Indigenous Gold from St. John, U.S. Virgin Islands:

A Materials-Based Analysis

Stephen Edward Jankiewicz

18 January 2016

In partial fulfillment of
Master's in Anthropology
Thesis Proposal

Committee Approval

Chair: Dr. Mark Mehrer ______________________

Dr. Leila Porter ______________________

Dr. L. Antonio Curet ______________________

Ken Wild, M.A. ______________________

ABSTRACT

The purpose of this research to examine the origin, manufacturing technique, function, and meaning of metals used during the twelfth and thirteenth centuries on the island of St. John, United States Virgin Islands. This project focuses on two metal artifacts recovered during National Park Service excavations conducted between 1998 and 2001 at a shoreline indigenous site located on Cinnamon Bay. These objects currently represent two of only three metal artifacts reported from the entire ancient Lesser Antilles. Chemical and physical analyses of the objects were completed with nondestructive techniques including optical microscopy, scanning electron microscopy, portable X-ray fluorescence spectrometry, and particle-induced X-ray emission spectrometry with assistance from laboratories located at Northern Illinois University, Beloit College, Hope College and the Field Museum. This data will be combined with contextual site data and compared to other metal objects recovered throughout the ancient Caribbean.

INTRODUCTION

Until recently, discussions concerning metal and metallurgical traditions in the ancient Caribbean were uncommon (see Oliver, 2000; Martinón-Torres et al., 2007, 2012; Valcárcel Rojas & Martinón-Torres, 2013). The limited amount of metal recovered from archaeological contexts in the Caribbean, less than fifty artifacts predating European contact reported, has considerably contributed to this phenomenon (Martinón-Torres et al., 2012; Valcárcel Rojas & Martinón-Torres, 2013). In addition, there is zero archaeological and ethnographic data that support localized smelting or casting occurring prior to the arrival of Europeans (Valcárcel Rojas & Martinón-Torres, 2013:515). Despite this lack of evidence, metal has a long historical tradition in the region dating as far back to the first century CE (Siegel & Severin, 1993).

Recent discussions that have focused on the composition, functional and symbolic meaning of metals have been heavily informed by ethnographic data (Oliver, 2000; Martinón-Torres et al., 2007, 2012; Valcárcel Rojas & Martinón-Torres, 2013). This data has been recently supplemented by the ongoing chemical and physical study being conducted by Marcos Martinón-Torres, Roberto Valcárcel Rojas and María Filomena Guerra on Cuban metals (Valcárcel Rojas & Martinón-Torres, 2013:516; see also Martinón-Torres et al., 2007;2012). Their research has supported much of the ethnographic data in regards to manufacturing techniques as recorded by the Spanish, but offers new insight into the symbolic function for many of the metal objects (Oliver, 2000; Martinón-Torres et al., 2007, 2012). This research project parallels the nondestructive chemical and physical techniques employed by past studies to add complimentary data to a larger regional discussion about technological and compositional patterns of metal that will now incorporate the Virgins Islands. This research will also examine these following questions:

1. What is the chemical composition of the Cinnamon Bay metals and can this help determine their origin? If the metals are not from local sources, do they provide evidence for Circum-Caribbean interaction?
2. What manufacturing techniques were employed to produce the Cinnamon Bay metals? Do these techniques parallel or contrast other patterns for Caribbean metals?
3. Can the chemical and physical data be combined with contextual site data to help determine the functional and symbolic role the Cinnamon Bay metals served at the local level? Do these behaviors reflect and/or contradict insular and regional patterns already observed?

Macroscopic (visual) analysis previously completed by Ken Wild has identified the two Cinnamon Bay metal artifacts as a “small perforated gold/copper mixed square pendant” (Wild, 2013:928) and a perforated gold disc that served as an inlay “for carved wooden and beaded idols” (Wild, 2013:926; see also Wild, 1999). Associated calibrated 2-sigma radiocarbon dates has yielded a date range of 1100-1200 CE for the proposed gold-copper pendant and a date range of 1180-1280 CE for the proposed gold disc (Wild, 2013:941). Wild’s compositional and functional hypotheses will be thoroughly assessed and expanded upon.

NATURAL SETTING

THE REGION

The islands that comprise what is considered the Caribbean region today extend along a chain heading north and northwest from Trinidad and Tobago originating near the mouth of the Orinoco River in South America (Figure 1). This chain eventually splits into two distinct directions near Hispaniola (the island including Haiti and the Dominican Republic). One chain extends west to Cuba near the Yucatán Peninsula in southeastern Mexico, while the other veers north and terminates near Florida in the United States. The Atlantic Ocean borders the islands to the east and northeast, while the Gulf of Mexico bounds the region in the northwest. Lastly, the Caribbean Sea forms the western and southern boundaries of the region dividing the islands from the mainland of Middle and South America.

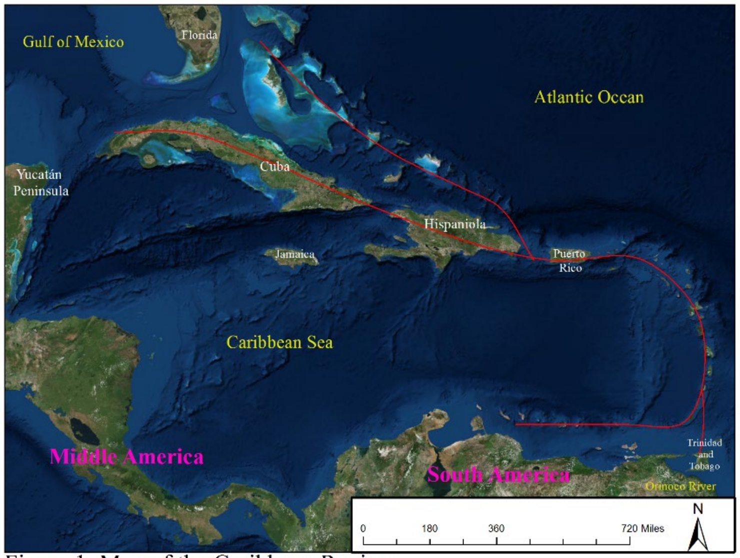

Figure 1. Map of the Caribbean Region

The Caribbean region is often further organized into three smaller groupings: the Greater Antilles, the Lesser Antilles and the Bahama (or Lucayan) Archipelago (Rouse, 1992:3). However, Keegan et al. (2013) identify five distinct archipelagoes (or island groups) (Figure 2). These authors identify two additional distinct regions based on the "geographical proximity, island size, and maximum elevation" between the various islands (Keegan et al., 2013:3). The two additional regions are labeled the "Southern Caribbean Region" and "Trinidad and Tobago" (Keegan et al., 2013:5).

The Greater Antilles is located in the northern section of the Caribbean and defined by the islands stretching from Cuba to Puerto Rico (Figure 2). These islands are composed of geologically related mountain ranges that crosscut the various islands in this region (Keegan et al., 2013:4-6). All four of the main islands (Cuba, Jamaica, Hispaniola and Puerto Rico) are relatively large compared to the rest of the Caribbean and have surfaces dominated by sedimentary and metamorphic rocks (Keegan et al., 2013:8). All fours main islands contain a high level of environmental diversity including areas with an abundance of fertile soil capable of supporting large populations (Rouse, 1992:3).

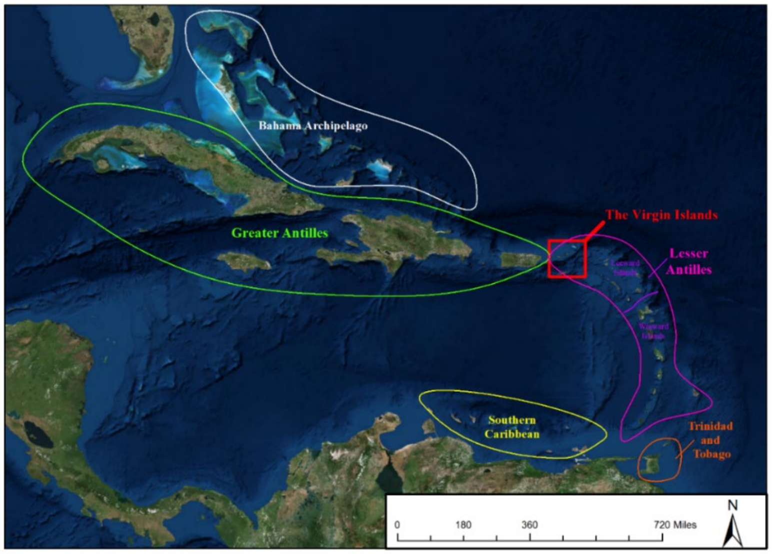

Figure 2: Map of the Five Subgroups

The Lesser Antilles extends from the Virgin Islands in the north down to Grenada in the south (Figure 2). The region is further divided into two groups: the Leeward Islands and the Windward Islands. The Leeward Islands are located in the northern section of the Lesser Antilles and are generally smaller than all of the islands in the Windward group. The Leeward group contains a combination of high volcanic and low limestone islands (Keegan et al., 2013:4). The Windward Islands are located in the southern section of the Lesser Antilles and contain distinctly larger islands of volcanic origin (Keegan et al., 2013:4). Interestingly, the Leeward/Windward distinction also parallels Irving Rouse's protohistoric cultural distributions defining the boundary between the "Eastern Tainos" in the north and the "Island Caribs" to the south (Rouse, 1992:8).

The Lucayan (or Bahamian) Archipelago borders the northeastern part of the Caribbean in the Atlantic Ocean and extends from the eastern edge of Florida down to Haiti and Cuba (Figure 2). The islands consist of calcareous rocks, typically limestone with high levels of calcium carbonate (Keegan et al., 2013:8). Technically, the island's shores do not border the Caribbean Sea, but they do share "a common history, similar climate, and have flora and fauna that is predominately Caribbean" (Keegan et al., 2013:9) and are included within the Caribbean cultural schema.

The Southern Caribbean Region is composed of the small island chain that runs between Aruba and Margarita parallel to the coast of Venezuela (Figure 2). The islands are volcanic in origin and archaeological evidence indicates people living in this region were more closely related culturally to people in the South American mainland versus the Caribbean (Keegan et al., 2013:4).

The final fifth region, comprised of Trinidad and Tobago, is marked by distinct geologic and geographic phenomena that separate these islands from the rest of the Caribbean (Figure 2). Trinidad is the largest island in the immediate area and was connected to the mainland as recently ~6,000 BP (Keegan et al., 2013:4). Thus, the island contains a greater amount of continental flora and fauna compared to other islands in the Caribbean. Trinidad and Tobago are in close proximity to the South American mainland and this has likely contributed to the archaeological data that suggests these islands contain some of the earliest evidence of peopling migrations into the Caribbean region (Keegan et al., 2013:4).

THE VIRGIN ISLANDS

The United States Virgin Islands, the group of islands that is the central focus of this research project, is located near the center of the Caribbean region and consists of three primary islands: St. Thomas, St. Croix, and St. John (Figure 3). Neighboring smaller islands, cays and rocks fill the rest of the group (Sleight, 1962:3). St. John is the smallest of the three principle islands and has an area of approximately nineteen square miles. St. John measures approximately eight miles along its east-west axis and four miles along its north-south axis (Sleight, 1962:3). Technically, the Virgin Islands are geologically related to the Greater Antilles (Rankin, 2002:2).

However, the islands themselves are more comparable in size and geographic location to the Lesser Antilles and typically grouped within this sub-region.

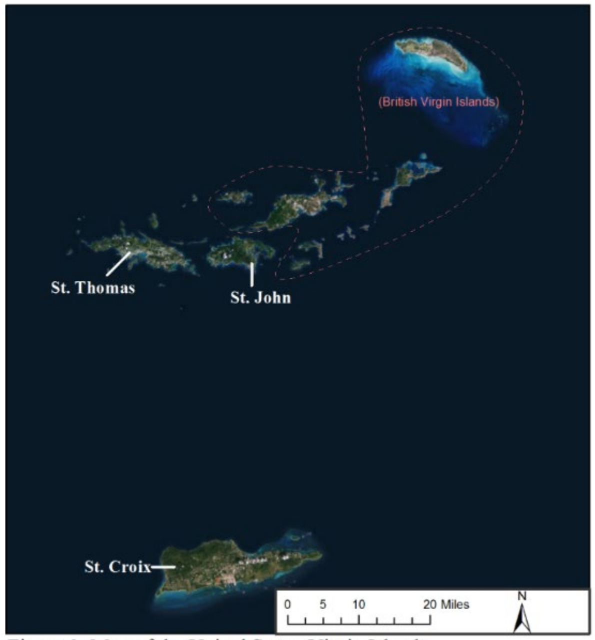

Figure 3: Map of the United States Virgin Islands

Geologically, St. John can be considered an exposed mountainous peak rising sharply from the sea with a majority of its land at angular and steep slopes (Sleight, 1962:13). The coast consists of a series or "rocky headlands with enclosed bays and crescent beaches" (Sleight, 1962:13). The interior areas of these beaches often contain limited semi-level valley mouths. These areas are "sometimes dry and sandy, sometimes characterized by mangrove swamps in various stages of transition" (Sleight, 1962:14). The bay-valleys are relatively broad and consist of long beaches with short depths (Sleight, 1962:14). In addition, the mountains tend to rise at steep angles along their sides and headlands (Sleight, 1962:14). There are exceptions to this topographic description, but the above characterization provides a general sense of St. John's surficial setting.

Early historic records indicate St. John was covered with a mix of wet and dry forests (Sleight, 1962:7). The dry forests cover most of the island and vegetation in these areas tend to be thorny and “essentially impenetrable” (Rankin, 2002:1). The water drainages (or guts) are largely vegetation free due to flash flood events (Rankin, 2002:1). It is important to note that most of the island was cleared for sugar plantation during colonial times and much of the island contains second-growth forests (Rankin, 2002:1-2).

The physical locations and distances between each island facilitate travel. Once the main island chain is entered, each island is essentially in sight from one another (Rouse, 1992:3). Strong currents flow through almost every passage and can be traversed during cooperating weather (Rouse, 1992:3). Accordingly, the sea should not be understood as an isolating barrier between, but instead a “highway that unites them” (Keegan, 2013:1). The Caribbean region is positioned to the southwest of the Azores High (a subtropical semi-permanent high atmospheric pressure zone in the Atlantic Ocean) and as a result trade winds move through the region from the northeast throughout most of the year (Sleight, 1962:10). This system also reinforces westward-moving sea currents (Rouse, 1992:4). Generally, the pressure system brings northeasterly winds in the fall and winter, while easterly winds dominate the spring and summer months (Sleight, 1962:10). However, St. John and the immediate surrounding islands tend to experience a prevailing easterly wind based on annually recorded wind averages (Sleight, 1962:10).

THE PROJECT AREA

Cinnamon Bay, the specific valley mouth and beach that yielded the archaeological material discussed in this project, is situated along the north coast of St. John (Figure 4). The valley is formed by a complex of drainages that flow during runoff events from slopes adjacent to the south (Sleight, 1962:19). The valley floor is marked by alluvial deposits the have fanned northwestward creating a triangular valley floor (Sleight, 1962:19). The floor is higher in the eastern half compared to a western half that shows evidence of frequent flooding caused by events from land and sea (Sleight, 1962:19). The sand dune bar, typical of most bay environments, runs parallel to the shoreline and likely formed from a combination of wind and fluvial processes. The structure of this feature indicates it has “moved, broken, and reformed many times” (Sleight, 1962:19).

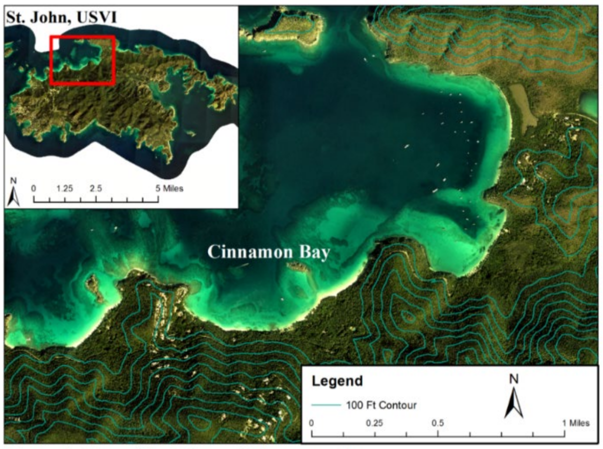

Figure 4: Map of St. John and Cinnamon Bay

THEORETICAL FRAMEWORK

“The material qualities of material culture are central to how they are used and made meaningful” (Jones 2004:330).

The materials-based theoretical framework applied within this study will help better understand the range of human behaviors associated with the Cinnamon Bay metals. To begin, it is important to remember this study is archaeometric in nature. It uses analytical instruments and techniques to characterize the chemical, physical and mechanical properties of the metal artifacts under review. Jones (2004) demonstrates how the concept and approaches to *materiality* are relevant to archaeometric studies. Jones (2004) states, “In essence, the notion of materiality encompasses the view that material or physical components of the environment and the social practices enacted in the environment are mutually reinforcing” (Jones, 2004:330). In other words, artifacts are not simply byproducts of the past, but are instead direct products, with the inverse ability to influence past human behavior. In fundamental terms, artifacts are culturally constructed and therefore, "*material qualities*" of artifacts influence their "*use and perception*" (Jones, 2004:331). Applying this framework allows the material properties (chemical and physical) of an object to become the principal point of inquiry. Hence, this study uses the material properties of the Cinnamon Bay metals as the starting point to explore the interwoven behaviors of the people who produced, exchanged and used these artifacts.

Past metallurgic archaeometric studies in the surrounding regions have demonstrated how issues of materiality can not only be discussed, but advanced by archaeometric methods (see Holser, 1995; Lechtman et al., 1975). In one notable study, Holser (1995), investigated metal use in ancient West Mexico and used archaeometric techniques to add quantitative data to discussions about the ritual significance of alloying metal to obtain a particular color (Hosler, 1995:100). She demonstrates analytically that bronze artifacts containing the alloying element, tin or arsenic, show concentration levels higher than what is deemed necessary for improving artifact design and mechanical function (Hosler, 1995:100-101). This data supports the hypothesis that the tin and arsenic are only added to obtain a particular color. By focusing on the chemical content of the metals, Hosler (1995) demonstrated color to be an important component of the materiality of these metals and consequently its use within ancient West Mexican communities.

Other studies in the Caribbean and Circum-Caribbean region have relied less on archaeometric techniques and focused more on the comparative aspects of materiality. One early example of this type of study, presented by Helms (1987), suggests a level of interaction between the Caribbean and Central America based on the shared shiny character of black polished wood items used typically by the elite. A recent trend has been to replicate these types of comparative materiality studies to draw further connections outside the insular Caribbean region to adjacent communities living in Central and South America (an area commonly referred to as the Circum-Caribbean).

Recent discussion on Circum-Caribbean interaction has advocated for the application of a pan-Caribbean perspective (see Hoffman et al., 2010). Hoffman et al. (2010) advocates for a research framework that "need[s] to view the wider Caribbean or Circum-Caribbean region as potentially one large arena within which Amerindians could have established and maintained local and regional circuits of mobility and exchange" (Hofman et al., 2010:4). The authors clearly note this perspective does not downplay the importance of "synchronic developments at the local scale of the community" (Hofman et al., 2010:4). In this scheme, Helm's (1993) seminal work, *Craft and the Kingly Ideal: Art, Trade and Power*, provides numerous perspectives on the interpretation of long-distance goods and the relationship between acquisition and political authority. Geurds (2011) argues however, that these ideas should be applied with caution in the Caribbean.

Geurds (2011) critiques the pan-Caribbean frameworks by mentioning they are typically "not based on samples of a particular data-set…[and] predominantly built around comparisons of resemblance" (Geurds, 2011:52). He further argues, these efforts need to be "accompanied by follow-up research taking a regional and site level perspective" (Geurds, 2011:52). He advocates for the study of how these exchanged objects were used at a local level arguing "material things are routinely drawn upon and applied to different agents in different situations" (Geurds, 2011:52). Fully understanding the context of each object, rather than comparing various styles and categories in isolation, offer an improved opportunity to reveal the significance and meaning of pan-Caribbean objects. Lechtman echoes this type of contextual study by advocating for the study of metals within a range of co-existing materials or "suites" (Lechtman, 2000:6). This approach "lessens the burden of having to determine meaning for any one subset of materials alone" (Lechtman, 2000:6) and allows for the characterization of assemblages. These identified associations between specific objects will in turn facilitate questions about individual categories of objects (Lechtman, 2000:5-6).

Finally, Guerds (2011) also provides an alternative perspective where research into the pan-Caribbean could target specific artifact types that contain "highly specific materiality" (Guerds, 2011:53). In other words, this targeted object "could not simply be replaced by some other arbitrary 'symbolic object' to which the same 'meaning' is ascribed" (Guerds, 2011:53). While difficult, it offers an avenue to apply materials-based approaches within pan-regional perspectives and further highlights the importance of multi-scalar approaches.

HISTORY OF RESEARCH

THE REGION

Caribbean archaeology has largely occurred within the epistemological, ontological, and methodological confines of the cultural-historic approach championed in the region by Irving Rouse beginning in the early 1930s (Pestle et al., 2013:244). Rouse conducted a multitude of small excavations across various islands including mainland South America using a research framework that focused primarily on pottery typology (Rouse, 1992). Rouse built a cultural-chronology based on styles, subseries, or series for the entire Caribbean region that was continuously refined over many years (Pestle et al., 2013:247). Rouse's main research goal aimed to further understand cultural evolution and migration patterns into the region (Rouse, 1986, 1992).

Cultural-historical theoretical frameworks dictated research in the region well into the 1990s and even govern over approaches in some islands today (Pestle et al., 2013:245). Theoretical critiques of Rouse's approach first appeared in the early 2000s when social-political organization at local site-levels became a central focus (Keegan, 2001; Curet, 2005). However, a "lack of a clean break between the new and old theoretical frameworks led Caribbeanists to continue to use the categories of culture history without adequate questioning of their veracity" (Pestle et al., 2013:245). Furthermore, "attacks against [Rouse's] position normally encountered strong resistance" (Pestle et al., 2013:245). Research in the region frequently occurs under Rouse's categories (styles, subseries, series) without critically acknowledging that these categories are not natural units with the ability for application within other frameworks (Pestle et al., 2013:246). Basically, the issue is the continued acceptance by researchers that the chronological, cultural, and social units are viewed as equivalents (Pestle et al., 2013:246).

The persisted influence of the cultural-historical approach has left even modern Caribbeanists in the routine to label the presence of specific "cultures" at sites solely based on changes in ceramic decoration. Pestle et al. (2013) provides a concrete example of why future research needs to critically question this continued practice. The authors demonstrate the category of "Cuevas" *style*, as developed by Rouse (see Rouse, 1992), to be invalid based on recent chronometric data that contradicts the temporal and geographic distribution of this cultural unit (Pestle et al., 2013). Rodríguez Ramos (2010) furthers this critique after assembling a large database of radiocarbon dates in Puerto Rico that provides examples where Rouse's "cultures" overlapped, especially lacking an ability to explain the occurrence of mixed archaeological deposits. Pestle et. al. (2013) suggest future studies should be undertaken in association with absolute chronology and with the acceptance that multiple pottery traditions and mechanisms for cultural change can exist simultaneously across space and time.

THE VIRGIN ISLANDS

The Rousean chronological classification system, nomenclature and framework has dominated archaeological research conducted in the Virgin Islands. While critiques of Rouse's chronology have been made (Lundberg & Wild, 2006; Lundberg, 2007; Wild, 2013), these attempts have simply refined the Cultural Historical perspective and do not reject the general tenants of this paradigm. My project does not claim to provide a "new" groundbreaking perspective completely reinterpreting previous lifeways on St. John. However, I move beyond Rousean nomenclature and its inherent limitations when possible. Fortunately, Wild (2013) collected and recently analyzed nine radiocarbon samples taken from charcoal within undisturbed stratigraphic contexts at the indigenous shoreline site on Cinnamon Bay. These calibrated 2-sigma radiocarbon dates will establish the baseline for reference while discussing the metal artifacts of particular focus in this project.

The archaeological record indicates people first settled St. John as early as 770 BCE (Wild, 1989:88). However, habitation sites dating to 4,000 BCE have been located on Puerto Rico suggesting people could have been living or visiting the Virgin Islands much earlier (Rodríguez Ramos, 2010:50). A site along the south shore of St. John in Lameshur Bay yielded flaked and ground stone tools (Wild, 1989). The lithic assemblage showed small degrees of utilization and wear patterns consistent with cutting, grinding and hammering (Wild, 1989:100). The lithic material was mixed in a context with a high number of potentially processed gastropods (Wild, 1989:106). These observations support the interpretation that food processing and tool production were done at the site (Wild, 1989:100). The Lameshur Bay site remains the only indigenous site identified on St. John with a cultural component that contains lithic tools without the presence of ceramics.

The second phase of occupation on St. John occurs during what Rouse identifies as the beginning of the Ceramic age (Rouse, 1992:71). This period (believed to begin sometime around 200 BCE in the region) was originally considered to mark the introduction of agriculture and ceramics into the region with the first major repeopling event (Rouse, 1992:71). However, other islands in the region, including Puerto Rico, have reported evidence of pottery and limited gardening being implemented as early as 660 BCE (Rodríguez Ramos, 2010:71). Regardless, people did not begin to organize themselves into semi-permanent villages until this period. They also introduced new agricultural practices (mounded earth beds) and produced finely made pottery (white-on-red and zic ware (see Rouse, 1992)), stone adzes, and used various ornaments carved from stone, bone, shell and wood that were strikingly different from earlier assemblages (Rouse, 1992:77-85). Coastal sites on St. John in Coral Bay, Cinnamon Bay, and Cruz Bay contain ceramics that likely date to this early period based on typological comparisons to other islands in the region (Donahue, 2014:22). However, radiocarbon dates from these sites have not produced absolute date ranges to properly confirm this association (Donahue, 2014:22).

St. John experiences a substantial increase in sites following 800 CE (Lundberg et al., 1992:7). Areas along the north shore are heavily occupied represented by large, dense cultural deposits located at Trunk Bay and Cinnamon Bay (Wild, 1999, 2013; Donahue, 2014). Unfortunately, only limited test excavations have been conducted at these sites so their size and layouts are not well understood. Ceramic assemblages from the sites of Calabash Boom and Trunk Bay have been studied in great detail by Lundberg (2005), and Lundberg and Wild (2006), and linked to similar ceramic developments in eastern Puerto Rico (see also Lundberg et al., 1992). Most notably, widespread and stark changes in ceramics biased towards plain finishes occur during this time. Rouse links these apparently abrupt changes in ceramic technology to insular cultural changes in the Greater Antilles as opposed to a second large-scale repeopling event (Rouse, 1992:105-109). Rouse also feels the origins of the contact-period chiefdoms (commonly referred to in the literature as "Taínos") encountered by the Spanish date to this localized transitional period (Rouse, 1992:109-123). Other artifacts from these assemblages include flaked stone tools, conch shell celts, coral reamers, small shell beads and clay spindle whorls (Lundberg & Wild, 2006).

Material culture on St. John changes dramatically again around 1000 CE based on the results of excavations at the shoreline sites along Trunk Bay (800 CE – 1200 CE) and Cinnamon Bay (1050 CE – 1440 CE), and an upland site overlooking Cinnamon Bay called Rustenberg North (985 CE – 1020 CE) (Wild, 1999, 2013; Donahue, 2014). Unfortunately, these sites have not received detailed attention and limited excavations occurred largely under salvage-type scenarios by the National Park Service. In general, site layout and size has been largely understudied. The data that comes from this period indicate significant shifts in ceramic design elements that include the introduction and proliferation of effigy faces and incised decoration (Wild, 1999, 2013). Also, elaborate items from the sites differ markedly from previous centuries. The assemblage includes stone and shell three-pointer zemis, nose plugs, stone and shell beads, shell pendants and inlays, potential ball belt fragments, and the metal artifacts under current investigation for this project (see Wild, 2013). It is important to note that Cinnamon Bay contains the only indigenous site to date on St. John that has a cultural component that post-dates 1300 CE. Occupation appears to end around 1440 CE (Wild, 2013). These final centuries, based largely on comparisons of artifact assemblages and radiocarbon dates to neighboring islands, are typically associated with the contact-period hierarchical chiefdom societies, known commonly as "Tainos," encountered and recorded by European chroniclers (see Rouse, 1992).

MATERIALS

TYPES OF METAL

Archaeological evidence for the presence of metals in the Caribbean is scarce (Oliver, 2000; Martinón-Torres et al., 2007, 2012; Valcárcel Rojas & Martinón-Torres, 2013). Multiple factors likely contribute to the skewed data including the common practice of Spanish pillaging and ethnohistoric records that describe the indigenous burial practice of metal removal from corpses prior to internment (Oliver, 2000; Valcárcel Rojas & Martinón-Torres, 2013). Metals first appear in the Caribbean archaeological record during the first century CE and are present during European contact (Siegel and Severin, 1993). Two types of metal dominate the landscape: natural (or alluvial) unalloyed (1) *gold*, and an artificial gold-copper alloy know ethnohistorically as (2) *guanín,* or more commonly known in Latin America as *tumbaga*. Overall, the data suggests metal use was dramatically higher in the Greater Antilles than in the Lesser Antilles (see Table 1). Table 1, borrowed and slightly modified from Valcárcel Rojas and Martinón-Torres (2013), details the accurately reported indigenous metal objects recovered from archaeological sites in the Caribbean.

Object	Length/ diameter (mm)	Max. width (mm)	Possible Metal	Metal Identified	Type of Analysis	Cu %	Ag %	Au %	Country/ island	Site/ region	Bibliographic reference
Nose Ring	22			gold				x	Puerto Rico	Tecla I	Chanlatte Baik 1977
Sheet			gold						Puerto Rico	Monserrate	Chanlatte Baik 1977
Sheet	10	7		guanín	SEM-EDS	55	5	40	Puerto Rico	Maisabel	Siegel and Severin 1993
Sheet with several perfor-ations			guanín						Vieques, Puerto Rico	Sorcé	Chanlatte Baik 1984; Siegel and Severin 1993:77; Oliver 2000:200

Sheet with perfor-ation	10			gold	XRF	-	-	-	St. John, U.S. Virgin Islands	Cinnamon Bay	Wild 1999; Wild 2013
Sheet with two perfor-ations	12	8		guanín	XRF	-	-	-	St. John, U.S. Virgin Islands	Cinnamon Bay	Wild 2013
Two sheets with perfor-ation			gold						Haiti	Cadet	Chanlatte Baik 1977
Sheet	20		gold						Haiti	Limonade	Vega 1987
Sheet with perfor-ation	100			gold				99	Domini-can Republic	Montecristi	Vega 1987
Sheet	23			gold				99	Dominican Republic	Montecristi	Vega 1987
Sheet				gold				x	Dominican Republic	Montecristi	Vega 1987
Sheet	18		gold						Dominican Republic	La Cucama	Vega 1987
Sheet	50	15	gold						Dominican Republic	La Cucama	Vega 1987
Sheet	27	13	gold						Dominican Republic	La Cucama	Vega 1987
Sheet	13	5	gold						Dominican Republic	La Cucama	Vega 1987
Sheet	18	5	gold						Dominican Republic	La Cucama	Vega 1987
Sheet	21	16		gold			7.2	92.5	Jamaica	Bellevue-White River	Lee 1985
Sheet	14		gold						Cuba	Potrero de El Mango	Rouse 1942:144, plate 8
Sheet with perfor-ation	24	6	guanín						Cuba	La Rosa de Los Chinos	Mesa 1989
Sheet with perfor-ation	12	10		gold	SEM-EDS		5.6	94.4	Cuba	Toma del Agua	Torres Etayo 2006:58
Sheet	35	7	gold						Cuba	El Martillo	Yero Masdeu et al. 2003:24
Sheet	13			gold	XRF	1.5	20.1	78.4	Cuba	Esterito	Valcárcel Rojas et al. 2007
Sheet with perfor-ation	14	7	gold						Cuba	El Paraiso	Ulloa Hung 2000
Sheet	20	16		gold	XRF	0.1	8.5	91.4	Cuba	Laguna de Limones	Valcárcel Rojas et al. 2007
Human figure	48		guanín						Cuba	Santana Sarmiento	Miguel Alonso 1951
Sheet with perfor-ation	21	9		guanín	XRF	49.5	13.9	36.5	Cuba	El Boniato	Valcárcel Rojas et al. 2007
Sheet with perfor-ation	13	9		gold	XRF	0.1	3.8	96.0	Cuba	El Morrillo	Valcárcel Rojas et al. 2007

Sheet with perfor-ation	20			gold	XRF		6.5	93.5	Cuba	Loma del Aíte	Valcárcel Rojas et al. 2007
Sheet with perfor-ation	13	17		guanín	SEM-EDS	47.9	12.6	39.5	Cuba	El Chorro de Maíta	Martinón-Torres et al. 2007
Sheet with perfor-ation	19	15		guanín	SEM-EDS	55.1	10.0	34.9	Cuba	El Chorro de Maíta	Martinón-Torres et al. 2007
Sheet with perfor-ation	16	15		guanín	XRF	41.7	12.9	45.4	Cuba	El Chorro de Maíta	Valcárcel Rojas et al. 2007
Sheet with perfor-ation	23	24		guanín	SEM-EDS	x	x	x	Cuba	El Chorro de Maíta	Guarch Delmonte 1996
Bell	13			guanín	XRF	26.8	30.0	43.1	Cuba	El Chorro de Maíta	Valcárcel Rojas et al. 2007
Sphere	3			guanín	XRF	x	x	x	Cuba	El Chorro de Maíta	Guarch Delmonte 1996
Bead	2			gold	SEM-EDS	1.3	5.2	93.4	Cuba	El Chorro de Maíta	Martinón-Torres et al. 2007
Bead	2			gold	XRF	1.8	8.1	90.1	Cuba	El Chorro de Maíta	Valcárcel Rojas et al. 2007
Bird figure	23			guanín	SEM-EDS	x	x	x	Cuba	El Chorro de Maíta	Guarch Delmonte 1996
Sheet	21			guanín	SEM-EDS	57.0	6.4	36.6	Cuba	Alcalá	Martinón-Torres et al. 2007
Sheet with perfor-ation	22	9		guanín	XRF	53.0	8.6	38.4	Cuba	Vega de Labañino	Valcárcel Rojas et al. 2007

Table 1. Accurately Reported Metal Artifacts Recovered from Indigenous Archaeological Sites in the Caribbean. Objects studied in this project are highlighted in red.
From Valcárcel Rojas and Martinón-Torres (2013). *Note: x indicates the unquantified presence of a given element. Chemical compositions reported in weight percent (wt%). X-Ray Fluorescence (XRF), Scanning Electron Microscopy-Energy Dispersive Spectrometry (SEM-EDS).*

Table 1 does not include a recent find made at the site of Anse du Coq on the island of Marie-Galante located near the island of Guadeloupe (Honoré et al., 2013). This object is the only other metal object recovered archaeologically in the ancient Lesser Antilles other than the two from Cinnamon Bay. The Anse du Coq metal object likely dates to 1290 CE – 1450 CE (Honoré et al., 2013:2,6). The object is triangular and measures 107 mm by 75 mm and has a thickness that does not exceed a millimeter (Honoré et al., 2013: 3). The object appears fragmentary and thus likely from a larger object. Interestingly, a side of the object that appears broken reveals layering and coloration variation between the surface and the interior. This is possibly related to enriching or depleting techniques used to obtain a particular surface color. Consequently, the surface and interior areas were chemically tested separately using PIXE and SEM-EDS. Both methods produced similar results and the compositional data was reported as average weight percent. The interior was composed of approximately 70 percent copper, 25 percent gold and four percent silver (Honoré et al., 2013: 5). The surface contained higher levels of gold reaching approximately 45 percent, and a reduction in copper content to about 50 percent (Honoré et al., 2013: 5). The silver values stayed relatively identical (Honoré et al., 2013: 5). The PIXE analysis also detected trace amounts of pallidum and tin which Honoré et al. linked to alluvial gold (Honoré et al., 2013: 5).

Less accurate reports of metal in the Caribbean include inlays on a wooden stool (or duho) (Oliver, 2000:204) and a bone figure (Channlatte Baik, 1977:61). Both objects are considered to be from the Dominican Republic and contain laminar incrustations that appear to be of gold. These objects combined provide an additional seven metal objects in total bringing the reported total to 47 (including the Anse du Coq guanín) (Valcárcel Rojas & Martinón-Torres, 2013). There are even more gold fragments reported from the Dominican Republic, Haiti and Puerto Rico, but their descriptions are too vague to include them in this study (Valcárcel Rojas & Martinón-Torres, 2013).

Table 2 provides a brief summary of the total (accurate and less descript) reported metal artifacts distributed throughout the ancient Caribbean.

	Island	Gold	Guanín	Total
Greater Antilles	Cuba	10	12	22
	Hispaniola (Haiti/Dominican Republic)	17	0	17
	Puerto Rico	2	1	3
	Vieques, Puerto Rico	0	1	1
	Jamaica	1	0	1
	Total	**30**	**14**	**44**
Lesser Antilles	St. John, USVI	1	1	2
	Marie-Galante	0	1	1
	Total	**1**	**2**	**3**
	Regional Total	**31**	**16**	**47**

Table 2. Distribution of Metal Artifacts in the Ancient Caribbean.

MORPHOLOGY

The predominant form of metal objects from the Caribbean is laminar (flat) sheets thinner than one millimeter (Valcárcel Rojas & Martinón-Torres, 2013:514). These sheets are commonly formed into simple subcircular, oval or trapezoidal shapes and typically include perforations (Valcárcel Rojas & Martinón-Torres, 2013:514). Rarely, objects are decorated with embossed lines and this occurs more often on guanín (Valcárcel Rojas & Martinón-Torres, 2013:514). These objects are usually smaller than three centimeters in maximum length and "may be related to the limitations imposed by the small size of the natural gold nuggets" (Valcárcel Rojas & Martinón-Torres, 2013:514).

Only seven known metal objects are not in the typical laminar form (Valcárcel Rojas & Martinón-Torres, 2013:514). These include a nose ring, beads, a bell, a single anthropomorphic figurine, and a potential bird-head pectoral fragment (Valcárcel Rojas & Martinón-Torres, 2013:514).

ANALYTICAL METHODS

The chemical and physical composition of the two metal objects from Cinnamon Bay will be analyzed using non-destructive techniques due to the rare nature of the objects. This will include: optical microscopy, scanning electron microscopy (SEM), portable X-ray fluorescence spectrometry (pXRF), and particle-induced X-ray emission spectrometry (PIXE).

TECHNOLOGICAL RECONSTRUCTION

The manufacturing techniques employed to create each metal object will be examined through the use of optical microscopy (primarily binocular stereomicroscopy) and scanning electron microscopy (SEM). The observations and images produced from these techniques allow for a high level of detailed physical assessment used to reconstruct specific production techniques. In particular, I am interested in the striation patterns that are consistent with certain polishing techniques, surface finishes obtained with various abrasives, perforating, cutting and punching techniques, finishing techniques used around the perforations and edges of each object, evidence of failed cut or perforation marks, and finally, cracks and stresses consistent with cold hammering.

CHEMICAL COMPOSITION

The chemical compositions of each metal object will be examined through the use of portable x-ray fluorescence (pXRF) and particle-induced X-ray emission spectrometry (PIXE). I am most interested in the various levels and ratios of copper, silver and gold present in each object. These values will then be compared and contrasted to other objects from the surrounding islands in order to draw correlations. These copper, silver and gold levels can also demonstrate if the metal is of natural (or alluvial) unalloyed origin, or an artificially produced alloy. Gold-alloys with copper contents higher than 25 percent do not generally occur in nature (Martinón-Torres et al., 2007:447). Silver levels in alluvial gold deposits, and even gold-copper alloys, can aid with determining the mineral source of the object as well. If exact source locations cannot be identified, variation in elemental composition can also indicate the use of multiple source locations. In addition, PIXE allowed for the additional acquisition of trace elemental data. This data typically helps identify inclusions or small trace amounts of elements in each object that are characteristic of a particular source. Unfortunately, there is a current lack of trace elemental data available in the Caribbean to draw comparisons, but this dataset will be accessible for future regional studies.

EXPECTED FINDINGS

Initial results suggest Wild's (2013) compositional hypotheses were correct and that both metal objects are composed at least partially of gold. One object appears to be unalloyed gold and of natural origin, while the other object is almost certainly a smelted, non-local, gold-copper alloy known ethnohistorically as *guanín*. The source location of the piece of guanín is under current investigation. Marcos Martinón-Torres (Personal Communication 2014) suggests Colombia as a potential place of origin based on compositional and morphological comparisons to the Cuban metal assemblage he is currently investigating (Martinón-Torres et al., 2007, 2012).

The stylistic and functional qualities of the two metal objects have yet to receive attention. Initially, it appears these objects fit well within the predominant form characterized by Valcárcel Rojas and Martinón-Torres (2013). The site-specific context of the metals will also be critically evaluated in the future and applied to the materials-based theoretical framework discussed previously.

SCHEDULE

The metal objects were acquired through loan from the United States Virgin Islands National Park during the summer 2014 field season and were returned in May 2015. The chemical and physical analysis was completed and data was collected over the course of the fall

2014 and spring 2015 semesters. The summer 2015 field season was spent acquiring additional information about the Cinnamon Bay site and the National Park Service excavations that occurred between 1999 and 2001. The fall 2015 and spring 2016 semesters will be use to compile the data and finish the actual writing of the thesis. The thesis defense will occur in April 2016.

Committee Members

Chair: Dr. Mark Mehrer
Dr. Leila Porter
Dr. L. Antonio Curet
Ken Wild, M.A.

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