**[For SUPPLEMENTARY MATERIAL]**

**Tracking glass beads: communities and exchange relationships across the Atlantic in the seventeenth century**

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**Detailed materials and methods**

Glass bead chemical compositions obtained from minimally invasive or non-destructive analysis methods are the data used for this article. These compositional data (n = 1012 total samples) can be divided into two groups: data collected by the authors (including some previously published) and legacy compositions published by others.

For Group 1, primary data were collected by the authors, and some are previously published (Walder 2013, 2018, 2022; Walder *et al*. 2021; Hawkins & Walder 2022). The method used was laser ablation – inductively coupled plasma – mass spectrometry (LA-ICP-MS) at the Field Museum Elemental Analysis Facility and Laurentian University Harquail Earth Sciences Facility (HES) (n = 682 total compositions). For Group 2, legacy compositions, data were collected from LA-ICP-MS (n = 69) (Dussubieux 2009; Dussubieux & Gratuze 2012; Dussubieux & Karklins 2016) and instrumental neutron activation analysis (INAA) (n = 261) (Hancock *et al*. 1994, 1999, 2000; Sempowski *et al*. 2000; Karklins *et al*. 2002, 2015). See Table S2 below for a summary of samples. Notably, trace elements such as zirconium (Zr), hafnium (Hf) and niobium (Nb) were not obtained for INAA analyses, and Hf was not reported for some of the LA-ICP-MS samples obtained at the HES. However, Nb and Hf values are correlated and Nb values were used for trace element biplots to show compositional differences. The analytical procedures, limits of detection and other methodological considerations for LA-ICP-MS and INAA are well-published elsewhere (Walder *et al*. 2021).

**Table S2. Summary of dataset. EAF = Field Museum Elemental Analysis Facility; HES = Laurentian University Harquail Earth Sciences.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Turquoise / Cu** | | **Cobalt / Co** | | **White / Sn** | | **TOTALS** | | |
| **LA-ICP-MS samples by Walder and Hawkins** | **EAF** | **HES** | **EAF** | **HES** | **EAF** | **HES** | **EAF** | **HES** | **TOT** |
| Western Great Lakes | 252 | 0 | 251 | 0 | 3 | 0 | 506 | 0 | **506** |
| Wendake (S. Ontario) | 53 | 11 | 55 | 8 | 27 | 16 | 135 | 35 | **170** |
| Netherlands | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 6 | **6** |
| ***TOTAL by authors LA-ICP-MS*** | **318** | | **316** | | **48** | | **682 samples** | | |
| **OTHER ANALYSTS** |  | |  | |  | |  | | |
| **INAA samples** |  | |  | |  | |  | | |
| Wendake (S. Ontario) | 26 | | 0 | | 111 | | 137 | | |
| Netherlands | 22 | | 22 | | 80 | | 124 | | |
| ***Total Other INAA*** | **48** | | **22** | | **191** | | **261** | | |
| **LA-ICP-MS samples** |  | |  | |  | |  | | |
| Western Great Lakes | 0 | | 1 | | 0 | | 1 | | |
| France | 17 | | 15 | | 1 | | 33 | | |
| England | 0 | | 19 | | 7 | | 26 | | |
| Netherlands | 3 | | 3 | | 3 | | 9 | | |
| ***Total other LA-ICP-MS*** | **20** | | **38** | | **11** | | **69** | | |
| **TOTAL ALL** | **386** | | **376** | | **250** | | **1012** | | |

Note: Because INAA data were not collected in consultation with First Nations descendants, we excluded all mortuary context beads (e.g. Ossossané ossuary) from legacy data.

Not all published glass bead compositions for the study region were included. To focus on Wendat/Wyandot exchange connections and population movement across the Great Lakes region *c*. AD 1600–1650, we restricted our dataset to beads produced before AD 1700, using two known recipe shifts. We excluded later, antimony (Sb) opacified white beads (Hancock *et al*. 1997) and we included only magnesium-low-phosphorus (Mg-low-P) pre-1700 compositions, as defined by Walder (2018). All of the beads fitting the later, post-1700 compositional subgroup (P-low-Mg) that were not included in the final comparative dataset (n = 110) were less than 2 parts per million (ppm) Hf, less than 50ppm Zr, in the potentially ‘Venetian’ silica source range (De Raedt *et al*. 2001) and came from later sites, such as French colonial Fort Michilimackinac and Fort St. Joseph.

This strategy of restricting the study dataset to pre-1700 beads based on their chemical compositions, rather than their archaeological contexts, allows comparison of potential heirloom beads made prior to AD 1700 but recovered from sites with later occupations (e.g. French colonial Fort Michilimackinac). For the French colony ship *La Belle,* which left France on 24 July 1684 and sank in 1686 off the coast of Texas (Bruseth *et al*. 2017), we included cobalt blue but not white beads. The shipwreck’s white beads were Sb-opacified, a shift which began from approximately AD 1625–1640 for archaeological sites in the Northeast; Sb-opacified beads had completely replaced tin- (Sn)-opacified white beads by *c.* AD 1675 (Sempowski *et al*. 2000). The cobalt-blue beads from *La Belle* fit the pre-AD 1700 sub-group (Walder 2022) and were included as comparisons for both the European production centres (from which the ship was likely provisioned) and to investigate connections to beads from Great Lakes region sites.

In glasshouses across Europe, different types of beads were produced, often with subtle variations in colour, opacity, shape, size and other attributes. Glass bead typologies (e.g. Kidd & Kidd 1970) use these attributes to assign beads to types and produce chronological seriations such as the Glass Bead Periods or GBPs (Kenyon & Kenyon 1983; Kenyon & Fitzgerald 1986; Fitzgerald *et al*. 1995). The dataset in this paper contains white, cobalt and turquoise-coloured glasses. For European samples, this includes production waste or scraps, not just finished beads. Cobalt or navy-blue glass (n = 376) contains cobalt (Co) at more than 300ppm with copper (Cu) at less than 0.65% and is generally translucent, and a few beads are coloured with both copper and cobalt. White beads (n = 140) are opaque and have Sn-opacified glass compositions. Turquoise glass compositions in the dataset are made with copper (Cu)-coloured glass, copper oxide (CuO) at 0.65% or greater, and may be translucent but sometimes are opacified with Sn to produce a ‘robin’s egg blue’ colour. The turquoise group includes reworked or refired glass fragments and pendants (n = 19) in addition to beads (Figure S1) for a total of 360 Cu-coloured glass compositions (beads, pendants, refired glass fragments).

These reworked turquoise glass compositions come from artefacts Indigenous people made by repurposing beads into pendants or other adornments (Walder 2013; Billeck 2016). An example of a refired glass fragment from the Zimmerman Site in north-central Illinois (Brown, J.A. 1961; Brown, M.K. 1975; Rohrbaugh *et al*. 1999) shows how beads obtained from multiple sources produced in different European locations were utilised in the interior. The white-appearing portion of this glass fragment (ZM\_07) is Sn-opacified but contains 1.3% CuO, indicating it was made with a mix of turquoise and white beads, some of which were Sn-opacified and may have been heirlooms, based on the presence of Sn and the moderate Hf, Nb and Zr trace elements present (Hf=7.1ppm, Nb=5.3ppm, Zr=236ppm,). The blue portion (ZM\_08) is Cu-coloured and fits the Mg-low-P pre-1700 subgroup for Cu-coloured beads from the Western Great Lakes and has low trace element values consistent with Venetian silica sources (Hf=0.5ppm, Nb=1.1ppm, Zr=13.7ppm). Both ZM\_07 and ZM\_08 are plotted with the AD 1660–1700 Western Great Lakes Cu-coloured group in this article.

A picture containing indoor

Description automatically generated

*Figure S1. Refired glass object from the Zimmerman site (sample IDs ZM\_07 and ZM\_08). Scale in millimetres (figure by authors).*

For this study, the most common Kidd and Kidd (1970) bead types in each colour category are as follows: turquoise: IIa31, IIa38, IIa40 and related types; cobalt: Ia19, IIa55, IIa56, IIa57 and related types; white: IIa13 or IIa14 and related types. In Figure 3, we have illustrated individual analysed beads from different sites, and here we list their sample ID and archaeological site: Type IIa40 = OS\_20 (Ossossané village); IIa38 = GL\_08 (Goose Lake Outlet#3 or ‘GLO#3’); IIa55 = TW\_26 (Max Oné-Onti Gros-Louis, formerly Thomson Walker); IIa57 = GL\_01 (GLO#3); IIa13 = GL\_34 (GLO#3); IIa15 = GL\_35 (GLO#3). We maintain that compositional, rather than typological, quantitative compositional analyses of glass bead assemblages are preferable when comparing large datasets, given the subjectivity of classifying beads according to visual assessments of their colour, opacity and other observable attributes. See the final compositional data tables for the assigned type for each bead in the dataset (Tables S3–S5).

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