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Abstract

This Open File contains a compilation of 122 published and unpublished radiocarbon dates relating to the age of 39 sensitive clay landslides and three "disturbed terrain" features in the Ottawa Valley, southeastern Ontario/southwestern Québec. Sixteen tables contain either the date(s) for individual landslides (or disturbed terrain) or the date(s) for multiple landslides within a specific geographical area. A brief paragraph introduces each table and overviews the landslide or disturbed terrain and the associated radiocarbon date(s). Each table lists the attributes of the dates, including sampling location, dated material, dating results, and contextual information between the age and the landslide/disturbed terrain. It is intended that this dataset will aid future studies investigating the chronology of prehistoric sensitive clay landslides in the Ottawa Valley and St. Lawrence Lowlands region.

Introduction

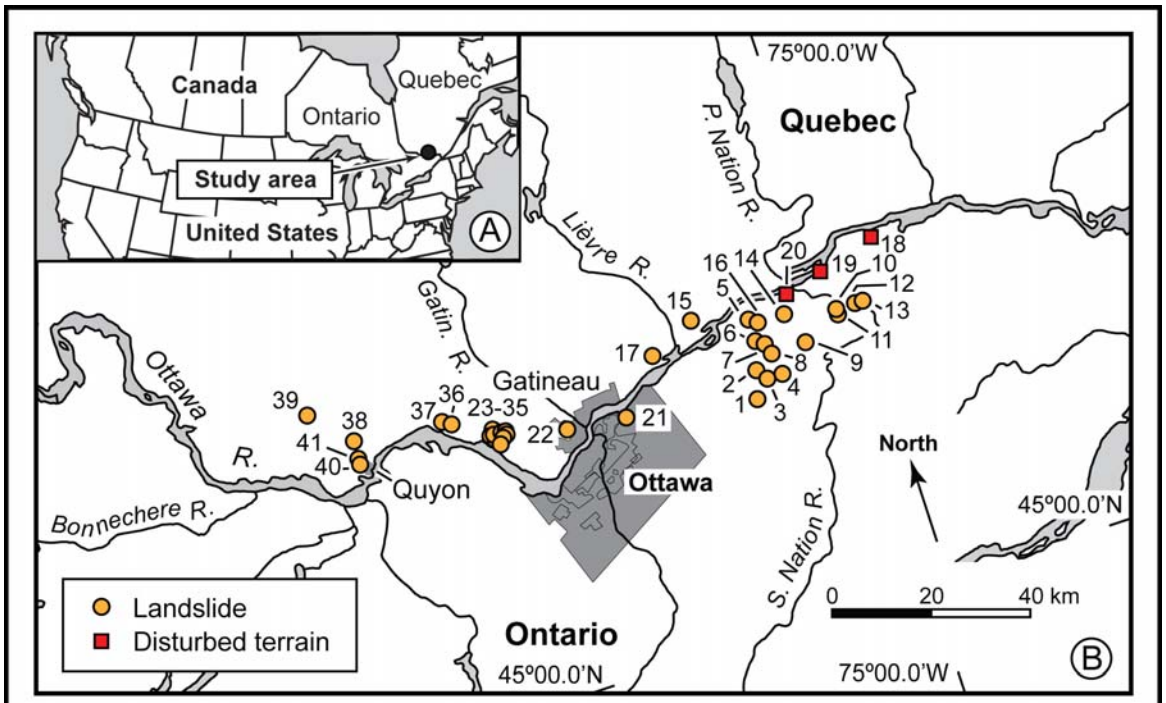
Large areas of the Ottawa Valley are underlain by glaciomarine silty-clay and clayey-silt deposits that were deposited in the Champlain Sea between 13.9 and 11.5 cal ka BP (12.0 and 10.0 ^{14}C ka BP; Dyke and Prest, 1987). The deposits were incised by the postglacial stream network in the early Holocene as the Champlain Sea receded because of regional uplift. The subsequent leaching of Na+ has caused some of the deposits to become geotechnically sensitive, and thus experience a substantial loss of strength when remoulded (see Crawford, 1961; Crawford, 1968; Mitchell and Markell, 1974; Fransham et al. 1976; Fransham and Gadd, 1977; Torrance, 2012). Sensitive 'clay' sediments are prone to rapid, large (> 1ha), retrogressive landslides and a number have occurred historically in the region (see, e.g., Ells, 1906; 1908; Eden et al., 1971; Evans and Brooks, 1994). Approximately 250 landslide polygons appear on surficial geology maps in the Ottawa Valley (see, for example, Fransham et al. 1976; Richard, 1982a; 1982b; 1984a; 1984b; 1990; 1991; Richard et al., 1978; St. Onge, 2009); most are prehistoric failures of unknown age.

Since the early 1960s, organic materials related to the age of landslides in the area have been collected at a number of sites. Some materials have been obtained opportunistically, e.g., from construction excavations, but the majority were collected through two targeted sampling programs by the Geological Survey of Canada (GSC). The initial targeted sampling occurred in the late 1990s and focused on determining the age of landslides clustered along Breckenridge Creek Valley and within the Mer Bleue, Hammond, Bourget and Plantagenet paleochannels located west and east of Ottawa, respectively. This sampling was originally intended to elucidate factors controlling landslide activity, but it became focused on substantiating a paleoearthquake mechanism, based on the close grouping of the initial set of landslide ages from the paleochannel area. Aylsworth et al. (2000) subsequently interpreted that a group of eleven landslides aged ~5120 cal BP were triggered by a contemporary paleoearthquake. A second targeted sampling program began in 2009 specifically to better understand the paleoseismicity of the West Quebec Seismic Zone. This work is ongoing at the time of writing and has resulted in the identification of a grouping of landslides aged ~1020 cal BP in the area west of Ottawa that Brooks (2013) attributes to being triggered by a second paleoearthquake.

This Open File compiles 122 published and unpublished radiocarbon dates relating to the age of 39 sensitive clay landslides and three "disturbed terrain" features in the Ottawa Valley, southeastern Ontario/southwestern Québec (Fig. 1). The dates range from 'modern' to about 8000 cal BP and the dated features represent about 17% of the mapped landslides of the area. All of the dates were obtained by GSC scientists or dated in the GSC Radiocarbon Laboratory. The Open File contains the full suite of radiocarbon dates, geographical coordinates, and provides the important contextual information between the dated organic material and the landslide deposit/scar. It is intended that the information be used by future studies investigating the chronology of prehistoric sensitive clay landslides in the Ottawa Valley and St. Lawrence Lowlands region. A summarized version of the dataset in this Open File is presented in Brooks (2014) who synthesized the landslides ages and morphologies as they relate to the paleoseismic investigations.

The radiocarbon age of a landslide

Intrinsic to determining the radiocarbon age of a landslide is the careful consideration of the geomorphic or stratigraphic relationship or context between the age of the organic material (wood, peat, macrofossils, etc.) to be dated and the timing of the failure (see Lang et al., 1999). Fundamentally, organic material living prior to a failure (e.g., wood buried within or underneath the debris) represents a 'maximum' age for the landslide, while a 'minimum' age is yielded from material that post-dates the landslide (e.g., peat accumulated in a depression on the debris field). If there is a



Landslide/disturbed terrain numbering key

Number	Landslide/dist. terrain	Number	Landslide/ dist. terrain	Number	Landslide dist. terrain
	Table 1		***Table 3***		***Table 11***
1	Landslide 1	16	Ramp.-Baseln. rd. lands.	36	Luskville landslide
2	Landslide 2a, 2b		***Table 4***		***Table 12***
3	Landslide 3	17	Angers landslide	37	Alary Rd. landslide
4	Landslide 4		***Table 5***		***Table 13***
5	Landslide 5	18	Lefaivre disturbed terrain	38	Quyon Valley landslide
6	Landslide 6		***Table 6***		***Table 14***
7	Landslide 7	19	Treadwell dist. terrain	39	Up. Quyon R landslide
8	Landslide 8		***Table 7***		***Table 15***
9	Landslide 9	20	Wendover dist. terrain	40	Murphy Rd landslide
10	Landslide 10		***Table 8***		***Table 16***
11	Landslide 11	21	Beacon Hill landslide	41	Verner landslide
12	Landslide 12		***Table 9***		
13	Landslide 13	22	Jomonville landslide		
14	Landslide 14		***Table 10***		
	Table 2	23-35	Breckenridge Valley scars 1, 2, 3, 4, 9, 11, 12, 13, 15, 17, 19, 22		
15	Masson landslide				

Fig. 1 Maps showing A) the general location of the Ottawa Valley study area in eastern Canada, and B) the locations of the landslides and disturbed terrains listed in tables 1 to 16. The map symbols in B) are not to scale.

sound basis for interpreting that the specifically dated material was living at the time of, immediately prior to, or immediately after the failure then it should yield an accurate (or "direct") radiocarbon age determination of the landslide event, as opposed to an approximate "indirect" or more general "relative" age from material only generally related to the timing of the failure (see Lang et al., 1999).

Ideally, a landslide should be dated using organic materials that yield a set of direct or indirect maximum and minimum ages to bracket the time of failure, although this is not always possible. Where materials that yield only maximum or minimum ages are available, the replication of similar ages from several independent samples will increase confidence in their representation of the landslide age. In general, the youngest maximum and/or oldest minimum age(s) should best represent the age of a landslide, assuming a direct or strong indirect link between the dated material and the landslide. However, in cases where the age of a landslide is represented by a single sample, the radiocarbon age commonly is *assumed* to reflect that of the failure event, however, there is always an unknown uncertainty with this assumption, even with carefully selection of the dated material. The variability of ages within groups of carefully selected material related to a given feature attests to this fact.

Radiocarbon dates should be calibrated from radiocarbon to sideral years to remove temporal deviations between the radiocarbon and sideral timescales (Bartlein et al., 1995). The calibration of a given date may increase or decrease the range of age uncertainty, depending on the shape of the relevant portion of the radiocarbon calibration curve. Interpreting chronology based on uncalibrated radiocarbon ages, however, is ignoring a level of uncertainty intrinsic with the dates.

Inferences that separate landslides have occurred simultaneously are made by correlating the 1σ or 2σ age ranges of calibrated radiocarbon ages. Overlapping age ranges, however, do not imply event synchronicity, since this can also be the product of closely-aged failures that occurred at distinctly separate times, even up to many decades (or more) apart. Such occurrences cannot be distinguished because of the radiocarbon age uncertainty, which is a limitation of the radiocarbon dating method. An interpretation of the synchronicity of multiple landslides based on radiocarbon ages thus is a hypothesis that must carefully consider the number of correlating events, possible triggering mechanism(s), and the geomorphic-geotechnical settings of the sites (see, for example, Aylsworth et al. (2000) and Brooks (2013)).

Radiocarbon date dataset

The dataset in this report lists radiocarbon dates relevant to the age of 39 landslides. As shown in Fig. 1, specifically targeted areas were along the Mer Bleue, Hammond, Bourget and Plantagenet paleochannels (15 landslides), Breckenridge Creek valley (13 landslides), the lower Quyon Valley area (four landslides), and isolated landslides (six) in the Masson, east Ottawa, Hull and Luskville areas (Fig. 1).

The dataset also includes dates from the 'disturbed terrains' at Lefaivre and Treadwell-Grand Presquîle, covering ~56 and ~27 km^2, respectively, which include areas on both sides of the Ottawa River (features 18 and 19 in Fig. 1; see Richard, 1984b; 1991; Aylsworth et al., 2000; Aylsworth and Lawrence, 2003). The origins of these two features, and the similar, but smaller, disturbed area at Wendover (feature 20), are enigmatic and have been variously interpreted to be landslide deposits (Crawford, 1961; Richard, 1980; 1984b), collapse features (Rodriguez et al., 1987), or "seismically disturbed" terrain (Aylsworth et al., 2000; Aylsworth and Lawrence, 2003). The subsurface deposits (up to ~50 m depth) within these areas are composed of variably deformed, folded, faulted and/or rotated deposits of glaciomarine silt and clay, and fluvial sand deposits, similar to sensitive clay

landslide debris. For the purpose of completeness, the dates from these features are included in this report.

Content of the dataset

The landslide radiocarbon dataset consists of 16 tables listing the radiocarbon dates from sites within the Ottawa Valley (Fig. 1). The dates are organized by specific feature or series of multiple landslides, as deemed appropriate, or as is consistent with a published source. A table that is relevant to a specific feature may consist of single or multiple dates, depending on how many samples were collected and/or dated. Fourteen of the tables contain dates relating to a single feature. A date series relates to multiple features within a specific geographical area. There are two date series within this dataset: Table 1 listing dates for 14 landslides located within the area of the Mer Bleue, Hammond, Bourget and Plantagenet paleochannels east of Ottawa, and Table 10 listing dates related to 13 landslides within Breckenridge Valley, near Aylmer, Québec. The date series in Table 1 follows Aylsworth et al. (2000) who originally reported and interpreted the dates, while Table 10 collates multiple dates collected within a valley that has experienced multiple landslides within a relatively confined area.

Content of tables

For each table, a brief paragraph summarizes background information on the landslide (or disturbed terrain) and the dates. Key background information sources related to landslides or dates are cited in the table descriptions or within tables, but it should not be assumed that all relevant literature is mentioned.

Attributes of the dates are listed under nine column headings that provide fundamental information on location, the dated material, dating results, and contextual information between the date and landslide scar or deposit. The column headings are:

Location – a succinct statement as to the location of the landslide. Some statements make reference to informal landslide numbers or names, a nearby town or road(s). Where used, landslide names and numbers follow those used in publications or in the collector's notes.

Sample name/number – that used in a publication or on a sample submission form by the submitter/collector; it presumably relates to their field notes.

Geographical coordinates – these relate to the sampling site and more generally to the landslide feature. All of the geographical coordinates have been plotted on Google Earth to verify the location with respect to the descriptive information on the collection site. In several cases, the published coordinates were clearly erroneous (e.g., Québec collection site, but the coordinates fall on a location in Ontario). Such errors usually are the result of a typo or transposition within one coordinate, which has been corrected, as noted in the respective table. In one case, what are believed to be the correct coordinates were obtained from the unpublished sample submission form. The coordinates listed in such cases, at the very least, are better than those contained in the original published source, but should be considered as an approximation.

Laboratory number – the unique number assigned to the date by the radiocarbon laboratory. All of the dates are from one of three laboratories: GSC – Geological Survey of Canada Radiocarbon Laboratory; Beta – Beta Analytic; and the UCIAMS – University of California Irvine Keck-CCAMS facility.

Radiocarbon age – the radiocarbon ages were determined by either regular or accelerator mass spectrometer (AMS) radiocarbon analysis procedures. The procedures are not identified in the table, but all of the GSC dates are regular radiocarbon ages while all of the Beta and UCIAMS dates are AMS determinations. Regardless of the procedure, all of the dates are derived from wood or terrestrial plant materials and are directly comparable to each another. All of the dates are assumed to have been corrected for $\delta^{13}C$ fractionation except where noted in a table. Of note, the uncertainty of the ages reported by the GSC radiocarbon laboratory are expressed to 2σ, while those of the other laboratory are reported to 1σ as is convention (see Stuiver and Polach, 1977).

Calibrated radiocarbon age – all of the radiocarbon dates were calibrated to calendar years (years before AD 1950) using Calib 6.1 (see Stuiver and Reimer, 1993) and the calibration dataset of Reimer et al. (2009). The calibrated ages are expressed as a single range representing both the full 1σ and 2σ calibration ranges, even where there were two or more intercepts on the calibration curve. The calibration datasets are updated periodically by the radiocarbon dating community, therefore, users of this information are advised to recalibrate specific dates of interest to ensure that they have the most up-to-date calibration determinations.

Collector – person(s) who collected the submitted organic materials.

Comment – these are succinct descriptions that provide context for the radiocarbon dates. They indicate the type of material dated, sample source (e.g., from coring or an exposure), and, as much as possible based on the information available, the stratigraphic and/or geomorphic context between the dated materials and the landslide. Care has been taken to retain the meaning and interpretation in the original descriptions, while providing a consistent structure for the comments. Words appearing in quotes were used in the original published or unpublished sources. Each comment also includes an assessment of whether the age represents a maximum or minimum age for the failure, as understood from the summarized stratigraphic and/or geomorphic context. How well an age is representative of the landslide age is something the users of these dates need to consider and *The Radiocarbon age of a landslide* section provides a general perspective towards this. Where an age is part of a date series, multiple ages in the series will be identified as maximum and/or minimum ages for the landslide. It is recommended that users interested in using the dates consult the original published sources, as available, for possible additional information on the dated organic material(s), the landslides, and the interpretation of the date(s). Perhaps surprisingly, there is limited published information on many of the dated landslides *per se*.

References – the data contained in the table were compiled from published and unpublished sources as cited in this column. Published sources include journal publications and/or published GSC radiocarbon date lists. The listed references are those used in compiling the information on a respective radiocarbon date; no attempt has been made to list publications that otherwise mention or make use of the radiocarbon age. Unpublished sources include the sample submission forms on file at the GSC as well as field notes (where available) pertaining to the collection of samples. These can include sketches of the collection site that are useful in understanding the context between the landslide and the dated material.

Landslides in the area of the Mer Bleue, Hammond, Bourget and Plantagenet paleochannels, Ontario

A number of large prehistoric landslides (up to 5 km^2) are present in the area of the Mer Bleue, Hammond, Bourget and Plantagenet paleochannels, east of Ottawa, Ontario (Figs. 1 and 2; see Lajoie, 1974; Gadd, 1976; Richard, 1982a; 1982b; 1984b; 1991; Aylsworth et al., 2000). The landslides originated from the steep-sided margins of the paleochannel (or terrace) that is generally composed of fine-grained glaciomarine sediments capped with sand. The debris from the landslides flowed onto the adjacent fluvial surface, forming a splayed 'tongue' of debris. Many of the splayed deposits are well preserved and have not been truncated by fluvial erosion, indicating that failures occurred after the abandonment of the paleochannel (or terrace) by the ancestral Ottawa River. Some of the landslide deposits coalesced within the paleochannels, reflecting the close-spacing of the scars (Aylsworth et al., 2000). Table 1 lists 17 radiocarbon dates collected in the late 1990s from 14 landslides each of which has a preserved tongue of landslide deposits. The sample numbers in the table follow Aylsworth et al. (2000) and are keyed to the landslides depicted on the map in Fig. 2. Aylsworth et al. (2000) interpreted 12 of the dates to indicate that 10 of the failures occurred at ~4550 BP (~5115 cal BP) and represent evidence of a paleoearthquake event. Aylsworth and Lawrence (2003) estimated this paleoearthquake to be M_w 6.2 or greater. Table 2 lists a date collected from beneath a landslide deposit nearby at Masson, Québec (landslide 15 in Fig. 2), which has a similar age to many of the dates in this table.

Table 1 List of radiocarbon dates related to the age of landslides in the area of the Mer Bleue, Hammond, Bourget and Plantagenet paleochannels, Ontario.

Location	Sample number /name	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector [a]	Comment	References
Landslide 1, Mer Bleue paleochannel	1; JA98-7-01	N 45.4139º W 75.2792º	Beta-127245	4570 ± 70	1σ: 5055-5443 2σ: 4979-5467	JMA	Date derived from isolated pieces of "sticks and bark" sampled at 0.36 m depth from "black organic layer", ~15 cm (6 in) thick, in "distorted landslide debris" within core recovered from pond on landslide scar. Date represents a maximum age for landslide 1.	Aylsworth et al. (2000).
Landslide 2, Hammond paleochannel	2a; HAM 95-1	N 45.4611º W 75.2611º	Beta-90880	4470 ± 80	1σ: 4976-5286 2σ: 4874-5308	TL	Date derived from wood sampled at 1.30 m depth in core recovered from "large" pond impounded against valley-side wall. Wood contained within "contorted layer of clay and organic material with wood"	Aylsworth et al. (2000); unpublished GSC data.

							that is overlain by fibrous peat. Date interpreted to represent maximum age for landslide 2.	
Landslide 2	2b; HAM 95-3	As above.	Beta-90881	3050 ± 70	1σ: 3163-3360 2σ: 3007-3438	TL	Data derived from wood sampled at 0.80 m depth in same core as above. Wood sample contained within bed of "contorted clay plus organics with wood", extending from 0.7-1.10 m depth, that is over- and underlain by deposits of stratified, fibrous peat. Date represents maximum age for a possible second failure at site of landslide 2.	Aylsworth et al. (2000); unpublished GSC data.
Landslide 3, Hammond paleochannel	3; LV98-08-04	N 45.4417º W 75.2222º	Beta-122473	4590 ± 40	1σ: 5087-5445 2σ: 5055-5460	AG and JG	Date derived from "good sized" piece of wood within sandy clay at 0.57 m depth in core recovered from pond situated between well-defined ridges on landslide. Date represents a minimum age for landslide 3.	Aylsworth et al. (2000).
Landslide 4, Mer Bleue paleochannel	4; LV98-12-02	N 45.4424º W 75.1924º [b]	Beta-122475	2760 ± 50	1σ: 2786-2921 2σ: 2759-2963	AG and JG	Date derived from "two twigs and organic matter" sampled from sand at 0.60 m depth in core recovered from pond on landslide. Pond contained between well-defined landslide ridges in wooded area. Date represents a minimum age for landslide 4.	Aylsworth et al. (2000).
Landslide5, Bourget paleochannel	5; JA98-2-01	N 45.5416º W 75.2416º	Beta-127281	5130 ± 60	1σ: 5753-5937 2σ: 5726-5995	JMA	Date derived from large piece of wood sampled from clay at 4.50 m depth in core recovered from landslide deposit. Sample situated near bottom of the landslide debris. Date represents a maximum age for landslide 5.	Aylsworth et al. (2000).
Landslide 6, Bourget paleochannel	6; JA98-6	N 45.5208º W 75.2667º	Beta-127284	4440 ± 80	1σ: 4889-5277 2σ: 4867-5295	JMA	Date derived from outer rings of large log (hemlock) contained within landslide debris on landslide tongue. Log collected by local farmer at unknown depth from an excavation. Date represents a maximum age for landslide 6.	Aylsworth et al. (2000).
Landslide 7, Bourget paleochannel	7a; JA98-3A-02	N 45.50º W 75.2028º	Beta-127243	4450 ± 70	1σ: 4967-5281 2σ: 4875-5291	TL	Date derived from a stick at 3.0 m depth in core recovered from landslide tongue near toe. Entire core composed of mixed	Aylsworth et al. (2000).

							red and grey clay and sand layers that are "very contorted" and "some mixed"; "lots of organic bits" are present. Date represents a maximum age for landslide 7.	
Landslide 7	7b; JA-98-3C-01	As above.	Beta-127244	4570 ± 70	1σ: 5055-5443 2σ: 4979-5467	TL	Date derived from "two small sticks" sampled at 5.33 m depth in same core as above. Date represents a maximum age for landslide 7.	Aylsworth et al. (2000).
Landslide 8, Bourget paleochannel	8; LV98-06-04	N 45.4833º W 75.1917º	Beta-122472	4520 ± 50	1σ: 5056-5300 2σ: 4979-5315	AG and JG	Date derived from "small organic bits" within sand sampled from 0.45 m depth in core recovered from pond formed between ridges near headscarp. Sand overlain by thick organic layer. Date represents a minimum age for landslide 8.	Aylsworth et al. (2000).
Landslide 9, Bourget paleochannel	9; JA98-4-01	N 45.475º W 75.1292º	Beta-127282	4540 ± 90	1σ: 5045-5430 2σ: 4881-5466	TL	Date derived from piece of wood sampled at 4.65 m depth in core recovered from landslide tongue near toe. Sample contained within "clayey organic layer" "surrounded by dense red and grey clay bands". Date represents a maximum age for landslide 9.	Aylsworth et al. (2000).
Landslide 10, Plantagenet paleochannel	10; JA98-5-01	N 45.525º W 75.0111º	Beta-127283	4530 ± 60	1σ: 5055-5308 2σ: 4974-5442	JMA	Date derived from "wood pieces" of a single log that was buried ~1 m deep in black peaty organic layer with numerous logs. Organic layer overlain with clay, 0.5 m thick, and exposed for several hundred meters in ditch excavated into landslide tongue. Sampled log was 23 cm long, saturated and very soft. Date represents a maximum age for landslide 10.	Aylsworth et al. (2000).
Landslide 11, Plantagenet paleochannel	11a; LV98-17-03	N 45.5139º W 75.0028º	Beta-122477	4450 ± 50	1σ: 4971-5276 2σ: 4878-5288	AG and JG	Date derived form "large seed" sampled at 0.37 m in core recovered from pond contained between well-defined landslide ridges. Sampled material contained within soft grey clay. Date represents a maximum age for landslide 11.	Aylsworth et al. (2000); unpublished GSC data.

Landslide 11	11b; LV98-17-04	As above.	Beta-122478	4700 ± 50	1σ: 5325-5573 2σ: 5318-5581	AG and JG	Date derived from "large sample of mixed organic material and seed", sampled at 0.49 m in same core as above. Sample contained within black organic layer. Date represents a maximum age for landslide 11.	Aylsworth et al. (2000).
Landslide 12, Plantagenet paleochannel	12; LV98-01-02	N 45.5185º W 74.9557º [c]	Beta-122471	1870 ± 40	1σ: 1739-1868 2σ: 1712-1890	AG and JG	Date derived from "minute grassy pieces" sampled at 0.42 m depth in core recovered from pond. Pond located between ridges, but impounded by beaver dam. Sampled material contained within very soft grey clay with organic strands; additional layers of sand and red and grey clay in core. Date represents a minimum age for landslide 12.	Aylsworth et al. (2000).
Landslide 13, Plantagenet paleochannel	13; JA98-1A-02	N 45.5138º W 74.9375º	Beta-127242	4820 ± 70	1σ: 5470-5642 2σ: 5326-5709	JMA	Date derived from piece of wood sampled at 1.88 m depth in core recovered from landslide tongue, ~45 m (150 ft) from edge of toe. Wood was contained within organic layer, 8 cm thick, buried in clayey debris, near base of landslide deposit. Date represents a maximum age for landslide 13.	Aylsworth et al. (2000).
Landslide 14, Ottawa River Terrace	14; LV98-09B-02	N 45.5361º W 75.1583º	Beta-122474	4470 ± 50	1σ: 4980-5280 2σ: 4891-5302	AG and JG	Date derived from sample of shattered bark and wood, sampled at 0.42 m depth in core recovered from pond contained between well-defined ridges near headscarp. Bark and wood contained within sand. Date represents a minimum age for landslide 14.	Aylsworth et al. (2000).

[a] JMA - Jan Aylsworth; AG - Alain Grenier; JG - Joanna Guertin; TL - Ted Lawrence.

[b] Coordinates in Aylsworth et al. (2000) fall about 5 km north of the landslide scar. The listed coordinates are based on the sample site shown on an annotated field map and a general description of the location, but they should be regarded as an approximation. The revised coordinates are consistent with the sample location shown on Fig. 2.

[c] Coordinates in Aylsworth et al. (2000) fall just north of the landslide backscarp. The listed coordinates are based on the sample site shown on an annotated field map and a general description of the location, but they should be regarded as an approximation. The revised coordinates are consistent with the sample location shown on Fig. 2.

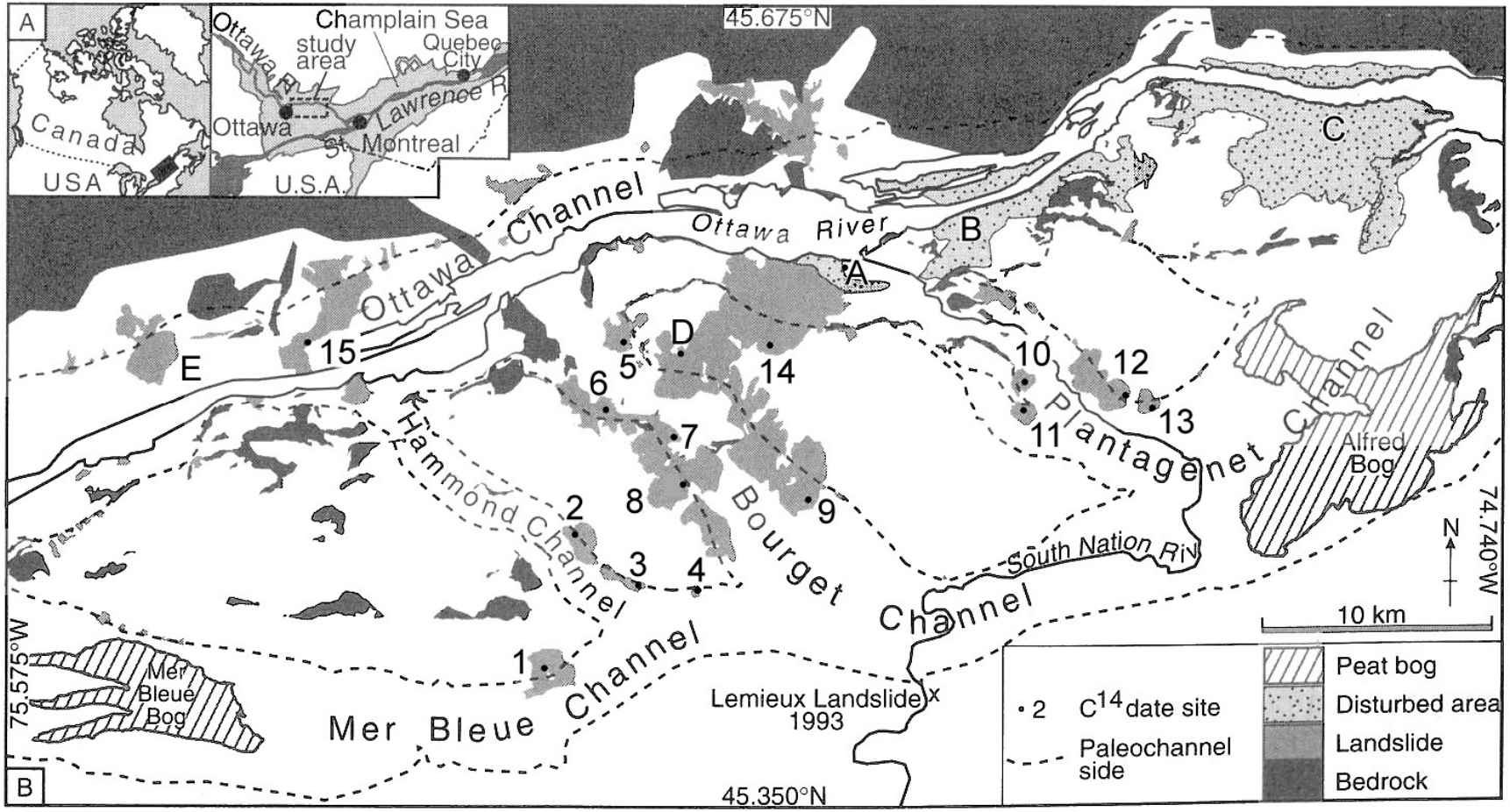


Fig. 2 Map showing the large landslides along the Mer Bleue, Hammond, Bourget and Plantagenet paleochannels, and terraces along the Ottawa River east of Ottawa, Ontario (modified from Aylsworth et al., 2000). The landslide site numbers 1 to 14 correspond to the sample numbers listed with each date listed in Table 1; a small black dot on the numbered landslides marks the sample collection locations. The landslide labeled as '15' is the location of the Masson landslide, listed in Table 2. The areas labeled A, B, C, D and E are the Wendover (Table 7), Treadwell (Table 6) and Lefaivre (Table 5), disturbed terrains, and the single Bourget (Table 3) and Angers (Table 4) landslides, respectively.

Landslide just east of Masson, Québec

A large landslide is present just east of Masson, Québec (Fig. 1), as shown on Richard (1991) and as landslide '15' in Fig. 2. The landslide retrogressed into fine-grained deposits underlying the Champlain Sea plain and flowed onto an abandoned terrace (or terraces) of the Ottawa River and the river floodplain. The map-unit polygon is unusually-shaped, with the intermediate portion of the deposit shown with two striking bends in landslide outline. The single date listed in Table 2 provides a maximum age for the landslide, but there is uncertainty on the location of the collection site, as mentioned in the comment. The age of this landslides coincides with those of 10 of the landslides listed in Table 1. Aylsworth et al. (2000) interpreted these eleven similarly aged landslides as evidence of a paleoearthquake event at ~4550 BP (~5115 cal BP).

Table 2 Radiocarbon date from landslide east of Masson, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector [a]	Comment	References
Landslide just east of Masson, Québec. Landslide 15 of Aylsworth et al. (2000)	J.D.-1972-1	N 45.5437 º W 75.4011º [b]	GSC-1922	4620 ± 80 [c,d]	1σ: 5305-5447 2σ: 5087-5469	JD	Date derived from wood of white pine (*Pinus stobus*) sampled from "complete tree" within sandy soil, buried beneath 2 m of "mudflow slide" clay. Wood sample was exposed along stream course incised through landslide deposit. Date represents a maximum age for landslide 15. Sample collected in 1972.	Unpublished GSC data; Lowdon and Blake (1973).

[a] JD - J. Dumanski.

[b] This location differs from the geographic coordinates published in Lowdon and Blake (1973). Their geographical coordinates (N 45º 31', W 75º 25') are identical to those on the GSC sample submission form, but define a location beside the Ottawa River channel in Ontario due south of the village Masson. The sample submission form also provides a grid location of 18TWF 690430, which differs in location from the geographical coordinates. This location is 1.5 km east of the main cross-street in Masson and is situated on the landslide deposit. The location, however, is in the middle of a field rather than along a stream bank, which is the described site on the sample submission form. The geographical coordinates in this table are the decimal degree equivalent of the grid location. While more reasonable than the previously published coordinates, this position must be regarded as an approximation.

[c] Radiocarbon age uncorrected for $\delta^{13}C$ fractionation.

[d] The uncertainty of this age is reported to two standard deviations.

Landslide along Bourget paleochannel, east of Ottawa, Ontario

A number of large landslides are present along the Bourget paleochannel in the Rockland-Bourget area, east of Ottawa, Ontario (Fig. 2). Dates related to the age of five of the landslides are listed in Table 1 that were reported by Aylsworth et al. (2000). Table 3 lists a date derived from organic material collected from within the scar of a sixth large landslide along the Bourget paleochannel ('D' in Fig. 2), but yielded a *modern* radiocarbon age. This should be considered as an unrepresentative minimum age for the landslide, however, until additional chronological data can verify this young age or an account is found confirming the occurrence of a major landslide historically at this site.

Table 3 Radiocarbon date from landslide scar located 5 km southeast of the village of Clarence Creek, Bourget paleochannel, Rockland-Bourget area, east of Ottawa, Ontario.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector [a]	Comment	References
Landslide along Bourget paleochannel in area of Rampage and Baseline roads	LV98-14-05	N 45.5361º W 75.1972º	Beta-122476	modern	na	AG and JG	Date derived from "small twigs" sampled from 1.09 m depth in core recovered from pond located between well defined landslide ridges within landslide scar. Sample material contained within sand. Date represents a minimum age for landslide, but likely is substantially younger than the landslide.	Unpublished GSC data.

[a] AG - Alain Grenier; JG - Joanna Guertin.

Landslide at Angers, Québec

A large landslide is present at the village of Angers, Québec, as shown on Richard (1991) and in Fig. 1 and as 'E' in Fig. 2. The failure originated by retrogressing into fine-grained deposits underlying the Champlain Sea plain along the side of a scarp along the margin of an Ottawa River terrace. The landslide deposit is splayed across an alluvial terrace of the Ottawa River and is shown to terminate just beyond the margin of a lower alluvial terrace. Table 4 lists two radiocarbon dates that were collected from different locations on the landslide deposit; one (GSC-6822) on the upper terrace surface and the other (GSC-2068) on the lower terrace. The geographical coordinates of GSC-2068 fall just beyond the mapped toe of the landslide, but likely are contained within landslide deposit, based on the description of the collection site in Lajoie (2001) and the age similarity with the other date. Both dates represent maximum ages for the 'Angers landslide'.

Table 4 Radiocarbon dates related to age of landslide at Angers, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector [a]	Comment	References
Landslide at Angers, Québec	PL-73-58b	N 45.5208º W 75.4917º [b]	GSC-2068	6240 ± 70[c]	1σ: 7032-7251 2σ: 7020-7257	PGL	Date derived from "branch of tree" (*Quercus sp. cf. Quercus borealis*), 9 cm diameter, sampled at ~3.5 m from within a trench excavated into landslide deposit. Sampled material was coated with a thin layer of sand and embedded in clay. Date represents a maximum age for Angers landslide.	GSC Unpublished data; McNeely (1989); Lajoie (2001).
Landslide at Angers	DL-2003-1	N 45.5369º W 75.4861º	GSC-6822	6140 ± 70[c]	1σ: 6955-7155 2σ: 6945-7160	DL	Date derived from "well-preserved" piece of "trunk or branch", sampled from excavation site of a new sewer line. Sampled material was retrieved from 3 m depth within landslide debris. Date represents a maximum age for Angers landslide.	Unpublished GSC data.

[a] PGL – Paul Lajoie; DL – Ted Lawrence.
[b] These coordinates are from the GSC sample submission form.
[c] The uncertainty of this age is reported to two standard deviations.

Lefaivre disturbed terrain, Ontario-Québec

The Lefaivre disturbed terrain, Ontario-Québec, is an area characterized by rolling hummocks and closed depressions that covers 46 km^2 on both sides of the Ottawa River in the general area of the village of Lefaivre, Ontario (Fig. 1 and 'C' in Fig. 2; see Aylsworth et al., 2000; Aylsworth and Lawrence, 2003). The terrain is composed of variably deformed, folded, faulted and/or rotated deposits of glaciomarine silt and clay, and fluvial sand. The origin of the ground disturbance is enigmatic and has been interpreted as representing a landslide deposit (Crawford, 1961; Richard, 1984b), collapse features (Rodriguez et al., 1987), and 'seismically disturbed' terrain (Aylsworth et al., 2000; Aylsworth and Lawrence, 2003). Two similar, also enigmatic, areas of rolling hummocky terrain exist nearby at Treadwell-Grand Presquîle, Ontario-Québec, and Wendover, Ontario (see tables 6 and 7, respectively). The two dates listed in Table 5 provide the only chronological control on the Lefaivre disturbed terrain; one represents a minimum, the other a maximum age. The two dates are not in accord, but the younger one is probably more representative of the age of the disturbance.

Table 5 Radiocarbon dates from the Lefaivre disturbed terrain, Ontario-Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comments	References
Lefaivre disturbed terrain, Ontario-Québec	na	N 45.6197º W 74.8480º	GSC-6470	7060 ± 80[b]	1σ: 7851-7941 2σ: 7795-7965	JMA	Date derived from outer 16-18 rings of tree buried, 1.5 m deep, within deformed clay sediments. Date represents a maximum age for the formation of the Lefaivre disturbed terrain.	Aylsworth et al. (2000); GSC unpublished data.
Lefaivre disturbed terrain	na	N 45.6152º W 74.8500º	GSC-6173	7530 ± 90[b]	1σ: 8325-8397 2σ: 8206-8413	TA and DG	Date derived from basal organic detritus-rich clay recovered in core, between 3.63-3.68 m depth, from the centre of pond, 4.6 km SE of village of Lefaivre, Ontario. Date represents a minimum age for the onset of organic deposition within pond and is inferred to represent a minimum age for the formation of the Lefaivre disturbed terrain.	Unpublished GSC data.

[a] TA – Thane Anderson; JMA – Jan Aylsworth; DG – Doug Grant.
[b] The uncertainty of this age is reported to two standard deviations.

Treadwell disturbed terrain, Ontario-Québec

The Treadwell disturbed terrain, Ontario-Québec, is an area characterized by rolling hummocks covering at least 21 km^2 on the Ontario side of the Ottawa River near the Village of Treadwell, Ontario, and on Grand Presquîle and Petit Presquîle, Québec (Fig. 1 and 'B' in Fig. 2; see Richard, 1984b; 1991). The terrain is composed of variably deformed, folded, faulted and/or rotated deposits of glaciomarine silt and clay, and fluvial sand. The origin of the ground disturbance is enigmatic and has been interpreted as representing a landslide deposit (Lajoie 1974; Richard 1980; 1984b; Lajoie, 2001) and 'seismically disturbed' terrain (Aylsworth et al., 2000; Aylsworth and Lawrence, 2003). The three radiocarbon dates listed in Table 6 provide the only chronological control on this area. The relationship between the terrain disturbance and these ages, however, is not unequivocal, as mentioned in the comments. Two similar, also enigmatic, areas of hummocky terrain exist nearby in the areas of Lefaivre, Ontario, and Wendover, Ontario (see Tables 5 and 7).

Table 6 Radiocarbon dates from the Treadwell disturbed terrain, Ontario-Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Treadwell disturbed terrain, Ontario-Québec	TreadLog 09-06-B	N 45.5798º W 75.0426º	UCIAMS-71217	7105 ± 20	1σ: 7884-7962 2σ: 7871-7971	GRB and BEM	Date derived from five *Scirpus* achenes (three achenes with partial bristles attached)[b], sampled between 1.81-1.83 m depth at base of lowest of three peat layers exposed along side of drainage ditch at corner of agricultural field. Date represents minimum age for the initiation of peat accumulation. If peat formed in response to the formation of Treadwell disturbed terrain, then date also represents a minimum age for the ground disturbance, although this is not unequivocal.	Unpublished GSC data.
Treadwell disturbed terrain	TreadLog 09-02-4	N 45.5793º W 75.0440º	UCIAMS-71216	7020 ± 20	1σ: 7839-7926 2σ: 7795-7932	GRB and BEM	Date derived from seven alder (*Alnus incana*) nutlets[b] sampled between 2.78-2.80 m depth near base of peat and organic detritus deposit, exposed along side of drainage ditch on agricultural field. Date represents minimum age for initiation of peat and organic detritus	Unpublished GSC data.

							accumulation. If peat and organic detritus deposit accumulated in response to the formation of Treadwell disturbed terrain, then date also represents a minimum age for the disturbance, but this is not unequivocal.	
Treadwell disturbed terrain	TreadLog 09-02-3	As above.	UCIAMS-71215	6790 ± 20	1σ: 7615-7559 2σ: 7593-7670	GRB and BEM	Date derived from wood of birch log with bark sampled at. 2.68 m depth at same location as date above. Date also represents minimum age for initiation of peat and organic detritus accumulation at this site. If peat and organic detritus deposit accumulated in response to the formation of Treadwell disturbed terrain, then date also represents a minimum age for the disturbance, but this is not unequivocal.	Unpublished GSC data.

[a] GRB – Greg Brooks; BEM – Barbara Medioli.
[b] Identified by A. Telka, Paleotec Services.

Wendover disturbed terrain, Ontario

The Wendover disturbed terrain, Ontario, is an area characterized by gently rolling hummocks, covering at least 2.5 km^2 (Fig. 1 and 'A' in Fig. 2). The terrain is composed of variably deformed, folded, faulted and/or rotated deposits of glaciomarine silt and clay, and fluvial sand. The topography of disturbed terrain at Wendover is more subtle than those in the areas of Lefaivre and Treadwell, Ontario (see Tables 5 and 6), but the disturbance is well defined in the sub-surface. The origin of the ground disturbance is enigmatic and has been mapped non-genetically as "deformed marine sediment" by Richard (1991), and interpreted as "seismically disturbed" terrain by Aylsworth et al. (2000) and Aylsworth and Lawrence (2003). The five radiocarbon dates listed in Table 7 represent the only chronological control on the Wendover disturbed terrain. The relationship between the terrain disturbance and these ages, however, is not unequivocal, as mentioned in the comments.

Table 7 Radiocarbon dates from the Wendover disturbed terrain, Ontario-Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Wendover disturbed terrain, Ontario	Wendover 09-02-C	N 45.5702º W 75.1156º	UCIAMS-71211	7140 ± 20	1σ: 7945-7978 2σ: 7937-8004	GRB and BEM	Date derived from wood of willow (*Salix* sp.) twig[b], sampled between 2.98-3.00 m depth, at approximate base of 10 m-wide, depression-filling accumulation of organic detritus materials (e.g., logs, branches, twigs and leaves) exposed at NW corner of rainfall runoff retention basin. Date represents minimum age for the start of accumulation of organic detritus in depression. If the accumulation of organic detritus has occurred in response to the disturbance of the Wendover disturbed terrain, then date also represents a minimum age for the ground disturbance, although this is not unequivocal.	Unpublished GSC data.

Wendover disturbed terrain	Wendover 09-02-A	As above.	UCIAMS-71210	7015 ± 20	1σ: 7835-7925 2σ: 7792-7931	GRB and BEM	Date derived from wood of buried log, 25 cm diameter, sampled at ~2.7 m depth at same site as above. Date also represents minimum age for the start of accumulation of organic detritus in depression, as above. If the accumulation of organic detritus has occurred in response to the disturbance of the Wendover disturbed terrain, then date also represents a minimum age for the ground disturbance, although this is not unequivocal.	Unpublished GSC data.
Wendover disturbed terrain	Wendover 09-03-A	N 45.5681º W 75.1233º	UCIAMS-71212	6950 ± 20	1σ: 7738-7824 2σ: 7704-7837	GRB and BEM	Date derived from eastern white pine (*Pinus strobus*) needles[b] sampled from between 0.68-0.70 m depth within reworked clay deposit containing sporadic organic material, situated 0.15 m below base of peat layer. Peat accumulated within depression that was exposed along drain ditch, 125 m ENE of corner of Regional Road 19 and Highway 17. Date represents minimum age for the start of accumulation of organic detritus in depression. If the accumulation of organic detritus has occurred in response to the disturbance of the Wendover disturbed terrain, then date also represents a minimum age for the ground disturbance, although this is not unequivocal.	Unpublished GSC data.
Wendover disturbed terrain	Wendover 09-03-B	As above.	UCIAMS-71213	6635 ± 25	1σ: 7499-7566 2σ: 7472-7572	GRB and BEM	Date derived from larch (*Larix laricina*) needle fragments[b] sampled from between 0.57-0.60 m relative depth within reworked clay deposit containing small 'clumps' of organic materials 0.1 m below base in same peat layer, as above. Date represents minimum age for the start of accumulation of organic detritus in depression, as above. If the accumulation of organic detritus has occurred in response to the disturbance of the Wendover disturbed terrain, then	Unpublished GSC data.

							date also represents a minimum age for the ground disturbance, although this is not unequivocal.	
Wendover disturbed terrain	Wendover 09-03-C	As above.	UCIAMS-71214	6615 ± 20	1σ: 7480-7560 2σ: 7445-7566	GRB and BEM	Date derived from eastern white pine (*Pinus strobus*) fascicle[b] with needles attached that was sampled at 0.5 m relative depth at base in same peat layer, as above. Date represents minimum age for the start of accumulation of organic detritus in depression, as above. If the accumulation of organic detritus has occurred in response to the disturbance of the Wendover disturbed terrain, then date also represents a minimum age for the ground disturbance, although this is not unequivocal.	Unpublished GSC data.

[a] GRB – Greg Brooks; BEM – Barbara Medioli.
[b] Identified by A. Telka, Paleotec Services.

Landslide at Beacon Hill, Gloucester, Ottawa, Ontario

The landslide at Beacon Hill (~2.0 Mm^3) is located in the suburb of Beacon Hill in east Ottawa, Ontario (Fig. 1; see summary of landslide by Aylsworth et al., 1997); the site is now completely covered by urban development. (Note, the location is referred as "Green Creek" or "Green Creek slide" in Lowdon et al. (1967) and Eden (1967), although the landslide did not occur along Green Creek, which is located 1.1 km away.) The landslide originated from a steeply-sloped scarp forming the margin of a broad, flat terrace of the ancestral Ottawa River. The debris splayed onto the terrace forming a large depositional lobe that remains intact and is readily visible on pre-development aerial photographs. The site was investigated in the 1960s, as reported by Crawford and Eden (1967), Eden (1967) and Jarrett and Eden (1970). The single date from this landslide listed in Table 8 was yielded from wood recovered in 1960 from a boring. A deep sewer trench excavated into the landslide deposit in 1966 exposed a buried soil and organic materials (peat, wood, trees) considered to be contemporary with the dated wood (see Eden, 1967). The single date represents a maximum ages for the Beacon Hill landslide. Brooks (2013) correlated the age of the Beacon Hill landslide to nine other landslides in the Ottawa-Pontiac region (see Tables 10, 11, 12, 13, 14 and 15) and hypothesized that they represent evidence of a paleoearthquake at ~1020 cal BP of estimated magnitude of at least M_w 6.1.

Table 8 Radiocarbon date from landslide at Beacon Hill, Gloucester, Ottawa, Ontario.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector [a]	Comment	References
Beacon Hill landslide, Gloucester, Ottawa, Ontario	NRC 90-30	N 45.4528º W 75.5960º [b]	GSC-550	1140 ± 150[c]	1σ: 972-1166 2σ: 938-1176	WJE	Date derived from two wood samples sampled at 6.79 m (22.3 ft), and 7.71 m (25.3 ft) depth in core recovered from apron of "flowslide" on Ottawa River terrace. The material was enclosed entirely in remolded clay. Wood samples assumed to be from same branch. Wood probably associated with soil buried beneath landslide debris that was revealed by later excavations in area. Date represents a maximum for landslide.	Lowdon et al. (1967); unpublished GSC data.

[a] WJE - W.J. Eden.
[b] These coordinates are from the GSC sample submission form and are located on the splayed landslide deposit.
[c] The uncertainty of this age is reported to two standard deviations.

Landslide along Jomonville Street, Hull, Gatineau, Québec

A large area of landsliding in the northern part of Hull (now part of Gatineau), Québec, is shown on Richard (1982a); this area is now covered by urban development. The single date listed in Table 9 and shown on Fig. 1 was collected in 1972 from a geotechnical borehole along Jomonville Street within the mapped landslide area. The context of the collected sample (depth of collection and type of enclosing material) is provided only broadly and there is uncertainty on the location of the boring site, which prevents relating the radiocarbon age to a specific landslide deposit or landslide scar. This single date represents a maximum age of a 'young' landslide in the Jomonville Street area that possibly occurred historically.

Table 9 Radiocarbon date from landslide deposit along Jomonville Street, Hull, Gatineau, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector [a]	Comment	References
Jomonville Street, Hull, Québec	PL-72-43	N 45.4650º W 75.7513º [b]	GSC-1741	120 ± 150 [c]	1σ: -3-268 2σ: -4-285	BH	Single piece of white pine (*Pinus strobus*) recovered from 10 m depth in borehole "on natural slope". Sampled material enclosed in saturated clay. Date represents a maximum age for landslide that is 'young'.	Lowdon and Blake (1973); unpublished GSC data.

[a] BH - B. Hopkins.

[b] The geographical coordinates in Lowdon and Blake (1973) and given on the GSC sample submission form fall 2.1 km due south of Jomonville Street, Hull, Gatineau, Québec. The latitude of the coordinates in the table has been adjusted so that the location is positioned on Jomonville Street (which is oriented east-west) using the original longitude. The location defined by these coordinates, however, must be considered as an approximation.

[c] The uncertainty of this age is reported to two standard deviations.

Landslides along Breckenridge Valley, near Aylmer, Québec

Breckenridge Creek is a small tributary of the Ottawa River, draining ~66 km^2 and located ~14 km northwest of Aylmer (now part of Gatineau), Québec (Fig. 1). Thirty-one landslide scars from distinctly separate failures are clustered within ~11 km^2, where the creek and its major tributaries are incised up to 30 m deep in fine-grained Champlain Sea deposits (Brooks and Medioli, 2011); numbers informally assigned to the scars (and referred to in Table 10, below) are shown in Fig. 3). The landslides include three scars (numbered 27 to 29) located along a scarp above an erosional fluvial terrace of the ancestral Ottawa River and two smaller landslides that occurred historically in 1963 and 2008. Table 10 lists 55 radiocarbon dates of which 52 of these are relevant to the age of 13 of the landslides. In some cases, however, the relationship of a date (or group of dates) to a specific landslide scar is not unequivocal because of the density of the scars and uncertainty as to the origin of the landslide debris containing or overlying the dated material(s). In such cases, the connection between a date and landslide scar is based on local geomorphology and/or proximity, and is indicated in the table as an *interpreted* relationship. Of note, one date (GSC-3337) is not attributed to any landslide because the collection site is located far from an obvious source scar. Also, two dates (GSC-6313 and GSC-6315) relate to the age of a mudflow that descended Breckenridge Creek. Brooks (2013) correlated the scars 1, 9, 13 and 15 to six other landslides in the Ottawa-Pontiac region (see Tables 8, 11, 12, 13 and 15) and hypothesized that they represent evidence of a paleoearthquake at ~1020 cal BP with an estimated magnitude of at least M_w 6.1.

Overview of dates in Table and how they related to scars:

Scar 1 – represented by three dates that are maximum ages for the landslide.

Scar 2 – represented by ten dates, but the four youngest ages are interpreted to be poorly representative of the landslide age. The oldest six ages represent three maximum and three minimum ages that bracket the timing of the landslide.

Scar 3 – interpreted to be represented by five dates that are maximum ages for the landslide.

Scar 4 – represented by three dates; one minimum and two maximum ages. The two maximum ages are representative of the landslide age, while the minimum age is substantially younger and interpreted to be unrepresentative.

Scar 9 – represented by three dates that are maximum ages for the landslide.

Scar 11 – represented by a single minimum age that may be significantly younger than the landslide age.

Scar 12 – represented by a single date that is a maximum age for the landslide age.

Scar 13 – represented by 11 dates that are maximum ages for the landslide.

Scar 15 – represented by four dates that are maximum ages for the landslide.
Scar 17 – represented by a single date that is a maximum age for the landslide.
Scar 18 – represented by four minimum age, two of which are substantially younger than the landslide.
Scar 19 – represented by five dates; one represents a minimum age that is significantly younger than the landslide, and four maximum ages for the landslide.
Scar 22 – represented by one minimum age that may be substantially younger than the landslide.
Unknown scar – one date that does not seem to be related to any scar.
Mudflow deposits(s) – two dates representing maximum ages of a mudflow deposit located along the lower course of Breckenridge Valley downstream of the landslide area (Fig. 3).

Table 10 Radiocarbon dates from Breckenridge Valley, near Aylmer, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Scar 1, Breckenridge Valley	Brkwood-01, sample 1	N 45.4829º W 75.9349º	UCIAMS-88796	1125 ± 15	1σ: 986-1056 2σ: 978-1061	GRB and BEM	Date derived from small tree branch with bark contained within buried humic/wood-rich layer exposed along side of scarp of landslide that occurred in 2008. Organic material is buried beneath landslide debris and situated ~5.7 m below top of terrace. Source area of overlying landslide debris is uncertain, but most obvious location is scar 1 on opposite side of creek valley. Date interpreted to represent maximum age for scar 1 landslide.	Brooks (2013).
Scar 1	Brkwood-01, sample 2	As above.	UCIAMS-88797	1115 ± 15	1σ: 980-1055 2σ: 974-1058	GRB and BEM	Date derived from outer rings of branch with bark contained within same buried organic-rich layer, as above. Date interpreted to represent maximum age for scar 1 landslide.	Brooks (2013).
Scar 1	Brkwood-01, sample 3	As above.	UCIAMS-88798	1205 ± 15	1σ: 1087-1172 2σ: 1069-1174	GRB and BEM	Date derived from outer rings of log partially covered with bark contained within same buried organic-rich layer, as above. Date interpreted to represent maximum age for scar 1 landslide.	Brooks (2013).

Scar 2, Breckenridge Valley	Core Breck 21-01A	N 45.4851º W 75.9339º	Beta-131934	1190 ± 40	1σ: 1064-1171 2σ: 983-1256	JG and RM	Date derived from "large stick" sampled between 0.42-0.45 m depth in 0.48 m long core recovered from pond on scar 2. Sample encapsulated within "grey clay with mixed organics". Pond is impounded behind edge of levee formed by landslide debris from scar 1, although modern level of pond is influenced by beaver dam. Date represents minimum age for scar 2 landslide, but landslide is interpreted to be significantly older.	Unpublished GSC data.
Scar 2	Core Brkcore-10A, sample 1, 0.79-0.81 m depth	N 45.4853º W 75.9363	UCIAMS-88704	2805 ± 20	1σ: 2871-2941 2σ: 2856-2956	GRB	Date derived from birch twig with bark sampled from organic layer, between 0.79-0.81 m depth, in 0.94 m long core recovered from perennial wetland on scar 2. Wetland is located on scar impounded behind levee of scar 1, although modern level of pond is influenced by beaver dam. Organic layer overlain by bed of clay with organic-rich bands (0.72-0.79 m depth) and bed of grey silt-clay (0.21-0.72 m depth). Date represents minimum age for scar 2 landslide.	Unpublished GSC data.
Scar 2	Core Brkcore-10A, sample 2, 0.92-0.94 m depth	As above.	na[b]	2872 ± 20	1σ: 2955-3060 2σ: 2929-3072	GRB	Date derived from branched leafy shoot of *Thuja occidentalis* (eastern white cedar)[c] sampled from 0.92-0.94 m depth in same core, as above. Date represents minimum age for scar 2 landslide.	Unpublished GSC data.
Scar 2	Core Brkcore-10A, sample 3, 0.92-0.94 m depth	As above.	na[d]	2852 ± 18	1σ: 2929-2997 2σ: 2882-3061	GRB	Date derived from terminal twig (with some needles attached) of *Tsuga Canadensis* (eastern Hemlock)[c] sampled from 0.92-0.94 m depth in same core, as above. Date represents minimum age for scar 2 landslide.	Unpublished GSC data.

Scar 2	Core Brkcore-11A, 0.70-0.75 m depth	N 45.4865º W 75.9327º	UCIAMS-88709	3220 ± 20	1σ: 3403-3453 2σ: 3387-3470	GRB	Date derived from wood fragment sampled between 0.70-0.75 m depth in 2.24 m long core recovered from perennial wetland in depression between ridges on scar 2. Sample contained within bed of mottled clay-silt with organic materials and wood fragments that was situated 23-30 cm above landslide deposit. Date represents minimum age for scar 2 landslide, but is stratigraphically higher and therefore less representative than the two older dates from this core (below).	Unpublished GSC data.
Scar 2	Core Brkcore-11A, sample 1, 0.96-1.00 m depth	As above.	UCIAMS-88707	3390 ± 20	1σ: 3591-3686 2σ: 3581-3690	GRB	Date derived from twig with bark sampled at 0.96-1.0 m depth from same core as above. Sample situated at base of post-landslide sediments that overlie stiff silt-clay landslide deposit. Date represents minimum age for scar 2 landslide.	Unpublished GSC data.
Scar 2	Core Brkcore-11A, sample 2, 0.96-1.00 m depth	As above.	UCIAMS-88708	3420 ± 20	1σ: 3640-3693 2σ: 3595-3811	GRB	Date derived from twig fragment (lacking bark) sampled between 0.96-1.0 m depth in same core as above. Date represents minimum age for scar 2 landslide.	Unpublished GSC data.
Scar 2	Brkwood-03, sample 3	N 45.4839° W 75.9330°	UCIAMS-88801	3460 ± 15	1σ: 3691-3818 2σ: 3644-3826	GRB and BEM	Date derived from outer portion of log with bark, ~8 cm diameter, that was contained within buried humic /wood-rich layer exposed in terrace along tributary B of Breckenridge Creek. Organic layer is buried beneath landslide debris and located 2.6-2.8 m below top of terrace. Landslide debris containing buried organic layer thought to have been remobilized as part of block in younger failure from scar 1. Date interpreted to be maximum age for scar 2 landslide.	Unpublished GSC data.

Scar 2	Brkwood-03, sample 5	As above.	UCIAMS-88802	3390 ± 15	1σ: 3594-3685 2σ: 3584-3689	GRB and BEM	Date derived from branch with bark, ~3 cm diameter, from same organic rich layer, as above. Date interpreted to be maximum age for scar 2 landslide.	Unpublished GSC data.
Scar 2	Brkwood-03, sample 6	As above.	UCIAMS-88803	3450 ± 15	1σ: 3646-3812 2σ: 3641-3824	GRB and BEM	Date derived from small log with bark, ~5 cm diameter, from same organic rich layer, as above. Date interpreted to be maximum age for scar 2 landslide.	Unpublished GSC data.
Scar 3, Breckenridge Valley	96-06-21-01-#1	N 45.3831° W 75.9332°	GSC-6233	7050 ± 80[e]	1σ: 7849-7935 2σ: 7794-7958	GRB and JMA	Date derived from outer portion of log of *Pinus strobus* (eastern white pine)[f] buried 2.2 m below the top of head scarp of slump that had formed within deposits of scar 3. Date represents maximum age for a landslide interpreted to have originated from scar 3.	Unpublished GSC data.
Scar 3	96-06-21-02-#2	As above.	GSC-6243	7030 ± 70[e]	1σ: 7838-7931 2σ: 7791-7943	GRB and JMA	Date derived from outer portion of the upper of two logs of *Pinus strobus* (eastern white pine)[f] buried between 2.0-2.4 m below top of head scarp at same location as above. Date represents maximum age for a landslide interpreted to have originated from scar 3.	Unpublished GSC data.
Scar 3	96-06-21-03-#1	As above.	GSC-6246	6980 ± 80[e]	1σ: 7758-7919 2σ: 7702-7929	GRB and JMA	Date derived from the outer portion of the lower of two logs of *Pinus strobus* (eastern white pine)[f], as above. Date represents maximum age for a landslide, interpreted to have originated from scar 3.	Unpublished GSC data.
Scar 3	Brkwood-02, sample 1	N 45.4834° W 75.9331°	UCIAMS-88799	7105 ± 20	1σ: 7884-7962 2σ: 7871-7971	GRB and BEM	Date derived from the outer rings of ~10 cm diameter log with bark contained within humic/wood-rich layer of buried soil exposed along the incised course of tributary A through the debris of 2008 landslide. Organic layer overlain by landslide debris and dips across bank face to	Unpublished GSC data.

							below level of observed creek surface. Sampling site situated 2.8 m from top of bank. Date represents maximum age for a landslide, interpreted to have originated from scar 3.	
Scar 3	Brkwood-02, sample 2	As above.	UCIAMS-88800	7000 ± 20	1σ: 7795-7920 2σ: 7787-7930	GRB and BEM	Date derived from outer rings of *in situ* stump with bark rooted within buried same soil/organic layer, as above. Date represents maximum age for a landslide, interpreted to have originated from scar 3.	Unpublished GSC data.
Scar 4, Breckenridge Valley	Core Brkcore-02-D, 0.88-0.92 m depth	N 45.4802° W 75.9309°	UCIAMS-88816	200 ± 15	1σ: -1-287 2σ: -1-294	GRB	Date derived from wood fragment sampled from 0.88-0.92 m depth in 1.51 m long core recovered from ephemeral wetland. Sample situated in grey silt-clay deposit ~8 cm below base of buried peat unit, 0.36 m thick. Date represents minimum age for scar 4 landslide.	Unpublished GSC data.
Scar 4	Core Brkcore-02-D, 1.40-1.41 m depth	As above.	UCIAMS-88674	600 ± 15	1σ: 554-639 2σ: 548-646	GRB	Date derived from wood fragment sampled from 1.40-1.41 m depth in core, as above. Sample is one of several wood fragments at base of grey silt-clay deposit that overlies partially penetrated sand deposit. Date represents maximum age for scar 4 landslide.	Unpublished GSC data.
Scar 4	Site of Core Breckcore02-E	As above.	UCIAMS-88675	600 ± 20	1σ: 553-640 2σ: 545-650	GRB	Date derived from wood fragment extracted from site of core which had poor deposit recovery. Buried wood at 2.02 m depth encountered by probing and sampled with a soil drill. Date represents maximum age for scar 4 landslide.	Unpublished GSC data.
Scar 9, Breckenridge Valley	Breck-28-02	N 45.4718° W 75.9129°	GSC-6449	1080 ± 70[e]	1σ: 938-1051 2σ: 932-1056	DL and JG	Date derived from wood of *in situ* stump rooted within well-defined organic layer, exposed upstream of scar 9 along tributary B. Organic layer is buried beneath silt-clay deposit and dips under stream	Brooks (2013).

							surface. Date interpreted to represent maximum age for scar 9 landslide.	
Scar 9	Breckwood-20-A	N 45.4722° W 75.9129°	UCIAMS-106584	1145 ± 15	1σ: 1002-1067 2σ: 979-1166	GRB	Date derived from outer rings of truncated, vertical tree trunk, 0.1 m diameter, protruding through side of tributary B channel upstream of scar 9. Enclosing clay sediment excavated several tens of centimeters to exposed portion of tree trunk with intact bark from which sample was obtained. Date interpreted to represent maximum age for scar 9 landslide.	Brooks (2013).
Scar 9	Breckwood-20-B	As above.	UCIAMS-106585	1130 ± 20	1σ: 986-1059 2σ: 969-1070	GRB	Date derived from outer rings of truncated, vertical, tree trunk, 0.15 m diameter, protruding through creek bed, as above. Date interpreted to represent maximum age for scar 9 landslide.	Brooks (2013).
Scar 11, Breckenridge Valley	Brkcore-08A	N 45.4799° W 75.9174°	UCIAMS-88703	180 ± 20	1σ: 1-283 2σ: -2-286	GRB	Date derived from raspberry seeds[b] sampled from between 0.41-0.42 m depth from 0.91 m-long core of perennial wetland on scar 11. Sample situated within stiff clay-silt deposit that extends from 0.37/0.39-0.91 m depth. Date represents minimum age for scar 11, but landslide probably is significantly older.	Unpublished GSC data.
Scar 12, Breckenridge Valley	Breck K-01	N 45.4786° W 75.9118°	GSC-6318	1030 ± 70[e]	1σ: 924-967 2σ: 803-1053	DL and JG	Date derived from root of upright stump of *Tsuga canadensis* (eastern Hemlock)[f] contained within an organic-rich, woody layer, several cm thick, buried by landslide debris, exposed within scar of recent slump opposite to scar 12 along tributary C. Date interpreted to represent maximum age for scar 12 landslide.	Brooks (2013).
Scar 13, Breckenridge Valley	Brkwood7-1B	N 445.4773° W 75.9028°	UCIAMS-88806	1895 ± 25	1σ: 1822-1872 2σ: 1738-1896	GRB and BEM	Date derived from outer rings of truncated, vertical, tree trunk protruding from incised bed of	Unpublished GSC data.

							tributary C. Enclosing clay sediment excavated several tens of centimeters to exposed portion of tree trunk (with intact bark) from which sample was obtained. Tree trunk located ~10 m upstream end of landslide debris along creek course. Date represents maximum age for scar 13 landslide.	
Scar 13	Brkwood7-2A	As above.	UCIAMS-88807	1915 ± 20	1σ: 1827-1883 2σ: 1821-1919	GRB and BEM	Date derived from outer rings of root of truncated, vertical, tree stump located immediately beside the tree trunk described above. Sampling site, as above. Date represents maximum age for scar 13 landslide.	Unpublished GSC data.
Scar 13	Brkwood7-3B	N 45.4775° W 75.9021°	UCIAMS-88808	1925 ± 15	1σ: 1831-1892 2σ: 1825-1920	GRB and BEM	Date derived from outer rings of truncated, vertical, tree trunk protruding from bank of tributary C. Enclosing clay sediment excavated several tens of centimeters to expose portion of tree trunk with intact bark from which sample was obtained. Sampling site located upstream from where landslide debris from scar 13 crosses creek. Date represents maximum age for scar 13 landslide.	Unpublished GSC data.
Scar 13	Brkwood7-4A	N 45.4775° W 75.9016°	UCIAMS-88809	2030 ± 20	1σ: 1949-1998 2σ: 1904-2044	GRB and BEM	Date derived from outer rings of log protruding at an angle from organic-rich layer overlain by landslide debris along bed of tributary C. Sampling site located upstream of location where landslide debris from scar 13 crosses creek. Date represents maximum age for scar 13 landslide.	Unpublished GSC data.
Scar 13	Brkwood7-5A	As above.	UCIAMS-88810	1920 ± 20	1σ: 1828-1889 2σ: 1822-1921	GRB and BEM	Date derived from outer rings of horizontal, buried tree trunk, ~50 cm diameter, rooted in organic-rich layer, as above. Bark preserved on portion of tree trunk. Sampling site, as above. Date represents maximum age for scar 13 landslide.	Unpublished GSC data.

Scar 13	Brkwood7-6B	N 45.4777° W 75.9010°	UCIAMS-88811	1885 ± 15	1σ: 1821-1865 2σ: 1741-1880	GRB and BEM	Date derived from outer rings of truncated, vertical, tree trunk protruding from bank of tributary C. Enclosing clay sediment excavated several tens of centimeters to expose portion of tree trunk with intact bark from which sample was obtained. Sampling site located upstream of location where landslide debris from scar 13 crosses creek. Date represents maximum age for scar 13 landslide.	Unpublished GSC data.
Scar 13	Brkwood8-1B	N 45.4754° W 75.9028°	UCIAMS-88812	2030 ± 15	1σ: 1950-1996 2σ: 1929-2038	GRB	Date derived from outer rings of one of two logs protruding from landslide debris exposed along gully incised into scar 13. Enclosing debris excavated several tens of centimeters to expose 'well-preserved' portion of tree trunk from which sample was obtained. Date represents maximum age for scar 13 landslide.	Unpublished GSC data.
Scar 13	Brkwood8-1D	As above.	UCIAMS-88813	1925 ± 15	1σ: 1831-1892 2σ: 1825-1920	GRB	Date derived from outer rings of second of two logs protruding from landslide debris exposed along gully incised into scar 13. Enclosing debris excavated several tens of centimeters to expose 'well-preserved' portion of tree trunk from which sample was obtained. Date represents maximum age for scar 13 landslide.	Unpublished GSC data.
Scar 13	Breck I-01	N 45.4794° W 75.9129°	GSC-6317	2100 ± 70[c]	1σ: 2006-2120 2σ: 1954-2291	DL and JG	Date derived from "mostly bark" sampled from woody organic-rich layer, several cm thick, buried beneath landslide debris, located downstream of scar 13. Date interpreted to be maximum age for scar 13 landslide.	Unpublished GSC data.
Scar 13	Breck J-02	N 45.4789° W 75.9123°	GSC-6316	1880 ± 70[e]	1σ: 1741-1876 2σ: 1721-1890	DL and JG	Date derived from wood (probably *Tsuga canadensis* (eastern	Unpublished GSC data.

							Hemlock))[f] sampled from woody, organic-rich layer, several cm thick, buried beneath landslide debris, located downstream of scar 13. Date interpreted to be maximum age for scar 13 landslide.	
Scar 13	Breckwood-21-A	N 45.4755° W 75.9120°	UCIAMS-106586	1930 ± 15	1σ: 1834-1897 2σ: 1826-1923	GRB	Date derived from root with preserved bark, ~1 cm diameter, that was part of a concentrated zone of wood exposed along tributary C. Woody zone situated ~1 m above modern creek surface and 0.10-0.20 m below discontinuous buried organic layer, several mm thick. Sample site is located downstream of scar 13 near collection site of GSC-6318. Date interpreted to be maximum age for scar 13 landslide.	Unpublished GSC data.
Scar 15, Breckenridge Valley	Breck-04-01	N 45.4812° W 75.9067°	GSC-6482	1210 ± 50[e]	1σ: 1082-1174 2σ: 1061-1234	GRB, JG and RM	Date derived from horizontally-oriented log, ~15 cm diameter, buried 0.4 m deep within clay-silt deposits of valley fill upstream of scar 15 that were exposed along incised gully upstream of scar 15. Log overlies unexposed base of tree trunk that yielded GSC-6481, located at same site. Date interpreted to represent maximum age of scar 15 landslide, based on younger ages of GSC-6481, UCIAMS-88804 and UCIAMS-88805.	Brooks (2013).
Scar 15	Breck-04-02	As above.	GSC-6481	1040 ± 60[e]	1σ: 929-964 2σ: 918-1051	GRB, JG and RM	Date derived from "outside piece" of truncated, vertical, tree trunk buried within clay-silt deposits of valley fill, as above. Date represents maximum age for scar 15 landslide.	Brooks (2013).
Scar 15	Brkwood6-1C	N 45.4815° W 75.9068°	UCIAMS-88804	1080 ± 15	1σ: 958-1048 2σ: 936-1053	GRB and BEM	Date derived from outer rings of truncated, vertical, tree trunk, ~50 cm diameter, exposed along gully incised into landslide debris of scar 15. Enclosing clay sediment excavated several tens of centimeters to exposed portion of	Brooks (2013).

							tree trunk with intact bark from which sample obtained. Date represents maximum age for scar 15 landslide.	
Scar 15	Brkwood6-2B	As above.	UCIAMS-88805	1110 ± 15	1σ: 978-1053 2σ: 971-1056	GRB and BEM	Date derived from outer rings of second truncated, vertical, tree trunk exposed along gully, as above. Enclosing clay sediment excavated several tens of centimeters to exposed portion of tree trunk with intact bark, as above. Date represents maximum age for scar 15 landslide.	Brooks (2013).
Scar 17, Breckenridge Valley	Breck-11-02	N 45.4854° W 75.8964°	GSC-6433	1440 ± 50[e]	1σ: 1307-1346 2σ: 1299-1375	GRB, JG and RM	Date derived from outer rings of back-tilted log sampled from organic-rich layer, 3.4-3.9 m deep and buried beneath debris, within backslope of recent slump scar on side of Breckenridge creek valley opposite to scar 17. Date interpreted to represent maximum age of scar 17 landslide.	Unpublished GSC data.
Scar 18, Breckenridge Valley	Core Brkcore05-A, 0.58-0.62 m depth	N 45.4852° W 75.9060°	UCIAMS-88818	2755 ± 20	1σ: 2795-2868 2σ: 2784-2920	GRB	Date derived from leaves of *Thuja occidentalis* (eastern white cedar)[c] sampled between 0.58-0.62 m depth in 1.5 m long core recovered from perennial wetland deposit on scar 18. The sample was situated within a silt-clay deposit containing abundant organic detritus that extend between 0.50-0.66/0.70 m depth. Date represents minimum age for scar 18, but is interpreted to be significantly younger than landslide.	Unpublished GSC data.
Scar 18	Core Brkcore05-A, 0.91-0.96 m depth	As above.	UCIAMS-88677	3455 ± 20	1σ: 3647-3819 2σ: 3641-3827	GRB	Date derived from needles with fascicle attached of *Pinus strobus* (eastern white pine)[c] extracted from peaty silt-clay deposit between 0.91-0.96 m depth in same core as above. Peaty silt-clay deposit extends from 0.66/0.70 m depth to base of recovered core. Date represents minimum age for scar 18 landslide.	Unpublished GSC data.

Scar 18	Core Brkcore05-A, 1.39-1.41 m depth	As above.	UCIAMS-88676	3600 ± 15	1σ: 3875-3957 2σ: 3847-3970	GRB	Date derived from needles with fascicle attached of *Pinus strobus* (eastern white pine)[c] extracted between 1.39-1.41 m depth from same core as above. Sample situated within peaty silt-clay deposit immediately above wood at base of recovered core. Date represents minimum age for scar 18 landslide.	Unpublished GSC data.
Scar 18	Core Brkcore05-A, 1.39-1.41 m depth	As above.	UCIAMS-88817	3625 ± 15	1σ: 3904-3969 2σ: 3890-3980	GRB	Date derived from leaves of *Thuja occidentalis* (eastern white cedar)[c] extracted between 1.39-1.41 m depth from same core, as above. Date represents minimum age for scar 18 landslide.	Unpublished GSC data.
Scar 19, Breckenridge Valley	98-14-2A	N 45.4825° W 75.9118°	GSC-6355	1170 ± 50[e]	1σ: 1057-1168 2σ: 990-1173	JMA and JG	Date derived from branch contained within a well-defined layer of logs and woody debris, several tens of centimeters thick, buried beneath 9.5 m of debris exposed in scar of recent slump along Breckenridge Creek. Age is anomalously young relative to other four ages from organic layer. Date interpreted to represent minimum age for scar 19 landslide, but is believed to be significantly younger than the age of the landslide.	Unpublished GSC data.
Scar 19	98-14-3	As above.	GSC-6357	1570 ± 90[e]	1σ: 1412-1517 2σ: 1359-1545	JMA and JG	Date derived from outer portion of log from same well-defined layer of logs and woody debris, as above. Date interpreted to represent maximum age for scar 19 landslide.	Unpublished GSC data.
Scar 19	98-14-1A	As above.	GSC-6311	1530 ± 50[e]	1σ: 1373-1508 2σ: 1351-1517	JMA and JG	Date derived from outer ~30 rings of large log from same well-defined layer of logs and woody debris, as above. Date interpreted to represent maximum age for scar 19 landslide.	Unpublished GSC data.
Scar 19	Brkwood10-1A	As above.	UCIAMS-88814	1525 ± 15	1σ: 1380-1412 2σ: 1355-1509	GRB and BEM	Date derived from branch, ~1 cm diameter, situated about 20 cm	Unpublished GSC data.

							above same well-defined layer of logs and woody debris, as above. Date interpreted to represent maximum age for scar 19 landslide.	
Scar 19	Brkwood10-1D	As above.	UCIAMS-88815	1565 ± 15	1σ: 1412-1513 2σ: 1409-1518	GRB and BEM	Date derived from branch, ~1 cm diameter, immediately overlying same well-defined layer of logs and woody debris, as above. Date interpreted to represent maximum age for scar 19 landslide.	Unpublished GSC data.
Scar 22, Breckenridge Valley	Core Breck-27-01A	N 45.4965° W 75.9278°	Beta-139135	310 ± 40	1σ: 306-434 2σ: 297-478	JG and RM	Date derived from "mix of very small wood bits embedded in clay" sampled between 0.15-0.16 m depth in 0.37 m long core recovered from small pond on scar 22. Sample encapsulated by grey clay with silt clasts. Date represents minimum age for scar 22 landslide, but landslide may be significantly older.	Unpublished GSC data.
Unrelated to a landslide?	Breck-20-01	N 45.4926° W 75.9254°	GSC-6437	1220 ± 70[e]	1σ: 1078-1224 2σ: 1061-1262	JG and RM	Date derived from barkless log, 25 cm diameter, sampled from a buried layer of woody debris within silt-clay sediment 2.5 m below top of bank and 0.5 m above the observed stream of tributary A. Relationship to any landslide scar along tributary A is uncertain.	Unpublished GSC data..
Mudflow deposit along lower reach of Breckenridge Creek	Breck-C-04A	N 45.4796º W 75.9456º	GSC-6313	1070 ± 50[e]	1σ: 935-1046 2σ: 931-1053	DL and JG	Date derived from outer rings of 0.5 m diameter log of *Tsuga canadensis* (eastern Hemlock)[f] exposed by recent slump along the lower portion of Breckenridge Creek, where stream is incised into terrace of ancestral Ottawa River. The solitary log is encapsulated by landslide debris and located ~2 m below top of ~7 m high bank. Date interpreted to represent maximum age of mudflow that descended Breckenridge Creek.	Unpublished GSC data.

Mudflow deposit	Breck-A-01	N 45.4803º W 75.9483º	GSC-6315	1060 ± 50[e]	1σ: 933-976 2σ: 928-1052	DL and JG	Date derived from log of *Tsuga canadensis* (eastern Hemlock)[f] protruding from a cutbank exposure along lower reach of Breckenridge Creek, as above. Sample was part of an "apparent horizon of organic material" overlain by "slide clay", ~1 m below top of ~ 2 m high bank. Date interpreted to represent maximum age of mudflow that descended Breckenridge Creek.	Unpublished GSC data.

[a] JMA – Jan Aylsworth, GRB – Greg Brooks, JG – Joanna Guertin, RM – Rick McNeil, BEM – Barbara Medioli, DL – Ted Lawrence.
[b] Average of 2895 ± 20 (UCIAMS-88705) and 2850 ± 20 (UCIAMS-88819) yr BP which are duplicate measurements of same organic material.
[c] Identified by A. Telka, Paleotec Services.
[d] Average of 2855 ± 20 (UCIAMS-88706)and 2850 ± 15 (UCIAMS-88820) yr BP which are duplicate measurements of same organic material.
[e] The uncertainty of the age is reported to two standard deviations.
[f] Identified by C. Keith.

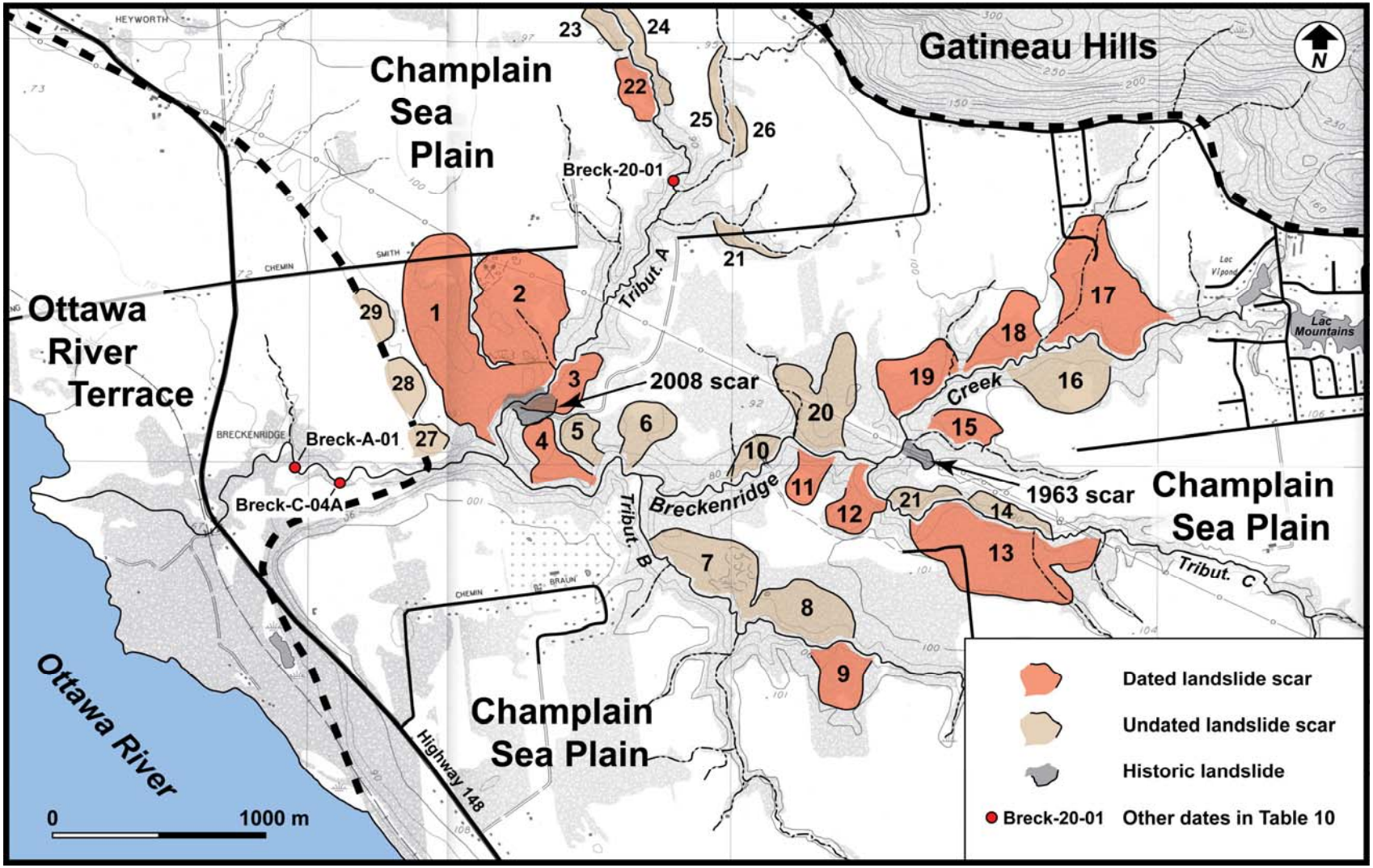


Fig. 3 Map showing the dated, undated and historic landslide scars (with assigned scar numbers or year of failure) along Breckenridge Creek and its major tributaries. The radiocarbon ages in Table 10 are listed under sub-headings of the 13 dated scars. Note, there are three dates on the map that are labeled by the sample number and are shown at the collection site - see Table 10 for explanation (they are the last three dates listed in the table).

Luskville landslide, near Luskville, Québec

The Luskville landslide is located ~1 km west of the village of Luskville, Municipality of Pontiac, immediately to the south of Highway 148, which parallels the backscarp (Fig. 4). The landslide retrogressed into a scarp slope that extends above a broad flat terrace of the ancestral Ottawa River (Fig. 4). The debris splayed onto this terrace forming a large depositional lobe. This deposit has not been truncated by fluvial erosion indicating that the Ottawa River had abandoned this portion of the terrace before the occurrence of the failure. The eastern edge of the scar is situated immediately adjacent to a smaller, but older scar (of unknown age), the deposits from which have been truncated by river erosion. The three dates in Table 11 were obtained from organic materials buried beneath the landslide debris that were recovered at a coring site located in the middle portion of the toe of the landslide (Fig. 4). They represent maximum ages for the Luskville landslide. Brooks (2013) correlated the age of the Luskville landslide to nine other landslides in the Ottawa-Pontiac region (see Tables 8, 10, 12, 13, 14 and 15) and hypothesized that they represent evidence of a paleoearthquake at ~1020 cal BP with an estimated magnitude of at least M_w 6.1.

Table 11 List of radiocarbon dates collected from the Luskville landslide, near Luskville, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Luskville landslide, Luskville, Québec	BaieAA-01, Sample 1	N45.5353° W76.0306°	UCIAMS-122468	1095±20	959-1059	GRB	Wood fragment subsampled from the upper 3 cm of a 7 cm-thick buried organic layer contained in core between 5.98-6.05 m depth. Organic layer buried beneath soft landslide clay. Coring site situated ~5 m from core BaieAB-01. Date represents maximum age for Luskville landslide.	Brooks (2013).
Luskville landslide	BaieAB-01, Sample 3	As above	UCIAMS-122469	1120±15	976-1060	GRB	Eastern white cedar leafy shoot (*Thuja occidentalis*)[b] subsampled from the upper 1 cm of an 11 cm-thick buried organic layer contained in core between 5.89-6.0 m depth. Organic layer buried beneath soft landslide clay. Coring site situated ~5 m from core BaieAA-01. Date represents maximum age for Luskville landslide.	Brooks (2013).

Luskville landslide	BaieAB-01, Auger sample C	As above.	UCIAMS-122467	1100±15	963-1056	GRB	Twig fragment from buried organic material recovered in cuttings on auger blades. Inferred depth of organic layer is between 5.89-6.0 m depth, based on core log. Organic layer buried beneath soft landslide clay. Coring site situated ~5 m from core BaieAA-01. Date represents maximum age for Luskville landslide.	Brooks (2013).

[a] GRB – Greg Brooks

[b] Identified by A. Telka, Paleotec Services.

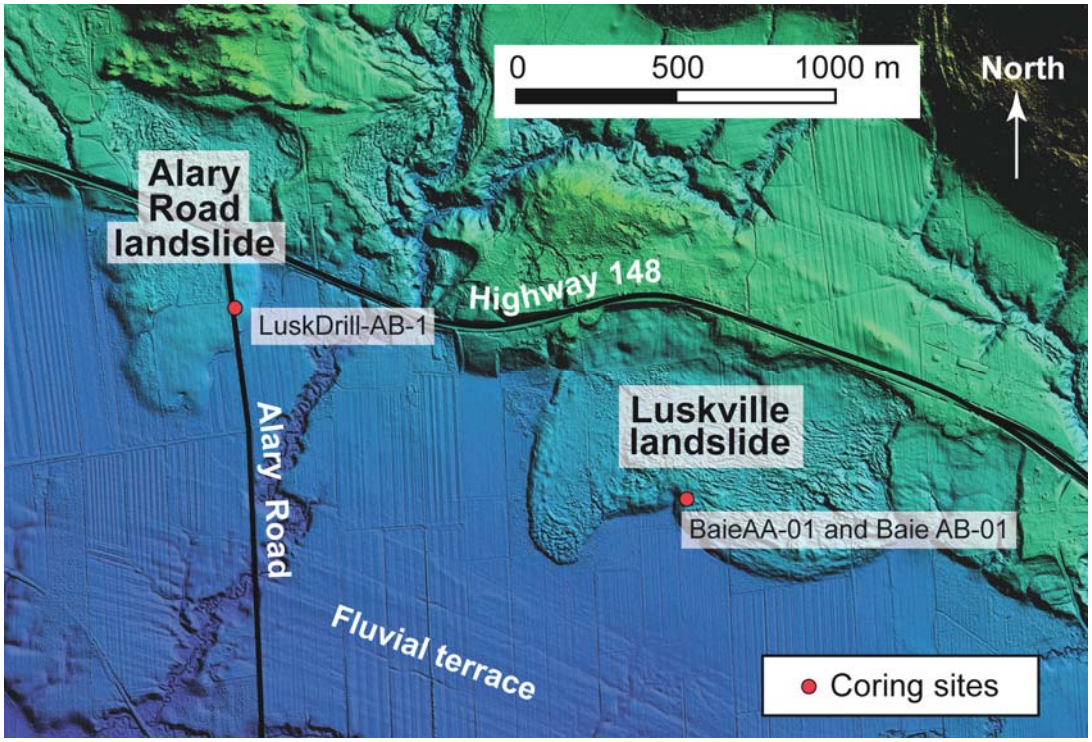


Fig. 4 Shaded relief map showing the coring sites on the Luskville (Table 11) and Alary Road (Table 12) landslides, near Luskville, Québec.

Alary Road landslide, near Luskville, Québec

The Alary Road landslide is located ~3 km west of the village of Luskville, Municipality of Pontiac (Fig. 1), and is crossed by Highway 148 and the northern portion of Alary Road (Fig. 4). The landslide retrogressed into a slope that forms a scarp above a broad flat terrace of the ancestral Ottawa River. The debris splayed onto this terrace forming a large depositional lobe. This deposit has not been truncated by fluvial erosion indicating that the Ottawa River had abandoned this portion of the terrace before the occurrence of the failure. The three dates listed in Table 12 were obtained from organic materials buried beneath the landslide debris that were recovered from a coring site along the eastern shoulder of Alary Road (Fig. 4). They represent maximum ages for the Alary Road landslide. Brooks (2013) correlated the age of the Alary Road landslide to nine other landslides in the Ottawa-Pontiac region (see Tables 8, 10, 11, 13, 14 and 15) and hypothesized that they represent evidence of a paleoearthquake at ~1020 cal BP with an estimated magnitude of at least M_w 6.1.

Table 12 List of radiocarbon dates collected from the Alary Road landslide, near Luskville, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Alary Road landslide, near Luskville, Québec	LuskDrill-AB-1, 5.87-5.89 m depth	N45.5409° W76.0489°	UCIAMS-106656	1150 ± 15	1σ: 1002-1073 2σ: 982-1167	GRB	Date derived from wood fragment sampled between 5.87-5.89 m depth in 6.71 m long core recovered from near toe of landslide. Wood overlain by clay-rich landslide debris. Date represents maximum age for Alary Road landslide.	Brooks (2013).
Alary Road landslide	LuskDrill-AB-1, 5.89-5.94 m depth	As above.	UCIAMS-106657	1145 ± 15	1σ: 1002-1067 2σ: 979-1166	GRB	Date derived from wood fragment sampled from buried organic-rich clay situated between 5.89-5.94 m depth in same core, as above. Date represents maximum age for Alary Road landslide.	Brooks (2013).
Alary Road landslide	LuskDrill-AB-1, 6.17-6.20 m depth	As above.	UCIAMS-106658	1155 ± 15	1σ: 1005-1119 2σ: 985-1168	GRB	Date derived from isolated wood fragment sampled between 6.17-6.20 m depth in same core, as above. Date represents maximum age for Alary Road landslide.	Brooks (2013).

[a] GRB – Greg Brooks

Quyon Valley landslide, Quyon, Québec

A large landslide scar, covering 28 km^2, extends along the lower ~11 km of Quyon Valley (Fig. 5). Geomorphic and chronological evidence presented by Brooks (2013) indicates that the scar is the site of a massive landslide, ~600 Mm^3, that occurred at ~1020 cal BP. Brooks (2013) correlated the age of the Quyon Valley landslide to nine other landslides in the Ottawa-Pontiac region (see Tables 8, 10, 11, 12, 14 and 15) and hypothesized that they represent evidence of a paleoearthquake at ~1020 cal BP with an estimated magnitude of at least M_w 6.1. Table 13 lists 19 radiocarbon dates collected from within the landslide scar and depositional area; 17 of these are relevant to the age of the massive failure. The seventeen dates represent eleven maximum and six minimum ages for the Quyon Valley landslide. Two additional dates are included in the table that were collected from within the landslide scar, but interpreted by Brooks (2013) to be substantially older and unrelated to the age of the massive landslide. The dates are organized by general location of collection area: lower scar zone, upper scar zone, depositional area and wetland coring sites. The sample collection sites of all 19 dates are shown on Fig. 5.

Table 13 List of radiocarbon dates collected from the lower Quyon River valley, Québec, related to the massive landslide at ~1020 cal BP.

Location	Sample number/ name	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Lower scar zone, Quyon Valley landslide	1; QUY-AC-01	N 45.5519° W 76.2863°	UCIAMS-106587	1180 ± 20	1σ: 1063-1168 2σ: 1018-1173	GRB	Date derived from outer rings of log buried within bank exposure along Quyon River. Sampled portion of log covered by preserved bark and was freshly exposed by excavating into the bank. Log encapsulated by sand and associated with a buried soil layer located ~10 m below the top of ~16 m high bank. Date represents maximum age for Quyon Valley landslide.	Brooks (2013).
Lower scar zone	2; QUY-AC-02	As above.	UCIAMS-106645	1135 ± 15	1σ: 989-1061 2σ: 979-1067	GRB	Date derived from outer rings of a second buried log at same location as above. Date represents maximum age for Quyon Valley landslide.	Brooks (2013).
Lower scar	3;	As above.	UCIAMS-	1130 ± 15	1σ: 980-1062	GRB	Date derived from outer rings of	Brooks (2013).

zone	QUY-AC-04		106646		2σ: 979-1064		buried root, ~ 5 cm diameter and with preserved bark, at same location as above. Date represents maximum age for Quyon Valley landslide.	
Lower scar zone	4; QUY-AL-01	N 45.5549° W 76.2941°	UCIAMS-106648	1350 ± 20	1σ: 1280-1296 2σ: 1264-1303	GRB	Date derived from outer rings of log buried ~2.5 m below top of ~20 m high bank exposure along Quyon River. Log encapsulated by sand and associated with a buried soil layer that dips across exposure surface. Modern roots picked from the sample prior to submission. Date represents maximum age for Quyon Valley landslide.	Brooks (2013).
Upper scar zone, Quyon Valley landslide	5; QUY-BB-03	N 45.5848° W 76.3212°	UCIAMS-112434	1145 ± 20	1σ: 988-1069 2σ: 977-1167	GRB	Date derived from outer rings of log, ~50 cm diameter, found protruding from clay-rich deposit along Quyon River. Log buried ~29 m beneath top of ~30 m high bank. Sampled portion of log covered by preserved bark and was freshly exposed by excavating into the bank. Log stratigraphically overlies sample 18 (UCIAMS-112433; this table) which is located ~25 m downsteam within same exposure. Date represents maximum age for Quyon Valley landslide.	Brooks (2013).
Upper scar zone	6; QUY-BD-01	N 45.5815° W 76.3161°	UCIAMS-112435	1185 ± 20	1σ: 1065-1168 2σ: 1059-1173	GRB	Date derived from outer rings of log, ~25 cm diameter, found protruding from clay-rich deposit along Quyon River. Log buried ~22.5 m beneath top of ~23.5 m high bank. Sampled portion of log covered by preserved bark and was freshly exposed by excavating into the bank. Date represents maximum age for Quyon Valley landslide.	Brooks (2013).
Depositional zone, Quyon Valley landslide	7; Vuori Log	N 45.5165° W 76.2373°	UCIAMS-106649	1215 ± 15	1σ: 1088-1175 2σ: 1069-1223	HV	Date derived from inner 35-40 rings of log, 13 cm diameter, recovered during winter of 1997 or 1998 from ditch excavated into wetland located within village of Quyon, at approximate level of modern Ottawa	Brooks (2013).

							River floodplain. Log was one of several encountered in ditch, ~2 m below surface of wetland buried within clay-rich deposit. Date represents maximum age for Quyon Valley landslide.	
Depositional zone	8; QUY-AA-01	N 45.5209° W 76.2407°	Beta-90879[b]	1180 ± 60	1σ: 1002-1177 2σ: 967-1261	DG	Date derived from "carbonized wood fragments plus other unidentified plant matter", ~ 1cm thick, from litter layer developed on cross-bedded, oxidized sand unit and overlain by internally-deformed, sand-clay mudflow bed, 2-3 m thick. Sampling site is a sand-clay pit within the village of Quyon. Underlying sand unit interpreted to be upper deposit of large block of intact Champlain Sea sediments rafted downvalley in Quyon Valley landslide that was capped by a thin mudflow deposit during transport. Date interpreted to represent maximum age for Quyon Valley landslide.	Aylsworth et al (1997); Brooks (2013).
Depositional zone	9; QuyDrill-AE-1	N 45.5145° W 76.2697°	UCIAMS-106653	1120 ± 15	1σ: 982-1056 2σ: 976-1060	GRB	Date derived from wood fragment sampled between 3.20-3.25 m depth in 4.27 m long core recovered from western edge of landslide deposit, just off Chemin Bronson-Bryant, near village of Quyon. Sample contained within clay-rich landslide debris and was situated 0.13 m above the upper of two wood/organic-rich layers, which are interpreted to represent the ground surface buried and (presumably) deformed beneath landslide. Date represents maximum age for Quyon Valley landslide.	Brooks (2013).

Depositional zone	10; QuyDrill-AE-1	As above.	UCIAMS-106654	1220 ± 20	1σ: 1084-1178 2σ: 1067-1237	GRB	Date derived from wood fragment sampled between 3.51-3.56 m depth in same core as above. Sample contained with the lower of two wood/organic-rich layers contained within core that represent surface buried and (presumably) deformed beneath landslide deposit. Date represents maximum age for Quyon Valley landslide.	Brooks (2013).
Depositional zone	11; QuyDrill-AE-1	As above.	UCIAMS-106655	1160 ± 15	1σ: 1010-1166 2σ: 1000-1170	GRB	Date derived from wood fragment sampled between 3.63-3.66 m depth in same core as above. Wood contained within lower of two wood/organic-rich layers, as above. Date represents maximum age for Quyon Valley landslide.	Brooks (2013).
Wetland 1, lower scar zone, Quyon Valley landslide	12; QuyCore-AB-1	N 45.5742° W 76.2803°	UCIAMS-106572	880 ± 20	1σ: 740-794 2σ: 733-901	GRB	Date derived from isolated wood fragment sampled between 0.73-0.75 m depth in 2.27 m long core recovered from wetland situated in depression between landslide deposits and side scarp, near Cain Lake. Sample encapsulated by sand and situated ~0.40 m below organic-rich sediment/sand interface. Date represents minimum age for Quyon Valley landslide.	Brooks (2013).
Wetland 1	13; QuyCore-AB-2	N 45.5742° W 76.2802°	UCIAMS-106573	1005 ± 20	1σ: 919-952 2σ: 833-962	GRB	Date derived from conifer needles (larch, fir and pine)[b] sampled between 0.41-0.43 m depth in 1.56 m long core from same wetland as above. Sample encapsulated by sand and situated 0.12 m below organic-rich sediment/sand interface. Date represents minimum age for Quyon Valley landslide.	Brooks (2013).
Wetland 1	14; QuyCore-AB-2	As above.	UCIAMS-106574	830 ± 20	1σ: 698-761 2σ: 692-779	GRB	Date derived from bark fragment sampled between 0.27-0.30 m depth in same core as above. Sample situated within lower 0.03 m of	Brooks (2013).

							organic-rich sediment. Date represents minimum age for Quyon Valley landslide.	
Wetland 2	15; QuyCore-AF-1	N 45.5585° W 76.2777°	UCIAMS-106578	705 ± 15	1σ: 663-673 2σ: 656-679	GRB	Date derived from cedar leaves[b] sampled between 0.33-0.38 m depth in 1.48 m long core from wetland on landslide surface. Sample situated within lower 0.05 m of peat deposits that overlie soft, massive, clay deposit. Date represents minimum age for Quyon Valley landslide.	Brooks (2013).
Wetland 2	16; QuyCore-AF-1	As above.	UCIAMS-106579	630 ± 20	1σ: 561-653 2σ: 556-660	GRB	Date derived from five needle pine needles[b] sampled between 0.33-0.38 m depth in same core as above. Date represents minimum age for Quyon Valley landslide.	Brooks (2013).
Wetland 2	17; QuyCore-AF-1	As above.	UCIAMS-106580	600 ± 15	1σ: 554-639 2σ: 548-646	GRB	Date derived from bur marigold seeds[b] sampled between 0.33-0.38 m depth in same core as above. Date represents minimum age for Quyon Valley landslide.	Brooks (2013).
Unrelated older age from Upper Scar Zone of Quyon Valley landslide.	18; QUY-BB-01	N 45.5848° W 76.3212°	UCIAMS-112433	3920 ± 20	1σ: 4299-4419 2σ: 4260-4423	GRB	Date derived from outer rings of log, 0.1 m diameter, buried ~28.5 m below top of ~30 m high bank exposed along Quyon River. Log encapsulated by deformed sand bed, 0.3-0.4 m thick, which contained other woody materials and logs. Sand bed overlain by thick clay-rich deposit. Sampled wood covered by preserved bark and was freshly exposed by excavating into the bank. Log stratigraphically underlies sample QUY-BB-03 (UCIAMS-112434) which is located ~25 m upstream within the same bank exposure. Date is substantially older than, and is interpreted to be unrelated to, age of large Quyon Valley landslide.	Brooks (2013).

Unrelated older age from Lower Scar Zone of Quyon Valley landslide.	19; QUY-AJ-01	N 45.5752° W 76.30°	UCIAMS-106647	8630 ± 30	1σ: 9539-9635 2σ: 9534-9665	GRB	Date derived from *Abies* needles[b] (some charred) sampled from deformed organic-rich layer contained within sand dike injected into lower ~1 m of clay-rich block. Sampling site situated at head of gully ~9 m below top of 25 m high bank. Date is substantially older than, and interpreted to be unrelated to, age of large Quyon Valley landslide.	Brooks (2013).

[a] GRB – Greg Brooks, DG – Doug Grant; BEM – Barbara Medioli; HV – Hank Vuori

[b] Identified by A. Telka, Paleotec Services.

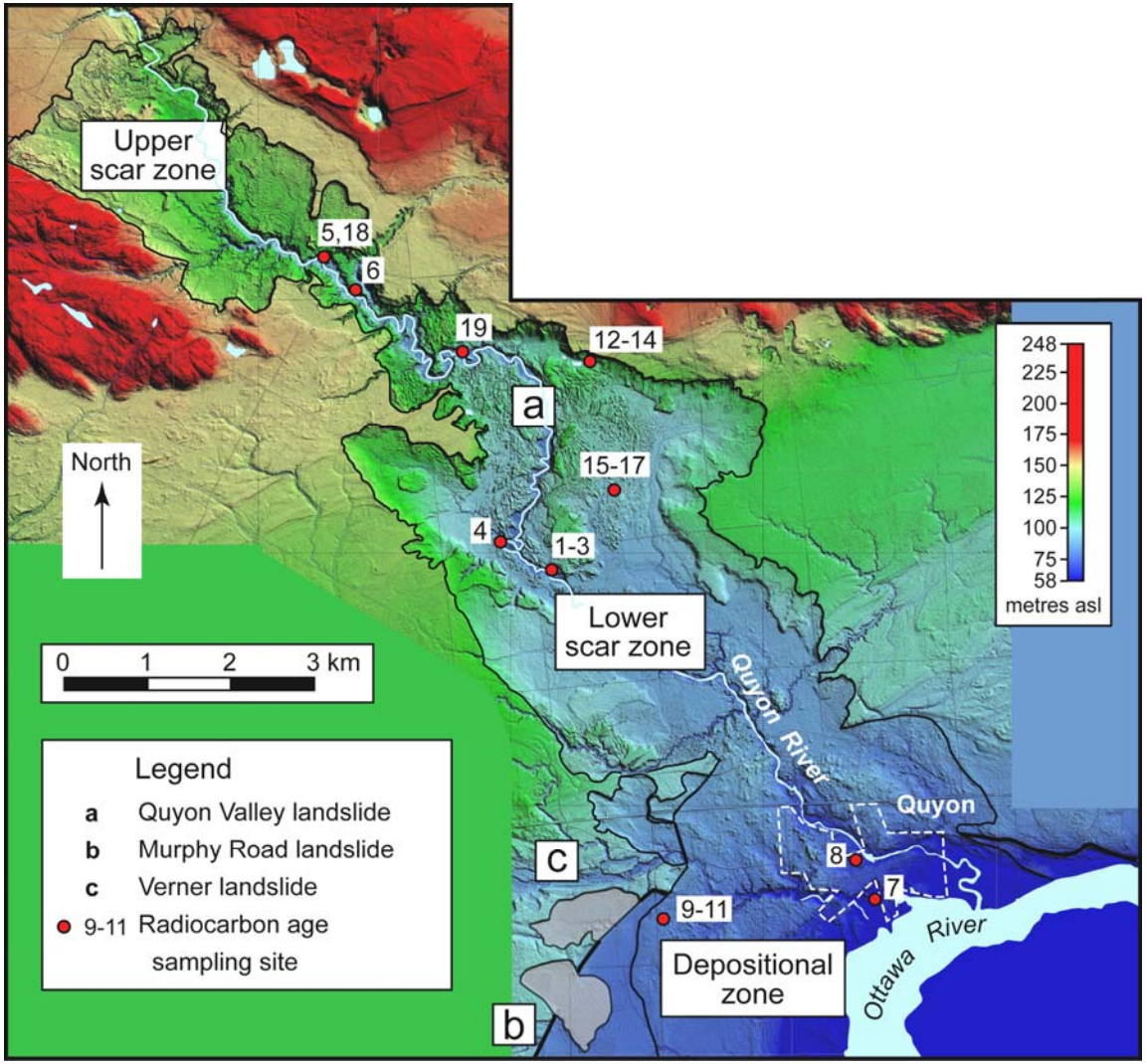


Fig. 5 Shaded relief map showing the sample locations within the upper and lower landslide scar zones and depositional area of the Quyon Valley landslide (area label 'a'; modified from Brooks, 2013). The samples numbers are keyed to those listed in Table 13. Also shown are the Murphy 'b' and Verner 'c' landslides for which dates are listed in tables 14 and 15.

Upper Quyon River landslide, ~10.3 km east-northeast of Shawville, Québec

The upper Quyon River landslide is located along the Quyon River just north of the 8th Line between Smith and Thorne Lake roads, Municipality of Bristol, ~10.3 km east-northeast of Shawville, Québec (Fig. 1). The failure resulted in a large 'flake' slide that translated to the northeast across the Quyon River valley (Fig. 6). Most of this block remained intact after transport; fracture blocks of debris are present between the intact slide block and the backscarp. The three dates listed in Table 14 were obtained from organic materials contained in a core recovered from a wetland that formed between the intact slide block and backscarp (Fig. 6). They represent minimum ages for the failure. This landslide is distinctly separate and not to be confused with the massive Quyon Valley landslide, the scar of which is located ~1 km downstream (see Table 13). Brooks (2013) correlated the age of the upper Quyon River landslide to nine other landslides in the Ottawa-Pontiac region (see Tables 8, 10, 11, 12, 13 and 15) and hypothesized that they represent evidence of a paleoearthquake at ~1020 cal BP with an estimated magnitude of at least M_w 6.1.

Table 14 List of radiocarbon dates collected from the upper Quyon River landslide, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Upper Quyon River landslide	QuyCore-AC-1, 0.61-0.63 m depth	N45.6192° W76.3719°	UCIAMS-106575	955 ± 15	1σ: 802-921 2σ: 797-926	GRB	Date derived from five needle pine needles[b] sampled between 0.61-0.63 m depth in 2.26 m long core recovered from wetland situated in zone between large, translated slide block and backscarp. Sample situated within lower 0.02 m of peaty deposits that overlie sand bed, ~0.1 m thick, and clay-rich sediment. Date represents minimum age for upper Quyon River landslide.	Brooks (2013).
Upper Quyon River landslide	QuyCore-AC-1, 0.59-0.61 m depth	As above.	UCIAMS-106576	955 ± 15	1σ: 802-921 2σ: 797-926	GRB	Date derived from birch bracts and nutlets[b] sampled from 0.59-0.61 m depth in same core as above. Sample situated within peaty deposits, 0.02 to 0.04 m above interface with underlying sand bed, ~0.1 m thick, and clay-rich sediment. Date represents minimum age for upper Quyon River landslide.	Brooks (2013).

Upper Quyon River landslide	QuyCore-AC-1, 0.59-0.61 m depth	As above.	UCIAMS-106577	970 ± 15	1σ: 804-927 2σ: 799-930	GRB	Date derived from fragments of five needle pine needles[b] sampled from 0.59-0.61 m depth in same core as above. Date represents minimum age for upper Quyon River landslide.	Brooks (2013).

[a] GRB – Greg Brooks

[b] Identified by A. Telka, Paleotec Services.

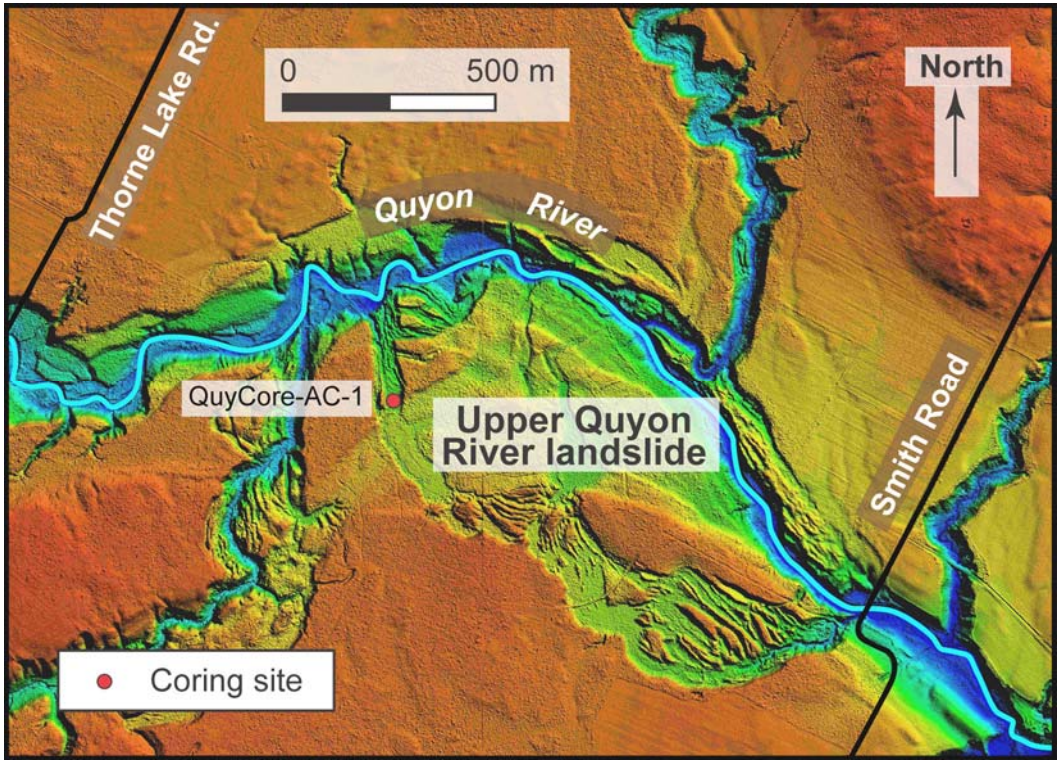


Fig. 6 Shaded relief map showing the coring site on the Upper Quyon River landslide.

Murphy Road landslide, near Quyon, Québec

The Murphy Road landslide is located ~4 km west-southwest of the village of Quyon, Québec, and just west of the margin of the Quyon Valley earthflow (Fig. 1). The landslide is crossed by the northern portion of Murphy Road and part of the 3rd Concession (Fig. 7). The landslide retrogressed into a steep-sided slope that forms a scarp along a broad terrace of the Ottawa River. The landslide debris splayed onto this terrace forming a large depositional lobe, some time after abandonment of this portion of the terrace by the Ottawa River. The Verner landslide (see Table 16), located ~1.2 km to the northeast of the Murphy Road landslide, originated from the same scarp (Fig. 7). The three dates listed in Table 15 were obtained from organic materials buried beneath landslide debris that were recovered in two cores (Fig. 7). The dates represent maximum ages for the Murphy Road landslide. Brooks (2013) correlated the age of the Murphy Road landslide to nine other landslides in the Ottawa-Pontiac region (see Tables 8, 10, 11, 12, 13 and 14) and hypothesized that they represent evidence of a paleoearthquake at ~1020 cal BP with an estimated magnitude of at least M_w 6.1.

Table 15 List of radiocarbon dates collected from the Murphy Road landslide, near Quyon, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Murphy Road landslide, near Quyon, Québec	QuyDrill-AF-1, 4.17-4.27 m depth	N45.5014° W76.2826°	UCIAMS-106650	1145 ± 20	1σ: 988-1069 2σ: 977-1167	GRB	Date derived from branch/twig fragment sampled from buried organic-rich layer situated between 4.17-4.27 m depth in 4.88 m long core recovered near edge of landslide splayed onto terrace of Ottawa River. Organic-rich layer overlain by clay-rich landslide debris. Date represents maximum age for Murphy Road landslide.	Brooks (2013).
Murphy Road landslide	QuyDrill-AF-1, 4.17-4.27 m depth	As above.	UCIAMS-106651	1140 ± 15	1σ: 1000-1064 2σ: 978-1077	GRB	Date derived from bark fragment sampled from same buried organic-rich layer, as above. Date represents maximum age for Murphy Road landslide.	Brooks (2013).
Murphy Road landslide	QuyDrill-AF-2, 4.83-4.88	N45.5018° W76.2823°	UCIAMS-106652	1145 ± 20	1σ: 988-1069 2σ: 977-1167	GRB	Date derived from wood fragment sampled from the upper of two organic layers buried between 4.83-4.88 m and	Brooks (2013).

	m depth		5.0-5.05 m depth in 5.49 m long core, recovered from edge of landslide, near same site mentioned above. Organic-rich layers overlain by sand and clay-rich landslide debris. Date represents maximum age for Murphy Road landslide.

[a] GRB – Greg Brooks

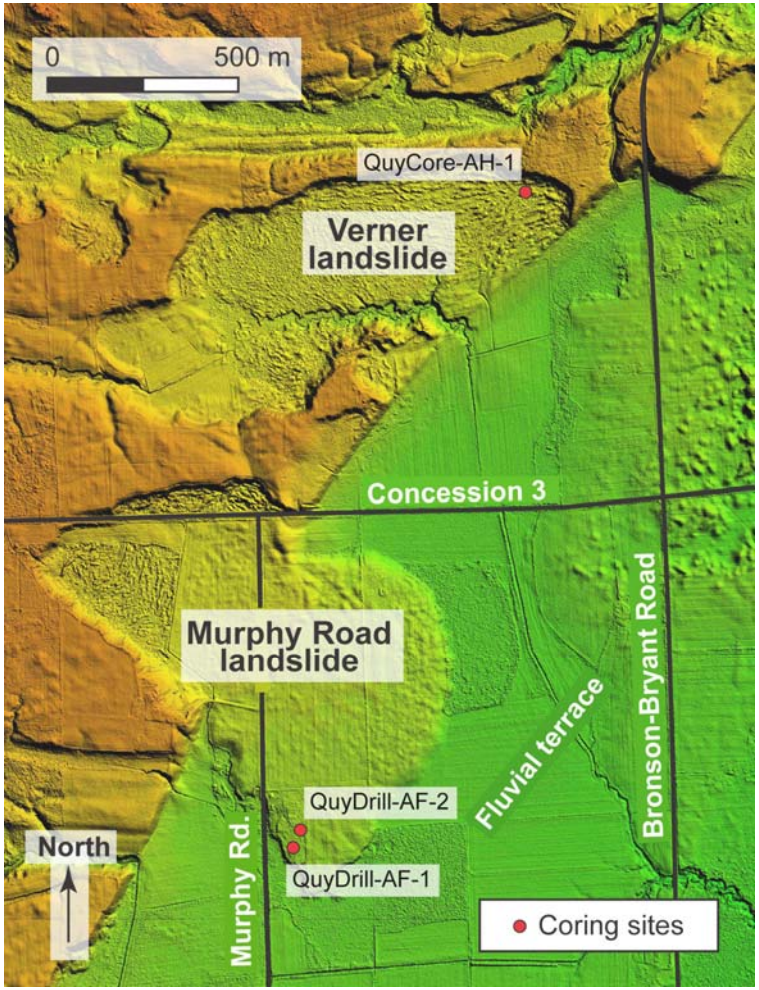


Fig. 7 Shaded relief map showing the coring locations on the Murphy Road and Verner landslides, near Quyon, Québec. The hummocky area in the right-centre of the map is a portion of the debris field from the Quyon Valley landslide (see Fig. 5).

Verner landslide, near Quyon, Québec

The Verner landslide is located ~3 km west-southwest of the village of Quyon, Québec (Fig. 1). The failure retrogressed into a steep-sided scarp forming the margin of a broad terrace of the Ottawa River (Fig. 7). Landslide debris flowing from the scar undoubtedly splayed onto the adjacent fluvial terrace, but this deposit is not preserved and was truncated to the base of the scarp by erosion from the Ottawa River (Fig. 7). The river evidently still flowed on this portion of the terrace surface at the time of the failure or shortly thereafter. The three dates in Table 16 were obtained from organic materials in a core recovered from a post-failure wetland that development between ridges on the scar (Fig. 7). They represent minimum ages for the Verner landslide. The Murphy Road landslide (see Table 15), located ~1.2 km to the southwest of the scar, originated from the same scarp.

Table 16 List of radiocarbon dates collected from the Verner landslide, near Quyon, Québec.

Location	Sample name/ number	Geographical coordinates	Laboratory number	Radiocarbon age (yr BP)	Calibrated age range (cal BP)	Collector[a]	Comment	References
Verner landslide, near Quyon, Québec	Quycore-AH-1, 0.42-0.47 m depth	N 45.5170° W 76.2747°	UCIAMS-106581	5830 ± 20	1σ: 6574-6673 2σ: 6563-6727	GRB	Date derived from 'aged' root fragment[b] sampled between 0.42-0.47 m depth in 1.65 m long core recovered from elongated wetland located between ridges on landslide scar. Sample situated within the lower 0.05 m of peaty wetland deposits that overlie organic-stained clay, and clay and sand landslide debris. Date represents minimum age for the Verner landslide.	Unpublished GSC data.
Verner landslide	Quycore-AH-1, 0.47 m depth	As above.	UCIAMS-106582	5790 ± 25	1σ: 6558-6640 2σ: 6503-6659	GRB	Date derived from wood fragment sampled at 0.47 m depth within same core as above. Date represents minimum age for the Verner landslide.	Unpublished GSC data.
Verner landslide	Quycore-AH-1, 0.42-0.50 m depth	As above.	UCIAMS-106583	5740 ± 20	1σ: 6492-6560 2σ: 6473-6632	GRB	Date derived from birch(?) twig[b] sampled between 0.47-0.50 m depth in same core as above. Sample situated within organic-stained clay sediment several cm above landslide debris. Date represents minimum age for the Verner landslide.	Unpublished GSC data.

[a] GRB – Greg Brooks
[b] Identified by A. Telka, Paleotec Services.

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