

Isotopic composition of lead white pigments on qeros: Implications for the chronology and production of Andean ritual drinking vessels during the colonial era

Allison N. Curley^{1*†}, Alyson M. Thibodeau^{1‡}, Emily C. Kaplan², Ellen Howe³, Ellen Pearlstein⁴, Judith Levinson⁵

¹Department of Earth Sciences, Dickinson College, P.O. Box 1773, Carlisle, PA, 17013, USA

²Smithsonian National Museum of the American Indian, 4220 Silver Hill Road, Suitland, Maryland 20746, USA

³Metropolitan Museum of Art, 1000 Fifth Avenue, NY, NY 10028, USA

⁴UCLA Information Studies and UCLA/Getty Program in Conservation of Archaeological and Ethnographic Materials, A410 Fowler, Los Angeles, California 90065, USA

⁵American Museum of Natural History, 200 Central Park West, NY, NY 10024, USA

*Present address: Department of Earth and Environmental Sciences, University of Michigan, 1100 North University Avenue, Ann Arbor, MI, 48109, USA

†corresponding author: ancurley@umich.edu

‡ corresponding author: thibodea@dickinson.edu

Additional File 3: Radiocarbon dating of wood and resin from a colonial qero residing in a private collection (“Private Collection A”)

Radiocarbon samples and methods

We sampled both wood and resin from a colonial qero that resides in a private collection (“Private Collection A”). The resin sample was removed using a scalpel from an area of pre-existing loss where design elements would not be affected (Fig. S1a). The wood sample was taken with a scalpel under magnification from areas of pre-existing loss (Fig. S1b). The samples were submitted for radiocarbon determination to the Keck Carbon Cycle Accelerator Mass Spectrometry (AMS) facility at the University of California at Irvine. Resin and wood samples were treated with acid-base-acid protocol (1N HCl and 1N NaOH, 75°C) prior to combustion.

Results of the radiocarbon determination are reported in Table S1. Radiocarbon concentrations are given as fractions of the modern standard, $\Delta^{14}\text{C}$ values, and conventional radiocarbon age following the conventions of Stuiver and Polach [1]. Sample backgrounds have been subtracted based on measurements of ^{14}C -free wood. All results have been corrected for isotopic fractionation according to the conventions of Stuiver and Polach [1], with $\delta^{13}\text{C}$ values measured on prepared graphite using AMS. These can differ from the $\delta^{13}\text{C}$ values of the original material if fractionation occurred during sample graphitization or the AMS measurement and thus are not shown. Radiocarbon ages were calibrated using OxCal v. 4.3.2 [2] and the SHCal13 atmospheric curve [3].

Discussion of Radiocarbon Results

The ^{14}C ages for the resin and wood samples from “Private Collection A” are 180 ± 15 BP and 300 ± 15 BP, respectively (Table S1). The calibrated age ranges for the materials (1513-1664 AD for the wood and 1671-1934 AD for the resin) do not overlap (Fig. S2). This discrepancy suggests that the wood is older than the resin. The apparent age of the wood may not be an accurate estimate for the timing of manufacture of the vessel because the wood sample

may derive from the interior portion of a relatively long-lived tree and/or because the death of the tree happened long before the wood was used to carve the qero. In addition, the time-width of the wood sample is unknown. Thus, ^{14}C ages obtained on wood from colonial qeros should be interpreted with caution and calibrated dates are best interpreted as maximum ages.

The resin sample from “Private Collection A” appears to be younger than the wood and was likely harvested after 1670 AD. Unfortunately, it is not possible to establish the date with greater specificity as the ^{14}C age of resin (180 ± 15 B.P.) corresponds to multiple historical date ranges in the 17th, 18th, 19th, and 20th centuries (Fig. S2a). The shape of the calibration curve during the colonial period limits the utility of radiocarbon dating to establish the chronology of colonial qeros manufactured from the 17th-19th centuries. Despite this limitation, we note that radiocarbon dating of resin samples may produce more reliable constraints on the age of colonial qeros than the dating of the wood. This is because resin samples likely do not have significant time-widths and because fresh plant material was likely harvested relatively close to the time of manufacture.

TABLE S1. RESULTS OF ^{14}C MEASUREMENTS ON “PRIVATE COLLECTION A”

Sample Name	fmc	±	$\Delta^{14}\text{C}$ (‰)	±	^{14}C age (BP)	±	Calendar age range
Resin	0.9778	0.0015	-22.2	1.5	180	15	1671-1923 AD
Wood	0.9635	0.0015	-36.5	1.5	300	15	1513-1664 AD

fmc - fraction modern carbon



Figure S1. Locations of sampling for radiocarbon dating of resin and wood from colonial qero “Private Collection A.” a) Circled area shows location where pigmented *Elaeagia* resin was removed from animal motif hindquarter. b) Circled area shows location where wood was removed from the qero rim.

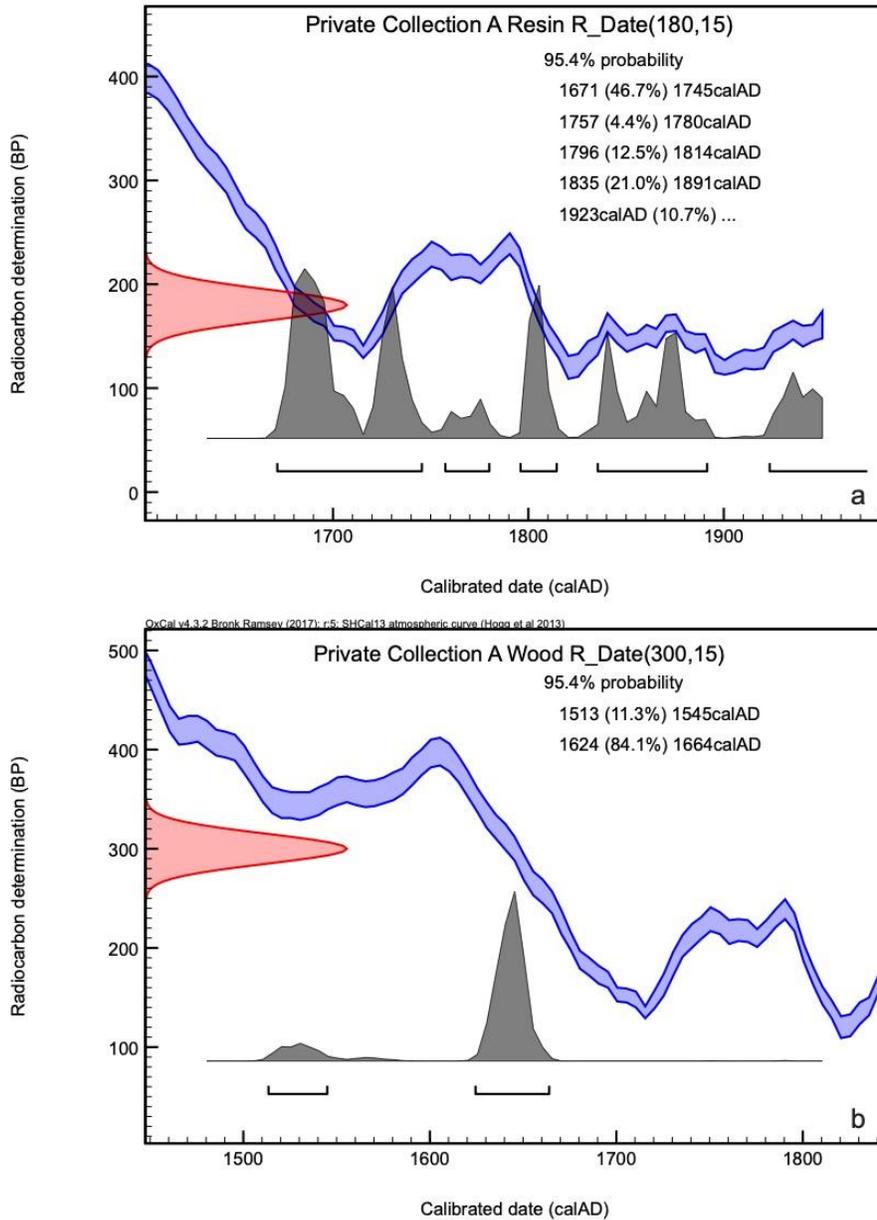


Figure S2. Radiocarbon age vs. calendar age for (a) resin and (b) wood from colonial qero “Private Collection A.” Plots generated using OxCal v. 4.3.2 [2] and the SHCal13 atmospheric curve [3]. Note that the ranges of possible calendar ages for the resin are all younger than those for the wood.

References

1. Stuiver M, Polach HA. Discussion reporting of ^{14}C data. *Radiocarbon*. 1977;19:355–63.
2. Bronk Ramsey C. OxCal Program, Version 4.3. Oxford Radiocarbon Accelerator Unit: University of Oxford. 2017. <https://c14.arch.ox.ac.uk/oxcal.html>.
3. Hogg AG, Hua Q, Blackwell PG, Niu M, Buck CE, Guilderson TP, et al. SHCal13 Southern Hemisphere calibration, 0–50,000 years cal BP. *Radiocarbon*. 2013;55:1889–903.