NUEVA CADIZ BEADS IN THE AMERICAS: A PRELIMINARY COMPOSITIONAL COMPARISON

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Nueva Cadiz and associated beads are among the earliest categories of European glass beads found in the Americas. Named after the site in Venezuela where they were first identified, these tubular, square-sectioned beads occur in regions of 16th-century Spanish colonial trade. A similar style occurs around Lake Ontario in northeastern North America in areas of 17th-century Dutch and French colonial trade. We compare the chemical composition of beads from South America and Ontario, Canada, to explore their provenience and technology. Differences in key trace elements (Hf, Zr, Nd) strongly indicate separate sand origins for the two bead groups. Comparison with soda-lime glass made in Venice and Antwerp reveals chemical similarities between the South American beads and Venetian glass, and between the Ontario beads and Antwerp glass. The analysis also sheds light on beadmaking technologies.

INTRODUCTION

Drawn glass beads described as "Nueva Cadiz" types are distinctive large tubular beads with a widespread distribution on 16th- and 17th-century colonial sites and come from diverse archaeological and historic contexts in the Americas (Little 2010; Liu and Harris 1982). These beads are square in section, sometimes twisted, and may have multiple layers of differently colored glass. In some cases, the name "Nueva Cadiz" has been used to refer to any tubular drawn bead with a square cross section, including compound examples with an opaque red exterior, and even those with a simple monochrome construction (e.g., Fairbanks 1968). The eponymous Nueva Cádiz site in Venezuela was a Spanish port town inhabited from 1498 to 1545. Beads from this and other early South American sites are associated with Spanish colonial trade (e.g., Donnan and Silton 2010). Beads of Kidd and Kidd (1970) varieties IIIc1, IIIc2, and IIIc3, as well as twisted variety IIIc'4, are referred to here as "archetypal" Nueva Cadiz varieties. These beads generally have a blue/white/turquoise or blue/white/gray cross section, with the outer turquoise or robin's egg blue color deriving from the use of copper as a colorant (Figure 1). Such beads have been recovered from Portuguese (Veiga and Figueiredo 2006), Flemish (Karklins and Oost 1992), Norman (Karklins and Bonneau 2019), and possibly Andalusian (Deagan 1987:164; Martins Torres 2019:155) sites, and may have been manufactured in several European locations.

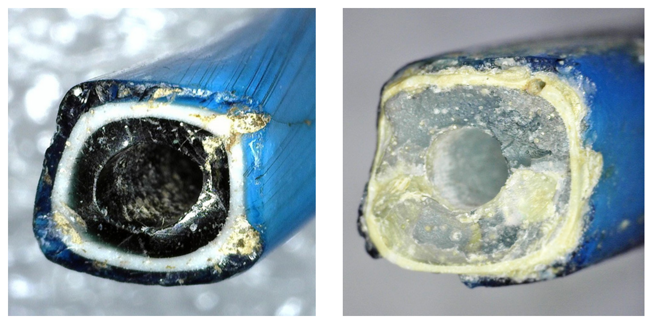

Figure 1. "Archetypal" Nueva Cadiz beads from 16th-century Spanish colonial contexts in South America with blue/white/blue and blue/white/gray layers (photo: Brad Loewen).

The "Nueva Cadiz" descriptor has also been applied to similar beads from later sites, particularly in the Northeast including southern Ontario, where French and Dutch traders were influential in the late 16th and early 17th centuries (Kenyon and Kenyon 1983; Smith 1983). These beads have a turquoise-blue outer layer with interior white and red layers and sometimes an additional innermost blue layer (Figure 2). They are categorized as type IIIc'3 and here are referred to as Nueva Cadiz Twisted – Red Variety (NCT-RV). Smith and Good (1982:51) argue that the red-core variety found in the Northeast could be considered a "revival" style that is not directly related to earlier Nueva Cadiz beads from Spanish contexts.

In this brief summary of ongoing research (Loewen 2021), we present a preliminary comparison of these two groups. The earlier blue/white/turquoise Nueva Cadiz beads from 16th-century Spanish colonial contexts are compositionally distinct from 17th-century varieties that

Figure 2. Nueva Cadiz Twisted – Red Variety. Two examples from the Huron-Wendat Le Caron site in Ontario. While these beads usually have three layers, these specimens have a fourth blue layer forming the core (scale in mm) (photo: Heather Walder).

include a red layer. Smith and Good (1982) and Karklins and Oost (1992:26) suggest that the term "Nueva Cadiz" only be used to describe those square-profiled tubular varieties associated with Spanish trade, which lack a red interior layer and may be identified by their blue/white/blue or gray cross section. The imprecise use of "Nueva Cadiz" as a descriptive category can lead to a loss of interpretive value.

By conducting compositional analyses, we hope to learn more about both the production processes used to make these technologically sophisticated polychrome beads and the European and Indigenous exchange networks that circulated these artifacts in the 16th and 17th centuries. Here we examine the white and turquoise layers of ten beads tentatively attributed to the site of Tiahuanaco in western Bolivia that were purchased by a collector in the 1970s (Loewen 2021), and six beads from controlled archaeological contexts on 17th-century Huron-Wendat occupations in Simcoe County, Ontario, Canada. The full compositions of all 16 beads are available on the Digital Archaeological Record (tDAR.org; tDAR Record ID: 463186) to promote further study of this important bead style.

PREVIOUS RESEARCH ON NUEVA CADIZ BEADS

Some research has examined the European origins of Nueva Cadiz beads in an effort to link their colonial contexts with centers of production such as Amsterdam, Venice, and other locations. Karklins and Oost (1992) describe Kidd and Kidd IIIc varieties at the Kaasstraat site in Antwerp, Belgium, from contexts dating to the 16th and 17th centuries. Several examples of "archetypal" Nueva Cadiz beads are also known from Dutch sites (Karklins 1974:75), but not NCT-RV (IIIc'3) (Karklins 2020: pers. comm.).

Karklins and Bonneau (2019) describe a broken archetypal Nueva Cadiz bead and a bead production tube (cerulean blue/white/cerulean blue) in an archaeological collection from Rouen, France. Attributed to the early 17th century, these items indicate that Nueva Cadiz beads may have been fashioned at this location, but it is also possible that the production tube was made elsewhere. Karklins and Bonneau (2019:7) further propose that the NCT-RV beads found in Northeastern North America could have "originated in beadmaking workshops scattered over northern France."

Martins Torres (2019:73) asserts that the Venetian Paternoster guild, established in the late 15th century, manufactured beads like Nueva Cadiz and chevrons, and Zecchin (2005:83) illustrates Venetian examples of production canes similar to those used to make Nueva Cadiz beads. The temporal and geographic data currently available suggest that archetypal Nueva Cadiz beads are distinct and were produced and distributed at an earlier date than NCT-RV beads. We have not done a comprehensive survey of the archaeological sites that have yielded archetypal Nueva Cadiz beads in Europe or the Americas, but many researchers (e.g., Deagan 1987; Fairbanks 1968; Little 2010; Smith 1983; Smith and Good 1982) associate them with Spanish colonial trade networks, whereas NCT-RV beads are associated with French and/or Dutch trade.

THE BEAD SAMPLE

The Nueva Cadiz samples from South America were analyzed in an ongoing collaborative effort by Loewen and Dussubieux at the Elemental Analysis Facility, Chicago Field Museum, using standard laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) procedures. In a brief note, Loewen (2021) describes the beads' trajectory and purported origin at Tiahuanaco, western Bolivia. A total of 22 glass compositions from ten beads are included in this compositional comparison (BL22-BL31). In two cases, distinct compositions were obtained from two copper-colored blue layers in the same bead.

The analyzed beads from Ontario come from three archaeological sites: Max Oné-Onti Gros-Louis (formerly Thomson-Walker) (n=1), Le Caron (n=4), and Ellery (n=1). Although there is some variation in the age of the sites, they all date to the second quarter of the 17th century. Max Oné-Onti Gros-Louis is considered the earliest, straddling Glass Bead Periods 2 (1600-1625) and 3a (1625-1630) (Fitzgerald et al. 1995; Kenyon and Kenyon 1983). The glass bead assemblage contains both a significant number of monochrome navy and white beads, typical of GBP2, and a number of round red beads, commonly found on GBP3 sites. Both Le Caron and Ellery are dominated by red beads, common on all GBP3 sites (1625/30-1650). At Le Caron, there are a large number of round red beads, including compound varieties such as IVa1 to IVa8, but few tubular red beads. This is typical of GBP3a (1625/30-1640). By contrast, Ellery, the latest site, has a significant proportion of tubular red beads, generally indicative of GBP3b (ca. 1640-1650).

All the beads were recovered through controlled archaeological excavations and their context and associations are considered solid. There is little doubt that they arrived in Ontario in the early to mid-17th century through either French or Dutch trade networks. The beads from the Le Caron site were analyzed at the Field Museum using the same procedures used for the South American beads. The beads from Ellery and Max Oné-Onti Gros-Louis were analyzed using LA-ICP-MS at the Harquail School of Earth Sciences, Laurentian University, Sudbury, Ontario. The data from analyses at these different facilities are comparable (Walder et al. 2021).

CHEMICAL COMPARISONS

We compared the two sets of beads in terms of both the base glass composition and in terms of trace element concentrations. Only the white and copper-colored blue (usually turquoise) layers are included in this comparison because these are the glass colors that are shared by both the archetypal Nueva Cadiz beads and those that include a red layer (NCT-RV).

Base Glass Composition

All six of the NCT-RV (Ontario) beads have similar base glass compositions for each color (Table 1). The relative standard deviations (RSD) for major components of glass (silica, soda, magnesia, lime, and potash) for both white and blue glass layers are reasonably low (0.7%-8.6%) (Table 2). These ingredients differ, however, *between* the turquoise and white glass (*see also* Hawkins and Walder 2022). Of particular note is the difference in soda and lime in the beads: the relative standard deviations for white glass are 5.4% and 7.9%, as compared with the values for turquoise glass: 2.9% and 2.2%. The homogeneity is demonstrated in tri-plots showing the relative contribution of potash, soda, and lime for the NCT-RV beads (Figure 3, left).

The base glass compositions for the ten archetypal Nueva Cadiz (South American) beads are distinct from the NCT-RV beads in two important ways. First, the archetypal Nueva Cadiz beads show a great deal more variation in the values of major constituents. For example, the relative standard deviations for potash values in the NCT-RV beads is 5.1% (white) and 4.1% (turquoise), while in the archetypal Nueva Cadiz beads, the standard deviations are 34.3% (white) and 37.5% (turquoise). Second, base-glass compositions for different colors within individual beads are similar. Figure 3 (right) shows that the relative proportions of soda, lime, and potash for white and turquoise glass in an individual bead are often nearly identical.

These data suggest that both colors of the white/turquoise tubes used to produce the archetypal Nueva

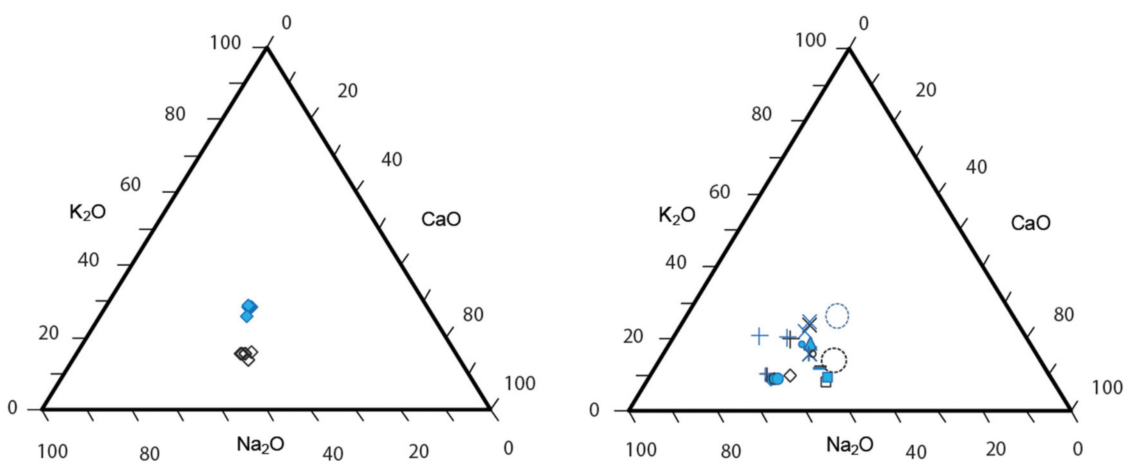

Figure 3. Triplots showing the relative contributions of soda, potash, and lime in white and copper-colored blue layers of Nueva Cadiz Twisted – Red Variety (left) and archetypal Nueva Cadiz beads (right). In the graph on the right, blue symbols indicate turquoise glass, whereas black symbols represent white glass. The ellipses in the right graph indicate the contributions of soda, potash, and lime in the NCT-RV beads for comparison (graphic: Alicia Hawkins).

Table 1. Summary of Mean Values and RSD of Important Elements in the Bead Samples.

Sample Source	Glass Color		SiO_2	Na_2O	MgO	Al_2O_3	P_2O_5	K_2O	CaO
South America	Turquoise (n=12)	Average	67.8%	12.7%	2.8%	0.9%	0.3%	3.8%	7.3%
		RSD	3.3%	9.7%	20.2%	28.7%	32.3%	37.5%	16.7%
	White (n=10)	Average	51.8%	10.1%	2.2%	0.7%	0.2%	2.7%	6.0%
		RSD	6.9%	11.1%	20.2%	22.6%	27.6%	34.3%	20.4%
Ontario	Turquoise (n=6)	Average	68.3%	9.0%	3.2%	1.0%	0.3%	6.3%	7.2%
		RSD	0.7%	2.9%	8.6%	3.4%	11.0%	4.1%	2.2%
	White (n=6)	Average	48.3%	8.4%	2.6%	1.7%	0.4%	2.8%	6.8%
		RSD	4.9%	5.4%	7.7%	14.0%	32.3%	5.1%	7.9%

Sample Source	Glass Color		MnO	Fe_2O_3	CuO	SnO_2	PbO	TiO_2
South America	Turquoise (n=12)	Average	0.1%	0.5%	2.4%	0.3%	0.4%	0.04%
		RSD	75.4%	47.4%	47.2%	121.4%	124.2%	38.8%
	White (n=10)	Average	0.1%	0.4%	0.1%	10.2%	15.0%	0.03%
		RSD	89.8%	22.3%	117.4%	19.1%	23.6%	34.5%
Ontario	Turquoise (n=6)	Average	0.0%	0.6%	3.0%	0.2%	0.4%	0.09%
		RSD	9.7%	12.1%	7.7%	17.9%	14.7%	6.5%
	White (n=6)	Average	0.5%	0.7%	0.1%	9.7%	17.5%	0.11%
		RSD	9.9%	11.2%	17.8%	36.2%	9.2%	13.6%

Cadiz beads were made in the same workshops, explaining the similarity in base glass composition within individual beads. Workers could have divided each batch of base glass into lots for coloring, then assembled the colors into the layered production tubes for each variety of bead being made. They finished with each batch of base glass as it came from the furnace before starting the next batch of base glass. Since glasses from a batch stayed together throughout the *chaîne opératoire*, we cannot infer the storage or shipping of base glass or colored tubes, which could have mixed batches prior to making beads. As well, since same-color glasses have variable compositions, we cannot infer large-scale production of one glass color at a time. These considerations indicate a compact, small-scale mode of workshop organization. Further, it is possible that a number of workshops produced these beads independently or over a significant amount of time, explaining the variation in the base glass composition across the dataset of archetypal Nueva Cadiz beads (Figure 3, right).

By contrast, the NCT-RV beads may have been produced using a different glass batch for each color, explaining the distinct composition of the white versus turquoise glass within individual beads. This could mean

Table 2. Relative Standard Deviations for Major Glass Ingredients, by Bead Type and Glass Color.

Glass Sample	SiO_2	Na_2O	MgO	K_2O	CaO
NCT-RV – white	4.9%	5.4%	7.7%	5.1%	7.9%
NCT-RV – turquoise	0.7%	2.9%	8.6%	4.1%	2.2%
Nueva Cadiz – white	6.9%	11.1%	20.2%	34.3%	20.4%
Nueva Cadiz – turquoise	3.3%	9.7%	20.2%	37.5%	16.7%

large-scale production of one glass color at a time. The high degree of similarity in the NCT-RV beads suggests that their constituent sand and plant ash came from closely related sources, and were combined according to the methods of a single workshop or local tradition. The form and degree of variability seen in the NCT-RV beads may indicate a larger scale of operation than for the archetypal Nueva Cadiz beads. We do, however, recommend expanding the study sample to include other beads from the Northeast.

Trace Elements

A comparison of trace elements present in the silica source(s) used to make the base glass is also useful for distinguishing production centers that utilized the same or similar glass recipes but different raw materials, especially the sands used as the main silica source. As with the major elements, there are some differences between trace elements in the white and the turquoise glasses, as well as differences between the examples from Ontario and those from South America (Figure 4).

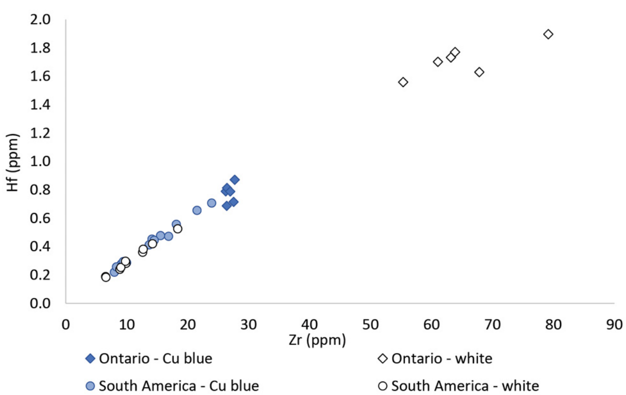

Figure 4. Concentrations of Hf and Zr in white and blue glass layers of archetypal Nueva Cadiz beads (South America) and NCT-RV beads (Ontario) (graphic: Heather Walder).

While quartz sands used to produce glass are mostly silica (Si), the mineral zircon is present in small quantities and contains, among others, the elements zirconium (Zr) and hafnium (Hf). These elements also have a positive correlation, indicating that they are related in their original glass ingredient. These elements can be diagnostic in identifying differences in the sources of sands used as the primary glass ingredient (Degryse and Shortland 2020; Wedepohl, Simon, and Kronz 2011). For a limited set of glass vessels, which were produced in both Venice and Antwerp in the 16th and 17th centuries, De Raedt et al. (2001) identified differences in Hf and Zr content associated with the production source of the glass. For Venetian glasses, both Hf and Zr content was lower than in the Antwerp glasses (De Raedt et al. 2001:1015, Figure 2b). The element neodymium (Nd) may also be of interest and is included for comparison in Table 3, though it was not reported in that study, and was not analyzed for the two NCT-RV beads investigated at Laurentian University.

We see the same pattern in the present study of Nueva Cadiz and similar types from South America and Ontario (Figure 4). Elements Hf and Zr are positively correlated and show distinctions between glass layers as well as between archaeological contexts. The NCT-RV beads may have two different silica sources for the white and the turquoise glasses, with the white glass containing Hf and Zr in the "Antwerp" range as published by De Raedt et al. (2001), while the turquoise glass falls into a separate, tightly clustered group at the high end of the Venetian range identified in that study. This cluster of turquoise-blue glass compositions from Ontario sites overlaps neither the white nor the blue glass from the archetypal Nueva Cadiz bead samples. These trace element concentrations are more variable for the South American beads sampled, but the white and the turquoise glasses appear to have a similar sand source that contributed the Hf and Zr, with concentrations that comfortably fit the range of Venetian glasses analyzed by De Raedt et al. (2001). A Venetian origin for the archetypal Nueva Cadiz beads fits with the findings of Zecchin (2005).

Further work is needed to identify the chemical compositions of known, well-provenienced glass samples from European bead production centers. Nevertheless, this preliminary analysis suggests that the different glass colors were produced separately for NCT-RV beads in the 17th century, rather than in a workshop using only one silica source to produce glasses of all the colors needed to make the beads. The white glass composition fits a trace element group known for sand used for different types of glasses produced in Antwerp. The different colored glass layers of the earlier, potentially 16th-century, Nueva Cadiz examples from South America appear to contain glasses produced using the same silica source, which fits a trace element group reported for Venetian glass. The technological differences in production for the Ontario and the South American beads indicate that earlier typological distinctions between these groups, particularly Smith and Good's (1982) argument that the two are unrelated, is supported by the compositional analysis.

CONCLUSION

Compositional analysis shows that the 16th-century archetypal Nueva Cadiz and the 17th-century NCT-RV beads

Table 3. Trace Element Comparison for Hf, Zr, and Nd.

Glass Sample	Hf	Zr	Nd
Colorless, Venice*	<0.5 ppm	<30 ppm	Not reported
Colorless, Antwerp*	>1.0 ppm	~30 to 80 ppm	Not reported
White, Tiahuanaco NC	<0.6 ppm	<20 ppm	~1.1 to 2.0 ppm
White, Ontario NCT-RV	>1.4 ppm	>55 ppm	~4.2 to 4.8 ppm
Turquoise, Tiahuanaco NC	~0.2 to 0.7 ppm	<25 ppm	~1.5 to 3.0 ppm
Turquoise, Ontario NCT-RV	~0.7 to 0.9 ppm	~25 to 30 ppm	~2.8 to 3.0 ppm

* De Raedt et al. (2001).

are distinct and come from different production centers. Our analysis suggests that an earlier style was adopted or "revived" later, in a different manufacturing context. Why beadmakers revived this style, and what motivated the addition of a red layer, requires further research. How widespread was the 17th-century manufacture? If it was located in the Low Countries, why have we found no evidence of NCT-RV production tubes or beads in this region, while there is evidence of the earlier archetypal Nueva Cadiz beads from Antwerp and Amsterdam?

This study shows that compositional analysis of glass beads from unprovenienced archaeological contexts can provide insight into their production source, even if not informative about their archaeological origins. In this case, the more diverse compositional makeup of the South American beads hints that they may have come from multiple sites, ones with longer occupational histories than those in Ontario, or that production of these beads was less tightly controlled than that of the NCT-RV beads. In our experience of analyzing beads excavated around the Great Lakes and in Quebec, compositions of beads of the same type from tightly dated archaeological contexts tend to be more similar to one another than to typologically identical beads from other sites, even those that are geographically and temporally comparable. This is because beads that were made from the same glass batch and that traveled together to a site where they were deposited archaeologically will have more similar compositions than beads from the same production site but made from different batches a few days, months, or years apart. The present example highlights the critical importance of recording the provenience of beads, and shows how decades of careful work by museologists caring for collections, even those with unknown provenience, can contribute to ongoing studies. We hope that these preliminary results will be confirmed with additional analyses of archetypal Nueva Cadiz beads from narrowly dated archaeological contexts in both the Americas and Europe.

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