Journal of Anthropological Archaeology 31 (2012) 439–454

Contents lists available at SciVerse ScienceDirect

Journal of Anthropological Archaeology

journal homepage: www.elsevier.com/locate/jaa

Metallic encounters in Cuba: The technology, exchange and meaning of metals before and after Columbus

Marcos Martinón-Torres [a,*], Roberto Valcárcel Rojas [b], Juanita Sáenz Samper [c], María Filomena Guerra [d]

[a] UCL Institute of Archaeology, 31-34 Gordon Square, London WC1H 0PY, United Kingdom
[b] Departamento Centro Oriental de Arqueología, Centro de Investigaciones y Servicios Ambientales y Tecnológicos (CISAT), Ministerio de Ciencia, Tecnología y Medio Ambiente (CITMA), Holguín, Cuba
[c] Museo del Oro, Banco de la República, Calle 16 No. 5-41, Bogotá, Colombia
[d] Centre de Recherche et de Restauration des Musées de France, UMR 171, Palais du Louvre, Porte des Lions, 14 quai François Mitterrand, 75001 Paris, France

ARTICLE INFO

Article history:
Received 28 June 2011
Revision received 12 March 2012
Available online 28 May 2012

Keywords:
Archaeometallurgy
Gold
Caona
Guanín
Brass
Cuba
Caribbean
Life-histories
pXRF
SEM–EDS

ABSTRACT

Metals held important symbolic and political values for the indigenous communities of the Caribbean islands. However, metal objects are not abundant in indigenous archaeological sites, and their study has hitherto been very limited. This paper presents the results of the first analytical programme focused on metal artifacts recovered in a range of Taíno sites in Cuba, chronologically covering the periods before and after contact with Europeans. Our aims were: (a) to identify metallurgical traditions related to a diversity of cultural or learning backgrounds; (b) to investigate the origins of different metal artifacts found in Cuba, as a proxy to reconstruct patterns of exchange and interaction among indigenous communities and between these and Europeans; and (c) to approach the meaning and symbolism of different metals by considering their contexts of appropriation and use. The techniques employed included optical microscopy, SEM–EDS, pXRF and PIXE. The results allow a diachronic picture of the procurement, transformation, use and symbolism of metals in Cuba with broader implications for Caribbean archaeology. We reveal culture-specific Taíno choices in their interaction with materials and value systems from continental America and Europe. We also discuss the selective appropriation, recontextualization and meaning of different metals in the indigenous cultures.

Introduction

Metal artifacts have seldom been used to investigate the cultural diversity of the Precolumbian cultures of the insular Caribbean and their diachronic developments (Chanlatte Baik, 1977; Vega, 1979; Lee, 1985; Siegel and Severin, 1993). The scanty presence of metals in archaeological reconstructions may partly be a result of their scarcity in the archaeological record, with less than fifty artifacts predating European contact reported for the Antilles. However, another important reason may have been an assumed lack of social or economic significance for metals in these societies, contrasting with the startling archaeological abundance and symbolic power of metal artifacts in other American regions. Recent appraisals have started to emphasize that metals played a crucial role as status symbols and means of connection with ancestors and the sacred in indigenous insular societies, and that they may also have had a part to play in the development of social hierarchies (Bray, 1997; Oliver, 2000; Rodríguez Ramos, 2010; Valcárcel Rojas et al., 2007, 2010; Valcárcel Rojas and Martinón-Torres, in press). Furthermore, these studies have hinted at the importance of metals not only as economic commodities but also as elements of cultural interaction and political negotiation with both continental societies and the European newcomers. In this sense, a contextual approach to metals can also offer a contribution to the archaeological and historiographic trend to focus on multicultural 'encounters', as opposed to a single-sided 'conquest' (Hulme, 1992; Abulafia, 2008).

This paper is an attempt to go further in the use of metals as sources of information about cultural diversity and social interaction in the Antilles. We present and discuss the results of a program of archaeometric analyses on a range of metal artifacts from different sites and chronologies in Cuba, which aimed to: (a) identify technological traditions in the selection and transformation of metals that might inform about a diversity of cultural or learning backgrounds; (b) investigate the origins of different metal artifacts found in Cuba, as a proxy to reconstruct patterns of exchange and interaction among indigenous communities, and between these and Europeans; and (c) approach the meaning and symbolism of different metals by considering not only ethnohistorical records,

* Corresponding author. Fax: +44 2073832572.
E-mail addresses: m.martinon-torres@ucl.ac.uk (M. Martinón-Torres), rvalcarcel@holguin.inf.cu (R. Valcárcel Rojas), jsaenzsa@banrep.gov.co (J. Sáenz Samper), maria.guerra@culture.gouv.fr (M.F. Guerra).

0278-4165/$ - see front matter
http://dx.doi.org/10.1016/j.jaa.2012.03.006

but also the contexts of appropriation and use of metals documented archaeologically.

Notwithstanding interim publications of the assemblage from El Chorro de Maíta (Martinón-Torres et al., 2007; Cooper et al., 2008) and some broader surveys (Valcárcel Rojas et al., 2007, 2010; Valcárcel Rojas and Martinón-Torres, in press), this constitutes the first comprehensive publication of analytical data covering a range of sites and contextualizing the information within wider research on metals from the broader Caribbean and with regards to ethnohistorical sources. Following a brief introduction to the assemblages considered and the methods employed, the results will be structured in groups based on the major metal/alloy compositions. Subsequent discussion will place the technical data back into archaeological contexts to offer a revised and more colorful picture of the production, exchange and meaning of metal artifacts among indigenous communities, and their role in cultural interactions with Europeans.

Metals in the Antilles: the Cuban sample

The number of metal objects recovered from indigenous archaeological sites in the Greater Antilles is rather limited, while only two such objects have been reported from the Lesser Antilles. This scarcity may owe to European plundering as well as to a relatively lower richness in metalliferous resources compared to other American regions, but of course it should not be taken as an indication of an equally low cultural significance. Leaving unquestionably European brass and iron aside, a recent review of the evidence brought to view only 37 metal objects in the literature, besides a few less precise mentions (Valcárcel Rojas and Martinón-Torres, in press). To this, we can add an item from Vega de Labañino in Cuba reported in this paper for the first time, and two little known finds from Cinnamon Bay in the Virgin Islands (Wild, 1999; Sebastian Knippenberg, pers. comm. to Valcárcel Rojas, 2011), making a total of 40 for the whole of the Antilles. All the artifacts are rather small, rarely exceeding 1 g and frequently weighing substantially less. Although showing different typological categories, all of them appear decorative, with small, perforated sheets predominating (Table 1 and below). The earliest artifact known is a small gold-alloy sheet found at the site of Maisabel, Puerto Rico, associated to Cedrosan Saladoid material in a context radiocarbon dated to AD 70–374 (2 sigma) (Siegel and Severin, 1993). Most of the artifacts, however, appear associated with Meillacan Ostionoid and Chican Ostionoid contexts, broadly dated to AD 1200–1500 (Rouse, 1992). These finds suggest a long temporal relation with a spectrum of communities of Arawac descent, showing different forms

Table 1
Descriptive features of gold and gold-alloy artifacts (plus a copper item from El Catuco) from archaeological sites in Cuba. Key to the last column: 1 = not analyzed (metal identification based on visual appearance); 2 = past qualitative or semi-quantitative analyses in Cuba; 3 = analyzed in this project, with data first published in Martinón-Torres et al. (2007) but reprinted here for completeness' sake; 4 = analyzed in this project, data published in this paper for the first time.

Site (province)	Object type	Max length × max width (cm)	Weight (g)	Metal	Context. Site ceramics	Notes
El Chorro de Maíta (Holguín)	Trapezoidal sheet with perforation	2.3 × 2.4		Guanín	Contact-period indigenous female burial with possible necklace of coral, stone and metal. Meillacan Ostionoid and European	2
	Trapezoidal sheet with perforation (CMP1)	1.7 × 1.3		Guanín		3
	Bilobular sheet with perforation (CMP2)	1.9 × 1.5		Guanín		3
	Trapezoidal sheet with perforation	1.6 × 1.5	0.30	Guanín		4
	Small sphere	0.3		Guanín		2
	Ornitomorphic figure	2.3	3.70	Guanín		2
	Bell	1.2 × 0.4	0.16	Guanín		4
	Cylindrical bead (CMP3)	0.2	0.04	Caona		3
	Cylindrical bead	0.2	0.04	Caona		4
El Boniato (Holguín)	Trapezoidal sheet with perforation	2.2 × 0.9	0.10	Guanín	Midden. Meillacan Ostionoid	4
Laguna de Limones (Guantánamo)	Trapezoidal foil	2.0 × 1.6	0.23	Caona	No info. Meillacan Ostionoid and Chican Ostionoid	4
El Catuco (Holguín)	Subtriangular sheet	3.2 × 1.8	0.83	Copper	Meillacan Ostionoid	4
Esterito (Holguín)	Elongated sheet with perforation	1.3 × 0.4	0.10	Caona	Midden. Meillacan Ostionoid	4
Vega de Labañino (Guantánamo)	Irregular, elongated sheet with perforation	2.2 × 0.9	0.12	Guanín	No info. Meillacan Ostionoid	4
El Morrillo (Matanzas)	Tear-drop shaped sheet with perforation	1.3 × 0.9	0.22	Caona	No info. Meillacan Ostionoid	4
Loma del Aíte (Las Tunas)	Subcircular sheet with perforation	2.0 × 1.8	0.50	Caona	Midden. Meillacan Ostionoid	4
La Rosa de los Chinos (Ciego de Ávila)	Sheet with perforation	2.4 × 0.6		Guanín	Meillacan Ostionoid	1
Potrero de El Mango (Holguín)	Sheet	0.1		Caona	No info. Meillacan Ostionoid	1
Toma del Agua (Santi Spíritus)	Sheet with perforation	1.2 × 1.0		Caona	Meillacan Ostionoid	2
El Martillo (Granma)	Sheet	3.5 × 0.7		Caona	Meillacan Ostionoid	1
El Paraiso (Santiago de Cuba)	Sheet with perforation	1.4 × 0.7		Caona	Meillacan Ostionoid	1
Santana Sarmiento (Holguín)	Anthropomorphic pendant	4.8		Guanín	Meillacan Ostionoid	1
Alcalá (Holguín)	Fragmented sheet (ALP14, ALP15)	2.1		Guanín	Midden. Meillacan Ostionoid	3

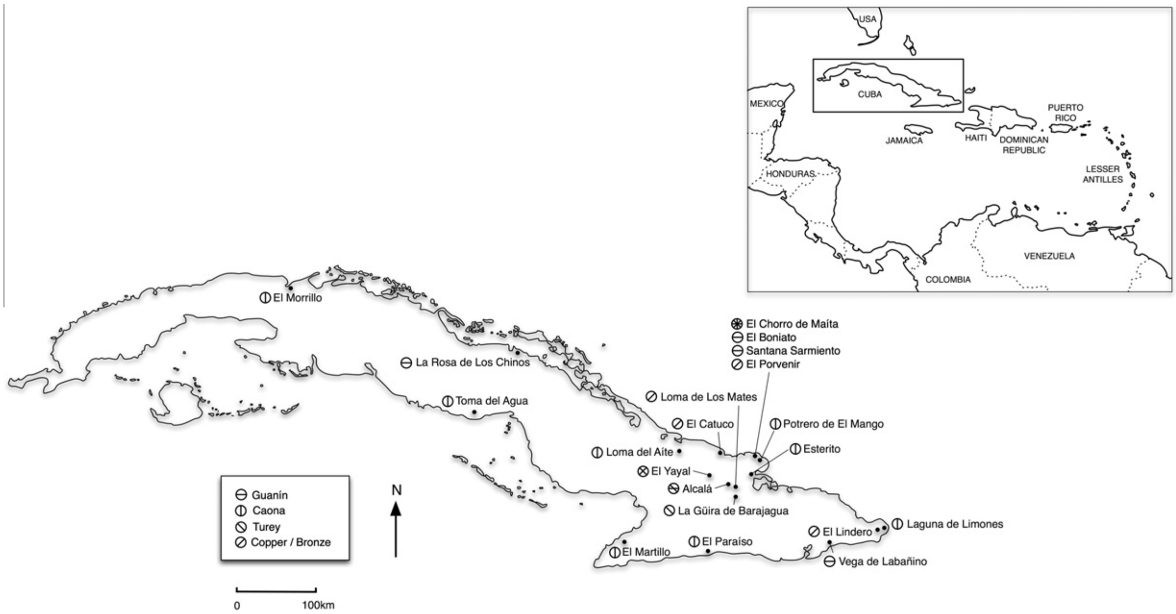

Fig. 1. Map of Cuba showing the location of the indigenous sites that have reported metal finds, including those cited in the text (drawn by Louise Iles). See Table 1 for details of the gold and gold-alloy artifacts found at each site.

of political structuration that archaeologists recognize as part of the Taíno culture (Rouse, 1992), or of an interaction sphere of Taínoness (Rodríguez Ramos, 2010). This culture was pre-eminent in the Greater Antilles at the time of the European arrival. Even though the nature of the term 'Taíno' and its ability represent the cultural diversity of the Greater Antilles is strongly questioned today (Valcárcel Rojas, 2008), this term will be kept here in lieu of its generalizing implications.

The archaeological record from Cuba shows the highest density of metal artifacts, with 55% of the entire population (i.e. 22 out of 40 objects) coming from this island (Valcárcel Rojas and Martinón-Torres, in press). This imbalance, although likely significant, may have been exacerbated by the vagaries of archaeological preservation and subsequent discovery. In fact, almost half of the Cuban objects come from a single site (nine out of 22, i.e. 40%, are from El Chorro de Maíta), whereas most of the other sites with metals, in Cuba and beyond, have so far yielded only a single artifact. European sources from the contact period do not mention Cuba as wealthier in metal terms than any of the other islands in the Antilles.

At least 14 archaeological sites in Cuba have yielded artifacts that have been interpreted as gold or gold alloys (Table 1; Valcárcel Rojas and Martinón-Torres, in press). Most of them are located towards the eastern part of the island, but there are a few finds from the center and even the western regions (Fig. 1). Their chronologies range from relatively early sites such as El Paraíso (AD 638–1218, 2 sigma) through intermediate sites such as El Boniato (AD 1222–1414, 2 sigma) and El Morrillo (AD 1264–1452, 2 sigma), to settlements with stratigraphies that start in the Prehispanic period but which, continuously or not, reach the contact period: Laguna de Limones, Esterito, Potrero de El Mango, El Chorro de Maíta and Alcalá.

Where the archaeological contexts are well understood, the sites constitute settlements that have yielded Meillacan Ostionoid pottery in its Cuban variants, with the exception of Laguna de Limones, where the ceramic assemblage shows a mixture of Meillacan Ostionoid and Chican Ostionoid. Some of these sites are of intermediate size, but others are large villages (Esterito, Potrero de El Mango, El Chorro de Maíta) showing signs of an emergent social complexity, which, in the case of Laguna de Limones, is manifest in one of the largest ceremonial squares recorded in the Antilles.

Of the 22 Cuban artefacts considered to be gold and gold alloys, so far we have analyzed around 60% of them, trying to cover the whole formal, spatial and chronological span (Table 1). In addition, we included a laminar copper object from El Catuco, from a context with evidence of European contact. As a whole, the sample includes items from nine archaeological sites held by five different museological institutions in Cuba. We also analyzed six small nuggets of alluvial gold recovered from an alluvial plain in the Holguín province.

Methods

Our investigation sought to obtain data about the manufacturing techniques and chemical compositions of the artifacts. Given the uniqueness and very high heritage value of the objects concerned, the vast majority of them had to be analyzed non-invasively.

The technological reconstruction was based on the application of microscopic techniques, namely binocular stereomicroscopy using a range of Leica microscopes and scanning electron microscopy (SEM) employing a Hitachi S-3400N. Whole objects were placed directly in the SEM chamber under high vacuum, and images obtained using primarily the secondary electron detector (SE) at 15–20 keV and variable working distances. All SEM images shown in this paper are from the SE detector.

Two main methods were employed for chemical analyses: portable X-ray fluorescence spectrometry (pXRF) and proton-induced X-ray emission (PIXE). Analyses by pXRF employed an Alpha 8000 LZX handheld device from Innov-X Systems, with a silver anode and a SiPIN detector with a resolution of ca. 180 eV FWHM for X-rays of 5.9 keV (at 4000 cps in the reference steel AISI 316), in an area of 6 mm^2. All the analyses were carried out at 40 keV, 30.5 μA, with a 2 mm aluminum filter in the X-ray path, an acquisition time of 25 s, and deadtimes of 12–24%. Quantification was based on the factory-built 'Alloys' method, based on fundamental

Table 2
Results of the analyses of reference materials by pXRF and PIXE. Note that the reference values are nominal (i.e. not certified by produced by a jewler based on actual weights) and thus may differ slightly from the real values.

	Cu	Ag	Au
A1			
pXRF	1.2	6.7	92.1
PIXE	1.0	6.4	92.5
Nominal	2	6	92
A2			
pXRF	3.6	25.1	71.3
PIXE	2.8	22.6	74.5
Nominal	3	27	70
E1			
pXRF		53.0	47.0
PIXE		49.0	50.7
Nominal		50	50
E2			
pXRF	0.5	47.7	51.9
PIXE	0.5	43.7	55.6
Nominal	1	44	55

Table 3
Comparison of the average composition of metal objects analyzed both by pXRF and PIXE, arranged in ascending copper content.

	PIXE			pXRF		
	Cu	Ag	Au	Cu	Ag	Au
Esterito	0.02	6.7	93.2	<0.1	6.5	93.5
Laguna de Limones	0.04	7.7	91.9	0.1	8.5	91.4
El Morrillo	0.09	3.4	96.3	0.1	3.8	96.0
Loma del Aíte	1.2	18.0	80.6	1.5	20.1	78.4
El Chorro de Maíta (bead)	2.4	8.2	89.2	1.8	8.1	90.1
El Chorro de Maíta (bell)	25.3	26.8	47.8	26.8	30.0	43.1
El Boniato	40.1	12.7	46.8	41.7	12.9	45.4
Vega de Labañino	47.3	14.5	37.4	49.5	13.9	36.5
El Chorro de Maíta (laminar)	52.6	7.4	39.8	53.0	8.6	38.4

parameters. Detection limits for this setup are estimated at 0.1% for the elements reported here. In all cases, the spectra were checked to ensure the presence of peaks corresponding with the relevant spectral lines. All the objects were analyzed at least three times, and average compositions are reported.

For PIXE, the established setup for gold analyses at the AGLAE accelerator was employed (see e.g. Guerra and Calligaro, 2003; Guerra et al., 2007). This uses a 3 MeV external proton beam of 30–50 μm diameter and two Si(Li) detectors to collect the X-rays emitted by the sample. One of the detectors has a 1 mm lead collimator and measures major elements while the other has a 75 μm copper filter to absorb the gold lines and thus enable measurement of trace elements. With a 20–40 nA current, the limits of detection reach 13–90 ppm for elements of atomic number between 20 and 60 and 100–1000 ppm for atomic numbers higher than 75. The artifacts were analyzed two to three times, with the beam scanning areas of 200 by 200 μm (except for a few artifacts with uneven surfaces, where smaller areas were analyzed). Quantification was performed with the GUPIX program (Maxwell et al., 1989), and average compositions are reported.

Precision and accuracy of pXRF and PIXE were tested through repeated analyses of a range of reference materials of compositions comparable to the gold alloys studied, obtaining reassuring results. Precision was found to be always better than 5% relative, and accuracy was typically better than 10% relative (Table 2). The degree of correspondence between pXRF and PIXE results was very good (Table 3 and Fig. 2), and thus the data from both instruments can be pooled together for interpretation (although we will distinguish them in all cases for data presentation).

For completeness' sake, the tables will include SEM–EDS data obtained previously on a number of samples (see Martinón-Torres et al., 2007 for details of method). Comparisons between these results, especially when deriving from surface analyses, and those of pXRF and PIXE should be performed more cautiously, given that SEM–EDS operates at lower energies and therefore the results are even more susceptible to not being representative, owing to surface enrichment or depletion phenomena.

SEM and pXRF analyses were performed at the Wolfson Archaeological Science Laboratories of the UCL Institute of Archaeology, while PIXE was carried out at the AGLAE laboratory of the Centre de Recherche et de Restauration des Musées de France in Paris. Optical microscopy was carried out at both laboratories.

Results

Caona

Manufacturing traits

'Caona' was the name used by the indigenous Taínos to refer to alluvial, unrefined gold collected from placer deposits (Las Casas, 1875, v1, p. 411; Velázquez, 1973, p. 68; Columbus, 1961, pp. 183–184; Oliver, 2000; Valcárcel Rojas and Martinón-Torres, in press). The compositions of six artifacts, with gold contents of 90% and higher, are broadly consistent with such origins (Table 4).

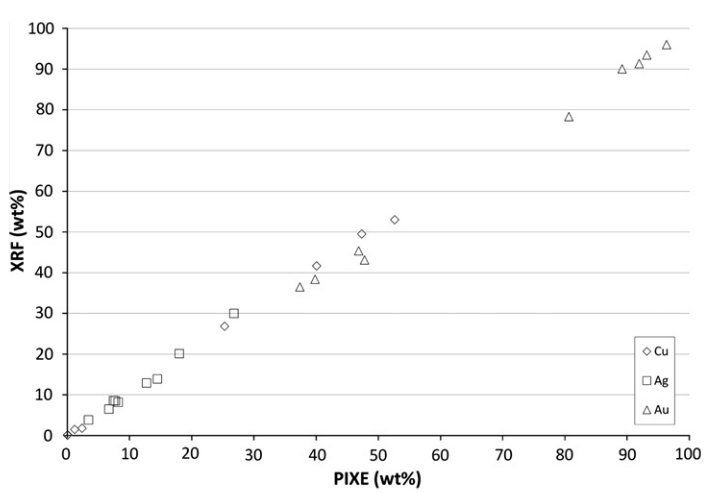

Fig. 2. Scatterplot comparing pXRF and PIXE data on the same artifacts, illustrating the good degree of correspondence between the two datasets.

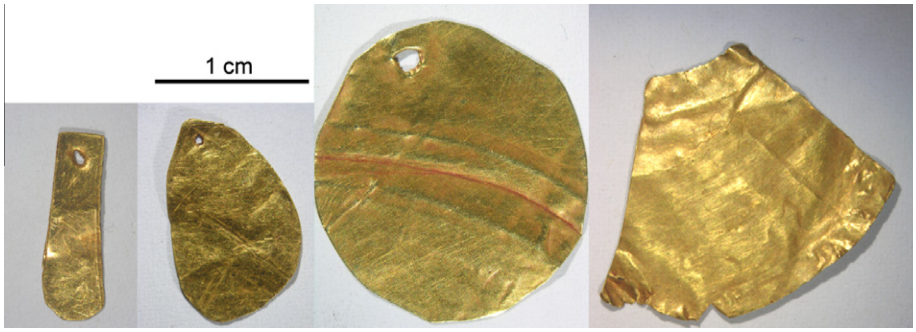

Fig. 3. Selection of *caona* laminar objects under the stereomicroscope. From left to right: Esterito, El Morrillo, Loma del Aíte, Laguna de Limones (photographs by Dominique Bagault, CR2MF).

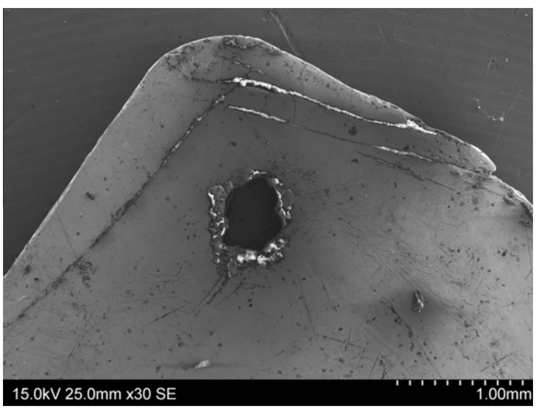

Fig. 4. SEM image of the item from El Morrillo, showing evidence of various failed attempts at cutting the metal sheet (top, now filled with bright corrosion products), the burrs around the perforation, and cracks and stress marks on the surface (most noticeable to the right of the perforation) (photograph by Marcos Martinón-Torres and Roberto Valcárcel Rojas).

Three of these are flat pendants, with maximum dimensions not exceeding 20 mm and thicknesses around 100–200 μm, often with variations within the same artifact. Their shapes are broadly subcircular (Loma del Aíte), drop-like (El Morrillo) or elongated (Esterito), although never perfectly symmetrical, and their surfaces show scratches of variable width in many directions that are consistent with polishing with a loose abrasive such as sand (Fig. 3). All three of them have off-centered perforations near the edges, suggesting that they could have been suspended as beads or affixed to other substrates. These perforations seem rather crudely made, in all cases made by punching with a needle from one side, leaving the burrs of torn metal protruding on the reverse (Figs. 4 and 6).

In the El Morrillo pendant, several features evidence the work of the goldsmith at attempting to homogenize the overall shape, with failed cut marks towards the top and flakes of metal folded around the edges (Fig. 4). Some subparallel concentric lines on one side of the perforation suggest that the perforating needle could have been rotated to widen the hole. The metal shows cracks and stress marks resulting from intense hammering (Fig. 4). Interestingly, an irregular seam with overlapping parts appears to run through the middle of the object, possibly from the flattening of an irregular nugget through hammering, or perhaps an imperfect mechanical bond between two or more gold nuggets (Fig. 5). No compositional differences were detected in readings taken by both pXRF and PIXE from each side of this line.

In the Esterito sample, it is quite obvious that two needles with different diameters were employed, leaving two overlapping perforations, but it is not possible to determine whether the two of them were made in rapid succession or at different moments of the object's life-history (Fig. 6). The polishing of this metal appears to have been more intense, but stress marks are still perceptible, especially towards the edges. Differences in the levels of silver were detected consistently between both sides of this pendant by both pXRF and PIXE, which may be related to variable compositions of the nuggets employed to make it.

The pendant from Loma del Aíte displays areas of irregular porosity that are interpreted as remnant features of the nuggets employed. This piece is decorated with three curved lines that

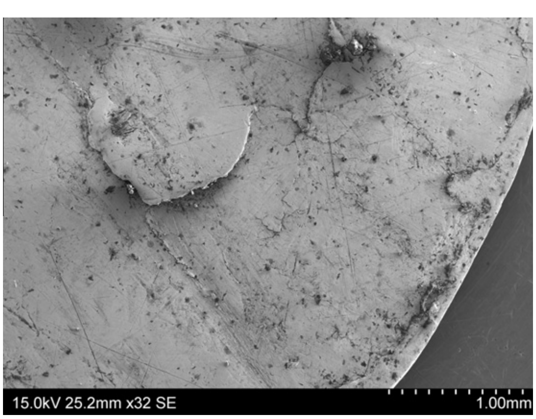

Fig. 5. SEM image of the item from El Morrillo, showing the imperfect overlap between two sections, possibly representing two different gold nuggets (photograph by Marcos Martinón-Torres and Roberto Valcárcel Rojas).

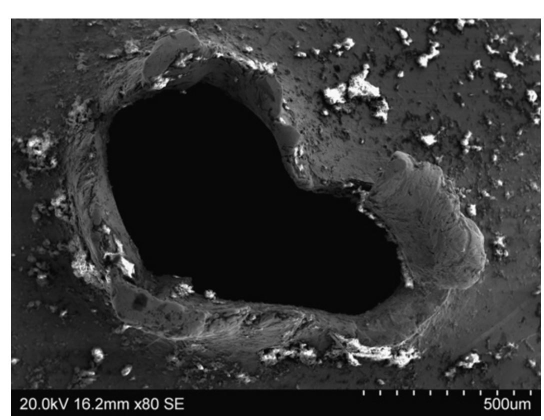

Fig. 6. SEM image of the underside of the perforation in the pendant from Esterito. Note the presence of two overlapping holes of different diameters, as well as the substantial burrs left unpolished (photograph by Marcos Martinón-Torres and Roberto Valcárcel Rojas).

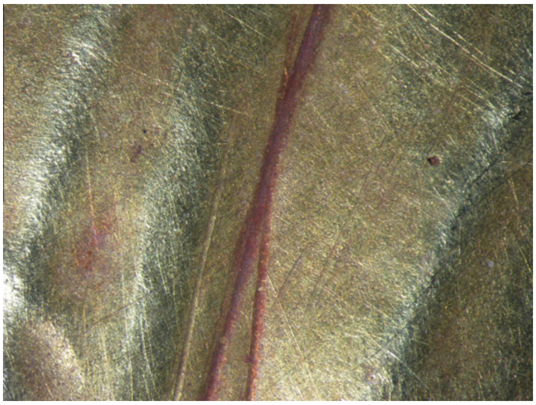

Fig. 7. Detail of the decoration of the Loma del Aíte piece under the stereomicroscope, showing the shallowness and curvature of the lines (photograph by Dominique Bagault, CR2MF).

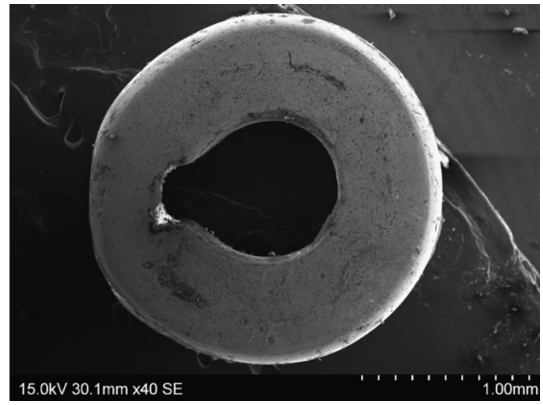

Fig. 9. SEM image of the microbead from El Chorro de Maíta. Note the faint traces of the seam to the left of the image (photograph by Marcos Martinón-Torres and Roberto Valcárcel Rojas).

were engraved from both sides, resulting in a basic embossed design. Based on the marks left on the surfaces, which are continuous and often curved, it seems that each of these lines was engraved by dragging a relatively blunt tool or round-headed burin several times across the object, rather than by hammering with a chisel (Fig. 7).

Another flat gold object comes from Laguna de Limones, but this is a much thinner foil (20–30 μm) and lacks any perforation in spite of appearing to be complete. Its shape is broadly trapezoidal, albeit with curved sides (Fig. 3). Given its thinness, it is quite likely that this metal would have been used to gild or decorate another substrate rather than by itself. Not surprisingly, the metal shows evidence of even more substantial mechanical stress, in the form of networks of cracks throughout the surface that can be noticed in spite of the intense polish. Remnants of the nugget porosity are discernable too, and they frequently contain miniscule quartz grains.

The four objects described above appear rather typical of the *caona* jewellery documented across the Taíno region. Although no pair of objects is identical to each other, all the metal artifacts documented in the insular Caribbean and provisionally identified as gold are small, flat, pieces, frequently showing perforations (Valcárcel Rojas et al., 2007; Valcárcel Rojas and Martinón-Torres, in press). Much more unusual is the typology of the last two *caona* pieces reported here, namely the microbeads recovered from El Chorro de Maíta.

These tiny cylindrical pieces appeared in a burial together with a cluster of coral and stone beads that include some stone beads of identical size, which perhaps formed a necklace. Their diameter is 2 mm, while the central hole has a diameter of 800 μm (Figs. 8 and 9). One of them, analyzed in the first stage of this research (Martinón-Torres et al., 2007; Cooper et al., 2008), was interpreted as produced from a square-section wire that was bent into a circular shape. The two tips of this wire were slightly thinner, possibly owing to the compression experienced by a longer wire when it was cut to form a series of beads, and thus the overall thickness of the bead remains the same at the joint where the two tips meet. While this joint is obvious on one side of the bead, the seam is much more diffuse on the reverse, indicating that some heat was applied to promote solid-state diffusion bonding. The second bead, analyzed more recently, displays exactly the same features but the seam is even more perfect, to such an extent that it is hardly discernable. If we had not examined the first bead, we might have been persuaded that the second one was cast rather than wrought. However, on balance, we are inclined to think that these microbeads were made by hammering gold nuggets, perhaps aided by hot sintering, and that no melting was involved. The remnant nugget porosity and the relative abundance of quartz inclusions in the metal (Fig. 10) support this interpretation.

Composition and origins

The chemical compositions of the *caona* pieces show variable silver and copper contents (PIXE data will be cited unless otherwise noted) (Table 4). Silver levels generally range between 3% and 8%, with one exceptional case in Loma del Aíte, where silver

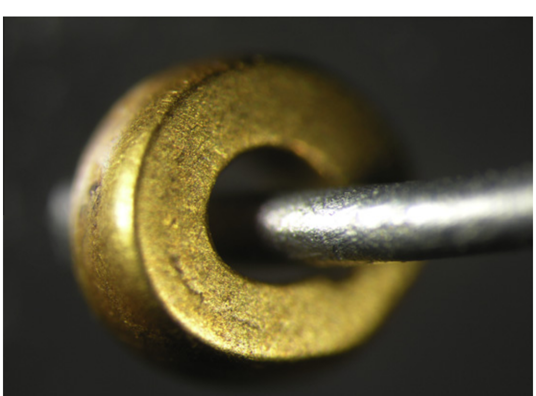

Fig. 8. Stereomicroscope image of gold microbead from El Chorro de Maíta (N.B. the aluminum wire inside the hole is modern and was placed there to facilitate handling) (photograph by Dominique Bagault, CR2MF).

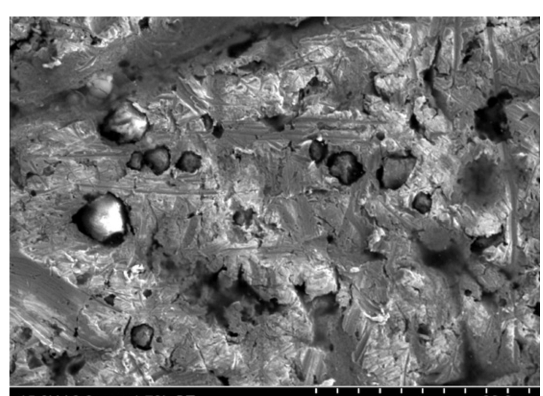

Fig. 10. SEM detail of the surface of the microbead from El Chorro de Maíta, showing abundant quartz inclusions (photograph by Marcos Martinón-Torres and Roberto Valcárcel Rojas).

Table 4
Average chemical composition of the gold and gold-alloy artifacts analyzed for this project. The bold horizontal line separates *caona* from *guanín* objects. All the results are from PIXE, except for those items marked with an asterisk (*), denoting SEM–EDS data (see Martinón-Torres et al., 2007). Blank cells denote values below detection limits. When the symbol '⩽' is used before a number, it means that the results for that element fell below PIXE detection limits in one or more of the analyses, and the highest values obtained are reported.

Site (observations)	Cu (%)	Ag (%)	Au (%)	Fe (ppm)	Ni (ppm)	Zn (ppm)	Sn (ppm)	Sb (ppm)	Pb (ppm)	Pd (ppm)	(Ag/Ag + Au) (%)
Loma de Aíte	1.2	18.0	80.6	1250	⩽50		⩽150		350	150	18
El Morrillo	0.09	3.4	96.3	550	50	250		<50	150	<50	3
Esterito (side A)	0.11	3.8	95.7	2400	100	300	⩽150		⩽50		4
Esterito (side B)	0.02	6.7	93.2	900	50	150	⩽200		⩽250		7
Laguna de Limones	0.04	7.7	91.9	2250	50	350	⩽50		250	⩽100	8
El Chorro de Maíta (bead)	2.4	8.2	89.2	1600	50	200			250	50	8
El Chorro de Maíta (bead CMP3)*	1.3	5.2	93.4								5
El Chorro de Maíta (lobular CMP2)*	55.1	10.0	34.9								22
El Chorro de Maíta (trapezoidal CMP1)*	47.9	12.6	39.5								24
El Chorro de Maíta (bell)	25.3	26.8	47.8	250			500		550	200	36
El Chorro de Maíta (trapezoidal)	52.6	7.4	39.8	⩽500		⩽1000	150		⩽250	⩽300	16
El Boniato	40.1	12.7	46.8	⩽700		⩽900	⩽150	⩽450	450	200	21
Vega de Labañino	47.3	14.5	37.4	600	1000	5950	350		200	850	28
Alcalá (sheet fragment ALP14)*	56.8	6.6	36.7								15
Alcalá (sheet fragment ALP15)*	57.2	6.3	36.5								15

Table 5
Chemical composition by PIXE of six nuggets of alluvial gold collected from an alluvial plain in Banes, Holguín, Cuba.

	Cu (%)	Ag (%)	Au (%)	Fe (ppm)	Ni (ppm)	Zn (ppm)	Sn (ppm)	Sb (ppm)	Pb (ppm)	Pd (ppm)	(Ag/Ag + Au) (%)
Banes nugget 1	0.09	0.8	98.4	5200	100	400					1
Banes nugget 2	0.09	3.4	96.4	900	100	200	250	50	⩽150	⩽200	3
Banes nugget 3	0.02	7.4	91.5	9950	250	250			200		7
Banes nugget 4	0.02	8.3	91.1	6200	150	250	100		150		8
Banes nugget 5	0.04	10.3	83.3	62,600	1100	300			300		11
Banes nugget 6	1.02	10.3	88.1	4200	50	550	100		300	50	10

reaches 18%. Copper is generally at or below 0.1%, except for the Loma del Aíte pendant (with 1.2%) and the microbead from El Chorro de Maíta (with 2.4%; surface SEM–EDS of the other microbead yielded 1.3% copper). Such compositions are broadly consistent with those of alluvial, unrefined gold from placer deposits (e.g. Chapman and Mortensen, 2006; Hough et al., 2009). The only problematic datum is the slightly elevated copper content in the microbeads from El Chorro, since copper values higher than 1% are exceptional in placer gold, with higher values generally indicative of primary smelted gold. On balance, however, and considering the small size and other nugget features described for these beads, we believe their composition may instead reflect a particularly copper-rich gold placer.

Given the relatively small sample numbers, it is difficult to confidently identify compositional groups that could be related to different metal sources. Trace elemental data are also of limited assistance here, since many of the traces recorded were around the detection limits of the PIXE rather than showing high values that could be considered diagnostic. Furthermore, no inclusions of platinum group elements (PGE), which could have assisted in discriminating sources (Meeks and Tite, 1980; Scott and Bray, 1980, 1994), were found in any of the artifacts. However, we believe that the data support the likelihood that more than one gold source is represented in this material. In particular, the microbeads from El Chorro show a distinct composition (higher copper and lower palladium and tin, plus a higher quartz content), as does the Loma del Aíte pendant (higher silver and copper, no zinc).

Regarding the small compositional differences among the remaining *caona* samples, it is harder to determine whether they represent variation within or between sources. So far, we have only been able to analyze geological alluvial gold from one source for comparative purposes. Our geological nuggets come from an alluvial plain in the Banes area of the Holguín province, roughly 9 km from El Chorro de Maíta and El Boniato, and some 27 km from Esterito (Table 5). While the archaeological pieces from Esterito, El Morrillo and Laguna de Limones appear compositionally consistent with these geological samples, it would be premature to attribute them to this source before exploring further the diversity of gold resources in and around the island. High silver levels consistent with those detected in the Loma del Aíte pendant have been recorded in alluvial gold placers deposited at the Mejías beach in northeast Cuba, although with lower copper contents (Díaz-Martínez et al., 1998).

All in all, the microscopic traits and compositions of the laminar *caona* objects examined support their manufacture from alluvial gold, likely collected from different placers on the island. They were formed by hammering and bonding together small nuggets using rather simple techniques, followed by polishing with sand and, in some cases, perforation by piercing with a needle or sharp burin. As such, the morphology of these objects would probably be dictated by a cultural preference for flat, shiny pieces, but also by technical constraints – namely, the lack of use of melting, refining, joining or soldering techniques that might have allowed larger or more sophisticated artifacts with a wider range of compositions. This technical study is in agreement with ethnohistorical sources: Europeans recorded the lack of high-temperature metallurgical technologies on the island; they also report the indigenous production of gold sheets that were incrusted, inserted or sawn onto other materials – exceptionally covering them completely – or were otherwise employed as pendants by the chiefs or 'caciques' (Oliver, 2000; Valcárcel Rojas and Martinón-Torres, in press).

Turning to the microbeads from El Chorro de Maíta, we have suggested elsewhere that they were most likely produced locally (Martinón-Torres et al., 2007). However, with the benefit of a

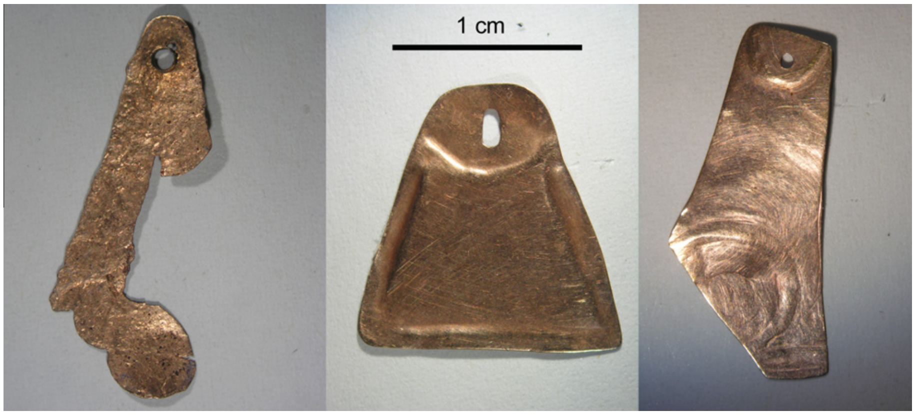

Fig. 11. Selection of *guanín* laminar objects under the stereomicroscope. From left to right: Vega de Labañino, El Chorro de Maíta, El Boniato. Note that tangent light was employed to exacerbate surface features – macroscopically, the last two objects show an excellent polish in spite of the marks visible in these images (photographs by Dominique Bagault, CR2MF).

Fig. 12. Group of artifacts recovered from burial 57 in El Chorro de Maíta, including several *guanín* objects (photograph by Roberto Valcárcel Rojas).

broader set of comparative material, their technology and composition stand out as distinct from the other *caona* pieces. While it is plausible that they were produced on the island by a particularly skilled goldsmith, perhaps we should also be open to the possibility that they were imported. So far we have been unable to find typological parallels in the broader Caribbean area. Besides considering obvious candidates such as Mexican or Colombian goldsmiths, future work should also seek to compare these objects to the many beads recovered in the Mesoamerican isthmus. Here, a cultural preference for flat gold pendants is also attested (albeit often with two rather than one perforation), and major element compositions compatible with those of the El Chorro microbeads, including the slightly higher copper levels, are recorded (Cooke and Bray, 1985; Cooke et al., 2003; Harrison and Beauvien, 2010; A. Harrison pers. comm. 2010).

Guanín

Manufacturing traits

According to Spanish colonial sources, the Taínos used the term 'guanín' to refer to a low-karat gold of purplish color, whose scent and iridescence made it particularly attractive (Oliver, 2000). An assay reportedly conducted in Columbus' time already showed this metal to be an alloy of gold, copper and silver (Las Casas, 1875, v2, p. 226). Unlike the newcomers, the Taínos preferred the alloy *guanín* to the higher-karat *caona*, and they willingly exchanged their unalloyed gold for *guanín* brought and offered to them by the Europeans at reported exchange rates of 200:1 (Szaszdi Nagy, 1982, as cited in Bray, 1997; see also Escobar, 1994).

Although it is possible that some may remain unpublished and unknown to us, currently only 15 *guanín* artifacts – identified as such or visually appearing to be so – are known from Caribbean collections, 12 of which are from Cuba (Valcárcel Rojas and Martinón-Torres, in press). Of these, seven come from the single site of El Chorro de Maíta and two from the surrounding region within a 4 km radius (El Boniato and Santana Sarmiento). We studied seven of the Cuban artifacts, including four from El Chorro de Maíta (Table 1).

On typological grounds, some of the *guanín* artifacts are figurative and three-dimensional, taking the form of a small bell, a bird head and an anthropomorphic figurine. Others are superficially similar to those made of *caona*, appearing as small, flat pendants with a single perforation (Figs. 11, 12 and 19). However, as shown by the detailed examination below, there are more differences than similarities between them.

The four laminar pendants from El Chorro and the one from El Boniato, two sites within 500 m of each other, clearly form a single group on stylistic and technological grounds, to such an extent that they could feasibly be the product of the same workshop (Figs. 11 and 12) – although this point is difficult to prove without further information. This is in spite of their different outline shapes, with one being triangular, the other one elongated and ending in two lobules, and three of them trapezoidal. The one from El Boniato displays a somewhat peculiar shape, in that it appears as a trapezoid but with one corner missing; this dissymmetry does not seem the result of post-depositional breakage – if it ever was a complete trapezoid, the fractured edge was carefully repolished. All four pendants examined (three from El Chorro, one from el Boniato) are very thin (~50 μm) and uniform in their thinness, although just about strong enough to feel less brittle than the gold sheet from Laguna de Limones discussed above, and as such useable as pendants in themselves. The perforations tend to be oval rather than subcircular, and no burrs are evident on either side. Although some shallow cut marks can be identified around the perforations, most tool marks have been removed by a very fine finishing polish that probably involved the use of textiles and a lubricated abrasive rather than sand alone (Figs. 13 and 14). Faint polishing marks

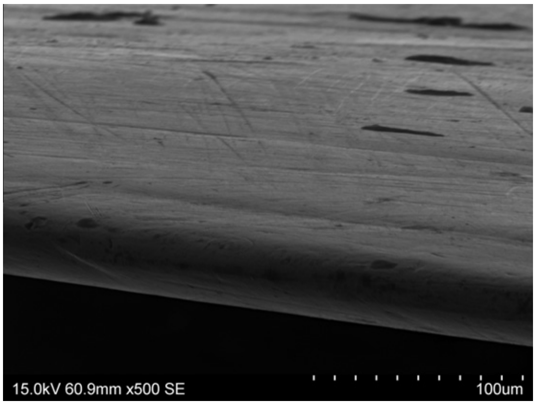

Fig. 13. SEM oblique image of a *guanín* pendant from El Chorro de Maíta, showing extremely fine polishing marks on the surface and edge (photograph by Marcos Martinón-Torres and Roberto Valcárcel Rojas).

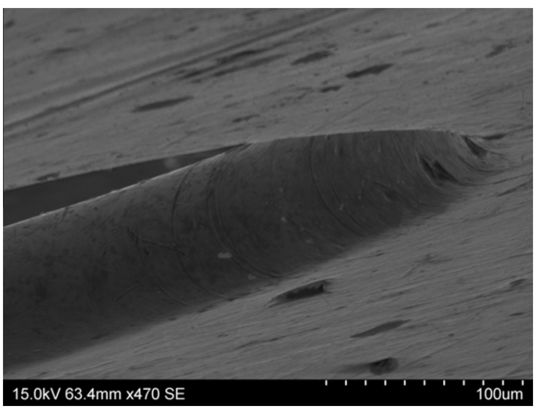

Fig. 14. SEM oblique image of the perforation in the pendant from El Chorro de Maíta, showing a fine polishing that has removed any tool marks (photograph by Marcos Martinón-Torres and Roberto Valcárcel Rojas).

often appear as subparallel bands with a curved arrangement (Fig. 11). This polishing extends to all the surfaces and the outer edges, to such an extent that – bar a few cut marks on the contour of El Boniato item – no definite evidence of hammering or working could be identified in any of the pendants outside the decorative features. Simple plano-relief decoration was accomplished through a combination of hammering or punching, typically creating a semicircular depressed area around the perforation, and depressed rims parallel to some or all the edges. Under the SEM, it is possible to distinguish some faint marks of shallow incisions made to accentuate these decorative features (Martinón-Torres et al., 2007, pp. 197–198). In the El Boniato object, some concentric lines are also present, which appear to have been made by stamping rather than engraving or chiseling.

The other *guanín* flat pendant comes from Vega de Labañino, some 230 km to the southeast of these sites (Fig. 11). This is a much coarser piece, much thicker than the previous ones (~300 μm) and it shows substantial surface pitting, probably as a result of hammering. No surface polishing is apparent. As such, it appears to be a piece of casting spillage that was crudely hammered and cut before being perforated, although this cannot be confirmed. The technique employed for the perforation is unique in the collection: like in the Esterito *caona* pendant, two holes were made, the second wider than the first and partly obliterating it; however, the Vega de Labañino holes – or the wider one at least – were made with a rotary mechanical drill, as evidenced by the faint, perfectly parallel striations remaining on the sides of the perforations. Such parallel lines are obvious in the hole with the larger diameter but also partly visible on the smaller perforation (Fig. 15). Nevertheless, the marks on the latter might have been produced in a failed attempt at enlarging it with the mechanical drill before the second perforation was made. It is rather unfortunate that this artifact was not recovered during controlled archaeological excavations and, as such, we cannot be sure of the antiquity of the rather modern-looking perforation or the object itself.

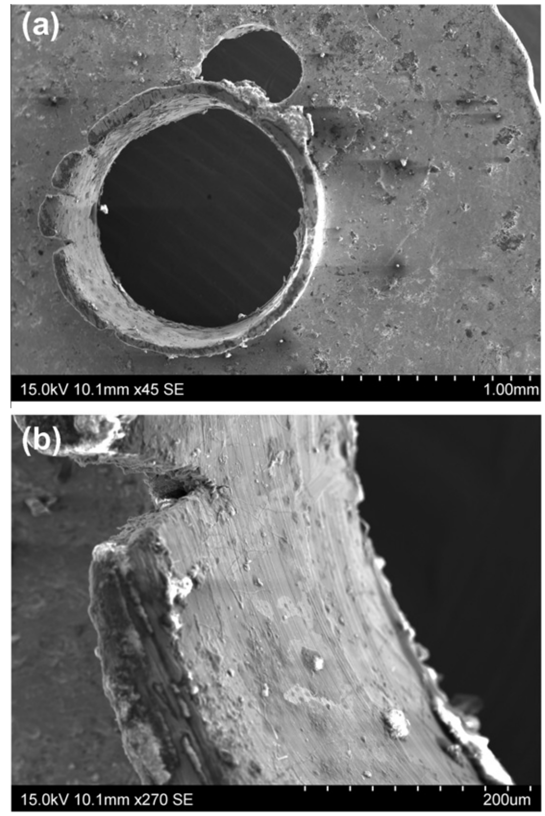

Fig. 15. (a) SEM image of the pendant from Vega de Labañino, showing the presence of a large perforation obliterating a previous, smaller one; (b) SEM detail of the main perforation in the pendant from Vega de Labañino. Note the density of concentric, parallel marks denoting the use of a mechanical drill (photographs by Marcos Martinón-Torres and Roberto Valcárcel Rojas).

The samples from Alcalá are two small fragments of what may well have been a single sheet approximately 120 μm in thickness. As reported elsewhere (Martinón-Torres et al., 2007, pp. 198–199), the metallographic structure of these pieces shows stress cracks and a tight, fibrous texture characteristic of a two-phased metal that was hammered but not annealed.

The last *guanín* artifact analyzed is a small bell found in El Chorro de Maíta, pear-shaped and topped with a suspension loop, showing a small casting imperfection on its body (Fig. 12). The overall morphology and the round casting voids identified on its surface are strong evidence that this object was made by the lost-wax casting technique. However, although no soldering remains could be clearly discerned, a small hole on the top side of the bell body might constitute a de-gassing hole, perhaps related to the soldering of the loop as a separate part (Fig. 16).

Composition and origins

The first aspect of the composition of the *guanín* pieces to be highlighted is the raised level of copper, which in all cases is higher than 25% (and reaching up to 57%) (Table 4). Given that gold alloys with such high copper contents do not occur in nature, the

Fig. 16. Detail of the top side of the bell from El Chorro de Maíta. Note the presence of a small hole towards the top of the body area (photograph by Dominique Bagault, CR2MF).

production of all of these artifacts must have involved high-temperature alloying. As mentioned above, European sources note that the Taínos did not practice high-temperature metallurgy – a point that remains unchallenged by archaeological evidence. Hence, the origins of these artifacts will have to be sought beyond Cuba. As regards the silver levels, these are significantly higher than those in the *caona* artifacts (with the exception of the Loma del Aíte piece), but this does not necessarily imply that silver was deliberately added to the alloy. Instead, it may simply corroborate that the gold employed for these items was not from Cuban sources. Even though occurrences of silver-rich alluvial gold are documented in Cuba (Díaz-Martínez et al., 1998), high silver levels are much more consistently documented in neighboring Colombia (e.g. Scott, 1982; Barrandon et al., 2004).

Assuming low or negligible copper levels in the unalloyed gold, the % (Ag/Ag + Au) value can provide a reasonable estimate of the silver contents in the gold employed. For the *guanín* pieces, most values oscillate between 15% and 21%. For comparison, a recent survey of over 200 objects of Muisca metalwork from Colombia yielded an average value (±standard deviation) of 14 ± 10 (Uribe, in press; Uribe and Martinón-Torres, 2012), and another study for the Sierra Nevada de Santa Marta yielded values between 12 and 18 (Sáenz, 2010). While there is no doubt that regional variations must have existed between Colombian sources, these results confirm the tendency for Colombian gold to have high silver values, comparable to those recorded in the Cuban *guanín*. Somewhat higher than usual values are given for the Vega de Labañino piece (27.9%) and, especially, for the bell from El Chorro de Maíta (35.9%) (Table 5; Fig. 17). Although certainly not unique, these values are exceptional even by Colombian standards and could denote the artificial addition of silver to the alloy.

Looking at the data more closely, it is also possible to discern provisional compositional patterns. To start with, the technical similarities between the flat pendants from El Chorro de Maíta and El Boniato seem to have a chemical counterpart: the two artifacts from this group with trace elemental data available show comparable levels of zinc, palladium and tin. As regards the Vega de Labañino piece, this shows the same trace elements but in higher levels and in addition to nickel (perhaps surface contamination), which was not detected in the previous samples. The bell stands out in its very high % (Ag/Ag + Au) value but also in the higher levels of tin and lead, contrasting with zinc below detection limits. The sheet from Alcalá, since it was analyzed only by SEM–EDS, cannot be confidently ascribed to, or excluded from, any group.

The relatively low levels of palladium (<800 ppm) and platinum (below the detection limits of ~1000 ppm) rule out some alluvial gold placers of Colombia as potential sources, especially the well-known coastal deposits exploited by the Tumaco-La Tolita goldsmiths around the border with Ecuador, and known to be very

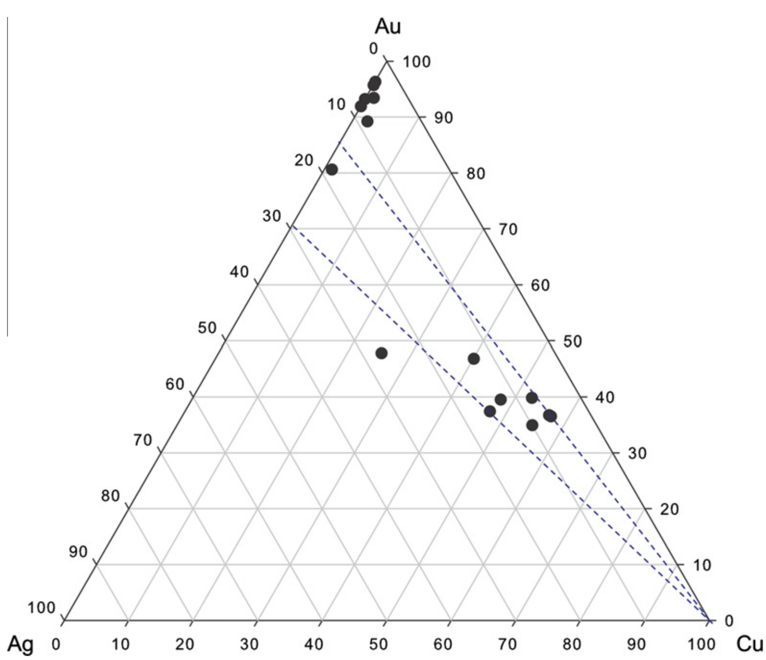

Fig. 17. Au–Cu–Ag ternary diagram displaying graphically the compositional data presented in Table 4. Note the generally different Ag/Au ratios of the *guanín* compared to the gold articles (except the Loma del Aíte gold pendant, with a Ag/Au ratio comparable to those in the *guanín*). The dashed lines separate the range of Ag/Au ratios for the *guanín*, excluding the extreme value of the bell from El Chorro.

rich in these elements. However, gold from the Colombian highlands and the northern plains has been shown to contain lower levels of these traces, in addition to a lack of PGE inclusions – as is the case with the artefacts studied here (Scott, 1998; Guerra, 2004; Barrandon et al., 2004; Bouchard and Guerra, 2009). All in all, even though alternative sources in Mesoamerica cannot be discarded, we are inclined to suggest a Colombian origin for some of these artifacts at least. Flat, highly polished, perforated pendants decorated with simple lines, similar to those from El Chorro and El Boniato, are known to have been produced by the Nahuange goldsmiths of Sierra Nevada de Santa Marta, on the Caribbean coast of Colombia (Sáenz, 2007, 2010).

The strongest argument supporting Colombia as a source of some of the *guanín* found in Cuba comes from iconographic rather than chemical data (cf. Bray, 1997). The first example whose provenance seems certain is the ornithomorphic head from El Chorro de Maíta (Fig. 12). These hollow bird heads, cast by the lost-wax technique, were important components crowning the pectorals made by Tairona goldsmiths in Colombia (Sáenz, 2001). Many of the Tairona pectorals held at the Gold Museum in Bogotá still display an arrangement of three or more bird heads, and there is one example that is almost identical to that found in Cuba (Fig. 18). The second item with a figurative style that bears similarities to Colombian metalwork is the anthropomorphic figurine from Santana Sarmiento (Fig. 19). Again, figures of this style, depicting men with joined hands, prominent eyes and nipples, and wearing a headdress, are common in Zenú goldwork, and we have found an example bearing remarkable similarities to the Cuban counterpart (Falchetti, 1995, p. 105, Fig. 45c). For these artifacts – even when we lack quantitative chemical analyses – a Colombian origin seems almost incontrovertible. The last item for which similar types can be found is the bell, but its relatively simple morphology makes a stylistic attribution more difficult. Similar lost-wax cast bells have been found abundantly in Colombia with, close parallels in early Zenú contexts (Falchetti, 1995, p. 182, Fig. 84D), but also in a substantial number of Mesoamerican sites, including Mayapan (Paris, 2008), Lamanai (Simmons et al., 2009), Tipu (Cockrell et al., in press) and West Mexico (Hosler, 1994). The different trace elemental pattern, and particularly the high silver content, make a Mesoamerican origin more plausible, since the practice of adding silver to gold-alloys appears more frequently documented in this region than in Colombia (e.g. Peñuelas et al., 2011). However, most of the Mexican bells published are made of copper-based rather than gold-based alloys.

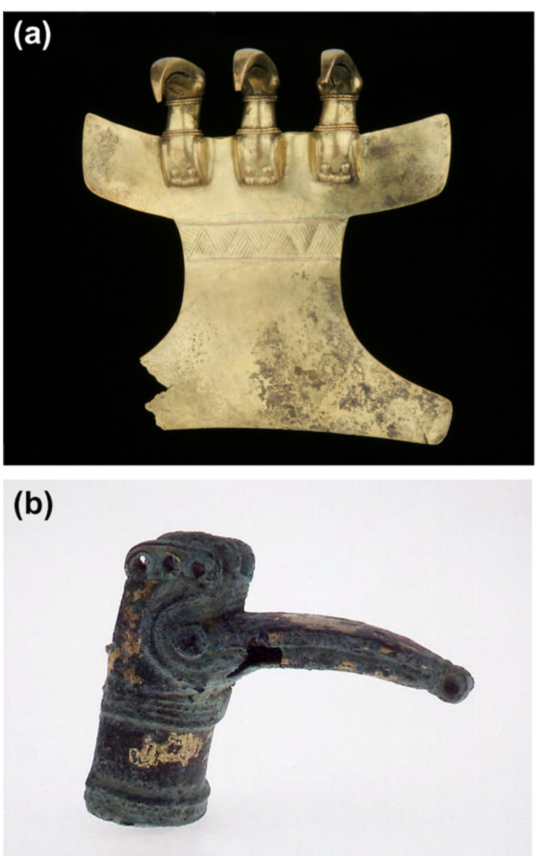

Fig. 18. (a) Tairona pectoral from Colombia (O13973), showing a typical arrangement of bird heads; (b) Tairona bird detached from a pectoral (O11056), showing remarkable formal similarities to the one found in El Chorro de Maíta (see Fig. 12) (Banco de la República – Gold Museum Colections. Bogotá, Colombia. Photographs by Clark M. Rodríguez).

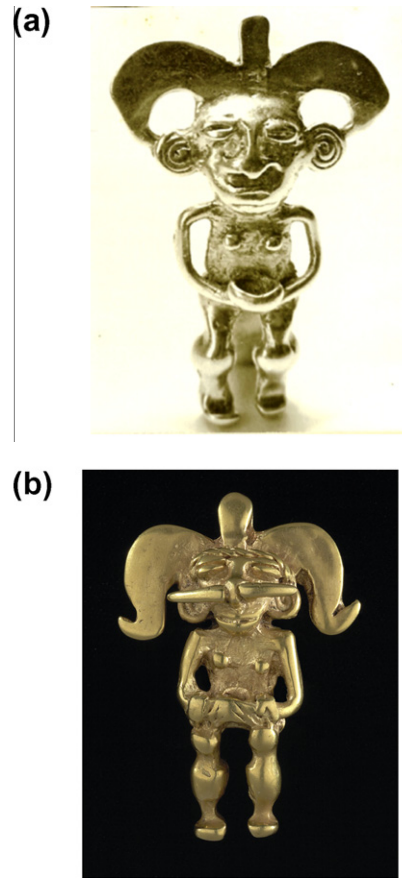

Fig. 19. (a) Anthropomorphic figurine from Santana Sarmiento (Archives of Departamento Centro Oriental de Arqueología, Holguín, Cuba); (b) Zenú figurine from the Caribbean lowlands of Colombia (O26346) (Banco de la República – Gold Museum Colections. Bogotá, Colombia. Photograph by Clark M. Rodríguez).

Other metals

Together with *caona* and *guanín*, the most prominent metal in Cuban indigenous sites is European brass, known locally as 'turey'. In a previous study (Martinón-Torres et al., 2007), we demonstrated that some of the 'pendants' worn by high-status Taínos were in fact brass lacetags or aglets from European clothing, i.e. the metallic tubes used at the tips of shoe- and other laces to decorate them and prevent fraying. The cultural and political implications of these finds have been discussed at length elsewhere (Valcárcel Rojas et al., 2010) and will be briefly recaptured in the discussion below, but the data will not be reiterated here.

Fig. 20. Copper object from El Catuco as seen under the stereomicroscope (photograph by Dominique Bagault, CR2MF).

Indigenous sites with contact-period levels in Cuba and La Hispaniola frequently yield metal artifacts including iron implements as well as brass, copper and bronze ornaments, and accessories of clearly European typologies. The assemblage from El Chorro de Maíta includes a metallic disc described as 'copper' (Guarch Delmonte, 1996, p. 17) as well as a perforated copper sheet, two brass bells and small iron fragments. To this catalog we can add a copper artifact from the site of Catuco and analyzed within this project (Fig. 20), comprising a flat, coarsely hammered piece of metal made into a shape vaguely resembling a blunt arrowhead.

Even though we lack any evidence for its exploitation, we should acknowledge that small occurrences of native copper are reported for eastern Cuba (Lovén, 1935, p. 473, as cited in Bray, 1997; Mitchem, 1999, p. 235), and even Columbus himself is said to have found a vein of this metal in Hispaniola (Vega, 1979, p. 27). The Taínos could potentially have exploited this metal just as they did with gold. Our surface pXRF analyses of the copper artifact from Catuco showed traces of antimony, lead and nickel, however, thus suggesting that it constitutes smelted rather than native metal.

Written sources report the use of simple copper and bronze implements as ornaments among indigenous communities – in all cases, metal obtained from the newcomers – and even the occasional use of European iron for tools (Valcárcel Rojas and Martinón-Torres, in press). However, on the basis of the evidence available, it seems that copper, bronze and iron were not as important to the Taínos as the other metals discussed here – at least, not in symbolic terms.

Cultural interactions, context and meanings

As highlighted throughout this study, our picture of the provision and use of metals among the Cuban Taíno is inevitably skewed by the scarcity of artifacts found. Besides biases in preservation and recovery, this scarcity must also be due to European plundering. Ethnohistorical accounts report that metals were circulated among caciques in order to strengthen ties and obligations, rather than being deposited in votive offerings or burials (Oliver, 2000). This would have increased their visibility and thus accessibility. In this sense, the metal goods in burials at the cemetery of El Chorro de Maíta must be regarded as an exception, possibly explained as a part of the cultural dynamics resulting from interaction with Europeans. Whatever the case, the research presented here shows that the Taínos produced flat pendants through the processing of alluvial gold from a variety of insular sources, but also that they had some access to gold–copper(–silver) alloys from Caribbean Colombia and, possibly, Mesoamerica. Some implications of these findings are discussed in the next paragraphs, together with some pointers for future research.

Cultural interaction and metal exchange

An important question that we have sidelined so far is that of chronology. We know from written sources that Europeans capitalized on the Taínos' appreciation of *guanín* by bringing this low-karat gold from other regions and exchanging it for their *caona*. However, is it possible to trace contacts that obtained metals from the continent before European arrival (cf. Szaszdi Nagy, 1984; Whitehead, 1990)? In addition to evidence that indicates interaction between the Greater Antilles and northern South America, including objects as well as raw materials that were used in stone and bone ornaments (Boomert, 2000), there are further suggestions of links between the Greater Antilles and the area of Colombia and the isthmus. These are patent in the shared iconographic themes, aspects of the structure of ceremonial spaces, and peculiarities in the distribution of some crops, raw materials and cultural practices (Wagner and Shubert, 1972; Veloz Maggiolo and Angulo Valdés, 1981; Rodríguez Ramos and Pagán Jiménez, 2007; Rodríguez Ramos, 2010). As regards metals, the early first millennium AD date of the *guanín* from Maisabel, Puerto Rico (Siegel and Severin, 1993), demonstrates that continental metals reached the insular Caribbean before European contact. It is harder, however, to assess the intensity of this trade, or indeed to confirm that it involved Cuba.

So far, most of the *guanín* found in Cuba has appeared in the northeast of the island, supporting the idea of an eastern route for the movement of this metal (Fig. 1). At the Cuban sites of El Boniato and Santana Sarmiento, there is *guanín* but so far no archaeological evidence of direct European contact. However, both sites are very close to El Chorro de Maíta and El Porvenir, where evidence of European presence is strong, and thus it is possible that they obtained the *guanín*, directly or indirectly, via Europeans. As Deagan (2004) has demonstrated, the apparent absence of European materials in indigenous sites cannot be taken as an indication of lack of direct contact with them; at the same time, it is likely that European metals traveled faster and farther through pre-existing indigenous trade networks (e.g. Ehrhardt, 2005). Whether *guanín* was primarily brought by Europeans or through direct indigenous interaction is thus hard to verify.

Turning to El Chorro, all the *guanín* from this site was associated with a single female burial, where it appeared together with other items of coral, pearl, stone and, crucially, European brass (Fig. 12). While this burial suggests a rather exclusive access to metals that would no doubt contribute to the reinforcement of incipient social inequality, it also suggests that access could well be mediated by the colonists. In Jamaica, Christopher Columbus reports the case of a cacique that adorned himself in metal only for their second meeting, that is to say, possibly *after* he had learned of the European interest in metals, in an attempt to impress them (Valcárcel Rojas and Martinón-Torres, in press). This shows the importance of metals in contexts of political negotiation, but also signifies the potential role of external cultures in altering indigenous perceptions of metals, their values and their uses.

The paucity of absolute dates associated with metal artifacts, in Cuba and beyond, makes higher-resolution inferences more difficult. A suggestive question for future inquiry is the occurrence, in the same burial of El Chorro de Maíta, of *guanín* artifacts echoing

Nahuange style with a bird head from a Tairona pectoral. Both goldworking traditions originate in the Sierra Nevada de Santa Marta, in northern Colombia, but they are understood to have succeeded each other chronologically, with Tairona designs and technologies becoming predominant from ca. 1000 AD (Sáenz, 2007, 2010; Giraldo, 2010). If the laminar pendants could be confirmed to be Nahuange and to predate the bird, then we could again be tempted to use this as material evidence not only for the import of Colombian metals in Precolumbian times, but also for the preservation and transmission of *guanín* items amongst the Taínos for numerous generations. However, another plausible explanation for this assemblage would be that all the items were mixed by the Europeans after the indiscriminate looting and plundering of Colombian graves before bringing them to Cuba (cf. Bray, 1997). For this same reason, even though the Zenú anthropomorphic figurine from Santana Sarmiento is evocative of early Zenú styles (200 BC to 1000 AD) (Gold Museum Guide, 2008), its deposit in a Cuban site could have taken place several centuries after its manufacture.

Context and significance of metals

Whatever the case, there is little doubt that metal artifacts played a crucial role in the articulation of social structures, the materialization and negotiation of identities, and as a medium of Taíno interaction with the sacred. Recent work has developed interpretations of the symbolism and use of metals amongst the indigenous communities (Oliver, 2000, 2009a, 2009b; Valcárcel Rojas et al., 2007, 2010; Valcárcel Rojas and Martinón-Torres, in press). These publications have relied mostly on ethnohistorical information, but they have also begun to draw on a growing body of archaeological data. The symbolic importance of gold is apparent from the beginning of the technological sequence, as suggested by the ritual behavior recorded in La Hispaniola, where men had to undergo a period of fasting and separation from their wives before embarking on gold collecting (Fernández de Oviedo, 1851). This was, according to current knowledge, the only metal exploited by the indigenous islanders, and invariably employed to manufacture and decorate ritual implements, religious images or attributes for chiefs. Importantly, the metal was used on objects imbued with *cemí*, that is, animated and with the power to interact with the cosmos. Access to metals was clearly restricted, and the majority of the metal artifacts obtained by the Europeans originated from chiefs. However, these restrictions did not exclude women (see, for example, Sued-Baldillo, 1979; Wilson, 1990; Deagan, 2004 for discussion regarding Taíno women's access to wealth and power).

These artifacts were invariably small and, in this sense, they appear to have followed human scales and dimensions (cf. Helms, 1987 on similar observations for the Intermediate Area). The largest metal object reported in the Antilles, from La Hispaniola, is barely 10 cm long, and all the other objects are considerably smaller (Table 1; Valcárcel Rojas and Martinón-Torres, in press). While economic and technological constraints may be partly responsible for the small size and scarcity of the artifacts recovered, it is also possible that their small scale may have been conceived as part of their specific cultural code – and perhaps contrasted with their sheer symbolic magnitude. *Caona*, the local gold, was related to concepts of femininity, profanity and pale colors, but it was nonetheless sought after and displayed by powerful individuals. Foreign *guanín* came from remote lands and had a special smell and iridescence that connected it to other sacred principles and materials, making its possession particularly fitting for chiefs and shamans, legitimizing their authority and their ability to communicate with the supernatural. As a non-Antillean material, *guanín* allowed references to other spaces, including those of the ancestors (Oliver, 2000; Valcárcel Rojas and Martinón-Torres, in press).

The above studies are thus beginning to outline a specifically Taíno metal value system, but there is an important aspect of this picture that has not been emphasized enough: the substantial change in value and meaning undergone by the metals as they changed hands. As foreign metals entered the Taíno sphere, they were filtered through a cultural system that was alien to the original. Not only did this journey add weight to the life-histories of the artifacts (Gosden and Marshall, 1999; Holtorf, 2002), it also meant a drastic change in their very conceptualization. Once in Cuba, gold–copper alloys were no longer *tumbaga* (as they were known in Colombia) but *guanín*, with radically different cultural values and uses.

Such transformation is clearly exemplified by the re-contextualization of the ornithomorphic head deposited in the burial of El Chorro de Maíta. In Colombia, the bird head would constitute just one of several components of a larger pectoral; detached from it, it would most likely be perceived as an item in need of repair or scrap to be recycled. In Cuba, however, the single bird head was understood as a part of a different symbolic code that made it worthy of deposition in a rich burial. While other colorful elements such as feathers, shell and wood seem no longer present, this burial integrated metal items of various colors with coral, pearl and stone beads, creating a visually powerful assemblage reminescent of a cacique described by European accounts in Jamaica (Oliver, 2000), and which could only be understood by reference to indigenous cultural codes. The Taíno interest in continental metals raises the possibility that foreign metalworkers, in Colombia or elsewhere, could have produced artifacts specifically for the export market – a hypothesis to be borne in mind in future work.

In the same vein, it is noteworthy that all the *guanín* so far recovered in Cuba appears to show a characteristic reddish tinge, as opposed to their Colombian counterparts where the surfaces were frequently made to appear golden by virtue of depletion gilding techniques. The only item that appears to have been gilded is the ornithomorphic figure, and even this shows some peculiarities: while the Colombian figure shown in Fig. 18b shows a corrosion pattern that is typical of gilded artifacts, the piece found in Cuba (Fig. 12) shows a redder surface appearance, bar some more golden areas preserved in clefts and crevices. Here, it seems that the golden surface has either faded through use-wear, or it was deliberately removed by polishing. Thus, while the Taínos placed special emphasis on sensorial aspects of metals such as their smell and sheen for their categorization and value, it would appear that they also favoured specific color hues – perhaps golden surfaces were considered too similar to *caona*. As an alternative explanation, for Postcolumbian contexts at least, the predominance of red *guanín* may be a result of European mediation, as they would only release items appearing to have a lower karat, while keeping the golden ones for themselves. Again, the question will have to remain unresolved until we have more direct dates associated with the contexts of metal deposition. In any case, the associations documented in Colombia between golden tumbagas and masculinity on the one hand, and redder tinges and femininity on the other (Falchetti, 1999; Uribe, 2005), seem not to apply in the Taíno sphere – which again highlights the defining role of the cultural context where the metals are adopted.

Further examples of the choices made by the Taíno in actively selecting, adapting, recontextualizing and reinterpreting foreign metals within their own codes are patent in their interaction with the European newcomers. As mentioned earlier, we have previously shown that some of the objects worn by high-status Taínos and previously classified as 'pendants' (e.g. Guarch Delmonte, 1996) were lacetags or aglets from European clothing (Martinón-Torres et al., 2007). In one case at least (burial 25 of El Chorro de Maíta), it was obvious that they had been detached from their original substrate and used to create new body ornaments (Valcárcel Rojas et al., 2010). Startled Europeans describe how their brass, in Taíno hands, was no longer brass but 'turey', a heavenly entity (Las Casas, 1875, v1, p. 402); little or nothing was left of these small metallic tubes as cheap, disposable, functional items: they were now a sacred, exotic material whose brilliance echoed that of the sky. This cultural adaptation would have dramatic implications for the indigenous social structures and value systems; the availability of *turey* presented a new resource whose ownership potentially increased authority and religious power, but access to it required negotiation with the Europeans. These would happily engage in exchanging their brass for local gold, while the indigenous peoples used the new material to redefine their social relationships and value systems. Importantly, like in the case of *guanín*, the adoption of foreign materials was not wholesale but selective, and it did not convey an acceptance of values and meanings.

Spatial and cultural diversity

A last point to be considered is the spatial distribution of metal finds across the island, which provides additional information potentially related to the choices made by the Taíno, their variable access to resources and their internal cultural diversity. Across the Caribbean islands, metals are recorded in a variety of contexts, seemingly including ethnic groups with different linguistic traits, behavior or body appearance. (Valcárcel Rojas and Martinón-Torres, in press). Surely, the significance of metals would have been understandable within a shared Antillean-wide code but there must have been local adaptations. This internal diversity can also be hinted at within Cuba. Fig. 1 shows the archaeological distribution of different metal and alloy finds in indigenous sites on the island. Besides the prevalence of *guanín* in the northeast as discussed above, it can also be seen that *turey* predominates in this same area. The latter, however, may not be representative of the reality, as it is likely that more brass remains unidentified in contact-period assemblages from other Cuban sites. As for *caona*, this metal appears more evenly scattered across the island. An interesting aspect shown on the map is the variable combinations of metals documented in the different sites studied: only one site displays an assortment of *turey*, *guanin*, *caona* and copper/bronze; others hold different permutations such as only copper/bronze, only *guanin*, only *caona*, or a combination of *caona* and *turey*. To this diversity one might add the plethora of sites where no metals are reported at all. The variable patterns of presence/absence of metals on the island are probably influenced by practical matters such as the differential power or connections allowing access to them. In this sense, future work involving larger survey and excavation campaigns may help clarify the extent to which the presence of certain metals correlates with the size or status of different sites. However, it is also possible that these patterns reflect different preferences or active choices on the part of the communities. Particularly, as news of the European arrival and their mixed reputation spread across the island, it is plausible that some communities could have chosen not to adopt their materials and customs (see Ponting, 2002 for a purported case of rejection of Roman brass in Jewish Galilee). Now that we accept that annihilation was not always the immediate outcome of cultural contact, *turey* might be taken as a very significant proxy of European influence, allowing future work to explore the relationships between the adoption of European metals and the survival rates of indigenous communities.

Conclusion

This project was based on the premise that metals, no matter how scarce in the archaeological record, played important social and culture-specific roles among the Taíno communities of Cuba. It was hoped that this study could thus be informative of indigenous values and social interaction. Since the biases of archaeological metals as sources of information are different from those of ethnohistorical accounts, we expected that they would offer complementary data less susceptible to the generalizing, homogenizing, de-humanizing view of indigenous communities derived from many European texts.

The information presented here leaves little doubt that that our starting premise was correct. The Taíno procurement and use of metals was entangled with ritual and symbolic behavior. Imbued with life, metals allowed connections with the supernatural and with remote times and spaces. Used for adormnent and display by those with the privileged access to them, they must have influenced the consolidation of power structures within and between communities. The supply and exchange of metals was also intrinsic to the relationships among diverse Antillean communities, and between these and those beyond. Furthermore, the role of metals in the encounter with the newcomers was more multidimensional than the mere stuffing of European coffers: metals were important to both cultures albeit in very different ways, and our understanding of these interactions cannot consider European ambitions only. All of these factors should be borne in mind in any future studies of the Antillean past before and after Columbus.

By combining archaeometric and stylistic analyses with a consideration of the contexts where the metals were found, we have been able to substantiate, on a scale never explored before, the differences between gold and *guanín* objects, as well as key components of regional interactions, hierarchies and symbolism. It has been possible to reveal the techniques employed by the Taínos to transform their local gold into *caona*. Furthermore, we have provided solid evidence for the import of gold–copper alloys from Colombia, and strengthened the possibility of further Mesoamerican links, even though chronological uncertainties do not allow us to confirm, for the Cuban case, whether this trade took place prior to European arrival. More importantly, we have emphasized the important role of the re-contextualization of metal artifacts as a transformative process that actively involved idiosyncratic Taíno cultural values. Far from being passive recipients of continental metals or European 'civilization', indigenous communities of Cuba dynamically negotiated the terms of their engagement in a way that was compatible with their ever-evolving social structures and value systems. Without a doubt, the study of the Antilles needs to be related to a cultural universe that goes beyond the borders of the islands. We anticipate that future comparative work on a broader regional scale will not only continue to highlight specific features of the Taíno material and culture, but also expose further internal diversity within this system, expanding our understanding of the indigenous world that Columbus encountered, and revealing it as a colorful mosaic of human diversity.

This research has demonstrated the value of applying archaeometric methods to the study of indigenous material culture, especially in the complex contexts generated by interaction with Europeans. While acknowledging the value of pioneer efforts before ours, we hope that this project precipitates the development of further coherent archaeometallurgical projects in the Circum-Caribbean region.

Acknowledgments

We would like to gratefully acknowledge the support, advice and technical assistance from the following individuals in various aspects of our work: Corinne Hofman, Thilo Rehren, Jago Cooper, Reniel Rodríguez Ramos, José Oliver, Kevin Reeves, Gerardo Izquierdo, Silvia Teresita Hernández, Daniel Torres, Elena Guarch, Diego Bosch, Alice Samson, Alistair Bright, Sebastian Knippenberg, Ana Luisa Gazón, Limber Martínez, Alfredo Figueredo, Elton Garriga, Ramón Garrido, Yunior García, Dominique Bagault and Louise Iles. Some parts of this research have been funded by the Netherlands Organisation for Scientific Research (NWO) Grant Communicating Communities (Project Number 277-62-001), European Union Marie Curie Programme (Contract MEST – CT 200, No. 514509) and European Union EU-Artech Programme. This paper was completed while Marcos Martinón-Torres was on research leave supported by an AHRC Fellowship (AH/I022228/1). We are particularly grateful for the assistance provided by the following institutions in Cuba: Departamento Centro Oriental de Arqueología, Instituto Cubano de Antropología, Museo El Chorro de Maíta, Museo Histórico de Matanzas, Museo Histórico de Guantánamo, Museo Histórico de Puerto Padre, Comisión de Monumentos de Holguín, Vicepresidencia Nacional de Monumentos and Subcomisión Nacional de Arqueología.

References

Abulafia, D., 2008. The Discovery of Mankind: Atlantic Encounters in the Age of Columbus. Yale University Press, New Haven.

Barrandon, J.N., Valdéz, F., Estévez, P., 2004. Identificación mineralógica de las fuentes del oro precolombino utilizado en la metalurgia prehispánica del Ecuador. In: Perea, A., Montero, I., García-Vuelta, O. (Eds.), Tecnología del oro antiguo: Europa y América. Anejos del Archivo Español de Arqueología XXXII. Consejo Superior de Investigaciones Científicas, Madrid, pp. 405–415.

Boomert, A., 2000. Trinidad, Tobago and the Lower Orinoco Interaction Sphere: An Archaeological/Ethnohistorical Study. Cairi Publications, Alkmaar.

Bouchard, J.F., Guerra, M.F., 2009. Archéologie précolombienne et analyses scientifiques: la figurine d'El Angel, une œuvre composite d'orfèvrerie de la culture La Tolita–Tumaco (Equateur – Colombie). ArcheoSciences – Revue. d'Archéométrie 33, 273–280.

Bray, W., 1997. Metallurgy and anthropology: two studies from Prehispanic America. Boletín del Museo del Oro 42, 37–55.

Chanlatte Baik, L.A., 1977. Primer adorno corporal (nariguera) en la arqueología indoantillana. Museo del Hombre Dominicano and Fundación García-Arévalo, Santo Domingo.

Chapman, R.J., Mortensen, J.K., 2006. Application of microchemical characterization of placer gold grains to exploration for epithermal gold mineralization in regions of poor exposure. Journal of Geochemical Exploration 91, 1–26.

Cockrell, B., Martinón-Torres, M., Graham, E., in press. Negotiating a colonial Maya identity. In: Proceedings of the 38th International Symposium on Archaeometry, Tampa, Florida, 10–14 May 2010.

Columbus, C., 1961. Diario de Navegación. Comisión Nacional Cubana de la UNESCO, La Habana.

Cooke, R., Bray, W., 1985. The goldwork of Panama: an iconographic and chronological perspective. In: Jones, J. (Ed.), The Art of Precolumbian Gold: The Jan Mitchell Collection. Weidenfeld and Nicolson, London, pp. 35–45.

Cooke, R., Isaza, I., Griggs, J., Desjardins, B., Sánchez, L.A., 2003. Who crafted, exchanged, and displayed gold in pre-columbian Panama? In: Quilter, J., Hoopes, J.W. (Eds.), Gold and Power in Ancient Costa Rica, Panama, and Colombia. Harvard University, Washington, DC, pp. 145–158.

Cooper, J., Martinón-Torres, M., Valcárcel Rojas, R., 2008. American gold and European brass: metal objects and indigenous values in the cemetery of El Chorro de Maíta, Cuba. In: Hofman, C.L., Hoogland, M.L.P., Van Gijn, A. (Eds.), Crossing the Borders: New Methods and Techniques in the Study of Material Culture in the Caribbean. University of Alabama Press, Tuscaloosa, pp. 34–42.

Deagan, K., 2004. Reconsidering Taíno social dynamics after Spanish conquest: gender and class in culture contact studies. American Antiquity 69, 597–626.

Díaz-Martínez, R., Proenza, J.A., Comas, J., Fernández-Bellon, O., Fabra, J.M., Guinart, O., Melgarejo, J.C., 1998. El placer lateral de playa Mejías (noreste de Cuba Oriental): un ejemplo de interacción de procesos aluviales y marinos en la concentración de minerales de elementos preciosos. Acta Geológica Hispánica 33, 351–371.

Ehrhardt, K.L., 2005. European Metals in Native Hands: Rethinking the Dynamics of Technological Change. University of Alabama Press, Tuscaloosa, pp. 1640–1683.

Escobar, G., 1994. Orejera de filigrana en un naufragio del siglo XVI. Boletín del Museo del Oro 37, 104–106.

Falchetti, A.M., 1995. El Oro del Gran Zenú. Metalurgia prehispánica en las llanuras del Caribe colombiano. Banco de la República, Museo del Oro, Bogotá.

Falchetti, A.M., 1999. El poder simbólico de los metales: la tumbaga y las transformaciones metalúrgicas. Boletín de Arqueología 14, 53–82.

Fernández de Oviedo, y Valdés, G., 1851. Historia General y Natural de Las Indias, Islas y Tierra Firme de la Mar Océano, vol. 1. Imprenta de la Real Academia de la Historia, Madrid.

Guerra, M.F., 2004. The circulation of South American precious metals in Brazil in the end of the 17th century. Journal of Archaeological Science 31, 1225–1236.

Guerra, M.F., Calligaro, T., Perea, A., 2007. The treasure of Guarrazar: tracing the gold supplies in the Visigothic Iberian Peninsula. Archaeometry 49, 53–74.

Guerra, M.F., Calligaro, T., 2003. Gold cultural heritage objects: a review of studies of provenance and manufacturing technologies. Measurement Science and Technology 14, 1527–1537.

Giraldo, S., 2010. Lords of the Snowy Ranges: Politics, Place, and Landscape Transformation in Two Tairona Towns in the Sierra Nevada de Santa Marta, Colombia. Unpublished PhD Dissertation, University of Chicago.

Gosden, C., Marshall, Y., 1999. The cultural biography of objects. World Archaeology 31, 169–178.

Guarch Delmonte, J.M., 1996. La muerte en Las Antillas: Cuba. El Caribe Arqueológico 1, 12–25.

Harrison, A., Beauvien, H.F., 2010. Bringing context to the Smithsonian collections of Precolumbian gold from Panama through technical examination and analysis. In: Mardikian, P., Chemello, C., Watters, C., Hull, P. (Eds.), Metal 2010. International Conference on Metals Conservation (Charleston, South Carolina, 11–15 October 2010). Clemson University, Clemson, South Carolina, pp. 198–203.

Helms, M.W., 1987. Art styles and interaction spheres in Central America and the Caribbean: polished black wood in the Greather Antilles. In: Drennan, R.D., Uribe, C.A. (Eds.), Chiefdoms in the Americas. University Press of America, Boston, pp. 67–83.

Holtorf, C., 2002. Notes on the life history of a pot sherd. Journal of Material Culture 7, 49–71.

Hosler, D., 1994. The Sounds and Colors of Power: Sacred Metallurgical Technology of Ancient West Mexico. MIT Press, Cambridge, Mass.

Hough, R.M., Butt, C.R.M., Fischner-Bühner, J., 2009. The crystallography, metallography and composition of gold. Elements 5, 297–302.

Hulme, P., 1992. Colonial Encounters: Europe and the Native Caribbean, 1492–1797. Routledge, London.

Las Casas, B.de, 1875. Historia de Las Indias, vol. 5. Imprenta de Miguel Ginesta, Madrid.

Lee, J.W., 1985. A pre-Columbian gold artifact from Jamaica. In: Allaire, L., Mayer, F.M., (Eds.), Proceedings of the Tenth International Congress for the Study of the Pre-columbian Cultures of the Lesser Antilles, Centre de Recherches Caraïbes, Université de Montréal, Montreal, pp. 343–345.

Lovén, S., 1935. Origins of the Tainan Culture, West Indies. Elanders, Göteborg.

Martinón-Torres, M., Valcárcel Rojas, R., Cooper, J., Rehren, Th., 2007. Metals, microanalysis and meaning: a study of metal objects excavated from the indigenous cemetery of El Chorro de Maíta, Cuba. Journal of Archaeological Science 34, 194–204.

Maxwell, J.A., Campbell, J.L., Teesdale, W.J., 1989. The Guelph PIXE software package. Nuclear Instruments and Methods B 43, 218–230.

Mitchem, J.R., 1999. The East Florida Expeditions of Clarence Bloomfield Moore. University of Alabama Press, Tuscaloosa.

Meeks, N.D., Tite, M.S., 1980. The analysis of platinum-group element inclusions in gold. Journal of Archaeological Science 7, 267–275.

Oliver, J.R., 2000. Gold symbolism among Caribbean chiefdoms: of feathers, çibas and guanín power among Taíno elites. In: McEwan, C. (Ed.), Pre-Columbian Gold in South America: Technology Style and Iconography. British Museum Press, London, pp. 196–219.

Oliver, J.R., 2009a. Caciques and Cemí Idols. The Web Spun by Taíno Rulers between Hispaniola and Puerto Rico. The University of Alabama Press, Tuscaloosa.

Oliver, J.R., 2009b. El Universo Material y Espiritual de los Taínos. In: Oliver, J.R., McEwan, C., Gilberga, A.C. (Eds.), El Caribe Precolombino. Fray Ramón Pané y el Universo Taíno. Ministerio de Cultura. Museu Barbier-Mueller d'Art Precolombí. Fundación Caixa Galicia, Barcelona, pp. 137–201.

Paris, E., 2008. Metallurgy, Mayapan, and the postclassic Mesoamerican world system. Ancient Mesoamerica 19, 43–66.

Peñuelas, G., Contreras, J., Ruvalcaba, J.L., Hernández, E., Ortiz, E., 2011. Non destructive in situ analysis of gold and silver artifacts from Tomb 7 of Monte Alban, Oaxaca, Mexico. In: Turbanti-Memmi, I. (Ed), Proceedings of the 37th International Symposium on Archaeometry, Siena, Italy, 13–16th May 2008. Springer, Berlin, pp. 623–627.

Ponting, M., 2002. Keeping up with the Romans? Romanisation and copper alloys in First Revolt Palestine. Institute for Archaeo-Metallurgical Studies Newsletter (IAMS) 22, 3–6.

Rodríguez Ramos, R., 2010. Rethinking Puerto Rican Precolonial History. The University of Alabama Press, Tuscaloosa.

Rodríguez Ramos, R., Pagán Jiménez, J.R., 2007. Las Antillas en el contexto circun-caribe: cincuenta años después. In: Reid, B., Roget, H.P., Curet, A. (Eds.), Proceedings of the Twenty-First Congress of the International Association for Caribbean Archaeology, vol. 2, University of West Indies, St. Augustine, pp. 778–784.

Rouse, I., 1992. The Taínos. Rise and Decline of the People Who Greeted Columbus. Yale University Press, New Haven.

Sáenz Samper, J., 2001. Las águilas doradas: más allá de las fronteras y del tiempo. El motivo de las aves con alas desplegadas en la orfebrería tairona. Boletín del Museo del Oro 48, 38–65, Banco de la República, Bogotá. <http://www.banrep.gov.co/museo/esp/boletin> (accessed 14.03.11).

Sáenz Samper, J., 2007. Continuidad y Cambio en La Sierra Nevada de Santa Marta. Una visión a través de la orfebrería. In: Lleras, R. (Ed.), Metalurgia en la América Antigua. Teoría, arqueología y tecnología de los metales prehispánicos. Fundación de Investigaciones Arqueológicas Nacionales Banco de la República. Instituto Francés de Estudios Andinos, Bogotá, pp. 179–211.

Sáenz Samper, J., 2010. Engraved in Metal: Goldworking Technologies at the Sierra Nevada de Santa Marta, Colombia. From Nahuange to Tairona. AD 100–AD 1600. Unpublished MSc Dissertation, Institute of Archaeology, University College London.

Scott, D., 1982. Pre-hispanic Colombian Metallurgy: Studies of Some Gold and Platinum Alloys. Unpublished PhD Dissertation, University of London, Institute of Archaeology.
Scott, D., 1998. Technical examination of ancient South American metals: some examples from Colombia, Peru and Argentina. Boletín Museo del Oro 44–45, 79–115.
Scott, D., Bray, W., 1980. Ancient platinum technology in South America, its use by the Indians in pre-Hispanic times. Platinum Metals Review 24, 147–157.
Scott, D., Bray, W., 1994. Pre-Hispanic platinum alloys: their composition and use in Ecuador and Colombia. In: Scott. D.A., Meyers, P. (Eds.), Archaeometry of Pre-Columbian Sites and Artifacts (Proceedings of a Symposium Organised by UCLA Institute of Archaeology and the Getty Conservation Institute, March 1992). The J.P. Getty Trust, Los Angeles, pp. 285–322.
Siegel, P.E., Severin, K.P., 1993. The first documented prehistoric gold–copper alloy artefact from the West Indies. Journal of Archaeological Science 20, 67–79.
Simmons, S., Pendergast, D.M., Graham, E., 2009. The context and significance of copper artifacts in Postclassic end Early Historic Lamanai, Belize. Journal of Field Archaeology 34, 57–75.
Sued-Badillo, J., 1979. La Mujer Indígena y su Sociedad. Editorial Antillana, Río Piedras, Puerto Rico.
Szaszdi Nagy, A., 1982. Las rutas del comercio prehispánicas de los metales. Cuadernos Prehispánicos 10, 5–132.
Szaszdi Nagy, A., 1984. Un mundo que descubrió Colón. Las rutas del comercio prehispánico de los metales. Publicaciones de La Casa-Museo de Colón and Seminario Americanista de la Universidad de Valladolid, Valladolid.
Uribe, M.A., 2005. Mujeres, calabazos, brillo y tumbaga. Símbolos de vida y transformación en la orfebrería Quimbaya Temprana. Boletín de Antropología Universidad de Antioquia 19(36), 61–93.
Uribe, M.A., in press. De los análisis químicos al significado: un estudio de materiales y elecciones en la orfebrería muisca. Fundación de Investigaciones Arqueológicas Nacionales del Banco de la República, Bogotá.
Uribe, M.A., Martinón-Torres, M., 2012. Composition, colour and context in Muisca votive metalwork (Colombia, AD 600–1800). Antiquity 86.
Valcárcel Rojas, R., 2008. Las sociedades agricultoras ceramistas en Cuba. Una mirada desde los datos arqueológicos y etnohistóricos. El Caribe Arqueológico 11, 2–19.
Valcárcel Rojas, R., Martinón-Torres, M., in press. Metals and indigenous societies in the Caribbean islands. In: Keegan, W.F., Hofman, C.L., Rodríguez Ramos, R. (Eds.), Oxford Handbook of Caribbean Archaeology. Oxford University Press, Oxford.
Valcárcel Rojas, R., Martinón-Torres, M., Cooper, J., Rehren, Th., 2007. Oro, guanines y latón. Metales en contextos aborígenes de Cuba. El Caribe Arqueológico 10, 116–131.
Valcárcel Rojas, R., Martinón-Torres, M., Cooper, J., Rehren, Th., 2010. Turey treasure in the Caribbean. In: Kepecs, S., Curet, A., de la Rosa, G. (Eds.), Beyond the Blockade: New Currents in Cuban Archaeology. University of Alabama Press, Tuscaloosa, pp. 106–125.
Vega, B., 1979. Los metales y los aborígenes de La Hispaniola. Museo del Hombre Dominicano and Fundación García-Arevalo, Santo Domingo.
Velázquez, D., 1973. Relación o extracto de una carta que escribió Diego Velázquez, Teniente de Gobernador de la Isla Fernandina (Cuba) a S.A. sobre el gobierno de ella. Año de 1514. In: Pichardo, H. (Ed.), Documentos para la Historia de Cuba, vol. 1. Editorial de Ciencias Sociales, La Habana, p. 78.
Veloz Maggiolo, M., Angulo Valdés, C., 1981. La aparición de un ídolo de tres puntas en la Tradición Malambo (Colombia). Huellas: Revista de la Universidad del Norte 4, 1–8.
Wagner, E., Shubert, C., 1972. Prehispanic workshop of Serpentinite Artifacts, Venezuelan andes, and possible raw material sources. Science 175, 888–890.
Whitehead, N.L., 1990. The Mazaruni pectoral: a golden artefact discovered in Guyana and the historical sources concerning native metallurgy in the Caribbean, Orinoco and Northern Amazonia. Journal of Archaeology and Anthropology 7, 19–38.
Wild, K.S., 1999. Investigations of a 'Caney' at Cinnamon Bay, St. John and social ideology in the Virgin Islands as reflected in pre-Columbian ceramics. In: Proceedings of the XVIIIth Congress of the International Association Caribbean Archeology (Grenada, 1999), vol. 2, Guadeloupe, pp. 304–310.
Wilson, S., 1990. Hispaniola: Caribbean Chiefdoms in the Age of Columbus. University of Alabama Press, Tuscaloosa.