



André E. Lalonde AMS Laboratory

Radiocarbon Laboratory

www.ams.uottawa.ca

Submission Form

Email an electronic copy of this submission form to radiocarbon@uottawa.ca

GENERAL	
Submitter Name:	Affiliation:
Submitter Email:	Street Address:
Submitter Phone:	City, Province:
Principal Investigator Name:	Postal Code:
Principal Investigator Email:	Country:
Principal Investigator Phone:	Date Submitted:

We are a LOW-BACKGROUND LABORATORY, FREE OF ANY ENRICHED 14C MATERIAL

I have read and understand the [Terms of Service](#). My samples do not contain, nor have been in contact with, enriched 14C materials.

BILLING	
<input type="checkbox"/> Address same as above	
Contact Name:	Affiliation:
Phone Number:	Street Address:
Email Address:	City, Province:
FOAP or PO (if applicable):	Postal Code:
Unit Price:	Country:
Discount:	<input type="checkbox"/> 10% quantity discount (10 or more samples) <input type="checkbox"/> Training Program (5 sample minimum)
Sector:	<input type="checkbox"/> Internal / OCGC <input type="checkbox"/> Academic <input type="checkbox"/> Non-profit <input type="checkbox"/> Public / Government <input type="checkbox"/> Private
Method of payment:	<input type="checkbox"/> Cheque (preferred) <input type="checkbox"/> Credit card <input type="checkbox"/> Wire Transfer / Direct Deposit
Return of Material:	Should unused material be returned? <input type="checkbox"/> Yes (min. \$15 minimum fee) <input type="checkbox"/> No

PROJECT INFORMATION	
Project Title:	
Country:	
Site Name:	
Collection Date:	
Approx. Age Range:	<input type="checkbox"/> Present-AD1955 <input type="checkbox"/> AD1955-1700* <input type="checkbox"/> <15,000 yrs <input type="checkbox"/> 15,000-35,000 yrs <input type="checkbox"/> >35,000 yrs
<i>* Please refer to tab 5. Data Reporting for an explanation of the "Seuss Effect" for samples with suspected ages between AD1955-1700.</i>	
Student Work:	Will the data be used by a student? If yes, please select: <input type="checkbox"/> B.Sc. <input type="checkbox"/> M.Sc. <input type="checkbox"/> PhD <input type="checkbox"/> PDF
Treatment (preservatives, etc.), and storage:	
Sample significance and any other relevant information (i.e. potential contamination, ΔR, % Marine):	

DATA REPORTING	
For radiocarbon dating, please select one option for calibration: <input type="checkbox"/> No calibration <input type="checkbox"/> cal AD/BC <input type="checkbox"/> cal BP	
-OR- For environmental analysis, please select one or both options for reporting: <input type="checkbox"/> Δ14C <input type="checkbox"/> D14C	

FOR LABORATORY USE ONLY		
Date Received (YYYY/MM/DD)	AELL Number	UOC Numbers Assigned

PLEASE COMPLETE TAB 2 LISTING ALL SAMPLES IN THIS SUBMISSION



Sample List

Samples must be clearly labelled with EXACT SAME submission IDs. Please sort samples by media code in the list below.

	Lab ID	Submitter's Sample ID ¹	Sample Material ¹	Material Code ²	Sample Size	% Carbon	Comments
	<i>UOC Number</i>	<i>20 characters max.</i>	<i>i.e. Wood, charcoal, bulk sediment, bone, shell, etc.</i>	<i>See tab 3 for material codes</i>	<i>Weight (g)</i>	<i>If available</i>	<i>Any information relevant to this sample</i>
1	<i>leave blank</i>						
2	<i>leave blank</i>						
3	<i>leave blank</i>						
4	<i>leave blank</i>						
5	<i>leave blank</i>						
6	<i>leave blank</i>						
7	<i>leave blank</i>						
8	<i>leave blank</i>						
9	<i>leave blank</i>						
10	<i>leave blank</i>						
11	<i>leave blank</i>						
12	<i>leave blank</i>						

¹Essential information; please enter one sample per line.

²To request CN analyses, please add 'CN' to your material code (i.e. B, CN)



Sample List

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13	<i>leave blank</i>						
14	<i>leave blank</i>						
15	<i>leave blank</i>						
16	<i>leave blank</i>						
17	<i>leave blank</i>						
18	<i>leave blank</i>						
19	<i>leave blank</i>						
20	<i>leave blank</i>						
21	<i>leave blank</i>						
22	<i>leave blank</i>						
23	<i>leave blank</i>						
24	<i>leave blank</i>						
25	<i>leave blank</i>						

¹Essential information; please enter one sample per line.

²To request CN analyses, please add 'CN' to your material code (i.e. B, CN)



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Material Codes and Pricing

Code	Description	Sample Size		Price per Sample (CAD) ¹	
		Minimum	Ideal	Can. Academic, Government, Non-Profit ²	Commerical, Independent, International
Refined material					
G	Graphite - please contact us	0.5 mgC	1.0 mgC	\$125	\$180
C	CO ₂ - known pCO ₂ , purified, 15cm length x 6mm OD pyrex	0.5 mgC	1.0 mgC	\$190	\$265
D	Direct combustion - please contact us, depends on %C	5 mg	10 mg	\$250	\$345
Q	Swipe test ³ - analyzed by liquid scintillation, please contact us	-	-	\$40	\$60
Charcoal, wood, peat, organics					
A	Acid wash only - bulk sediment	100 mg	500 mg	\$315	\$430
AAA	Acid, Alkali, Acid - wood, charcoal, most organics	10 mg	>20 mg	\$315	\$430
α-C	Alpha-cellulose extraction	-	-	\$400	\$555
HcF	Humic acid extraction	100 mg	500 mg	\$400	\$555
HnF	Humin fraction	100 mg	500 mg	\$400	\$555
Bone, tooth, antler, ivory⁴ * Please pre-screen for collagen preservation⁵					
B	AAA, collagen extraction	300 mg	2 g	\$445	\$615
BU	AAA, collagen extraction, ultrafiltration ⁶	500 mg	2 g	\$475	\$660
B, BU	Tooth, dentin	800 mg	2 g	\$445	\$615
SB	Calcined bone	1g	2 g	\$320	\$455
Shells, carbonates					
S	Pre-etch and digestion	20 mg	50 mg	\$280	\$390
SN	No pre-etch - recommended for small samples (i.e.. forams)	10 mg	20 mg	\$280	\$390
Particulate organic carbon					
POC	Particulate organic carbon - on quartz filters	0.5 mgC	1.0mgC	\$270	\$370
Skin, parchment, leather, hide, textiles, other					
X	Typically AAA - may require a solvent wash, please contact us	-	-	\$315	\$430
Please note - we do not report AMS δ13C values For bone collagen - δ13C, δ15N (by IRMS) will be reported with all collagen dates as a QA measure For all other materials - If stable isotope data are desired, please contact the Ján Veizer Stable Isotope Laboratory					

Shipping instructions can be found on our [website](#)

¹ We offer a 10% quantity discount for submission of 10 or more samples.

² University of Ottawa Users and Ottawa-Carleton Geoscience Center (OCGC) members please contact us for internal pricing.

³ Please contact us if you are considering sending a swipe test.

⁴ Collagen yield, δ13C, δ15N and atomic C:N (by EA-IRMS, through our partner lab) will be reported for all bone collagen samples a QA measure.

⁵ Please consult our website for [tips on pre-screening bone samples](#).

⁶ Ultrafiltration is used to concentrate longer protein molecules and can be used to remove shorter chain proteins more likely to originate from contaminants (e.g. Brown et al., 1988; Bronk Ramsey et al 2004). Please contact us for a consultation prior to selecting ultrafiltration.

References

Brown, T.A., Nelson, D.E., Vogel, J.S., Southon, J.R., 1988. Improved collagen extraction by modified Longin method. Radiocarbon, 30, 171-177.

Bronk Ramsey, C., Higham, T., Bowles, A., Hedges, R., 2004. Improvements to the pre-treatment of bone at Oxford. Radiocarbon, 46, 155-163.



Radiocarbon Laboratory

Terms of Service

This Agreement is a legally binding contract. By submitting a Submission Form to the André E. Lalonde (AEL) AMS Laboratory at the University of Ottawa (“AEL AMS Laboratory, uOttawa, We, Us, Our or Ours”), the Submitter (“Submitter, They, Their, Theirs”) acknowledges and agrees to the following terms and conditions.

1. Low-Background Disclaimer:

The AEL AMS Laboratory is a **low-background laboratory, free of any enriched material (including but not limited to 14C)**. By submitting this form, the Submitter warrants that Their samples are free of any enriched material. If enriched material from the Submitter’s samples, or the packaging in which they are shipped, results in contamination of equipment or instrumentation requiring cleanup or replacement, significant charges will be incurred.

2. Sample Submission:

The Submitter will provide a completed Submission Form (the “Submission”) and the samples to be analyzed (the “Samples”). We reserve the right to decline a Submission. By making a Submission, the Submitter certifies that They are legally capable of entering into binding contracts on behalf of Themselves, Their supervisor, and/or Their Company.

3. Ownership:

The Samples are not the property of the AEL AMS Laboratory or uOttawa, and we assume no responsibility for any loss or damage to the Samples. The Submitter acknowledges that the analysis process is destructive; therefore, unless otherwise specified in the Submission, any remaining sample material will be held for a period of six (6) months, after which time it will be discarded. If the Submitter specifies the return of the Samples, a minimum fee of \$15 will be applied to Their invoice; larger return shipments are the responsibility of the Submitter.

4. Liability:

We expressly disclaim all warranties in respect of the analyses and the data including all expressed or implied warranties of merchantability and fitness for a particular purpose, including as evidence in any legal proceeding. By analyzing the Samples and providing the data, uOttawa, its employees, students or other uOttawa representatives are not providing an opinion and declines to be a witness in any legal or other adversarial proceeding. Our liability to the Submitter whether arising in contract, tort, negligence, breach of statutory duty or otherwise shall not exceed the price paid for the analysis. The Submitter acknowledges and agrees that: (i) analyses and the data are provided by the AEL AMS Laboratory “as is”; (ii) in no event shall We be liable for any direct, indirect, incidental, punitive or consequential damages whatsoever with respect to the analyses and the data; (iii) that any reliance upon the analyses and/or the data shall be at the Submitter’s sole risk; (iv) Title and risk of loss with rering the majority of this period. This is due to the “Seuss Effect”, which is a flat portion of th

5. Indemnification:



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The Submitter shall indemnify, hold harmless and defend uOttawa, and their respective officers, directors, employees, students and agents (the "indemnified parties") against any and all claims, demands, actions, liability and expenses ("claims") including claims, allegedly resulting in whole or in part from the negligence of the indemnified parties or from acts or omissions for which the indemnified parties otherwise would be liable, related to or arising from the tests, the Samples, the data or Your use of the data. The Submitter shall be responsible for any damage to uOttawa's facilities and/or personnel caused by the Samples.

6. Confidentiality:

"Confidential Information" means any materials, written information, and data marked "Confidential" by the Submitter and provided to the AEL AMS Laboratory for the purpose of conducting the analyses. We will use reasonable efforts to maintain the Confidential Information as confidential to the extent permitted by law. Our obligations do not apply to information in the public domain or independently known or obtained by uOttawa. The Submitter acknowledges that uOttawa is subject to the Freedom of Information and Protection of Privacy Act (Ontario) and as such records in its custody or control, including the Confidential Information, may be subject to access to information requests.

7. Dating of Antiquities:

The Submitter certifies that any samples of artwork, or cultural artefacts submitted to the AEL AMS Laboratory are the property of the Submitter, or that the Submitter is acting as an agent of the owner. If requested, the Submitter will provide evidence of the ownership of the artwork or artefact. The Submitter declares that the articles are legally imported and exported from any country through which they passed; if requested, the Submitter will provide documentation to this effect. The Submitter undertakes not to use the radiocarbon date in an advertisement, or in a description of the samples for sale, and not to pass the date on to a third party who might do likewise. If authentication is required, or valuable artifacts are involved, We ask that these be sampled by a conservator (as they possess the required knowledge to sample with a minimum reduction of value to the artifact). AEL AMS Laboratory staff will not sub-sample artefacts or artwork. The Submitter will provide a photograph of the artefact or artring the majority of this period. This is due to the "Seuss Effect", which is a flat portion of the calibration curve caused by the burning of fossil fuels and a Maunder M

8. Fee Schedule & Payment Terms:



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Invoices are payable upon receipt (net 30). The fee schedule rates for all lab units are assigned based on the billing address listed on the Submission Form, and the pricing listed on our website at the time of submission. A purchase order (PO) is required for submissions over \$5,000 CAD. Duty charges are the responsibility of the Submitter and will be added to Their invoice. Canadian Academic, Non-Profit, and Government Users: Submitters affiliated with Canadian academic institutions, registered non-profit organizations, indigenous groups, and government agencies will be invoiced following the delivery of Their results. Commercial, Independent, and International Users: Submitters affiliated with private Canadian companies, Submitters not affiliated with a company or academic institution, and those from abroad are required to remit payment in full prior to release of Their results. An invoice will be issued upon receipt of the Submission. Internal Users: Submitters affiliated with the University of Ottawa the majority of this period. This is due to the "Seuss Effect", which is a flat portion of the calibration curve caused by the burning of fossil fuels and a Maunder Minimum. For marine samples, the Marine13 calibration curve is used with the appropriate marine reserv

9. Discounts:

Discounts will be applied to Submissions that meet the following criteria: Radiocarbon Laboratory: A 10% discount will be applied to single Submissions of 10 or more samples, or cumulative Submissions of 10 or more samples, where all 10 samples are processed on the same accelerator run. For fully trained outside users processing samples at the AEL AMS laboratory, a 20% discount will be applied at the discretion of AEL-AMS staff. Radiohalide Laboratory: A 5% discount will be applied to Submissions of 8-15 samples; a 10% discount will be applied to Submissions of 16 or more samples. Submitters eligible for internal rates are not eligible for quantity discounts.

10. Suspension of Work:

We reserve the right to suspend work and/or withhold data delivery if the Submitter fails to make timely payment of Their invoices. We will not be held responsible for any damages incurred by the Submitter caused by Our work suspension or withholding of data precipitated by Their failure to promptly pay invoices.

11. Results:

Upon successful completion of the requested analyses, the AEL AMS Laboratory will provide the Submitter with results using the email address provided in Their Submission. Results will not be released to third parties not listed on the Submission without written consent of the original Submitter.

12. Failed Analyses:

For Samples which fail due to the nature of the sample itself, and which are outside the control of the laboratory, the AEL AMS Laboratory reserves the right to recover partial or full costs for laboratory treatment up to the point of failure. Please refer to the **Sample Failure Charging Policy** for each lab unit for more details.



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13. Unforeseen Event / Force Majeure:

We will not be liable or responsible for any failure to perform, or delay in performance of, any of our obligations under a Contract that is caused by events outside our reasonable control, commonly known as “force majeure”.

14. Entire Agreement:

This Agreement constitutes the Entire Agreement between the Submitter and the AEL AMS Laboratory. It supersedes all other written or verbal communications between the Submitter and the AEL AMS Laboratory. It can only be amended in writing by mutual agreement.

15. Jurisdiction:

This Agreement shall be governed by and interpreted in accordance with the laws of the Province of Ontario that are in force. The Submitter expressly accepts jurisdiction of the Ontario Courts.



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Data Reporting

1. Sample Processing:

Sample pre-treatment techniques and definitions of media codes can be found in Crann et al. (2017) and Murseli et al. (2019). For more information about the equipment used for sample preparation, please see St-Jean et al. (2017).

2. Radiocarbon Analysis:

Radiocarbon analyses are performed on a 3MV accelerator mass spectrometer (AMS) built by High Voltage Engineering. ^{12}C , ^{13}C , $^{14}\text{C}+3$ ions are measured at 2.5 MV terminal voltage with Ar stripping. The fraction modern carbon, $F_{14\text{C}}$, is calculated according to Reimer et al. (2004) as the ratio of the sample $^{14}\text{C}/^{12}\text{C}$ to the standard $^{14}\text{C}/^{12}\text{C}$ (Ox-II) measured in the same data block. Both $^{14}\text{C}/^{12}\text{C}$ ratios are background-corrected and the result is corrected for spectrometer and preparation fractionation using the AMS measured $^{13}\text{C}/^{12}\text{C}$ ratio and is normalized to $\delta^{13}\text{C}$ (PDB). Radiocarbon ages are calculated as $-8033\ln(F_{14\text{C}})$ and reported in ^{14}C yr BP (BP=AD 1950) as described by Stuiver and Polach (1977). Errors on ^{14}C ages (1σ) are based on counting statistics and $^{14}\text{C}/^{12}\text{C}$ and $^{13}\text{C}/^{12}\text{C}$ variation between data blocks. $\Delta^{14}\text{C}$ (defined as per mil Depletion or Enrichment Relative to Standard Normalized for Isotope Fractionation) is calculated as $(F_{14\text{C}} - 1) \cdot 1000$. $\Delta^{14}\text{C}$ (defined as the absolute amount of ^{14}C in the sample in the year it was measured) is calculated as: $(F_{14\text{C}} \cdot e^{(1950-y)/8267} - 1) \cdot 1000$. If Year of Collection "z" and Measurement "y" are not the same, multiply by $e^{(y-z)/8267}$.

3. Reporting of Data:

In the analysis report, we have followed the conventions recommended by Millard (2014). An analysis report will include the $F_{14\text{C}}$, and uncalibrated age in the units of yr BP ("years before present", present = AD1950). We do not report $\delta^{13}\text{C}$ because it is not measured by Isotope Ratio Mass Spectrometry (IRMS). A $\delta^{13}\text{C}$ measured by an accelerator mass spectrometer (AMS) includes both natural and machine fractionation and is used as a fractionation correction of a radiocarbon age (see Section 2), and therefore should not be used for dietary or environmental inference. We report $\Delta^{14}\text{C}$ and $\Delta^{14}\text{C}$ only when requested by the submitter.

4. Calibration:

Calibration is performed using OxCal v4.2.4 (Bronk Ramsey, 2009). Calibrated results are given as a range (or ranges) with an associated probability, as point estimates (mean, median) cannot represent the uncertainties involved (Millard, 2014). We acknowledge that point estimates are often desired and are thus included on the calibration plots in the Appendix, but we recommend that data tables used in publication maintain calibrated age ranges. Where the $F_{14\text{C}}$ is less than 1 (older than AD1955), the IntCal13 calibration curve is used for Northern Hemisphere samples (Reimer et al., 2013) and ShCal13 for Southern Hemisphere samples (Hogg et al., 2013). For samples with an $F_{14\text{C}}$ greater than 1 (younger than AD1955), the post-bomb atmospheric curve is used with an appropriate geographic zone selected (Hua et al., 2013). Post-bomb samples have two age ranges due to calibration on both sides of the bomb pulse. Samples that calibrate between the 1700's and early 1950's will always result in a calibrated age range covering the majority of this period. This is due to the "Seuss Effect", which is a flat portion of the calibration curve caused by the burning of fossil fuels and a Maunder Minimum. For marine samples, the Marine13 calibration curve is used with the appropriate marine reservoir correction (Reimer et al., 2013). A marine reservoir correction is applied following coordinates provided by the client in the submission file. ΔR values (regional difference from the average global marine reservoir correction) are provided by the client, or determined using 14CHRONO Queen's University Belfast marine reservoir correction database (<http://radiocarbon.pa.qub.ac.uk/marine>), and incorporated into the calibrated dates. Marine samples with Radiocarbon ages minus ΔR that is less than 460 ^{14}C yr BP should not be calibrated due to high atmospheric ^{14}C levels from nuclear weapons testing (Reimer et al. 2004).

5. References:

1. Bronk Ramsey C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51: 337–360.



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Data Reporting

2. Crann CA, Murseli S, St-Jean G, Zhao X, Clark ID, Kieser WE. 2017. First status report on radiocarbon sample preparation at the A.E. Lalonde AMS Laboratory (Ottawa, Canada). *Radiocarbon* 59(3): 695–704. <http://doi.org/10.1017/RDC.2016.55>
3. Hogg A, Hua Q, Blackwell PG, Niu M, Buck CE, Guilderson TP, Heaton TJ, Palmer JG, Reimer PJ, Reimer RW, Turney CS, Zimmerman SRH. 2013. SHCal13 Southern Hemisphere Calibration, 0–50,000 Years cal BP. *Radiocarbon* 55(4): 1889–1903.
4. Hua Q, Barbetti M, Rakowski AZ. 2013. Atmospheric radiocarbon for the period 1950-2010. *Radiocarbon* 55(4): 2059–2072.
5. Millard A. 2014. Conventions for reporting radiocarbon determinations. *Radiocarbon* 56(2): 555–559.
6. Murseli S, Middlestead P, St-Jean G, Zhao X, Jean C, Crann CA, Kieser WE, Clark ID. 2019 The preparation of water (DIC, DOC) and gas (CO₂, CH₄) samples for radiocarbon analysis at AEL-AMS, Ottawa, Canada. *Radiocarbon* 61(5): 1563-1571.
7. Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE, Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Hafliðason H, Hajdas I, Hatté C, Heaton TJ, Hogg AG, Hughen KA, Kaiser KF, Kromer B, Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Turney CSM, van der Plicht J. 2013. IntCal13 and MARINE13 radiocarbon age calibration curves 0-50000 years calBP. *Radiocarbon* 55(4): 1869–1887.
8. St-Jean G, Kieser WE, Crann CA, Murseli S. 2017. Semi-automated equipment for CO₂ purification and graphitization at the A.E. Lalonde AMS Laboratory (Canada). *Radiocarbon* 59(3): 941–956. <https://doi.org/10.1017/RDC.2016.57>
9. Stuiver M, Polach HA. 1977. Discussion: reporting of ¹⁴C data. *Radiocarbon* 19(3):355–63.