-27.5‰
uncorrected age:	2650 ± 70

Basal peat sample FP-25.07.90-02 (79°56′30″N, 84°30′W; 92 m elevation; 1.5 m depth; 35 g dry weight), enclosed in sand below and peat above, was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (16.6 g) yielded L of CO_2 gas. The age estimate is based on one count for 2140 minutes in the 2 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 13.325 ± 0.084, 1.094 ± 0.019, and 18.531 ± 0.106 cpm, respectively.

Figure 20. *Radiocarbon-dated sites in the Arctic Archipelago, Nunavut.*

Nunavut, 'Kitikmeot region'

Stefansson Island

GSC-4336. Stefansson Island I

normalized age:	9960 ± 100
corrected age:	9560 ± 100
$\delta^{13}C$:	+0.73‰
uncorrected age:	9550 ± 100

Marine shell sample HCA-86-30-7-2A (whole valves and fragments of *Hiatella arctica*, identified by D.A. Hodgson), enclosed in silt, was collected by D.A. Hodgson on July 30, 1986 from 7 km from M'Clintock Channel on the east coast of Stefansson Island, 'Kitikmeot region', Nunavut (73°29.2′N, 104°42.0′W), at an elevation of 110 to 120 m. The sample was submitted by D.A. Hodgson to obtain a minimum age for the enclosing ice-thrust sediments.

The sample (28.5 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (22.8 g) yielded 4.6 L of CO_2 gas. The age estimate is based on two counts for 4180 minutes in the 2 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): These shells, together with whole and fragmented valves of *Mya truncata* and *Portlandia arctica*, were both concentrated in bands and scattered through the silt, which is at least several metres thick, and either cores or caps several 10 m high ridges that parallel the coast. The ridges are well above the local marine limit (<80 m, *see* GSC-4316 and GSC-4377, this list; >66 m, see GSC-4484, McNeely and Jorgensen, 1993) and are presumed to be marine deposits thrust up by the last readvance of ice from M'Clintock Channel ('Flow 3'; Hodgson, 1994). The margin of this onshore advance lies 1 km to the west.

This is a revision of the information (but not the age) published in McNeely and McCuaig (1991).

GSC-4377. Stefansson Island II

normalized age:	10 000 ± 110
corrected age:	9630 ± 110
$\delta^{13}C$:	+2.09‰
uncorrected age:	9600 ± 110

Marine shell sample HCA-86-1-8-4 (*Hiatella arctica*, identified by D.A. Hodgson), enclosed in reddish white silt overlying till, was collected at GSC locality O-107753 by D.A. Hodgson on August 1, 1986 from 4 km inland from the junction of M'Clintock Channel and Viscount Melville Sound, northeastern Stefansson Island, 'Kitikmeot region', Nunavut (73°36.1′N, 104°42.0′W), at an elevation of 75 m. The sample was submitted by D.A. Hodgson to ascertain the age of the final glacial readvance northwestward from M'Clintock Channel and the age of the contemporary sea level.

The sample (28.0 g dry weight) was treated with an acid leach to remove the outer 10%. The treated sample (25.2 g) yielded 5.2 L of CO_2 gas. The age estimate is based on two counts for 2300 minutes in the 2 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): These shells, together with whole and fragmented valves of *Mya truncata*, were concentrated at the base of a 5 m thick deposit of reddish white silt overlying till. The top of the silt unit is a lag gravel representing the topset bed of a delta, 75 to 80 m in elevation, deposited by outwash from the 'Flow 3' readvance (Hodgson, 1994) where it entered Viscount Melville Sound.

This is a revision of the information (but not the age) published in McNeely and McCuaig (1991).

Victoria Island

GSC-4409. Cape Geelmuyden

normalized age:	9240 ± 120
corrected age:	8840 ± 120
$\delta^{13}C$:	+1.6‰
uncorrected age:	8810 ± 120

Marine shells sample HCA-86-8-8-4 (fragments and some whole valves of *Hiatella arctica* and *Mya truncata,* identified by D.A. Hodgson), a surface collection on marine-washed silty till, was collected by D.A. Hodgson on August 8, 1986 from 16 km inland from the western shore of M'Clintock Channel and 30 km northwest of Cape Geelmuyden on the east side of Storkerson Peninsula, Victoria Island, 'Kitikmeot region', Nunavut (72°08′N, 105°27′W), at an elevation of 82 m. The sample was submitted by D.A. Hodgson to determine the age of the marine limit.

The sample (14.8 g dry weight) was treated with an acid leach to remove the outer 5%. The treated sample (14.0 g) yielded 2.8 L of CO_2 gas. The age estimate is based on two counts for 2150 minutes in the 2 L counter with a mixing ratio of 1.40.

Comment (D.A. Hodgson): The whole and fragmented valves were collected downslope from, and 2 m lower in elevation than, a 10 m wide beach composed of limestone blocks derived from underlying bedrock. Upslope from the beach, 'Flow 3' till appeared undisturbed by marine processes (Hodgson, 1994). The beach is assumed to record the marine limit, dated 8.8 ka, or less likely, the onset of a period of summer open water.

Goldsmith Channel series

A series of marine shell samples was collected by D.A. Hodgson on July 24, 1986 from 12 km inland from Goldsmith Channel, northern Storkerson Peninsula, Victoria Island, 'Kitikmeot region', Nunavut (72°57.7′N, 106°08.4′W), at an elevation of 75 m. These samples were submitted by D.A. Hodgson to define the age of the final glacial readvance northwestward from M'Clintock Channel and the age of the contemporary sea level, and to assess the interspecies variability in ages.

GSC-4316. Goldsmith Channel I

normalized age:	9740 ± 100
corrected age:	9340 ± 100
$\delta^{13}C$:	+1.20‰
uncorrected age:	9320 ± 100

Marine shell sample HCA-86-24-7-4 (40 g dry weight; paired whole valves of *Hiatella arctica*, identified by D.A. Hodgson), collected within prodeltaic silt at GSC locality O-107764, was treated with an acid leach to remove the outer 20%. The treated sample (32 g) yielded 6.5 L of CO_2 gas. The age estimate is based on two counts for 2670 minutes in the 5 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): These marine shells, which occurred together with *Portlandia arctica* and a few *Mya truncata*, were collected on the surface and within an extensive (several square kilometres) and thick (10 m) deposit, in which laminations dip northwest at 30°. The silt overlies stony silty till (*P. arctica* common at this contact), contains a few gravel strata, and is capped by a thin veneer of pea gravel

and silt at 80 m elevation. The capping deposit accords with the surface of a delta that drained the margin of 'Flow 3' ice where it entered the east end of Goldsmith Channel, between Storkerson Peninsula and Stefansson Island (Hodgson, 1994).

This is a revision of the information (but not the age) published in McNeely and McCuaig (1991).

GSC-6642. Goldsmith Channel II

normalized age:	10 100 ± 150
corrected age:	9740 ± 150
$\delta^{13}C$:	-0.48‰
uncorrected age:	9750 ± 150

Marine shell sample HCA-86-24-7-4 (9.1 g dry weight; whole valves and fragments of *Portlandia arctica,* identified by D.A. Hodgson), enclosed in prodeltaic silt, was treated with an acid leach to remove the outer 5%. The treated sample (8.3 g) yielded 1.7 L of CO_2 gas. The age estimate is based on one count for 3945 minutes in the 2 L counter with a mixing ratio of 2.41. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 5.363 ± 0.089, 1.133 ± 0.023, and 18.058 ± 0.124 cpm, respectively.

Comment (D.A. Hodgson): These marine shells occurred close to a sample of *Hiatella arctica* (GSC-4316, above). The adjacent till has a 90% carbonate content, which probably explains why the age of this sample, composed of an infauna species, is 300 years older than the sample of *Hiatella arctica*, which is an epifauna species.

Hadley Bay series

A series of samples was collected and submitted by D.A. Hodgson in July and August, 1986 from the east and west sides of Hadley Bay, northern Victoria Island, Nunavut. Most samples were submitted to gain information on the rate of Holocene sea level change in the bay; some also bear on the date of deglaciation and time of establishment of the marine limit; two marine shell samples were ice transported during the final glacial event in the bay. As noted below, five dates in the series were first published in Hodgson, (1994, Table 1); one has been published without comments in McNeely and McCuaig (1991); and three dates were unpublished.

GSC-4356. Hadley Bay I

normalized age:	10 700 ± 90
corrected age:	10 300 ± 90
$\delta^{13}C$:	-0.49‰
uncorrected age:	10 300 ± 90

Marine shells sample HCA-86-8-7-6A (whole valves of *Hiatella arctica,* identified by D.A. Hodgson), enclosed in stony silt, was collected by D.A. Hodgson on July 8, 1986 from 20 km west of southwestern Hadley Bay, Victoria Island, 'Kitikmeot region', Nunavut (72°08.4′N, 109°07.5′W), at an elevation of 190 m. The sample was submitted by D.A. Hodgson to define the maximum age of a glacial readvance that filled at least the southern and central sections of Hadley Bay.

The sample (47.8 g wet weight) was treated with an acid leach to remove the outer 20%. The treated sample (47.8 g) yielded 37.1 L of CO_2 gas. The age estimate is based on one count for 3770 minutes in the 5 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): These whole valves were among numerous concentrations of shell fragments and stony layers in a pinkish grey sandy silt, a presumed till consisting mainly of glacial ice thrust marine deposits. The extensive deposits, of unknown thickness, probably contain massive deposits of preserved glacial ice, the thawing of which is responsible for the numerous flow slides in the area. The molluscs entered Hadley Bay during the initial marine incursion following deglaciation about 11 ka BP. This material was transported northwestward during the 'Flow 2' glacial readvance (Hodgson, 1994), as was GSC-4492 (below). The subsequent early Holocene marine incursion is registered downslope by a 90 m marine limit.

Hodgson (1994) indicated that this date had not previously been published; however, it had been reported in McNeely and McCuaig (1991) without comments.

GSC-4403. Hadley Bay II

normalized age:	10 200 ± 100
corrected age:	9820 ± 100
$\delta^{13}C$:	+0.62‰
uncorrected age:	9810 ± 100

Marine shell sample HCA-86-10-8-6 (*Hiatella arctica,* identified by D.A. Hodgson), enclosed in silt, was collected by D.A. Hodgson on August 8, 1986 from the east shore of Hadley Bay on the west side of Storkerson Peninsula, Victoria Island, 'Kitikmeot region', Nunavut (72°37N, 107°53.0′W), at an elevation of 81 m. The sample was submitted by D.A. Hodgson to obtain a minimum age for deglaciation and establishment of the marine limit on the east shore of Hadley Bay.

The sample (37.3 g wet weight) was treated with an acid leach to remove the outer 20%. The treated sample (34.5 g) yielded 33.3 L of CO_2 gas. The age estimate is based on one count for 4200 minutes in the 5 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): The whole valves were collected among shell fragments on the surface of silt, which extends upslope to contact till at 90 m elevation. Nearby outwash deltas indicate a marine limit between 90 and 100 m a.s.l. This date is from the highest of three collections from the east side of Hadley Bay (*see* GSC-4445, S-2954, this report), yet is the youngest of the three barely overlapping ages. Deglaciation of this segment of the bay was at or slightly earlier than 10 ka BP (Hodgson, 1994). A series of dates from the southeast corner of the bay, which was

probably deglaciated several hundred years later than the middle section, was reported in McNeely and Jorgensen, 1992 (p. 78–79).

GSC-4445. Hadley Bay III

normalized age:	10 400 ± 110
corrected age:	10 000 ± 110
$\delta^{13}C$:	+0.57‰
uncorrected age:	10 000 ± 110

Marine shell sample HCA-86-18-7-6 (mostly whole valves of *Hiatella arctica*, identified by D.A. Hodgson), enclosed in very silty diamicton, was collected by D.A. Hodgson on July 18, 1986 from the east shore of Hadley Bay on the west side of Storkerson Peninsula, Victoria Island, 'Kitikmeot region', Nunavut (72°51′N, 108°02′W), at an elevation of 70 m. The sample was submitted by D.A. Hodgson to obtain a minimum age for deglaciation and establishment of the marine limit on the east shore of Hadley Bay.

The sample (76.4 g wet weight) was treated with an acid leach to remove the outer 30%. The treated sample (46.1 g) yielded 44.9 L of CO_2 gas. The age estimate is based on two counts for 2510 minutes in the 2 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): These whole valves were collected at the contact between stony till and a 5 m thick overlying unit of marine silt, in which laminations dip toward the centre of a consequent valley at 25°. The minimum sea level at the time of deposition of the shells was 75 m. The date is nominally older than shells collected at 81 m at a site 24 km to the south-southeast (GSC-4403, above), and is nominally older than whale bone collected 200 m down slope (S-2954, see below). A nearby outwash delta indicates a marine limit of 100 m a.s.l.; hence, deglaciation of this segment of Hadley Bay was slightly earlier than 10 ka BP (Hodgson, 1994).

GSC-4482. Hadley Bay IV

normalized age:	1190 ± 50
$\delta^{13}C$:	-25.0‰
uncorrected age:	1190 ± 50

Wood sample HCA-86-15-7-3B (*Picea* identified by H. Jetté in unpublished GSC Wood Report 87-30), a driftwood stump partly embedded in a gravel beach ridge, was collected by D.A. Hodgson on July 15, 1986 from the head of the unnamed bay at the northeastern limit of Hadley Bay, northwestern Storkerson Peninsula, Victoria Island, 'Kitikmeot region', Nunavut (73°12.5′N, 107°52.0′W), at an elevation of 3.5 m. The sample was submitted by D.A. Hodgson to gain information on late Holocene sea level change.

The sample (13.6 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (6.9 g) yielded 28.7 L of CO_2 gas. The age estimate is based on two counts for 2430 minutes in the 5 L counter with a mixing ratio of 1.00. See GSC-4481 (below) for further comments.

GSC-4481. Hadley Bay V

normalized age:	1890 ± 50
$\delta^{13}C$:	-23.7‰
uncorrected age:	1870 ± 50

Driftwood sample HCA-86-15-7-3A (*Picea*, identified by H. Jetté in unpublished GSC Wood Report 87-29), a surface collection on gravelly silt of a beach swale, was collected by D.A. Hodgson on July 15, 1986 from the head of the unnamed bay at the northeastern limit of Hadley Bay, northwestern Storkerson Peninsula, Victoria Island, 'Kitikmeot region', Nunavut (73°12.5′N, 107°52.0′W), at an elevation of 5 m. The sample was submitted by D.A. Hodgson to gain information on late Holocene sea level change.

The sample (10.5 g wet weight) was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (7.0 g) yielded 29.1 L of CO_2 gas. The age estimate is based on one count for 4200 minutes in the 5 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): Sample GSC-4481, together with GSC-4482, provides evidence that late Holocene emergence has probably continued to the present. The relative agreement between age and elevation indicates that the two samples were probably not appreciably displaced by sea-ice push.

GSC-4492. Hadley Bay VI

normalized age:	10 800 ± 90
corrected age:	10 400 ± 90
$\delta^{13}C$:	+1.86‰
uncorrected age:	10 400 ± 90

Marine shell sample HCA-86-10-7-1B (fragments of *Hiatella arctica*, identified by D.A. Hodgson), enclosed in stony silt, was collected by D.A. Hodgson on July 10, 1986 from 25 km west of the west shore of Hadley Bay, Victoria Island, 'Kitikmeot region', Nunavut (72°05.3′N, 109°13.0′W), at an elevation of 240 m. The sample was submitted by D.A. Hodgson to define the maximum age of a glacial readvance that filled at least the southern and central sections of Hadley Bay.

The sample (42.7 g wet weight) was treated with an acid leach to remove the outer 20%. The treated sample (34.2 g) yielded 32.7 L of CO_2 gas. The age estimate is based on one count for 4200 minutes in the 5 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): These fragments were found in one of the farthest inland and highest elevation flow-slide scars on the southwestern side of Hadley Bay. See GSC-4356 (above) for additional comments.

GSC-4560. Hadley Bay VII

uncorrected age:	8030 ± 100

Moss peat sample HCA-86-8-7-6B, enclosed in sand, was collected by D.A. Hodgson on July 8, 1986 from 20 km west of southwestern Hadley Bay, Victoria Island, 'Kitikmeot region', Nunavut (72°08.4′N, 109°07.6′W), at an elevation of 195 m. The sample was submitted by D.A. Hodgson to provide a minimum age of deglaciation and the establishment of vegetation.

The sample (51.2 g dry weight) was treated with hot base, hot acid, and distilled water rinses. The treated sample (16.7 g) yielded sufficient CO_2 gas to count. The age estimate is based on two counts for 2320 minutes in the 2 L counter with a mixing ratio of 1.00.

Comment (D.A. Hodgson): The moss peat was taken over a 10 cm interval at the base of an 80 cm thick peat stratum exposed in the back of a flowslide adjacent to sample GSC-4356 (above). This terrestrial postglacial deposit was overlain by 1.5 m of stony silty colluvium. The peat is much younger than the minimum possible age for the marine limit in the area (9.4 ka BP) and more than 1 ka younger than peat exposed 130 km to the south-southwest in an area deglaciated no earlier than the head of Hadley Bay (McNeely and McCuaig, 1991, sample GSC-4193; McNeely and Jorgensen, 1992, sample GSC-4521).

S-2954. Hadley Bay VIII

uncorrected age: 9935 ± 190

Whale bone sample HCA-86-18-7-7, embedded in a silty gravel beach, was collected by D.A. Hodgson on July 18, 1986 from the east shore of Hadley Bay on the west side of Storkerson Peninsula, Victoria Island, 'Kitikmeot region', Nunavut (72°51′N, 108°01′W), at an elevation of 68 m. The sample was submitted by D.A. Hodgson to determine the shoreline emergence pattern in the early Holocene and when Hadley Bay became sufficiently free of glacial and sea ice to permit immigration of whales.

Comment (D.A. Hodgson): The jaw bone, several vertebrae and unidentified whalebones embedded in beach gravel at 68 m a.s.l. were 7 m lower in elevation than the 75 m minimum sea level related to the nearby shell collection (GSC-4445, above) which is nominally 65 years older (Hodgson, 1994). Thus, the probably intact carcass of the whale is assumed to have sunk, rather than being deposited at a contemporary shoreline (cf. Dyke and Morris, 1990; Dyke et al., 1991).

TO-533. Hadley Bay IX

corrected age: 10 350 ± 80

Marine shell sample HCA-86-19-7-9 (whole valves of *Portlandia arctica*, identified by D.A. Hodgson), enclosed in sandy marine silt, was collected at GSC locality O-107763 by D.A. Hodgson on July 19, 1986 from 10 km inland from northeastern Hadley Bay on northwestern Storkerson Peninsula, Victoria Island, 'Kitikmeot region', Nunavut (73°06.3′N, 107°44.7′W), at an elevation of 110 m. This sample was submitted by D.A. Hodgson to gain information on sea level change and deglaciation. The age was corrected to $\delta^{13}C = 0.0‰$.

Comment (D.A. Hodgson): The very fragile paired valves, which disintegrated during collection, were taken from a horizontal reddish stratum 1 m below the top of 2 m of stratified, generally brownish grey sandy silt. The 6 m high silty exposure was capped by a gravel lag that included striated clasts and was either till or colluvium derived from upslope till. The silt appears to be part of a degraded delta 1 to 2 km distal to 'Flow 2' on northern Storkerson Peninsula (Hodgson, 1994). The delta is possibly contemporaneous with the final stage of 'Flow 2', and records the sea level of the first postglacial marine incursion into northeastern Hadley Bay.

Northwest Territories, District of Franklin

Brock Island

Brock Island southeast series

Two collections of fragmented marine shells (believed to be *Hiatella arctica*, identified by D.A. Hodgson), samples HCA-92-15-8-2b and 2c, were made from the surface of pebbly, platy sandstone and siltstone clasts by D.A. Hodgson and R.B. Taylor on August 15, 1992 on the centre of the southeast-facing coast of Brock Island, Northwest Territories (77°44.7′N, 113°48′W), at elevations of 17 m and 11 m respectively. These samples were submitted by D.A. Hodgson to gain information on sea level change (*see* Fig. 19).

GSC-5511. Brock Island I

normalized age: 15 000 ± 340
corrected age: 14 600 ± 340
$\delta^{13}C$: +2.40‰
uncorrected age: 14 600 ± 340

Marine shells sample HCA-92-15-8-2c (*Hiatella arctica*, identified by D.A. Hodgson) was a surface collection on pebbly, platy sandstone and siltstone fragments at GSC locality O-107777. The age was normalized to $\delta^{13}C = -25‰$ and corrected to $\delta^{13}C = 0.0‰$.

TO-4246. Brock Island II

normalized age: 34 890 ± 420
corrected age: 34 480 ± 420

Marine shell sample HCA-92-15-8-2c (fragments of *Hiatella arctica*, identified by D.A. Hodgson) was a surface collection on pebbly, platy sandstone and siltstone fragments at GSC locality O-107777. The age was normalized to $\delta^{13}C = -25‰$ and corrected to $\delta^{13}C = 0.0‰$.

TO-3561. Brock Island III

normalized age: 28 270 ± 210
corrected age: 27 860 ± 210

Marine shell sample HCA-92-15-8-2b (fragments of (?)*Hiatella arctica*, identified by D.A. Hodgson), was a surface collection on pebbly, platy sandstone and siltstone fragments at GSC locality O-107777. The age was normalized to $\delta^{13}C$ = -25‰ and corrected to $\delta^{13}C$ = 0.0‰.

Comment (D.A. Hodgson): Unvegetated raised beaches were identified rising from present sea level to 9 m elevation; probable beaches rise to 11 m and possible beaches to 17 m, where a washing limit was tentatively identified (Hodgson et al., 1994). Rare shell fragments at 11 m (sample 2c) provided a conventional radiocarbon age estimate (GSC-5511, above) with an unusual value (14.6 ka BP) that was believed due to mixing of younger and older shells by marine processes. The latter assumption was confirmed by an AMS date (TO-4246) of 34.5 ka BP, obtained from a single shell fragment. Shells 17 km to the north, related to a sea level elevation of more than 6 m, had previously been reported to have an age of 10.7 ka BP (McNeely and Atkinson, 1996, sample GSC-5148), whereas shell fragments (GSC-352) collected by J.G. Fyles from an elevation of 9 m, 5 km to the southwest, were dated at 10.6 ka BP (Fyles, 1965; Lowdon et al., 1967). Shell fragments from 17 m elevation (TO-3561, above) also provided an older AMS age estimate of 27.9 ka BP.

Melville Island

Winter Harbour series

A series of marine shell samples was collected by D.A. Hodgson and J-S. Vincent on August 3, 1980 from 0.1 km inland from the head of the bay between Fife and Braithwaite Points, Winter Harbour, Melville Island, District of Franklin, Northwest Territories (74°48.25′N, 110°28′W). These samples were submitted by D.A. Hodgson to gain information on sea level change.

GSC-5225. Winter Harbour I

uncorrected age:	6840 ± 150

Marine shell sample HCA 80 3-8-3 (30 cm depth; 11.3 g dry weight; a single paired valve of *Mya truncata*, identified by D.A. Hodgson), enclosed in littoral or deltaic sand at an elevation of 1.2 m, was treated with an acid leach to remove the outer 10%. The treated sample (10.6 g) yielded 2.29 L of CO_2 gas. The age estimate is based on two counts for 2120 minutes in the 2 L counter with a mixing ratio of 1.93. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.852 ± 0.133, 1.110 ± 0.028, and 18.388 ± 0.133 cpm, respectively.

GSC-5235. Winter Harbour II

normalized age:	9140 ± 140
corrected age:	8740 ± 140
$\delta^{13}C$:	+1.9‰
uncorrected age:	8710 ± 140

Marine shell sample HCA 80 3-8-2 (2 m depth; 13.9 g dry weight; a single paired valve of *Mya truncata*, identified by D.A. Hodgson), enclosed in littoral or deltaic sand at an elevation of 7.5 m, was treated with an acid leach to remove the outer 10%. The treated sample (13.2 g) yielded 2.84 L of CO_2 gas. The age estimate is based on two counts for 2230 minutes in the 2 L counter with a mixing ratio of 1.58. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 6.218 ± 0.087, 1.110 ± 0.028, and 18.388 ± 0.133 cpm, respectively.

Comment (D.A. Hodgson): The single paired valve (GSC-5235), buried by 2 m of littoral or deltaic sand, provides a maximum age for the 9.5 m sea level, in agreement with GSC-668 (Hodgson et al., 1984, Table 2).

Prince Patrick Island

GSC-5501. Dyer Bay

normalized age:	580 ± 110
$\delta^{13}C$:	-26.1‰
uncorrected age:	600 ± 110

Moss sample HCA-92-17-8-2c, enclosed in sand, was collected by D.A. Hodgson and R.B. Taylor on August 17, 1992 from the west coast of Dyer Bay, 12 km north-northeast of Cape Manning, Prince Patrick Island, District of Franklin, Northwest Territories (75°59′N, 122°10′W), at an elevation of 2.4 m. The sample was submitted by D.A. Hodgson to gain information on ice-push ridge development.

The sample (8.5 g dry weight) was treated with cold base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.2 g) yielded 1.08 L of CO_2 gas. The age estimate is based on two counts for 2230 minutes in the 2 L counter with a mixing ratio of 3.99. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 17.009 ± 0.219, 1.200 ± 0.024, and 18.324 ± 0.104 cpm, respectively.

Comment (D.A. Hodgson): The moss, from a 1 cm thick 100 m long discontinuous stratum exposed by wave erosion, probably represents tundra overlain by sea-ice thrust material.

GSC-5539. Wilkie Point

normalized age:	11 500 ± 110
corrected age:	11 100 ± 110
$\delta^{13}C$:	+1.61‰
uncorrected age:	11 100 ± 110

Marine shell sample HCA-92-14-8-9 (*Hiatella arctica*, identified by D.A. Hodgson), enclosed in black shale fragments underlain by nonfossiliferous silt and silty sand, was collected at GSC locality O-107776 by D.A. Hodgson and R.B. Taylor on August 14, 1992 from 1 km inland and 7 km west-northwest of Wilkie Point, Prince Patrick Island, District of Franklin, Northwest Territories (77°17.5′N, 117°34′W), at an elevation of 6 m. The sample was submitted by D.A. Hodgson to gain information on sea level change.

The sample (46.10 g dry weight) was treated with an acid leach to remove the outer 20%. The treated sample (37.0 g) yielded 8.3 L of CO_2 gas. The age estimate is based on one count for 3900 minutes in the 5 L counter with a mixing ratio of 1.00. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 7.160 ± 0.075, 2.200 ± 0.056, and 28.346 ± 0.137 cpm, respectively.

Comment (D.A. Hodgson): The shells were collected below a 7 m elevation terrace cut within older sediments during progradation of the first large marine delta west of Wilkie Point. This date overlaps GSC-354 (11.2 ka BP; Lowdon et al., 1967), collected by J.G. Fyles from deltaic sediment below the 26 m surface of the raised delta at Wilkie Point (Hodgson et al., 1994). That feature is the highest clearly marine feature recorded for Prince Patrick Island.

TO-2291. Green Bay

normalized age: 5290 ± 60

Twig sample HCA-90-25-7-2A (*Salix capensisa,* identified by G. Argus), enclosed in clayey silt, was collected by D.A. Hodgson on July 25, 1990 from a gully 10 km northwest of Green Bay, Prince Patrick Island, District of Franklin, Northwest Territories (76°34.2′N, 119°15.5′W), at an elevation of about 60 m. This sample was submitted by D.A. Hodgson because it was believed to be from a raised shoreline terrace within a formerly ice-dammed lake basin. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (D.A. Hodgson): The wood was part of a 1 cm by 20 cm lens of twigs (GSC Wood Report 90-39) and moss fragments. J. Janssens has commented that the fossil bryophyte assemblage is composed of detrital material typical of moss flora in the high Arctic. The well consolidated and block fractured silt containing a few clasts of local bedrock underlies a well defined terrace on the east side of the small (1 km long) lake. The basin drained south through a spillway 8 m above the lake when the north end was blocked by a lobe from an ice cap over the central section of the island. The ice is assumed to have withdrawn in the Late Pleistocene–early Holocene; thus, the terrace and dated twig are probably from a nonglacial stage in the lowering of the lake outlet.

TO-2290. Mould Bay

normalized age: 2020 ± 50

Moss sample HCA-90-24-7-1H (unidentified fragments), enclosed in grey silt overlying a 15 cm thick unit of brown gravel, was collected by D.A. Hodgson on July 24, 1990 from a stream bank 8 km northeast of the head of Mould Bay, Prince Patrick Island, District of Franklin, Northwest Territories (76°23.1′N, 119°14.4′W), at an elevation of about 120 m. This sample was submitted by D.A. Hodgson because it was believed to be from glaciolacustrine sediments. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (D.A. Hodgson): The sample site lies within an area, several square kilometres in extent, composed of silty sediment up to 25 m thick that displays, in cross-section, structures including planar bedding, rhythmites, crossbedding, climbing ripples and load casts, and overlies till that includes numerous clasts of exotic lithologies. The generally light grey silt is capped by up to several metres of oxidized material. The moss fragments, which are the only organic materials found in the 'glaciolacustrine' sediment, occur in small (1 cm long) mats at the base of several metres of grey silt and at the top of the underlying 15 cm thick unit of brown gravel. It is assumed that the upper silt unit has slumped over a younger surface lag or gully-floor deposit.

Mould Bay series

A river terrace, 2.5 m in elevation and located 2 km south-southeast of Mould Bay weather station, Prince Patrick Island, Northwest Territories (76°13.5′N, 119°19.5′W), was cored to a depth of 182 cm. The sandy terrace surface is patterned by low-centre polygons; peat is exposed in wedge troughs. The core, which commenced at the top of permafrost at 27 cm depth, was composed of moss peat and rare sandy strata with no visible ice. The base of the core is probably the bottom of the peat. The core was collected by D.A. Hodgson and T.G. Fisher on July 14, 1989. Samples were submitted by D.A. Hodgson to indicate late Holocene sea level change.

TO-1559. Mould Bay I

normalized age: 2940 ± 80

Moss peat sample HCA-89-14-7-2-15cm (about 41 cm core depth) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

TO-2289. Mould Bay II

normalized age: 2480 ± 60

Moss peat sample HCA-89-14-7-2-145cm (about 172 cm core depth) was enclosed in peat. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (D.A. Hodgson): The sample from the base of the core indicates that sea level was below 1 m elevation at 2.9 ka BP (Hodgson et al., 1994). The two dates (TO-2289 and -1559) indicate that 140 cm of peat accumulated in 500 years about 2.5 ka BP.

INTERNATIONAL

Washington State

Figure 21. *Radiocarbon-dated sites in Washington State, United States of America.*

Cranberry Lake series

A series of wood samples was collected by J.J. Clague and I. Hutchinson on September 26, 1997 from sediment cores taken from Cranberry Lake, Whidbey Island, Washington State, United States (48°23.8′N, 122°39.5′W), in a water depth of 8 m. These samples were submitted by J.J. Clague to gain information on late Holocene sea level change.

GSC-6210. Cranberry Lake I

normalized age:	4470 ± 80
$\delta^{13}C$:	-27.3‰
uncorrected age:	4500 ± 80

Twig sample CIA-97-142-1 (3.7 g dry weight; unidentifiable, according to C. Keith), enclosed in peat, was treated with hot base, hot acid (noncalcareous), and distilled water rinses. The treated sample (2.6 g) yielded 2.5 L of CO_2 gas. The age estimate is based on one count for 3800 minutes in the 2 L counter with a mixing ratio of 1.61. The count rates for the sample (net) and for monthly backgrounds and standards (net) were 10.341 ± 0.083, 1.214 ± 0.025, and 18.117 ± 0.109 cpm, respectively.

TO-6847. Cranberry Lake II

normalized age:	5580 ± 70

Twig sample CIA-97-142-2 was enclosed in sand. The age was normalized to $\delta^{13}C$ = -25‰.

Comment (J.J. Clague): Cranberry Lake is separated from the sea by a narrow, low barrier bar constructed during the late Holocene as sea level rose relative to the land. Sample GSC-6210 is from the middle of a freshwater fibrous peat unit overlying sand of unknown origin. The peat is about 155 cm thick and is gradationally overlain by about 150 cm of humified peat or gyttja. The peat and gyttja in Cranberry Lake may have accumulated as the sea rose, and GSC-6210 suggests that relative sea level 4500 BP was lower than today. Sample TO-6847 was obtained on a twig sample collected from sand 55 cm below GSC-6210.

REFERENCES

Anderson, T.W.
1971: Postglacial vegetative changes in the Lake Huron –Lake Simcoe district, Ontario, with special reference to glacial Lake Algonquin; Ph.D. thesis, University of Waterloo, Waterloo, Ontario, 246 p.

Anderson, T.W. and Lewis, C.F.M.
1992: Climatic influences of deglacial drainage changes in southern Canada at 10 to 8 ka suggested by pollen evidence; Geographie physique et Quaternaire, v. 46, p. 255–272.
2002: Upper Great Lakes climate and water-level changes 11 to 7 ka: effect on the Sheguiandah archaeological site; in The Sheguiandah Site: Archaeological, Geological and Botanical Studies at a PalaeoIndian site on Manitoulin Island, Ontario, (ed.) P. Julig; Canadian Museum of Civilization, Archaeological Survey, Mercury Series 161, p. 195–234.

Batterson, M.J., Liverman, D.G.E., and Kirby, G.E.
1983: Glacial lake development and marine inundation, Deer Lake area, Newfoundland, Canada; Journal of Quaternary Science, v. 8, p. 327–337.

Bauer, I.E.
2002: Internal and external controls over Holocene peatland development in Boreal western Canada; Ph.D. thesis, University of Alberta, Edmonton, Alberta, 242 p.

Beaudoin, A.B.
1992: Early Holocene palaeoenvironmental data preserved in 'non-traditional' sites; Second Palliser Triangle Global Change Conference, Regina, Saskatchewan, November 13–15, 1992, Program with Abstracts, p. 1–2.
1999: What they saw: the climatic and environmental context for Euro-Canadian settlement in Alberta; Prairie Forum, v. 40, no. 1, p. 1–40.

Beaudoin, A.B., Yansa, C.H., and Vance, R.E.
1998: The landscape context for early postglacial Palaeoindian occupation on the northern Plains; *in* Beyond the Concept of Cultural Areas: Paleoindian Adaptations on the Edges of the Great Plains and Adjacent Areas; Canadian Archaeological Association, 31st Annual Conference, May 6–10, 1998, Victoria, British Columbia, p. 36–37.

Behrensmeyer, A.K. and Hill, A.P. (ed.)
1980: Fossils in the Making; University of Chicago Press, Chicago.

Bell, T., Liverman, D.G.E., Sheppard, K., and Batterson, M.J.
2001: Sedimentology and stratigraphy of southern St. George's Bay; Canadian Journal of Earth Sciences, v. 38, p. 851–869.

Bell, T., Sheppard, K., and Liverman, D.G.E.
1999: Late Quaternary glacial and glaciomarine sediments in southern St. George's Bay; *in* Current Research; Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 99-1, p. 125–138.

Berger, G.W. and Nielsen, E.
1991: Evidence from thermoluminescence dating for Middle Wisconsinan deglaciation in the Hudson Bay Lowland; Canadian Journal of Earth Sciences, v. 28, p. 240–249.

Blake, W., Jr.
1988: Geological Survey of Canada radiocarbon dates XXVII; Geological Survey of Canada, Paper 87-7, 100 p.
1995: Holocene glacier fluctuations, northernmost Baffin Bay to Kane Basin; *in* Programme, Abstracts and Field Guides, Canadian Quaternary Association (CANQUA)–Canadian Geomorphology Research Group (CGRG), Joint Meeting, St John's, Newfoundland, June 5–7, 1995, p. CA 43.

Blake, W., Jr., Douglas, M.S.V.D., Smol, J.P., and Janssens, J.A.
1997: Holocene glacier fluctuations and paleolimnology of a nunatak pond, Stygge Glacier, Ellesmere Island, Arctic Canada; 8th Biennial Canadian Quaternary Association (CANQUA) Meeting, Montréal, Quebec, May 22–25, 1997, Programme, Résumés -Abstracts, p. 6.

Brookes, I.A.
1974: Late-Wisconsin glaciation of southwestern Newfoundland (with special reference to the Stephenville map-area); Geological Survey of Canada, Paper 73-40, 31 p.

Clague, J.J.
1981: Late Quaternary geology and geochronology of British Columbia, part 2: summary and discussion of radiocarbon-dated Quaternary history; Geological Survey of Canada, Paper 80-35, 41 p.

Clague, J.J. and Bobrowsky, P.T.
1994: Tsunami deposits beneath tidal marshes on Vancouver Island, British Columbia; Geological Society of America Bulletin, v. 106, p. 1293–1303.

Clague, J.J. and Mathewes, R.W.
1989: Early Holocene thermal maximum in western North America: new evidence from Castle Peak, British Columbia; Geology, v. 17, p. 277–280.

Clague, J.J. and Mathews, W.H.
1992: The sedimentary record and Neoglacial history of Tide Lake, northwestern British Columbia; Canadian Journal of Earth Sciences, v. 29, p. 2383–2396.

Clague, J.J. and Shilts, W.W.
1993: Two landslide-dammed lakes in the Cascade Mountains, southwestern British Columbia; *in* Current Research, Part E; Geological Survey of Canada, Paper 93-1E, p. 47–54.

Clague, J.J., Evans, S.G., Rampton, V.N., and Woodsworth, G.J.
1995: Improved age estimates for the White River and Bridge River tephras, western Canada; Canadian Journal of Earth Sciences, v. 32, p. 1172–1179.

Clague J.J., Hutchinson, I., Mathewes, R.W., and Patterson, R.T.
1999: Evidence for late Holocene tsunamis at Catala Lake, British Columbia; Journal of Coastal Research, v. 15, p. 45–60.

Clague, J.J., Luternauer, J.L., Monahan, P.A., Edwardson, K.A., Dallimore, S.R., and Hunter, J.A.
1998: Quaternary stratigraphy and evolution of the Fraser delta; *in* Geology and Natural Hazards of the Fraser River Delta, British Columbia, (ed.) J.J. Clague, J.L. Luternauer, and D.C. Mosher; Geological Survey of Canada, Bulletin 525, p. 57–90.

Clague, J.J., Mathewes, R.W., Guilbault, J-P., Hutchinson, I., and Ricketts, B.D.
1997: Pre–Younger Dryas resurgence of the southwestern margin of the Cordilleran ice sheet, British Columbia, Canada; Boreas, v. 26, p. 261–278.

Clague, J.J., Naesgaard, E., and Mathewes, R.W.
1998: Geologic evidence for prehistoric earthquakes; *in* Geology and Natural Hazards of the Fraser River Delta, British Columbia, (ed.) J.J. Clague, J.L. Luternauer, and D.C. Mosher; Geological Survey of Canada, Bulletin 525, p. 177–194.

Clague, J.J., Saunders, I.R., and Roberts, M.C.
1988: Ice-free conditions in southwestern British Columbia at 16 000 years BP; Canadian Journal of Earth Sciences, v. 25, p. 938–941.

Dallimore, S.R., Wolfe, S.A., Matthews, J.V., Jr., and Vincent, J-S.
1997: Mid-Wisconsinan eolian deposits of the Kittigazuit Formation, Tuktoyaktuk coastlands, Northwest Territories, Canada; Canadian Journal of Earth Sciences, v. 34, p. 1421–1441.

Dionne, J.C.
1996: La terrasse Mitis à la pointe aux Alouettes, cote nord du moyen estuaire du Saint-Laurent; Géographie physique et Quaternaire, v. 50, p. 57–72.

Dionne, J.C. (cont.)
2001: Relative sea-level changes in the St. Lawrence estuary from deglaciation to present day; *in* Deglacial History and Relative Sea-Level Changes, Northern New England and Adjacent Canada, (ed.) T.K. Weddle and M.J. Retelle; Geological Society of America, Special Paper 351, p. 271–284.

Dyck, W.
1967: The Geological Survey of Canada radiocarbon dating laboratory; Geological Survey of Canada, Paper 66-45, 45 p.

Dyck, W. and Fyles, J.G.
1963: Geological Survey of Canada radiocarbon dates I and II; Geological Survey of Canada, Paper 63-21, 31 p. (reprinted).

Dyck, W., Fyles, J.G., and Blake, W., Jr.
1965: Geological Survey of Canada radiocarbon dates IV; Geological Survey of Canada, Paper 65-4, 23 p. (reprinted).

Dyke, A.S.
1999: Last glacial maximum and deglaciation of Devon Island, Arctic Canada: support for an Innuitian Ice Sheet; Quaternary Science Reviews, v. 18, p. 393–420.

Dyke, A.S. and Morris, T.F.
1990: Postglacial history of the bowhead whale and of driftwood penetration: implications for paleoclimate, central Canadian Arctic; Geological Survey of Canada, Paper 89-24, 17 p.

Dyke, A.S., Morris, T.F., and Green, D.E.C.
1991: Postglacial tectonic and sea level history of the central Canadian Arctic; Geological Survey of Canada, Bulletin 397, 56 p.

Edwards, B.R., Anderson, R.G., and Russell, J.K.
1996: Geology of the Quaternary Hoodoo Mountain volcanic complex and adjacent Mesozoic and Paleozoic basement rocks, parts of Hoodoo Mountain (NTS 104B/14) and Craig River (NTS 104B/11) map areas, northwestern British Columbia; Geological Survey of Canada, Open File 3321, 2 maps at 1:20 000 scale.

Fenton, M.M.
1974: The Quaternary stratigraphy of a portion of southeastern Manitoba, Canada; Ph.D. thesis, University of Western Ontario, London, Ontario, 285 p.

Friele, P. and Clague, J.J.
2002: Readvance of glaciers in the Britsh Columbia Coast Mountains at the end of the last glaciation; Quaternary International, v. 87, p. 45–58.

Fulton, R.J.
1995: Day 1: Quaternary stratigraphy of the Kamloops, Merritt, and Highland Valley areas; *in* A4 Field Trip Guidebook: Quaternary Geology and Placer Gold Deposits of Central British Columbia, (ed.) V.M. Levson; Geological Association of Canada–Mineralogical Association of Canada, Joint Annual Meeting, 1995, Field Trip Guidebook A4, p. 19–28.

Fyles, J.G.
1965: Surficial geology, western Queen Elizabeth Islands; *in* Report of Activities: Field, 1964; Geological Survey of Canada, Paper 65-1, p. 3-5.

Gagnon, M.
1994: Cartographie, lithostratigraphie et paléogéographie des dépots quaternaires de la région de saint-Raymond-de-Portneuf; rapport non-publié, Maitrise en sciences de l'environment, Université du Québec à Montréal, 74 p.

Gaston, A.J. and Donaldson, G.
1995: Peat deposits and thick-billed murre colonies in Hudson Strait and northern Hudson Bay: clues to post-glacial colonization of the area by seabirds; Arctic, v. 48, p. 354–358.

Hebda, R.J.
1977: The paleoecology of a raised bog and associated deltaic sediments of the Fraser River delta; Ph.D. thesis, University of British Columbia, Vancouver, British Columbia, 202 p.

Hodgson, D.A.
1994: Episodic ice streams and ice shelves during retreat of the northwesternmost sector of the late Wisconsinan Laurentide Ice Sheet over the central Canadian Arctic Archipelago; Boreas, v. 23, p. 14–28.

Hodgson, D.A., Taylor, R.B., and Fyles, J.G.
1994: Late Quaternary sea level changes on Brock and Prince Patrick islands, western Canadian Arctic Archipelago; Géographie physique et Quaternaire, v. 48, p. 69–84.

Hodgson, D.A., Vincent, J-S., and Fyles, J.G.
1984: Quaternary geology of central Melville Island, Northwest Territories; Geological Survey of Canada, Paper 83-16, 25 p.

Hughes, O.L., Rampton, V.N., and Rutter, N.W.
1972: Quaternary geology and geomorphology, southern and central Yukon (northern Canada); 24th International Geological Congress, Montreal, 1972, Guidebook to Field Excursion A-11, 59 p.
Karrow, P.F., Anderson, T.W., Clarke, A.H., Delorme, L.D., and Sreenivasa, M.R.
1975: Stratigraphy, paleontology, and age of Lake Algonquin sediments in southwestern Ontario, Canada; Quaternary Research, v. 5, p. 49–87.
LaSalle, P.
1987: The Québec city area; *in* Pleistocene Stratigraphy in the St. Lawrence Lowland and the Appalachians of Southern Quebec, a Field Guide, (ed.) M. Lamothe; Environment et Géologie, Université de Montréal, v. 4, 280 p.
LaSalle, P. and Shilts, W.W.
1993: Younger Dryas–age readvance of Laurentide ice into the Champlain Sea; Boreas, v. 22, p. 25–37.
LaSalle, P., Martineau, G., and Chauvin, L.
1977: Morphologie, stratigraphie et déglaciation dans la région de Beauce–Monts Notre-Dame–Parc des Laurentides; Ministere des Richesses Naturelles du Québec, Open File DPV-516, 74 p.
Lebuis, J. and David, P.P.
1977: La stratigraphie et les événements géologiques du Quaternaire de la partie occidentale de la Gaspésie, Québec; *dans* Troisiéme Colloque sur le Quaternaire du Québec. S. Occhietti (ed.); Géographie physique et Quaternaire, v. 31, p. 275–296.
Levesque, A.J., Mayle, F.E., Walker, I.R., and Cwynar, L.C.A.
1993: A previously unrecognized late-glacial cold event in eastern North America; Nature, v. 361, p. 623–626.
Liverman, D.G.E. and Bell, T.
1996: Late Quaternary glacial and glaciomarine sediments in southern St. George's Bay; *in* Current Research; Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 96-1, p. 29–40.
Lowdon, J.A.
1985: The Geological Survey of Canada radiocarbon dating laboratory; Geological Survey of Canada, Paper 84-24, 19 p.
Lowdon, J.A. and Blake, W., Jr.
1973: Geological Survey of Canada radiocarbon dates XIII; Geological Survey of Canada, Paper 73-7, 61 p.
Lowdon, J.A., Fyles, J.G., and Blake, W., Jr.
1967: Geological Survey of Canada radiocarbon dates VI; Radiocarbon, v. 9, p. 156–197.
Lowdon, J.A., Robertson, I.M., and Blake, W., Jr.
1977: Geological Survey of Canada radiocarbon dates XVII; Geological Survey of Canada, Paper 77-7, 25 p.
Marcoux, N. and Richard, P.J.H.
1995: Végétation et fluctuations climatiques postglaciaires sur la côte septentrionale gaspésienne, Québec; Canadian Journal of Earth Sciences, v. 32, p. 79–85.
Mathewes, R.W. and Clague, J.J.
1994: Detection of large earthquakes in the Pacific Northwest by microfossil analysis; Science, v. 264, p. 688–691.
Mayle, F.E. Levesque, A.J., and Cwynar, L.C.
1993: Accelerator-mass spectrometer age for the Younger Dryas event in Atlantic Canada; Quaternary Research, v. 39, p. 355–360.
McAslan, A.A. and Rawlence, D.J.
1991: Late-glacial history of Harrigan Lake, Saint John County, New Brunswick, based on diatom and sedimentary pigment distributions; *in* Late-Glacial and Postglacial Events in Coastal and Adjacent Areas; Canadian Quaternary Association (CANQUA) Conference, University of New Brunswick, Fredericton, New Brunswick, June 3–4, 1991, Program and Abstracts, p. 26.
McCuaig, S.J.
2000: Glacial history of the Nass River region; Ph.D. thesis, Simon Fraser University, Vancouver, British Columbia, 275 p.
McNeely, R.
1988: Radiocarbon dating laboratory; Geos, v. 17, no. 2, p. 10–12.
2002: Geological Survey of Canada radiocarbon dates XXXIII; Geological Survey of Canada, Current Research 2001, 51 p.
McNeely, R. and Atkinson, D.E.
1996: Geological Survey of Canada radiocarbon dates XXXII; Geological Survey of Canada, Current Research 1995-G, 92 p.
McNeely, R. and Jorgensen, P.K.
1992: Geological Survey of Canada radiocarbon dates XXX; Geological Survey of Canada, Paper 90-7, 84 p.
1993: Geological Survey of Canada radiocarbon dates XXXI; Geological Survey of Canada, Paper 91-7, 85 p.
McNeely, R. and McCuaig, S.
1991: Geological Survey of Canada radiocarbon dates XXIX; Geological Survey of Canada, Paper 89-7, 134 p.
Michaud Y. and Bégin, C.
2000: Past environmental change recorded in dune fields; Chapter 8 *in* The Physical Environment of the Mackenzie Valley: a Baseline for the Assessment of Environmental Change, (ed.) L.D. Dyke and G.R. Brooks; Geological Survey of Canada, Bulletin 547, p. 69–77.
Morlan R.E., McNeely, R., and Nielsen, E.
2000: Manitoba radiocarbon dates; Manitoba Industry, Trade, and Mines, Manitoba Geological Survey, Open File Report OF2000-1, 198 p.
Morlan R.E., McNeely, R., Wolfe, S.A., and Schreiner, B.T.
2001: Quaternary dates and vertebrate faunas in Saskatchewan; Geological Survey of Canada, Open File 3888, 155 p.
Naumann, C.M.
1990: The Cheam slide: a study of the interrelationshiop of rock avalanches and seismicity; M.Sc. thesis, University of British Columbia, Vancouver, British Columbia, 203 p.
Nichols, H.
1967: The postglacial history of vegetation and climate at Ennadai Lake, Keewatin, and Lynn Lake, Manitoba; Eiszeitalter und Gegenwart, v. 18, p. 176–197.
Nielsen, E., Morgan, A.V., Morgan, A., Mott, R.J., Rutter, N.W., and Causse, C.
1986: Stratigraphy, paleoecology and glacial history of the Gillam area, Manitoba; Canadian Journal of Earth Sciences, v. 23, p. 1641–1661.
Occhietti, S. and Hillaire-Marcel, C.
1982: Les Paléoenvironments de la Mer de Champlain dans la région de Québec entre 11 500 et 9000 BP; 50e Congrès de l'Association francophone pour le savoir, Montréal.
Parent, M. and Occhietti, S.
1988: Late Wisconsinan deglaciation and Champlain Sea invasion in the St. Lawrence valley, Quebec; Géographie physique et Quaternaire, v. 42, no. 3, p. 215–246.
Plouffe, A.
2000: Quaternary geology of the Fort Fraser and Manson River map areas, central British Columbia; Geological Survey of Canada, Bulletin 554, 62 p.
Rampton, V.N.
1988: Quaternary geology of the Tuktoyaktuk coastlands, Northwest Territories; Geological Survey of Canada, Memoir 423, 98 p.
Richard, P.J.H., Veillette, J.J., Larouche, A.C., Hetu, B., Gray, J.T., and Gangloff, P.
1997: Chronologie de la déglaciation finale en Gaspésie: nouvelles données et implications; Géographie physique et Quaternaire, v. 51, no. 2, p. 163–184.
Ryder, J.M. and Clague, J.J.
1989: British Columbia (Quaternary stratigraphy and history, Cordilleran Ice Sheet); *in* Chapter 1 of Quaternary Geology of Canada and Greenland, (ed.) R.J. Fulton; Geological Survey of Canada, Geology of Canada, no. 1, p. 48-58 (*also* Geological Society of America, The Geology of North America, v. K-1).
Ryder, J.M. and Thomson, B.
1986: Neoglaciation in the southern Coast Mountains of British Columbia: chronology prior to the late Neoglacial maximum; Canadian Journal of Earth Sciences, v. 23, no. 3, p. 273–287.
Schweger, C.E. and Hickman, M.
1989: Holocene paleohydrology, central Alberta: testing the general-circulation-model climate simulations; Canadian Journal of Earth Sciences, v. 26, p. 1826–1833.
Shaw, J., Grant, D.R., Guilbault, J-P., Anderson, T.W., and Parrott, D.R.
2000: Submarine and onshore end moraines in southern Newfoundland: implications for the history of late Wisconsinan ice retreat; Boreas, v. 29, p. 295–314.
Sheppard, K., Bell, T., and Liverman, D.G.E.
2000: Stratigraphy and age of Quaternary sediments exposed along the coast in southern St. George's Bay, western Newfoundland; Quaternary International, v. 68–71, p. 275–283.

Spurgeon, T.
1984: Preliminary report of archaeological investigations at the Park Farm site: DhRq 22; The Midden, v. 16, no. 4, p. 4–5.
Taylor, R.B.
1987: Cruise report 86303: coastal surveys in the central Queen Elizabeth Islands (Dundas, Devon, Somerset, Cameron and Lowther Islands, NWT); Geological Survey of Canada, Open File 1595, 45 p.
Wagner, F.J.E.
1970: Faunas of the Pleistocene Champlain Sea; Geological Survey of Canada, Bulletin 181, 85 p.
Yansa, C.H. and Basinger, J.F.
1999: A postglacial plant macrofossil record of vegetation and climate change in southern Saskatchewan; *in* Holocene Climate and Environmental Change in the Palliser Triangle: A Geoscientific Context for Evaluating the Impacts of Climate Change in the Southern Canadian Prairies (ed.) D.S. Lemmen and R.E. Vance; Geological Survey of Canada, Bulletin 534, p. 139–172.
Zoltai, S.C. and Vitt, D.H.
1990: Holocene climatic change and the distribution of peatlands in western interior Canada; Quaternary Research, v. 33, no. 2, p. 231–240.

INDEX

* = sample counted in both counters
HP = 'High Pressure' (5L counter at 4 atmospheres)

INDEX (cont.)

INDEX (cont.)