Indigenous adornment in the circum-Caribbean: The production, use, and exchange of bodily ornaments through the lenses of the microscope

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Title: Indigenous adornment in the circum-Caribbean: The production, use, and exchange of bodily ornaments through the lenses of the microscope
Issue date: 2020-03-26

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Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof.mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op donderdag 26 Maart 2020
klokke 11:15 uur

door

Catarina Guzzo Falci

geboren te Governador Valadares, Brazilië
in 1990

Promotoren:
Prof. dr. C.L. Hofman (Universiteit Leiden)
Prof. dr. A.L. van Gijn (Universiteit Leiden)

Overige leden:
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This research has been funded by the NWO Spinoza Prize awarded to Prof. dr. Hofman in 2014 (Nederlandse Organisatie voor Wetenschappelijk Onderzoek). It has also received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ERC grant agreement n° 319209. The research presented in Chapter 3 has been funded by the *Bourse d'étude pour la documentation des collections 2016–2017* of the Musée du quai Branly awarded to C. Guzzo Falci in 2017.

Dit proefschrift volgt de Ethische Code van Universiteit Leiden.

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Introduction

Bodily adornment was extremely varied and ubiquitous among the indigenous communities of the pre-colonial Caribbean, as noted in both ethnohistoric sources and archaeological collections (*e.g.*, Alegría 1995; Fewkes 1903; Las Casas 1992; Lóven 1935; Petitjean Roget 1963). Body modifications, body paint, hairstyles, tattooing, and the addition of objects to the surface of the body can be encompassed under this general category. However, when it comes to most Caribbean archaeological contexts, only a portion of this last group is commonly recovered. A range of non-perishable artefacts that would have been attached to bodies, such as beads, pendants, plaques, ear spools, and plugs, have been recovered from contexts associated to the Ceramic Age (400 BC – ca. AD 1500). At certain moments during this long time period, such artefacts have not only been produced and used in large numbers, but, most notably, have also been circulated across large distances (Boomert 1987; 2000; 2001a; 2001b; 2007; Cody 1993; Hofman et al. 2007; 2014; Laffoon et al. 2014; Martinón-Torres et al. 2012; Mol 2007; 2014; Narganes Storde 2005; Rodríguez 1993; Rodríguez Ramos 2010a; 2010b; 2011; 2013; Serrand and Cummings 2014; Watters 1997; Watters and Scaglion 1994). Ornaments exhumed from Caribbean archaeological sites are now incorporated in many collections and museum displays across the globe. In these new settings, individual beads are often assembled together with strings or glue in aesthetically pleasing compositions that are at least partially based on analogies with indigenous material culture from the lowlands of South America. While engaging, such reconstructions run the risk of constraining the potential of these artefacts to provide us with insights on the Caribbean past.

The importance of researching collections that have been previously excavated and are now housed in institutional repositories is being increasingly stressed worldwide. A plea for the generation of new data from “old” materials has surfaced around discussions of the “curation crisis” and “legacy collections” (Frieman and Janz 2018; King 2016; Merriman and Swain 1999). Repositories worldwide harbour understudied collections, excavated at different points in time by both archaeologists and amateurs. Many of these have not been (extensively) described and investigated, lack (substantial) documentation, include potential forgeries or mislabelled items, and/or would profit from new theoretical and methodological developments in archaeology (Brody 2009; Frieman and Janz 2018; Gamble 2002; Guerra 2008; King 2016; Rodet et al. 2013; Woodward and Hunter 2015). Furthermore, even recently excavated collections become, to a certain degree, legacy collections when they enter a repository, as they no longer are under the custody of the investigator who exhumed them (King 2016, 7). The circum-Caribbean is no exception in this regard, with collections of diverse materials housed locally, in Europe, and in the United States (*e.g.*, Antczak et al. 2019; Díaz Peña 2004; Françozo and Strecker 2017; Françozo and Ordoñez 2019; Hardy 2009; Hicks and Cooper 2013; Siegel 2009; Watters and Brown 2001; Watters and Scaglion 1994). Furthermore, Caribbean archaeological material culture is not only housed in institutional repositories, such as museums, but is also in the possession of individuals as private collections.

Despite the regional abundance of ornaments and the interest they have raised, analytical approaches have not been given priority in ornament research in the Caribbean (see section 1.1). As a result, ornaments remain a poorly understood artefact category. The goal of this dissertation is, therefore, to provide new insights concerning the circulation, production, and use of bodily ornaments in the Caribbean. This will be done through the detailed study of assemblages of ornaments from key time periods in the archipelago. Three main research questions will be posed to ornament assemblages from the region:

1. What are the patterns in the ways ornaments were dealt with in each time period?
2. How do such patterns relate to the social roles these objects had?
3. What are the new insights given by a focus on technology and use to our understanding of exchange patterns and the social mechanisms responsible for them?

In order to accomplish this, it is necessary to set out another goal: to devise a strategy for the study of collections of ornaments from diverse origins. One is required to acknowledge the diverse ways in which collections have been and are being formed in the region. Collections have been and are still formed through both systematic archaeological research and unsystematic collecting.

More than requiring a single and specific protocol of actions, such collections demand flexibility and clarity regarding their potentials and limitations. One can identify a number of methodological and interpretative limitations that need to be taken into account during their study. Here we can include 1) extensive raw material and typological variability, 2) low numbers of production debris and associated tools, and 3) challenges with extrapolating from a single artefact (such as a bead) to an object that performed in a certain way in the past (for instance, a whole necklace). Other limitations are related to the lack of sufficient contextual information and to the complex trajectories artefacts undergo after they leave the ground. Devising a strategy to deal with such issues is not only relevant for the Caribbean region, as many limitations permeate the study of collections everywhere.

This chapter introduces the main themes and issues that will serve as threads connecting the individual components of this dissertation. We start with an overview of previous research on bodily adornment from the Ceramic Age Caribbean. The goal of this section is to highlight how ornaments have been integral elements in narratives about socio-cultural interaction and socio-political organization. In particular, focus is given to two time periods in which ornaments were produced in large numbers and exchanged between different islands. Such review will allow us to single out gaps in knowledge that will be addressed by the present research. In order to create a framework for this investigation, we delve into what ornaments are and what kinds of social roles they could have held in the following section. The concept of artefact biographies is introduced as an approach for making sense of the multiple life stages ornaments are engaged in both as individual artefacts and composite constructions. Microwear analysis is then proposed as a method for investigating ornaments, having as basis previous research carried out worldwide. Finally, the outline of the dissertation is explained and the goals of each chapter are made clear.

1.1. Bodily ornaments in Caribbean archaeology

The exchange patterns, sociopolitical organization, and worldview of past Antillean societies have often been interpreted by analogy with indigenous communities from lowland South America (*e.g.*, Boomert 1987; 2001a; 2001b; Rodríguez 1997; Roe 1989; 1997; Siegel 1997; 2010). The location of the Antillean archipelago in relation to surrounding continental masses is shown in Figure 1. These researchers have favoured such connections on the basis of the purported Orinocan origin of Saladoid communities that occupied the islands, as proposed on the traditional culture-historical schemes put forward by Irving Rouse (1986; 1992). It was posited that, from 500 BC, migration waves of Saladoid peoples would have replaced the Archaic Age populations that occupied the islands. This would mark the beginning of the Ceramic Age period, as these new people would bring with them ceramic making traditions and a horticultural lifestyle, accompanied by the settlement of semi-permanent villages (Rouse 1986; 1992). Over the centuries and through local developments, they would become the bearers of Ostionoid ceramics from the Greater Antilles, which would eventually develop incipient chiefdoms and would give origin to the so-called Taíno peoples met by the first Europeans to arrive to the Americas. As new research has been carried out, different aspects of this culture-historical trajectory have been debated and criticized from a number of standpoints (*e.g.*, Chanlatte-Baik 1983; 1987; Chanlatte-Baik and Narganes 1980; Keegan 2000; Rodríguez Ramos et al. 2008; Veloz Maggiolo et al. 1981). Researchers have challenged the cultural and stylistic boundaries traditionally defined in the discipline and the considerable focus previously given to migration and colonization as monotonic events (Curet 2005; Hauser and Curet 2011). The

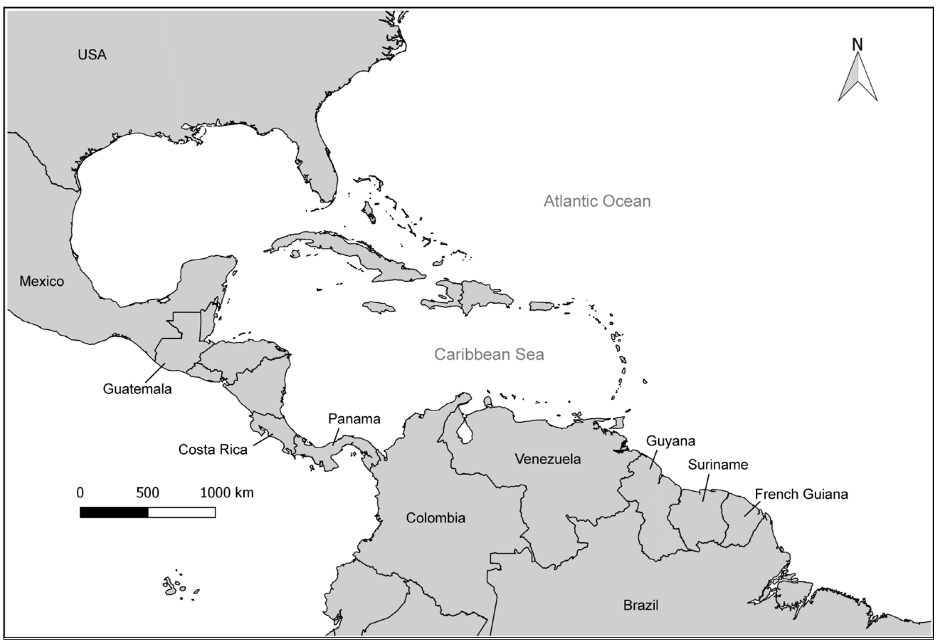

Figure 1: Geographical location of the circum-Caribbean in relation to South, Central, and North America.

Caribbean region is now seen as highly interconnected and ethnically diverse throughout its pre-colonial history (Hofman et al. 2007; 2010; 2011; Keegan and Hofman 2017; Mol 2014; Oliver 2009; Rodríguez Ramos 2010b; Rodríguez Ramos and Pagán Jiménez 2006; Wilson 1993; 2007; see also contributions in Curet and Hauser, eds. 2011 and in Hofman and Van Duijvenbode, eds. 2011). In this panorama, ornaments have often served as proxies for reconstructions of past Caribbean connectivity. Island-island and island-continent interactions have been suggested on the basis of the differential distribution of (exotic) goods and on the predominance of similar material culture over large areas. However, the specific social mechanisms responsible for the observed patterns of material translocation are still not fully understood (Curet and Hauser 2011, 7; Hofman et al. 2011).

1.1.1. Some thoughts on material exchange and social organization

More than half a century ago, it was argued that human economy is embedded in socio-political institutions (Polanyi 1957, 250). According to its supporting social structure, the circulation of materials in a given society can take place through different mechanisms or forms of integration, namely reciprocity, redistribution, and market exchange. Reciprocity would be characteristic of symmetrically organized groups, such as kinship groups. The exchange of social valuables or prestige goods has been argued to play an important role in small-scale stateless societies (Dalton 1977). It would be crucial in alliance building between corporate descent groups, having political, economic, and social functions concurrently. Notable among such social transactions are delayed-reciprocal ceremonial exchanges held in the context of feast celebrations and exclusively between group leaders. Amassing and distributing goods would be key factors in crafting a big man's personal success and in outranking potential competitors (Sahlins 1963). Success in ceremonial exchanges would play a role in the attaining and maintaining of political power in one's corporate group, at the same time as providing a big man with fame and renown to outsiders (Dalton 1977, 196; see also Boomert 2001b). In contrast, redistribution would involve movement of goods toward and from a (*e.g.*, political or religious) centre. One should note that Polanyi (1957, 256) stressed that such forms of integration are not stages of development, as no progression in time is implied and as certain societies are known to practice, to varying degrees, both reciprocity and redistribution (see also Ibáñez et al. 2016). Nevertheless, non-reciprocal modalities of material distribution have generally been connected to systems with institutionalized social hierarchies (Service 1971[1962]).

Abundant archaeological research has focused on evidencing the social patterns producing the translocation of materials in past societies, particularly in connection with the advance of scientific and statistical approaches afforded by processual archaeology (see contributions in Earle and Ericson 1977 and Ericson and Baugh 1993; also Hirth 1978; Hodder 1974; Ibáñez et al. 2016; Kirch 1988). Such efforts have replaced concerns with issues of migration and cultural diffusion that had previously occupied a prominent role in archaeological endeavours. Efforts have been made to explain patterns in artefact distribution across a given region according to specific models of exchange. For instance, reciprocal/symmetrical exchange would produce a down-the-line model, a pattern resulting from materials being passed down from hand to hand in transactions between neighbouring villages (Renfrew 1977, 77-79). As a result of this process, material distribution would follow the "law of monotonic decrement", according to which materials become rarer with increased distance from the supply zone. In contrast, when a certain location is supplied preferentially, a pattern of directional trade has been referred to (Renfrew 1977, 85). From such a location, i.e. a central place, goods would then be redistributed to neighbouring areas (see also Hirth 1978). This hierarchy of exchange would be reflective of a hierarchy between settlements or individuals. However, limitations have been pointed out in such models, particularly concerning the issue of equifinality (Hodder 1974; Renfrew 1977, 82-83). Furthermore, the presence or absence of a given raw material should not be considered in isolation from data concerning the technical states materials may be in and the different spheres of production they may belong to (Perlès 2007).

Craft specialization and the roles of material culture in legitimizing social hierarchies hold a persistent place in ornament research, due to the exoticness of raw materials used and to the high skill often involved in their production (Arnold and Munns 1994; Baysal 2013; Bellina 2014; Brumfiel and Earle 1987; Carter 2015; Kenoyer and Vidale 1992; Kenoyer et al. 1991; Miller 1996; Trubitt 2003; Watson et al. 2015; Zerboni et al. 2018). However, the large-scale production of lapidary materials and ceremonial artefacts need not to be connected to the presence of an emerging elite social stratum. As Spielmann (2002) highlights, communal rituals and feasts, which are intrinsic part of social life in small-scale and uncentralized societies, create considerable demand for food and for objects to be used in ritual performance and social transactions. Household-level production, in a context of community-wide specialization, can support large-scale demand for social valuables to be used in display and exchange. In this sense, Spielmann (2002) proposes the “ritual mode of production” as an alternative to the common explanations for production intensification and specialization: economic efficiency in face of uneven resource distribution or demand from aspiring and competitive elites.

In the following, previous efforts to understand the roles of Caribbean bodily adornment and to model its exchange are reviewed. It is not my goal to provide an exhaustive overview of such literature, but instead to provide context to the issues and case-studies that will later on occupy us in the present dissertation.

1.1.2. Profusely adorned: Lapidary materials in the early part of the Early Ceramic Age

Large-scale production of ornaments took place in workshops found throughout the Lesser Antilles and Puerto Rico during the earlier part of the Ceramic Age (400 BC – AD 400) (Figure 2; Bartone and Crock 1991; Boomert 2000; Cody 1991a; Chanlatte-Baik and Narganes 1980; Crock and Bartone 1998; Faber Morse 1989; Hofman et al. 2007; 2014; Murphy et al. 2000; Narganes Storde

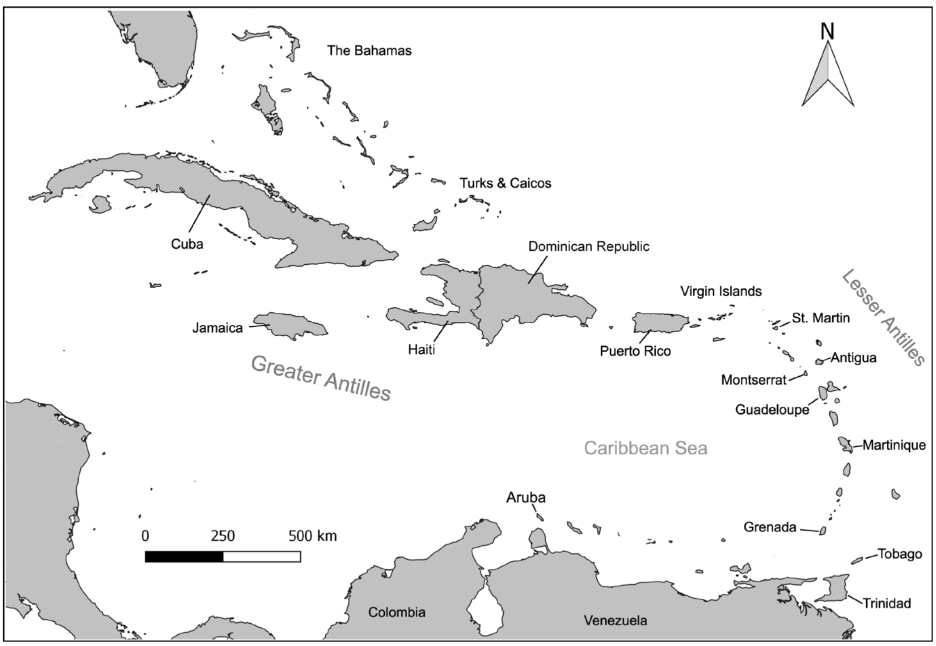

Figure 2: Map of the Caribbean.

1999; Rodríguez 1991; Vescelius and Robinson 1979; Watters 1997; Watters and Scaglion 1994). Workshop sites have been identified by the abundance of lapidary remains, in particular unfinished ornaments, flaking debris, and raw materials. Beads and pendants made of a range of raw materials were produced, especially of hard and semi-precious minerals and rocks (see Chapter 4 for an overview of previous studies and the potential geological sources). Further evidence for the circulation of ornaments comes from freshwater mussel shells (Unionoida) and perforated mammal teeth, whose origins have been traced to northern South America and/or lower Central America (Laffoon et al. 2014; Narganes Storde 2005; Serrand and Cummings 2014; Vescelius and Robinson 1979). Raw materials and finished products were exchanged between different islands, probably as high prestige valuables (Boomert 2000; 2001b). For instance, carnelian from Antigua, together with other lithic resources (Long Island flint, St. Martin mudstone, and Puerto Rican serpentinite), was entangled in exchange networks connecting the northeastern Caribbean (Hofman et al. 2007; 2014; Knippenberg 2007; Mol 2014). These carnelian beads were also exchanged for amethyst specimens produced in the southern island of Grenada (Cody 1991a; 1991b; Watters 1997). Connections of even greater distances have been suggested: similarities were noted between pendants from Puerto Rico and the Isthmo-Colombian region in terms of iconography and raw material (Rodríguez Ramos 2010a; 2010b; 2011; 2013). However, the jadeitite used for the Antillean artefacts has not been definitely linked to the Guatemalan sources used for Costa Rican specimens (Garcia-Casco et al. 2013; Harlow et al. 2006; Schertl et al. 2019).

The most systematic investigation of exchange patterns in the region through material and technological variability has been carried out by Knippenberg (2007), who examined the mechanisms behind the circulation of lithic materials in the northeastern Caribbean (from Puerto Rico to Martinique). His work focused on how the distribution of three materials, namely Long Island flint, St. Martin mudstone, and calci-rudite, evolved from the beginning of the Early Ceramic Age to the end of the Late Ceramic Age. Based on the study of the assemblages from several sites, Knippenberg (2007) created fall-off graphs illustrating the percentage of materials in the studied region in relation to their geological source, and distribution maps, which show the extent of the interaction networks across the region. Materials used in ornament production were also taken into account. Particularly, it was argued that lapidary materials were distributed within the same exchange networks as flint and mudstone during the Early Ceramic A (400 BC – AD 400). This would have involved the long distance distribution of rocks, alongside other items, through down-the-line exchange between communities in a context in which the islands were still limitedly occupied.

The long distance connections between the Early Ceramic Age communities with those on the surrounding continental masses (in particular, South America) has been explained through a "lifeline" or "homeland" model (Hofman et al. 2007; 2011; Keegan 2004; Watters 1997). This model, originally proposed for the Lapita cultural complex of the Pacific, sees long-distance exchange of prestige items as a formal mechanism for the maintenance of ties with homeland communities (Kirch 1988). The continuation of regular contacts with parent communities would provide demographic, ecological, and economic safety to colonizing groups faced with uncertainties associated with the occupation of previously unknown and still-sparsely occupied islands. At the same time, we should not overlook the presence of Archaic Age occupations on many islands during the first centuries of this period (until ca. AD 100). Huecoid/Saladoid communities exploited the same flint sources as the Archaic Age populations and are very likely to have interacted on different levels (Hofman et al. 2011; 2014; 2019; Rodríguez Ramos 2010a).

Material specialization and control over the sources of certain lithic materials would have supported the competitive exchange and display of valuables by big men in ceremonial intercommunity feasting (Boomert 2000; 2001b; Hofman et al. 2014; 2019; Mol 2014). In this sense, large settlements were located next to key geological sources, such as those of Antiguan carnelian and Puerto Rican serpentinite. These sites, operating as regional social hubs, also functioned as lapidary producing communities. However, such reconstructions have focused primarily on the northeastern Caribbean islands. On the southern Caribbean, the site of Pearls on the island of Grenada was a large settlement that functioned as lapidary workshop. In contrast to the aforementioned researchers, Cody (1991a; 1993), who investigated the site, has supported a more hierarchical view of Early Ceramic Age communities. Pearls would represent a gateway community, as it was situated in a key locale for controlling the movement of goods (notably amethyst) between South America and the islands (Cody 1991a; 1993, 210). The strategic location of gateway communities would allow for a reduction in transportation costs related to the acquisition of exotic resources to be redistributed to “hinterland” (consuming) communities (Hirth 1978). This would guarantee a secure supply of goods and would allow the gateway community to assume a hierarchical place in a long distance exchange network. Cody (1991a; 1993) further connected this to the centralization of power by elite groups, who controlled the manufacture of prestige goods; the exchange of such goods would reinforce their status and serve for the formation of alliances. Evidence for this would be found in the intra-site differential distribution of valuables (i.e. ceremonial ceramics and lapidary materials), the investment in the production of such items, and the symbolism of the zoomorphic beings depicted on them; such elements would be supportive of elite ideology. However, one may wonder if it makes sense to import such a hierarchical model from Mesoamerica to the Early Ceramic Age Caribbean, especially as the assemblages of the Pearls site remain understudied. Previous studies of collections of lapidary materials from this site have focused on typological classification and geological identification (Boomert 2007; Cody 1991a). Technological studies, which would be crucial for assessing many of such issues, are still missing.

1.1.3. Beads of the cacique? Ornaments in the later part of the Late Ceramic Age

In the subsequent periods (AD 400 – ca. 1500), beads and pendants still circulated across the Caribbean Sea, but the spheres of interaction were reduced in extent and widely available local raw materials were predominant (Hofman et al. 2007; 2011; Knippenberg 2007; Rodríguez Ramos 2010a, 175-176). Exchange networks involving rock materials become more localized, which is hypothesised to correspond to changes in socio-political organization and in orientation of the social relationships established between different communities (Knippenberg 2007). In contrast to the Early Ceramic Age, in which many exchanged lapidary materials are unequally distributed across the region, the ornament materials used in later periods are often available across the archipelago, thus rendering it more difficult to reconstruct potential networks of ornament circulation (see Chapter 5; Boomert and Rogers 2007; Hofman et al. 2007; 2011, 82; Knippenberg 2007). Marine shells, calcite, and diorite are commonly recovered from archaeological sites across the archipelago (Berman 2011; Blick et al. 2010; Boomert and Rogers 2007; Lammers-Keijsers 2007; Serrand 1997; 2007).

It has been argued that the Late Ceramic Age period (AD 600/800 – ca.

1500) sees the development of greater social complexity in the form of incipient chiefdoms (*cacicazgos*) in the Greater Antilles (Curet 1996; 2014; Keegan 2013; Keegan and Hofman 2017, 11-14; Rouse 1992; Siegel 2010; Wilson 2007). This is particularly expressed in Chican Ostionoid ceramics and other representational material culture (from AD 1200), often connected to the "Classic Taíno" peoples met by the Spaniards (Rouse 1992, 33-34; also Arrom 1975; Bercht et al., eds. 1997; Keegan 2013). The exchange of "Taíno"-like ritual paraphernalia would have taken place in connection with the regional formalization of a ritual grammar across the Greater Antilles and northern Lesser Antilles (Hofman 2013; Hofman et al. 2008; 2011, 82-82; Hofman and Hoogland 2011; Hoogland and Hofman 1999; Rodríguez Ramos 2010a, 197-198). The increase in the numbers of conspicuous ritual artefacts and spaces, as opposed to that of more personal items like bodily ornaments, has been argued to be connected to the greater importance of the public display of power in ceremonial events (Curet 1996; Helms 1987; Rodríguez Ramos 2010a, 198; Roe 1989). This includes intricately carved items such as stone collars, elbow stones, stone three-pointers, and shell ornaments depicting faces (*guaízas*). Whereas the evidence for three-pointer exchange is based on the occurrence of specimens in raw materials exotic to the region/island where they were found (Breukel 2013; Knippenberg 2007; Rodríguez Ramos 2010a, 198), *guaízas* are believed to have been exchanged due to their iconographic distinctiveness and rarity (Mol 2007; 2011; 2014).

At the same time, bodily adornment has been argued to be a crucial aspect of the display and enactment of the supernatural and political power of the *cacique* (Oliver 2000; see complete review in Chapter 5). Ornaments are also thought to have been produced in large numbers as products of specialized workshops and exchanged as part of social transactions between elite groups (Las Casas 1992, 611, 1288; Lóven 1935). However, the archaeological evidence for their specialized production and exchange is not easily traceable. An exception is found in the Turks and Caicos islands, where marine shell beads, notably small beads used for embroidery ("seed beads"), were produced in large numbers in specialized workshops; they would have arguably been commissioned by an elite from the Greater Antilles (Carlson 1995; Littman and Keegan 1991). It has further been argued that, as products of elite wealth, they would be kept in cacical storehouses, where they could be integrated into valuable composite artefacts or be redistributed as gifts (Ostapkowicz 2018; see also Mol 2007, 86-87). In turn, lithic ornaments recovered from sites in the Bahamas archipelago are hypothesised to be trade items, as diorite and quartz sources cannot be locally found (Berman 2011). Beads and pendants made of lithic materials are indeed known to occur widely across the Greater Antilles, as abundantly illustrated in a number of publications (Arrom 1975; Fewkes 1903; 1922; Knight 2017). Bodily ornaments have also been recovered in caches in Puerto Rico and the Dominican Republic. From the former, a ceramic bowl with hundreds of beads has been recovered from a burial plaza in Utuado (Fewkes 2009 [1907]) and a wooden bowl containing a necklace with indigenous ornaments and European glass beads has been found in Quebradillas (Ostapkowicz 2018; Ostapkowicz et al. 2012). A similar find was made from a rock shelter in El Variar, southern Dominican Republic (Ortega 2005; Ortega and Fondeour 1976; also Keehnen 2019). It included two ceramic bowls with 262 stone beads, 89 shell beads, two anthropomorphic pendants, and four metal beads and pendants. Another find from a rock shelter comes from Sabana Yegua in San Juan de Maguana, on the centre-west of the Dominican Republic (Vega 1979, 11-13). It consisted of abundant European material alongside three stone necklaces, three pendants, and two amber earplugs. In Manantial El Cabo San Rafael, a rock shelter on the eastern tip of the island, another cache has been found with approximately 4000 perforated dog and seal teeth, some of which with decorative carvings (Ortega 2005, 115-116; Samson 2010, 103-104). Based on this combined evidence, it can be hypothesized that there was an increase in the production and circulation of ornaments made of different raw materials in this period. However, apart from the aforementioned studies of shell beads and others focused on gold and *guanín* (Cooper et al. 2008; Martinón-Torres et al. 2012; Valcárcel Rojas et al. 2007), little research has focused on ornaments from the period.

1.1.4. Research gap and case-studies

The present dissertation will be conducted against this background of research regarding periods of increase in production and exchange of bodily adornment in the Caribbean archipelago. The two main case-studies that will concern us are the early part of the Early Ceramic Age in the eastern Caribbean and the later part of the Late Ceramic Age in the Greater Antilles. The two periods highlighted here have been previously regarded as two “climaxes” in the culture-historical development of the pre-colonial Caribbean separated by a “dark age”, in particular in what concerns ceramic styles and so-called ceremonial art (Rouse 1982, 52; for critiques, see Curet 1996 and Oliver 2009). However, this is not the intention or the approach advocated here. As mentioned previously, this view of Caribbean pre-colonial history is an outdated one.[1] At the same time, the overview presented above shows that there is an overlap in the ways the ornaments from both periods have been interpreted: even though the models of socio-political organization differ, ornaments tend to be unanimously seen as social valuables produced by craft specialists and exchanged between competitive high-status individuals. In this sense, it remains unclear how the social mechanisms and corresponding archaeological patterns differ from one period to the other—even though the material remains themselves (raw materials and types) are notably different. While considerable archaeological attention has been placed on bodily adornment, research that systematically addresses material acquisition, production, use, and deposition of ornaments are scarce or more generally missing (for a more thorough review of this issue, see Falci 2015 and chapters 4 and 5). As the two case-studies selected refer to different regions and time periods, they will be addressed independently from each other in the next chapters. This independent attention will allow us to characterize in detail ornament-related practices that are specific to each context. Nevertheless, we should keep in mind that both case-studies are relatable as evolving patterns in long-term interaction networks that stretched across multiple islands of the archipelago.

1.2. What is in a bead? Theoretical approaches

The previous section has provided a review of hypotheses concerning the abundant presence of bodily adornment in the Ceramic Age Caribbean. We learned from previous research that ornaments functioned both as markers of political and supernatural power and as trade items—and that both functions cannot be entirely disassociated from each other. In other words, ornaments had at least two different roles over their lifetime. It is, therefore, our goal to assess the specific ways in which these roles were performed and how they differed between the Early and the Late Ceramic Age. For this purpose, it is necessary to build a framework through which these artefacts can be investigated.

Beads, pendants, and other artefacts interpreted to be ornaments have been intensively studied by archaeologists worldwide. Since the development

1 Furthermore, bodily ornaments from other time periods should be researched, such as Archaic-Age and early Ostionoid ornaments (for examples, see Rodríguez Ramos 2010a, 65-68, 175-176).

of archaeology as a discipline in the 19th century, the role of bodily adornment in past human societies has been regarded in different ways in connection with trends in the social sciences (notably, anthropology) and art history (Moro Abadía and Nowell 2015). Among others, they have been labelled minor art, decorative items, cosmetics, primitive money, amulets and talismans, identity and status markers, symbolic and communicative items. Perhaps as a result of the challenges in defining the cross-cultural "function" or "role" of ornaments (and, in a sense, justifying their research as a collective), finding an appropriate terminology to refer to this somewhat loosely defined group of "small finds" has also been a concern. Scholars discussing artefacts recovered from archaeological sites have focused on the terms such as personal adornment, ornament, and dress. Both *ornament* and *adornment* have been noted to be problematic terms, in that they imply a lack of practical function, a purely aesthetic role, and a positive value judgement (Moro Abadía and Nowell 2015; Roach-Higgins and Eicher 1992). *Dress* has been proposed as a less ethnocentric, value-charged, or ambiguous term; it conceptually groups under the same rubric direct modifications of and supplements added to the body (Eicher and Roach-Higgins 1992; Roach-Higgins and Eicher 1992). Without overlooking such concerns, I have opted for the words adornment and ornament as the most adequate way to collectively refer to the set of portable artefacts that will be studied here. The use of these terms strengthens the dialogue between the research being conducted here and other analytical archaeological research carried out on ornaments worldwide.

Following a structuralist tradition to the study of art (Lévi-Strauss 1963; Panofsky 1955), bodily adornment has been regarded as part of complex symbolic systems of meanings that have a communicative role in society (Wobst 1977). In this sense, crucial information concerning an individual's identity and group belonging would be broadcast to those around them through socially-regulated properties of adornment, such as raw material, design, colour, shape, volume, size, and the arrangement and position of components (Lévi-Strauss 1936; Loren 2009; 2010; Newell et al. 1990; Ribeiro 1988; Roach-Higgins and Eicher 1992; Seeger 1975; Turner 2012[1980]; Vidal, ed. 1992; White 1992; White and Beaudry 2008; Wobst 1977; Wright and Garrard 2003). The formal study of such strictly regulated patterns could thus provide insights into a society's underlying ideas and principles concerning personhood, social norms, and cosmology. As items attached to the bodies of people, ornaments are both personal and social, allowing for the active construction, performance, control, and manipulation of personal identity *vis-à-vis* the social groups one belongs to. A notable avenue in past bodily adornment research has focused on prehistoric archaeology of Eurasia and Oceania, particularly of the Paleolithic period (see, for instance, recent contributions in Bar-Yosef Mayer and Bosch 2019). In early human contexts, forms of dress are regarded as invaluable proxies to the study of: 1) the emergence of behavioural complexity connected to cognitive or environmental changes (Brumm et al. 2017; d'Errico et al. 2005; Gilligan 2010; Kuhn and Stiner 2007; Rifkin et al. 2015) and 2) prehistoric ethno-linguistic boundaries and identities (Newell et al. 1990; Rigaud et al. 2015; Vanhaeren and d'Errico 2006). The importance of investigating ornaments often made of hard animal materials (i.e. bones, teeth, ivory, claws, and shells) has thus been stressed on account of their symbolic function. It is within this research context that the use of wear-trace analysis of ornaments has developed and expanded, providing a new means of assessing how people from the past produced and used such items (d'Errico 1993a; 1993b; d'Errico et al. 1993; Taborin 1991; 1993; White 1992; 2002; 2007; see section 1.3). Researchers have thus used diverse analytical techniques to address issues such the anthropic and intentional nature of artefacts and the aesthetic, symbolic, or pragmatic function of certain practices. However, one must wonder whether this latter question retains its relevance outside of the field of human evolution and whether the dichotomy between the aesthetic, the symbolic, and the pragmatic (or, more generally, art and artefact) is relevant outside of modern Western society (a.o., Ingold 2001; 2013; Conneller 2004; Dobres 2001; 2010).

Representational and visual characteristics of ornaments have gained great scholarly attention. However, one should not overlook the fact that dress is more than *appearance*, as it has other properties through which it can be experienced, such as texture (touch), odour, and sound (Eicher and Roach-Higgins 1992, 14; Roach-Higgins and Eicher 1992). Furthermore, material culture does not just passively reflect meanings bestowed onto it by a thinking mind (Gosden 2005; Hodder 2011; Ingold 2001; 2013; Jones 2004; Knappett 2012; Olsen 2012; Pfaffenberger 2001). As Malafouris (2008, 408) argues: "instead of seeing early ornaments as existing for the self we should be seeing the self as emerging through the ornament". The human brain should be understood as intrinsically plastic, being moulded through its interaction with material culture. The body itself is not a purely biological entity to which cultural meanings and materials are added: it cannot be fully disassociated from the experiences, treatments, rituals, and practices that it has engaged in (Alberti 2012; Conklin 1996; Hamilakis et al. 2002; Joyce 2005; Rival 2005; Thomas 2002; Vilaça 2005; Warnier 2009). This becomes more evident when more permanent forms of body modification are considered. While somewhat elusive in the archaeological record, a number of studies have pursued evidence for such practices, for instance, studies on cranial modification (*e.g.*, Van Duijvenbode 2012), on the impact of the use of lip plugs on an individual's teeth (Cybulski 2001; Torres-Rouf 2012), or on proxies for past tattooing (Deter-Wolf and Peres 2013; Gates St-Pierre 2018). Mauss (1973[1935]), in his essay on the techniques of the body, argues that the habits of the body are transmitted from one generation to the next, being simultaneously mechanical, psychological, and sociological, regardless of how ordinary and innate they may seem (Mauss 1973[1935]). While bodily adornment is not considered a technique of the body, he does refer to "techniques of care for the body" (Mauss 1973[1935], 84) and to walking in particular types of shoes as a learned disposition (Mauss 1973[1935], 83).[2] In light of more recent theories of the body cited above, this brings an interesting thought to mind: ornament making certainly involves the use of multiple techniques and tools emerging from socially-mediated bodily dispositions (see next section); but one should not overlook the fact that forms of adornment are themselves makers of bodily habits (see Naji and Douny 2009; Warnier 2009). Therefore, bodily ornaments, hygiene, and other forms of bodily care and performance are inseparable as constitutive elements in the creation and maintenance of personhood and, more broadly, social life (Brück and Davies 2018; Choyke 2006; Loren 2010; Miller 2009; Santos-Granero 2012; Turner 2012[1980]; Walker 2009; Warnier 2009). This implies a shift in focus from the potential messages carried by inert ornaments to how artefacts were capable of action: they affected, mediated, and transformed past bodies and minds. Whereas this realization frees us from the conundrum of not being able to assess the meaning of bodily adornment in the past, it does leave us with many unanswered questions. In particular, our main questions remain: how to approach bodily ornaments recovered from archaeological sites? How can we assess the ways in which *specific* ornaments

2 Elsewhere, Mauss (1993[1947]) discusses body arts (cosmetics and ornaments) as forms of plastic arts, i.e. *techniques* marked by a pursuit for the aesthetic. Mauss (1973[1935]) defines a technique as traditional and efficacious action. Warnier (2009) notes that, even though scholars in the anthropology of techniques have taken this to exclusively mean action *on matter*, one should also consider action *on subjects*. As examples, he argues that ritual performance and skin care are technologies of the subject mediated by bodies, material culture, and words.

performed in *specific* past societies?

1.2.1. Status, career, and expectations: objects lead interesting lives

Despite their apparent lack of a pragmatic function, the diverse items that find themselves gathered in the adornment category may have performed multiple tasks: they may have created, unified, protected, reminded, empowered, or even subjugated people. More than labelling and "trapping" certain finds in a self-evident and somewhat static "personal adornment" category, it is important to acknowledge that their function, meaning, or agency are dependent on the archaeological contexts in which such artefacts have been produced, used, assembled, and, ultimately, found (Loren 2010, 10). For this reason, these attributions can also oscillate over the lifetime of such items. It is therefore our goal to inquire into these social lives led by objects (Appadurai 1986; Kopytoff 1986). Objects are expected to follow ideal "careers" in accordance with the social contexts they are part of, involving stages analogue to birth, life, and death (Kopytoff 1986). These pathways are intrinsically connected to their expected performance and perceived value or status.

Building onto the foundations first set out by Mauss (2003[1925]) in his *Essay on the Gift*, Kopytoff (1986) proposes that an object's status can be seen in a continuum that stretches from gift (sacred/inalienable) to commodity (profane/fully alienable). Through processes of singularization or commoditization, objects can undergo changes in status during their *biographies* as they oscillate between different spheres of circulation. These shifts are particularly striking in cases of culture contact, as materials leave their original social context and enter a new one where they are expected to perform in rather different ways. Examples can be found in mass produced European glass beads received in exchange by indigenous peoples of the Americas, who perceived them to be valuable and powerful items (*e.g.*, Keehnen 2012; 2019); and in indigenous material culture taken from source communities to be stored, catalogued, studied, and exhibited in Western museums (*e.g.*, Françozo 2012; Gosden and Marshall 1999; Grognet 2005). In both cases, items used as bodily adornment have been notable (albeit not sole) "currency" of exchange. Contemporary processes, such as the cultural appropriation of forms of traditional dress by the fashion industry, can likewise serve to illustrate the idea of commoditization as a process: "as one makes [things] worthy of being collected, one makes them valuable; and if they are valuable, they acquire a price and become a commodity and their singularity is to that extent undermined" (Kopytoff 1986, 81). In modern and contemporary case-studies, historical sources and ethnographic insights play an important role in tracking the regional or global circulation of object types and the corresponding changes in expectations surrounding them.

By reconstructing object biographies, we can assess how objects were entangled in the biographies of people (Gosden and Marshall 1999; Hoskins 1998; 2006). In other words, a biographical approach offers a framework to understand the ways in which objects were appropriated by social actors, who interacted with them and who attributed sets of meanings to them. However, no specific research method is implied by a biographical approach; this has led to varied applications across and within each discipline concerned with the study of material culture. When studying archaeological artefacts, any biographical pursuit must inquire into the properties of materials and into the stages that predate those in which the artefacts are found—since the archaeological context is only their final repository.[3] This is done by examining the qualities of objects and materials that demand and encourage action from humans (Gosden 2005; Hodder 2011; Jones 2004). Pursuing *artefact* biographies (Van Gijn 2010; 2012; Van Gijn and Wentink 2013) involves a focus on the materials themselves as means to seek answers. Archaeologists are well equipped to assess the changes artefacts undergo as a result of their successive life stages, as "[b]iographical information resides in the artefact, in the patina of age, wear and repair it acquires through its life" (Joy 2009, 545).

Archaeologists have indeed paid considerable attention to the life stages of artefacts, in particular by using an approach often referred to as the *chaîne opératoire*. This concept was originally proposed in francophone ethnology and archaeology and has since become an analytical tool for the understanding of technical processes (Balfet 1991; Cresswell 1983; Desrosiers 1991; Leroi-Gourhan 1993[1964]). This interest in technical sequences, gestures, and in bodily habits at large can be traced back to, among others, Mauss's (1973[1935]) essay on techniques of the body. The use of the *chaîne opératoire* in archaeology has involved the detailed study of entire assemblages of, *e.g.,* lithic remains recovered from archaeological sites (Bodu 1999; Cahen et al. 1980; Cahen and Karlin 1980; Inizan et al. 1999; Pelegrin 2000; 2005). Focus is not placed exclusively on (formal) tools to be classified into static typologies based on

3 That is, before they start their new careers as archaeological artefacts, museum objects, and their representations (Joyce and Gillespie 2015; Gosden and Marshall 1999).

their morphological or stylistic attributes. Instead, all remains are hierarchically organized according to their raw material and position in idealized operational sequences. These sequences of technical gestures and procedures would have had specific end-products, set as templates in the mind of the craftsperson (Pelegrin 1991). The recovered remains are thus understood as products of (technical) processes, rather than as fixed categories. The typical life stages of artefacts assessed in such manner can include raw material acquisition, production (itself divided in many successive stages: blank production, roughing-out, shaping, retouching, etc.), hafting, use, recycling, reuse, and discard (Cahen et al. 1980; Inizan et al. 1999; Wright 1992). The performance of technical operations, notably artefact production, is at the same time conservative and flexible: it involves individual skill and knowledge of materials, but follows socially-constrained procedures according to which materials can be successfully worked. In combination with experimental replications and contextual studies, such an approach has allowed researchers 1) to investigate processes of decision-making, knowledge transmission, and innovation (Cresswell 1983; Lemonnier 1993; Pelegrin 1991; 2005; Roux and Brill, eds. 2005; Tixier 1980) and 2) to understand how materials and resources were managed by prehistoric communities (Geneste 1992; Perlès 1980; 2007).

This understanding of the performance of techniques follows a social constructionist view of technology (*sensu* Killick 2004; Martinón-Torres and Killick 2015), according to which technological choices are not exclusively guided by material constraints, environmental conditions, pragmatism, or efficiency. Instead, the choices made from a pool of available alternatives are influenced by the socio-cultural context an individual was raised in and by what this person has been taught as the correct way of performing a given task (Cresswell 1983; Dobres 2010; Killick 2004; Lemonnier 1993; Pfaffenberger 1988; 1992; Sillar and Tite 2000). For this reason, a *chaîne opératoire* approach has also been regarded as providing an avenue into the social relationships and symbolism that shape and are shaped by craft practice (Dobres 2001; 2010; Farbstein 2011; Knappett 2012; Lemonnier 1993; Pfaffenberger 2001). Here I will use the *chaîne opératoire* approach to organize and make sense of the technological data gathered from the studied ornaments, such as techniques, tools, gestures, and sequences of production, alongside technical performance and technological choices. This data will constitute a key component of the ornament biographies that will be discussed in chapters 2, 4, and 5.

However, one must be aware of the limitations of the chosen approaches. In particular, pleas for a less mechanistic understanding of the life of objects have been made as a reaction to common assumptions in applications of the *chaîne opératoire* approach. The description and classification of material remains is arguably over-formalized and imposes an artificial linearity to the engagement of humans with materials, through the definition of discrete stages with clearly defined goals (Bar-Yosef and Van Peer 2009; Conneller 2006; Ingold 2013). Reconstructions have focused on an image of craft practice as the task of a single problem-solving individual. However, as Conneller (2006, 47) argues: "in practice *chaînes opératoires* are never individual, but always multiple, inter-connected networks of action". A compartmentalized treatment of past activities often fails to grasp how certain artefacts were integrated in composite objects or in complex (inter-, multi-, or cross-)craft systems (Brysbaert 2007; 2011; Miller 2007; Shimada 1996; Tsoraki 2011; Van Gijn 2012; Van Gijn et al. 2008). Furthermore, an economic perspective is often prioritized when building the life of an artefact as a linear construct that follows a strict sequence of stages towards a single end-product with a specific function. Objects have *use* lives that extend beyond any purely utilitarian expectations; for instance, they can also be handled, passed down from hand to hand, wrapped and unwrapped, hidden away, displayed, cleaned, or be treated with a variety of substances (Breukel 2013; Choyke 2006; 2010; d'Errico 1993b; Van Gijn 2014b; 2017; Van Gijn and Wentink 2013; Wentink 2006; see also Chapter 3). We should not regard these processes as mere aesthetic or curious additions to an artefact's "real function". By recording the trajectories undergone by artefacts, we are equipped to highlight departures from our expected "utilitarian" biographies. Likewise, assuming that all object lives have a birth/beginning and a death/end, as understood in analogy with human lives, is rather limiting (Hahn and Weiss 2013; Joyce and Gillespie 2015). This had led researchers to propose *itineraries* as a more dynamic way to frame the lives of objects and their "extraordinary changeability" (Hahn and Weiss 2013, 9; also Fontijn 2013). This can be also linked to a concern with acknowledging that matter is in a perpetual state of becoming (Joyce and Gillespie 2015; also Ingold 2007; 2013). Here I opted for retaining the term biography, but keeping in mind that it does not need to be a coherent narrative with a beginning and an end. An object biography narrative is often incomplete due to limitations intrinsic to archaeological data (Joy 2009, 544). Despite the perpetual continuity of the lives of matter and the intrinsic incompleteness of our reconstructions, a biographical approach can still be used to pursue a more holistic and relational view of how, throughout its life, an object is entangled in social interactions with other objects and humans. The biography metaphor will thus be used to provide a structuring framework with which we can make sense of the complex, dynamic, cyclical, and perhaps chaotic lives of objects.

1.2.2. No strings attached: pursuing the biographies of ornaments

Even if often found separated from each other in archaeological sites, beads and pendants were likely once connected to other components through string materials. The resulting objects (necklaces, belts, arm bands, and the like) are here collectively referred to as "composite ornaments"[4]. This often overlooked, but intrinsic characteristic of ornaments makes them particularly prone for having unexpected biographies, as aptly put in the following: "The integrity of a beaded dress ornament is as fragile as the material that holds it together […]. Anyone who wears beaded jewellery or clothing is aware of its precarious nature, and has left at one time or another a trail of sequins or beads that if sufficiently valued are gathered up and refabricated" (Cifarelli 2018, 53; see also Bigi and Vidale 2009). Fragmentation and transformations are thus recurrent in the lives of composite ornaments. This may not be exclusively the product of accidental breakages, but also may be connected to a deliberate desire 1) to refashion a piece once it has served its purpose, 2) to add a personal touch to an object prior to further exchange, or 3) to gather pieces with different biographies in a single (powerful or memory-laden) object (*e.g.*, Campbell 1983; Ewart 2012; Gaydarska et al. 2004; Van Gijn 2017; Wiessner 1982, 72; Walker 2009). This is because composite ornaments are assemblages of components, which are at a given point in time linked to each other. Despite the recurrent reassembly and reconstruction of archaeological necklaces as complete, symmetrical, and harmonious from a Western point of view, the individual components need not to have the same materials, colours, shapes, or even biographies (Frieman 2012; Woodward and Hunter 2015). Studying the biographies of individual components has allowed researchers to identify processes of fragmentation, singularization, and curation. For instance, objects may be removed from their typical life cycles, in order to be made into (parts of) something else. Through such processes, they can become "mnemonic devices" or "ancestor materials":

4 Examples of such objects are illustrated and discussed in Chapter 3.

new artefacts with a new role, but which are still reminiscent of their prior lives and their prior sets of meaning (Caple 2010; Cifarelli 2018; Jennings 2014; Loren 2009; Skeates 1995). The intergenerational circulation of ornaments as heirlooms has also been put forward on the basis of detailed artefact analysis (Choyke 2010; Van Gijn 2017; Woodward 2002; Woodward and Hunter 2015; see also Lillios 1999).

A biographical approach has often been used in the study of material exchange, particularly across different cultures. The capacities of a given object can be linked to its raw material and to its known or imagined origins. This can be illustrated by several case-studies from across the globe, such as ornaments made of skeletal materials (Chaumeil 2004; Choyke 2010), 18th-19th century remembrance hair jewellery (Holm 2004), and, more generally, exotic materials from faraway (Helms 1988). At the same time, the status of an object at any given time is a “state of being” (Lillios 1999, 243) dependent on the way it is regarded and dealt with by people (Fontijn 2013, 190-191; Stockhammer 2015). Nevertheless, the topic of exchange in archaeology has more often than not been addressed through studies that focus exclusively on the *transfer* of material. As Pollard and colleagues (2014) argue, a “simplistic view of provenance, with ‘instantaneous’ lines drawn from source to the final object, though objectively true, fails to engage with the rich life of the material beyond its first and last points” (Pollard et al. 2014, 627; see also Breukel 2019; Van Gijn and Wentink 2013). As argued above, this “rich life” can be assessed through the identification of processes such as technological modifications, fragmentation, curation, assemblage, and use (Brück and Davies 2018; Choyke 2006; Gaydarska et al. 2004; Perlès 2007; Sheridan and Davies 2012; Van Gijn 2017; Walker 2009; Woodward 2002; Woodward and Hunter 2015). For instance, we know from ethnographic accounts that composite ornaments acquired greater value depending on their specific histories of exchange and ownership, as visible on the surface of the objects themselves (Gosden and Marshall 1999; see references in Pollard et al. 2014, 628, and Spielmann 2002, 201). Practices of repolishing ornaments and groundstone celts upon receipt are also known archaeologically and ethnographically (Breukel 2019; Campbell 1983; Pétrequin and Pétrequin 2016). Researchers, therefore, need to also focus on elucidating what happens to a material after arrival and prior to (further) exchange. A purely quantitative assessment of the occurrence of exotic or presumably valuable materials cannot be sufficient for generating a comprehensive understanding of how materials were circulated and made active in the past. Artefacts must also be investigated from a qualitative perspective that can further elucidate human action leading to observed patterns in material distribution (Lillios 1999, 238; Perlès 2007). This type of investigation is crucial in making the study of past exchange relevant from a social and technical point of view (Pollard et al. 2014). Furthermore, as discussed in section 1.1.3, certain materials may have been exchanged in the past, but present limited potential for provenance studies due to their wide regional availability. For instance, Kirch (1988) contrasts the exclusive focus archaeologists had placed on the exchange of mineral resources across the Pacific islands to the abundant and well-known ethnographic evidence for the long-distance exchange of shell ornaments. In order to demonstrate the exchange of shell valuables and explore its patterns, Kirch (1988) maps the occurrence of these items, taking into account not only raw material and typological variability, but also evidence for local production. In fact, the operations that compose a *chaîne opératoire* are organized in time and across geographical space (Perlès 1980; Geneste 1992). The hierarchical organization of an archaeological assemblage in technical stages can highlight the presence or absence of certain products, thus pointing to the states in which materials were brought into a given site (Perlès 2007). The percentage of each raw material and the corresponding states of importation can provide insight into the mechanisms of material acquisition and circulation. When seen as a group, these studies stress the need for pursuing the roles of ornaments in the past not only in connection with their types and raw materials, but also through careful examinations of their biographies.

1.3. Methodology

The previous section demonstrated that we cannot successfully inquire into the roles of ornaments by limiting ourselves to a typo-morphological approach. Furthermore, the identification of raw materials and their geological sources also present us with only part of the story. I argued that we should pursue the biographies of ornaments as a means of generating a more holistic understanding of the ways materials were dealt with by people in the past. This pursuit for a less static approach to the study of ornaments forms a key component of this dissertation. In the following, the method used here to operationalize artefact biographies is presented.

1.3.1. Through the jeweller's loupe: microwear analysis of ornaments

Biographies can be reconstructed by investigating the artefacts themselves. The direct observation of the surface of artefacts can provide information on the processes they have endured. Technological and functional approaches to artefact analysis have developed on the basis of this general idea, although not specifically visualizing these processes as part of a biography. While microscopic studies of wear traces have originally developed to study the function of isotropic lithic resources (Keeley 1974; 1980; Keeley and Newcomer 1977; Mansur 1990; Odell 2001; Plisson and Van Gijn 1989; Semenov 1973[1964]; Van Gijn 1990), they have been increasingly applied to other raw materials. In particular, microwear analysis[5] has now been carried out on a much broader range of materials, focusing on traces connected to both technological and use activities (*e.g.*, Adams 2004; Adams et al. 2009; Bradfield 2015; Breukel 2019; Buc 2011; Cuenca Solana et al. 2017; d'Errico 1993a; 1993b; De Angelis and Mansur 2010; Dubreuil and Savage 2014; Hamon 2008; Kelly 2003; Kononenko et al. 2010; Lammers-Keijsers 2007; Little et al. 2016; Maigrot 2005; Sidéra and Legrand 2006; Van Gijn et al. 2008; Van Gijn and Hofman 2008). The most common instruments of analysis are based on optical light microscopy (i.e. a stereomicroscope and a reflected or incident light metallographic microscope). At the same time, explorations of new instruments are ongoing, in particular of those providing quantitative measurements of wear (*e.g.*, Borel et al. 2014; d'Errico et al. 2000; Evans and Donahue 2008; Ollé et al. 2016; Procopiou et al. 2013; Stemp et al. 2016). The identification of specific techniques, tools, and, more generally, contact materials is dependent on reproducing observed archaeological traces through controlled experiments (Bamforth 2010; Hurcombe 2008; Keeley 1980; Keeley and Newcomer 1977). Experiments may focus on reproducing specific tasks with controlled conditions (*e.g.*, cleanness, time, number, type and strength of gesture), only changing one variable at a time. This type of clinical experiment allows for the characterization and identification of material interaction. Actualistic experiments can also be conducted, focusing instead on complex activities or production sequences that incorporate multiple gestures and variables. This has proven to be of importance, as real life conditions tend to be markedly different from laboratory settings (Van Gijn 2014a). Furthermore,

5 In order to highlight this focus on the study of traces from multiple origins, I opted for using the term microwear analysis throughout this dissertation, instead of other common terms, but of narrower scope, such as use-wear or functional analysis.

traces form on an artefact from multiple interactions over its biography, creating a micro-stratigraphy or even complex palimpsests on its surface (Akoshima and Kanomata 2015). Researchers have also investigated how natural or post-excavation processes affect studied materials and the preservation of wear, for instance by characterizing the damage caused by predators, taphonomic agents, and cleaning or curating practices on shell and bone (*e.g.*, d'Errico 1993a; Cuenca-Solana 2013; Graziano 2015; Orłowska 2018). It is in this context of an ever-growing and increasingly more diversified field of microwear studies that the present research is situated.

Here we consider primarily the study of ornaments produced through extractive-reductive crafts (*sensu* Miller 2007), such as the working of lithics and hard animal materials.[6] This is because these are the most commonly recovered ornament raw materials from pre-colonial Caribbean contexts (section 1.1). Ornaments have received considerable attention from an artefact analysis perspective, in particular by researchers using some degree of magnification in search of greater insight on production, use, and taphonomy. The success and popularity of the use of magnification for ornament studies can be at least partially explained by: 1) the small sizes of ornaments, which limit the usefulness of direct observation with the naked eye, and 2) to the recurrent use of abrasive technologies in their production, which not only do not produce abundant remains such as debitage, but also tend to superpose and erase traces left by previous life stages. Many studies have used low power microscopy (magnifications of less than 100×), using a stereomicroscope or a DinoLite. Such instruments allow for the identification of manufacture traces, generally to the level of technique (i.e. percussion, pressure, drilling, and grinding), and their sequence of application. They also provide an understanding of use-wear presence, types, distribution, and degree of development. Archaeologists have focused especially on automorphic artefacts (in which the natural shape of the material has not been changed significantly), such as perforated whole shells or teeth (Alarashi 2010; Álvarez Fernández 2006; Bonnardin 2008; 2012; Cristiani and Borić 2012; Cristiani et al. 2014; d'Errico et al. 2005; Gutiérrez Zugasti and Cuenca Solana 2015; Langley and O'Connor 2016; Mărgărit et al. 2018; Sidéra and Giacobini 2002; Sidéra and Legrand 2006; Tatá et al. 2014). Low magnification microscopes have also been used for the study of lithic materials,

6 To the exclusion of ornament materials produced by transformative crafts, such as ceramic, porcelain, glass, and metals.

such as amber, jet, calcite, diorite, carnelian, and steatite (Alarashi 2016; Falci 2015; Sebire 2016; Van Gijn 2006; 2008; 2014b; 2017; Verschoof 2008).

Low magnification instruments are often used in combination with at least another microscope providing high magnifications (from 50x up to 1000x). A metallographic microscope can offer insight into contact materials, directionality, and superposition of traces. The analysis works through the same principles as more traditional use-wear studies, entailing the study of the surface micro-topography of an artefact. Observed features include polish, rounding, micro-removals, striations, pits, directionality, the micro-stratigraphy of traces, and potential residues (Adams et al. 2009; Keeley 1980; Mansur 1990; Van Gijn 1990). It has been used to identify both technological and use-related features, such as successive surface treatments, production toolkits, residues associated to attachment systems, and contact with other beads, skin, or fabrics (Brasser 2015; Breukel 2019; Cristiani and Borić 2012; Cristiani et al. 2014; Falci 2015; Groman-Yarolavski and Bar-Yosef Mayer 2015; Martí et al. 2017; Milner et al. 2016; Van Gijn 2006; 2008; 2014b; 2017; Verschoof 2008). The use of this type of microscope has been somewhat limited in ornament studies. This may be connected to the need for a 90° angle between the light source and the surface of the artefact, which can pose a challenge for the rounded surfaces common in ornaments. In addition, the bright, white, and/or reflective surfaces of certain materials, such as shell, teeth, and some lithics, may render observation of diagnostic features difficult. Furthermore, poor surface preservation affects this type of analysis to a greater degree than analyses with low magnification. Detailed examination of the inside of deep and steep features, such as perforations and incised grooves, requires the production of negative silicone impressions (casts) of the surface.

A Scanning Electron Microscope (SEM) has been used for a long time in bead studies, particularly for assessing the raw material of drill bits and the drilling mechanisms used (*e.g.*, twisting motion, palm drill, bow drill, etc.) (*e.g.*, Bains 2012; Gwinnett and Gorelick 1979; Gorelick and Gwinnett 1989; 1990; Kenoyer 1997; Kenoyer and Vidale 1992; Vidale 1995). This microscope allows good visibility of curvilinear surfaces, wider depth of field, a longer working distance, higher resolutions, and higher magnifications (Borel et al. 2014; Ollé et al. 2016). The SEM is also being used for the identification of carving techniques and toolkits, through the examination of the morphology and sequence of carved grooves and of the width of bands of striations under high magnification (d'Errico 1993a; 1993b; d'Errico et al. 2005; Melgar Tísoc and Andrieu 2016; Milner et al. 2016; Sax et al. 2004; Sax and Ji 2013; Velázquez Castro 2012). Multiple raw materials have been studied with the use of a SEM, both lapidary materials (agate, carnelian, nephrite, and jadeitite) and hard animal materials (shell, bone, and teeth). Limitations involved with the use of this microscope are higher costs, time-consuming analysis protocol, and the need for sample preparation (i.e. producing silicone casts of artefact surfaces and gold- or carbon-coating them for placement in a high vacuum chamber) (Borel et al. 2014). Furthermore, it does not permit direct observation and instant manipulation of samples.

More recently, X-ray micro-Computed Tomography (μ-CT scanning) has also been used for the study of (non-metallic) ornaments. It creates a 3D virtual model of the scanned object at high resolution (5 – 10 μ), including not only its surface, but also its inner structure. The model can be sectioned in multiple planes and observed features can be measured, isolated, or removed. In this way, it is possible to visualize both technological traces, such as the shape of the perforation and drilling marks, and structural features, such as different layers, inclusions, or air bubbles in a material (Huisman et al. 2012; Ngan-Tillard et al. 2014; 2018; Winnicka 2017; Yang et al. 2009; 2011; 2016). Thus far, it has been used for the study of beads made of glass, amber, steatite, jadeite, ostrich eggshell, and bone. It is a non-destructive technique and no sample preparation is required, as most beads are sufficiently small to be scanned in their entirety. Other analytical techniques have also been experimented with to assess their potential for the study of ornament making, such as microscopes for measuring surface roughness (*e.g.*, Confocal Microscopy; Astruc et al. 2011; d'Errico et al. 2000; Wei et al. 2017) and Reflectance Transformation Imaging for examining incised carvings (Lauffenburger et al. 2015; Milner et al. 2016).

1.3.2. Adjusting the focus: studying ornaments from the Caribbean

The application of technological and, especially, microwear analyses to ornaments has been sparse in the Caribbean. Shell ornaments from sites in the French West Indies and Aruba have been studied, with emphasis on production sequences and toolkits (Lammers-Keijsers 2007; Serrand 1997; 2007). An experimental programme has been conducted alongside the study of shell bead-making remains from the workshop site at Grand Turk (Carlson 1993; 1995). In fact, experiments aiming to replicate the sequence of production and the use of marine shell tools have been relatively more common in the region (Antczak 1999; Dacal Moure 1997; Lammers-Keijsers 2007; Lundberg 1987; O'Day and Keegan 2001). Despite the abundance of ornaments in lithic materials found throughout the Caribbean, there have not been many studies focused on their technology or use. Ornaments in lapidary materials from Saladoid and Huecoid contexts have received more attention from a technological point of view than later varieties (see Chapter 4 for a complete review). For instance, a study has been carried out on the reduction sequences involved in bead manufacture in lapidary materials, notably carnelian, from Montserrat (Bartone and Crock 1991; Crock and Bartone 1998). Four stages of ornament making were defined, involving hard hammer percussion and pressure flaking in the first two stages, respectively. The authors also recorded remnant drilled cones inside unfinished holes that suggest the use of hollow drill bits for perforating (Crock and Bartone 1998, 213). Other studies have been performed on assemblages recovered from sites in Martinique and St. Martin (Bérard 2004; Haviser 1999). Only a pilot experimental study focused on drilling technologies has been conducted, using SEM to examine traces produced on calcite (De Mille and Varney 2003; De Mille et al. 2008). In summary, despite the abundance of ornaments recovered from archaeological sites across the Caribbean, not many studies have focused on understanding crucial stages in their biographies. Chapters 4 and 5 provide more detailed reviews of previous studies focused on Caribbean ornaments, also including those primarily concerned with typology, iconography, raw material identification, and sourcing.

Microwear analysis of individual ornaments recovered from archaeological sites in the Caribbean will provide first-hand and fine-scale data that can be contrasted to the models reviewed in section 1.1. In order to create a dialogue and challenge previous ideas, we will investigate not only artefacts retrieved during recent systematic excavations, but also specimens from previously excavated and/or looted sites without good provenience data. Sites and collections that have for a long time served as basis for building the regional culture history need to be redressed by new approaches and methods, as noted at the onset of this chapter. Microwear analysis can be used to study artefacts with such different post-excavation biographies, provided that their limitations are acknowledged. Different collections require different approaches to their successful study. In each of the following chapters, collections of different composition and history of formation are researched. As a result, they have experienced different degrees of modification after removal from archaeological sites or source communities. Furthermore, a great variety of ornament types and raw materials are encompassed in this selection. Different materials have different physico-chemical properties, which affect not only their workability, but also the formation of use-wear and their taphonomic preservation. Ornament types also varied considerably, encompassing minute “seed beads”, 10cm-thick tubular beads, exquisitely carved anthropomorphic pendants, and a broad range of morphologies in between. The setting where the research was conducted oscillated between the Laboratory for Artefact Studies of Leiden University (Chapters 2 and 5), the Atelier de Conservation et Restauration of the Musée du quai Branly (Chapter 3), and field-based improvised laboratories in Grenada and the Dominican Republic (Chapters 4 and 5). This entailed the use of different microscope models for the studies: relatively portable equipment had to be transported to the Caribbean, while microscopes were available in the museum facilities in Paris. The Laboratory in Leiden is especially designed for microwear research; it thus provided ideal conditions for analysis. However, in many instances, it was decided not to take archaeological material from the Caribbean out of its country of origin. In each of the following chapters, the microscopic equipment used and the research protocol are specified. As a general rule, both low and high magnification microscopes were used. In spite of the differences in collections and research setting, the analysis form and registered features remained the same across all case-studies (form in Appendix 1). An image of the Access database used for registering each artefact can be found in Appendix 2. A supplementary analysis form was used for the ethnographic objects studied in Chapter 3 for general description (form in Appendix 3), alongside multiple forms for the individual ornaments that are part of each object. The cleaning protocol for ethnographic objects took into consideration their composite nature and fragility; it is described in detail in Chapter 3. For archaeological artefacts (Chapters 2, 4, and 5), the cleaning protocol involved carefully washing each artefact by hand in water with soap. When it was not possible to remove dirt by hand, artefacts were placed in an ultrasonic tank for a few minutes; this was only done in Leiden, as we did not have an ultrasound in the Caribbean. During analysis, the surfaces of artefacts were often cleaned with cotton soaked in alcohol or lighter fluid in order to remove grease produced by handling.

1.3.3. Reference collections

Bead research has a long tradition of experimental programmes, many of which concerned with technical performance, time expenditure, and craft specialization (*e.g.*, Francis 1982; Carlson 1993; Miller 1996; Yerkes 1993). Only a portion of these experiments have been carried out with the goal of reproducing manufacture traces for comparison to microwear data (*e.g.*, d'Errico et al. 1993; 2000; Groman-Yarolasvski and Bar-Yosef Mayer 2015; Gurova et al. 2013; Mărgărit et al. 2018; Tatá et al. 2014). In the present research, experiments related to ornament production were carried out to support interpretation. They have been performed in different occasions on the years of 2014, 2015, and 2016; experiments from the first two years have been previously reported elsewhere (Breukel 2019; Breukel and Falci 2017; Falci 2015). While the experiments of 2014 were exploratory, the experiments carried out in 2015 and 2016 were focused on addressing specific questions raised by the analysis of archaeological materials. Rather than replicating entire production sequences, I opted for reproducing individual techniques with use of different tools and additives. The techniques were intended to represent the main ornament making operations identified on the studied assemblages, namely blank acquisition (sawing), surface treatments (grinding and polishing), perforating (drilling and sawing), and carving for shaping or decorative purposes (incising and notching). In some cases, more than one technique was applied to a same bead blank; for instance, a surface was ground prior to polishing, while surfaces obtained through sawing were sometimes ground over. This provided insights on the micro-stratigraphy of traces, i.e. how traces belonging to earlier operations in the manufacture sequence would appear on (nearly) finished ornaments. Time was recorded for most experiments and photographic registration was made of all activities and products. The grinding and polishing experiments from 2016 were sequential experiments; in other words, casts were made of the worked surfaces at selected time intervals (for instance, 0', 15', 30', 60'). Moreover, the effects of the addition of abrasives (sand) and lubricants (water) were tested both individually and in combination.

Preference was given to working with only certain raw materials as ornament blanks, in particular those most common in the archaeological case-studies. This led to the choice of three marine shell species (*Lobatus gigas, Spondylus americanus,* and *Oliva reticularis*), one stony coral species (*Acropora cervicornis*), and the following lithic materials: calcite, diorite, amethyst, and, to a lesser degree, nephrite and serpentinite. The contact materials (i.e. tools) used for each experiment were chosen on the basis of a range of factors: preliminary hypotheses concerning the origin of observed traces on archaeological specimens, regional availability of raw materials, hypotheses previously advanced (Clerc 1974; Rostain 2006; Rodríguez Ramos 2010b), experiments by other researchers (Carlson 1993; Kelly 2003; Lammers-Keijsers 2007; Melgar Tísoc and Andrieu 2016), ethnohistoric sources (Las Casas 1992, 587), and ethnographic sources from lowland South America (Koch-Grünberg 2005; Ribeiro 1988; Roth 1924). The complete list of experiments conducted for this research can be found in Appendix 4, while the standard form used for recording the experiments can be found in Appendix 5. The relevant experiments are described and illustrated in Chapters 2 and 5, where they serve as basis for interpretation. Chapter 4 refers to the preliminary results of the sequential grinding and polishing experiments.

For the interpretation of ornament use-wear, we referred to published experiments that describe its location, characteristics, and formation rates (Álvarez Fernández 2006; Brasser 2015; d'Errico 1993a; d'Errico et al. 1993; Langley and O'Connor 2016; Mărgărit 2016; Minotti 2014; Vanhaeren et al. 2013; Verschoof 2008). The contributions and limitations of use-wear experiments for the study of ornaments are discussed in-depth in Chapter 3. Replicating the use of ornaments was not part of the experimental programme carried out here; this was due to the large number of studied raw materials and of artefacts that have undergone multiple stages of production. Their replication for use experiments would require more time and resources than at disposal. Here I investigate use-wear formation on ornaments through the systematic analysis of ethnographic composite ornaments. The studied objects belong to the lowland South American collections of the Musée du quai Branly. The choice for objects from this region is related to the traditionally advanced connections between this region and the Caribbean, as referred to in section 1.1. The studied objects include components made of mollusc shell, animal bone, quartz, among others. Even though we cannot control for variables such as use duration and contact materials when looking at such objects as a reference collection, they do provide a valuable window into attachment systems and the ways that individual components would have undergone processes of wear in real life. The variety of processes an ornament undergoes in its lifetime is very difficult to replicate in experimental programmes. A thorough overview of this study and its results can be found in Chapter 3.

1.4. Thesis outline

The remainder of this dissertation is composed of four chapters and a concluding chapter. The four main chapters have been published in peer-reviewed journals, as independent contributions to ornament studies and circum-Caribbean archaeology. The order of the chapters should not be regarded as a strict and predetermined sequence. Instead, it should be conceived as a beadwork: individual chapters are connected to each other at multiple levels and rely on each other for interpretation, but do not need to be read in the presented order. Nonetheless, they are separated in two consecutive parts, each dealing with one of the two main goals of this dissertation as proposed earlier in this introduction (Figure 3). The aim of Part 1 (Chapters 2 and 3) is to develop an approach for researching the biographies of bodily ornaments, taking into account challenges that are particularly common in circum-Caribbean archaeology—but, certainly not exclusive to it. In this sense, they provide the basis for the interpretations that will be made in the second part of the dissertation.

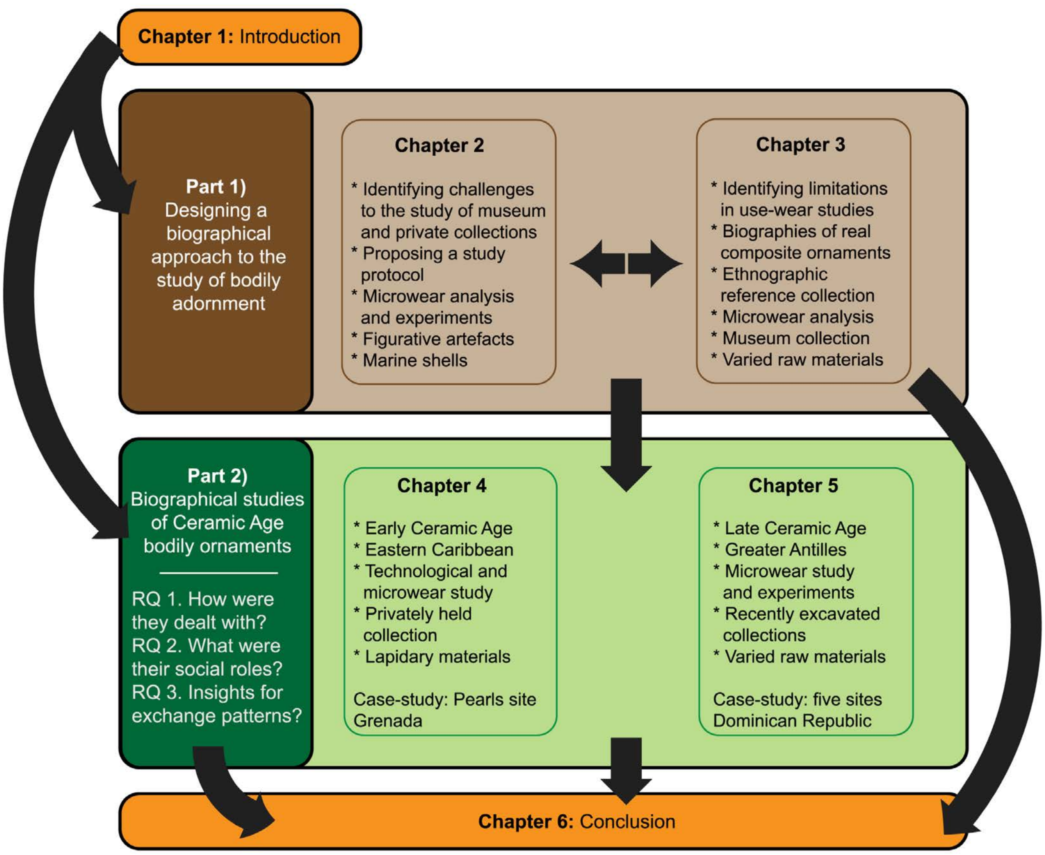

Figure 3: Graphical representation of the outline of this dissertation.

Part 2 (Chapters 4 and 5) focuses on applying the biographical approach developed in the previous chapters to the study of assemblages of ornaments from the two case-studies selected here. Each chapter primarily deals with the first research question posed above, i.e. how people dealt with ornaments in each of the studied contexts. The two case-studies give us the opportunity to delve into the biographies of ornaments not only from two different time periods, but also from different types of sites and assemblages: 1) a large assemblage of ornaments in different stages of production from a workshop site and 2) smaller assemblages of finished ornaments from settlement sites. In this sense, they illustrate the wide applicability of the approach proposed here. Both chapters include a review of archaeological debates surrounding ornaments and their raw materials for the relevant time period. The newly generated microwear data is interpreted in the form of ornament biographies, which are then contrasted to previous narratives about the socio-political roles of bodily adornment and its exchange.

Part 1: Designing a biographical approach to the study of bodily adornment

Chapter 2: Identifying challenges and proposing solutions

In this chapter, a case-study from north-central Venezuela is used as basis for developing a protocol for approaching ornaments from circum-Caribbean collections. We carried out a microwear study of 15 archaeological marine shell figurative ornaments from an early 20th century collection of the Ethnologisches Museum Berlin.[7] This study deals with specific challenges faced during the analysis of collections that do not have (abundant) associated data concerning their provenience or specific archaeological context. This chapter, therefore, proposes an avenue for studying ornaments such as those found in many museum and private collections around the world. As (mostly) finished artefacts with no associated tools, production remains, or clear context of usage or deposition, the detailed analysis of their surfaces through microwear analysis offers one of the few avenues into their biographies. With this in mind, we propose a protocol for dealing with the micro-stratigraphy of traces observed on the surfaces

7 This research has been presented in its entirety in the author's Research Master thesis (Falci 2015). The processes of recontextualizing this collection in relation to, first, its particular history and, second, to trends in research and collecting in the Valencia Lake Basin are discussed in another two published journal articles (Antczak et al. 2019; Falci et al. 2017).

of such artefacts, involving technological stigma from multiple stages of production, use-wear and rejuvenation, post-depositional surface modifications, and curatorial interventions. The paper contextualizes the studied material in relation to other figurative ornaments, notably pendants, recovered across the Caribbean and northern South America. Similarly figurative artefacts in lithic materials and marine shells from the Antilles will be discussed in Chapters 4 and 5, so Chapter 2 also sets a protocol for investigating such complex items. The contents of this chapter have been published as the following:

Falci, C.G., Van Gijn, A.L, Antczak, M.M., Antczak, A.T., Hofman, C.L., 2017. Challenges for microwear analysis of figurative shell ornaments from pre-Colonial Venezuela. *Journal of Archaeological Science Reports* 11, 115-130. http://dx.doi.org/10.1016/j.jasrep.2016.11.029

Chapter 3: Ornament biographies and use-wear studies

Following one of the research avenues in need of further study suggested in the previous chapter, this chapter looks at ethnographic collections of ornaments from lowland South America. The 38 objects studied here belong to multiple 19th-20th century collections housed at the Musée du quai Branly (Paris). Many specimens are composite objects, incorporating components made of organic, inorganic, and biomineral materials. The chapter reviews studies of ornament use-wear and notes some of their limitations. It critically discusses how the biographies of composite ornaments contrast to common archaeological interpretations, in particular regarding use-wear types and distribution. In other words, composite ornaments from real-world contexts are complex constructions whose biographies do not necessarily proceed in a linear manner. Many of the studied raw materials (*e.g.*, shell, bone, quartz) feature in the case-studies that follow; the ethnographic collection will thus be used as reference for the interpretation of use-wear. The contents of this chapter have been published as the following:

Falci, C.G., Cuisin, J., Delpuech, A., Van Gijn, A.L., Hofman, C.L., 2019. New insights into use-wear development in bodily ornaments through the study of ethnographic collections. *Journal of Archaeological Method and Theory* 26(2), 755-805. http://dx.doi.org/10.1007/s10816-018-9389-8

Part 2: Biographical studies of Ceramic Age bodily ornaments

Chapter 4: A clash between production and exchange: lapidary biographies

The first case-study concerns the circulation of lapidary materials during the early part of the Early Ceramic Age in the eastern Caribbean. We focus on the study of a large private collection of ornaments retrieved from the site of Pearls on the island of Grenada. The site has been regarded as an important node in exchange networks of the period for its size, abundance of recovered materials, and proximity to South America (as discussed in section 1.1.2). This chapter presents the results of a combined study, involving identification of lithologies and technological analysis of 1273 ornaments in varied lithic raw materials and in different production stages. Of this total, a sample set of 100 ornaments was analysed for microwear. The studied collection is recontextualized through comparison with data stemming from previous research on the Pearls site and on other lapidary workshops from across the Caribbean. The combined use of these research methods provides insights on production logics and management strategies specific to each lapidary raw material. While the research carried out in this chapter is guided by a *chaîne opératoire* approach, the distribution of lapidary production sequences not only across time, but also across space highlights the importance of a biographical perspective. Only by tracing networks of action as expressed through the "fragmented" production sequences of many ornament materials, can we reconstruct past networks of interaction taking place across the Caribbean Sea. The contents of this chapter have been published as the following:

Falci, C.G., Knaf, A.C.S., Van Gijn, A.L., Davies, G.R., Hofman, C.L., 2020. Lapidary production in the eastern Caribbean: a typo-technological and microwear study of ornaments from the site of Pearls, Grenada. *Archaeological and Anthropological Sciences* 12:53. https://doi.org/10.1007/s12520-019-01001-4.

Chapter 5: Recollecting lost beads: the biographies of ornaments from settlement sites

The second case-study concerns bodily adornment in the later part of the Late Ceramic Age in the Greater Antilles. As reviewed in section 1.1.2 and further argued in the chapter itself, ornaments are assumed to have a role in reinforcing inherited social hierarchies. However, few studies have been concerned with material-based research of ornaments from the period, despite the great interest they have generally sparked. In this chapter, assemblages from five recently excavated settlement sites in the Dominican Republic are studied: the neighbouring sites of El Flaco, El Carril, and La Luperona in the northwestern region[8], the site of Playa Grande on the northern coast, and the site of El Cabo on the eastern coast. The 312 recovered ornaments are made of a broad range of raw materials, but with clear predominance of calcite, plutonic rocks, and marine shells. The ornaments have been exhumed through modern and systematic excavation techniques, in contrast to materials in the previous chapters. Nevertheless, we are faced with challenges when making sense of such artefacts, albeit different ones: most of them are finished specimens, have been recovered either in isolation or in small groups from across the sites and in non-structured deposits, are not associated to identified ornament production tools or remains, and are not placed in burials that could offer insight on mode of wear and composite ornament type. A microwear study of these assemblages can provide a new perspective on their biographies and on the regional variability in ornament types, technologies, and raw materials. All artefacts were thus studied through microwear analysis and 10 specimens underwent μ-CT scanning to provide better visualization of their perforations. While researchers have stressed the role of bodily adornment in exchange, the widespread regional occurrence of the raw materials from which the studied ornaments are made prevents sourcing efforts. We circumvent this limitation by identifying ornament morpho-technical groups and their occurrence patterns across the five studied sites. The identification of such groupings provided insights into possible regional connections. The contents of this chapter have been published as the following:

Falci, C.G., Ngan-Tillard, D., Hofman, C.L., Van Gijn, A.L., 2020. The biographies of bodily ornaments from indigenous settlements of the Dominican Republic (AD 800–1600). *Latin American Antiquity* 0, 1-22. https://dx.doi.org/10.1017/laq.2019.101

In the concluding chapter, the main findings of each study are revisited. In particular, the biographical patterns for ornaments in each time period are

8 Part of the research on the ornaments from the northwest of the Dominican Republic has been presented in the author's Research Master thesis (Falci 2015). It included materials from the 2013 and 2014 excavations of El Flaco and La Luperona, in addition to specimens recovered during surveys in the region.

summarized. The second and third research questions are addressed in this chapter: the contributions of our study to the understanding of exchange are discussed, at the same time as providing insights on the social roles held by bodily ornaments in the Caribbean. Furthermore, the contributions and limitations of the chosen approach and methods are evaluated. The implications of the results obtained here in regards to the (microwear) study of ornament collections are also stressed. Finally, avenues for future research are proposed.

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Part 1: Designing a biographical approach to the study of bodily adornment

2

Challenges in the analysis of circum-Caribbean collections

Published as:

Falci, C.G., Van Gijn, A.L, Antczak, M.M., Antczak, A.T., Hofman, C.L., 2017. Challenges for microwear analysis of figurative shell ornaments from pre-Colonial Venezuela. *Journal of Archaeological Science Reports* 11, 115-130. http://dx.doi.org/10.1016/j.jasrep.2016.11.029

Journal of Archaeological Science: Reports 11 (2017) 115–130

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

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

Challenges for microwear analysis of figurative shell ornaments from pre-Colonial Venezuela

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ARTICLE INFO

Article history:
Received 17 June 2016
Received in revised form 11 November 2016
Accepted 15 November 2016
Available online 1 December 2016

Keywords:
Shell ornaments
Microwear analysis
Bodily adornments
Pre-Colonial South America
Circum-Caribbean
Valencioid archaeology
Museum collections

ABSTRACT

Figurative ornaments displaying biomorphic and geometric designs have often been recovered from pre-Colonial sites in the Caribbean and northern South America. Such artefacts are held in museum and private collections, but often have not been the focus of systematic research. On the other hand, recent research into ornaments worldwide has focused on simple beads and automorphic shell ornaments. In this article, microwear analysis is used to assess technologies of production and use-wear of figurative shell ornaments from north-central Venezuela. It is our goal to reflect on the challenges posed by such collections, in terms of reproducibility of traces through experiments, post-depositional and curatorial modifications, and the complexity of past attachment configurations. The underlying question is how to deal with the limitations posed by the very nature of the studied collection in terms of preservation and of the high skill required in the reproduction of figurative artefacts.

1. Introduction

In recent years, a number of microwear studies have been conducted on the topic of production technologies and use of archaeological bodily ornaments, especially beads and pendants. Specimens made of stone, minerals and hard animal materials, such as shell and teeth have received considerable attention (e.g., Bonnardin, 2008, 2012; D'Errico et al., 2009; Gorelick and Gwinnett, 1989; Groman-Yaroslavski and Bar-Yosef Mayer, 2015; Gutiérrez-Zugasti and Cuenca-Solana, 2015; Rigaud et al., 2014; Sax and Ji, 2013; Stiner et al., 2013; Van Gijn, 2006, 2014a; Vanhaeren et al., 2006; Vanhaeren and D'Errico, 2003). Automorphic shell artefacts and simple geometric beads predominate as the main objects of study. In spite of the abundance of shell and lithic ornaments recovered in the circum-Caribbean, a microwear approach has only seldom been applied to such artefacts (De Mille et al., 2008; Falci, 2015; Lammers-Keijsers, 2007; Serrand, 1999). It is our goal to show how the ornaments from the region can bring new insights for the field of ornament studies worldwide.

In the circum-Caribbean, figurative ornaments made of lithic materials and shells were recovered from Early Ceramic Age sites (400 BCE–600 CE/800) in the Lesser Antilles and Puerto Rico and from the Late Ceramic Age (600 CE/800–1500) in the Greater Antilles and north-eastern South America (Antczak and Antczak, 2006; Boomert, 1987, 2001; Chanlatte Baik, 1984; Falci, 2015; Hofman et al., 2007; Narganes Storde, 1995). The pendants depict beings with zoomorphic (e.g., frogs, turtles, and birds) and/or anthropomorphic (males, females, or undefined) traits. A wide range of lithic materials was used for the production of figurative ornaments, including calcite, plutonic rocks, jadeite, nephrite, and serpentinite (Boomert and Rogers, 2007; Hofman et al., 2007, 2014a; Murphy et al., 2000; Rodríguez Ramos, 2010, 2013; Watters and Scaglion, 1994). In northern South America, ornaments, especially frog-shaped pendants known as *muiraquitãs*, have been widely exchanged, as suggested by their wide occurrence across the Amazon and the Guianas during the late pre-Colonial period (Barata, 1954; Boomert, 1987; Moraes et al., 2014; Falci and Rodet, 2016; Rostain, 2006, 2014). The *muiraquitãs* are made of varied raw materials, including jadeite, nephrite, albite, variscite-strengite, and quartz (Meirelles and Costa, 2012). Bivalve and gastropod shells, common raw materials on the islands and the coast of South America, have also been shaped into biomorphic ornaments (Antczak and Antczak, 2006; Lammers-Keijsers, 2007; Murphy et al., 2000; Vargas Arenas et al., 1997). Such artefacts received attention from researchers interested in iconographic designs, raw materials, cultural interaction, and cosmologies in the circum-Caribbean (e.g., Boomert, 2001; Chanlatte Baik, 1984; Hofman et al., 2007, 2014a; Laffoon et al., 2014; McGinnis, 1997; Mol, 2011; Roe, 2011). However, technology and use-wear remain underexplored.

The present research focuses on figurative ornaments from the eastern shore of Lake Valencia in north-central Venezuela. Produced in the area from approximately 800 CE to 1500, the ornaments have been associated with other *muiraquitã* production centres, due to the similarity in iconographic motifs (Boomert, 1987; Rostain, 2006, 2014). Many artefact assemblages from the Valencia Lake Basin are the result of

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http://dx.doi.org/10.1016/j.jasrep.2016.11.029

unsystematic excavations during the late 19th and 20th centuries (Antczak and Antczak, 2006; Díaz Peña, 2006). A collection of ornaments made of shells and lithics is currently housed in the Ethnologisches Museum Berlin (formerly the Museum für Völkerkunde). The artefacts display multiple perforations, notches and figurative elements. Such elaborate morphologies lead us to questions regarding the presence of highly skilled and specialized craftsmen in the region, as suggested by other researchers (Vargas Arenas et al., 1997).

At the same time, designing a research methodology necessitates an evaluation of whether task-oriented experiments can offer us insight into production technologies and patterns of wear. Similarly, post-depositional surface modifications (PDSM) and long post-excavation trajectories have to be taken into account during analysis. It is necessary to assess how detrimental those are to a microscopic analysis. The aim of the present article is therefore threefold: 1) to present the results of the microwear analysis of the ornaments and suggest new avenues for future research in the studied regions; 2) to discuss the challenges faced during laboratory analysis and interpretation; and 3) to demonstrate how microwear analysis can shed light into the complex biographies of figurative ornaments which involve multiple stages of production and use.

1.1. The Valencia Lake Basin

The north-central Venezuela region comprises a rich combination of diverse geological and topographic features, and ecosystems. From north to south it includes: 1) the oceanic islands and archipelagos; 2) the Caribbean coast; 3) the Cordillera de la Costa mountain range; and 4) the Valencia Lake Basin with islands and alluvial/lacustrine fertile valleys (Fig. 1). To the south, the Serranía del Interior separates the lake from the llanos (savanna plains) and the Orinoco River valley. The geographical centre of the study region is Lake Valencia, a landlocked formation that dates back to the Middle Tertiary (Böckh, 1956; Schubert, 1978, 1980). Located in an area with seasonally dry tropical climate, the lake is the largest, permanent freshwater reservoir in lowland South America, north of the Amazon (Bradbury Platt et al., 1981; Curtis et al., 1999; Leyden, 1985; Raymond and Chardón, 1941; Xu and Jaffé, 2008). It rests at an altitude of 402 m ASL, and has a spill point at 427 m ASL, attaining a maximum depth of 38 m. It covers an area of 350 km^2 with a watershed of 2646 km^2. In the recent past, the lake reached a maximum areal extent of 1050 km^2 and a maximum depth of 63 m (Berry, 1939). The Valencia Lake Basin and the Cordillera de la Costa mountain range to the north are geological formations rich in a variety of rocks of igneous and metamorphic origin (Berry, 1939; Urbani, 2000; Urbani and Rodríguez, 2003).

The basin was a magnet for humans probably since the late Pleistocene-initial Holocene times. It housed pottery making horticulturalists since the beginning of the Common Era, and from 800 CE, the bearers of Valencioid material culture. Around 1200 CE, these societies fostered the conformation of the Valencioid Sphere of Interaction that covered the entire north-central Venezuela region (Antczak and Antczak, 2006). On wide geographical scale of northeastern South America, the region has been portrayed as an entrepôt of interregional exchange, and the circulation of peoples and ideas to and fro the Andean west, the insular Caribbean north, and the Tropical Lowland south (Kidder, 1944, 1948; Osgood, 1943; Osgood, 1943; Rouse and Cruxent, 1963).

Thousands of artefacts have been collected by amateurs and scholars since late 19th century (Ernst, 1895; Marcano, 1971[1889–1891]; Requena, 1932). However, attention was placed on artefacts with perceived "museum value", leading to a limited collection of non-formal lithic tools. In the cases when lithics were collected in stratigraphically controlled excavations (Bennett, 1937; Del Valle and Salazar, 2009; Kidder, 1944; Osgood, 1943), they were not thoroughly studied. Preliminary studies were conducted on lithic artefacts from the north-central coast (Martín, 1995) and from the Los Roques Archipelago (Antczak and Antczak, 2006). Diverse lithic raw materials have been reported in tools from the Valencia Lake Basin, including chert, schist, andesite,

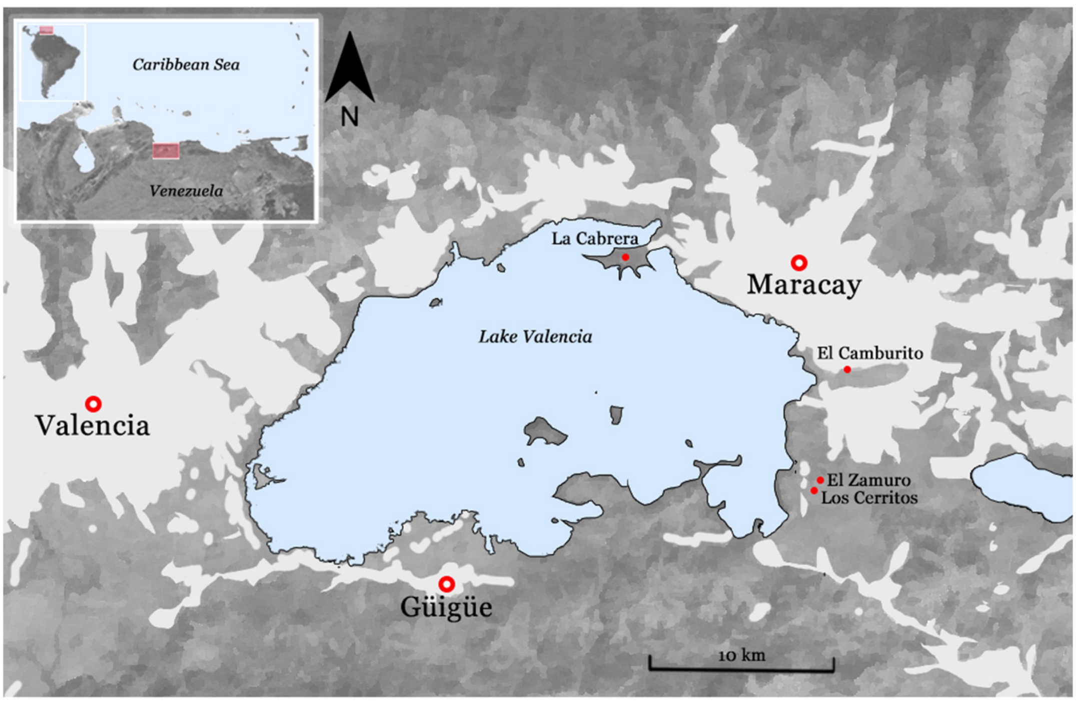

Fig. 1. The north-central Venezuela region with Lake Valencia in its centre and the archaeological sites of Los Cerritos, El Zamuro, El Camburito and La Cabrera situated on its eastern and north-eastern shores. Maracay, Valencia and Güigüe are modern cities surrounded by urbanized and industrialized areas. Map by Oliver Antczak.

granite, sandstone, quartzite, and steatite (Kidder, 1944). It is likely that some of these raw materials were regionally available around the shores of the Lake Valencia and in the Cordillera's coastal bays.

Numerous beads and pendants made of a variety of materials (shells, lithics, bone, metal, etc.) have been recovered from domestic and burial contexts in artificial mound structures in the Valencia Lake Basin (Antczak and Antczak, 2006). Many ornament raw materials are not local and were brought from different areas of Venezuela; for instance, serpentinite was probably traded from the Andean region and jet from the Venezuelan south or west (Cirimele, 1989; Wagner and Schubert, 1972). In the case of the shell material, both the recent and the archaeological distribution of different mollusc species on the coast and islands immediately to the north have been the topic of extensive previous studies (Antczak, 1998; Antczak and Antczak, 2005, 2006, 2008). Marine shells, especially *Lobatus gigas* (commonly known as Queen Conch), seem to have held great importance and were not only used as food source, but also for making bodily ornaments, musical instruments, and tools. Whole and preliminarily shaped shells were brought to the basin from the coast and the offshore oceanic islands, through a total distance of 150 km across the Cordillera de la Costa, with peaks reaching up to almost 3000 masl (Antczak and Antczak, 2006, 2008). While there is no available information on a potential ornament making toolkit, corals brought inland together with the shells and recovered from the archaeological sites could have been used as grinding platforms (Berry, 1939, 558).

2. Materials and methods

The ornaments analyzed in this paper come predominantly from sites located on the eastern shore of the Lake Valencia (Fig. 1). The collection was excavated between 1901 and 1903 by Alfredo Jahn, an engineer commissioned by the Museum für Völkerkunde Berlin (Antczak and Antczak, 2006; unpublished results; Jahn, 1932; Osgood, 1943). The entire collection consisted of approximately 1000 artefacts made of ceramics, lithics, and shell from the sites of Los Cerritos, El Zamuro, El Camburito, and La Cabrera. The collection included “28 necklaces” of different raw materials, although the actual numbers are not clear. Almost a quarter of the whole collection comprised lithic beads and pendants, as well as abrading and pecking lithic tools. However, no contextual or stratigraphic data is available for most objects. Moreover, a significant part of Jahn's original collection has been lost over time, particularly bodily ornaments (Antczak and Antczak, unpublished results; Díaz Peña, 2006). The surviving artefacts identified as potential bodily ornaments ($n = 62$) were analyzed through microwear analysis (Falci, 2015). For the purpose of the present paper, 15 carved shell ornaments are discussed, which encompasses the beads and pendants with figurative and geometric shapes (Fig. 2). Table 1 includes a summary of the information gathered for each analyzed artefact.

2.1. Description of the material

The ornaments from the studied Lake Valencia collection are xenomorphic, since the blanks for their production had to be removed from the shell before being shaped into an ornament (sensu Lammers-Keijsers, 2007; Linville, 2005; Vargas Arenas et al., 1997). In contrast, automorphic artefacts are directly made from whole shells which undergo minimal modification. While beads of simple geometric shapes are also xenomorphic, this article focuses on ornaments with complex morphologies, especially non-circular, asymmetrical, and biomorphic. Most ornaments discussed in this study are classified as pendants (66,7%), given the decentred position of the perforations (cf. Barge, 1982; Watters and Scaglion, 1994). Despite the abundance of shell beads reported from the region, only five beads were analyzed, due to their irregular shape mimicking the folded legs of a frog.

The use of shells as raw materials in the pre-Colonial Caribbean can be related to their properties, such as colour, workability, toughness, and homogeneity (Clerc, 1974; Serrand, 1999, 2007; Sutty, 1990). In the studied collection, bivalve shells predominate, including *Spondylus americanus* ($n = 9$) and specimens of unidentified genera ($n = 3$). The *S. americanus* shell (known as Atlantic thorny oyster) is characterized by a relative thickness, large size, red colour, and thorny appearance with long spines (Abbott and Dance, 2000) (Fig. 3a). The gastropod *L. gigas* is also present in the collection ($n = 3$) (Fig. 3b). Its shell is large, thick, and has a cross-lamellar microstructure, rendering the shell tough and suitable for the production of tools and ornaments (Kamat et al., 2000; Lammers-Keijsers, 2007; O'Day and Keegan, 2001). The lip was commonly used for artefact manufacture, due to its large size and thickness, but other parts such as the body whorl, the columella, the spire, and nodules have also been used by Amerindian communities (Antczak, 1998; O'Day and Keegan, 2001; Serrand, 1999, 2007).

Shell artefacts can undergo a range of post-depositional mechanical and chemical processes that eliminate or superimpose anthropogenic traces depending on the conditions of the soil (Claassen, 1998; Cuenca-Solana, 2013; Cuenca-Solana et al., 2015; Dittert et al., 1980). Surface erosion, pitting and detachment of the coloured layer were observed on some analyzed ornaments (11; 73,3%) (Fig. 4a–b). Additionally, 12 ornaments (80%) have sediment from the archaeological deposits encrusted to the surface (Fig. 4b, c). Breaks were observed on two artefacts, one displaying an old patina while the other one appeared fresh and recent.

Long-term curation and storage may also result in modifications of artefact surfaces. Different systems of identification were used in the past: the attachment of labelling stickers to the surfaces of two ornaments (13,3%), ink markings (7; 46,7%), and nail polish (5; 33,3%). Both systems can be observed on the same artefact due to successive recording episodes. When added to the surface, nail polish creates a reflective layer that hinders the use of high-power magnifications for analysis (Fig. 4d). Pencil lead stains, accidentally created during the drawing of artefacts, were also noted (4; 26,7%) (Fig. 4b). Even though the modifications covered part of the surfaces of the ornaments, none of them rendered analysis impossible; certain traces and residues had to be nevertheless considered with caution. Likewise, for certain specimens, analysis had to be restricted to low magnification.

2.2. Microwear analysis and experiments

A broad range of research has been conducted on technologies of production of shell ornaments in the circum-Caribbean (Carlson, 1995; Falci, 2015; Lammers-Keijsers, 2001, 2007; Serrand, 1999, 2007; Turney, 2001; Van der Steen, 1992; Vargas Arenas et al., 1997) and elsewhere (e.g., Barge, 1982; Bar-Yosef Mayer, 1997; D'Errico et al., 1993, 2005, 2009; D'Errico and Villa, 1997; Francis, 1982; Stiner et al., 2013; Suarez, 1981; Taborin, 1991, 1993; Tátá et al., 2014; Vanhaeren et al., 2006; Velázquez-Castro, 2011, 2012; Thomas, 2015). Microwear analysis has proved to be successful in identifying perforating techniques, differentiating them from natural features caused by predators and by wave and sand action (Cadée and Wesselingh, 2005; Çakirlar, 2009; D'Errico, 1993; D'Errico et al., 1993, 2009; Francis, 1982; Joordens et al., 2014). In addition, microscopic and experimental studies have provided insight into past systems of attachment and degrees of usage (Bonnardin, 2008, 2012; Langley and O'Connor, 2015; Mărgărit, 2016; Taborin, 1993; Vanhaeren and D'Errico, 2003; Vanhaeren et al., 2013). Studies have also demonstrated that shell mechanics and the formation of wear can vary according to the species and its (micro-)structure (Cuenca-Solana et al., 2015; Szabó, 2010; Weston et al., 2015).

The approach used here couples microscopic analysis with experiments in order to assess the technologies, toolkits, and stages involved in the *chaîne opératoire* of ornament production. Technology is regarded as encompassing cultural choices and transmission of knowledge across generations within a same community (Dobres, 2010; Gosselain, 2000; Lemonnier, 1993; Sillar and Tite, 2000). It may involve not only a mental

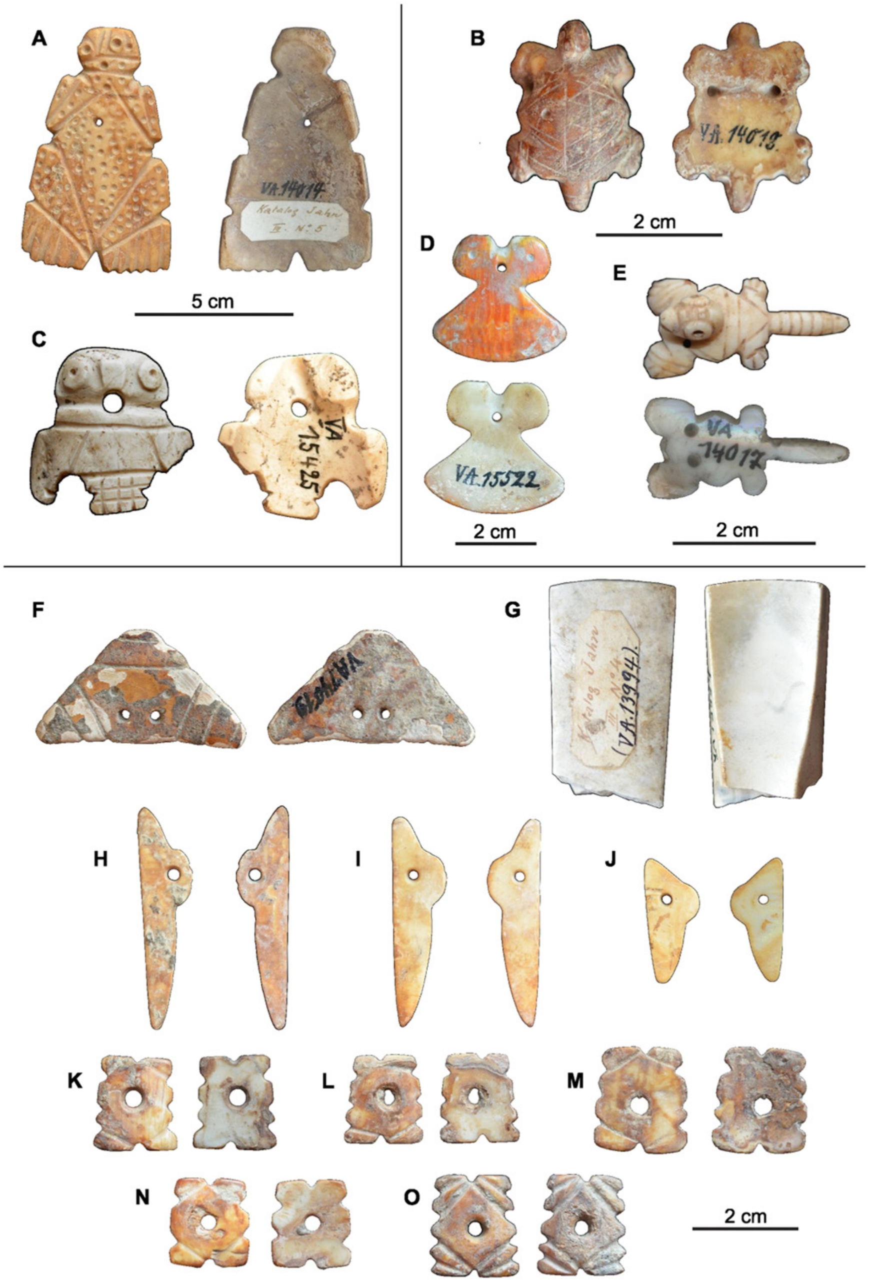

Fig. 2. Shell ornaments from the Alfredo Jahn collection analyzed in this article. Staatliche Museen zu Berlin - Ethnologisches Museum, Preußischer Kulturbesitz, (a) VA 14014, (b) VA 14018, (c) VA 15425, (d) VA15522, (e) VA 14017, (f) VA 14019, (g) VA 13994, (h–j) VA 15431 III, II, I, (k–o) VA 14021 I, II, III, IV, V.

template and *savoir-faire* guiding the execution of an activity, but also an active engagement with materials giving room for flexibility and creativity (Leroi-Gourhan, 1993; Pelegrin, 1991, 2005). A Leica M80 Stereomicroscope was used for the observation of traces under low magnifications (7.5 to 64×), together with a Leica MC120HD camera. Grooves, notches, and perforations are indicative of varied production techniques depending on their location, disposition, morphology, and presence of striations. Photographs of entire artefacts were made with a Nikon Digital Camera D5100. For high magnifications (50× to 200×), a Leica DM 6000 m Metallographic microscope was used, equipped with a Leica DFC 450 camera, which can create Z-stack photographs. The analysis involved recording the location, distribution, topography, and directionality of polish and striations (Cuenca-Solana, 2013; Cuenca-Solana et al., 2015; Lammers-Keijsers, 2007). It was focused on evaluating the presence and extent of use-wear and also surface treatments, such as grinding traces. Specific wear patterns on the surfaces were considered as evidence of use: 1) polish and rounding on the rim of perforation; 2) deformation of the rim; 3) scratches

Table 1
Attributes of the analyzed shell ornaments from the Alfredo Jahn collection. Measurements are in mm. I: ink, NP: nail polish, S: labelling sticker, PO: pencil outline, MR: modern residue, SN: stains, E: erosion; Sed: encrusted sediment, OB: old break, FB: fresh break.

Sample id	Taxa	Type	L	W	T	Weight (g)	Perf n°	PDSM	Post-excavt.	Technology				Use	Provenience
										Sawing	Grinding	Polishing	Decoration		
VA14021-I	Spond.	Bead, frog	17	14	1	0.910	1	E, Sed	No	Yes	Yes	No	Inc	Yes	Los Cerritos
VA14021-II	Spond.	Bead, frog	16	15	2	1.030	1	E, Sed	No	Yes	Yes	No	Inc	Yes	Los Cerritos
VA14021-III	Spond.	Bead, frog	19	17	1	0.870	1	E, Sed	No	Yes	Yes	No	Inc	Yes	Los Cerritos
VA14021-IV	Spond.	Bead, frog	16	14	1	0.680	1	E, Sed	No	Yes	Yes	No	Inc	Yes	Los Cerritos
VA14021-V	Spond.	Bead, frog	18	15	2	1.410	1	E, Sed	No	Yes	Yes	No	Inc	Yes	Los Cerritos
VA14018	Spond.	Pend, turtle	33	25	7	7.410	2	E, Sed	I	Yes	Yes	Yes	Inc, Exc, Dril	Hi	Los Cerritos, burial
VA15431-I	Bivalve	Pend, knob	24	10	2	0.830	1	Sed	No	Yes	Yes	No	No	Hi	El Zamuro
VA15431-II	Bivalve	Pend, knob	43	10	2	1.370	1	E, Sed	No	Yes	Yes	No	Yes	Yes	El Zamuro
VA15431-III	Bivalve	Pend, knob	39	10	2	1.330	1	E	No	Yes	Yes	No	Yes	Yes	El Zamuro
VA15522	Spond.	Pend, shell	30	32	3	5.220	1	E	I, NP, PO	Yes	Yes	Yes	Dril	Yes	El Zamuro/Camburito
VA14019	Spond.	Pend, triangle	22	40	2	3.590	2	E, Sed	I	Yes	Yes	No	Inc, dril	Yes	Los Cerritos, burial
VA15425	Lobatus	Pend, owl	49	48	5	31.630	1	OB, Sed	I, NP, PO	Yes	Yes	Yes	Inc, Exc, Dril	Hi	El Zamuro
VA14017	Lobatus	Pend, armadillo	32	16	12	3.000	2	No	I, NP, PO	Yes	Yes	Yes	Inc, Exc, Dril	No	Los Cerritos, burial
VA14014	Spond.	Pend, hybrid	76	46	3	25.220	1	E, Sed	I, NP, S, PO, MR	Yes	Yes	No	Inc, Exc, Dril	No	Los Cerritos, burial
VA13994	Lobatus	Pend, axe	43	22	11	19.820	1	FB, Sed	I, NP, S, SN	No	Yes	No	No	No	La Cabrera

entering the rim of perforation; and 4) polish and rounding on the edges. The presence, distribution, and intensity of these traces provided data regarding the relative length of use.

Interpretation in microwear research works through analogies and inferential leaps whose limits must be acknowledged (Van Gijn, 2010, 2014b). Artefacts undergo several processes that can

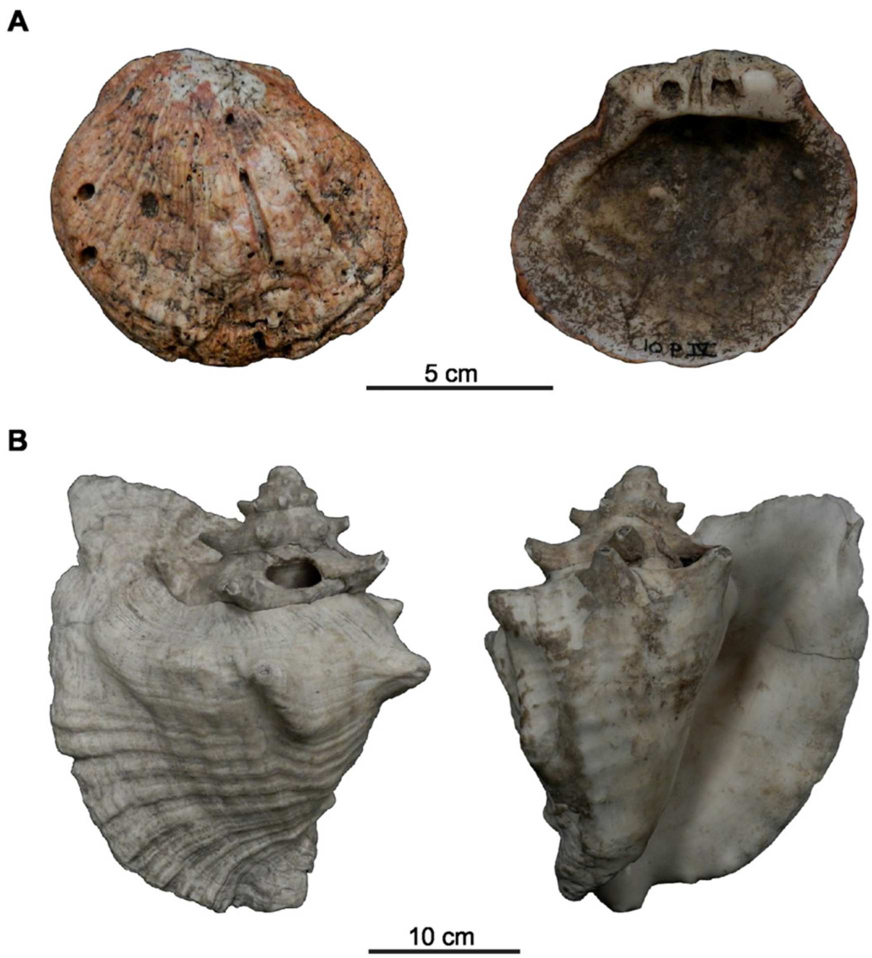

Fig. 3. Shells used in the production of Valencioid ornaments: (a) water worn *Spondylus americanus*, (b) *Lobatus gigas* with a hole made on the apex by a fisherman to remove the animal.

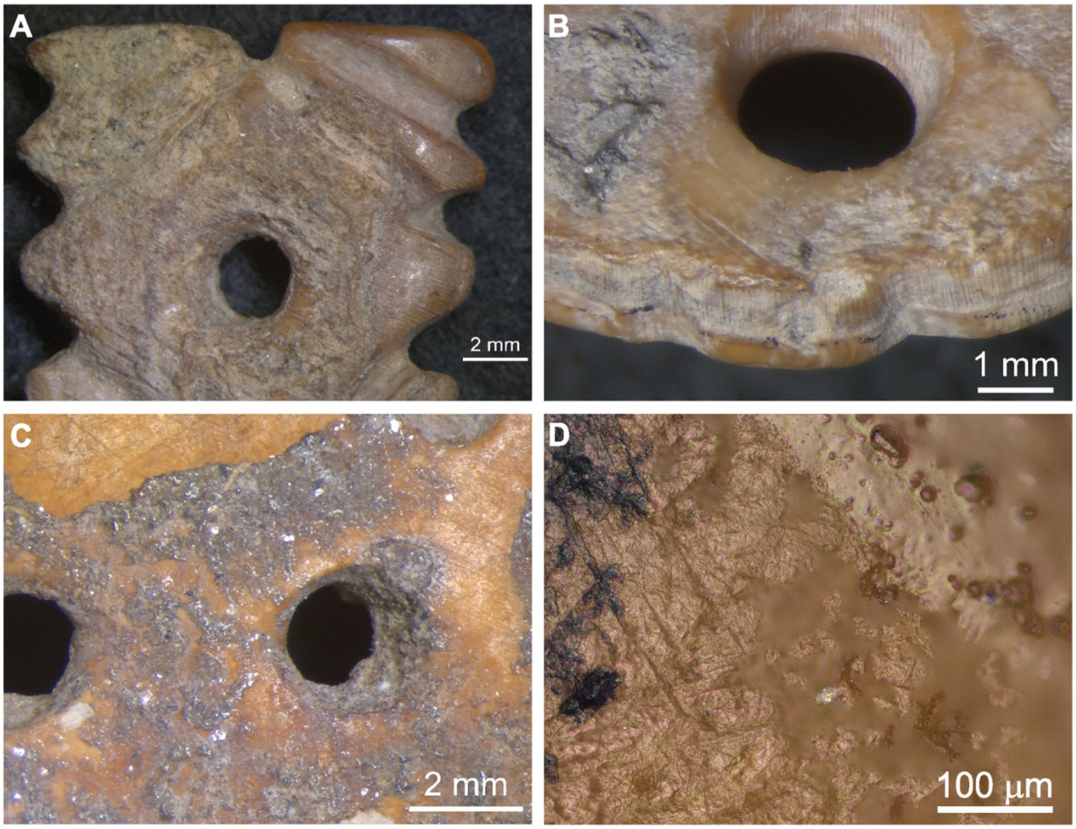

Fig. 4. Post-depositional and post-excavation modifications on the surface of shell ornaments: erosion (a, b, c), encrusted sediment (c), pencil outline (b), ink and nail polish (d). Staatliche Museen zu Berlin - Ethnologisches Museum, Preußischer Kulturbesitz, VA 14021 V (a), VA 15431 II (b), VA 14019 (c), VA 14018 (d).

impair the recognition of traces on their surfaces. In addition to the already mentioned post-depositional and curatorial modifications, new traces superpose previous ones, modifying or erasing them during ornament manufacture and use. Experiments reproduce activities in a mechanical and controlled fashion which offers limited comparison to the complex activities that take place in a real social context (Van Gijn, 2014b). In this sense, traces on experimental pieces cannot be taken as replicas of those on archaeological artefacts. The limits of interpretation become clearer in the case of figurative ornaments, whose production involved the application of several techniques in succession, thus requiring high skill and experience. For the present research, it was decided to just reproduce individual techniques, i.e. testing the interaction between certain tools and contact materials, in order to contrast the microscopic traces experimentally generated to the archaeological ones. This somewhat mechanical approach would avoid the issue of our lack of skills and expertise to some extent. Attention was also given to the microstratigraphy of traces on artefacts: this allowed us to assess how the techniques were applied in succession, thus constituting a production sequence.

Table 2
Experiments conducted; slurries used: water (W), sand (S), coral (C).

Exp n°	Blank	Technique	Tool	Slurry	Time	Efficiency
2480	*L. gigas* lip	Percussion	Hammer-stone, wood anvil	No	–	Effective
2484-1	*L. gigas* lip	Grinding	*Acropora palmata*	W	–	Effective
2484-2	*L. gigas* lip	Drilling	Hafted flint palms	No	–	Effective
2486	*L. gigas* lip	Drilling	Bow drill flint	No	–	Effective
2487-1	*L. gigas* lip	Drilling	Hafted G. officinale wood palms	S, W, C	–	Ineffective
2487-2	*L. gigas* lip	Drilling	Mechanical drill wood	S, W	102′55″	Effective
2490-1	*L. gigas* lip	Sawing	Flint blade	No	–	Effective
2500	*L. gigas* lip	Grinding	*A. palmata*	No	24′	Effective
3055-1	*L. gigas* lip	Sawing	Flint	S, W	135′	Effective
3043	*Spondylus* sp.	Sawing	Flint	No	63′	Effective
3045	*Spondylus* sp.	Grinding	*A. palmata*	S, W	35′	Effective
3061-1	*Spondylus* sp.	Percussion	Hammer-stone, wood anvil	No	–	Effective
3061-2	*Spondylus* sp.	Drilling	Mechanical drill bone	S, W	110′	Effective
3062-1	*Spondylus* sp.	Grinding	Sandstone	W	80′	Effective
3062-2	*Spondylus* sp.	Notching	Flint	No	25′	Effective
3062-3	*Spondylus* sp.	Notching	G. officinale wood	S, W	91′	Effective

The main objective of the experimental research was to assess production techniques of *S. americanus* and *L. gigas* ornaments. The choice for toolkits was based on observed archaeological traces, and ethnographic and ethnohistoric descriptions from the Caribbean and lowland South America. Other experiments previously conducted in the Caribbean also served as reference (e.g., Antczak, 1998; Carlson, 1995; De Mille et al., 2008; Lammers-Keijsers, 2007). Our experiments covered different stages of manufacture, including blank acquisition, grinding, decorating, and drilling (Table 2). Whereas hard lithic tools have been found associated to bead-making debitage in some Caribbean sites (Carlson, 1995; Haviser, 1990; Narganes Storde, 1995; Rodríguez, 1991), different sources suggest that wood, bone and cotton strings were probably likewise used for sawing and drilling (Koch-Grünberg, 2005; Las Casas, 1967; Lothrop, 1955; Ribeiro, 1988; Rodríguez Ramos, 2013; Rostain, 2006; Roth, 1924). As grinding platforms, coral slabs made of *Acropora palmata* (Lamarck, 1816) were used in our experiments, as suggested by abundant Caribbean literature and site inventories (Antczak, 1998; Clerc, 1974; Kelly, 2003; Kelly and Van Gijn, 2008; Lammers-Keijsers, 2007; Van Gijn et al., 2008). The results of the experiments will be discussed below (Section 3), where they will be contrasted to traces observed on the Valencia Lake artefacts.

3. Results: production sequence

In the sections below, the different stages, techniques, and tools involved in the *chaîne opératoire* of complex figurative ornaments will be discussed. Potential challenges in the analysis and interpretation will also be highlighted. As we hope to demonstrate, shell ornament technology in the Valencia Lake Basin involved multiple stages, high skill, and good understanding of raw material properties, alongside clear forward planning.

3.1. Blank acquisition

The majority of ornaments were made through sawing and breaking flat blanks from a shell (11; 73,3%), which can be recognized by their flat or convex cross-section with straight or tilted sides. These traits were observed on frog-shaped beads (VA 14021 I-V) and on the shell- (VA 15522), the triangle- (VA14019) and the "knob"-shaped pendants (VA 15431 I-III). Cut marks were left on the sides, although they were often erased by subsequent surface treatments (Fig. 5). The application of this technique involved the sawing of cut grooves, followed by snapping the piece of raw material. Whereas sawing a *Spondylus* sp. shell with flint is quite fast and allows for the production of controlled blanks (exp. 3043), flaking the shell does not easily produce blanks of a desired shape (exp. 3061-1). The choice for sawing could therefore be related to an efficient use of the marine shells given their sparse availability in the Valencia Lake Basin.

In contrast, the pendants made from shells of the *L. gigas* required a preliminary method of blank acquisition. No clear traces from this stage are observed on the ornaments, as their manufacture led to considerable modification of the original blank. Nevertheless, the natural morphology and curvature of the shell, in addition to the presence of nacre and natural irregularities, provide insight into the sectors of the shell from which the blanks were obtained: the lip and the body whorl. Sawing experiments with a flint tool on *L. gigas* showed that the technique is time-consuming and results in constant breakage of the edge of the flint flake (exp. 3055–1). The complex cross-lamellar microstructure of the *L. gigas* shell renders it tough, and alongside its thickness, makes the shell resistant in the natural environment (Kamat et al., 2000). Flaking or breaking the shell is necessary, especially if the primary goal is to separate the lip from the body whorl or to open the whorl (Antczak, 1998). One can also take advantage of the natural layering of the shell to obtain blanks (Suarez, 1981; Vargas Arenas et al., 1997). Antczak (1998, 399–401) demonstrated the varied ways in which the *L. gigas* shell was broken in the islands off the Venezuelan coast for the creation of usable parts to be taken to the Valencia Lake Basin. Knapping operations could be performed using the apex of the shell or a hammerstone, and a slab of *Acropora palmata* or stone as anvil.

3.2. Grinding

In the shaping stage, different techniques were applied in order to render the morphology of the blank closer to that of the desired end-product. Grinding was the most common shaping technique, being used to remove irregularities of the shell, the nacreous layer and to create a smooth surface for carving. The microtopography observed on artefacts, with flat and striated polish predominantly on the tops, suggests the use of mineral hard materials for grinding, possibly stones or corals (Fig. 6a, c, e). The experimental grinding of *L. gigas* shells was time-consuming, especially when compared to *Spondylus* sp. (exp. 3045). The use of sandstone platforms with abrasives generated an intensively flattened microtopography and abundant regular striations on the shells, produced by the grains dislodged from the platform and/or added abrasives (Fig. 6d). Grinding with an *A. palmata* platform was facilitated by the addition of water, due to the formation of a thin abrasive paste by the dislodged coral grains (Breukel, 2013; Kelly, 2003; Lammers-Keijsers, 2007). The *Spondylus* sp. blank ground on coral presented less pronounced flattening and fewer striations, probably related to the lack of coarse abrasives (Fig. 6f), while the *L. gigas* blank presents intense thin striations (Fig. 6b). In this sense, at this stage, it is not possible to distinguish the material used for grinding the archaeological artefacts. Further experiments are required.

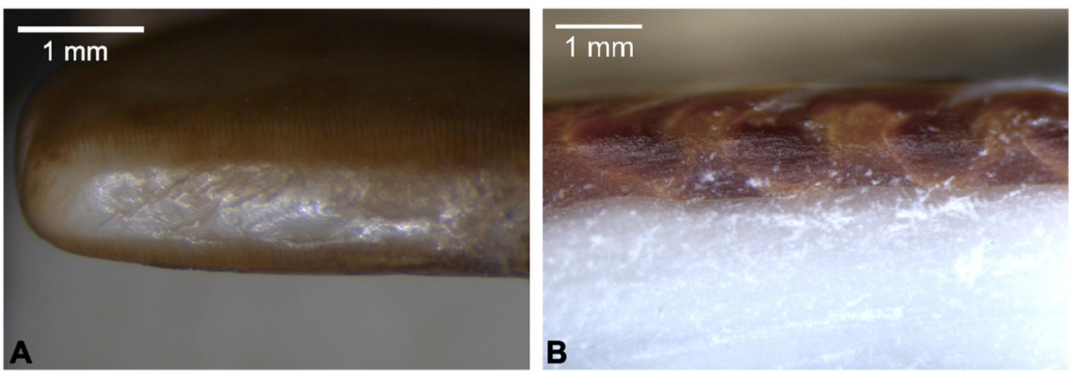

Fig. 5. Partially erased cutting traces on archaeological (a) and experimental (b) shell ornaments. Staatliche Museen zu Berlin - Ethnologisches Museum, Preußischer Kulturbesitz, VA 14021 V (a).

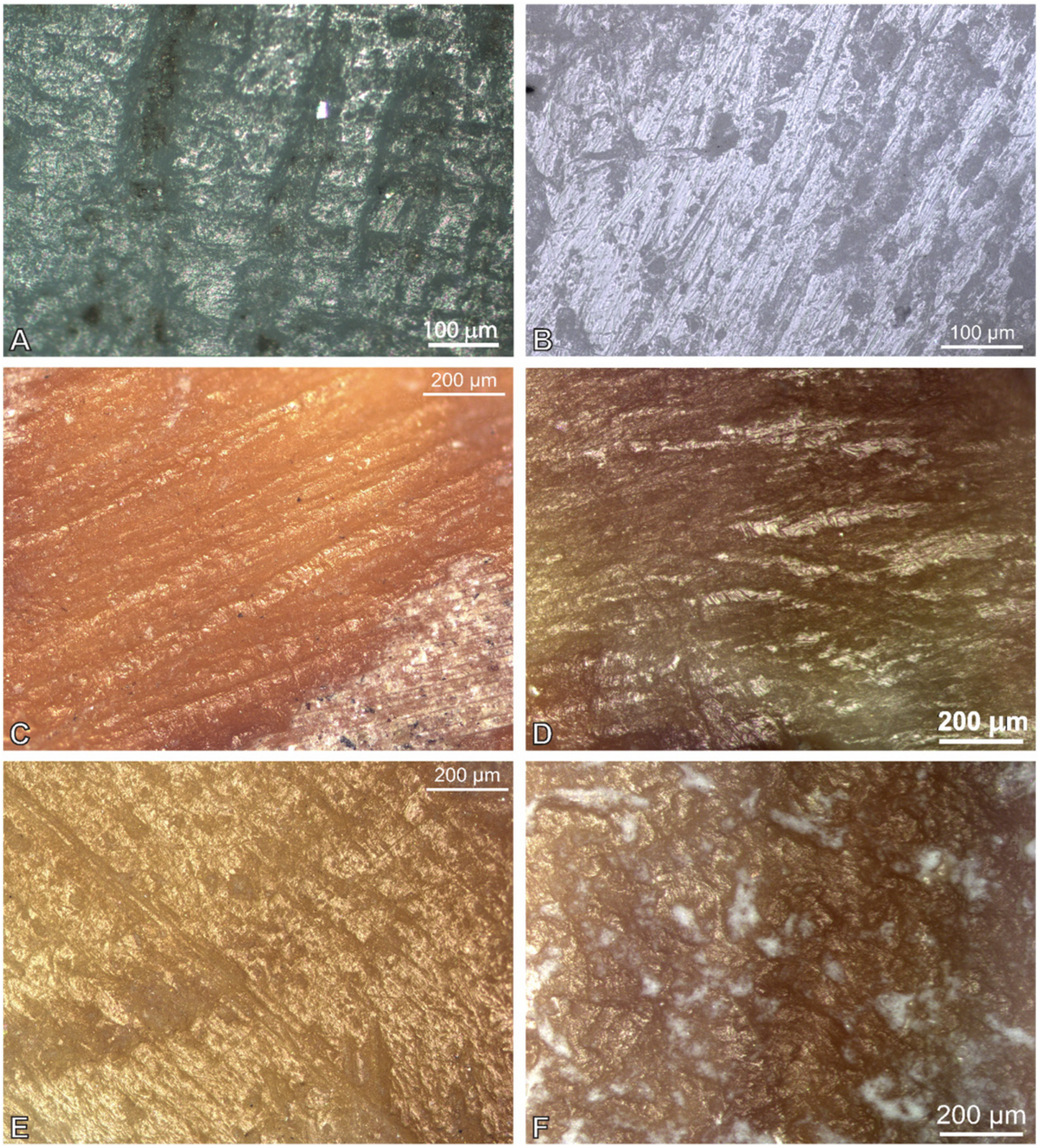

Fig. 6. Archaeological (a, c, e) and experimental (b, d, f) grinding traces. Staatliche Museen zu Berlin - Ethnologisches Museum, Preußischer Kulturbesitz, VA 14017 (a), VA 14019 (c), VA 14018 (e).

3.3. Notching and incising

Notches with V-shaped profiles and striations were observed on frog-shaped beads and "knob" pendants (Fig. 7a). These notches could be made by sawing with a hard lithic tool on the side of the artefacts, in order to give the blanks specific figurative designs. After the first cuts in a same position, notches were expanded by the execution of multiple cuts by the same tool in slightly different positions. Both notch the V- and stepped V-shapes were reproduced during the experiments using flint (Fig. 7b). Other notches, observed on *S. americanus* and *L. gigas* biomorphic pendants, have a U-shape and striations (Fig. 7c). These notches may have also been started with a hard lithic tool, but were subsequently widened with a softer tool, for instance wood or bone. It has been argued that, when using soft tools for sawing, slurries must be added as the abrasiveness of the hard grains, carried back-and-forth by the tool's edge, is the active agent, while the water is lubricating and cooling both surfaces in contact (Miller, 2007, 59; Hodges, 1971, 105). In order to reproduce a U-shaped notch on the side of a *Spondylus* sp. shell fragment with a *Guaiacum officinale* wooden flake (Fig. 7d), a preliminary notch had to be made with flint (exp. 3062-3). On archaeological specimens, the notch was produced by first sawing the opposing faces of the shell, before linking the two grooves by sawing the side. During experiments, this proved to be easier than directly sawing the thin side, where there is less support for the edge of the tool.

On the studied ornaments, sawing was also used to add decorative designs or to create morphological patterns on the depicted animals. The technique produced U-shaped incised lines with striations (Fig. 8a–d). The carved lines are generally thicker on the centre of the surface, while they appear thinner closer to the edges of the artefacts. This is a

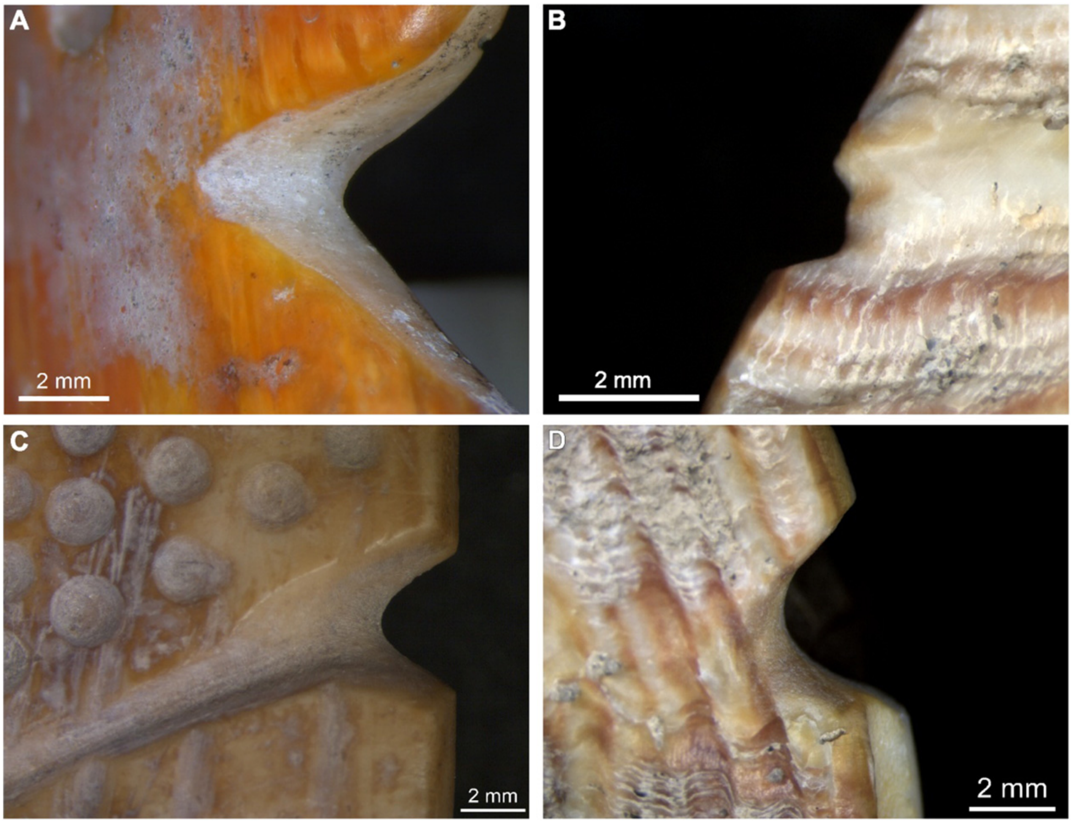

Fig. 7. Archaeological (a, c) and experimental (b, d) side notches. Staatliche Museen zu Berlin - Ethnologisches Museum, Preußischer Kulturbesitz, VA 15522 (a) and VA 14014 (c).

result of the sequence of gestures used for sawing: according to the experiments, it is easier to start by sawing the pronounced centre of a convex surface, and only afterwards proceed towards the edges. Therefore, a greater number of cuts are present on the centre, generating a wider and deeper incision groove. The observation of the artefacts shows that side notches were often produced after the decorative incisions. In fact, certain incisions were applied at an early stage of manufacture probably to serve as a sketch of the desired shape, guiding its execution (Fig. 8e). This can be regarded as evidence that the choice for a specific blank is connected to the desire of creating an end-product with a certain shape. For example, morphological features of zoomorphic ornaments were excised through the execution of multiple incisions and notches, isolating an area from the rest of the artefact (Fig. 8f). In this sense, a sufficiently long and thick blank had to be selected for making the armadillo-shaped pendant, so that its head and tail could be separated from the main body. This blank is rather different from the one necessary for the production of, for instance, the turtle-shaped pendant. The maker knew how to manipulate the volumes and properties of each raw material in order to create the desired figures.

3.4. Drilling

Drilling was used to create suspension holes and as a decorating technique, producing dots, eye sockets and mouths on the ornaments. Decorative perforations were not completed, creating just a shallow stepped circle (Figs. 7c, 8c, f). The abundance of this feature on the artefacts shows that their production was not considered risky from a technological point of view. The drilling technique produced suspension holes with similar characteristics in all ornaments, suggesting the use of a specialized massive drill. Features include cone-shaped or cylindrical perforations, a diameter of 2–3 mm, a tapering but relatively flat leading edge, and thick and regular circular furrows (Fig. 9a, b). Perforations were made predominantly from one face and only finished from the other. The exceptions are the perforations in which the two cones are placed in angles close to 90°.

To explore the kind of drill that would produce these features, experiments were conducted using different drilling mechanisms and bits. A handheld flint tool was used to start perforations, so that the drilling devices could be stabilized. While all the experiments with flint proved to be effective, the use of drill bits of organic materials was only efficacious when mounted on a mechanical drill and with addition of sand and water. *G. officinale* wood and mammal bone were used to drill *L. gigas* and *Spondylus* sp. respectively (exp. 2487-2 and 3061-2). Both tasks were time-consuming, but nevertheless efficacious. Depending on the morphology of the drill bit, the perforations were cone-shaped or cylindrical. The micromorphology of the experimental perforation made with wood is closer to the archaeological ones, including a tapering cylindrical shape, furrows, and a flattened leading edge (Fig. 9c, d). The furrows are quite regular in shape, in contrast to those experimentally obtained by working with a flint drill bit. They could have been caused both by accumulations of abrasive powder and debris and by the wearing of the wood, which makes the edge blunt and larger. More experiments need to be carried out to test this hypothesis.

3.5. Polishing

The presence of modern additions to the surface of some ornaments prevented a detailed analysis of the polish on a number of cases. Many

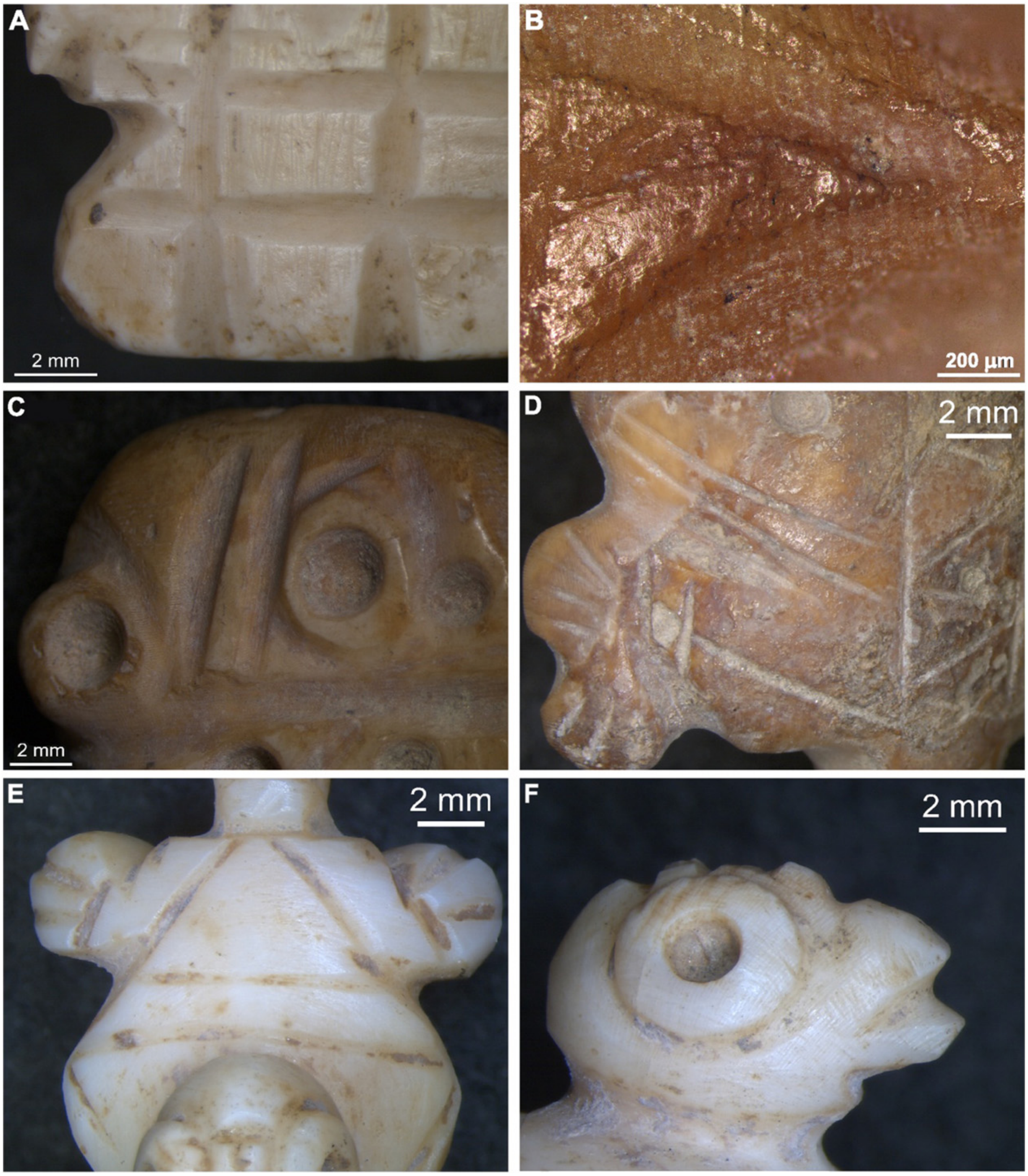

Fig. 8. Decorating techniques: incision (a–e), excision (f), and unfinished perforations (c, f). Staatliche Museen zu Berlin - Ethnologisches Museum, Preußischer Kulturbesitz, VA 15425 (a), VA 14014 (b, c), VA 14018 (d), VA 14017 (e, f).

artefacts had a rounded appearance and polish along the edges, which is likely connected to continuous use (see Section 4). The presence of a polishing stage, understood as a surface treatment designed to smoothen the artefacts' surfaces, alongside giving it sheen, was only possible to ascertain on few artefacts. It was used for the zoomorphic ornaments, where traces from the preceding production stages were intentionally smoothened. A soft and malleable material was rubbed on low areas of the artefacts in order to erase cut marks from notching and excising. These low-lying areas would not be in direct contact with the skin during use. However, the abundance of misplaced cut marks on the figurative ornaments suggests that, in comparison to the extent of the grinding stage, the effort put into polishing was minimal. The technique was also used for giving certain features a more rounded appearance.

4. Results: use-wear

Most shell ornaments display evidence for having been used (12; 80%), often in the form of polish and rounding on the rim of perforation (6; 40%) (Fig. 10). These traces are produced by friction of the string on the rim of perforation during attachment and by the presence of body fluids (Vanhaeren et al., 2013). On one pendant, scratches entering the rim were observed, probably caused by the abrasive nature of the string

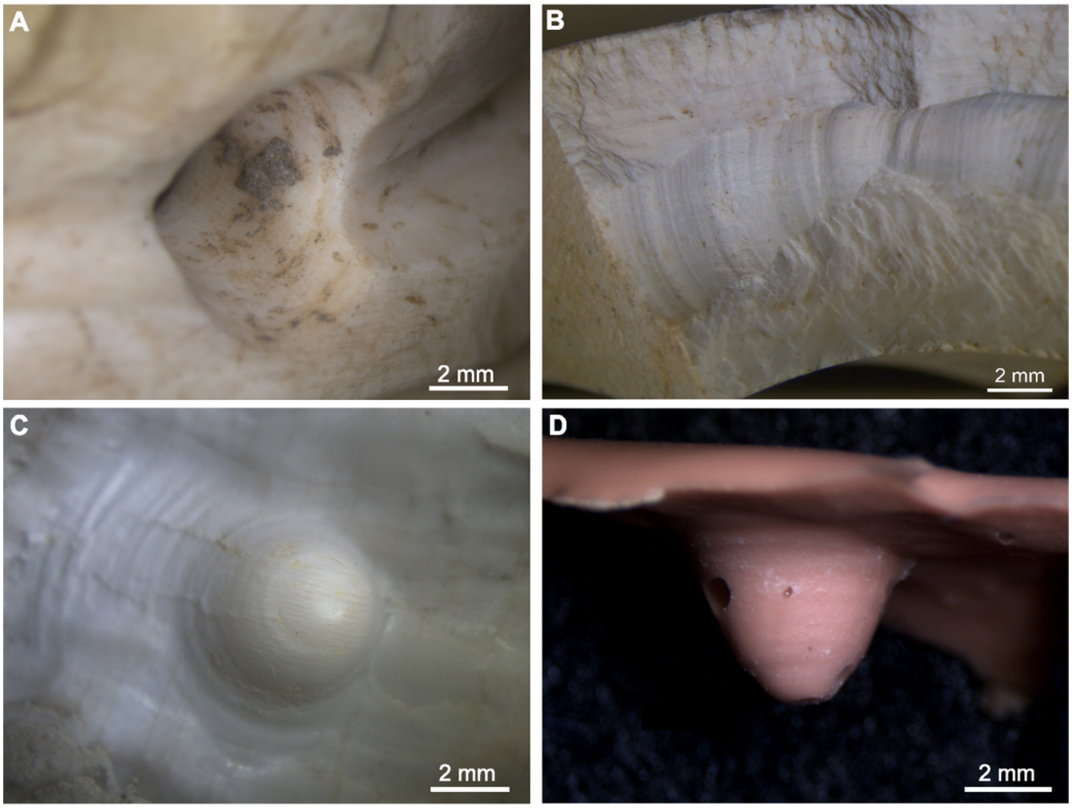

Fig. 9. Holes produced by drilling on *Lobatus gigas* shell: detail of the holes on VA 15425 (a) and VA 13994 (b). Staatliche Museen zu Berlin - Ethnologisches Museum, Preußischer Kulturbesitz. Hole experimentally produced with a *Guiacum officinale* tip (c) and its cast made with polyvinylsiloxane (d).

material, as in the case of siliceous plants (Fig. 10a, b). Deformation of the rim of perforation was noted on seven artefacts (46,7%), being probably connected to long-term usage of the ornament (Fig. 10c, e). The association of deformed grooves and scratches with the use polish allows for a clear differentiation from deliberate cut marks. Contact with the human body and/or clothing caused a distinctive polish around the edges of artefacts on the non-decorated, concave faces ($n = 7$) and on both faces ($n = 3$). Three artefacts do not display use-wear traces. Post-depositional surface modifications affected the interpretation of some artefacts, whenever they underwent breakage, extensive erosion of the rim, and sediment encrustation. On the concave surfaces, the remains of nacre, alongside nail polish and ink, impaired interpretation. No residues that could have been used to attach the ornaments, such as adhesives or gums, have been observed on the artefacts. The interpretation of any potential residue as archaeological is also considered problematic due to the long post-excavation trajectory of the collection.

The two perforations at angles of approximately 90° on the sides observed on two studied pendants (VA 14018 and VA 14017) are also typical of the Amazonian *muiraquitãs*; it has been suggested that they were related to a specific system of attachment, different from just hanging the artefact on a necklace (Barata, 1954; Gomes, 2001; Moraes et al., 2014). Similarly, size and weight must have been relevant in the placement of ornaments, as larger artefacts were potentially placed in positions of notice (e.g., on the centre front, on the back or on the sides). Most zoomorphic pendants display highly developed traces on these zones. The combination of the different use-wear traces on each artefact suggests that they were in fact woven into a composition. For instance, the owl-shaped pendant probably had strings attached from the sides and through the mouth (Fig. 10e, f). The turtle-shaped pendant was likely attached with a single string passing along the width of the artefact, but with knots on the end of each perforation in order to keep the pendant in place (Fig. 10g, h).

In relation to the asymmetric and geometric specimens, deformation was clearly observed on the "knob" pendants, which displayed grooves on both faces, extending from the perforation to one of the edges of the artefacts (Fig. 10d). The grooves were caused by use and are indicative of strings being tied on both sides of the pendant. They were probably kept in place by multiple strings (or the same one passing inside the hole more than once), which attached it to a fixed position on a band. The shell-shaped pendant had a similar system of attachment, but the visible part would be the coloured face, rather than the side. In the frog-shaped beads, the erosion of the perforation area prevented an interpretation of the systems of attachment.

5. Discussion and conclusion

Microscopic analysis of ornaments has developed into an established field of studies over the past 20 years (Moro Abadía and Nowell, 2015; White, 2007). In the present article, we expand this method to a region where it has seldom been applied, i.e. the circum-Caribbean (see also Falci, 2015). By displaying complex and varied shapes, the Venezuelan collections studied here pose new questions for the field. We identified three challenges regarding the nature of these collections that require a critical approach to interpretation: 1) the conditions of preservation, 2) the complexity of the three-dimensional artefact shapes and our limitations in replicating them, and 3) the varied ways in which the artefacts may have been used. These will be further discussed below.

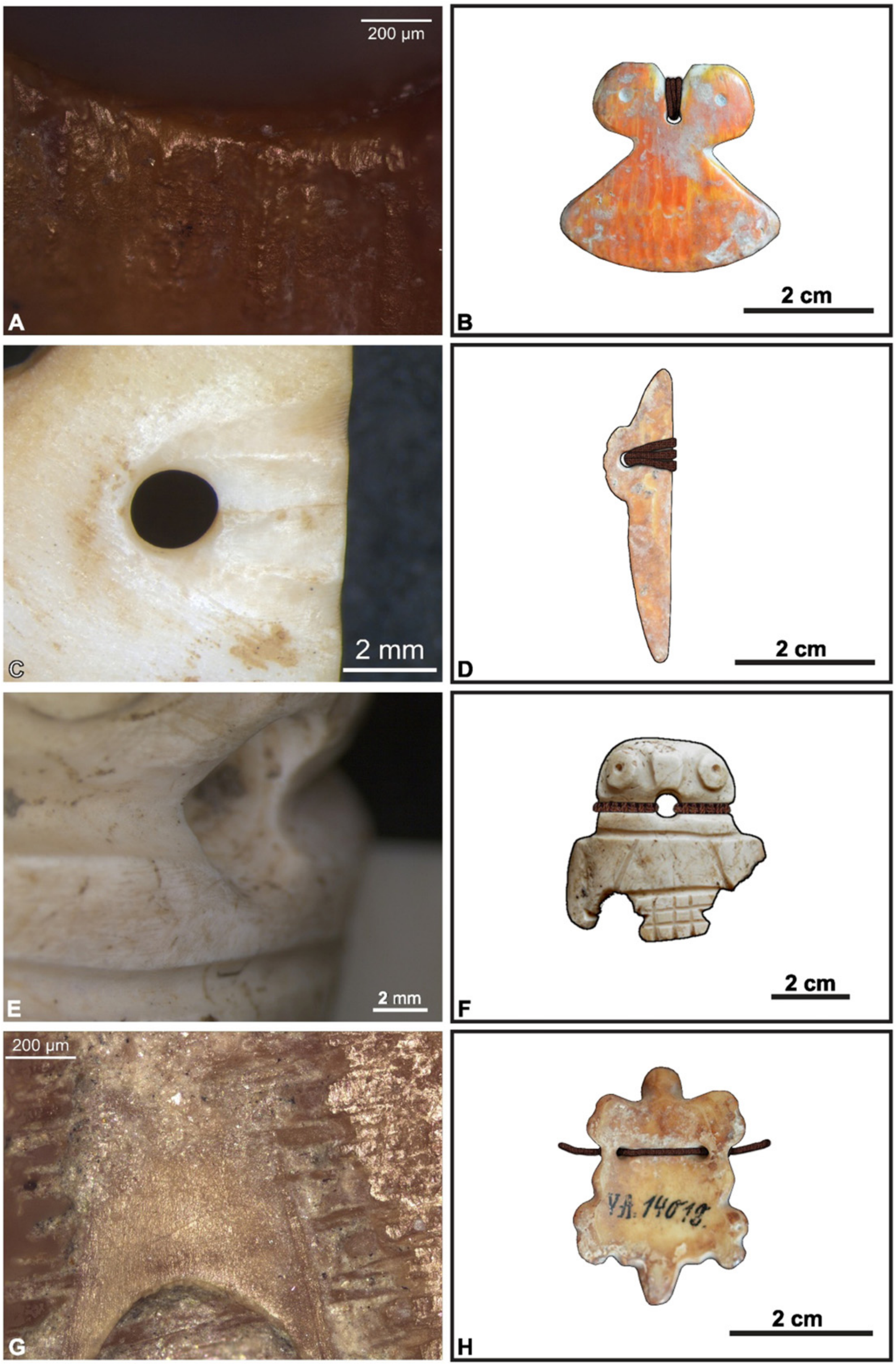

Fig. 10. Use-wear traces on shell ornaments (a, c, e, g) and potential attachment systems (b, d, f, h). Staatliche Museen zu Berlin - Ethnologisches Museum, Preußischer Kulturbesitz, VA 15522 (a, b), VA 15431 I (c), VA 15431 III (d), VA 15425 (e, f), VA 14018 (g, h).

The state of preservation of the artefacts that make part of museum collections was the first challenge dealt with. Post-depositional and curatorial surface modifications cannot be ignored, as analysis and interpretation of a number of specimens is impaired. The great variability in types in the assemblage, alongside modern surface modifications, limited analysis to low power stereomicroscopy. Nevertheless, a careful examination of most artefacts under varying magnifications, alongside an experimental programme, allowed a range of conclusions to be drawn in relation to the production and use of these complex figurative ornaments.

The microwear method, for its focus on individual artefacts, proved to be particularly useful in understanding complex biographies. At the same time, it provided insight into the local tradition in ornament making. In this sense, despite the variety of shapes, the same basic techniques were used, involving a combination of hard stone tools to start knapping, incising, sawing, and drilling, and softer materials to widen the features produced. The microstratigraphy of traces on individual ornaments points to a systematic and recurring sequence in which the techniques were applied. This evidence, alongside the choice for specific shell parts for the production of certain shapes, suggests the existence of a common technological system and mental templates guiding manufacture. The three-dimensional shapes of the ornaments and the lack of technical errors are evidence of the high craftsmanship involved in shell working. Future research on Valencioid collections is necessary to provide further insights into the topic of craft specialization in the production of complex figurative ornaments and its relation to increasing social complexity in the Valencia Lake Basin.

Regarding the experimental programme, the choice for replicating only certain techniques and toolkits, instead of entire production sequences, provided an appropriate reference collection. However, the superposition of different surface treatments and the toolkits used for these purposes also require more extensive research. The performance of several techniques in a sequence in order to produce complex figurative shapes can only be better understood with further experiments in collaboration with skilled artisans.

In relation to use-wear traces, there is a gap between systems of attachment of individual artefacts and actual composite ornaments. Our preconceptions regarding how ornaments were used in the past can lead to biased analysis and interpretation (Frieman, 2012; Van Gijn, 2010, 2014a). On a practical level, these assumptions may result in exclusive attention to areas on ornaments where traces are expected (i.e. rim of perforation and edges) and in overlooking artefacts which are not typologically categorized as ornaments. In broader terms, the very idea that composite ornaments would have been constituted solely by a string, beads of a single type and a pendant is misleading. While further interpretation of the position of individual beads and pendants in composite pieces is hampered by different preservation rates of materials in the archaeological record, drawing a linkage between use-wear traces and actual ethnographic artefacts (e.g., necklaces, bands and clothing items) can provide fruitful insights (e.g., Bonnardin, 2008; Cristiani et al., 2014, 2016; Langley and O'Connor, 2015).

Ethnographic and early historic composite ornaments belonging to indigenous communities from the lowlands of South America involve a range of raw materials, such as seed or glass beads, nuts, bird feathers, stones, metal sheets, animal parts, and plastic (Ribeiro, 1986; Ribeiro, 1988). However, figurative ornaments are not common. Whilst necklaces with carved animal figures of *tucum* nut (*Astrocaryum* sp.) are made by the Tukúna and Mehináku peoples (Ribeiro, 1988, 167), the *tucum* pendants are small and light-weighted and, therefore, not comparable to the pendants studied here. The other known example is of a figurative pendant of polished black stone, which was added to belts and necklaces made of shell disc beads by communities in the Upper Xingu (Hartmann, 1986, 190; Ribeiro, 1988, 160). While different types of attachment were present, they all involved the stone pendants being suspended from a string. Conversely, the use-wear evidence suggests that the large figurative pendants (VA14018 and VA15425) were integrated in woven bands, rather than suspended from a string. Freshwater and land snail shell ornaments are recurrent among some communities in southern Amazonia and central Brazil as necklace pieces, but are generally light-weighted and display simple geometric shapes (Ribeiro, 1988). The shell-shaped pendant (VA15522) may have been part of similar necklaces. The attachment system seen on the "knob" pendants (VA15431) is comparable to necklaces and crowns with jaguar claws found in the Upper Xingu and among the Borôro (Ribeiro, 1988, 166–69). The claws are tied in a band so that the sharp tip of the claws faces upwards. In the future, a systematic comparison with indigenous ornaments from the South American lowlands will be made by generating microscopic data from ethnographic specimens.

Lapidary industries have gained considerable attention in circum-Caribbean archaeology in the last decades, as they play an important role in accounts of the Caribbean as a hub of intense indigenous mobility and interaction (Boomert, 1987; Cody, 1991; Hofman et al., 2007, 2014a, 2014b; Serrand and Cummings, 2014; Watters, 1997). Nevertheless, the majority of research has focused on rock identification and typo-technological studies. As a result, the toolkits used in the production of ornaments of varied types and raw materials are unknown; likewise, little is known regarding the extent to which there would have been specialization in their production. Future microwear research on other collections can provide a better understanding of the biographies of ornaments in the circum-Caribbean. Despite the challenges these artefacts may pose to microwear analysis, they should be further studied due to their varied nature in terms of raw materials, designs, and the skill involved in their production.

Acknowledgements

This work was made possible through the collaboration of the Ethnologisches Museum Berlin, especially Dr. Manuela Fischer, curator and department head of the South American Collections. We would further like to thank Diederik Pomstra and Tom Breukel for their collaboration in the experimental programme, and the latter for his comments on an early version of this manuscript. This research is part of the project NEXUS1492, which has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ERC Grant agreement n° 319209, under the direction of Prof. dr. C. L. Hofman. This research has also benefitted from the support of the NWO Spinoza Prize awarded to Prof. dr. C. L. Hofman in 2014.

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3

Use-wear and the complex biographies of ornaments

Published as:

Falci, C.G., Cuisin, J., Delpuech, A., Van Gijn, A.L., Hofman, C.L., 2019. New insights into use-wear development in bodily ornaments through the study of ethnographic collections. *Journal of Archaeological Method and Theory* 26(2), 755-805. http://dx.doi.org/10.1007/s10816-018-9389-8

Journal of Archaeological Method and Theory (2019) 26:755–805
https://doi.org/10.1007/s10816-018-9389-8

New Insights into Use-Wear Development in Bodily Ornaments Through the Study of Ethnographic Collections

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Published online: 5 September 2018

Abstract

The use of microwear analysis has made substantial contributions to the study of archaeological bodily ornaments. However, limitations persist with regard to the interpretation of use and the reconstruction of systems of attachment, hampering a holistic understanding of the diversity of past bodily adornment. This is because the complexities of ornament biographies and the resulting wear traces cannot be grasped exclusively from the study of experimental reference collections. In this paper, we propose to bridge this gap in interpretation by systematically researching ethnographic collections. We conducted a microscopic study of 38 composite ornaments from lowland South America housed at the Musée du quai Branly (Paris). These objects involve organic, biomineral, and inorganic components, attached through different string configurations. The combined use of optical and 3D digital microscopy at different magnification ranges provided a thorough understanding of wear trace formation, distribution, and characterization. We demonstrate how individual beads develop characteristic use-wear in relation to one another and to the strings. We further challenge common assumptions made in the analysis of archaeological ornaments. In sum, this research addresses methodological and interpretative issues in the study of bodily adornment at large, by providing insight into the biographies of objects that were actually worn in a lived context. In the future, our results can be applied as reference for a more effective understanding of the use of ornaments worldwide.

Keywords Ornaments · Use-wear · Hard animal materials · Ethnographic collections · Lowland South America · Object biography

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10816-018-9389-8) contains supplementary material, which is available to authorized users.

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Introduction

Bodily adornment is a prevalent feature of human societies, whose richness and variability are attested in both ethnographic and archaeological contexts. Ethnographic sources have shown that ornaments are often associated with symbolic systems, ethnic identity, and personhood (Miller 2009; Roach-Higgins and Eicher 1992; Seeger 1975; Strathern 1979; Turner 1995, 2012; Wiessner 1982). For this reason, ornaments are thought to provide a window into social, cultural, and cognitive aspects of past human societies otherwise elusive in the archaeological record (DiPaolo Loren 2009; Joyce 2005; Kuhn and Stiner 2007; Moro Abadía and Nowell 2015; Newell *et al.* 1990; Vanhaeren and d'Errico 2006; White 1992; White and Beaudry 2009; Wright and Garrard 2003). Great efforts have thus been put into the study of ornament assemblages from a wide variety of contexts and time periods. Microwear analysis forms a key method in assessing the biographies of ornaments, in particular their production and use. Many researchers have carried out experimental programs, replicating techniques, toolkits, and sequences of production (*e.g.*, Álvarez Fernández 2006; d'Errico *et al.* 1993; d'Errico *et al.* 2005; Francis Jr 1982; Gurova *et al.* 2013; Mărgărit *et al.* 2016; Melgar Tísoc 2012; Sax and Ji 2013; Tátá *et al.* 2014; Velázquez-Castro 2012; Vidale 1995; Yerkes 1993). Experiments generally focus on certain variables considered to be relevant in a given study; this control allows the researcher to establish a relation between observed production microtraces and specific variables (Adams 2010; Bamforth 2010; Outram 2008; Reynolds 1999). In its turn, the study of use-wear has offered insight into how individual ornaments integrated composite constructions. However, few studies have addressed the conditions under which this type of wear develops, in spite of the abundance of research dedicated to the observation of use-wear in archaeological ornaments.

Experimental studies focused on the use of beads include both the actualistic wearing of ornaments (Álvarez Fernández 2006; d'Errico 1993a; d'Errico *et al.* 1993; Mărgărit 2016; Minotti 2014; Verschoof 2008) and the (mechanical) replication of use-wear in a clinical setting (Brasser 2015; d'Errico 1993a, b; d'Errico *et al.* 1993; Langley and O'Connor 2016; Rainio and Mannermaa 2014; Vanhaeren *et al.* 2013). On the one hand, actualistic experiments provide a more accurate reference collection, as artifacts are subjected to conditions that are more similar to those of the past: they rest against the human body and may be worn during a range of quotidian activities. On the other hand, a mechanized system is capable of more easily isolating and adding variables, in addition to including longer durations or more intense use. Use duration and intensity are relevant variables to explore, as certain raw materials seem to require different periods of time to develop use-wear of comparable extent (*e.g.*, compare results for 3-month-long use of beads in Mărgărit 2016 and Verschoof 2008; also Álvarez Fernández 2006).

There are, nevertheless, a number of limiting factors in the creation of experimental ornament use-wear reference collections, whether they are actualistic or clinical. First, the differential preservation of raw materials in the archaeological record results in a partial view of past ornament components. A large variety of organic bead and string materials may have been part of a composite ornament but left no evidence in an archaeological site. Second, beads can be integrated in multiple types of ornaments, for instance bracelets, necklaces, anklets, aprons, and earrings. It is generally not possible to know the exact ornament type a studied artifact was part of, although well-preserved burial contexts can provide a wealth of information. This is an issue because the specific attachment system and composition of each ornament type have been shown to affect the distribution of use-wear (Langley and O'Connor 2016; Vanhaeren *et al.* 2013). Third, ornaments can be placed directly against the human skin, which may have paint or oils, or on top of clothing made of a variety of materials. Added substances and contact materials must be taken into account, as they affect the formation of use-wear. Fourth, wearing an ornament cannot be reduced to either a specific task or activity; in other words, it cannot be completed or finished, unless the components fall apart. Furthermore, it is not clear how different activities carried out while wearing an ornament may affect use-wear formation, such as dancing, hunting, fighting, or bathing. In sum, it is nearly impossible to tackle all such variables in experimental programs.

An alternative approach has been the study of composite ornaments belonging to ethnographic museum collections (Cristiani *et al.* 2014; Langley and O'Connor 2015; Wright *et al.* 2016). Thus far, this type of research has been conducted alongside the study of archaeological assemblages and, for this reason, has focused on specific ornament typologies and raw materials. Its main concern has been to provide comparison between ethnographic and archaeological microtraces in the context of specific case studies. Such collections can offer a great variety of use scenarios and provide (potentially highly developed) use-wear formed in a daily or ceremonial context. Differences between ethnographic and experimental collections can be connected to the specific *savoir-faire* involved in object production, length of usage, multiple types of use, storage, cleaning (or lack thereof), maintenance, and other forms of curation of objects over time (Choyke 2006; González-Urquijo *et al.* 2015; Hamon and Le Gall 2013; Stone 2011; Van Gijn 2014a).

In the study of archaeological artifacts, inferences are made concerning the presence or absence of use-wear, the relative degree of usage, and the system of attachment. However, such interpretations often implicitly reduce the lives of ornaments to a linear sequence that proceeds from raw material acquisition to stringing and, eventually, to discard. This assumed linearity dictates how we interpret ornaments to the exclusion of evidence that suggests that ornaments can have complex object biographies (*sensu* Kopytoff 1986), being restrung, repaired, broken apart, hidden away, widely exchanged, or kept as heirlooms over generations (*e.g.*, Chaumeil 2004; Ewart 2012; Lillios 1999; Oliveira 2017; Wiessner 1982). This is because assessing such specific intentionalities and biographies archaeologically is rather challenging. In this sense, the study of ethnographic ornaments may help us challenge commonly held assumptions in the analysis of archaeological artifacts, such as the idea that a necklace is a homogenous construct, in which all components have the same biography (Frieman 2012; Van Gijn 2017; Walker 2009; Woodward 2002). The ornament as a heterogeneous assemblage of components can be connected to the particular agentive capacities that it was expected to hold. Furthermore, any approach to ornaments that aims to focus on their communicative or agentive roles in society has to address the incompleteness of the archaeological record: a presumably complete necklace will be missing essential components. The choice for specific materials may not be related to an intrinsic value; rather, it may be connected to the presentation of such material in a specific composition together with other bead types and raw materials. In this sense, ethnographic composite ornaments can provide a more holistic picture of bodily adornment that should serve as reference for archaeological research—both from a methodological and conceptual standpoint. Their study can aid us in reconceptualizing the biographies of ornaments and the way the use of beads has been regarded in archaeological and anthropological research.

In the present paper, we provide new insights into the formation of use-wear in bodily ornaments. Rather than studying a specific type of ornament, a systematic research of a varied assemblage was carried out. Different ornament types were selected from indigenous South American collections of the Musée du quai Branly - Jacques Chirac in Paris (henceforth, MQB). The goal is to elucidate the relation between use-wear, systems of attachment, and contact materials. First, the present paper will evaluate how microwear research of ethnographic ornaments can be optimally conducted. The challenges involved in the analysis of complex and fragile composite objects must be clearly addressed. Second, the performances of three types of microscopes are evaluated: a stereomicroscope, a metallographic microscope, and a 3D digital microscope. While the first two have traditionally been used in use-wear research, the use of high magnification optical microscopy has been somewhat limited in the study of ornaments, especially of ethnographic ones. Furthermore, we apply for the first time the 3D digital microscope with a rotary head to the microwear study of ornaments and demonstrate how its use aided with handling and observation issues encountered during the study of composite objects. Third, this study characterizes use-wear across different raw materials and ornament types. The evidence will then be contrasted to common assumptions in the study of archaeological ornaments, such as whether specific wear trace distributions can be correlated to certain attachment systems. The study therefore constitutes a reference for future interpretations, providing a window into the biographies of ornaments actually worn in a lived context and into how this use affected their surfaces. It ultimately aims to bring us a step closer to understanding how artifacts retrieved from archaeological sites once composed whole objects that were integrated in the social fabric of past societies.

Material and Methods

Ethnographers and voyagers have often recorded numerous and diverse bodily ornaments among indigenous communities from the lowlands of South America. Depending on the ethnic group, there is great typological and material diversity, further varying according to age group, gender, social position, and other affiliations, such as to clans or moieties (Albisetti and Venturelli 1962; Lévi-Strauss 1936; Ribeiro 1988; Seeger 1975; Turner 1995). Recent anthropological studies have stressed the mythical and social importance of ornaments in the region, as well as their agentive and prophylactic capacities (Chaumeil 2004; Erikson 2001; Lagrou 2013; Ladeira 2007; Miller 2009; Oliveira 2017; Santos-Granero 2009, 2012; Walker 2009). Collaborations between museums, anthropologists, and indigenous communities have provided new information and perspectives on Amerindian collections (*e.g.*, Françozo and Van Broekhoven 2017; Oliveira 2017; Silva and Gordon 2013; Shepard Jr *et al.* 2017; Van Broekhoven 2010). Nevertheless, approaches focused on the analysis of the biographies of ornaments are still missing. This pronounced diversity, combined with the lack of previous studies, led to the choice of lowland South American ornaments as the focus of this study.

More than 12,000 objects from the lowlands of South America make part of the collection of the MQB, encompassing items collected as early as the sixteenth century up to the present day (Delpuech *et al.* 2013). As a result, the collection presents considerable regional and cultural variability, alongside a long and complex history. Among such objects, 38 bodily ornaments were selected for the present study due to their composite nature. Composite ornaments offer a contrast to the disconnected beads commonly recovered in the archaeological record. Most objects were collected between the late nineteenth and twentieth centuries in the context of scientific expeditions. They represent a broad range of ornament types and raw materials. The typological variability allows us to build a rich use-wear reference collection with diverse systems of attachment and bead raw materials. This study brings together objects belonging to 17 ethnic groups, in addition to three objects with unknown provenience. Diverse geographical regions are encompassed, notably Amazonia ($n = 22$), Central Brazil ($n = 6$), and the Gran Chaco ($n = 6$). The most prevalent indigenous communities represented in this study are the Bororo from Central Brazil ($n = 6$), the Guaycurú ($n = 5$) from the Gran Chaco, and the Capanahua from the Peruvian Amazon ($n = 4$).

In general, each composite ornament involves a supporting attachment system, in the form of strings or woven bands, and a range of attached components. Necklaces constitute over 60% of the sample ($n = 23$), whereas ornaments of other types are present in lower numbers: bracelets ($n = 3$), ear ($n = 4$) and nose ($n = 2$) ornaments, a labret ($n = 1$), and a baby sling ($n = 1$). Noncomposite ornaments are additionally included: two labrets (71.1936.48.163 and 71.1884.29.38) and two ear discs (71.1884.29.29.1–2). Such artifacts are generally underrepresented in the archaeological record, being identified only when they present a characteristic morphology. Therefore, the analysis focused on understanding the distribution and characteristics of use-wear on artifacts that were inserted directly into the skin. Glues, dyes, and other residues of unknown origin and functionality are present on 18 objects, in all but two cases added directly to the string.

Whereas the collection of the museum encompasses large numbers of objects made of feathers, plant fibers, wood, and seeds, we gave preference to ornaments with mineral and biomineral beads, pendants, and plaques. These raw materials are comparable to those typically found in the archaeological record. At the same time, material diversity within the same object formed a relevant factor in the sample selection, since it offers insight into the wear traces formed as a result of the interaction between different bead materials during use (bead-on-bead wear). Table 1 provides an overview of the studied ornaments. Mollusk shell components are by far dominant in the selected sample, with a total of 21 objects including them (55.3%). Of this total, eight are objects with only shell components and 11 are composed of shell and a single other material. Animal teeth are present in 23.7% of the objects, most commonly in combination with other materials, such as bone, seeds, and nuts. Similarly, bone components (18.4%) are always accompanied by other raw materials, with the exception of the noncomposite bone labret. Lithic materials are generally poorly represented in ornaments from the lowlands (Ribeiro 1988); here they are present in the form of a quartz and two rock crystal pendants (7.9%). Nuts, seeds, glass, porcelain, and feathers only appear alongside other raw materials. Use-wear on seeds, glass, and porcelain will not be discussed here, even though it was often observed on the studied objects.

Table 1 Studied objects, including inventory number, type, provenience, individual components, and main types of use-wear observed. Taxonomical identifications followed by a * were made on the basis of available literature or information provided by the MQB's database, rather than by specialists. (B) refers to Bivalvia and (G) to Gastropoda

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1980.61.27	Baby sling	Peru, Ucayali department, Urubamba River, Matsigenga	Teeth	Peccary canines and incisors (*Tayassu* sp.)	Automorphic	Cotton	Rim polish Rim deformation Erasure of manufacture traces/natural patterns Polish on the edges No use-wear on some components
			Bones	Peccary long, squamosal, sphenoid bones (*Tayassu* sp.) Tapir scapula, mandible, basin (*Tapirus* sp.)	Elongated pendants Double-perforated pendant		
			Shell (G)	*Corona incisa* or *C. regalis*	Automorphic		
			Seeds	Indet.	Automorphic		
			Nuts	Indet.	Automorphic		
71.1929.8.292	Bracelet (fragment)	Brazil, Acre State, Capanahua	Shell (B)	Unionoida order	Disc beads	Cotton	Polish on the edges Erasure of manufacture traces/natural patterns Residue Perforation cannot be observed
71.1900.47.14.1	Bracelet	Peru, Ucayali River, Capanahua	Teeth	Monkey canines (*Aotus azarai*)	Automorphic	Cotton	Rim polish Erasure of manufacture traces/natural patterns Polish on the edges Flattening

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1900.47.14.2	Bracelet	Peru, Ucayali River, Capanahua	Teeth	Monkey canines (*Aotus azarai*)	Automorphic	Cotton	Rim polish Erasure of manufacture traces/natural patterns Polish on the edges Flattening
71.1929.8.81	Nose ornament	Brazil, Acre or Amazonas State, Kanamari	Shell (B)	*Anodontites* sp.	Crescent-shaped	Indet. plant	Shell: no use-wear Wood: surface damage Wood: rounding
			Glass		Disc beads		
			Wood	Indet.	Cylindrical stick		
71.1929.8.225	Nose ornament	Brazil, Acre or Amazonas State, Kanamari	Shell (B)	*Anodontites* sp.	Crescent-shaped	Indet. plant	Shell: no use-wear
			Glass	Indet.	Disc beads (glass)		
71.1884.29.38	Labret (noncompo-site)	Bolivia, Santa Cruz department, Vallegrande Province, Chiriguano	Wood	Indet.	T-shaped (short)	NA	Surface damage Polish Residue (?)
71.1936.48.150	Labret (noncompo-site)	Brazil, Mato Grosso State, Vermelho River, Bororo	Bone	Mammal tibia, jaguar (*Panthera onca*)*	T-shaped (long)	NA	Polish Deformation Erasure of manufacture traces/natural patterns
71.1936.48.163	Labret	Brazil, Mato Grosso State, Vermelho River, Bororo	Shell (B)	Unionidae family	T-shaped mouth piece Double-perforated plaques	Cotton	Surface damage Bead-on-bead wear (damage) Residue
			Feather	Macaw (*Ara chloropterus*)	NA		

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1884.29.29	Necklace	Bolivia, Santa Cruz department, Vallegrande Province, Toba (Guaycurú)	Shell (B)	Unionidae family	Double-perforated rectangular pendants	Cotton	Rim polish Rim deformation Flattening Bead-on-bead wear (scratches)
71.1900.47.7	Necklace	Peru, Ucayali River, Capanahua	Shell (G)	*Pomacea* sp.	Drop-shaped pendants	Cotton	Rim polish Rim deformation Polish on the edges Bead-on-bead wear (damage and scratches)
			Nuts	Indet.	Drop-shaped pendants		
71.1900.47.9	Necklace	Peru, Ucayali River, Capanahua	Shell (G)	Indet. gastropod	Drop-shaped beads	Cotton	Rim polish Rim deformation Polishing on the edges Erasure of manufacture traces/natural patterns Bead-on-bead wear (flattening)
			Nuts	Indet.	Drop-shaped beads		
71.1971.30.62	Necklace	Brazil, Amazonas State, Upper Solimões, Tikuna	Nuts	Tucum* (*Astrocaryum* sp.) Inajá* (*Maximiliana martiana*)	Zoomorphic pendants	*cf. Astrocaryum chambira**	Rim polish Rim deformation Rounding of the edges Erasure of manufacture traces/natural patterns Bead-on-bead wear (widening of perforation)
			Seeds	Indet.	Automorphic		

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1881.34.75	Necklace	Colombia, Vichada River, Guahibo	Tooth	Caiman (Caimaninae family)	Automorphic	Indet. plant	Rim polish Rim deformation Polish on the edges Erasure of manufacture traces/natural patterns Bead-on-bead wear (microbreakage) Residue
			Rock crystal		Automorphic		
71.1881.34.78	Necklace	Colombia, Vichada River, Guahibo	Rock crystal		Automorphic	Indet. plant	Polish Residue Attachment sector partially concealed
70.2015.8.34	Necklace	Colombia, Amazonas department, Tikuna	Teeth	Peccary canines (*Tayassu* sp.)	Automorphic	Indet. plant (*A. chambira*?*)	No use-wear observed
			Bone	Flat bone (frog?)	Elongated pendants		
			Seeds	*Ormosia* sp.* *Coix lacryma-jobi**	Automorphic		
			Nuts	Tucum* (*Astrocaryum* sp.)	Automorphic		

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1880.7.14	Necklace	Peru, Amazonas department, Marañón River, unknown ethnonym	Shell (B)	Unionidae family	Drop-shaped pendants	Cotton	Rim polish Rim deformation Polish on the edges Erasure of manufacture traces/natural patterns Bead-on-bead wear (microbreakage and deformation)
			Glass		Disc and spherical beads		
71.1881.34.28	Necklace	French Guiana, Wayana	Shell (G)	*Megalobulimus* sp.	Double-perforated rectangular plaques	Cotton	Rim polish Rim deformation Erasure of manufacture traces/natural patterns Bead-on-bead wear (damage and scratches)
71.1884.29.63	Necklace	Bolivia, Santa Cruz department, Vallegrande Province, Toba (Guaycurú)	Shell (B)	Unionoida order	Disc beads	Indet. plant	Rim polish Rim deformation Erasure of manufacture traces/natural patterns Bead-on-bead wear (scratches)

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1884.102.40	Necklace	Chile, Tierra del Fuego, Hoste Island, Yamana	Shell (G)	Margarella violacea	Automorphic	Sinew (whale?*)	Polish Deformation Flattening Bead-on-bead wear (damage)
71.1903.13.20	Necklace	Colombia, Ecuador, or Peru, Amazonia, Shuar/Achuar	Bone	Bird femurs (*Nyctidromus* sp.*)	Cylindrical pendants	Indet. plant	Rim polish Polish on the edges Bead-on-bead wear (deformation, residue) Residue
			Feather	Toucan (Ramphastidae family)	NA		
			Porcelain		Disc and tubular beads		
71.1908.22.1524	Necklace	Ecuador, Shuar/Achuar	Shell (B)	*Mycetopoda* sp.	Crescent-shaped pendants	Indet. plant	Rim polish Erasure of natural patterns Surface damage Perforation cannot be fully observed
			Glass		Disc beads		
71.1929.8.36	Necklace	Brazil, Amazonas State, Juruá River, Kulina	Shell (B)	Unionidae family	Double-perforated rectangular pendants	Monocot plant (*A. chambir-a*?*)	Rim polish Rim deformation Polish on the edges Erasure of manufacture traces/natural patterns

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1929.8.83	Necklace	Brazil, unknown ethnonym	Bone	Bony fish vertebrae	Automorphic	Indet. plant	Rim polish Polish on the edges Erasure of manufacture traces/natural patterns Bead-on-bead wear (flattening, deformation, residue)
			Tooth	Monkey canine (*Cebus* sp.)	Automorphic		
			Porcelain		Disc beads		
71.1939.88.693	Necklace	Brazil, Mato Grosso or Rondônia State, Pimenta Bueno River, Kabisiana	Shell (B)	Unionoida order	Disc bead	Cotton	Rim polish Rim deformation Erasure of manufacture traces/natural patterns Bead-on-bead wear (scratches)
71.1948.76.296	Necklace	Brazil, Tiquié River, Bará	Milky quartz		Cylindrical pendant	*cf. Ananas erectifolius* (Bromeliaceae)*	Rim polish Rim deformation Polish on the edges Erasure of manufacture traces Residue
			Bone	Hawk-eagle talons (*Spizaetus* sp.)	Automorphic		
			Teeth	Peccary canines (*Tayassu* sp.)	Automorphic		
			Seeds	Indet.	Automorphic		

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1948.76.297	Necklace	South America, unknown ethnonym	Teeth	Caiman (Caimaninae family) Peccary canine (*Tayassu* sp.)	Automorphic	Indet. plant	Rim polish Polish on the edges Bead-on-bead wear (deformation and scratches) Residue
			Bone	Clavicle (turtle?)	Automorphic		
			Wood	Indet.	Hour-glass shaped beads Elongated pendants		
71.1964.39.42	Necklace	Paraguay, Caazapá department, San Juan Nepomuceno, Arroyo Moroti, Aché (Guayaki)	Teeth	Monkey canines (*Cebus* sp. and *Alouatta cf. caraya*)	Automorphic	*cf. Urera baccifera* (Urticaceae)*	Rim polish Rim deformation Bead-on-bead wear (root deformation) Residue (?)
71.1964.119.23	Necklace	Brazil, Pará State, Zinho River, Kayapó	Shell (B)	Mycetopodidae family	Trapezoid pendants	Cotton	Rim polish Polish on the edges Bead-on-bead wear (damage and scratches)
			Glass		Disc and spherical beads		
71.1971.30.82	Necklace	Brazil, Amazonas State, Upper Solimões River, Tikuna	Bone	Monkey humeri (*Cebus* sp.) Indet. long bones (*cf.* agouti, *Dasyprocta* sp.)	Tubular beads	*cf. A. chambira* (Arecaceae)*	Rim polish Polish on the edges Erasure of manufacture traces Bead-on-bead wear (polish and scratches)
			Seed	Indet.	Automorphic		

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1971.43.26	Necklace	Brazil, Mato Grosso State, Upper Xingu River, Mehinaku	Shell (G)	Megalobulimus oblongus	Double-perforated rectangular plaques	Cotton	Perforation cannot be fully observed Rim polish Erasure of manufacture traces/natural patterns
71.1933.72.638	Necklace	Argentina, Formosa Province, Estero Patiño, Guaycurú	Wood	Indet.	Figurative pendant	Wool (indet. animal)	Polish Erasure of manufacture traces Attachment area cannot be directly observed Residue
			Porcelain inlay		Disc bead		
71.1884.29.24.1	Ear ornament (noncomposite)	Bolivia, Santa Cruz department, Vallegrande Province, Toba (Guaycurú)	Wood	Indet.	Disc	NA	Surface damage Erasure of manufacture traces Residue (?)
71.1884.29.24.2	Ear ornament (noncomposite)	Bolivia, Santa Cruz department, Vallegrande Province, Toba (Guaycurú)	Wood	Indet.	Disc	NA	Surface damage Erasure of manufacture traces Residue (?)

Table 1 (continued)

Inventory no.	Object type	Provenience	Components			String material	Use-wear
			Raw materials		Types		
71.1936.48.168.1	Ear ornament	Brazil, Mato Grosso State, Vermelho River, Bororo	Shell (B)	Unionidae family	T-shaped attachment piece Double-perforated rectangular plaques	Cotton	Bead-on-bead wear (damage) Residue
			Feather	Macaw (*Ara macao*) Parrot (*Amazona cf. aestiva*)	NA		
71.1936.48.168.2	Ear ornament	Brazil, Mato Grosso State, Vermelho River, Bororo	Shell (B)	Unionidae family	T-shaped attachment piece Double-perforated rectangular plaques	Cotton	Bead-on-bead wear (damage) Residue
			Feather	Macaw (*Ara macao*)	NA		
71.1936.48.195.1	Ear ornament	Brazil, Mato Grosso State, Vermelho River, Bororo	Shell (B)	Unionidae family	Rectangular plaques with 2–3 perforations	Cotton	Bead-on-bead wear (damage) Residue
			Feather	Macaw (*Ara chloropterus*)	NA		
71.1936.48.195.2	Ear ornament	Brazil, Mato Grosso (state), Vermelho River, Bororo	Shell (B)	Unionidae family	Rectangular plaques with 2–10 perforations	Cotton	Bead-on-bead wear (damage) Residue
			Feather	Macaw (*Ara chloropterus*)	NA		

The taxonomical identification of animal components was based on visual examination and comparison with specimens from the collections of the Muséum National d'Histoire Naturelle (MNHN). The process was particularly easy when the parts (or fragments) were sufficiently large or distinctive to be identified immediately or very quickly according to the morphology, the biometry, or any diagnostic features (certain bones, teeth, shells, feathers, *etc.*). In this case, the identification was based upon external characteristics: pattern of coloration in relation to dimensions (*e.g.*, feathers, shells), visual and touching aspects (odor in some cases), and anatomical features. Anatomical characteristics of bone are considerably different between mammals, birds or reptiles, and fishes. Bone density, thickness, type of porosity, bony structures, and traces of vascular vessels can provide good indications of the animal taxon. Identifications of bony elements were only made when a sufficient number of such traits were available. Generally speaking, the methodology used is the same as for archaeozoological investigations. Regarding dental elements, the same method used for bone artifacts was applied, *i.e.*, the size of the tooth or of the worked part was used to reconstruct the size of the original animal. The shape and general morphology of the tooth was also fundamental, allowing to distinguish a monkey from a carnivore, for example. In relation to the shells, identification was quite easy, given their good state of preservation; the more complete the organic material is, the easier it is to identify them.

In the case of small or highly worked fragments, the first step was to determine what the used part is. From this point, it was possible to estimate the size of the original animal, then to compare the considered fragment with reference collections or literature. Finally, the possible species was selected on the basis of physical criteria mentioned above. It could also be necessary to check the distribution of the identified species in relation to that of the ethnic group considered. Depending on the level of certainty, the identifications were made to the family, genus, or species level. Some fragments remain without precise identification, especially when highly modified. Identifications followed by question mark or by "sp." represent the most reasonable proposition according to observed traits. In this study, only external methods have been used, without any help of molecular analysis. Finally, reference collections are fundamental, as well as prior experience.

State of Preservation

While postdepositional surface modification is not a concern for an ethnographic assemblage, other events during the biography of an object may affect its integrity. Overall, the components of the objects made from different raw materials presented well-preserved surfaces, sometimes covered by original residues or more recent additions. Breakages were noted on 14 objects, being restricted to few components. In contrast, the strings often presented pronounced use-wear, leading to the shedding of fibers and breakage. Most studied ethnographic ornaments have a long postcollection biography, during which they belonged to three different museums: the Musée d'Ethnographie du Trocadéro, the Musée de l'Homme, and, lastly, the Musée du quai Branly (Delpuech and Roux 2015; Delpuech *et al.* 2013; Grognet 2005). As demonstrated elsewhere (Falci *et al.* 2017a; also Breukel *et al.*, in prep.), modifications to the surface of artifacts carried out in museum contexts must be acknowledged, as they can affect microwear analysis. The change from one museum to the others resulted in the addition of successive glued identification tags and ink markings with varnish. Glued tags and ink markings coexist on nine specimens, while only ink with varnish is found on another 13 objects. They are placed directly on top of individual components, partially concealing their surface. Furthermore, the removal of identification tags, carried out at some point along their museum biography, also left macro- or microscopic traces of glue, which can mislead the interpretation of microwear (Fig. 1b–d). It was possible to note that new complementary strings were added to six objects prior to collection as a means of repairing them. The new strings could be identified on the basis of differential raw material or relative degree of wear. The wear displayed by the strings, the complex modes of attachment, and the presence of residues confirm that the objects have not been restrung after arrival at the museum.

Objects can present considerable dirt on their surfaces, such as dust, stains, sediment, and handling grease. Therefore, the cleaning of artifacts prior to analysis plays an important role in microwear studies, as a means of preventing the misinterpretation of traces. For instance, at low magnification, handling grease can be mistaken for the presence of use polish and rounding. At high magnification, it conceals the surface's microtopography (Fig. 1a). Depending on the raw material, cleaning can be carried out with different products, such as water and soap, alcohol, acetone, or other chemical solutions (*e.g.*, HCl, KOH, and H_2O_2) (Evans and Donahue 2005; Macdonald and Evans 2014; Van Gijn 1990, 2014a). An ultrasonic bath can also be used in combination with these products. However, such types of thorough cleaning were considered to be potentially damaging to the studied objects, as they often involve organic and fragile components. For the present research, only individual components were cleaned, making use of ethanol, carefully applied with cotton buds. Areas with original residues

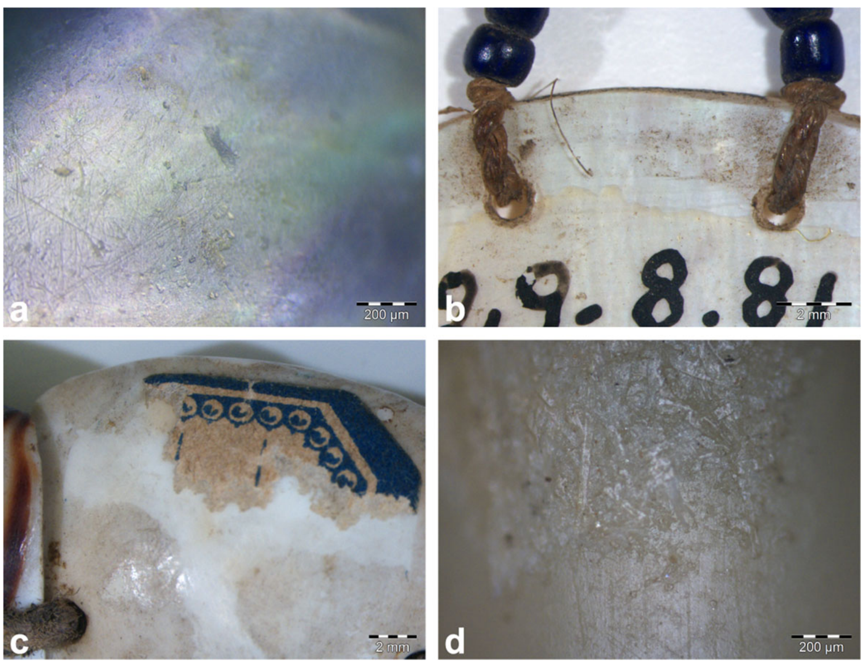

Fig. 1 Postcollection modifications on individual components of the studied objects, including handling grease (**a**), ink marking with varnish (**b**), and remains of glued identification tags, directly visible (**c**) and only observable with high magnification (**d**). MQB inventory numbers: 71.1884.102.40 (**a**), 71.1929.8.81 (**b**), 71.1881.34.28 (**c**), and 71.1936.48.150 (**d**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

were avoided during cleaning. Excessive postcollection handling may lead to the formation of wear traces on the studied objects, which can be confused with original use-wear. However, this problem could be ruled out on the basis of two factors: (1) the individual components in composite pieces are not often handled due to their fragile attachments, and (2) original use-wear has a distinctive distribution, being often located only on certain sectors of the individual components, rather than on their entire surfaces.

Methods of Analysis

The present study was conducted at the Atelier de Conservation et Restauration of the MQB. The microwear analysis of objects involved the combined use of low- and high-magnification microscopes. In the first stage of analysis, an Olympus SZX7 stereomicroscope was used, with magnifications of 8–56. We identified traces and residues on ornaments, recording their location, association to each other, and characteristics. This could be done relatively fast and comprised the observation of all components in a given object (*i.e.*, all the beads in a necklace). In the second stage, an Olympus BX51 microscope was used with incident light and magnifications of 40–200. It allowed for the observation and analysis of the surface's microtopography and polish, which can be diagnostic of materials an artifact has been in contact with. This stage of analysis was time-consuming; thus, it was restricted to two to four components depending of the object. Through the combination of the two magnification ranges, the observed traces could be better contextualized and interpreted. The main goal was to record all microwear on the objects, including the technology (techniques, toolkits, and production sequence), use-wear (characteristics and distribution), residue, and preservation of individual components.

In the present paper, we will focus exclusively on use-wear. Traces recorded on individual components include polish, rounding, deformation, smoothing of manufacture traces and natural patterns, flattening, surface damage, microbreakages, and scratches. Such features were further characterized by their location in relation to the attachment and to other components, brightness, presence of fine striations, distribution, directionality, and invasiveness. The latter was assessed by the degree to which the use polish entered the interstices of used sectors, in comparison to the surrounding surface. Intensity of use could be qualitatively assessed by evaluating to what extent natural and man-made surface features appear rounded, erased, or deformed. Wear traces were recorded on different analysis forms: a general form for low magnification analysis of an object and supplementary forms for each individual component analyzed with high magnification. Figure 2 summarizes the terminology used to describe the location of use-wear on individual components.

Microwear analysis has been applied to artifacts made of minerals, stone, bone, shell, and wood, thus proving its suitability for their study (*e.g.*, Buc 2011; Caruso Fermé *et al.* 2015; Cuenca-Solana *et al.* 2017; Dubreuil and Savage 2014; Kononenko *et al.* 2010; Lammers-Keijsers 2007; Lavier *et al.* 2009; Ollé *et al.* 2016; Sidéra and Legrand 2006; Van Gijn 1990, 2005, 2006, 2014a, 2014b). To our knowledge, it has not been previously applied to artifacts made of nut (palm endocarps); here, we evaluate which information can be gained by their study, in comparison to more commonly researched raw materials. The interpretation of microwear as correlated to

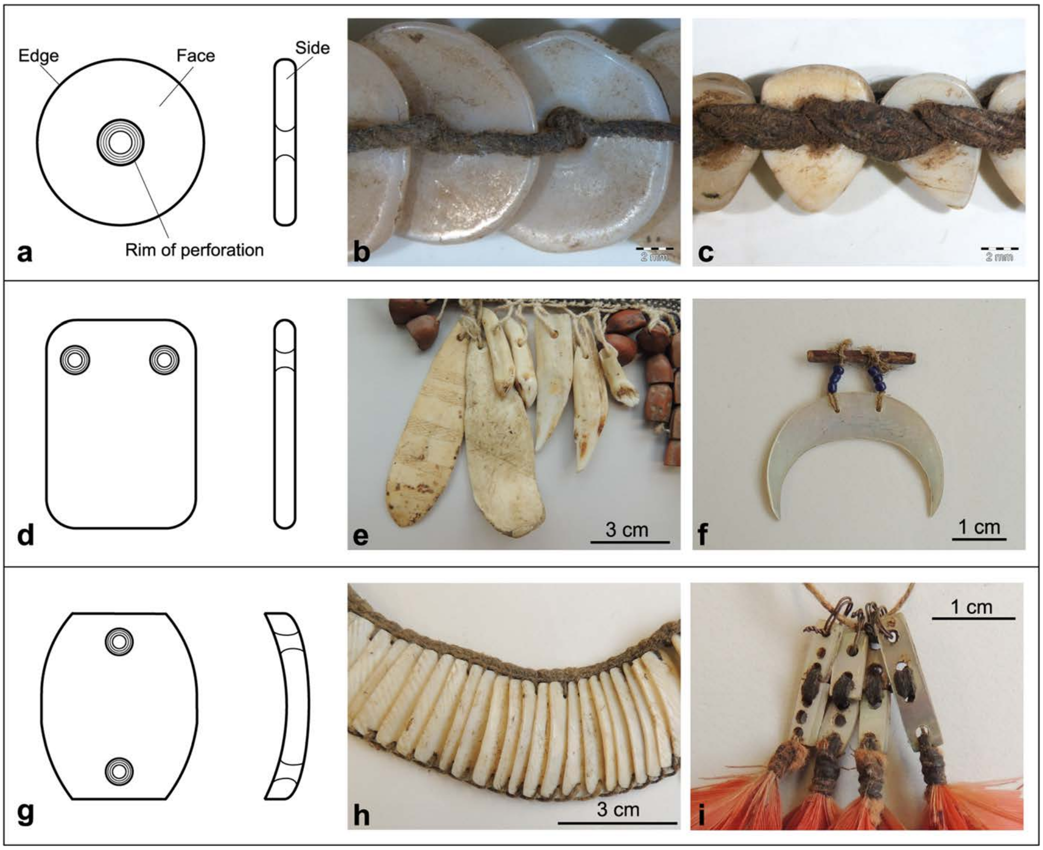

Fig. 2 Terminology used to describe individual components and use-wear distribution on them: beads (**a**–**c**), pendants (**d**–**f**), and plaques (**g**–**i**). Note that perforation position and number in relation to the general shape of a component is used as diagnostic of type. MQB inventory numbers: 71.1939.88.693 (**b**), 71.1900.47.9 (**c**), 71.1980.61.27 (**e**), 71.1929.8.81 (**f**), 71.1971.43.126 (**h**), and 71.1936.48.195.1 (**i**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

specific activities was based on previous studies, especially on those focused on the replication of ornament use-wear. There are, however, important differences between ethnographic objects and archaeological artifacts: ethnographic ornaments are often large, composite, and fragile. In addition, they have many individually connected parts, being therefore difficult to carefully handle and to stabilize under a microscope. This contrasts to the archaeological ornaments, which are often small single items that can be easily fixed on a regular microscope plate. As a consequence, it was necessary to modify the protocol, which was originally designed for the study of archaeological specimens. A similar issue has been previously noted by Kononenko *et al.* (2010), leading them to use a Dino-Lite USB digital microscope for low-magnification analysis. Here, the stereomicroscope was adapted to a free arm, thus allowing the microscope's height to be changed according to each studied object. Conversely, the metallographic microscope had a short working distance, preventing the analysis of certain objects (*e.g.*, 71.1964.39.42 and 71.1884.29.24.1–2). Furthermore, stabilizing individual beads or pendants under the microscope's incident light at a 90° angle also proved to be difficult, as they were still attached to each other in a composition. Another limitation to analysis was that use-wear is predominantly located under the strings of attachment. As these strings cannot be removed, the analysis often had to focus on partially broken or loosely attached components. Despite the limitations, the use of high magnification proved to be important, as it provides direct visualization of the microtopography and state of preservation of a surface. This was central in (1) verifying the traces observed with lower magnifications; (2) differentiating between handling grease and use polish; (3) recognizing natural patterns, damage, striations, and glue remains; and (4) characterizing use-wear according to different contact materials.

A third microscope was used in order to tackle some of the noted limitations and to evaluate its general usefulness for use-wear analysis: a 3D digital microscope (HIROX KH-8700) with magnifications of 20–160 and a Rotary-Head adapter (HIROX AD-2016RLM). The adapter includes a rotating prism that allows 360° view of an object. This mechanism made the observation of difficult-to-reach areas possible, without the constant manipulation of the objects. In addition, it provided views of a given feature from different angles in relation to the light source and a better understanding of the shape and characteristics of the observed traces. The 360° view could also be made into videos that provided an invaluable 3D recording of the characteristics and distribution of traces (see Videos 1–6). All components in each object were analyzed with this microscope. This model does not replace the metallographic microscope, as its light configuration (dark field vertical lighting) and image quality prevent the observation of microtopographical features of wear polishes. At the same time, it provided superior magnifications in comparison to the stereomicroscope, thus allowing for better observation and descriptions of microtraces. The data provided by each microscope proved to be complementary, leading us to rely on the combined use of the three models for the study of this collection (Fig. 3).

Use-Wear Patterns Across Materials

In the following, we discuss use-wear patterns according to the raw material of the individual components, as the properties of each have been shown to influence wear formation. The data will be further organized according to use-wear types and how these relate to both attachment system and composition of each object (*i.e.*, the neighboring beads and string material). The observed use-wear types develop in connection to one another and will only be divided here in order to highlight how, where, and in which conditions they occur. Finally, the challenges faced during analysis and their implications for interpretation are also discussed.

Shell

Mollusk shell is probably the material category that has received the greatest attention in ornament use-wear studies (*e.g.*, Bonnardin 2008, 2012; Breukel 2018; d'Errico *et al.* 1993; d'Errico *et al.* 2005; Falci *et al.* 2017a, b; Lammers-Keijsers 2007; Mărgărit *et al.* 2016; Taborin 1993; Vanhaeren *et al.* 2013). Abundant studies have recorded use-wear patterns on automorphic shell ornaments, that is, on shells that underwent only minor technological modifications before being integrated into a composite ornament. Xenomorphic shell beads and pendants have received comparatively minor attention, in particular complex figurative carvings (Falci *et al.* 2017a). The sample studied here is primarily composed of shell beads, pendants, and plaques, encompassing freshwater,

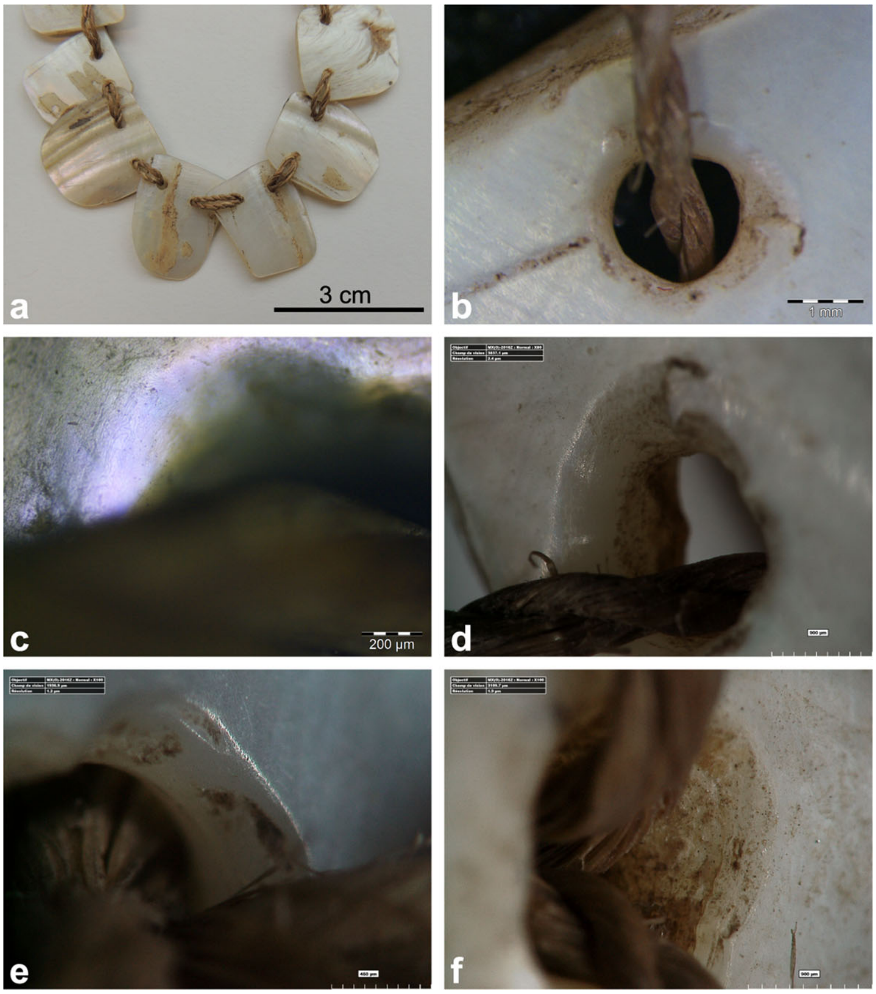

Fig. 3 Compared microscope performance in use-wear observation: stereomicroscope (**b**), metallographic microscope (**c**), and 3D digital microscope (**d**–**f**); **b**–**d** illustrate the same perforation on a freshwater bivalve pendant, while **e**–**f** show opposing sides of another perforation. All images (**a**–**f**) taken from the same necklace. MQB inventory number: 71.1929.8.36. ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

land, and marine specimens. Mollusks present different layers, with different microstructural arrangements. The microstructure varies according to shell taxa and has an impact on the shell's working properties and wear development (Claassen 1998; Cuenca-Solana *et al.* 2017; Debruyne 2014; Szabó 2008).

Freshwater Bivalves

The majority of shell species were identified as freshwater bivalves ($n = 15$; 71.4%); however, most specimens cannot be attributed to a species or genus. Most pendants and plaques can be described as nearly flat shell fragments, with at least one nacreous face. In addition, many specimens present a natural dark layer (periostracum), which has been partially ground off. There is considerable variability in attachment systems in the sample, with only two necklaces (71.1884.29.63 and 71.1939.88.693) having beads attached in a similar way (Fig. 4j, g).

Seven shell objects present clear evidence of having been worn as bodily adornment, identified by the combination of multiple use-wear types present on their components. The first use-wear type, observed on 10 objects, was the formation of polish and rounding on the rim of the perforations from which the artifacts are suspended (Figs. 4b, i, l and 5h, i). Such traces tend to develop directly under the string. The sectors of the hole that are not in constant contact with the string still display fresh drilling traces and a ragged aspect (Fig. 3). In four objects, string contact additionally led to the deformation of the rim. This can be characterized as the formation of a depression adjacent to the perforation rim in a specific direction (a "notch," see Fig. 4k) or the general widening of the hole. The shape of the pendants and the positioning of the hole may also be connected to the presence of rim deformation, as they may cause greater string tension (*e.g.*, 71.1880.7.14) (Fig. 4a–d). The characteristics of the deformation can also vary on different faces of a same component, as observed on two disc bead necklaces (71.1884.29.63 and 71.1939.88.693) (Fig. 4g–l; Video 1). On one face of the beads, notches with specific directionality were formed following the string position; on the other face, a general widening of the rim occurred, due to the presence of two thick strings. On another necklace (71.1884.29.29) (Fig. 5a–c), slight notches are seen on one face, while only flattening on the other. The notches on the nacreous face are caused by direct contact with the string, while the flattening on the back of the pendants is connected to the presence of a woven cotton band (Fig. 5d–f). In this face, the rims are still fresh because the string is not in direct contact with the rim, but the surrounding surface is flattened and whitened due to the placement of the band.

Polish formation and rounding also occurred on the sides and edges of eight ornaments. On a macroscale, it can be characterized by the smoothening of manufacture traces, sharp edges, breakages, and microremovals. With high magnification, it can be recognized as a bright, invasive, and smooth polish developing on top of previous traces, accompanied by fine and multidirectional scratches. It is likely the result of contact between the ornaments and the human body during use. The partial or complete erasure of natural shell patterns and manufacture traces was observed on eight objects. It occurred on different areas of the ornaments, especially in and around the rim of perforation (Fig. 4c, f). Depending on the extent of wear, the erasure of traces may also happen on the faces and sides of ornaments that are in contact with the human body. On the Bororo labret (71.1936.48.163) (Fig. 6a–c), there is extensive damage on the exterior face of the top plaque, which has a T-shape and would be inserted in the lower lip of the wearer. Damage is only seen on the top two plaques of the labret, probably resulting from the constant contact with saliva in the case of the top plaque and with the chin of the wearer, in the case of the second plaque (Fig. 6e). The other plaques in the composition do not present clear use-wear. The contact between individual components on six objects during use has created "bead-on-bead wear." Observed features include (1) microbreakage and deformation created by friction between the shell pendants and beads of a harder material, such as glass (71.1880.7.14, Fig. 4e, f; Video 2); (2) flattening, scratches, and the erasure of features on the backs of the components due to their partial superposition (71.1964.119.23, 71.1884.29.29, and 71.1939.88.693, Fig. 5j–l); and (3) damage to the ends of the Bororo plaques that are tightly attached to each other (71.1936.48.163, Fig. 6f).

Fig. 4 Use-wear types on ornaments with freshwater bivalve components. MQB inventory numbers: 71.1880.7.14 (**a**–**f**), 71.1939.88.693 (**g**–**i**), and 71.1884.29.63 (**j**–**l**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

No clear use-wear was observed on the Bororo earrings (71.1936.48.168.1–2 and 71.1936.48.195.1–2) (Fig. 6g–l) and on the Kanamari nose ornaments (71.1929.8.81 and 71.1929.8.225) (Fig. 2f). These objects are composite ornaments that were inserted directly into the skin through the use of perishable attachment components. In the case of the nose ornaments, wooden sticks perform this function; for the Bororo earrings, attachment strings would have been used, but they are missing. The Bororo plaques appear unused, with well-preserved periostracum and production traces (Fig. 6h, l). However, it must be highlighted that, during use, the shell components would not necessarily be in constant contact with the wearer's skin, limiting the formation of wear traces even in used specimens.

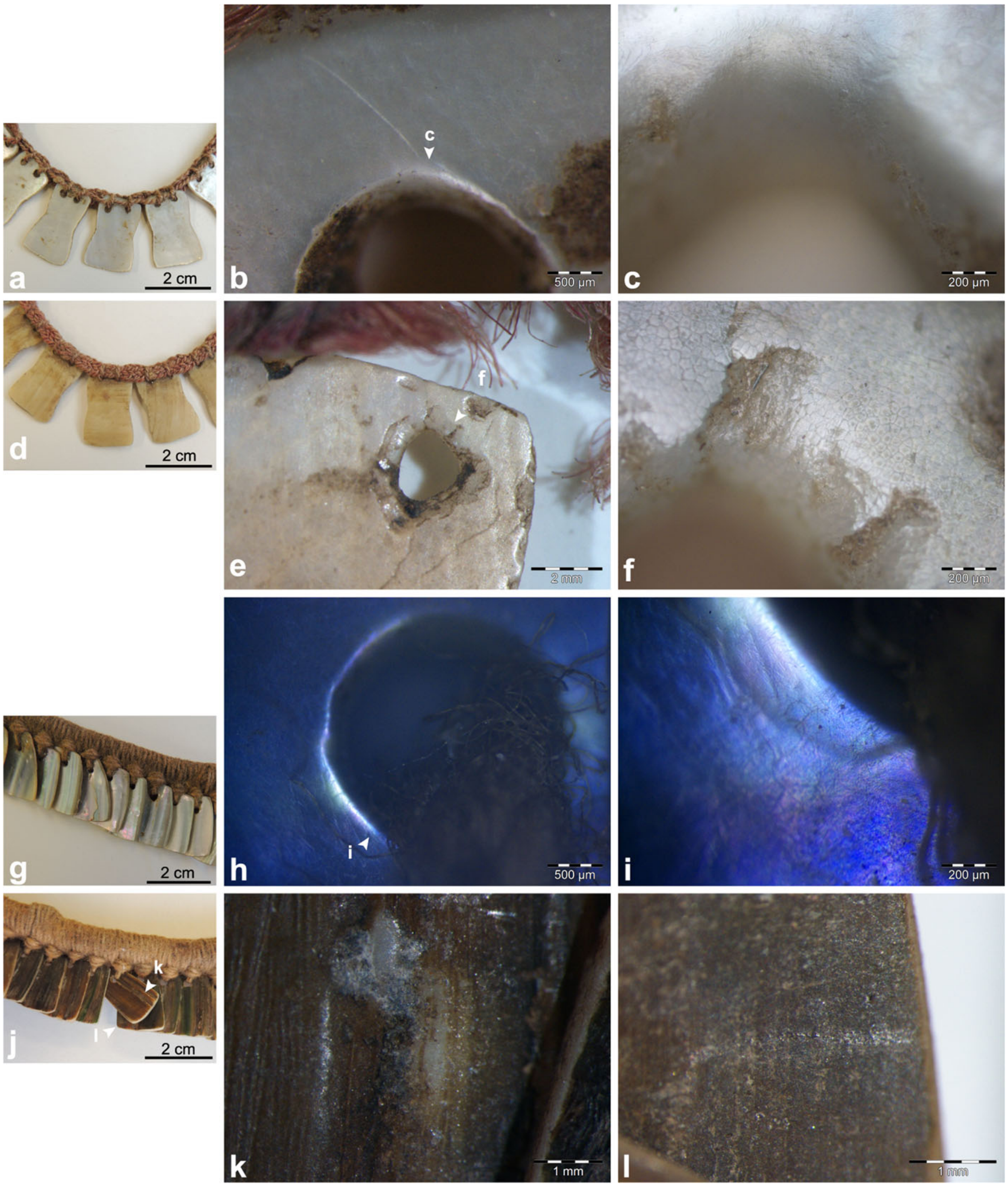

Fig. 5 Use-wear types and on ornaments with freshwater bivalve components. MQB inventory numbers: 71.1884.29.29 (**a**–**f**) and 71.1964.119.23 (**g**–**l**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

Gastropods

Terrestrial, freshwater, and marine gastropods are represented in the studied collection. Rounding and polish on the perforation rim were observed on five objects (83.3%), although observation was limited on some specimens. For instance, the tight string attachment on the top perforation of the Mehinaku plaques (71.1971.43.126) limited the observation of use-wear (Fig. 2h). In contrast, the attachment of the lower perforation is relatively loose, resulting in less pronounced use-wear development. In the Yamana necklace (71.1884.102.40) (Fig. 7a–c), the string is connected to a relatively thin “bridge” of shell in between the lip and the perforation, thus rendering it fragile and

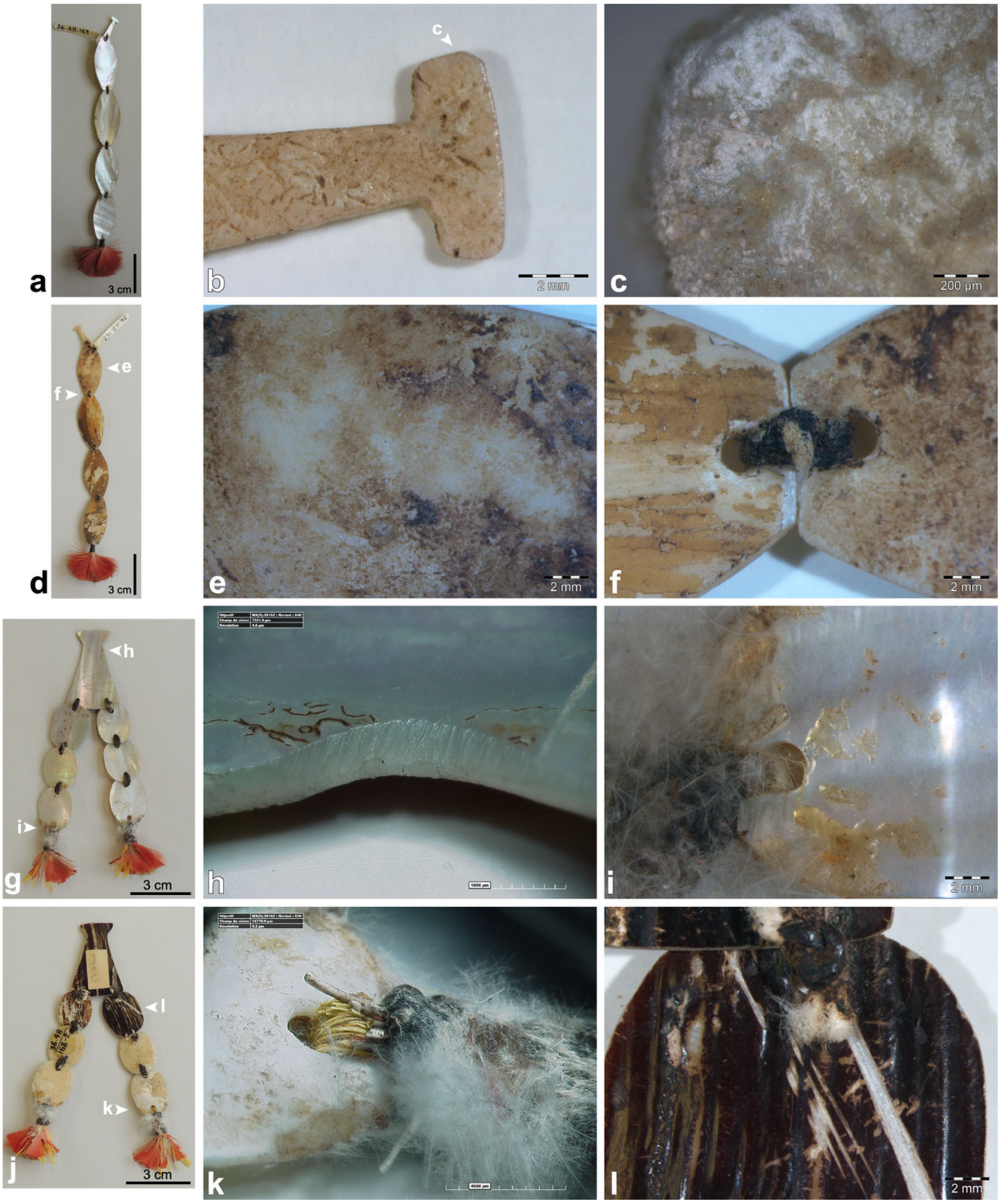

Fig. 6 Use-wear types on ornaments with freshwater bivalve components. MQB inventory numbers: 71.1936.48.163 (**a**–**f**) and 71.1936.48.168.2 (**g**–**l**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

difficult to handle. Rounding and polish are present exclusively on the parts in contact with the braided sinew. These areas are also greasy, flattened, and display microdamage as a result of permanent contact with the sinew.

Rim deformation was observed on four necklaces. Notches are seen on the perforation rim of the Wayana plaques (71.1881.34.28) (Fig. 7d, g), being more pronounced on their back than on the front. This is because only one string is passing between the holes of neighboring plaques in the front (Fig. 7d–f), while two strings are passing on the back (Fig. 7g–i). Rim deformation is also very pronounced on the Capanahua necklaces: on the beads (71.1900.47.9) (Fig. 8a–c), the presence of two strings attached in different

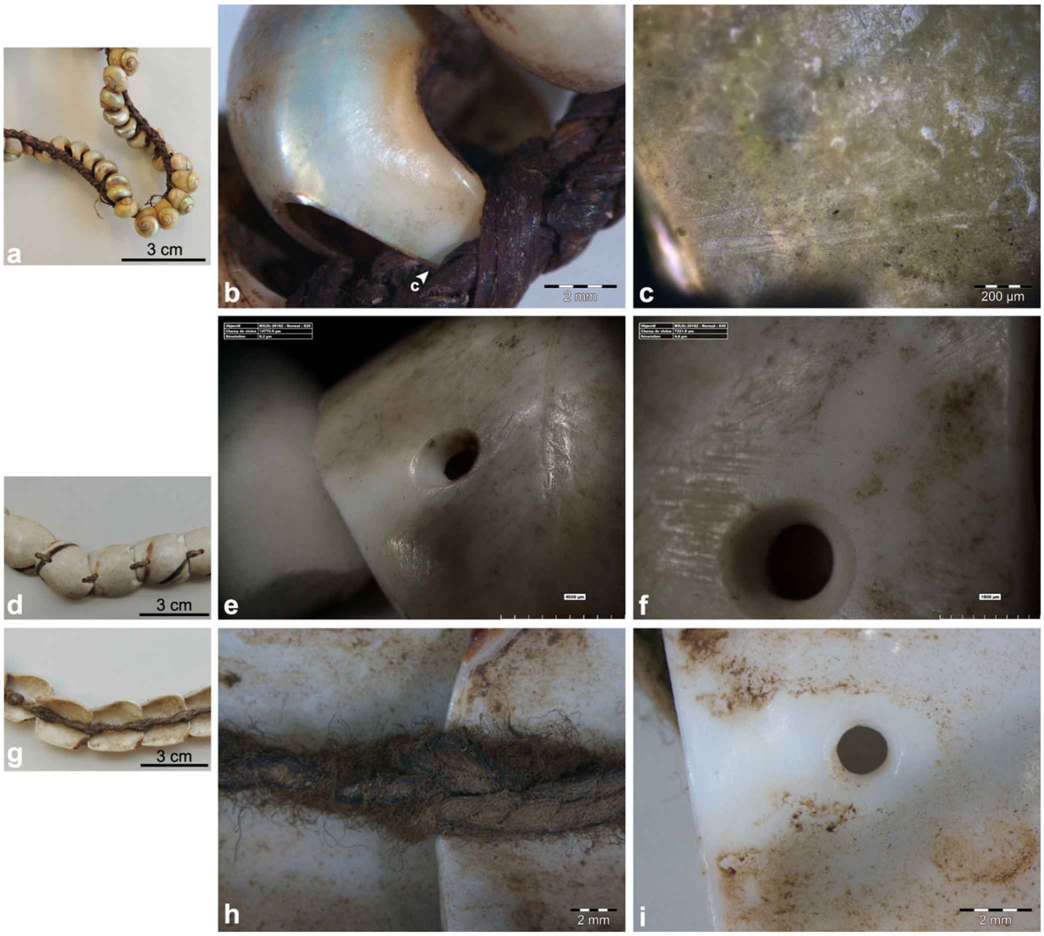

Fig. 7 Use-wear types on ornaments with gastropod shell components. MQB inventory numbers: 71.1884.102.40 (**a**–**c**) and 71.1881.34.28 (**d**–**i**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

directions resulted in the general widening of the perforations, creating at the same time side notches. This is also accompanied by the rounding of the material that remains under the strings. The attachment of the *Pomacea* sp. necklace (71.1900.47.7) is relatively loose, which means that the pendants can move more freely (Fig. 8d–g; Video 3). Despite this, the perforation rim presents side notches on most specimens. The presence and orientation of the notches are, however, not as regular and predictable as on the other ornaments. They can be present on both sides of the rim and on both faces of a pendant or only on one side or face. This variability in the placement of the notches could not be related to the specific position of a given pendant on the necklace; it may therefore be also related to other parameters that are not easily controllable, such as the size of each pendant and the specific shell layers used in its production. Such parameters vary considerably in this necklace, especially pendant length and thickness.

Manufacture traces and natural patterns were partially erased on five objects, in particular, on the areas adjacent to the strings on the shell plaques (71.1881.34.28 and 71.1971.43.126) (Figs. 2h and 7d–f). All specimens present edge rounding and polish. Short and bright fine scratches can be observed associated with polish on the edges and

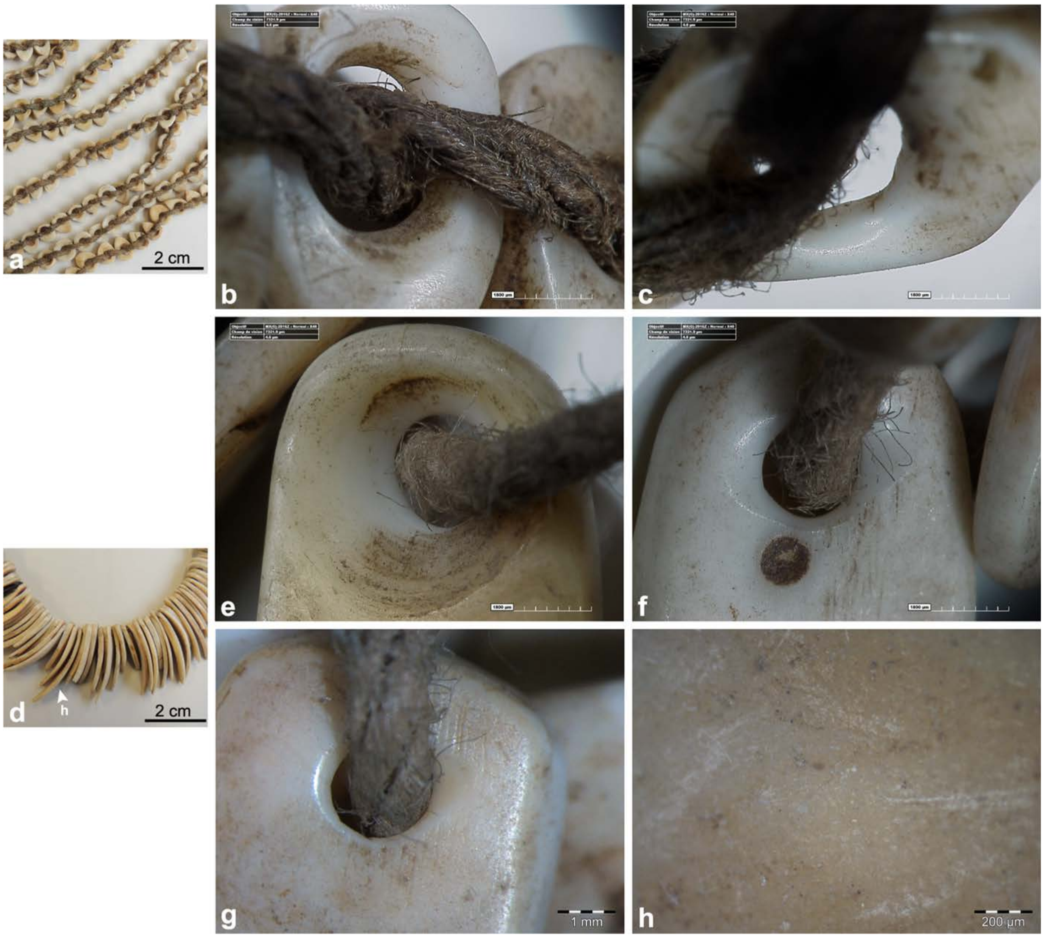

Fig. 8 Use-wear types on ornaments with gastropod shell components. MQB inventory numbers: 71.1900.47.9 (**a**–**c**) and 71.1900.47.7 (**d**–**h**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

on the perforation rim of all specimens. Bright and randomly distributed scratches are observed on the *Pomacea* sp. pendants (71.1900.47.7) (Fig. 8h), on top of a surface that appears damaged with high magnification. The combined presence of the traces on the center of the pendants, where they are in contact with each other, suggests that such features are caused by bead-on-bead wear. The beads on the other Capanahua necklace (71.1900.47.9) (Fig. 8b, c) present slightly flattened sides due to the placement of beads side by side in the same string loop. On the Wayana necklace (71.1881.34.28) (Fig. 7f), bead-on-bead wear is recognizable on the areas where each plaque is partially placed on top of another one. This area of contact presents a damaged shell layer, thus being whiter, scratched, and lacking grinding traces. With high magnification, the damaged sectors can be clearly differentiated from the used areas adjacent to the perforation, which are greasier, brighter, and present a characteristic use polish. Finally, the shells of the Yamana necklace (71.1884.102.40) (Fig. 7a) are in constant contact, as the top of the body whorl of one specimen touches the lower part of the whorl of the next one. The resulting wear can be characterized by the formation of a white abraded patch on the area of contact.

Osseous Materials

Ornaments made of bones and teeth have also been the focus of considerable use-wear research (*e.g.*, Cristiani and Borić 2012; d'Errico 1993a; Mărgărit *et al.* 2016; Poulmarc'h *et al.* 2016; Radovčić *et al.* 2015; Rigaud *et al.* 2014; Vanhaeren and d'Errico 2003; Winnicka 2016; Wright *et al.* 2016). Both raw materials are relatively soft and develop diagnostic microtraces fairly quickly (Van Gijn 2005); this also means that postdepositional and curation traces may form quite easily, in particular those related to handling, storage, and cleaning (d'Errico 1993a; Graziano 2015). In total, 11 objects present components made of osseous materials, including teeth, bones, and hawk-eagle talons. In most cases, bone ornaments were produced through the removal of a blank from a long or flat bone, which subsequently went through several shaping and abrasive production stages. In contrast, the natural morphology was preserved on the teeth ornaments, as they were only removed from a mandible and perforated. The exceptions are the vertebrae beads, which did not require extensive modification, and some teeth ornaments that were ground, sawn, and/or decorated by incising and drilling.

Teeth

The teeth of five different animal species were used for nine objects, with peccary (*Tayassu* sp.) canines being the most common. Monkey teeth are also quite common, notably 86 incisors of *Aotus azarai* in two bracelets (71.1990.47.14.1–2) and *ca.* 900 canine teeth of *Cebus* sp. and *Alouatta cf. caraya* monkeys in a single necklace (71.1964.39.42). The attachment systems of three objects limited use-wear observation (71.1948.76.297 and 71.1900.47.14.1–2), whereas the teeth on two objects did not present use-wear (71.1980.61.27 and 70.2015.8.34).

Use-wear was observed on the teeth of seven objects, in particular as rim polish and rounding, accompanied by a general greasy aspect. This appearance is probably a result of contact with the human body, as rounding and polish on the edges are also recurrently present. The erasing of manufacture traces was also common, often in the form of partial elimination of drilling traces. In addition, decorative perforations and cut marks on the large caiman tooth (71.1881.34.28) have also been smoothened by use (Fig. 14d–f). Deformation of the rim is, once again, a less predominant use-wear type, only present in connection with specific attachment systems. Notches were formed on top of the perforations of the hanging peccary canines that make part of the Bará necklace (71.1948.76.296, Fig. 9c, d). Large worn down circular depressions are present around the perforations on the teeth of an unprovenienced necklace (71.1948.76.297) (Fig. 9e–g). This deformation is produced by contact with wooden beads that are tightly placed next to the teeth. With high magnification, fine, short, and bright scratches are visible in the polish of the area, distributed in multiple directions. In another necklace (71.1929.8.83) (Fig. 10f, g), the tooth is in contact with a knot made with the string, which led to the formation of a concavity around the tooth's perforation. This feature is only seen on the face that is in contact with the knot, but not on the other face. The other face is in contact with a vertebra bead and appears slightly flattened, presenting scratches (Fig. 10h). The perforation on the caiman tooth (71.1881.34.28) is also deformed due to the presence of two thick strings. In the Aché necklace

Fig. 9 Use-wear types on ornaments with teeth components. MQB inventory numbers: 71.1964.39.42 (**a**–**e**) and 71.1929.8.83 (**f**–**h**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

(71.1964.39.42) (Fig. 10a), the perforations of the teeth were widened by contact with the nettle string. The teeth are tightly attached to each other, so that each tooth is in an angle in relation to the next one. The contact between the teeth led to deformation and flattening of their roots (Fig. 10a–c; Video 4). The deformation of the roots is, in this case, a product of bead-on-bead wear. In contrast, the teeth located closer to the end knot of the necklace are more loosely attached. In these specimens, the perforation is facetted and ragged, being clearly less worn (Fig. 10d, e).

Bone

Seven of the studied ornaments included bones of at least 10 different animal taxa, with mammals, fishes, and birds identified with certainty (Table 1). Use-wear was observed on the bones integrating all but two objects (70.2015.8.34 and 71.1948.76.296). Rim rounding and polish, alongside the erasure of drilling traces, were the most common use-wear types (Figs. 11 and 12). Smoothening of cut marks on the faces of tubular beads was observed on a Tikuna necklace (71.1971.30.82, Fig. 11a, b). On the Matsigenga baby sling (71.1980.61.27) (Fig. 13), use-wear is observed on only three out of six bone artifacts, where it is accompanied by the erasure of drilling traces and smoothening of incised designs. The extension of the use-wear also varies between the worn pendants (Fig. 13, compare d, g, i, and k). Rim deformation is only seen in a double-perforated pendant integrating the baby sling, but the direction of the deformed notches does not match the present attachment system (Fig. 13j–l). This suggests that the pendant had been previously used and that it was attached to this baby sling in a different position. A Bororo labret (71.1936.48.150) (Fig. 12d) is the only noncomposite and nonperforated bone object. It appears very rounded and with well-developed polish. The T-shaped attachment sector, which would have been inserted in the lower lip, is partially deformed, due to the extreme rounding of its edges (Fig. 12e, f). This is accompanied by a characteristic smooth, invasive, and scratched polish that superposes production traces. The latter can only be observed with high magnification (Fig. 12g, h), as the advanced degree of use-wear development has made the grinding traces invisible at low magnification.

On the Jivaro necklace (71.1903.13.20) (Fig. 11f), worn down circular patches are present on the areas of contact between the bones and the porcelain beads. While grinding traces can be recognized, suggesting that the concavities were created during manufacture, they have been smoothened and expanded by bead-on-bead wear. This contact also produced a bright and poorly linked polish, associated with a black residue (Fig. 11f–h; Video 5). Bead-on-bead wear also seems to be the main mechanism behind the formation of use-wear on two other necklaces. In the Tikuna necklace (71.1971.30.82) (Fig. 11a), the contact between the ends of the bone tubes produced a smooth surface, with use-wear only visible on the rim of perforation. With high magnification, the polish seems to cover most of the surface, but it is flat and restricted to the tops (Fig. 11e). In contrast, the contact with a seed bead created a more rounded aspect on the end of the bones (Fig. 11d). With high magnification, this polish is bright and invasive, displaying long scratches in multiple directions. In the vertebrae necklace (71.1929.8.83) (Fig. 12a), use-wear is recognizable on the vertebrae faces, which have become bright and slightly flattened due to bead-on-bead wear. The drilling traces have been partially smoothened on the walls of perforation and, on the specimens in contact

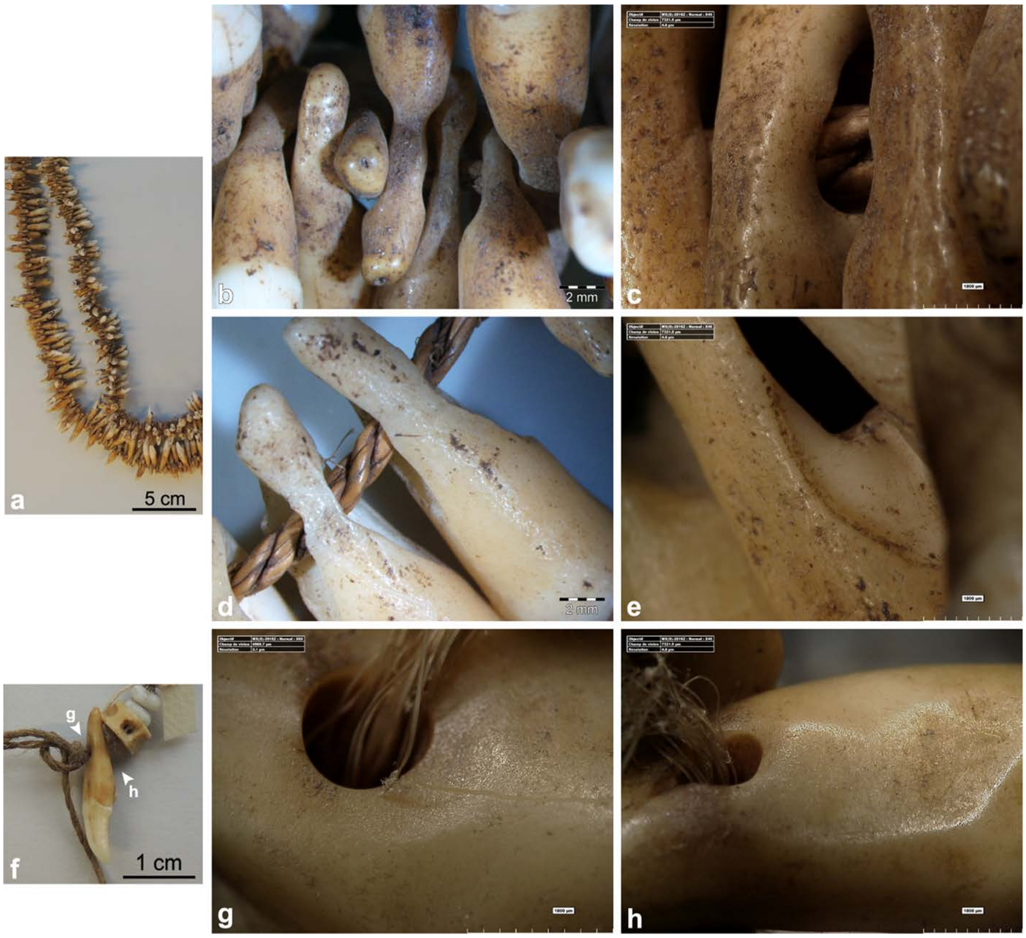

Fig. 10 Use-wear types on ornaments with teeth components. MQB inventory numbers: 71.1964.39.42 (**a**–**e**) and 71.1929.8.83 (**f**–**h**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

with porcelain beads, been covered in the black residue left by these beads. In addition, contact between vertebrae and porcelain beads led to the widening of the vertebrae's centrum. The hole at the center of each vertebra appears smooth, clean, and with a lighter color than the surrounding surface, due to the friction produced by the string (Fig. 12a–c).

Quartz

Studies focused on ornament use-wear on hard and brittle lithic materials are not common (Alarashi 2016), despite the abundance of studies focused on gemstone technology (*e.g.*, Groman-Yaroslavski and Bar-Yosef Mayer 2015; Gwinnett and Gorelick 1979; Kenoyer 1997; Roux 2000; Roux *et al.* 1995; Sax and Ji 2013). Quartz materials have received more attention in use-wear studies as flaked lithic tools (Clemente Conte *et al.* 2015; Fernández-Marchena and Ollé 2016; Ollé *et al.* 2016). It has been argued that polish in rock crystal only forms as a result of "highly abrasive activities with great pressure and after a relatively long working period" (Fernández-Marchena and Ollé 2016, p. 183). In addition, despite the shared basic chemical composition and hardness, quartz and rock crystal develop use-wear differently due

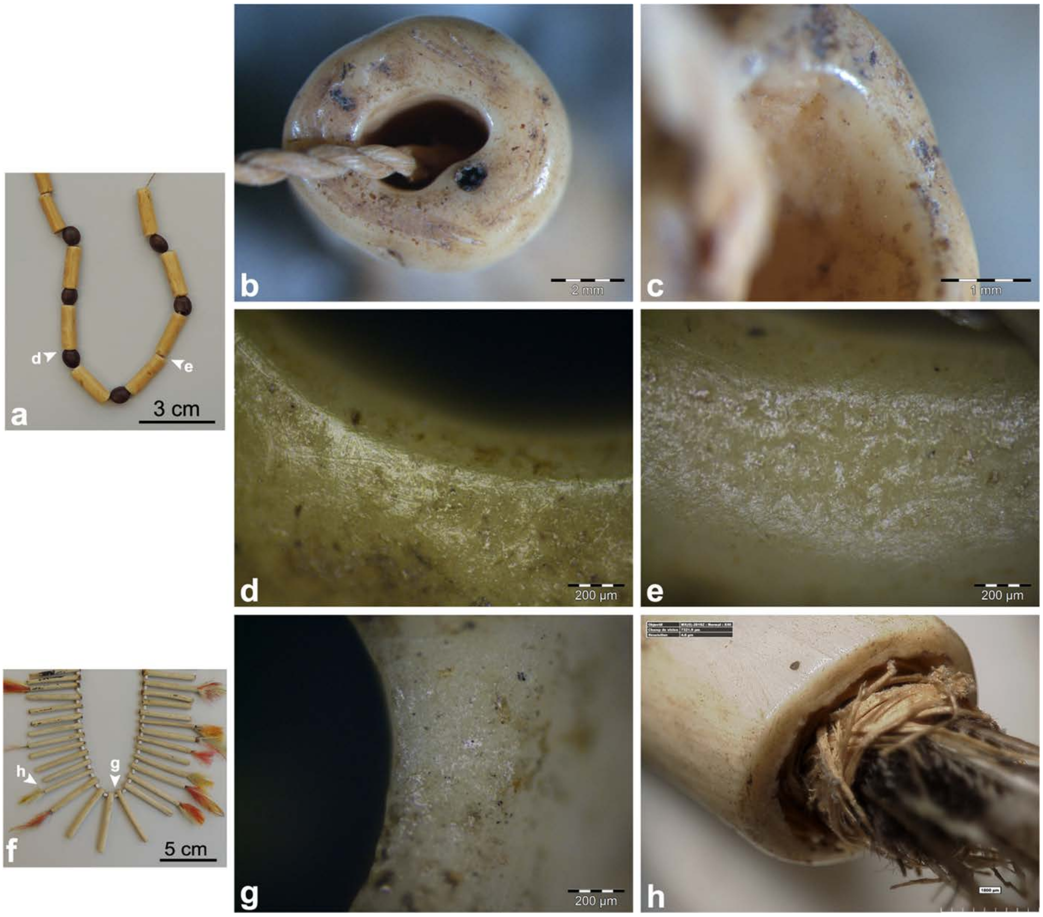

Fig. 11 Use-wear types on ornaments with bone components. MQB inventory numbers: 71.1971.30.82 (**a**–**e**) and 71.1903.13.20 (**f**–**h**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

to their specific material structures (Ollé *et al.* 2016, p. 166). Differences in the use-wear characteristics on the two materials were noted in the present study, although we cannot rule out the potential role played by the morphology of the components, string raw material, and length of use. A larger sample will help to properly address this issue in the future.

The Bará quartz pendant (71.1948.76.286) (Fig. 14a) is the only perforated specimen, displaying extensively developed string wear with clear directionality. The polish developed on the top of the perforation, at the same time smoothening drilling traces, microcraters, and cracks. With low magnification, the polish appears dull and is accompanied by a deformed notch on the perforation rim (Fig. 14a–c; Video 6). With high magnification, the polish is more invasive and less pitted than the surrounding manufacture polish, presenting some scratches. Despite the fact that the pendant is hanging loosely on the string, the use-wear on the perforation is extremely localized. This may be connected to the considerable weight of the quartz pendant in comparison to the other necklace components (two peccary teeth and the bird talons).

The two rock crystal pendants are secured by a string placed around the root end, together with adhesive residue (Fig. 14d, g). This string attachment hampers the complete visualization of the worn sectors. Additionally, it is not possible to observe the attachment area of the crystal that is inserted in a caiman tooth (71.1881.34.75)

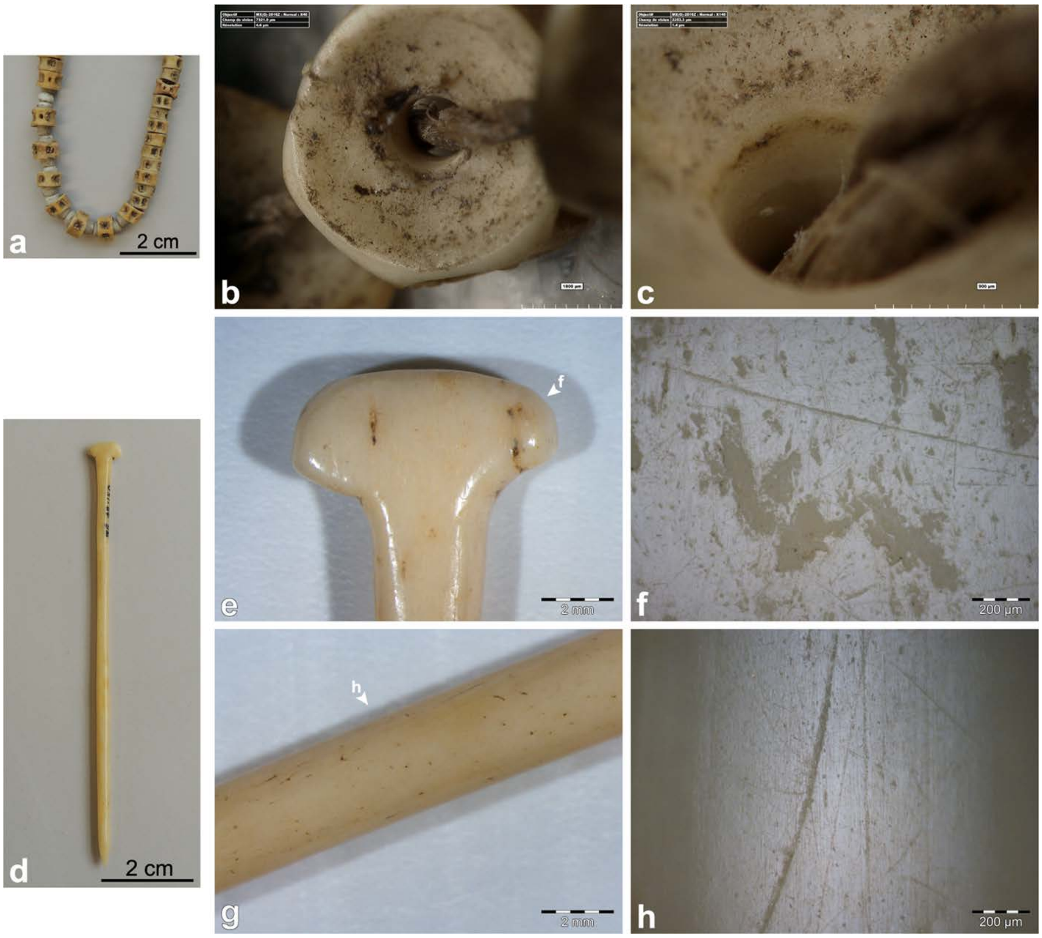

Fig. 12 Use-wear types on ornaments with bone components. MQB inventory numbers: 71.1929.8.83 (**a**–**c**) and 71.1936.48.150 (**d**–**h**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

(Fig. 14d), thus preventing the characterization of string wear. Minimal use-wear was observed on the body of the crystal, with the exception being a broken notch on its side, likely caused by brusque contact with the tooth during use (Fig. 14d–f). Rounding and the formation of a dull polish were observed on the other rock crystal pendant (71.1881.34.78) (Fig. 14g). Such traces could only be observed on areas where the string seems to have moved from its original position. However, the use-wear is less developed on this specimen, being characterized primarily by a discreet dulling of the surface (Fig. 14g–i). In this case, stress is only present on certain contact areas, due to the natural faceted morphology of the crystal. Use-wear is also partially concealed by string residue and by the ink marking and identification tag glued to the artifact. Despite such limitations, the analysis suggests that use-wear development on both milky quartz and rock crystal is characterized by rounding and the formation of a dull polish in contrast to the surrounding surface (Ollé *et al.* 2016).

Wood

While microwear studies have been conducted on wooden artifacts (Breukel 2018; Caruso Fermé *et al.* 2015; Lavier *et al.* 2009), research focused on use-wear of wooden

Fig. 13 Teeth (**b**, **c**), bone (**d**–**l**), and nut (**m**–**o**) components on baby sling (**a**), with (**g**–**o**) and without use-wear (**b**–**f**). Note different degrees of use-wear development on bone components. MQB inventory number: 71.1980.61.27. ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

ornaments is still missing, thus hampering the comparability of the traces described here. Considerable typological variability is found among the six objects with wooden components. All components are notably light-weight, in particular the Toba ear discs (Fig. 15a, d) in spite of their large size (*ca.* 6 × 3 cm). While the species used in their production among the Toba is indeterminate, similar discs were made with the *barriguda* tree (*Ceiba ventricosa*) among the Botocudo from eastern Brazil (Ehrenreich 2014, p. 75). In the Guaycurú necklace (71.1933.72.638) (Fig. 15m), the

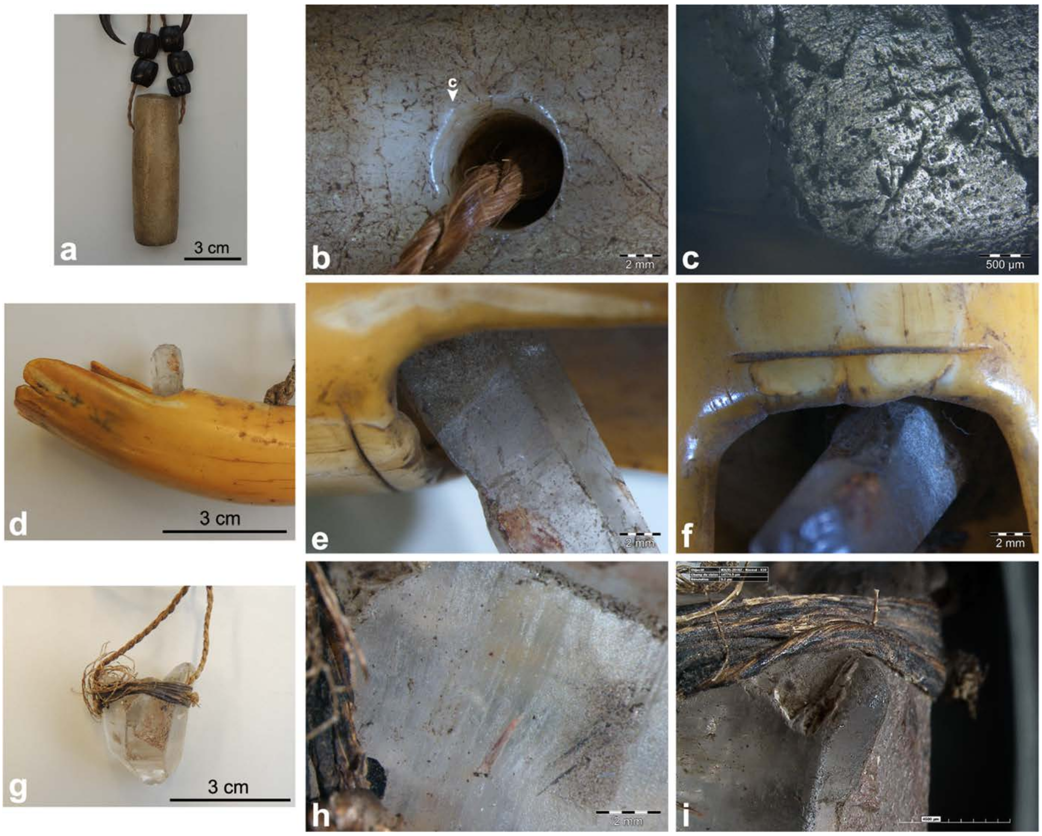

Fig. 14 Use-wear types on necklaces with milky quartz and rock crystal components. MQB inventory numbers: 71.1948.76.196 (**a**–**c**), 71.1881.34.75 (**d**–**f**), and 71.1881.34.78 (**g**–**i**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

pendants appear greasy and worn, but the position of the string inside a notched area prevented the direct observation of string wear (Fig. 15n). The back of the pendants has a more developed polish on its center, greasier, invasive, and with fine scratches in different directions. This polish stands out from the manufacture traces, being potentially connected to body contact during use (Fig. 15o). In the case of the nose ornament (71.1929.8.81) (Fig. 2f), the wooden attachment stick has a greasy appearance and some damage on its lower surface, which would rest against the nasal septum. However, this association is only tentative, relying primarily on low magnification, as the area cannot be directly observed with the metallographic microscope.

The main evidence of use on the other four objects is damage to the surface of the wood, rather than polish development. The observed damage patterns correspond to the way these objects would likely be used. By recording their extension, it is possible to establish which faces of the ear discs (71.1884.29.24.1–2) were placed against the skin and which ones faced outward. The former is light-colored and cratered (Fig. 15d–f), while the latter is darker and better preserved (Fig. 15a–c). This pattern corresponds to the slanted position of the discs in the earlobes, according to illustrations of the Botocudos wearing this type of ornaments (Branner 1893; photos by W. Garbe in Ehrenreich 2014). The damage distribution on the face in contact with the skin additionally suggests which disc was used in which ear: 71.1884.29.24.2 in the right and 71.1884.29.24.1 on the left. Damage patterns were also seen on the labret

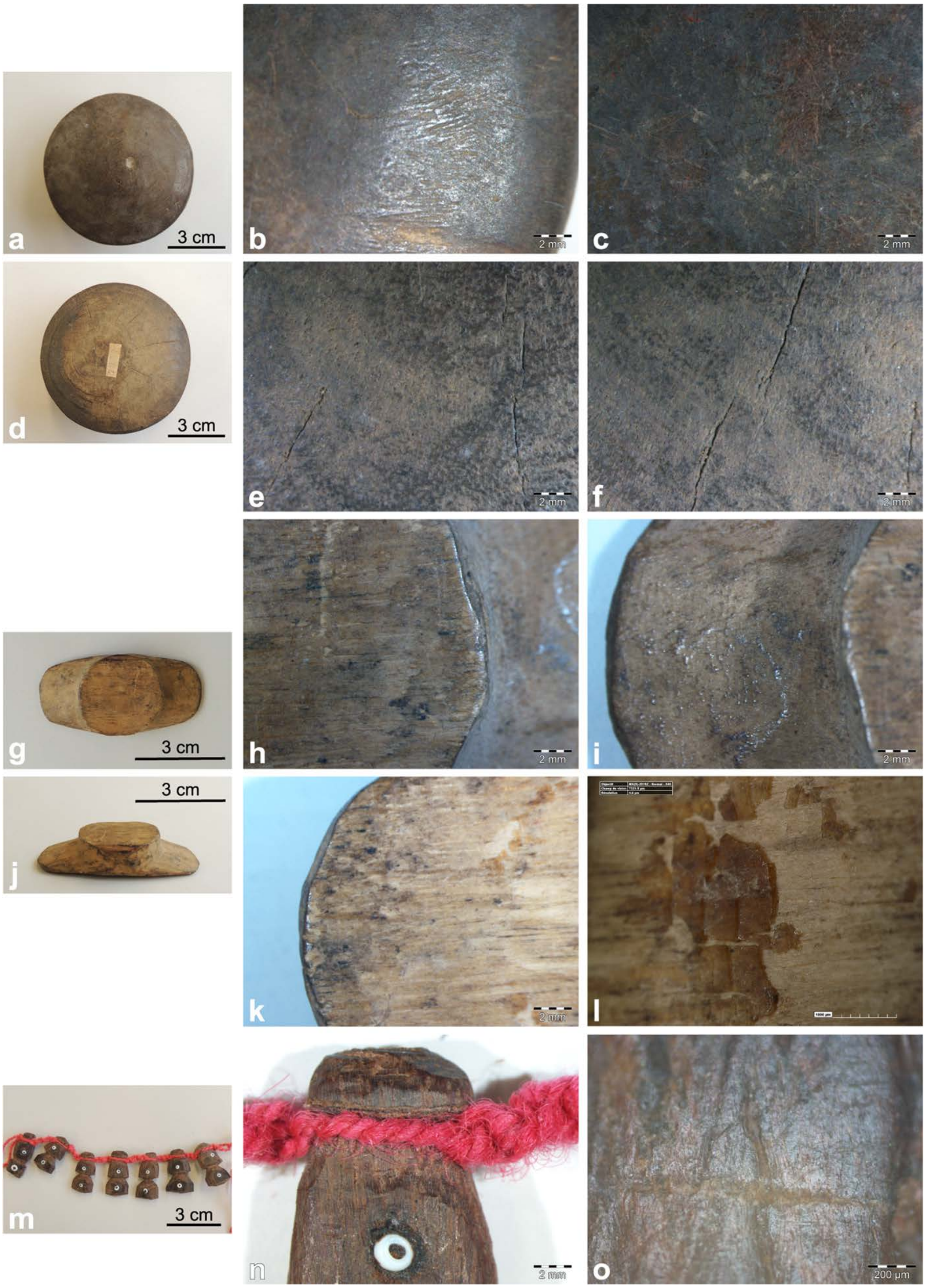

Fig. 15 Use-wear types on ornaments with wooden components. MQB inventory numbers: 71.1884.29.24.2 (**a**–**f**), 71.1884.29.38 (**g**–**l**), and 71.1933.72.638 (**m**–**o**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

(71.1884.29.38) (Fig. 15g, j), concentrated on the back of the "wings" and on the sides of the knob (Fig. 15i–k). The face of the knob, which would not be in contact with the skin during use, is better preserved (Fig. 15h). As with the ear discs, the damage can be tentatively attributed to contact with the human skin, which carries acidic bodily fluids capable of affecting the wooden objects' surface over a certain period of usage. However, the surfaces of the ear discs and labret are partially covered by identification tags, ink markings, and unidentified residues (Fig. 15l), limiting interpretation.

Nuts

Palm endocarps make part of many Amerindian ornaments, either serving as tinkling bells or as blanks for figurative and geometric carvings (Harding 2003; Ribeiro 1988). All studied ornaments made of nuts present use-wear, except for the sectioned nuts in one necklace (70.2015.8.34) (Fig. 9a). Use-wear appears as polish and rounding of the rim of perforation on three objects, sometimes associated with rim deformation. Erasure of manufacture traces and a general greasy aspect were also observed. The distribution of use-wear on the nut components of the Capanahua necklaces (71.1900.47.7 and 71.1900.47.9) is the same as on their shell counterparts (Fig. 16h–j). In fact, use-wear characteristics and distribution on nuts are largely comparable to those developed on the hard animal materials previously discussed. Different degrees of use-wear were observed on figurative pendants present in the same necklace (71.1971.30.62, Fig. 16a). Four pendants present use-wear more developed (Fig. 16b, d, f) than all other specimens in the necklace (Fig. 16c, *e.g.*): greater deformation of the perforation and nearly complete erasure of manufacture traces. In the place of manufacture striations, a bright polish with short and fine scratches in multiple directions can be observed on their surface with high magnification. The natural patterns of the *tucum* nuts have also been largely erased, giving them a darker color in comparison to the other specimens. The edges are markedly rounded, in particular on the back of the pendants, where a highly developed invasive polish is also observed. The pendants with more developed use-wear were probably reused in this necklace, after being removed from an older object. Bead-on-bead wear was only observed on the baby sling (71.1980.61.27) (Fig. 13): the nut pendants are stacked on top of each other, which led to polish development and slight deformation of the rim (Fig. 13m, o). Some polish is also observed on a narrow opening through which the string is inserted on the top of the nut (Fig. 13n).

Discussion: Interpreting Ornament Use-Wear

The systematic microwear study of ethnographic ornaments has provided insights into the characteristics and distribution of microtraces on the surfaces of individual components. In the following, the patterns observed across raw materials will be discussed, in order to assess how they relate to specific conditions, such as the type of attachment, contact materials, and composition of a given ornament (Table 2). The diagnostic value of the traces for archaeological analysis will be evaluated. Finally, we address how the observed patterns may challenge common assumptions or showcase the limits of archaeological interpretation.

Fig. 16 Use-wear types on ornaments with nut components. Note poorly developed use-wear (**b**, **d**, **f**) in contrast to highly developed traces (**c**, **e**, **g**) in components of the same necklace. MQB inventory numbers: 71.1971.30.62 (**a**–**g**), 71.1900.47.7 (**h**, **i**), and 71.1900.47.9 (**j**). ©Musée du quai Branly - Jacques Chirac, photos by C. Guzzo Falci, 2017

Use-Wear Characteristics, Distribution, and Diagnostic Features

Most raw material categories analyzed consistently presented the following use-wear types: (1) polish formation and rounding of the attachment area (generally, the rim of perforation), (2) its deformation, (3) the erasure of manufacture traces and natural patterns, (4) polish formation and rounding of the edges, (5) a general greasy aspect, and (6) bead-on-bead wear. Such traces were systematically observed, despite the generally different mechanical and chemical properties of the materials. Another type of use-wear, observed mainly on wooden artifacts and on a shell labret, was (7) damage to the worn surface. The first use-wear type is the most common and forms the main indication of use regardless of attachment system. Use-wear distribution on the rims and walls of perforation is extremely localized on most specimens. This was seen on objects in which the attachment is tightly secured, but not necessarily glued in place.

Table 2 Use-wear types observed according to attachment system and ornament composition. The number of objects with each configuration is informed between parentheses. Six objects are not represented in the table, as they do not present most types of use-wear

	Beads		Pendants/plaques					Elements inserted through the skin	
	Loosely attached ($n = 2$)	Tightly attached to the string and to other beads ($n = 4$)	Tightly attached to beads ($n = 4$)	Loosely attached ($n = 2$)	Tightly attached to string, but not to other pendants ($n = 7$)	Tightly attached to string and to other pendants ($n = 6$)	Tightly attached to other pendants, but not to the string ($n = 1$)	Noncomposite ($n = 4$)	Composite ($n = 2$)
String wear									
Polish	++	++	++	++	++	++	++	NA	+
Deformation	–	++	+	++	+	+	++	NA	–
Erasure of production traces and natural patterns	++	++	+	++	+	+	++	NA	–
Surface flattening	–	+	–	–	–	+	++	NA	–
Surface damage	–	–	+	–	+	+	–	NA	–
Body wear									
Polish	++	++	+	++	+	+	++	++	+
Deformation	–	–	–	–	–	–	–	+	–
Erasure of production traces and natural patterns	+	+	+	+	+	+	–	++	+

Table 2 (continued)

	Beads		Pendants/plaques					Elements inserted through the skin	
	Loosely attached ($n = 2$)	Tightly attached to the string and to other beads ($n = 4$)	Tightly attached to beads ($n = 4$)	Loosely attached ($n = 2$)	Tightly attached to string, but not to other pendants ($n = 7$)	Tightly attached to string and to other pendants ($n = 6$)	Tightly attached to other pendants, but not to the string ($n = 1$)	Noncomposite ($n = 4$)	Composite ($n = 2$)
Surface flattening	−	+	−	−	−	−	−	−	−
Surface damage	−	−	−	+	−	−	−	+	+
Bead-on-bead wear									
Polish	++	−	+	−	−	+	++	NA	−
Deformation	+	−	++	−	−	+	++	NA	−
Flattening	++	+	−	−	−	−	++	NA	−
Surface damage	−	+	++	+	−	+	–	NA	+
Examples	71.1971.30.82	71.1900.47.9	71.1880.7.14	71.1900.47.7	71.1884.29.29	71.1881.34.28	71.1964.39.42	71.1936.48.150	71.1936.48.163

++ feature present on all specimens, + feature present on some specimens, − absent feature, NA not applicable

The distribution of the traces follows the position where the string is most commonly resting and generating tension. For this reason, such distribution can be highly diagnostic of the placement of the string. In contrast, the rim polish on the pendants of the Capanahua necklace (71.1900.47.7) has a larger distribution than the immediate position of the string (Fig. 8e–g). Nevertheless, its location does correspond to the areas that the string is sometimes in contact with (Video 3), given that the attachment is relatively loose and the pendants can oscillate back and forth.

Rim deformation was observed on fewer specimens, both on objects with components fixed in place (71.1980.61.27, 71.1900.47.9, 71.1884.29.63, and 71.1939.88.693) and on objects with loosely attached components (71.1900.47.7 and 71.1948.76.296). In the study of archaeological assemblages, the presence of use notches to the sides of the perforation is generally interpreted as the presence of two strings placed in opposing directions, similar to the attachment of the Capanahua beads (71.1900.47.9) (Fig. 8a). In this necklace, the deformation of the perforation is characteristic of its attachment, as it is more pronounced on the areas right beneath the strings. In contrast, the position of the use notches on the other Capanahua necklace (71.1900.47.7) (Fig. 8d) cannot be directly correlated to string position. This highlights the interpretation limits associated with estimating necklace configurations from archaeological artifacts. Likewise, the top of the peccary teeth in the Bará necklace (71.1948.76.296) (Fig. 9c, d) has deformed notches, even though they are loosely attached on the string. This distribution may be connected to the presence of the quartz pendant on the center of this necklace. The quartz is larger and heavier than the other components, thus creating greater string tension. A localized and well-developed use-wear is also found on the quartz pendant itself (Video 6). The differential development of use-wear on the two perforations of the Mehinaku plaques (71.1971.43.126) (Fig. 2h) can also be indicative of the tension of the string attachment. The lower perforation does not present considerable use-wear, only some rounding and polish on an otherwise ragged rim. This is probably connected to the loose string attachment on this perforation, as opposed to the top one.

In sum, multiple factors affect the formation and distribution of string wear on ornaments: (1) the position of the string, (2) whether the string and the ornaments being hung are in a static or in a free-moving attachment, (3) the tension of the string attachment, and (4) the thickness and/or number of strings passing through the hole of a component. While the position of the string is a main factor, it is not possible to isolate it from other variables. Regarding the polish formed in association to string wear, it has been suggested that the presence of scratches is connected to the use of silica-rich plants as string raw material. However, no direct correlation between specific string raw materials and scratches within use-wear polishes was noted: scratches are part of the use polish produced by different string materials, such as cotton and palm fibers. Furthermore, strings attract and trap abrasives from both the human body and the environment during the use of ornaments. The dirt particles trapped in the string may account for the fine scratches observed in association to the polish. The erasure of manufacture traces was also a recurrent use-wear type observed, especially inside of the perforations, where drilling traces are smoothened. On other areas of a component, such traces are connected to contact wear, in particular with the human body. In most studied composite ornaments, the observed contact use-wear is primarily the result of objects loosely hanging against the body (naked or clothed). Scratches were often observed in association to the body-contact polish along the edges. They were likely produced by particles already present on the contact surface (possibly the human skin), similarly to what is suggested by d'Errico (1993a, p. 150) in relation to the formation of scratches in the polish produced by handling.

Bead-on-bead wear refers to the use-wear formed due to contact between two neighboring components of an ornament. It concerns the contact between beads or pendants of the same type or of different types and raw materials. It is not as common as the other use-wear types, being strictly connected to attachment systems where individual components touch each other. The contact between adjacent beads or pendants generates traces that are fairly diagnostic of the object's configuration. In many cases, bead-on-bead wear formed as a product of the mechanical interaction between two materials, when they abrade each other as a result of any movement. In this sense, it can be found in artifacts that were just strung together, but not actually worn. Its specific traits and distribution can be indicative of the way in which the components were attached in relation to each other and what materials they were made of. For instance, diagnostic traces were observed in the following cases: bone-bone and bone-seed contact (71.1971.30.82), vertebra-porcelain and vertebra-vertebra contact (71.1929.8.83), porcelain-bone contact (71.1903.13.20), and also glass-shell contact (71.1880.7.14). The use-wear created by comparable materials (bone-bone) or artificial materials (shell-glass) produces greater damage and abrasion, while the wear produced by softer and organic materials (seeds-bone) generates more rounding and a more invasive polish. The specific morphology of the components in contact also influences use-wear distribution, as evidenced by the wooden beads and teeth pendants (71.1948.76.297) (Fig. 9e–g).

While many traces can be recognized with low magnification, the combination of different microscopes proved to be central for a correct identification. For instance, while some scratches in the use polish may be visible with low magnification, their secure identification requires the use of a metallographic microscope. This is because other activities, such as polishing and bead-on-bead contact, may lead to the formation of linear traces, which cannot be properly distinguished with low magnification. Another example is the general greasy appearance attested on the components of many objects. While this appearance may serve as macroscopic indication of the use of an artifact, it may also result from a range of other activities, such as handling, transporting, or wrapping an artifact (Breukel 2013; d'Errico 1993a; Graziano 2015; Wentink 2006).

Different Degrees of Use-Wear

The variation in use-wear development between artifacts of the same type and raw material has been used by archaeologists as an indication of degrees of use within an assemblage (*e.g.*, Bonnardin 2008, 2012; Sidéra and Giacobini 2002; Sidéra and Legrand 2006; Van Gijn 2017). Controlled experiments corroborate the relation between intensity and extent of wear development and its duration (Mărgărit 2016). In the present research, different degrees of use-wear have been observed on the components of the baby sling and on the nut figurines necklace. The variation in use-wear can be interpreted in both cases as related to extent of use. In the baby sling, we see the gathering of individual components with different biographies, including freshly made and reused pendants, either highly or moderately used. On the other hand, beads integrating a necklace with a homogeneous biography may still present different degrees of use-wear development or may not even present all the types of traces that other components in the same object do. For instance, in the Aché necklace (71.1964.39.42) (Fig. 10a), the difference is connected to how tightly attached the teeth are in different sectors of the necklace. However, the causes of variability are not always clear. In some cases (71.1929.8.36, 71.1900.47.7, and 71.1900.47.9), differences in wear development cannot be safely correlated to different use trajectories for the components. Other factors may also influence wear development, such as the specific layer of the material used for the production of each bead, the thickness of the bead, and the positioning and nature of the drilled hole. All these variables can easily vary from bead to bead in the same composition.

In addition, we must consider other variables in the biographies of ornaments. As mentioned previously, six objects present evidence of the replacement of their strings, possibly due to degradation. The relative degree of wear of the new strings suggests that such replacements happened to the objects prior to collection. This type of "recycling" practice also stresses the complexity of the lives of ornaments. Discard and replacement of components may be important parts of the biographies of objects, but cannot be easily observed in the study of archaeological assemblages. The selection of beads with particular biographies to compose a new ornament may have held social and cosmological significance (Walker 2009), but has only seldom been noted in archaeological assemblages (Van Gijn 2017).

The Absence of Use-Wear

The presence of use-wear on most studied ornaments indicates that they were produced for use within the community and not just to be traded with collectors. At the same time, its absence on some objects highlights the fact that use-wear is not only the result of the friction between a string and a given raw material. The formation of string wear further involves the interaction with acidic bodily fluids (d'Errico 1993a, p. 168; Vanhaeren *et al.* 2013), as well as body paint, oils, and dirt particles. When interpreting objects that do not present use-wear, we are faced with a limit of this method of study. While use length can be suggested with some security by compared analysis of artifacts within an assemblage, it is not possible to establish whether an artifact has been worn sporadically or not been used at all. For instance, some ornaments may only be worn in specific ceremonies or by certain age groups, leading to the formation of little to no use-wear. Nevertheless, when analyzing the Bororo earrings (71.1936.48.168.1–2 and 71.1936.48.195.1–2) and the Tikuna necklace (70.2015.8.34), it became clear that not only the use-wear was absent, but also the dirt typically observed on used objects. In this sense, the analysis of ethnographic ornaments cannot determine that an ornament has definitely not been worn, but it does allow us to build a strong case for it. Even if the Bororo ear ornaments have not been worn, the individual plaques present residue added to the string (Fig. 6i, k) and bead-on-bead wear. These traces are the result of the attachment of the plaques, but not necessarily of their use. Exposed to the same conditions, archaeological artifacts would likely present the same traces. However, it is very unlikely that the "correct" interpretation (*i.e.*, having been strung, but not worn) would be reached. Similarly, the individual components would hardly be recognized as integrating ear or lip ornaments if recovered from an archaeological context. With the exception of the attachment pieces that have a T-shape and may develop characteristic use-wear on the external surface and edges, there is no distinguishable evidence of this particular composition and usage on the other plaques. In this case, the interpretation remains elusive.

Conclusion

In the last couple of decades, many studies have addressed the technology and use of archaeological ornaments, generally focusing on specific raw material categories. While material specialization is a common, and generally desired, feature of archaeological research, it is not necessarily an accurate portrait of how such artifacts were integrated within a living community. More often than not, ornaments are composite constructions, involving multiple materials: strings, bands, and a variety of bead and pendant raw materials. In order to bridge this gap, archaeologists have often referred to ornament compositions, uses, meanings, and social roles among traditional communities (*e.g.*, Bonnardin 2008; Falci *et al.* 2017a; Vanhaeren and d'Errico 2003). This microwear study of an ethnographic collection is a step further toward bridging this gap.

The primary goal of the present research was to create a reference collection that sheds light on the formation, characterization, and distribution of use-wear on ornaments from a lived context. This collection serves as a strong basis for interpreting traces on ornaments made of different raw materials recovered from a variety of contexts worldwide. It showcases many types of traces that can be searched for during the analysis of archaeological ornaments and how they may be interpreted. This study further demonstrates that the specific conditions of attachment influence ornament use-wear: raw material, morphology, and relative weight of the elements in contact, composition, tension and fixity of the attachment, body contact, among other factors. The study of this collection helps us broaden the scope of possible interpretations of beads, pendants, and plaques, not only in terms of how they were integrated in composite ornaments, but also of how they may have been taken apart, replaced, and/or discarded.

At the same time, it should not be understood as an ideal reference collection, as the objects are not the result of controlled experiments. Rather, this is a collection constituted in a lived context, which means that we cannot reconstruct every given situation an object has gone through. Its value lies precisely in the complexity of its biographies that resulted in the formation and superposition of traces in a less "orderly" manner when compared to experimental specimens. For this reason, the practical and interpretative limits to such a research have to be acknowledged and the ways they have been dealt with clearly stated. Previous research has not been sufficiently clear about such crucial issues. The different magnifications and visual possibilities afforded by each microscope had a crucial role in designing a critical, careful, and feasible analysis protocol for this assemblage. While the stereomicroscope served as the basis for initial interpretation, the 3D digital and metallographic microscopes permitted a more thorough understanding of the characteristics and distribution of microwear.

This research sheds light into the biography of a museum collection, as ethnographic objects display several traces that are witness to their specific histories. Therefore, microwear research can be used not only as a way to interpret archaeological artifacts but also as a standalone study. Future microwear research of ethnographic ornaments can shed light into the interactions between people and ornaments, in regard to their conceptualization, production, use, social role, and temporality. By focusing on the microtraces left on the surfaces of the objects and organizing them into specific biographies, such an approach will provide valuable insights for archaeologists and anthropologists regarding the multiple and active roles of bodily adornment in human societies.

Acknowledgments The authors would like to thank the assistance of the staff of the Musée du quai Branly - Jacques Chirac, in particular Dr. Christophe Moulherat for his contributions to the research. Céline Kerfant is additionally thanked for her input in the identification of plant fibers. Finally, the authors are also grateful to the editor and the four anonymous reviewers for their comments, which improved the manuscript considerably.

Funding This study was funded by the *Bourse d'étude pour la documentation des collections 2016–2017* of the Musée du quai Branly - Jacques Chirac and by the NWO Spinoza Prize awarded to Prof. Dr. Corinne L. Hofman in 2014. This research is part of the project NEXUS1492, which has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007–2013)/ ERC Grant agreement no. 319209.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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Affiliations

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Part 2: Biographical studies of Ceramic Age bodily ornaments

4

Early Ceramic Age lapidary

Published as:

Falci, C.G., Knaf, A.C.S., Van Gijn, A.L., Davies, G.R., Hofman, C.L., 2020. Lapidary production in the eastern Caribbean: a typo-technological and microwear study of ornaments from the site of Pearls, Grenada. *Archaeological and Anthropological Sciences* 12:53. https://doi.org/10.1007/s12520-019-01001-4

Archaeological and Anthropological Sciences (2020) 12:53
https://doi.org/10.1007/s12520-019-01001-4

ORIGINAL PAPER

Lapidary production in the eastern Caribbean: a typo-technological and microwear study of ornaments from the site of Pearls, Grenada

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Received: 2 July 2019 / Accepted: 16 October 2019

Abstract

The present paper examines bodily ornaments made of semiprecious lithic materials from the site of Pearls on the island of Grenada. The site was an important node in long-distance interaction networks at play between circum-Caribbean communities during the first centuries of the Common Era. Pearls was an amethyst bead-making workshop and a gateway to South America, from where certain lapidary raw materials likely originated. The importance of the site for regional archaeology and local stakeholders cannot be overstated. However, it has undergone severe destruction and looting over the decades. Here, we present a study of a private collection of ornaments from Pearls, which combines raw material identification, typo-technological analysis and microwear analysis. We identify great diversity in lithologies and in techniques adapted to their working properties. Multiple abrasive techniques for sawing, grinding, polishing and carving are identified. Furthermore, the use of ornaments is examined for the first time. Finally, we contrast our dataset to other Antillean sites and propose management patterns for each raw material. Our approach ultimately provides new insights on ornament making at Pearls and on its role in regional networks.

Keywords Ornaments · Technological analysis · Microwear analysis · Jade · Caribbean archaeology · Exchange

Introduction

Bodily ornaments have been regarded as proxies for the existence of large-scale exchange networks connecting the eastern Caribbean islands with northern South America, the Isthmo-Colombian region and Mesoamerica (Fig. 1a) (Cody 1993; Hofman et al. 2007, 2014a; Rodríguez López 1993; Rodríguez Ramos 2010; Watters 1997). In the first centuries of the Common Era, lithic materials used as ornaments were extremely varied and unequally distributed across the circum-Caribbean (Chanlatte Baik 1983; Hofman et al. 2007; Murphy et al. 2000; Watters and Scaglion 1994). The identification of workshop sites specialized in certain raw materials has further supported the idea of continuous reciprocal exchanges between islands (Hofman et al. 2007, 2014a; Watters 1997). Lapidary items have been linked to ceremonial and competitive interactions between village big men and aspiring individuals (Boomert 2001; Curet 2003; Hofman et al. 2007, 2019; Roe 1989; Siegel 2010). Despite the great interest sparked by lapidary circulation, the near absence of technological studies has hindered our understanding of the skilled production of ornaments in hard lithics. Decoding such patterns is a crucial step in acknowledging the sophistication of the indigenous heritage of the region.

The Pearls archaeological site, on the southeastern Caribbean island of Grenada (− 61°36′51.78″ W 12°8′39.45″ N[1]; Fig. 1b), was a key node in the exchange networks connecting the Antilles with northern South America (Cody 1993; Boomert 2007; Hofman et al. 2007; Laffoon et al. 2014). The site was the locus of a lapidary workshop, with marked focus on amethyst bead making. However, the data produced since its discovery in the 1960s remains limited. This is due to the continuous

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s12520-019-01001-4) contains supplementary material, which is available to authorized users.

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[1] DMS coordinates for the airport landing strip that crosses the site of Pearls. See Supplementary data 2.

Published online: 27 January 2020

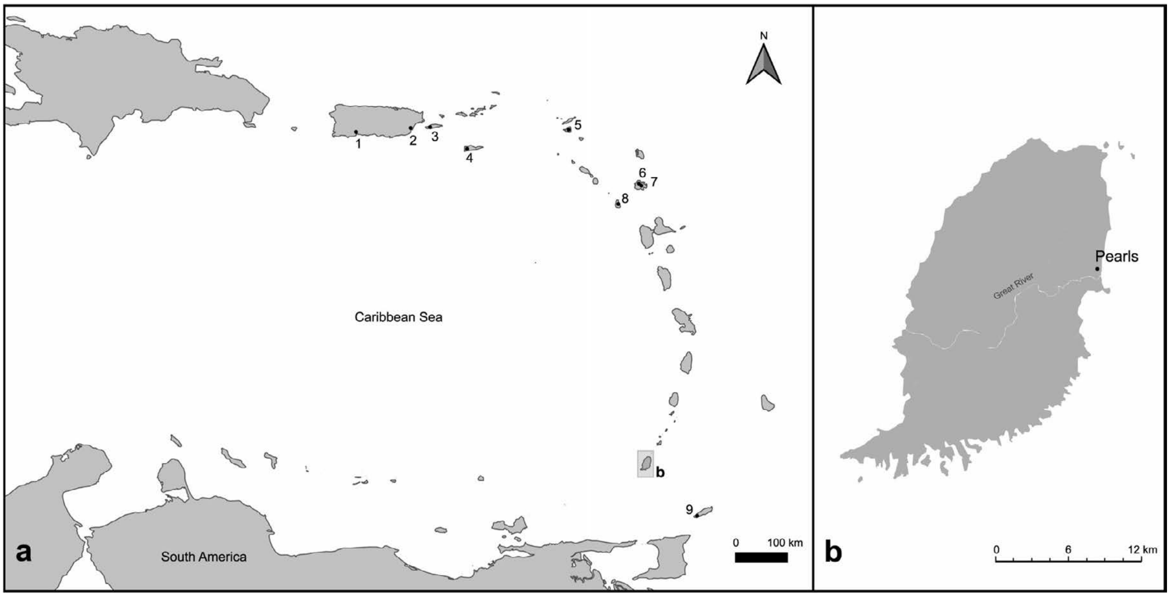

Fig. 1 **a** Map of the eastern Caribbean with locations of lapidary workshop sites mentioned in the text: 1 Tecla (Puerto Rico), 2 Punta Candelero (Puerto Rico), 3 La Hueca/Sorcé (Vieques), 4 Prosperity (St. Croix), 5 Hope Estate (St. Martin), 6 Royall's (Antigua), 7 Elliot's (Antigua), 8 Trants (Montserrat), 9 Golden Grove (Tobago). **b** Map of Grenada with the location of the archaeological site of Pearls

destruction, and looting the site has undergone over the decades. As this is the only lapidary workshop on the southern Antilles during this period, an investigation of its assemblages fills a significant gap in our understanding of indigenous networks. The present research is carried out in the context of a MoU between Leiden University and the government of Grenada. Our goal is to provide a thorough study of a large assemblage from Pearls, which has been unsystematically collected from the site and now makes part of a private collection.[2] We assess variability in raw materials, ornament types and production technologies. Lithologies were determined by macroscopic examination with a hand lens. Production technologies and technical stages were studied through a typo-technological approach; furthermore, a microwear study of a selected sample set was carried out in order to provide an in-depth assessment of production micro-traces and use-wear.

This new data is compared with the assemblages recovered during the excavations of the Pearls site (Cody 1990; Keegan and Cody 1990) and of other eastern Caribbean sites dated to the same period (e.g. Chanlatte Baik 1983; Murphy et al. 2000; Watters and Scaglion 1994). This study provides an approach for investigating previously looted sites that hold an important place in both archaeological narratives and society at large. At the same time, it documents this collection and makes its dataset available for a wider archaeological public. While new archaeological assessments of the site and preservation measures are necessary, we argue that the lapidary collections that have already been exposed need to be thoroughly researched. The proper documentation of such collections is indispensable to archaeological debates concerned with the specialized production and exchange of valuables across the Caribbean.

Archaeological background

The Early Ceramic Age period (400 BC–AD 600/800) has been traditionally defined by the arrival to the Antilles of pottery-bearing horticulturalist populations from northern South America (Rouse 1992, 34–37). These new occupants have been identified with the Cedrosan Saladoid and the Huecoid pottery series. More recently, the research focus has changed towards a more dynamic understanding of island occupation, involving constant voyaging, contact and exchange between communities (Curet and Hauser 2011; Hofman et al. 2007, 2014a, b, 2019; Mol 2014; Rodríguez Ramos 2010). Of particular interest, here are lapidary industries, i.e. assemblages of bodily ornaments made of a large variety of lithic materials found at several Saladoid and Huecoid sites.

[2] Artefacts from the collection have also been featured in previous archaeological research (Breukel 2019; Keegan and Hofman 2017, 60, 213; Petitjean Roget 2015, 147–150; Scott et al. 2018).

State of the art on Antillean lapidary studies

Lapidary workshops

Lapidary workshop contexts have been identified on many islands (Fig. 1a): Tecla and Punta Candelero on Puerto Rico and La Hueca/Sorcé on Vieques (Chanlatte Baik 1983; Chanlatte Baik and Narganes Storde 1989; Rodríguez López 1991), Prosperity on St. Croix (Vescelius and Robinson 1979), Elliot's and Royall's on Antigua (Murphy et al. 2000), Trants on Montserrat (Watters and Scaglion 1994), Hope Estate on St. Martin (Bonnissent 2008; Haviser 1999) and Pearls on Grenada. Their production output varied quantitatively, with some sites producing less than others (Boomert 2007). Certain sites were specialized in the working of selected raw materials (Hofman et al. 2007; Watters 1997; Watters and Scaglion 1994). However, the low chronological resolution and the use of different excavation strategies hamper true comparability between sites and inferences concerning socio-political organization (Curet 2003; Oliver 1999; Rodríguez Ramos et al. 2010).

Raw material provenance

Overviews of Early Ceramic Age lapidary circulation are continually revised as new data comes to light (Cody 1990, 1993; Hofman et al. 2007, 2014a; Knippenberg 2007; Rodríguez López 1993). Lithic identification has involved the use of macroscopic examination, refractive index and specific gravity tests, petrography, SEM-EDS, XRD and Raman spectroscopy (Cody 1990, 46; Cody 1993; Hardy 2008, 223–226; Murphy et al. 2000; Queffelec et al. 2018; Watters and Scaglion 1994). However, the sources of most raw materials remain uncertain. For instance, nephrite sources may be located in the Brazilian Amazon (Costa et al. 2002) or in the Sierra Nevada de Santa Marta (Acevedo Gómez et al. 2018). Turquoise veins have been reported from St. John (Virgin Islands) (Alminas et al. 1994; Knippenberg 2007, 152) and from near the mouth of the Amazon River (Costa et al. 2004). Carnelian was arguably sourced in Antigua, mainly worked in Montserrat, and exchanged with other islands (Crock and Bartone 1998; Hofman et al. 2014a; Mol 2014; Murphy et al. 2000; Watters and Scaglion 1994). Amethyst sources have been identified in Martinique and southeastern Amazonia (Cody 1993; Epstein 1988; Watters 1997). However, it is not clear whether the Antillean amethyst and turquoise sources were exploited, due to the small size of their products and the lack of evidence for local exploitation (Cody 1993; Knippenberg 2007, 168; Queffelec et al. 2018). Jadeitite sources are known in the Motagua Fault Zone on Guatemala (Foshag and Leslie 1955; Harlow et al. 2011), eastern Cuba (García-Casco et al. 2009), and northern Dominican Republic (Schertl et al. 2012). Whereas stone celts from Early Ceramic Age sites have been identified as jadeitite, "greenstone" ornaments have been shown to be made of materials such as nephrite and serpentinite (García-Casco et al. 2013; Hardy 2008; Harlow et al. 2006; Rodríguez Ramos 2011). Quartz, calcite and diorite are found in multiple islands, hampering sourcing efforts (Boomert and Rogers 2007; Hofman et al. 2007).

Production technologies

Flaking technologies involved in lapidary production have only been studied for the site of Trants (Crock and Bartone 1998). Due to the abundance of carnelian production waste in Trants, greater focus was placed on quartz varieties. Drilling technologies have been the focus of experimental and SEM studies, with the preliminary suggestion of the use of drill bits made of wood (De Mille et al. 2008). Finally, the use of string sawing has been suggested for the creation of decorative grooves (Rodríguez Ramos 2010). The use of abrasive technologies is a crucial evidence for assessing high technological achievement, as they require great skill, fore-planning and appropriate toolkits (e.g. Beck and Mason 2002; d'Errico et al. 2000; Gwinnett and Gorelick 1979; Kenoyer and Vidale 1992; Pétrequin et al. 2012). But our current understanding of such techniques is exclusively based on the presence of associated tools, such as quartz and flint drill bits and grooved grinding stones (e.g. Chanlatte Baik 1983, 34–35; Crock and Bartone 1998; Rodríguez Ramos 2010).

The site of Pearls, Grenada

Grenada lies at approximately 145 km north from the island of Trinidad and the northern coast of Venezuela. The island has an area of 306 km^2, with a mountainous topography whose highest peak reaches 840 m above sea level. Five volcanic centres have been identified on the centre and western coast of the island, with basic lava flows of basanitoids and alkalic basalts, as well as subalkalic basalts, andesites and dacites (Arculus 1976). Geologically reworked volcanics are predominant on the eastern coast. Plutonic rocks can be brought to the surface as small intrusions in the lava flow; likewise, they are occasionally found washing ashore (Arculus and Wills 1980).

The site of Pearls is located in an alluvial plain to the north of the Simon River, about 400 m inland from the Atlantic Ocean (Keegan and Cody 1990). Pearls is a large and dense archaeological site, covering approximately 500,000 m^2 (Hanna 2019, 13; also Bullen 1964, 18). Saladoid ceramics found at Pearls were traditionally attributed to the first centuries AD (Bullen 1964). Excavations took place from 1988 to 1990 (Cody 1990; Keegan and Cody 1990); three radiocarbon dates were obtained from marine shells found in the central midden: 1711 ± 74 BP, 1725 ± 54 BP and 1914 ± 51 BP (Cody 1990). The dates were recently calibrated by Hanna (2019), who proposes a time span of AD 370–770.

However, the occupation timespan remains unclear due to the stratigraphic complexity and extension of the site.

Domestic middens were identified at the eastern and western portions of the site, comprising faunal and plant remains, plain ceramics and beads (Cody 1990, 43). A large midden at the centre of the site (unit B) displayed decorated ceramics, hand-stones, a chert whetstone and ornaments (Cody 1990, 41). To the north, a thin midden layer (unit A) included lapidary making remains, a worn drill bit and another chert whetstone. This unit was interpreted as the setting of a lapidary workshop, where part-time craft specialists worked (Cody 1990). A map showing the location of the excavations was only recently made available (see Hanna 2019, 13). Furthermore, the site has been continuously impacted by bulldozing for airport construction, levelling, sand mining, soil removal, storm action, agriculture and long-term looting (Cody 1990, 40; Hanna 2019).

Pearls is regarded as the main centre for amethyst bead production, whose products were exchanged with the islands to the north (Boomert 2007; Hofman et al. 2007; Watters 1997). It is also an important heritage site due to both its indigenous and historic components. Destruction of the site through multiple mechanisms is still ongoing (Fitzpatrick 2012; Hanna and Jessamy 2017). Ceramic adornos and lapidary items illegally removed from Pearls are part of multiple private collections (Boomert 2007; Hofman and Hoogland 2016). In this sense, new archaeological research, recontextualization of private collections and preservation measures are necessary.

Materials and methods

The present research aimed to document lapidary artefacts that form a part of a large private collection. The studied assemblage has been reported to be exclusively from Pearls. However, this assemblage is the product of an unsystematic collection strategy: the association of artefacts to each other, to ornament making contexts, or to toolkits is unclear. There may also be diachronic variability between artefacts. Another expected bias is the low presence of artefacts in the early stages of modification.

The studied collection is composed of 1273 ornaments made of lithic raw materials, encompassing beads ($n = 1056$; 82.95%), pendants ($n = 167$; 13.12%) and buttons ($n = 15$; 1.18%). Many unfinished ornaments were identified ($n = 317$; 24.9%), next to crystals, unmodified pebbles and debitage ($n = 29$; 2.28%). The typological classification was based on artefact morphology and position of the suspension holes (Supplementary data 3). The sizes of beads varied between 4 and 27 mm of diameter and between 2 and 99 mm of thickness. Pendants varied from 11 to 63 mm of length, 6 to 40 mm of width and 3 to 25 mm of thickness. A large variety of geometric pendants was identified, both with and without carvings (Supplementary data 8, d1, g1, i1, j1; Supplementary data 9, g1, j1). Most flat pendants present a triangular morphology, although there are also rectangular, oval and square specimens. Three-dimensional pendants (Supplementary data 8, f1, h1; Supplementary data 9, b1, e1, h1, i1) have more varied shapes, afforded by larger and thicker blanks and more naturalistic carving patterns. Figure-in-profile pendants (Supplementary data 9, a1) are characterized by a triangular cross section displaying two faces with matching carvings and a narrow plain face. Finally, buttons present a broadly circular morphology, alongside a plano-convex cross section and a V-shaped perforation on one face (Supplementary data 5, f1). Their sizes varied from 11 to 15 mm of length, 10 to 14 of width and 7 to 10 mm of thickness.

A *chaîne opératoire* approach will be used here to characterize ornament making in Pearls. This approach offers an analytical tool for the identification of technical processes and for their hierarchical organization in operational sequences (Inizan et al. 1999; Sellet 1993; Soressi and Geneste 2011). The organization of the assemblage in technical stages highlights which products are present or absent, thus pointing to the states in which materials were brought into a given site (Perlès 2007). In combination with microwear analysis, insights can be gained on use, reuse or recycling of artefacts, the inter-relation between *chaînes opératoires* of different materials and the states in which artefacts have been disposed of (a.o. Cahen et al. 1980; Van Gijn 2012).

Lithologies were determined by examination of each ornament with a hand lens, with reference to geological collections housed at the Vrije Universiteit Amsterdam. The resulting raw material groups served as basis for the subsequent two stages of analysis. In the first stage, a typo-technological analysis of the entire lapidary assemblage was carried out. Macroscopic examination was used to identify flake scars, pecking marks, drilling traces, surface treatments, breakages, recycling, and possible use evidence. Technical stages (Table 1) were thus defined following previous studies on ornament making (Falci and Rodet 2016; Kenoyer et al. 1991; Roux 2000; Wright et al. 2008). The goal of this stage of analysis was to establish operational sequences per raw material and to assess which

Table 1 Definition of ornament-making technical stages

Technical stage	Definition
Raw material	Unmodified pieces (pebbles, nodules, crystals)
Debitage	Flaking products (cores, flakes and blanks)
Rough-out	Only knapped or sawn pieces (no grinding)
Preform 1	Partially or completely ground preform (no perforation)
Preform 2	Preform completely ground and carved (no perforation)
Preform 3	Pieces with unfinished perforations
Complete	Finished ornament (completed perforation)

technical procedures were carried out at the site. In the second stage of the study, a sample of 100 artefacts was subjected to microwear analysis in order to identify pecking marks, abrasive techniques and use-wear (Supplementary data 1). This sample set was formed by selecting preforms and finished ornaments representing every stage present in the Pearls collection for each raw material group.

The analysis was carried out in Grenada with equipment from the Laboratory for Artefact Studies of Leiden University. A DinoLite USB digital microscope (model AD7013MZT Premier) was used for low magnification observation (× 20–× 60). An incident light, metallographic microscope (Nikon Optiphot-1) was used for high magnification analysis (×100–× 200). Micrographs were made through the oculars using a digital camera (Olympus VR-340). High magnifications afford better insights into the contact materials used for treating the surface of lithic artefacts during manufacture, such as stone platforms, polishing materials and abrasives (Breukel 2019; d'Errico et al. 2000; Groman-Yaroslavski and Bar-Yosef Mayer 2015; Melgar Tísoc et al. 2013; Procopiou et al. 2013). Interpretation was based on comparison with the preliminary results of an on-going experimental programme focused on pre-colonial Caribbean technical systems (Breukel 2019; Breukel and Falci 2017; Falci 2015; Falci et al. 2017).

Results: raw materials

Lithic ornaments were split in 15 raw material categories (Supplementary data 3) (Fig. 2). Plutonic rocks are predominant in the collection, particularly diorite (29.07% of 1273). Diorite has a similar proportion of mafic to felsic minerals, resulting in a distinctive mottled white and black appearance (Supplementary data 7, a-g2). It is a hard, heterogeneous and medium to coarse-grained rock (Rapp 2009, 51). The group other than plutonic rocks encompasses great diversity (Supplementary data 7, h1-l2): from specimens presenting exclusively pyroxene to specimens with nearly 100% plagioclase.

Quartz varieties are also numerous in the collection. Amethyst is a macrocrystalline quartz with purple colouration caused by the presence of iron impurities (9.5%; Supplementary data 5, a-h2). Ornaments made of both rock crystal (i.e. translucent and colourless specimens) and milky quartz were grouped together as "quartz" (9.8%; Supplementary data 5, i1-m3). Macrocrystalline quartz varieties are characterized by their composition (SiO_2), conchoidal fracture and hardness of 7 in Mohs scale (Oldershaw 2009, 184–185). Carnelian is a microcrystalline quartz variety, with hardness of 6.5, conchoidal fracture and yellow to red colour (5.2%; Supplementary data 6, a-g2). Turquoise was one of the most numerous raw materials (13.3%; Supplementary data 6, h1-k2). It is a hydrated phosphate of copper and aluminium, being opaque and displaying a light to intense blue colour. It is a brittle mineral, also having a conchoidal fracture and hardness of 5–6 in Mohs scale.

Among metamorphic rocks, the most numerous is jadeitite ($Na(Al,Fe^{3+})Si_2O_6$) (13%). Jadeite is a high pressure pyroxene mineral, which is very tough and hard (6.5–7 in Mohs scale) and has a splintery to uneven fracture. In the studied collection, jadeitite appears as a light green opaque rock and as a coarse-grained and sparkly granular rock (Supplementary data 8, a-i4). Other metamorphosed ultramafic rocks with serpentine alteration were also identified (0.8%; Supplementary data 9, g1-j2). Nephrite ($Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$) is a tremolite-actinolite rock, characterized by its considerable toughness and hardness (6.5 in Mohs scale), being also fibrous and elastic (2%, Supplementary data 9, a1-e4). Other metamorphic rocks rich in tremolite were also identified (2.12%). Specimens were often opaque and with pronounced schistosity (Supplementary data 9, f1-h4). Low temperature hydrothermal alteration products (2.12%) also presented different shades of green (Supplementary data 8, j1-k2).

Results: production sequences

In general, the studied collection is well preserved. Fragmentation is present in 23 artefacts among the 100 analysed specimens, but only three of them are recent breaks. Traces produced by contact with heat are not common in the general assemblage, but almost ubiquitous among carnelian artefacts. This may be an indication that carnelian was heat-treated for better workmanship and colour, as known from other regions of the world (Kenoyer et al. 1991; Roux 2000).

The most common raw materials were predominantly used for the production of beads, for instance, macro- and microcrystalline quartz varieties ($n = 275$), diorite ($n = 369$) and a yellowish variety of plutonic rocks containing few mafic minerals ($n = 62$) (Supplementary data 7, k1-l2). Many beads were also made of jadeitite ($n = 106$) and turquoise ($n = 157$). The main raw materials used for the production of pendants were jadeitite ($n = 57$), nephrite ($n = 18$), diverse metamorphic rocks ($n = 41$) and other plutonic rocks ($n = 64$). Buttons were only made of quartz, amethyst and opal. The debitage is predominantly made of quartz varieties and diverse metamorphic rocks (Supplementary data 4). Table 2 compiles all identified production techniques for each raw material group (see also Supplementary Data 1).

Blank production

Flaking

Debitage products are present in low numbers in the assemblage, thus limiting our understanding of the early stages of raw material exploitation. Most ornament preforms and

Fig. 2 Main raw material groups found in the studied collection: **a** amethyst, **b** quartz, **c** carnelian, **d** turquoise, **e** diorite, **f** other plutonic rocks, **g** low temperature alteration products, **h** jadeitite, **i** nephrite, **j** metamorphic with tremolite, and **k** metamorphosed ultramafics".

rough-outs do not retain remnants of natural surfaces. Exceptions are the preforms of a quartz button and of an amethyst tubular bead, which display crystal facets. The scars on flaked amethyst cores point to the production of small flakes (with a maximum of 1 cm length), possibly to be used as blanks for disc beads. Flake scars were observed on a core point to the use of percussion on an anvil to work it from multiple directions (Supplementary data 5, a). Small carnelian pebbles are also present, alongside a partially flaked core (Supplementary data 6, a). A jadeitite core displays flake

Table 2 Production techniques identified for each technical operation and raw material[a]

	Blank acquisition	Shaping	Surface treatment	Decorating	Drilling	Technical errors/recycling	Total
Amethyst	Flaking	Flaking Pecking	Grinding 1, 2 Polishing 1	-	Biconical	Re-pecking Re-grinding Second hole	121
Quartz	Flaking	Flaking Pecking	Grinding 1, 2 Polishing 1, 2, 3	-	Biconical	Poorly aligned perforations	125
Carnelian	Flaking	Flaking Pecking	Grinding 1, 2 Polishing 1, 2, 3	-	Biconical Conical	–	66
Calcite	No evidence	Flaking (?) Notching	Grinding 1 Polishing 3	Incising	Biconical Bi-cylindrical	–	6
Turquoise	Sawing (rigid saw?)	Flaking Notching	Grinding 1, 2 Polishing 3	Incising Notching	Biconical Bi-cylindrical	Poorly aligned perforations	169
Diorite	Sawing (rigid saw) Flaking	Flaking Notching	Grinding 1, 2 Polishing 1, 3	Notching	Biconical Conical Cylindrical	Re-grinding Second hole	370
Other plutonics	Sawing (rigid saw) Sawing (string)	Notching	Grinding 1, 2 Polishing 2, 3	Incising Excising	Biconical Bi-cylindrical	Second hole Re-grinding Poorly aligned perforations	99
Jadeitite	Flaking Sawing (rigid saw)	Flaking Notching	Grinding 1, 2 Polishing 2, 3	Notching Incising Excising Drilling	Biconical	Re-grinding	166
Nephrite	Sawing (rigid saw?) Sawing (string)	Notching Pecking Flaking	Grinding 1, 2 Polishing 1, 3	Incising Notching Drilling	Biconical Cylindrical	-	26
Metamorphosed ultramafics	Sawing (?)	Flaking Notching	Grinding 1, 2 Polishing 3	Incising	Biconical	-	11
Metamorphic with tremolite	Sawing (rigid saw)	Notching Drilling	Polishing 3	Incising	Biconical	Re-polishing and carving	27
Low temperature alteration product	Flaking Sawing (?)	Flaking Notching	Grinding 1, 2	Incising	Biconical	Poorly aligned perforations	27

[a] Opal ($n = 1$), basement schist ($n = 2$) and indeterminate ($n = 57$) are not included in this table

removals made from multiple directions through hard hammer percussion (Supplementary data 8, a). A flaked diorite core has been observed on the surface of the site by one of the authors. These cores point to the use of flaking in the early stages of ornament making. The lack of flaking evidence in other raw materials may be connected to the poor suitability of this technique for working tough and/or heterogeneous materials.

Sawing

Sawing was used for blank production through a groove-and-snap technique. Small beads of diorite and turquoise were made by splitting a long blank in small sections (Supplementary data 7, a, e1). The blanks for geometric, three-dimensional and figure-in-profile pendants were also produced in this way. Such multi-ornament preforms were ground prior to sawing, so that sawing products already had the desired shape to be made into ornaments. A second grinding operation removed sawing traces and irregularities left from snapping. We identified two types of traces produced by sawing: (1) cut grooves with triangular cross section, in which the bottom is markedly narrower than the outer edges and the sides display straight scratches and (2) narrow cut grooves (ca. 2 mm) with parallel sides and a convex bottom, on which semi-circular scratches are visible. The first set of traces has been attributed to the use of rigid straight saws possibly made of lithic materials (Supplementary data 8, c1, c2; Supplementary data 9, f1). The second set of traces was attributed to sawing with a string accompanied by abrasives (Kovacevich 2011; Sax and Ji 2013). Such traces correspond to those obtained in previous experiments sawing conch shell, diorite and amber with cotton strings (Breukel and Falci 2017; Falci 2015, 146–148; Verchoof and Van der Vaart 2010). String sawing was attested on (multi-)pendant preforms (Supplementary data 7, h1-h3, i1-i3; Supplementary data 9, a2, b2). Preliminary cut grooves made with rigid saws were placed to fix the string for sawing. String sawing was then carried out in both parallel and perpendicular plans on plutonic rock preforms, suggesting that it was adapted to the shape of the block to be sawn.

Shaping

Flaking was used to shape the sides and sometimes the faces of beads made of quartz varieties. Pressure flaking has been identified on beads from Trants, being used for the controlled removal of small flakes (Crock and Bartone 1998, 213). In the Pearls collection, the flake scars observed on rough-outs and preforms are small, narrow and long, giving the beads an irregular faceted appearance (Supplementary data 5, b1; Supplementary data 6, b1). The flake scars are often superposed by pecking and grinding traces, thus preventing further technological characterization. Similarly, faceted sides were sometimes observed on turquoise, diorite and nephrite beads (Supplementary data 6, i1; Supplementary data 7, b1).

Pecking traces can be recognized as several adjacent concentric impact craters (Supplementary data 5, b1, b2, c1). The use of microscopy permitted their identification even when the traces had been largely removed by subsequent surface treatments (Supplementary data 5, b3, c1, c2, f2, i2; Supplementary data 6, b2, c2). Pecking was used as a means of removing excessive material, sharp ridges left by flaking and grinding facets (Supplementary data 5, h2, k2, k3).

Surface treatments

Different grinding and polishing types were identified on the samples studied through microwear analysis. The characteristics of the observed polishes are produced by differences in the nature of the tool, abrasives and coolants used. They are further dependent on the raw materials of the ornaments themselves, as their mechanical properties vary greatly. Half of the ornaments display partially overlapping polishes that result from the successive application of different surface treatments.

Grinding

A first rough grinding stage (grinding 1) was noted across different materials ($n = 34$). In this stage, the shape of the ornament is defined, but in many cases, the surface remains dull and faceted. Pecking traces are gradually replaced by abraded patches on the tops of the microtopography, sometimes with incipient striations (Supplementary data 5, b3, d2; Supplementary data 6, b2, c2, h2; Supplementary data 7, b2, c2; Supplementary data 8, d2, j2). The general flattening of the micro-surface and the overall absence of polish suggests the use of a hard contact material without water. Grinding 2 is characterized by the presence of a continuous polish located on the tops of the microtopography ($n = 53$). Furthermore, it displays fine and regularly spaced striations on a flat and bright polish (Supplementary data 5, e3, j2, j3; Supplementary data 6, i2, i3; Supplementary data 8, e2; Supplementary data 9, h3). This treatment is likely the result of the use of a grinding stone with added abrasives and water.

Polishing

Polishing is directed toward erasing manufacturing traces, smoothening the surface and increasing the sheen of the material. Different polishing types can be distinguished. Polishing 1 is characterized by a flat mirror-like polish ($n = 14$). Hard fine-grained stone platforms with added water could have produced this type of polishing, such as the chert whetstones found at Pearls (Cody 1990, 41–42). Polishing 1 is commonly seen on certain sectors of plano-convex and tubular beads, as well as on buttons (Supplementary data 5, e3, f2, k3; Supplementary data 6, g2; Supplementary data 7, d2, d3, j2; Supplementary data 9, d2, d3). The polished shiny surfaces would be visible when the buttons are attached to a composition, whereas the surfaces with dull surface treatment are hidden. Polishing 2 is characterized by domed and smooth patches of polish ($n = 5$). It is not continuous or extensively developed, leaving the general microtopography rough and irregular (Supplementary data 5, i2). Polishing 3 is greasy, bright and invasive, reaching the lowest interstices of the microtopography ($n = 45$). It often displays abundant fine scratches, created by the use of abrasives. The polish was produced with unidentified soft and pliable contact materials (Supplementary data 6, e2, j2; Supplementary data 7, e2, f2, j3; Supplementary data 8, f2, k2; Supplementary data 9, a3, h4).

Carving

Shaping and decorating operations carried out through sawing can be divided into notching, incising and excising. Notching refers to the creation of indentations on the sides of ornaments in order to give them elaborate shapes, often zoomorphic ($n = 28$). Incising was used to create decorative lines and zoomorphic depictions ($n = 19$). Excision involved the combined use of incising and notching to isolate certain sectors of a pendant, thus giving to a depiction greater naturalism ($n = 5$).

The cross-section of cut grooves varies according to the specific shape and raw material of the tool used. Sharp, V-shaped notches were observed on nine specimens (29% of 31 carved specimens; Supplementary data 7, k1; Supplementary data 8, f3, f4; Supplementary data 9, e2, h2). They were likely made with hard lithic tools, such as the flaked chert tools recovered from the site (Cody 1990, 41–42, 57–58). Notches were sometimes made through multiple cuts, creating a wide and composite groove (Supplementary data 7, j4; Supplementary data 8, h2). The remaining artefacts displayed U-shaped grooves (67.7%; Supplementary data 8, i2; Supplementary data 9, c2, c3). Lithic tools that are not as hard, fine-grained and brittle as chert may have been used to produce such wider notches. Alternatively, U-shaped grooves displaying linear scratches may be the result of widening and polishing after their initial carving. Widening may have been carried out using organic saws with abrasives, which have a rounded cross-section or wear more easily when working hard lapidary materials. Three frog-shaped pendants display wide and shallow central incisions with abundant and continuous

Table 3 Distribution of ornaments analysed by microwear according to raw material and presence of use-wear in this analysed sample

	Analysed sample ($n = 100$)			Complete artefacts ($n = 71$)			
	Total	Unfinished	Complete	Use-wear		No use-wear	Indeterminate
				n	%		
Amethyst	11	3	8	1	12.50	7	-
Quartz	8	2	6	1	16.67	2	3
Carnelian	8	3	5	1	20	4	-
Calcite	2	–	2	1	50	1	-
Turquoise	8	2	6	3	50	3	-
Diorite	14	3	11	4	36.36	4	3
Other plutonics	14	4	10	7	70	2	1
Jadeitite	18	6	12	8	66.67	3	1
Nephrite	7	-	7	6	85.71	1	-
Metamorphosed ultramafics	3	2	1	1	100	-	
Metamorphics with tremolite	2	2	-	-	-	-	-
Low temperature alteration product	2	-	2	1	50	1	-
Basement schist	1	1	-	-	-	-	-
Indeterminate	2	1	1	1	100	-	-
Total	100	29	71	35	-	28	8

striations (Supplementary data 8, g2; Supplementary data 9, b3, i1, i2). Such incisions were likely produced by the use of pliable soft materials (e.g. plant leaf or strips of hide), which were pulled back-and-forth while the pendants were held still. Finally, drilling was used for creating decorative circular depressions on three zoomorphic pendants (Supplementary data 9, a1, c1, c2).

Perforation

Drilling was used for creating the suspension holes. Most perforations are biconical (83.1% of 83), i.e. the holes are formed by two opposing cones, each presenting a tapering profile (Supplementary data 5, d1, g2, h2, k1, l1; Supplementary data 8, g3, h3, h4; Supplementary data 9, j2). Abundant and regular circular scratches are observed on the perforation walls. This indicates the use of solid (non-hollow) drill bits across all raw materials, in contrast to the use of hollow drills reported for the site of Trants (Crock and Bartone 1998, 213). The diameter of the perforations varied between 1.0 and 6.0 mm (measured on the surface), with most specimens presenting between 2.0 and 3.0 mm (68.6%). The perforations of beads made of quartz varieties are of up to 4.5 cm in length, whereas they are of up to 10 cm in the plutonic rock beads. Semi-circular striations were observed in association with a bright and flat polish adjacent to the rim of the perforation of some quartz and carnelian beads (Supplementary data 6, b3, b4, f2, f3). This polish suggests the use of a lithic drill. This is in agreement with purported chert and quartz drill bits recovered from Pearls and other lapidary workshops. However, experimental studies have questioned the suitability of chert for drilling ornaments made of materials of comparable hardness (Gurova et al. 2013). In fact, some tool variability can be attested: while most perforations are biconical, the sector where the cones meet in the centre of the bead can have a cylindrical cross-section and be quite narrow (less than 1.0 mm; Supplementary data 5, g2). This suggests the use of a different and smaller tool for uniting the perforation cones. Likewise, cylindrical perforations with discreet tapering were noted on nine artefacts made of non-quartz materials (10.8%). Cylindrical perforations may have been produced by drill bits made of different raw materials.

We noted unperforated ornaments displaying a highly developed polishing and fully perforated specimens with a coarse surface treatment and faceted sides. Drilling traces on some specimens are sometimes quite fresh, suggesting that these sectors were not reground or polished after drilling. In this sense, the order between polishing and drilling was not strict. This evidence suggests that some flexibility were afforded in ornament production sequences.

Technical errors and recycling

Artefacts displaying technical errors were noted in the studied collection, namely ornaments (1) with unfinished perforations (preform 3), (2) with poorly aligned perforation cones, (3) broken along the perforation and (4) that snapped in the wrong place. This collection was recovered from a site containing workshop contexts; in this sense, many of such artefacts may have been perceived as undesirable products to be discarded. Likewise, 12 recycled beads and pendants were observed (Table 2; Supplementary data 1). Recycling was carried out through the (re-)application of various techniques, such as grinding (Supplementary data 5, e1, e2; Supplementary data 7, l1) and drilling. Recycling has also been noted in other lapidary workshops, being interpreted as an efficient management of rare raw materials (Durand and Petitjean-Roget 1991; Narganes Storde 1995, 1999; Rodríguez López 1991).

Results: use-wear

Of the 100 artefacts studied through microwear analysis, only specimens with complete perforations are considered in this section ($n = 71$). Many studied artefacts display a fresh and partially ragged rim of perforation when examined with microscopy (39.4% of 71). In addition, the intersection of the cones in the centre of the perforation is often narrow and fragile. The lack of use-wear did suggest that such ornaments were not strung. In contrast, almost half of the studied ornaments display use-wear (49.2%) in the form of smoothening of the rim of perforation and formation of a distinctive polish. The perforation becomes more uniform as a result of the progressive erasure of drilling traces. In double perforated pendants, use-wear often led to the deformation of the perforation rims dependant on the position of the string (Supplementary data 8, g3, g4, i3, i4, j3; Supplementary data 9, e3, e4). Another observed use-wear type was the formation of polish and rounding on the edges of the pendants due to the contact with the body during use. Table 3 presents the percentage of artefacts with use-wear per analysed raw material group. General trends can be noted despite the reduced sample size. Nearly all nephrite ornaments present use-wear (85.7%). Jadeitite, plutonic rocks and turquoise also present notable percentages of used artefacts (Supplementary data 6, k2; Supplementary data 7, f3, g2, k1, k2, l1, l2). In contrast, a relatively low percentage of amethyst and carnelian ornaments displays use-wear (12.5% and 20%). Quartz also records a low percentage of used specimens (16.6%; Supplementary data 5, m2, m3), although the evidence was not conclusive on three other beads. This is a low value when contrasted to the large numbers of analysed ornaments for each of these quartz varieties.

Discussion

The present study documented unprecedented variability in the collection from the site of Pearls. In an effort to recontextualize it, we now compare the typological and raw material variability observed with assemblages from other eastern Caribbean sites.

Ornament typology

Considerable archaeological debate has taken place regarding the chronological and socio-cultural relations between the Saladoid and Huecoid series, with focus on site distributions and relative chronologies based on ceramic styles (Chanlatte Baik 1983; Chanlatte Baik and Narganes Storde 1989; Roe 1989; Rouse 1992; Rouse and Alegría 1990). However, no conclusive decisions have been reached after decades of debate (Oliver 1999; Rodríguez Ramos et al. 2010; also Keegan and Hofman 2017, 67–68). With regard to lapidary materials, distinctive styles have also been proposed and attributed to one of the series.

Comparison with Saladoid lapidary production

It has been argued that Saladoid lapidary production is more limited, homogeneous and stylistically different from the Huecoid varieties (Bérard 2013; Chanlatte Baik and Narganes Storde 1989; Narganes Storde 1995, 1999; Rodríguez Ramos et al. 2010). The former is characterized by tubular and barrel-shaped beads made of quartz, amethyst, carnelian and diorite (Murphy et al. 2000; Narganes Storde 1999; Watters and Scaglion 1994). The studied beads are very similar to those recovered from Saladoid sites in Montserrat and Antigua. At the same time, we identified other ornament types, such as disc beads, buttons and a pendant. The two first types had already been reported during the excavations of Pearls (Cody 1990, 54) and of Sorcé and Tecla (Narganes Storde 1999). Beads and pendants of other materials, such as turquoise, malachite, calcite and jasper, have been recovered from sites associated to both archaeological series.

Zoomorphic pendants are known from Saladoid contexts, notably three-dimensional frog-shaped pendants (e.g. Bonnissent 2008, 491; Durand and Petitjean-Roget 1991; Murphy et al. 2000; Narganes Storde 1999). There is considerable stylistic and material variability between known specimens. The two nephrite three-dimensional frog-shaped pendants from Pearls are similar to specimens often referred to as *muiraquitãs*, due to their similarity to Amazonian pendants (Boomert 1987; Cody 1993; Costa et al. 2002).

Comparison with Huecoid lapidary production

The sites of La Hueca and Punta Candelero contained large numbers of “segmented frog pendants”. These are flat-schematized frog-shaped pendants with a perforation across the neck and made of varied raw materials (serpentinite, jasper, nephrite and calcite) (Chanlatte Baik 1983, 16; Cody 1993; Narganes Storde 1995, 142). Few of such specimens are found in the studied collection ($n = 6$; Supplementary data 8, j1), mostly made of jadeitite. The abundance and stylistic variability of small and flat frog-shaped pendants led us to

Table 4 Raw material management at the site of Pearls based on the studied collection

Raw materials	Suggested geological sources[a]	Local production	Which stages	Brought into the site
Amethyst ($n = 121$)	Martinique Southeastern Amazon (Brazil)	Yes (beads and buttons)	All stages	Raw material
Quartz ($n = 125$)	Available throughout the archipelago	Yes (beads and buttons) Minor evidence (pendants)	All stages	Raw material
Carnelian ($n = 66$)	Antigua	Yes (beads)	Disc bead production Finishing barrel-shaped beads	Raw material (pebbles) Preforms of barrel-shaped beads Finished tubular beads
Turquoise ($n = 169$)	St. John (Virgin Islands) Lower Amazon (Brazil)	Yes (beads and pendants)	Polishing Drilling	Preforms Finished beads and pendants
Diorite ($n = 370$)	Tobago Available throughout the archipelago	Yes (beads and pendants)	All stages Flaking (minor evidence) Shaping (minor evidence)	Raw material Preforms
Other plutonics ($n = 99$)	Available throughout the archipelago	Yes (pendants) No evidence (beads)	All stages (pendants)	Raw material Partially worked specimens to be made into pendants (?) Beads
Jadeitite ($n = 166$)	Northern Dominican Republic Eastern Cuba Motagua Fault Zone (Guatemala)	Yes (pendants) Minor evidence (beads)	All stages	Raw material Bead preforms Finished beads
Nephrite ($n = 26$)	Lower Amazon (Brazil) Sierra Nevada de Santa Marta (Colombia)	Yes (beads and pendants in light green variety)	Grinding Polishing Drilling	Pebbles (light green variety) Preforms (light green variety) Finished pendants (dark green variety)
Metamorphosed ultramafics ($n = 11$)	Greater Antilles South America	Yes (mostly pendants)	Grinding Polishing Drilling	Raw material (?) Blanks, rough-outs, preforms (?) Finished beads and pendants (?)
Metamorphic rocks with tremolite ($n = 27$)	Greater Antilles South America	Yes (pendants)	All stages, except for blank acquisition	Raw material Blanks, rough-outs (?)
Low temperature alteration products ($n = 27$)	Available throughout the archipelago	Yes (pendants) Minor evidence (beads)	All stages	Raw material Finished beads Bead preforms

[a] Based on bibliographic references mentioned in the "Raw material provenance" section

group them under the broader subtype "carved flat pendants", as they were made on similar blanks. Pendants that do not fit in the segmented frog type were also found at La Hueca, but in comparatively low numbers (Chanlatte Baik 1983, 43; Narganes Storde 1995). Many plain geometric pendants noted in the Pearls collection share the same production sequence as the flat frog-shaped pendants, but do not display carvings. Pendants shaped as raptorial birds were also numerous in Huecoid sites. As the pendants are thought to depict bird species not endemic to the Antilles, they have been regarded as evidence of the continental origins of Huecoid people (Chanlatte Baik 1983, 40–42; Chanlatte Baik and Narganes Storde 1989). A single specimen has been reported from another private collection from Pearls (Boomert 2007). The studied figure-in-profile pendants share certain morphological features with the bird pendants: the orientation of the carved figure and the blank morphology obtained by sawing. This similarity is also noted by Narganes Storde (1995, 144), who suggests that the figure-in-profile pendants (*pendientes cefalomorfos*) could be reworked raptorial bird pendants (also Durand and Petitjean-Roget 1991). In summary, we note elements traditionally attributed to both series on this assemblage from Pearls. However, no systematic comparison of zoomorphic pendants across Antillean sites has been carried out to date, thus limiting the value of such cultural attributions.

Raw material management

The limitations imposed by the unsystematic means by which this collection was formed should not be overlooked. First, the low numbers of artefacts in early production stages may partially be a product of this collection strategy. Second, the absence of chronological control prevents us from grasping how identified patterns may have changed over time. Nevertheless, raw material management patterns can be suggested based on suggested raw material sources and on the technical stages identified in the collection (Table 4). We recorded a large number of amethyst artefacts, encompassing most bead-making stages. Pearls was likely the main provider of amethyst beads to the islands to the north. Similar percentages of quartz and carnelian unfinished ornaments and debitage were found. Even though carnelian artefacts are less numerous (n = 66), more than half of them are in the form of production waste. Therefore, at least part of the manufacture of carnelian beads took place at Pearls. Carnelian pebbles and preforms were brought from Antigua (the geological source) or Montserrat and were locally made into beads using the same procedures used for amethyst and quartz.

Diorite is the most prevalent raw material in the collection, but presents only 19.4% of unfinished specimens. A large number of similar diorite beads are also reported from Trants, with an even lower percentage of unfinished specimens (Watters and Scaglion 1994, 226). Some diorite bead-making activities took place at Pearls, as already noted by Cody (1990, 41). The lack of rough-outs and debitage suggests that there was a focus on the last stages of the production sequence, such as fine grinding, polishing and drilling. Diorite and other plutonic rocks are not commonly found on Grenada, so they had to be brought in. Diorite could be obtained from Tobago, from where geological sources and bead workshop sites are known (Boomert and Rogers 2007). Whereas the occupation of the Golden Grove site on Tobago starts at a later period (AD 690–900), there is an overlap with the newly calibrated dates for Pearls (Hanna 2019). Regarding the other plutonic rocks, there is evidence for the production of geometric pendants, but no evidence for the production of yellowish plutonic rock beads.

Other lapidary workshop sites contain few turquoise ornaments. Despite their large numbers in the Pearls collection, turquoise is represented by almost exclusively finished beads and pendants (91.1%). Most specimens have small sizes (1.0 cm of diameter or less) and large portions of brownish matrix. Jadeitite is found in large numbers in the studied collection, even though its presence in other lapidary workshops has been contested. In the studied group, non-modified pebbles and preforms represent nearly 25%. Among pendants, 49.1% are unfinished. Therefore, similarly to plutonic rocks, there is more evidence of pendant production, despite the predominance of beads in the assemblage.

Nephrite ornaments have been reported from many sites, but in low numbers and with limited production evidence. This pattern is repeated in the studied collection, although there are some unfinished specimens ($n = 7$; 26.9%). Most unfinished specimens are made from a light coloured and translucent variety of nephrite (e.g. Supplementary data 9, c). Most nephrite pendants have a dark colour and are not markedly translucent; this variety was probably obtained as finished pendants. The metamorphic rocks with tremolite include a large number of unfinished specimens mostly related to pendant production ($n = 17$; 62.9%). The other two raw material categories, metamorphosed ultramafics and low temperature hydrothermal alteration products, include large percentages of unfinished beads and pendants (54.5% and 59.3%, respectively).

Ornament production technologies

The working of ornaments made of quartz varieties follows a relatively standardized sequence for bead production. It involved flaking for blank acquisition and shaping, followed by pecking, two stages of grinding, polishing and drilling. The creation of long and regular perforations on hard materials demonstrates great skill in ornament making. The general production sequence remains largely the same across different ornament types. The main differences are related to blank production and blank morphology, which are chosen according to the desired end product. Two techniques were identified for blank production through flaking: direct hard hammer percussion and percussion on an anvil. However, the low amount of debitage prevents further insights on their use. We also identified varied surface treatments used on different ornaments and even on different sectors of a same specimen.

Abrasive techniques had not been previously investigated in the Caribbean. Their identification is a direct result of the microwear analysis. Non-quartz raw materials have been used for the production of multiple bead and pendant types. Prior to this study, no information was available on how such ornaments were produced. We identified the use of diverse blank production and shaping techniques, even within a same raw material group. For instance, turquoise and diorite tubular beads were produced from both multi-bead preforms and from flake blanks. Likewise, pendants were produced through the use of both string sawing and rigid lithic saws. Different decorative tools and techniques have also been identified, alongside vast stylistic diversity in carved pendants. Technological variability may have corresponded to differences in production loci within the site, to diachronic variation or to the production of some artefacts in another workshop. Nonetheless, the diversity of raw materials being worked highlights the great technological achievement of the indigenous inhabitants of the Caribbean to a degree that had not been previously attested.

The use of ornaments

Most analysed macro- and microcrystalline quartz ornaments did not display use-wear, despite their presence in large numbers. It is therefore possible that certain locally produced ornaments were not for local use, even though the raw materials were brought from other islands or even from South America. In other words, Pearls would have been primarily a production site for amethyst, quartz and carnelian. A specific pattern has also been noted for nephrite ornaments: all but one of the analysed specimens displayed use-wear. Three-dimensional frog-shaped pendants have been reported from funerary contexts in many eastern Caribbean sites (Bonnissent 2008, 103; Durand and Petitjean-Roget 1991), including Pearls (Cody 1990, 44, 50). We can thus suggest that nephrite ornaments were acquired through exchange, used as bodily adornment and ultimately deposited with the dead. Jadeitite, diorite, other plutonic rocks and turquoise assemblages also include large percentages of worn specimens (Table 3). Whether they arrived as raw material, finished or unfinished specimens, some among them were used at the site. In this sense, we do not observe a clear opposition between ornaments locally produced for export and imported raw materials for local use. Lapidary materials were dealt with in different ways depending on their raw material and ornament type. This preliminary use-wear study demonstrates that, rather than being exclusively valuables kept in circulation, certain ornaments were also produced or acquired to be worn in Pearls itself. This is in agreement with the retrieval of ornaments from domestic middens during the excavations of the site (Cody 1990, 42–43).

Conclusion

The typo-technological and microwear study of the Pearls collection provides new perspectives on the production and use of ornaments in the Caribbean. The collection is comparable with those retrieved from other sites of the Early Ceramic Age period, although notably large and with great variety of ornament materials and types. The presence of large quantities of allochthonous materials from different geological sources reinforces the role of Pearls as an important node in far-reaching networks. Some materials may have come from nearby Windward Islands and South America, while others may have come from the Leeward Islands, the Greater Antilles or even from Central America. We identified a marked focus on the production of beads made of quartz varieties, thus reframing previous ideas regarding sole specialization on amethyst beads at Pearls. The preliminary results of the use-wear study suggest that these exotic materials were made into ornaments to be (at least partially) sent away once again, rather than locally worn.

The identification of jadeitite pendant production at the site is unprecedented in the region. Unmodified pebbles, ornaments in different technical stages and used specimens were part of the collection. This was also observed for diorite, nephrite and turquoise, but to rather different degrees. These materials were likely being circulated across the Caribbean sea in different technical stages. Further insights on their circulation will require analytical studies focused on material characterization and provenance. The results of these studies will be reported in a future publication (Knaf et al. in prep).

The present study further demonstrates the technological variability and expertise present in the Early Ceramic Age. A deliberate choice was made in this period for investing time and skill in ornament making, as opposed to other lithic industries considered to be opportunistic, expedient and lacking standardization (Crock and Bartone 1998). The high skill in lapidary working is demonstrated by the use of a large variety of raw materials and the development of a range of techniques and toolkits suited to work them. The typo-technological study of the entire collection combined with the microscopic analysis of a selected sample provided insights into the production sequences applied to all raw materials, even to those that are neither numerous nor present in multiple technical stages (for instance, nephrite and turquoise). Likewise, it allowed us to identify production techniques that remained invisible in previous studies, such as (1) sawing with rigid saws and string sawing as blank acquisition strategies and (2) different types of grinding and polishing. The reduction of hard materials through abrasive techniques is notably time-consuming, in particular, through grinding and sawing. In this sense, their specialized use is evidence of the knowledge, skill and time invested in ornament making in the past.

The role of the different islands in Early Ceramic Age networks needs to be further studied, in particular, by re-analysing previously excavated (legacy) collections and by applying an interdisciplinary approach. In-depth technological studies of other sites can highlight craft differences between islands. Only then will we be able to assign specific technical products to a given workshop, rather than just raw material groups and ornament types.

Acknowledgements The authors would like to thank the Willcox family for allowing access to the collection. Angus Martin is also thanked for his help during this research. Finally, we would like to acknowledge the support of the Grenada Ministry of Culture.

Funding information This research has received funding from the NWO (Netherlands Organization for Scientific Research) Spinoza Prize awarded to Prof. Dr. Corinne L. Hofman in 2014. This research is part of the project NEXUS1492, which has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ERC Grant agreement n° 319209.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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Supplementary data 1: Database with the information gathered for 100 ornaments studied through microwear analysis (Here formatted as Appendix 6).

Supplementary data 2: DMS geographical coordinates of the archaeological sites mentioned in the text

Island	Site name	Longitude	Latitude	Observations
Antigua	Elliot's[a]	-61.443521	17.044235	Murphy et al. 2000
Antigua	Royall's[a]	-61.491279	17.91830	Murphy et al. 2000
Grenada	Pearls[b]	-61.365178	12.83945	Airport landing strip
Montserrat	Trants[b]	-62.95249	16.455616	Trant's Bay
Puerto Rico	Punta Candelero[a]	-65.472223	18.052655	Geographical feature
Puerto Rico	Tecla[a]	-66.471517	18.0914	Chanlatte Baik 1976
St. Croix	Prosperity[b]	-64.530069	17.434895	Estate
St. Martin	Hope Estate[b]	-63.22551	18.53852	Estate
Tobago	Golden Grove[a]	-60.482074	11.100824	Boomert and Rogers 2007
Vieques	La Hueca/Sorcé[a]	-65.292975	18.55876	Chanlatte Baik 1983

a Approximate coordinates for the archaeological sites obtained from Google Earth Pro using published maps as reference

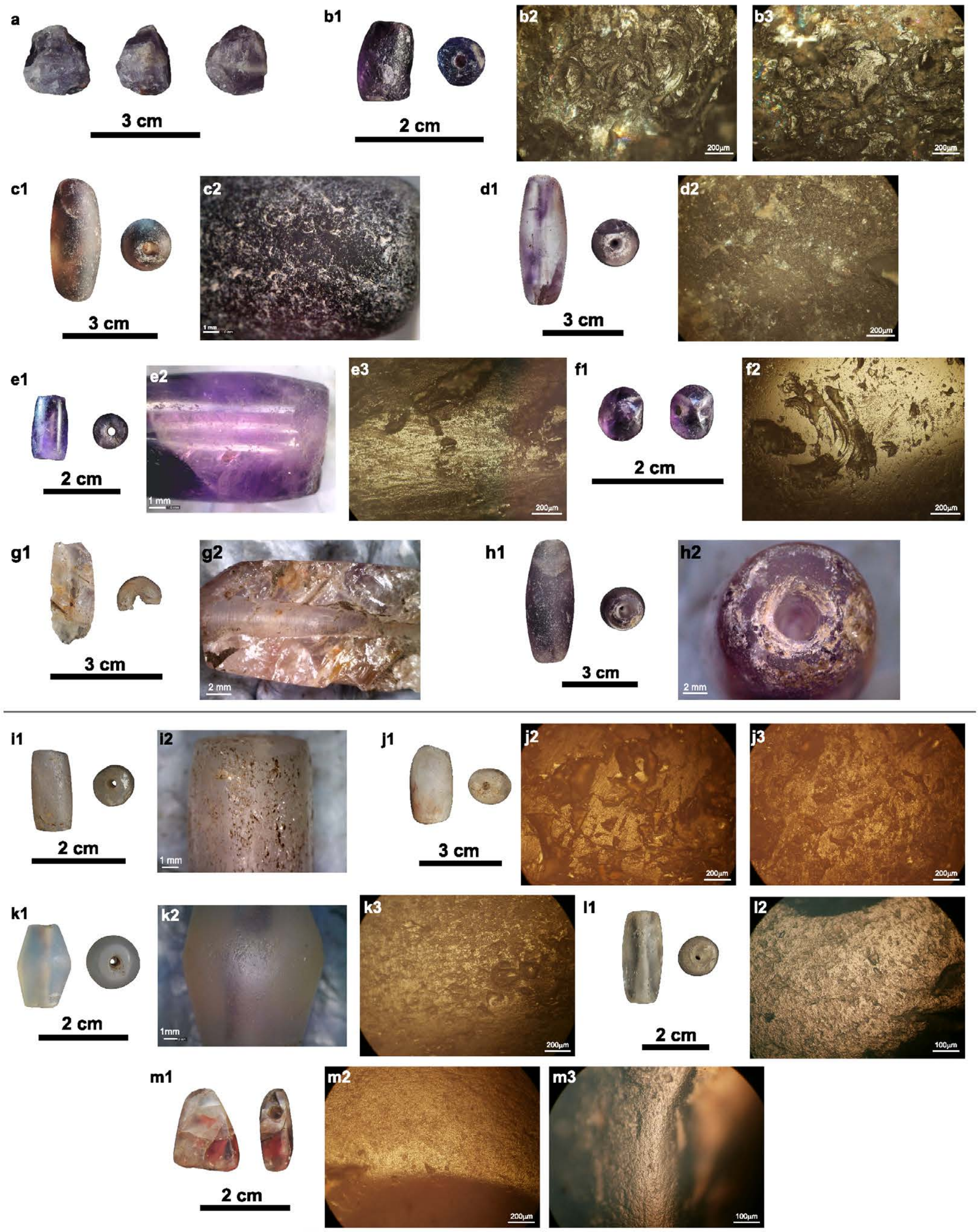
b Coordinates for the modern toponym obtained from Google Earth Pro

Supplementary data 3: Ornament types and raw materials identified in the Pearls collection

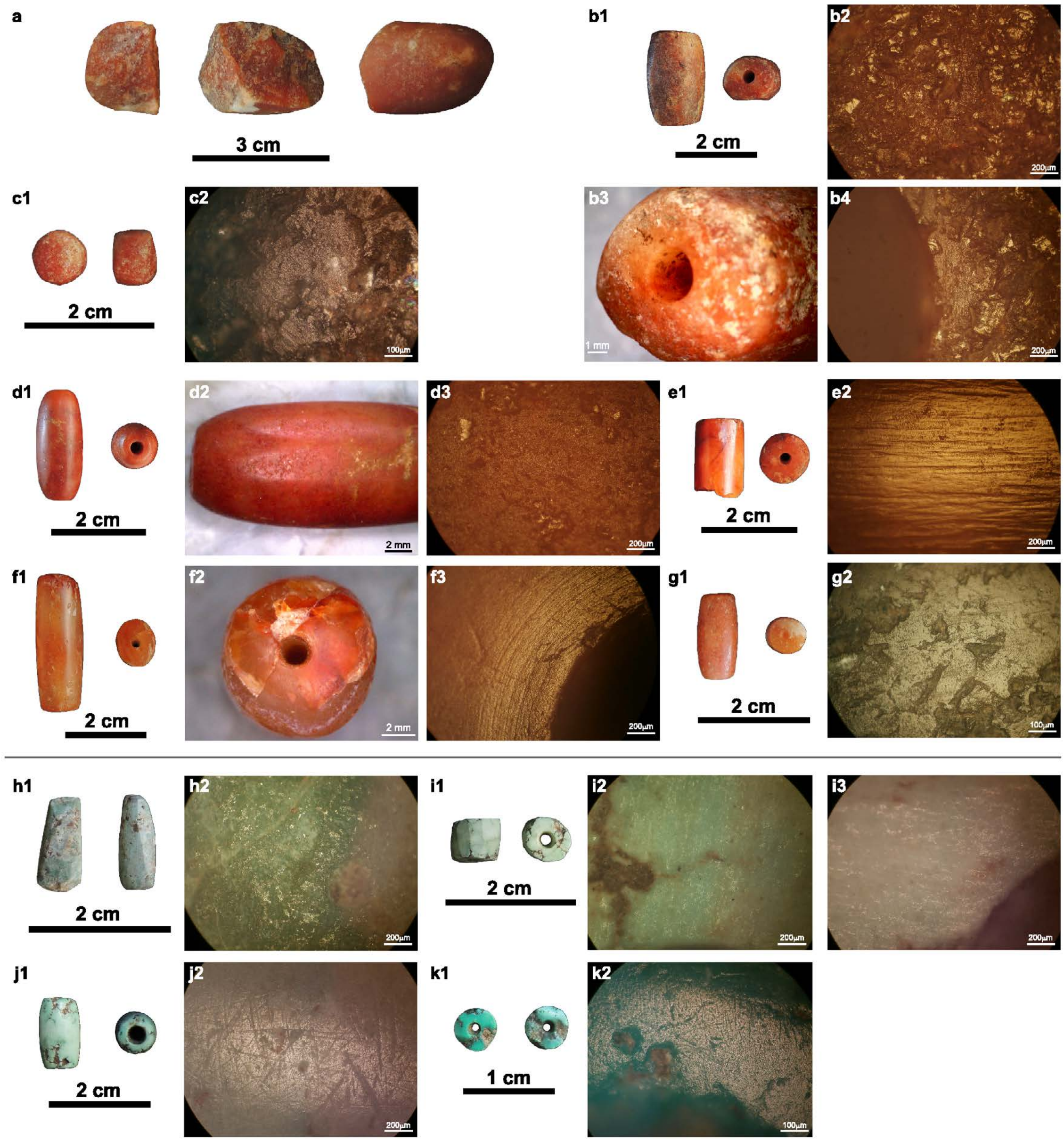
Types	***Beads***					***Button***	***Pendants***				***Debitage/indet***	***Total***
	Disc	**Tubular**	**Barrel**	**Plano-convex**	**Biconical**		**Geometric**	**Carved flat**	**Figure-in-profile**	**Carved 3D**		
Amethyst	34	20	50	-	-	7	-	-	-	-	10	121
Quartz	56	19	31	-	3	7	1	-	-	-	8	125
Carnelian	10	16	36	-	-	-	-	-	-	-	4	66
Opal	-	-	-	-	-	1	-	-	-	-	-	1
Calcite	3	1	-	-	-	-	-	2	-	-	-	6
Turquoise	115	3	15	24	-	-	9	3	-	-	-	169
Diorite	142	127	97	2	1	-	-	1	-	-	-	370
Other plu-tonics	17	21	24	-	-	-	6	25	2	1	3	99
Jadeitite	96	-	7	1	2	-	29	23	3	2	3	166
Nephrite	1	2	1	3	-	-	6	5	4	3	1	26
Metamor-phosed ultramafics	3	-	-	-	-	-	2	2	1	2	1	11
Metamor-phics with tremolite	1	-	-	-	-	-	14	7	-	4	1	27
Low temperature alteration products	12	1	2	-	-	-	4	3	-	2	3	27
Basement schist	-	-	2	-	-	-	-	-	-	-	-	2
Indetermi-nate	34	15	5	1	-	-	1	-	-	-	1	57
Total	**524**	**225**	**270**	**31**	**6**	**15**	**72**	**71**	**10**	**14**	**35**	**1273**

Supplementary data 4: Frequencies of identified technical stages according to raw material

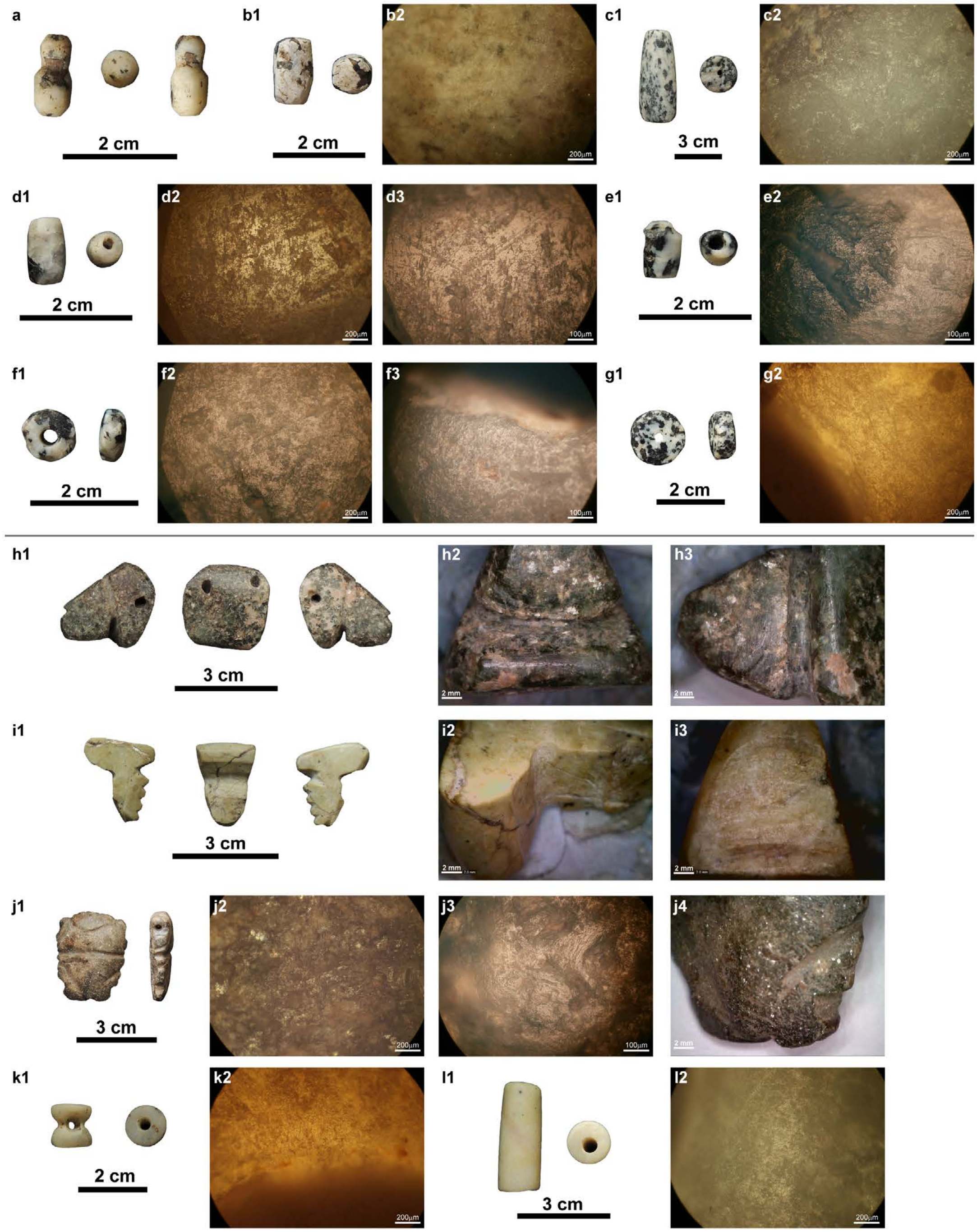
	Finished	**Rough-out**	**Preform 1**	**Preform 2**	**Preform 3**	**Debitage**	**Raw material**	**Total**
Amethyst	55	10	32	-	14	8	2	121
Quartz	85	2	24	-	6	4	4	125
Carnelian	28	-	21	-	13	2	2	66
Opal	1	-	-	-	-	-	-	1
Calcite	5	-	-	-	1	-	-	6
Turquoise	154	1	7	-	7	-	-	169
Diorite	298	-	44	-	28	-	-	370
Other plutonics	77	-	8	10	4	-	-	99
Jadeitite	123	-	31	6	3	1	2	166
Nephrite	19	-	5	1	-		1	26
Metamorphosed ultra-mafics	5	-	3	2	-	1	-	11
Metamorphics with tremolite	10	1	12	4	-	-	-	27
Low temperature alteration product	11	-	11	3	1	1	-	27
Basement schist	-	-	2	-	-	-	-	2
Indeterminate	56	-	-	-	-	1	-	57
Total	**927**	**14**	**200**	**26**	**77**	**18**	**11**	**1273**



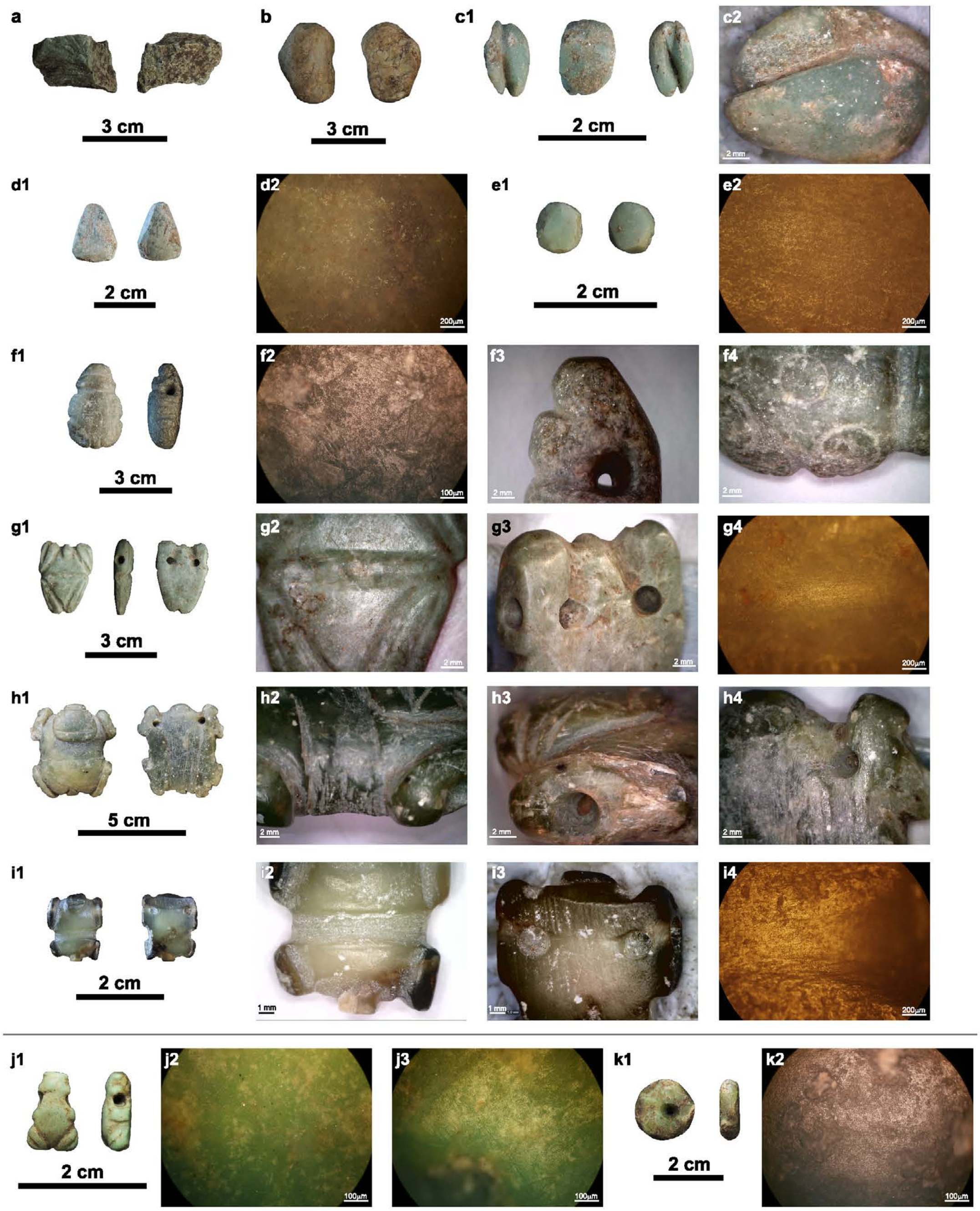
Supplementary data 5: Amethyst ornaments: a) flaked core, b) tubular bead preform (WPb078), with details of pecking (b2) and incipient grinding 1 (b3), c) barrel-shaped bead (WPb003) with detail of incipient grinding 1 (c1), d) barrel-shaped bead (WPb002) with biconical perforation and detail of grinding 1 (d2), e) barrel-shaped bead (WPb004) with detail of lustre and regrinding (e2) and of incipient polishing 1 on top of grinding 2 (e3), f) button (WPb082) with detail of polishing 1 on top of pecking traces (f2), g) broken tubular bead (WPb025) with detail of perforation cone (g2), h) barrel-shaped bead (WPb001) with detail of fresh drilling traces and pecking (h2). Quartz ornaments: i) tubular bead (WPb020) with detail of pecking traces (i2), j) barrel-shaped bead preform (WPb022) with detail of grinding 2 (j2, j3), k) biconical bead (WPb021) with detail of pecking (k2) and polishing 1 (k3), l) barrel-shaped bead (WPb017) with biconical perforation and detail of polishing 2 (l2), m) pendant (WPb018) with detail of use-wear on the perforations (m2, m3).



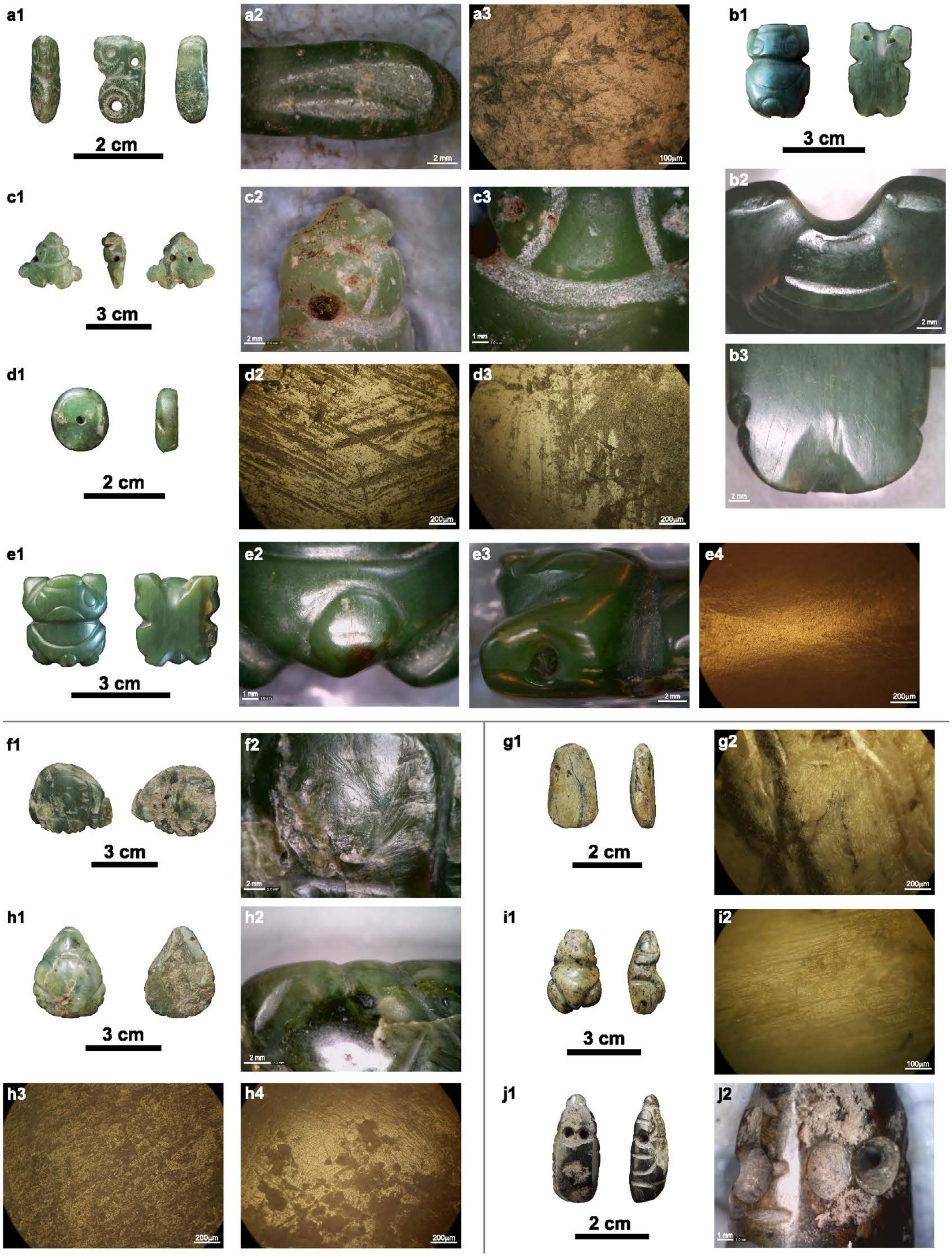
Supplementary data 6: Carnelian ornaments: a) flaked pebble core, b) barrel-shaped bead preform (WPb012) with detail of pecking (b2) and of the perforation (b3, b4), c) disc bead preform (WPb014) with detail of grinding 2 (c2), d) barrel-shaped bead (WPb011) with detail of grinding 1 (d2, d3), e) broken tubular bead (WPb008) with detail of polishing 3 (e2), f) tubular bead (WPb009) with detail of perforation (f2, f3), g) barrel-shaped bead preform (no number) with detail of polishing 1 (g2). Turquoise ornaments: h) flat pendant preform (WPb058) with detail of grinding 1 (h2), i) faceted tubular bead (WPb054) with detail of grinding 2 (i2, i3), j) barrel-shaped bead (WPb055) with detail of polishing 3 (j2), k) disc bead (WPb056) with detail of use-wear on perforation (k2).



Supplementary data 7: Diorite ornaments: a) Multi-bead preform (WPb067), b) tubular bead preform (WPb059) with detail of grinding 1 (b2), c) barrel-shaped bead (WPb063) with detail of grinding 1 (c2), d) barrel-shaped bead (WPb069) with detail of polishing 1 (d2, d3), e) tubular bead with evidence of groove-and-snap (WPb066) with detail of polishing 3 (e2), f) disc bead (WPb070) with detail of polishing 3 (f2) and use-wear on perforation (f3), g) disc bead (WPb060) with detail of use-wear on perforation. Plutonic rock ornaments: h) multi-pendant preform (WPb032) with detail of cut grooves produced by string-sawing (h2, h3), i) multi-pendant preform (WPb033) with detail of cut groove produced by string-sawing (i2) and of semi-circular cut marks (i3), j) frog-shaped flat pendant (WPb042) with detail of grinding 1 (j2), polishing 3 (j3), and U-shaped carvings (j4), k) hourglass bead with double perforations (WPb076) and detail of use-wear on the length perforation (k2), l) tubular bead (WPb095) with detail of use-wear on the perforation (l2).



Supplementary data 8: Jadeitite ornaments: a) flaked core, b) pebble, c) multi-pendant preform (WPb096) with detail of sawn area (c2), d) flat pendant preform (WPb043) with detail of grinding 1 (d2), e) disc bead preform (WPb046) with detail of grinding 2 (e2), f) three-dimensional frog-shaped pendant (WPb037) with detail of polishing 3 (f2) and of V-shaped carvings (f3, f4), g) flat frog-shaped pendant (WPb029) with detail of polished incision (g2), of use-wear in between perforation cones (g3, g4), h) three-dimensional frog-shaped pendant (WPb007) with detail of composite side notch (h2) and of the biconical perforation and excision of the figure's head and forelimb (h3, h4), i) flat frog-shaped pendant (WPb097) with detail of U-shaped carvings (i2), of use-wear in between perforations (i3), and of deformed use-wear notch on a perforation (i4). Ornaments made of low temperature hydrothermal alteration products: j) flat frog-shaped pendant (WPb089) with detail of grinding 1 (j2) and of use-wear on the figure's neck (j3), k) disc bead (WPb088) with mismatched perforations and detail of polishing 3 (k2).



Supplementary data 9: Nephrite ornaments: a) figure-in-profile pendant (WPb098) with detail of semi-circular cut-marks (a2) and of polishing 3 (a3), b) three-dimensional frog-shaped pendant (WPb030) with detail of cut grooves likely produced by string-sawing (b2) and of polished notch (b3), c) flat carved pendant (WPb016) with detail of carvings (c2) and of U-shaped incisions (c3), d) plano-convex bead (WPb084) with detail of polishing 1 (d2, d3), e) three-dimensional frog-shaped pendant (WPb005) with detail of carvings (e2), of perforation and central U-shaped incision (e3), and of use-wear on the perforation (e4). Ornaments made of metamorphic rocks with tremolite (f, h) and of metamorphosed ultramafic rocks (g, i, j): f) flat carved pendant (WPb006) with detail of cut marks from blank removal (f2), g) flat pendant preform (WPb090) with detail of grinding 2 (g2), h) three-dimensional frog-shaped pendant preform (WPb034) with detail of V-shaped carvings (h2), of different varieties of polishing 3 on each face (h3, h4), i) three-dimensional frog-shaped pendant preform (WPb038) with detail of polishing of the central groove (i2), j) flat frog-shaped pendant (WPb039) with detail of biconical perforations and use-wear in between perforations (j2).

5

Late Ceramic Age ornaments

Published as:

Falci, C.G., Ngan-Tillard, D., Hofman, C.L., Van Gijn, A.L., 2020. The biographies of bodily ornaments from indigenous settlements of the Dominican Republic (AD 800–1600). *Latin American Antiquity*, 1-22

https://dx.doi.org/10.1017/laq.2019.101

ARTICLE

The Biographies of Bodily Ornaments from Indigenous Settlements of the Dominican Republic (AD 800–1600)

Catarina Guzzo Falci, Dominique Ngan-Tillard, Corinne L. Hofman, and Annelou Van Gijn

In this study, we generate novel insights regarding bodily ornaments from indigenous societies of late precolonial Greater Antilles. Previous research has highlighted the sociopolitical role of valuable, exotic, and figurative ornaments, yet there are many gaps in our current understanding of these artifacts. Here, we focus on ornaments from five recently excavated sites in the Dominican Republic (AD 800–1600). We used microwear analysis to investigate each ornament and assess its production sequence and use life. These data permitted the definition of morpho-technical groups, which we then compared to depositional contexts and the regional availability of raw materials. We demonstrate that (1) there was small-scale production of ornaments at the sites, (2) the most recurrent morpho-technical groups were likely imported from production centers, and (3) ornaments of the same group could lead different use lives and be deposited through varied processes. We conclude that bodily ornaments had highly diverse biographies involving local and regional interaction networks.

Keywords: stone beads, shell ornaments, microwear analysis, micro-CT, object biography, Caribbean archaeology

El presente estudio se centra en los adornos corporales indígenas de finales del período precolombino en las Antillas Mayores. El rol sociopolítico de los ornamentos figurativos realizados en materiales de valor o exóticos ha tenido un papel destacado en investigaciones anteriores. A pesar de la abundancia de estudios, poco se conoce acerca de estas piezas. En este trabajo presentamos el análisis de los adornos corporales de cinco yacimientos arqueológicos recientemente excavados en la República Dominicana (800–1600 dC). Para el análisis de cada artefacto se empleó la traceología, con el objetivo de comprender la secuencia de producción y utilización. Se definieron grupos morfo-tecnológicos los cuales fueron relacionados con los contextos de deposición y con la disponibilidad regional de materias primas. Los resultados muestran que (1) existió una producción local a pequeña escala de adornos en los sitios, (2) los grupos morfo-tecnológicos más frecuentes probablemente fueron importados desde los centros de producción y (3) los adornos pertenecientes a un mismo grupo pudieron ser utilizados de modos variados y ser depositados mediante diferentes procesos. Se concluye que los adornos corporales tenían biografías diversas que involucraban redes de interacción locales y regionales.

Palabras clave: cuentas líticas, adornos en concha, traceología, micro-tomografía, biografía de los objetos, arqueología del Caribe

The adornment of the body among Greater Antillean indigenous societies was notably diverse at the time of first contact with Europeans (from AD 1492). It encompassed body paint; feather garments; beaded necklaces and armlets; arm-, ankle- and headbands; embroidered belts and skirts; nose rings; earrings; and ear plugs (Alegría 1995; Fewkes 1903; García Castañeda 2012; Lóven 1935). Early historical accounts have provided privileged lenses through which these practices have been interpreted, with emphasis often placed on the Taíno *cacicazgos*, or chiefdoms, described by the Spaniards (Curet 1996, 2014; Keegan 2013; Keegan and Hofman 2017: 11–14; Rouse 1992; Siegel 2010; Wilson

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Latin American Antiquity, pp. 1–22

doi:10.1017/laq.2019.101

2007). For instance, gift giving of stone beads and plates of gold-copper alloy (*guanín*) was allegedly crucial in the maintenance of sociopolitical order, alongside intermarriage between high-status individuals (Lóven 1935:478–479). Furthermore, the religious beliefs of Hispaniolan societies described by Fray Ramón Pané in 1498 have served as the basis for interpreting pendants thought to depict mythical characters (Alegría 1995; Arrom 1975; Fewkes 1903; McGinnis 1997; Maciques Sánchez 2018). The provenance, manufacture, and sociopolitical role of gold and *guanín* ornaments have been the focus of considerable research (Lóven 1935; Martiñón Torres et al. 2012; Oliver 2000; Vega 1979). An aesthetic of brilliance (Saunders 1999) has been used to explain the indigenous appreciation for certain materials, which would have differed markedly from European monetary systems of valuation (Berman 2011; Helms 1987; Keehnen 2012; Oliver 2000; Ostapkowicz 2018). Such interpretations have stressed the supernatural character of certain materials, such as *guanín*, mother-of-pearl, and feathers, as expressed in their exoticness, colors, and reflectance. The adornment of the body would display the political and shamanic powers of the cacique (Oliver 2000).

This reasoning has also been extended to less visually conspicuous ornaments, particularly stone beads and pendants from the Late Ceramic Age (AD 800–1492). Nevertheless, it seems paradoxical to include such ornaments in a narrative about the power of exotic and brilliant things, given that their raw materials are dull and widely available. Furthermore, concepts such as "Taíno" have been criticized as artificial labels that obscure the indigenous diversity of the region and simplify the complex relationships that communities maintained with each other (e.g., Curet 2014; Hofman et al. 2018; Keegan 2013; Keegan and Hofman 2017:239–249; Rodríguez Ramos 2010:200–203; Torres Etayo 2008; Ulloa Hung 2013; Wilson 1993, 2007). If ornaments were linked to high-status individuals, this exclusive access should be reflected archaeologically, and yet ornaments have seldom been recovered with the deceased. An exception is the site of El Chorro de Maíta (Cuba), where hundreds of ornaments were associated with a burial (Valcárcel Rojas 2012:108–121; see also Oliver 2000:201–202). Caches with hundreds of ornaments have also been found inside ceramic and wooden bowls in Puerto Rico (Fewkes 2009 [1907]:109; Ostapkowicz 2018) and the Dominican Republic (Ortega 2005:240–244; Ortega and Fondeour 1976; Vega 1979). Our knowledge about the biographies of ornaments is otherwise very limited. It has been argued that certain artifacts, such as *cemí* idols and greenstone celts, acquired their social status as a result of their biographies, involving investment in manufacture, reputation, or antiquity (Breukel 2019; Oliver 2009:255). In this perspective, only thorough examinations of ornaments can allow us to assess how people interacted with them. Here we apply microwear analysis to ornaments from five recently excavated archaeological sites across the Dominican Republic (Table 1; Figure 1), where they were predominantly recovered from domestic contexts. This study allows us to pursue these ornaments' biographies among indigenous Caribbean communities during the late precolonial period.

Biographies of Ornaments

Previous studies of ornaments have emphasized their symbolic and communicative roles when added to the human body. This perspective has prioritized the meaning of visual aspects of finished ornaments and raw materials. Archaeologists have more recently moved away from the pursuit of meaning in material culture to focus instead on its active potencies in society (e.g., Hodder 2011; Jones 2004; Malafouris 2008). Here, we propose a biographical approach as a means to move past a view of ornaments as passive and unchanging repositories of meaning. In its original proposition, the concept of object biography was connected to the oscillation of objects between different spheres of consumption (Kopytoff 1986). The entrance into new social contexts could lead to changes in meaning and expectations surrounding an object (Gosden and Marshall 1999; Joy 2009).

The study of archaeological artifacts requires a more holistic and empirical approach to the biography concept (Van Gijn and Wentink 2013). The biography of an artifact can be

Table 1. Archaeological Sites Referenced in Text, Excavation Details, and Ornament Collections.

Site	Municipality	Province	Region	Occupation (Centuries AD)	Ostionoid Subseries	Excavated Area (m^2)	Studied Ornaments	
							N	%[a]
El Flaco	Loma de Guayacanes	Valverde	Northwest	Thirteenth–fifteenth Tenth	Mixed Chican and Meillacan Ostionan	1,256	162	51.92
El Carril	Laguna Salada	Valverde	Northwest	Eleventh–fourteenth	Meillacan with other styles mixed	354	18	5.77
La Luperona	Unijica	Puerto Plata	Northwest	Thirteenth	Meillacan	120	7	2.24
Playa Grande	Río San Juan	María Trinidad Sánchez	North	Ninth–seventeenth	Ostionan, Meillacan, Chican	500	31	9.93
El Cabo	El Cabo de San Rafael	La Altagracia	East	Ninth–sixteenth Sixth–eleventh	Chican Ostionan	1,164	94	30.13

[a]Percentage based on the total number of studied ornaments ($n = 312$)

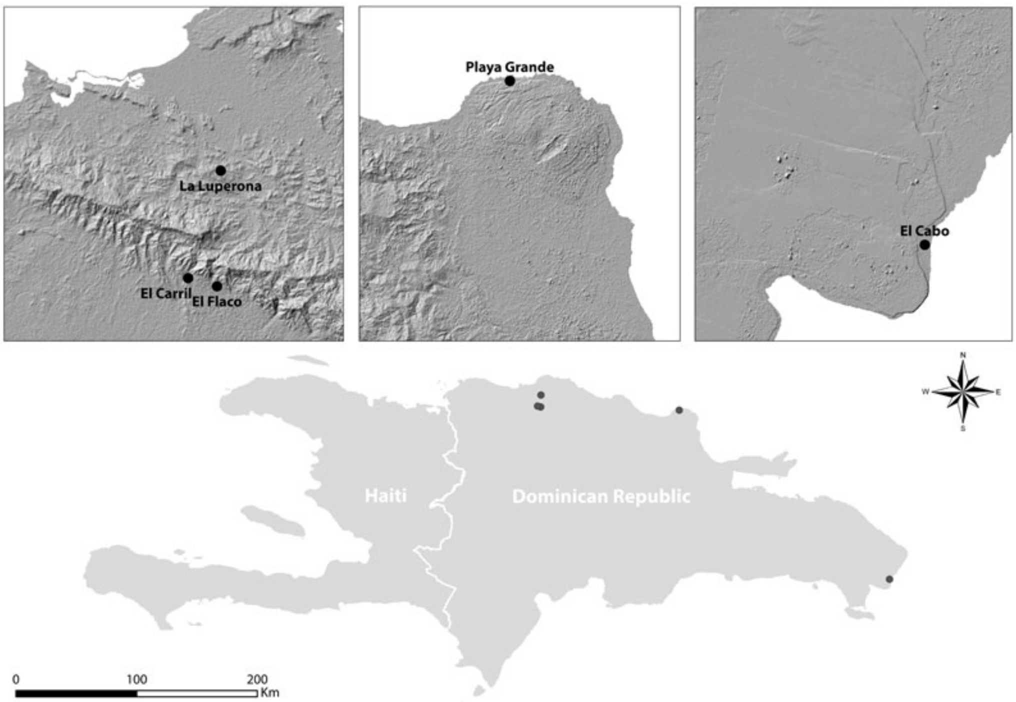

Figure 1. Map of Hispaniola with studied sites plotted. (Map by Eduardo Herrera Malatesta.)

assessed through the study of its multiple stages: conceptualization or design, raw material acquisition, manufacture, its addition to an assemblage, (re)use, recycling, fragmentation, and deposition (Van Gijn 2010). Understood in such a way, a biographical approach allows us to address the ways people physically interacted with materials. By tracking the ways in which ornaments were transformed, we can begin to explore their past social roles. A first step in this direction involves a focus on the *chaîne opératoire* of ornaments (Balfet 1991; Cresswell

1983; Leroi-Gourhan 1993 [1964]). This approach provides a window into the choices made in the past regarding material properties and qualities, production sequences, techniques, tool kits, and gestures (Lemonnier 1993; Sillar and Tite 2000). This type of research also offers insights into the technical stages at which materials reached an archaeological site and were discarded (Perlès 2007). This can ultimately inform us about networks of material acquisition and exchange.

A technological approach needs to be supplemented by use-wear investigations, which have proved to be an important avenue for understanding how ornaments were (re)used, fragmented, or cared for (Van Gijn 2010, 2017; Woodward 2002; Woodward and Hunter 2015). Depositional contexts, such as burials, have offered extensive evidence regarding the compositions in which individual beads were attached and their association with certain social categories (e.g., Bonnardin 2012; Cristiani and Borić 2012; Hommel and Sax 2014). It is through the combination of different empirical lines of evidence that we can reconstruct the biographies of Late Ceramic Age ornaments.

Archaeological Contexts

Northwestern Region

Recent archaeological surveys across northwestern Dominican Republic have identified a diverse and interconnected sociocultural landscape (Hofman et al. 2018; Ulloa Hung 2013; Ulloa Hung and Herrera Malatesta 2015). Ongoing archaeological research focuses on late precolonial and early colonial sites along the route Christopher Columbus followed in 1494 from La Isabela, the first Spanish town in the New World, to the Cibao Valley (Hofman et al. 2016, 2018; Hofman and Hoogland 2015). The majority of ornaments described in this article were recovered from three open-air sites along this route.

El Flaco is a midsize settlement situated on the southern slopes of the Cordillera Septentrional about 20 km from the present coast. The site presents an occupation pattern characteristic of the northwestern region, which involves intentional modifications to the landscape to create flat areas for the placement of houses and other roofed structures (Hofman and Hoogland 2015; Sonnemann et al. 2016; Ulloa Hung 2013; Veloz Maggiolo and Ortega 1980). These flat areas are typically devoid of archaeological material, given that most domestic refuse has been “swept” aside, forming mounds. These mounds present evidence for the burning of garbage, human and dog burials, and food preparation on hearth structures. The lithic collection comprises greenstone celts, hammer stones, and decorated pestles. The celts were mostly imported to the site, with limited local production (Breukel 2019). Flint and quartz remains are nearly absent.

El Carril is currently under investigation and has thus far presented a similar pattern of landscape management (Hofman 2017; Hofman et al. 2018; Sonnemann et al. 2016). The settlement is located 2 km from El Flaco; a larger settlement, it has 102 mounds recorded to date (Hofman 2017; Veloz Maggiolo et al. 1981). La Luperona is located on the northern slopes of the Cordillera Septentrional, 8 km distant from El Flaco and 12 km from the coast (Hofman et al. 2016). The site differs in its spatial organization in that no mounds were recorded.

Playa Grande

Excavations at the site of Playa Grande, located on the northern Dominican coast, have exposed house plans, refuse middens, hearth structures, and potential agricultural mounds (López Belando 2012; Veloz Maggiolo and Ortega 1980:42–45). Multiple occupation phases have been identified, including mixed indigenous and Spanish material culture on the upper layers (López Belando 2012). The inhabitants of the site were engaged in the production and regional exchange of greenstone celts, notably of jadeitite—a rare lithic material, the geological source of which is located 20–30 km to the southwest of Playa Grande (Breukel 2019; Knippenberg 2012; Schertl et al. 2018). Other recovered lithic tools include flint flakes, grooved grinding stones of sandstone, hammer stones, polishing stones, and pestles (Knippenberg 2012).

El Cabo

The eastern tip of the Dominican Republic was a densely occupied region in the late precolonial period (Ortega 1978, 2005; Samson 2010; Samson and Hoogland 2007). The site of El Cabo is located on a coastal promontory overlooking the Mona Passage, which separates Hispaniola from western Puerto Rico (Hofman et al. 2008, 2014; Samson 2010; Samson and Hoogland 2007). The earliest occupation, situated on the north of the site, is characterized by ring-shaped midden deposits. The later occupation, situated to the south, continued until about AD 1504, as indicated by associated Spanish material (Keehnen 2012). Postholes dug into the limestone bedrock enabled the reconstruction of 30 house plans, the establishment of a typology of structures, and insight into the periodical rebuilding of house structures over centuries of occupation (Samson 2010, 2011). Recovered nonceramic artifacts include carved lithic and shell artifacts, greenstone celts, and flint and quartz flakes (Breukel 2019; Samson 2010). In addition, a cache with more than 4,000 canine teeth pendants was recovered from a nearby water spring (Ortega 2005:115–116).

Methods

In archaeological contexts without production debris, only limited information can be gathered from observing ornaments with the naked eye. This is because finished ornaments are highly modified and do not preserve clear evidence of their production stages. Microwear analysis offers the possibility of identifying traces formed on the surface of a bead during its lifetime. We examined all potential ornaments to which we had access, and those specimens positively identified as ornaments were analyzed for microwear ($n = 312$). Analysis was carried out in the Dominican Republic or at Leiden University. Different microscope models were used according to the research setting: DinoLite digital microscopes (magnification: 20–60x), a Leica M80 stereomicroscope (7.5–64x), and a Leica DM6000M and a Nikon Optiphot metallographic microscope (50–500x). An experimental archaeology program was carried out to provide reference materials for the interpretation of tools and techniques used in ornament making (Breukel and Falci 2017; Falci et al. 2017; Supplemental Table 1; Figure 2a–o). For the interpretation of use-wear, we referred to our previous study of ethnographic composite ornaments (Falci et al. 2018) and to published experiments (e.g., Mărgărit 2016; Vanhaeren et al. 2013). The results of this analysis provided the basis for grouping ornaments into morphotechnical groups (Table 2).

We also used a desktop X-ray µ-CT scanner to image the inner structures of 10 beads in 3D. Several researchers (Gu et al. 2014; Ngan-Tillard et al. 2018; Yang et al. 2018) have proven the added value of µ-CT scans in the study of ornaments made of diverse materials, such as lithic, ceramic, shell, and glass artifacts. Scans reveal the morphology of bead perforations, which are difficult to examine using optical microscopy. The resolution of the scans (5–10 micrometers for a 10 mm diameter bead) is sufficient to observe features related to the manufacturing process and use. We selected for scanning beads of different raw materials or with double perforations. Here we include a qualitative assessment of the perforations reconstructed digitally. We offer a preliminary interpretation that contrasts the scanned archaeological specimens (Figure 3a–j) to silicone casts of the materials drilled during the experiments.

Results

Bodily ornaments were most commonly made of lithic raw materials, particularly calcite and plutonic rocks (Supplemental Table 2). Calcite is a carbonate mineral, characterized by low hardness (3 in Mohs scale) and relative ease of work using abrasive techniques. Beads and pendants made of this material have low translucency and a white color (Figure 4a–q). Plutonic rocks are medium to hard rocks that are generally tough, heterogeneous, and coarse grained (Figure 5a–r). They are composed of mafic and felsic minerals, displaying a mottled white and black or green color. Other lithic materials were also made into varied ornament types (Figure 6a–o). Hispaniola has a diverse geological makeup (Draper et al. 1994), with calcite and plutonic rocks fairly common across the island. Small to medium pebbles can be collected from riverbeds in the northwestern region, such

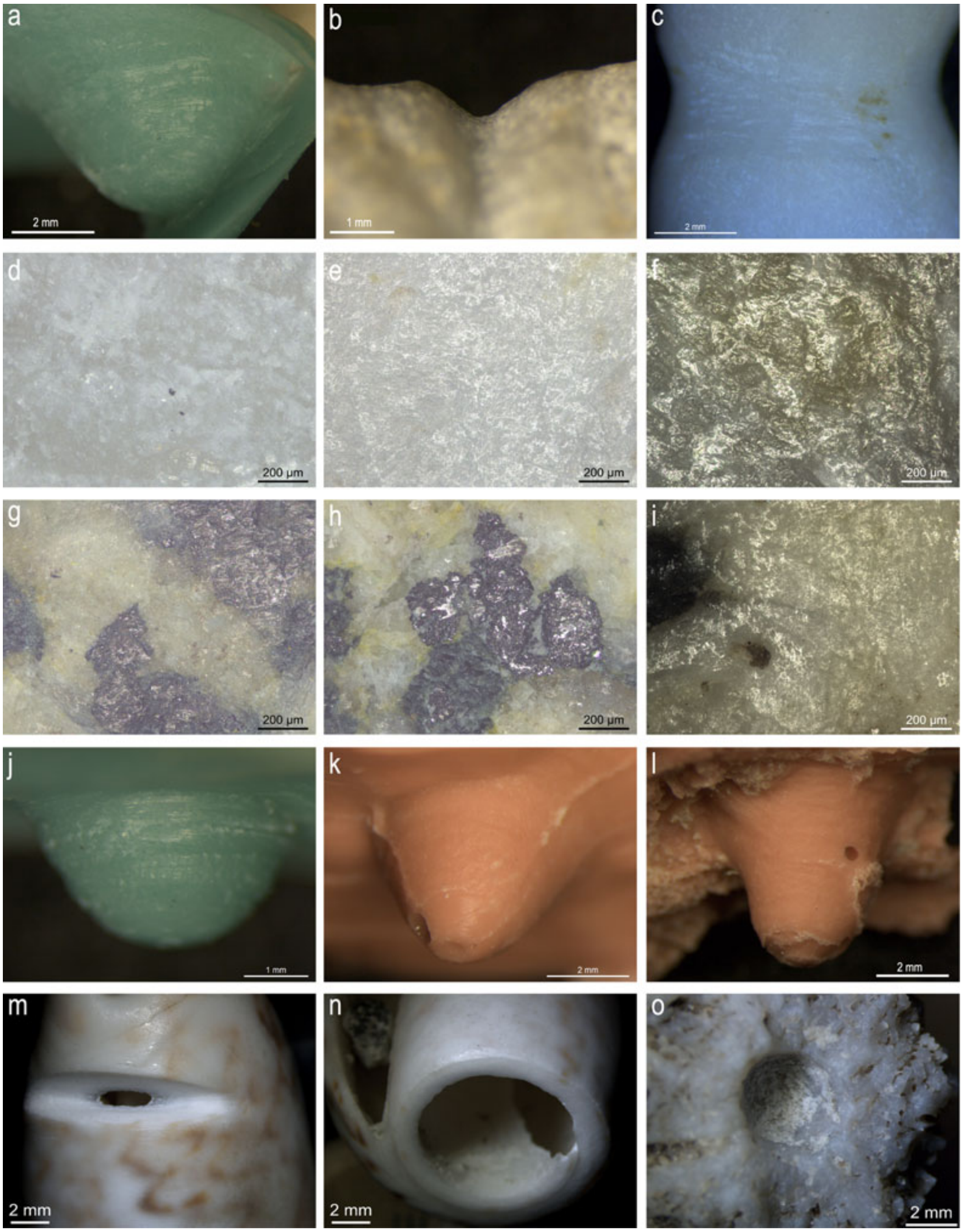

Figure 2. Experiments with calcite (a–f), diorite (g–i), *Lobatus gigas* (j, k), *Spondylus americanus* (l), *Oliva reticularis* (m, n), and *Acropora cervicornis* (o). (Color online)

as from the Yaque del Norte and the Bahabonico Rivers. Because of their regional ubiquity, tracing their geological sources with geochemical techniques is challenging. Only at El Cabo can we argue that plutonic rocks originated from elsewhere, because carbonates and volcanics predominate on eastern Hispaniola (Draper et al. 1994).

Many ornaments were produced using marine resources, including varied mollusk shells (Figure 7a–u), corals (Figure 8a–b), and fish skeletal materials (Figure 8c–e). Seashells were

Table 2. Number of Ornaments in Each Morpho-Technical Group Divided according to Archaeological Site.

Raw Material Groups	El Flaco	La Luperona	El Carril	El Cabo	Playa Grande	Total
Calcite						
Group 1: double perforated tubular beads with hourglass shape	15	1	3	3	–	**22**
Group 2: disc beads	32	–	–	–	–	**32**
Group 3: small barrel-shaped beads	9	–	–	–	–	**9**
Group 4: Short and wide barrel-shaped beads	4	–	–	–	–	**4**
Other beads	5	1	–	3	1	**10**
Pendants	–	2	1	–	1	**4**
Plutonic rocks						
Group 1: double perforated tubular beads with hourglass shape	1	–	1	2	–	**4**
Group 2: short tubular beads with decorative side perforations	2	1	–	11	1	**15**
Group 3: double perforated tubular beads	4	–	2	2	1	**9**
Group 4: disc beads with incisions on the sides	6	–	–	9	–	**15**
Other beads	3	–	–	1	7	**11**
Earplug	–	–	–	–	1	**1**
Pendants	1	–	–	–	1	**2**
Stalactite						
Beads	–	–	2	–	–	**2**
Earplug	–	–	–	1	–	**1**
Other lithics						
Beads	9	1	–	3	–	**13**
Inlay	–	–	–	1	–	**1**
Earplug	–	–	–	1	3	**4**
Pendants	–	–	1	–	1	**2**
Shell						
“Seed beads”	12	–	–	8	–	**20**
Disc beads	1	–	–	1	3	**5**
Scaphopod shell beads	10	–	–	–	–	**10**
Conus sp. apex beads	–	–	–	2	–	**2**
Frog-shaped beads	–	–	1	6	–	**7**
Tinklers	12	–	2	11	1	**26**
Other automorphic shell pendants	1	–	1	4	1	**7**
Flat nacre pendants	3	–	1	2	–	**6**
Flat pendants and inlays	7	–	–	18	1	**26**
Three-dimensional pendants and plugs	2	–	–	1	6	**9**
Bone						
Vertebrae beads	5	–	–	–	–	**5**
Tubular bead	1	–	–	–	–	**1**
Highly modified	–	1	1	–	–	**2**
Teeth						
Automorphic	4	–	–	–	1	**5**
Ground and perforated	3	–	–	1	–	**4**
Coral						
Beads	6	–	1	1	–	**8**
Disc	–	–	–	1	–	**1**
Ceramic						
Globular beads	3	–	–	–	–	**3**
Incised bead	1	–	–	–	–	**1**
Wood						
Disc	–	–	1	–	–	**1**
Earplug	–	–	–	–	1	**1**
Resin						
Earplug	–	–	–	1	–	**1**

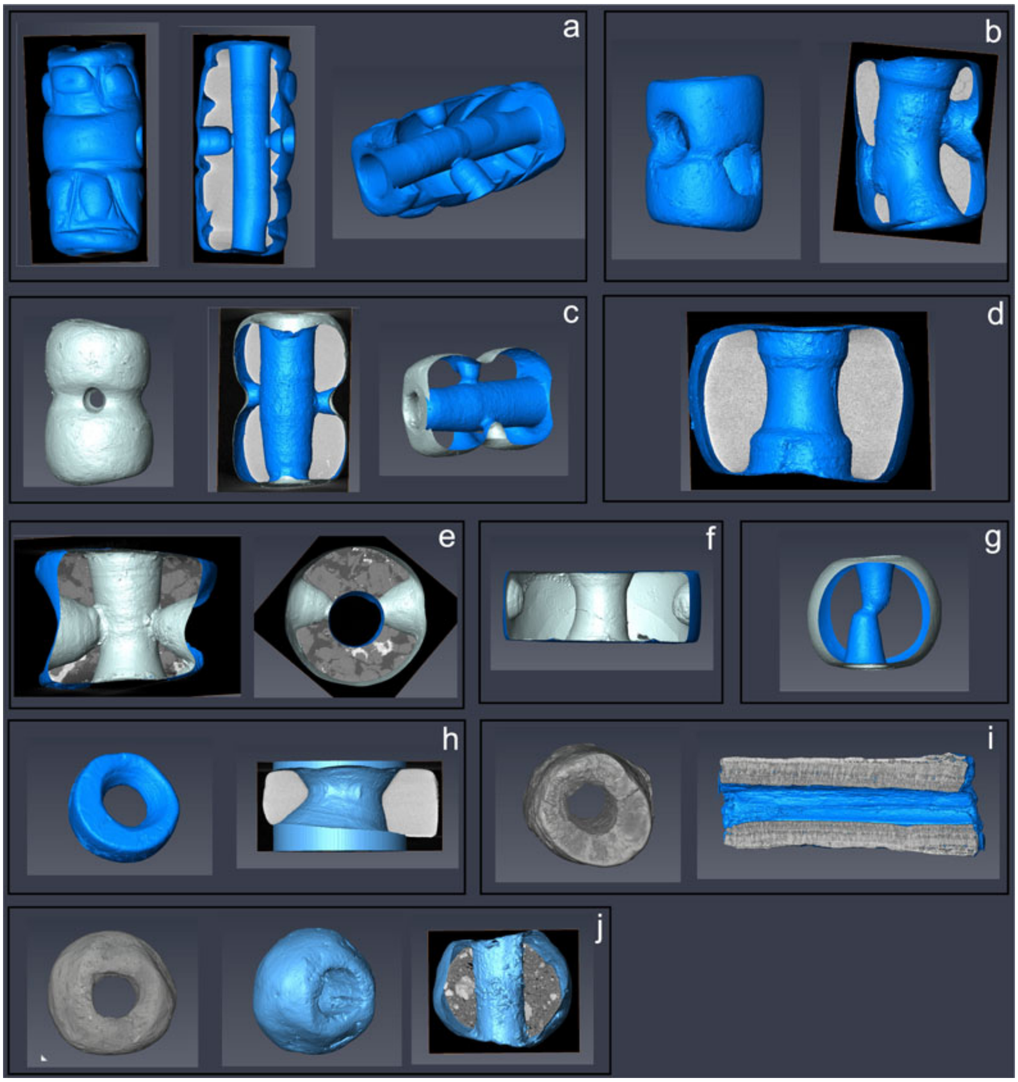

Figure 3. **µ-CT scans of beads: calcite group 1 (a–c), calcite group 4 (d), diorite group 2 (e, f), other lithic raw material (g), shell group 1 (h), coral (i), and pottery (j). (Color online)**

the second most abundant raw material. Depending on the species, they provide tough, but relatively soft media (4 in Mohs scale) with a great variety of shapes and colors. The sites in the northwestern region are located at significant distances from the coast. Although marine resources contributed to the local diet (Hofman 2017), the species used for ornament production were not commonly retrieved as production debris or tools. In contrast, both Playa Grande and El Cabo are located on the coast, accounting for the larger percentages there of recovered shell artifacts.

Production Technologies

The collections recovered from the sites mainly comprise finished ornaments, with few preforms (7%; Supplemental Table 3). Evidence for blank production and early reduction techniques is thus scarce. Most ornaments are well preserved, with only 31.7% displaying postdepositional surface modifications. Surface preservation of shell and certain lithic ornaments was notably poor at El Cabo ($n = 46$). In addition, 90 artifacts (28.8%) were fragmented, with minor ($n = 30$) and major breakages ($n = 34$). Most breakages likely

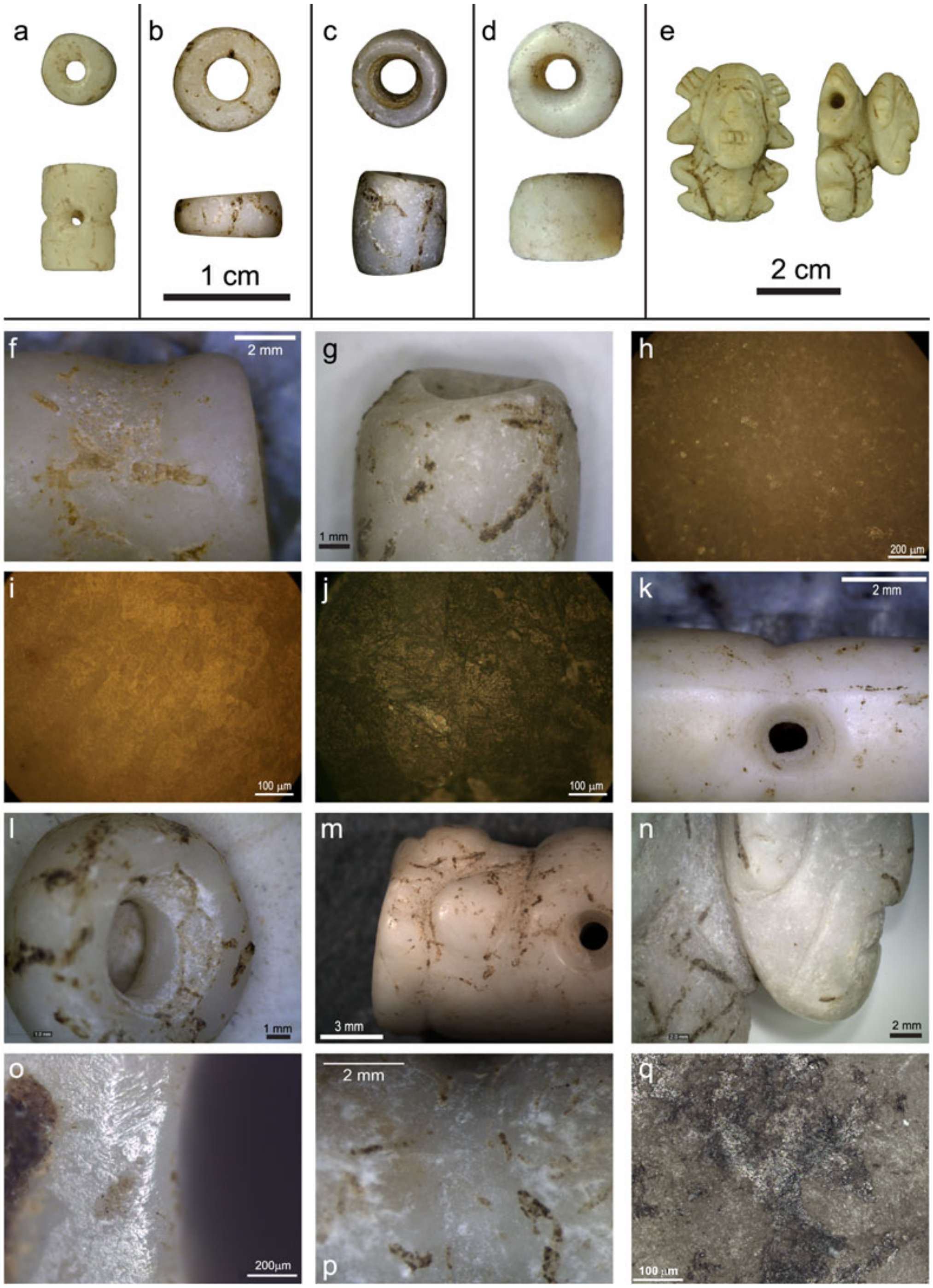

Figure 4. Calcite ornaments of groups 1 (a), 2 (b), 3 (c), 4 (d), and anthropomorphic pendant (e). Manufacture and use traces: sawing (f, g), grinding (h), polishing (i, j), side perforation and central notch (k), drilled cone in three stages (l), anthropomorphic carvings (m, n), use-wear (o, p), and residue (q). (Color online)

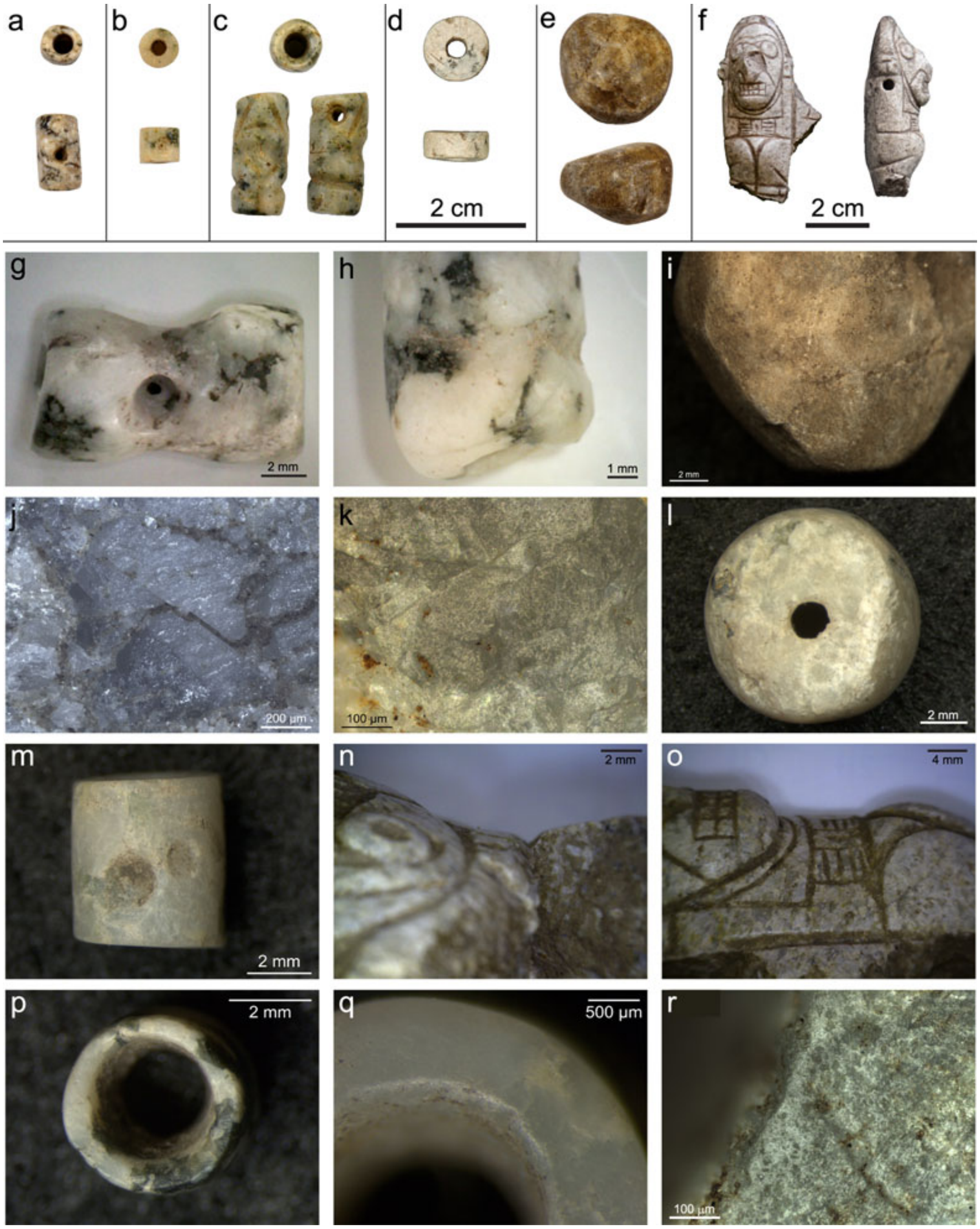

Figure 5. Plutonic rock ornaments of groups 1 (a), 2 (b), 3 (c), 4 (d), other (e), and anthropomorphic twin pendant (f). Manufacture and use traces: sawing and fresh side perforation (g), sawing and incision (h), sawing and snapping (i), grinding (j), polishing (k), pecking (l), unfinished side perforations (m), carvings (n, o), and use-wear on perforations (p–r). (Color online)

happened before or during deposition ($n = 83$). The most frequently occurring morpho-technical groups are discussed in the following sections. Detailed data for each group are available in Supplemental Table 4.

Calcite. Calcite is the most prevalent lithic material in the studied sample, being predominantly used for bead production (Figure 4). Cut-and-break was identified as a blank acquisition technique on 11 artifacts (13.6%), which

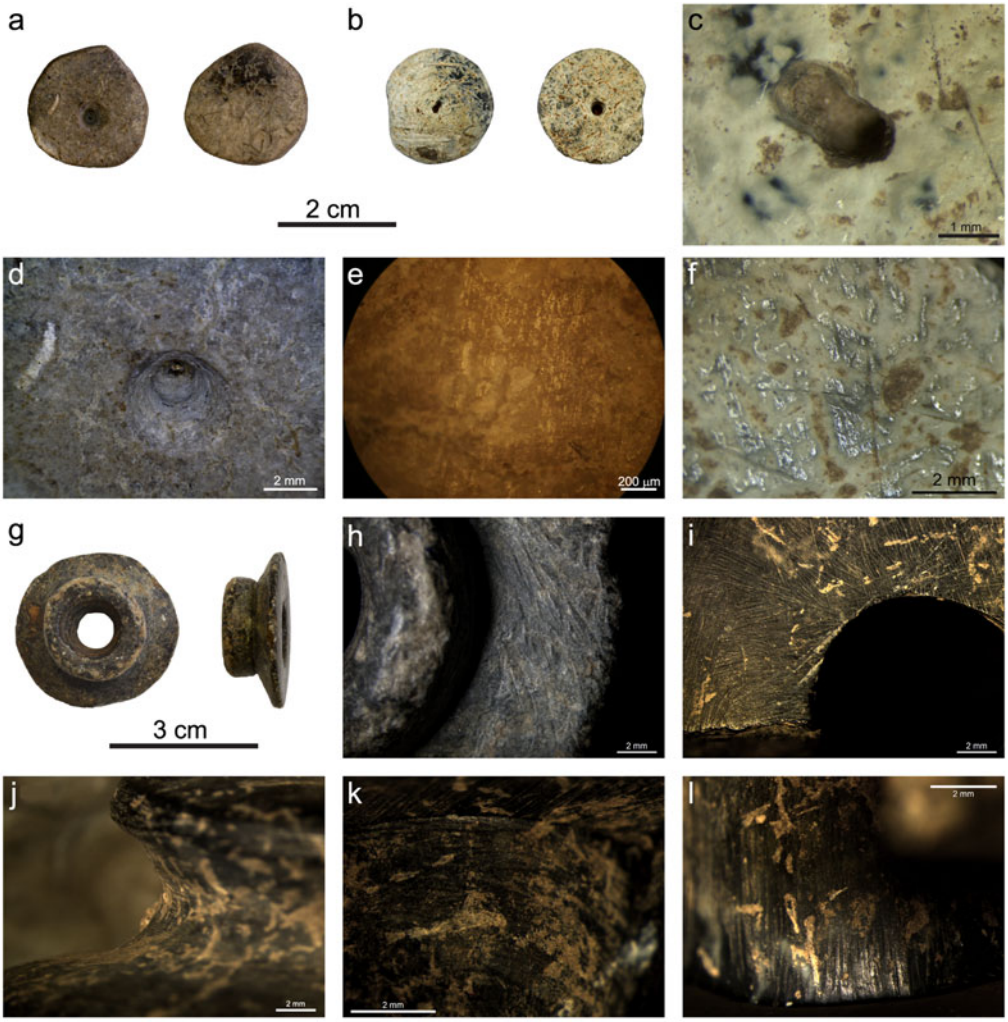

Figure 6. Bead preforms (a–f) and ear spools (g–l) made of diverse lithic materials with evidence for manufacture. (Color online)

displayed cut marks, a pronounced wedge shape resulting from a poor snapping of the blank, or both. The experiments carried out show that a calcite blank can be easily sawn with a flint flake. This technique offers the possibility of quickly obtaining bead blanks with good control. Pendants were likely produced from whole nodules or crystals, given that they are much larger than the beads.

Grinding is identifiable by coarse striations and by the presence of faceting. Using high magnification, we observed it on 27 specimens, being characterized by a flattened and dull surface, either with no clear polish or with polish restricted to the tops of the micro-topography, alongside bright bands of striations. Polishing was noted on most calcite ornaments ($n = 52$; 64.2%); it is characterized by a greasy and invasive polish, with some variability in roughness, number of pits, and striations. Polishing experiments were carried out using a dried high-silica leaf (*Cecropia* sp.) and a cane section from a palm (*Sabal* cf. *domingensis*). Some similarity between experiments and recovered artifacts is apparent in the invasiveness and general greasy appearance of the resulting polishes, in particular with the experiments produced with the cane. Despite this similarity, no direct correspondence

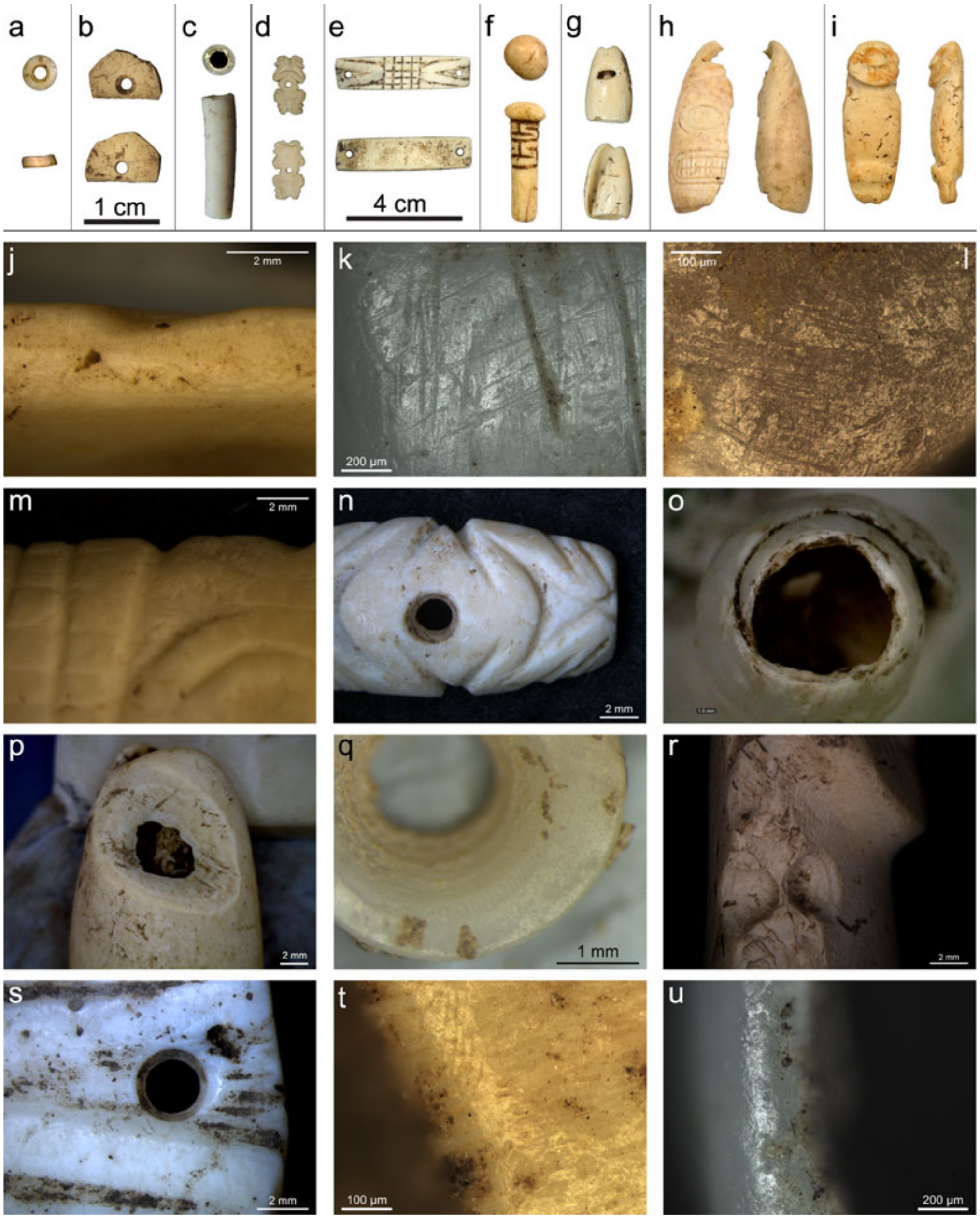

Figure 7. Shell ornaments: "seed bead" (a), disc bead (b), scaphopod bead (c), frog-shaped bead (d), plaque (e), conical plug (f), tinklers (g, h), and anthropomorphic pendant (i). Manufacture and use traces: sawing (j, k), grinding (l), incising and notching (m, n), percussion to remove apex (o), sawn perforation (p), drilling (q), incomplete drilling (r), and use-wear on perforations (s–u). (Color online)

was possible, in part because of the variability of polish characteristics observed and the interaction between the surface treatment, use-wear, and postdepositional processes. We thus attributed the observed surface treatment to a soft contact material, but we did not consider it to be not sufficiently distinctive for more precise identification.

All calcite ornaments were perforated with massive drill bits. (Bi-)cylindrical perforation

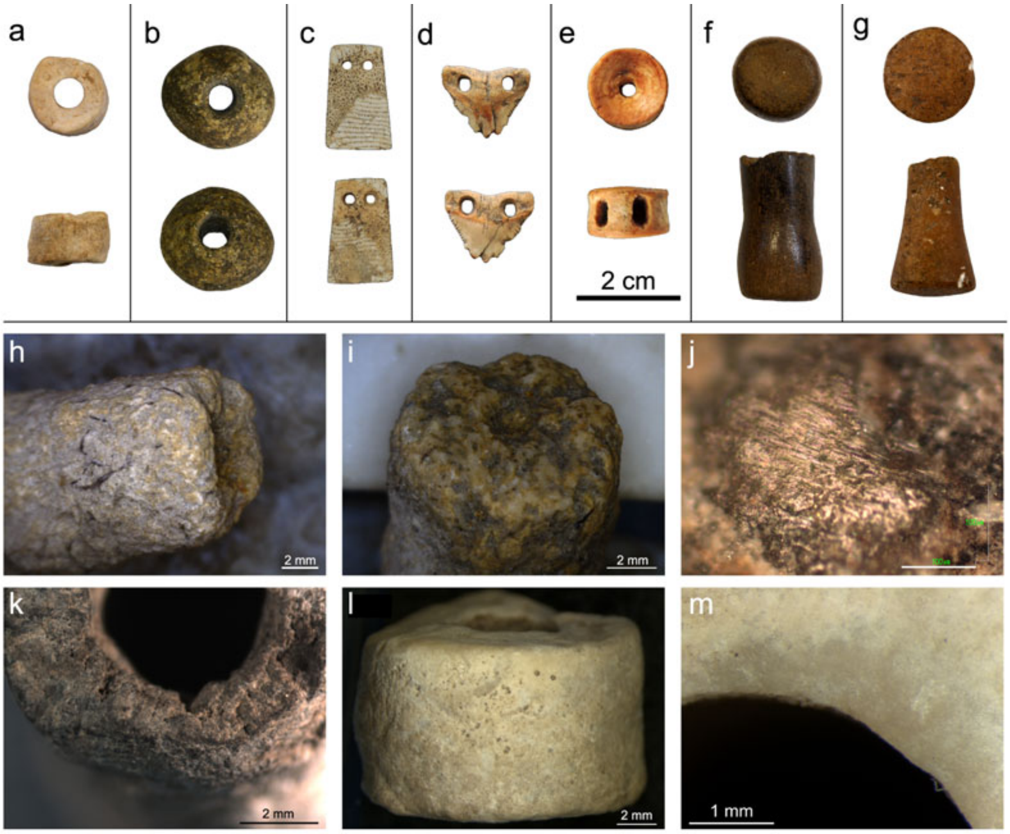

Figure 8. Ornaments of diverse raw materials with manufacture and use traces: coral beads (a, h–m), ceramic bead (b), pendants made of dental elements (c, d), wooden plug (f), and resin plug (g). (Color online)

profiles with circular grooves and scratches were observed on group 1 beads. These traces suggest that the craftsperson used a long and cylindrical drill bit, probably of organic origin, with abrasives. Drilling experiments with wooden and bone drills to perforate shells (which have a similar composition and hardness to calcite) show comparable perforations with no clear surface polish or scratches but occasional broad circular rings (Figure 2k–l). The end tip of the drilled hole can present polish and fine scratches because of the accumulation of abrasive material on the leading edge.

The drilling method used for group 1 involved two stages: (1) drilling a tubular bead predominantly from one face, thus producing a wide rim of perforation, and (2) drilling the opposite face, producing a small, conical perforation. Additionally, a second perforation was added to the sides of the beads, perpendicular to the first one. Investigation with the μ-CT scan showed that side perforations are similar to the main ones and are therefore likely produced by the same tool kit (Figure 3a, c). In contrast, group 3 and the "other" group were drilled with brittle and hard lithic drill bits, as evidenced by biconical perforations with irregular concentric scratches (cf. Figure 2a). Group 2 disc beads displayed yet another drilling method, involving three stages: before biconical drilling with a hard lithic drill, they were perforated with a cylindrical drill bit, evidenced by a narrow and smooth cylindrical sector in between the two fresher cones. A comparable perforation is observed on a group 4 bead (Figure 3d). Group 1 beads were further modified by the addition of a groove on the side. This groove was made either with the thin edge of a brittle lithic flake, producing an incised line, or with a broader edge that produced a wider groove. Polishing took place after the creation of the grooves and side perforations, thus producing an hourglass shape. Six artifacts display anthropomorphic carvings made with hard and brittle lithic tools, which combine incision, notching, drilling, and bas-relief.

Plutonic Rock. Plutonic rock ornaments display greater morpho-technical variability (Figure 5a–r). Cut-and-break was identified on 10 beads (17.5%). This technique is evident on poorly shaped bead preforms from Playa Grande, which were not extensively modified after sawing. Sawing diorite is a time-consuming task; to avoid mishaps, a deep groove needs to be sawn as a guide to snapping. Pecking was possibly used to remove sharp ridges, but diagnostic traces have been erased in all but two beads. Grinding traces were predominant on 24 ornaments (42.1%), which are characterized by a dull and coarse surface. Polishing with a soft contact material was identified on 23 beads (40.3%). Both treatments were observed in combination on nine ornaments. The main perforations were likely made with the same tool kit used for calcite group 1 beads (organic drill bits), given that bi-cylindrical profiles with circular grooves are common across all bead morpho-technical groups. In contrast, the side perforations, either complete holes or decorative pits (not pierced through), were produced with hard and brittle lithic tools. Decorative carvings are present on 23 ornaments (40.4%), with the use of hard and brittle lithic tools identified on 10 ornaments. Four artifacts display biomorphic carvings made by a combination of incision, excision, and notching.

Other Lithic Materials. Beads, pendants, and an inlay were made of diverse materials, including stalactite ($n = 2$), limestone ($n = 1$), and "greenstones" ($n = 4$). Some of these beads do not fit any previously defined group, testifying to the existence of ornament biographies that are poorly represented at the sites. Two examples are the only lithic bead preforms recovered from El Flaco and El Cabo: a large and faceted disc bead (Figure 6a) and a plano-convex bead (Figure 6b). Both beads display misaligned and unfinished perforation cones (Figure 6, c–d) and rough grinding (Figure 6, e–f), having been abandoned before completion. The two beads are different from all other studied beads.

Plugs. Both conical and biconical plugs are represented, with a great variety in raw materials. Biconical plugs were likely ear spools, whereas T-shaped conical specimens could have been ear or lip plugs. The conical plugs were produced by a combination of grinding, sawing, and scraping to create different shapes varying from a marked T-shaped artifact (Figure 7f) to a nearly perfect cone (Figure 8f–g). Incised patterns were added to the surfaces of conical plugs made of stalactite and shell. The stone ear spools (Figure 6g–l), all from Playa Grande, were shaped in multiple stages: (1) grinding a thick circular blank in shape, (2) drilling a biconical perforation on its center, (3) sawing a notch around the sides with a V-shaped lithic tool, (4) widening the notch with a broad-edged tool, (5) smoothing the drilled hole with an abrasive tool, and finally (6) polishing with soft contact materials. Their dull surfaces, with preserved manufacture traces, suggest that certain specimens were discarded during production, but the small number of specimens and their fragmented nature limit interpretation.

Shell. Shell ornaments encompass great variability (Figure 7). One morpho-technical group includes 20 "seed beads"—very small disc beads made of different shell species: *Lobatus gigas*, *Chama sarda*, and an unidentified bivalve. The recurring diameters (5–6 mm) and perfectly circular shapes of the beads suggest some standardization of production, probably by grinding their sides on a mineral platform while strung together (Lammers-Keijsers 2007:64). The beads were individually perforated with tiny flakes of hard and brittle lithics.

Nine tubular beads were made from sections of tusk shell (Scaphopoda). They are hollow and slightly curved, with a smooth surface. Most beads display stepped fractures at the ends; in addition, cut marks or incisions left from blank acquisition are commonly seen (Figure 7c, k). Complete shells were not identified, although beads of different heights were retrieved from El Flaco. Their recurring diameters suggest a sustained preference for the least curved sector of the shell for bead making.

Flat and three-dimensional pendants, plaques, and inlays were produced with mollusk shell, often *L. gigas*. Different parts of the shell were

Table 3. Use-Wear Presence per Archaeological Site.

	El Flaco		El Carril		La Luperona		Playa Grande		El Cabo		Total	
Use-wear	N	%	N	%	N	%	N	%	N	%	N	%
Present	100	61.73	13	72.22	7	100	15	48.39	66	70.21	201	64.42
Absent	18	11.11	2	11.11	–	–	5	16.13	8	8.51	33	10.57
Half products[a]	8	4.94	2	11.11	–	–	8	25.80	4	4.25	22	7.05
Indeterminate	36	22.22	1	5.55	–	–	3	9.68	16	17.02	56	17.95
Total	**162**	**100**	**18**	**100**	**7**	**100**	**31**	**100**	**94**	**100**	**312**	**100**

[a]Use-wear presence/absence is not applicable to half products, as they are not finished ornaments.

selected (e.g., lip or columella), depending on the desired volume and shape of the artifact. The blanks of both flat and three-dimensional artifacts were initially shaped through sawing. Next, they underwent grinding and biconical drilling with hard lithic drills. Flat ornaments received geometric patterns through incision and the creation of bas-relief, whereas three-dimensional specimens underwent notching, incising, excising, and drilling. The combination of techniques allowed the carvers to create both anthropomorphic and zoomorphic figures.

Tinklers were carved on whole gastropod shells, particularly *Oliva reticularis*. Their production consisted of two operations: (1) removal of the apex of the shell through percussion (Figure 7o), grinding, or both and (2) perforation of the body whorl. In most cases, the perforation displays a U-shaped profile produced by sawing with a broad-edged lithic tool or with an organic tool, such as a wooden one, with abrasives (Figure 7p). Six specimens do not display a side perforation, being possibly unfinished. Four tinklers display incised and drilled carvings made with hard and brittle lithic tools, creating facial attributes or geometric patterns. *O. reticularis* shells were also used for the sawing of blanks for frog-shaped beads. These blanks were ground, drilled biconically with a hard and brittle lithic bit, and carved into a flat schematic frog by notching, incising, and creating bas-relief areas.

Stony Coral. Eight coral beads—most of which were made of *Acropora cervicornis* (Figure 8a, h–m)—were recovered from three sites. Two specimens have unfinished perforations, being interpreted as preforms. Unperforated branches of *A. cervicornis* were also recovered. One bead displays cut marks close to its edge, possibly linked to the splitting of the branches in small sections. The beads were drilled and sometimes also chiseled. The specimen scanned by the μ-CT does not display clear drilling traces. Our drilling experiment has shown that a calcium carbonate paste forms on the perforation on drilling, which may account for the absence of diagnostic traces.

Use-Wear

Worn artifacts are prevalent across nearly all raw materials (Supplemental Table 5). More than 70% of lithic ornaments are worn in contrast to about 15% of preforms and ornaments without use-wear. A different picture is observed for shell ornaments: more than 50% of the ornaments are worn, whereas 20% are unfinished or do not display use-wear. Because of the poor preservation of shell ornaments from El Cabo, use-wear could not be assessed on many specimens found there (25.4%). The difference in the presence of use-wear in shell and lithic ornaments can also be related to the greater number of shell preforms. We observed a predominance of worn ornaments across all sites and nearly all morpho-technical groups (Table 3; Supplemental Table 4). Playa Grande is the only site where the percentage of worn ornaments does not reach 50%. This is not surprising considering that it is the only site for which sustained evidence for ornament making is available.

Discussion

The particular trajectories of artifacts within each morpho-technical group help us understand ornament biographies at the sites and the different interaction spheres enabling their acquisition. Even though lithic raw materials tend to be locally available, the samples do not display evidence for local production of most morpho-technical groups. Production waste, blanks, and preforms are absent, and the lithic tools likely used for drilling and carving were not commonly recovered. Nevertheless, the presence of two lithic bead preforms at El Flaco and El Cabo shows that bead-making knowledge was present to some degree in these communities. In other words, most ornaments were brought into the sites already finished, despite the local availability of raw materials and the presumed existence of local bead-making knowledge. Nevertheless, Late Ceramic Age stone bead-making workshops, from where such finished beads could have come, are not known.

The final products and production sequences of certain lithic morpho-technical groups are quite similar, despite the use of raw materials such as calcite and plutonic rocks with different physical properties. A shared mental template and some degree of standardization were involved in the production of double-perforated beads, as suggested by the occurrence at all sites of specimens made with similar tools and on select raw materials. At the same time, instances of poor technical performance were commonly noted, including technical errors (Supplemental Table 4) and a lack of regularity in shape and size. Such variations in performance and resulting morphologies suggest, among others, a low level of standardization of production, a low level of craftsmanship, presence of apprentices, or a lack of care in production. Double-perforated beads occur across the Greater Antilles (e.g., Fewkes 2009 [1907]:109; García Castañeda 2012:71). Group 1 calcite beads are the most standardized and well distributed of all morpho-technical groups. Plutonic rock beads are more common at El Cabo than at El Flaco, where they are responsible for the larger variability in morpho-technical groups. By contrasting the most common bead groups in El Cabo and El Flaco, we can argue that there were different production centers, likely specializing in different raw materials and end products. Therefore, multiple production centers may have supplied beads to these communities. Bead groups that were only recovered from one site may be the result of local networks of artifact distribution.

Double perforated beads are of particular interest because it was previously speculated that the main perforation served for the insertion of feathers, whereas the bead was attached to a string composition through the side perforation (Fewkes 2009 [1907]:109). This traditional assumption is challenged by the use-wear distributions, which show that double perforated beads were assembled in a variety of compositions. For instance, beads with string-wear located exclusively on the main perforation were fairly common. These beads must have been strung exclusively along their longest axis; that is, as common beads. Evidence for the placement of adjacent beads or knots was also noted, in the form of deformed concavities on calcite beads. In contrast, 12 beads display string-wear on both length and side perforations; three such specimens also display evidence of a string being wrapped around the center of the bead, connecting the cones of the side perforation (Figure 4p). Beads with strings passing along both axes may have served to connect multiple strands of an ornament. An anthropomorphic calcite bead displays black residue on one of its faces (Figure 4q) but no clear string-wear. The observed residue can be the result of an attachment string covered with residue or of an adhesive being used to fix something inside of the bead, such as a feather. Beads with string-wear exclusively on the side perforations, such as the two stalactite beads, would have hung asymmetrically, similarly to pendants.

Most lithic ornaments from Playa Grande do not fit the morpho-technical groups noted from the other sites. In particular, the plutonic rock beads from Playa Grande constitute a very diverse group in size, shape, and subtype. Four of these beads are preforms, whereas others display rather coarse surface treatments. Ear spools were also potentially made locally. Ornament production from lithic materials was taking place at the site, but it was not a specialized activity. Playa Grande did not provide other sites with lithic ornaments, in contrast to its known role as provider of greenstone celts to a wide region. Ornament production was likely connected to local use.

In addition to "imported" lithic ornaments, the inland sites in the northwest of the Dominican Republic also yielded ornaments made of marine resources. We interpret this as evidence of multiple networks of ornament and/or material acquisition. Shell "seed bead" production centers have been identified in the Turks and Caicos, dated from around AD 1100–1300 (Carlson 1995; Keegan et al. 2008:645; Littman and Keegan 1991; Sinelli 2001:94). The sites were interpreted to be outposts in these small islands, specializing in the acquisition of *L. gigas* and *C. sarda* shells for large-scale bead making. Although these small beads could be used in necklaces, they are generally thought to be part of embroidered fabrics involving thousands of beads (Ostapkowicz 2013, 2018; Ostapkowicz et al. 2017). In the present study, we noted standardization in the production of "seed beads," in stark contrast with lithic beads and other shell ornaments. Therefore the "seed beads" recovered from El Flaco and El Cabo may have been obtained from workshops.

The shell bead production centers do not present evidence for the manufacture of the other shell ornaments we studied. As such, an alternative pattern of acquisition can be suggested. Evidence has been found for the local production of ornaments from marine resources at El Flaco (tinklers and coral beads), El Cabo (frog-shaped beads and plaques), and Playa Grande (biomorphic pendants and disc beads). In all cases, the production was of relatively small scale. It was likely not sufficient for local consumption, given that composite ornaments would have required numerous elements. This is clearer for tinklers, large numbers of which are believed to have hung in rattling bands tied around the arms and ankles of dancers (García Castañeda 2012:58; Lovén 1935:481). During use, it is likely that individual tinklers often broke because of collision with neighboring components. Locally produced tinklers may have served as replacements for repairing and thus extending the life of a rattling ornamental band. This reasoning can perhaps be extended to other forms of local production, with the possible exception of three-dimensional pendants. Large figurative pendants were likely central pieces around which composite ornaments were conceived. Diverse marine resources could be directly acquired by the inhabitants of the coastal sites of Playa Grande and El Cabo. The inhabitants of the northwestern sites were immersed in a regional network of villages located in different ecological niches (Hofman et al. 2018; Ulloa Hung 2013). Shells, corals, and fish skeletal materials were obtained directly or through exchange with people occupying mangrove or coastal sites and used as food resources, raw materials, and ornaments.

In sum, there was nonspecialized household-level production of ornaments in different raw materials at the three most extensively excavated sites. The difference between locally produced and imported ornaments did not correlate strictly to raw material variability (e.g., marine versus lithic resources). It was dependent on the specific trajectories of certain morpho-technical groups within each raw material. The depositional data also testify to the varied biographies of ornaments at these settlements.

Deposition of Ornaments

Most of the analyzed ornaments were not found in large groups or in closed contexts, which prevents us from assessing how composite body ornaments would have looked. At El Flaco, ornaments follow the pattern observed for other archaeological materials: they are found in the mound structures or adjacent to house structures. La Luperona and El Carril have thus far presented a similar picture. There is only one context from El Flaco where multiple beads were seemingly deposited as a group: 36 disc and barrel-shaped calcite beads (groups 2 and 3) were recovered from the same square meter in a mound with burials and hearth structures but not in direct association with any one individual. Beads of these two morpho-technical groups have been found only at El Flaco and in very small numbers outside of this particular context. They were likely obtained as a group from a specific producing community. In this sense, the singularity of the two morpho-technical groups is also reflected in their singular deposition.

The majority of ornaments from El Cabo were retrieved from the southern excavation area, which was occupied from AD 800 to about 1504. Some ornaments were recovered from postholes integrating 10 house plans, notably in entrance posts. This pattern arguably represented the ritual deposition of ornaments at the end of the life cycle of a house, before its abandonment and the construction of a new structure (Samson 2010, 2011). Other ornaments were recovered from the areas of greatest artifact density, following the same distribution pattern of most ceramic sherds and shell remains. The contrast between areas of dense artifact distribution and nearly clean areas was proposed to be due to the sweeping of refuse from the habitation areas toward the edge of the cliff (Samson 2010). The majority of ornaments found in Playa Grande were retrieved from activity areas associated with hearth structures or food preparation or from refuse middens (80.6%). These areas date from AD 1000 to the early seventeenth century (López Belando 2012).

Most studied ornaments displayed use-wear and were deposited as the result of cleaning the house areas, rather than being deliberately added to hidden caches or burials. Beads can easily be lost, either by chance or by the restringing of composite ornaments. The fact that more than 70% of the sample is not fragmented suggests that these are not cases of intentional discard because of breakage. Integrating mounds and refuse areas, ornaments are the product of the regular maintenance of house areas as clean, functional, and desirable spaces. It may thus be suggested that ornaments reached the archaeological record as a result of their daily use at the sites, in the context of quotidian activities. Likewise, the importance of ornaments in daily life and the difficulty of their acquisition may be the reasons why they were not deposited with the dead, but perhaps were passed on to kin. Their homogeneous distribution throughout the sites can be regarded as an indication that the use of ornaments was widespread across all social categories. There may have been differential use according to social grouping, such as age and gender; nevertheless, these differences cannot be assessed through the data at hand. The small total amount of ornaments recovered from the sites highlights the concern with caring for and maintaining bodily ornaments, which limited their discard outside of prescribed deposition events such as closing rituals and hidden, perhaps votive, caches.

Conclusion

Archaeological debates concerning the adornment of the body in the Greater Antilles have focused on its role in reinforcing the political and religious power of high-status individuals. Little attention has been paid to demonstrating how people interacted with the commonly recovered ornament types. The present study applied for the first time an artifact biography approach to ornaments from Late Ceramic Age settlements. Our results show that bodily adornment cannot be taken for granted as a homogeneous category. First, a given ornament undergoes multiple changes during its lifetime—from raw material through production, circulation in networks of exchange, incorporation into composite ornaments, and eventual loss or discard. An ornament was dealt with in different ways in each life stage, and its status possibly evolved accordingly. Second, the morpho-technical groups had contrasting biographies, possibly as a result of their different expected social roles or of their participation in different social contexts. At the same time, the microwear study revealed how ornaments made of different materials or retrieved from different settlements shared certain biographical stages, such as material acquisition and production. Furthermore, our approach provided evidence for the circulation of ornaments and raw materials across different communities and regions. Future research focused on other sites is necessary to elucidate alternative ornament biographies and the interaction networks that encompassed them. Only then we will be able to more fully understand how ornaments were used in the establishment and negotiation of local and regional identities.

Acknowledgments. The authors acknowledge the Ministerio de la Cultura of the Dominican Republic and the Museo del Hombre Dominicano for granting permission to conduct this research. Furthermore, we would like to thank Jorge Ulloa Hung, Adolfo López Belando, the Torres family, Alice Knaf, Menno Hoogland, Darlene Weston, Eduardo Herrera Malatesta, Diederik Pomstra, Tom Breukel, and the students who assisted with the experiments. The present research was funded by the NWO Spinoza Prize awarded to Prof. Dr. Corinne L. Hofman in 2014. It is also part of the project NEXUS1492, which has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ERC Grant agreement no. 319209.

Data Availability Statement. The Museo del Hombre Dominicano in Santo Domingo is the official repository of the collections studied in this research.

Supplemental Materials. For supplementary material accompanying this article, visit https://doi.org/10.1017/laq.2019.101.

Supplemental Table 1. List of Experiments.

Supplemental Table 2. Ornament Raw Materials according to Archaeological Site.

Supplemental Table 3. Unfinished Ornaments Retrieved from the Studied Sites.

Supplemental Table 4. Technological and Use-Wear Data Collected for Each Morpho-Technical Group.

Supplemental Table 5. Use-Wear Presence according to Ornament Raw Material.

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Submitted February 12, 2019; Revised August 24, 2019; Accepted December 5, 2019

Supplemental material 1: List of experiments

Experiment n°	Technique	Tool	Material worked	Additives	Time (min)
2475	Grinding	Coral grinding slab (*Acropora palmata*)	Calcite	N/A	45
2477	Sawing	Flint blade	Calcite	N/A	2
2479-1	Grinding	Coral grinding slab (*Acropora palmata*)	Calcite	Water	4
2479-2	Incising	Flint, shell, wood	Calcite	N/A	N/A
2488-2	Drilling	Bow drill, flint tip	Calcite	N/A	27
2488-3	Drilling	Palm drill, flint tip	Calcite	N/A	30
2484-1	Grinding	Coral grinding slab (*Acropora palmata*)	*Lobatus gigas* (lip)	Water	-
2484-2	Drilling	Palm drill, flint tip	*Lobatus gigas* (lip)	N/A	-
2486	Drilling	Bow drill, flint tip	*Lobatus gigas* (lip)	N/A	-
2487-2	Drilling	Mechanical drill, wooden tip	*Lobatus gigas* (lip)	Sand, Water	103
2490-1	Sawing	Flint blade	*Lobatus gigas* (lip)	N/A	-
2500	Grinding	Coral grinding slab (*Acropora palmata*)	*Lobatus gigas* (lip)	N/A	24
2498-1	Grinding	Coral grinding slab (*Acropora palmata*)	*Oliva reticularis* (apex)	N/A	60
2498-2	Sawing	Flint blade	*Oliva reticularis* (body whorl)	N/A	60
3036	Grinding	Sandstone	Diorite	Sand, Water	60
3037	Grinding	Coral grinding slab (*Acropora palmata*)	Diorite	Sand, Water	60
3039	Grinding	Sandstone	*Acropora cervicornis*	Water	35
3054	Sawing	Flint blade	*Acropora cervicornis*	N/A	11
3055-1	Sawing	Flint blade	*Lobatus gigas* (lip)	Sand, Water	135
3061-2	Drilling	Mechanical drill, bone tip	*Spondylus americanus*	Sand, Water	110
3062-1	Grinding	Sandstone slab	*Spondylus americanus*	Water	80
3063-1	Sawing	Flint blade	Diorite	N/A	26
3068	Drilling	Mechanical drill, bone tip	*Acropora cervicornis*	Sand, Water	90
3411-A	Grinding	Basalt slab	Calcite	N/A	60
3411-B	Grinding	Basalt slab	Calcite	Water	60
3414-A	Grinding	Limestone slab	Calcite	N/A	60
3414-B	Grinding	Limestone slab	Calcite	Water	60
3415	Sawing	Flint blade	Calcite	N/A	65
3417-A	Grinding	Coral grinding slab (*Acropora palmata*)	Calcite	N/A	60
3417-B	Grinding	Coral grinding slab (*Acropora palmata*)	Calcite	Water	60
3418-A	Grinding	Limestone slab	Diorite	N/A	90
3418-B	Grinding	Coral grinding slab (*Acropora palmata*)	Diorite	Water	60

3419-A	Grinding	Basalt slab	Diorite	N/A	90
3419-B	Grinding	Basalt slab	Diorite	Water	90
3421-A	Grinding	Coral grinding slab (*Acropora palmata*)	Diorite	N/A	60
3421-B	Grinding	Quartzite slab	Diorite	N/A	90
3426-A	Grinding	Limestone slab	Diorite	Water	60
3426-B	Grinding	Quartzite slab	Diorite	Sand, Water	90
3428-A	Grinding	Basalt	Calcite	Sand, Water	60
3429-A	Grinding	Quartzite	Diorite	Water	90
3429-B	Grinding	Sandstone	Diorite	N/A	90
3429-C	Grinding	Basalt	Diorite	Sand, Water	90
3430-A	Grinding	Limestone	Diorite	Sand, Water	90
3432-A	Grinding	Limestone	Calcite	Sand, Water	90
3432-B	Grinding	Sandstone	Calcite	N/A	90
3435-all	Grinding	Sandstone	Calcite	Water	60
3436-A	Grinding	Sandstone	Diorite	Water	90
3436-B	Grinding	Sandstone	Diorite	Sand, Water	90
3438-A	Grinding	Sandstone	Calcite	Sand, Water	90
3438-B	Grinding	Quartzite	Calcite	N/A	90
3441-A	Grinding	Quartzite	Calcite	Water	90
3444	Grinding/ Sawing	Sandstone	Calcite	Water	120
3445-all	Grinding	Sandstone	Calcite	Water	60
3445-A	Polishing	Cane section (*Sabal* cf. *domingensis*)	Calcite	N/A	30
3445-B	Polishing	Cane section (*Sabal* cf. *domingensis*)	Calcite	Water	30
3446-all	Grinding	Sandstone	Diorite	Water	345
3446-A	Polishing	Cane section (*Sabal* cf. *domingensis*)	Diorite	N/A	30
3446-B	Polishing	Cane section (*Sabal* cf. *domingensis*)	Diorite	Water	30
3447-A, B	Grinding	Sandstone	Diorite	Sand, Water	A: 45; B:30
3447	Sawing	Quartzite flake	Diorite	N/A	270
3451	Grinding	Sandstone	Diorite	Water	210
3452	Grinding	Sandstone	Diorite	Sand, Water	490
3453	Grinding	Sandstone	Diorite	Sand, Water	30
3453	Drilling	Flint	Diorite	Sand, Water	172
3520-A	Grinding	Sandstone	Calcite	N/A	15
3520-A	Polishing	High-silica leaf (*Cecropia* sp.)	Calcite	N/A	25

Supplemental material 2: Ornament raw materials according to archaeological site

Raw materials		El Flaco	El Carril	La Luperona	Playa Grande	El Cabo	Total
Lithic	Calcite	65	4	4	2	6	81
	Stalactite	-	2	-	-	1	3
	Plutonic rocks	17	3	1	11	25	57
	Others/Indeterminate	9	1	1	4	5	20
	Total	91	10	6	17	37	161
Ceramic	N/A	4	-	-	-	-	4
	Total	4	-	-	-	-	4
Shell	*Lobatus gigas*	15	-	-	10	19	44
	Oliva reticularis	11	3	-	1	15	30
	Conus sp.	1	-	-	-	5	6
	Gastropod other/ indeterminate	1	-	-	-	2	3
	Chama sarda	1	-	-	-	4	5
	Oyster (*Isognomon* sp.)	2	1	-	1	1	5
	Nacre indeterminate	3	1	-	-	2	6
	Scaphopoda	10	-	-	-	-	10
	Indeterminate	4	-	-	-	5	9
	Total	48	5	-	12	53	118
Coral	*Acropora cervicornis*	5	1	-	-	-	6
	Indeterminate	1	-	-	-	2	3
	Total	6	1	-	-	2	9
Dental elements	Human incisor	1	-	-	-	-	1
	Human premolar	1	-	-	-	-	1
	Stingray dental plate	2	-	-	-	1	3
	Shark tooth	1	-	-	1	-	2
	Parrot fish jaw	1	-	-	-	-	1
	Indeterminate	1	-	-	-	-	1
	Total	7	-	-	1	1	9
Bone	Vertebrae cartilaginous fish	5	-	-	-	-	5
	Bird long bone	1	-	-	-	-	1
	Indeterminate	-	1	1	-	-	2
	Total	6	1	1	-	-	8
Wood	Indeterminate	-	1	-	1	-	2
	Total	-	1	-	1	-	2
Resin	Indeterminate	-	-	-	-	1	1
	Total	-	-	-	-	1	1
Total		162	18	7	31	94	312

Supplemental data 3: Unfinished ornaments retrieved from the studied sites

Raw materials		El Flaco	El Carril	La Luperona	Playa Grande	El Cabo	Total
Lithic	Diorite	-	-	-	4	-	4
	Limestone	-	1	-	-	-	1
	Indeterminate	1	-	-	-	1	2
Total / % [a]		**1 / 1.09%**	**1 / 10%**	**-**	**4 / 23.5%**	**1 / 2.7%**	**7**
Shell	*Lobatus gigas*	1	-	-	3	-	4
	Oliva reticularis	3	-	-	-	3	6
	Cassis sp.	1	-	-	-	-	1
	Isognomon sp.	-	1	-	1	-	2
Total / %[b]		**5 / 10.4%**	**1 / 20%**	**-**	**4 / 33.3%**	**3 / 5.66%**	**13**
Coral	*A. cervicornis*	2	-	-	-	-	2
Total / %[c]		**2 / 33.3%**	**-**	**-**	**-**	**-**	**2**
Total / %[d]		**8 / 4.93%**	**2 / 11.2%**	**-**	**8 / 25.8%**	**4 / 4.25%**	**22 / 7.05%**

Notes: All specimens are preforms with the exception of the *Isognomon* sp. valve

[a]Percentage based on the total of lithic ornaments at each site

[b]Percentage based on the total of shell ornaments at each site

[c]Percentage based on the total of coral ornaments at each site

[d]Percentage based on the total of ornaments at each site

Supplemental data 4: Technological and use-wear data collected for each morpho-technical group

Groups	Technical operations					Technical performance	Use-wear
	Blank acquisition	Surface treatment	Perforation technique	Side perforations	Decoration		
Calcite							
Group 1 (n=22)	Cut-and-break (n=2)	Grinding (n=10) Polishing (n=12)	Cylindrical with small opposite cone, concentric grooves (n=20)	Biconical with concentric scratches (n=16)	Incision (n=12) Excision (n=3) Notching (n=5)	Medium or poorly carved (n=13)	Worn (n=19) Unused (n=1) Indeterminate (n=2)
Group 2 (n=32)	No evidence	Grinding (n=9) Dull polishing (n=23)	Biconical with concentric scratches and a smooth center (n=27)	N/A	N/A	Perforation not well centered (n=1) Slightly faceted sides	Worn (n=26) Unused (n=1) Indeterminate (n=5)
Group 3 (n=9)	Cut-and-break (n=2)	Polishing (n=9)	Biconical with concentric scratches (n=8)	N/A	N/A	Snapping evidence not completely erased (n=2) Faceted (n=2)	Worn (n=8) Indeterminate (n=1)
Group 4 (n=4)	Cut-and-break (n=3)	Grinding (n=1) Polishing (n=3)	Bi-cylindrical (n=2) Biconical (n=2) with concentric scratches (n=4)	N/A	N/A	N/A	Worn (n=3) Unused (n=1)
Other beads (n=10)	Cut-and-break (n=3)	Grinding (n=2) Polishing (n=3)	Biconical with concentric scratches (n=5) (Bi)cylindrical (n=5)	N/A	Incision (n=1)	Poorly shaped bead, faceted or highly tilted (n=4)	Worn (n=7) Unused (n=2) Indeterminate (n=1)
Pendants (n=4)	Sawing (n=1, shaping)	Grinding (n=3) Polishing (n=1)	Biconical with concentric scratches (n=4)	N/A	Incision (n=3) Excision (n=2) Notching (n=3) Drilling (n=2)	Reused failed bead (n=1)	Worn (n=2) Unused (n=1) Indeterminate (n=1)
Plutonic rocks							
Group 1 (n=4)	Cut-and-break (n=1)	Grinding (n=2) Polishing (n=2)	Cylindrical with small opposite cone, concentric grooves (n=4)	Biconical with concentric scratches (n=4)	Notching (n=1)	Poorly shaped bead, faceted or highly tilted (n=3)	Worn=4
Group 2 (n=15)	Cut-and-break (n=1, potential cut marks remains on one face)	Grinding (n=6) Polishing (n=7) Indeterminate (n=2)	(Bi)cylindrical with concentric grooves (n=14) Perforation in three stages: biconical drilling + inner cylinder (n=1)	Real biconical with concentric scratches (n=2)	Drilling biconical perforations with circular scratches (n=13) Notching (n=3) Incising (n=1)	Four decorative perforations (n=1) Side perforations slightly misplaced (n=2) Tilted (n=1)	Worn (n=13) Unused (n=2)

Group 3 (n=9)	Cut-and-break (n=2)	Grinding (n=2) Polishing (n=9)	(Bi)cylindrical with concentric grooves (n=9)	Absent (n=1) Biconical with concentric scratches (n=8)	Absent (n=1) Incision (n=6) Notching (n=3)	Incisions not made carefully (n=1) Decentered perforation (n=1) Side perforations slightly mismatched (n=1) Unfinished hole where a side perforation was going to be placed (n=1)	Worn (n=8) Unused (n=1)
Group 4 (n=15)	Cut-and-break (n=3) Pecking (n=1)	Grinding (n=6) Grinding + polishing (n=4) Polishing (n=5)	(Bi)conical, mostly with concentric scratches (n=4) (Bi)cylindrical, mostly with concentric grooves (n=11)	N/A	Incisions on the edge (n=4), one has also an incision along the side	Faceting (n=7) Roughly/medium carved (n=5) Decentered perforation (n=2)	Worn (n=8) Unused (n=3) Indeterminate (n=4)
Other beads (n=11)	Cut-and-break (n=3) Pecking (n=1)	Grinding (n=7) Grinding + polishing (n=4)	(Bi)conical (n=5) (Bi)cylindrical (n=3) Unfinished (n=2) Absent (n=1)	N/A	Incision on the side (n=1) Excision + Notching + Incision (n=1)	Medium/roughly carved (n=6) Slightly misplaced cones (n=1) Decentered perforation (n=2) Poorly snapped blank (n=1)	Worn (n=4) Unused (n=2) Half product (n=4) Indeterminate (n=1)
Earplug (n=1)	Indeterminate	Grinding + polishing	Indeterminate, smoothed wall	N/A	Notching to create central groove	N/A	Indeterminate (n=1)
Anthropomorphic pendants (n=2)	Indeterminate	Grinding (n=1) Grinding + polishing (n=1)	Two biconical perforations with concentric scratches (n=2)	N/A	Incision (n=2) Notching (n=2) Excision (n=1) Drilling (n=1)	Poorly carved (n=1)	Worn (n=1) Indeterminate (n=1)
Stalactite							
Group 1 (n=2)	Cut-and-break (n=2)	Grinding (n=2)	Natural, cylindrical (n=2)	Biconical with concentric scratches (n=2)	N/A	N/A	Worn (n=2)
Earplug (n=1)	Indeterminate	Grinding	Natural, cylindrical	N/A	Incision	N/A	Worn (n=1)

Other lithic materials							
Beads (n=13)	Indeterminate (n=11) Cut-and-break (n=2) Flaking? (shaping, n=1)	Grinding (n=5) Grinding + polishing (n=5) Polishing (n=2) Indeterminate (n=1)	(Bi)conical (n=7) (Bi)cylindrical (n=4) Unfinished two-sided (n=2)	Biconical with concentric scratches (n=1)	Incision (n=1) Drilling (n=1)	Decentered perforation (n=4) Slightly misaligned perforations (n=1) Irregular shape (n=3)	Worn (n=7) Unused (n=2) Half product (n=2) Indeterminate (n=2)
Inlay (n=1)	Indeterminate Pecking (shaping)	Grinding + polishing	N/A	N/A	N/A	Faceted, not fully ground	Worn
Biconical earplugs (n=3)	Indeterminate (n=3) Pecking (n=1, shaping)	Grinding + polishing (n=2) Polishing (n=1)	(Bi)conical, coarse circular scratches (n=3) Widening/smoothing of perforation (n=2)	N/A	Notching (n=3, V-shaped and U-shaped)	Broken during production? (n=1)	Worn (n=2) Unused (n=1)
Conical earplug (n=1)	Indeterminate	Grinding	N/A	N/A	Notching (shaping)	Faceted	Worn
Pendants (n=2)	Indeterminate	Grinding (n=1) Polishing (n=1)	Absent (n=1) Three connected cones, concentric scratches (n=1)	N/A	Incision (n=1) Notching (n=2) Drilling (n=1) Nacre inlay (n=1)	Very coarse, not completely ground (n=1)	Worn (n=1) Half product (n=1)
Shell							
“Seed” beads (n=20)	Indeterminate	Grinding (n=8) Grinding + polishing (n=9) Indeterminate (n=3)	(Bi)conical with concentric scratches (n=20)	N/A	N/A	Decentered perforation (n=2)	Worn (n=15) Unused (n=1) Indeterminate (n=4)
Disc beads (n=5)	Indeterminate	Grinding (n=4) Polishing (n=1)	(Bi)conical with concentric scratches (n=5)	N/A	Incisions on the side (n=1)	Faceting (n=2)	Worn (n=3) Half product (n=1) Indeterminate (n=1)
Scaphopod beads (n=10)	Cut-and-break (n=8)	Grinding (n=2) Grinding + scraping (n=3) Absent (n=4) Indeterminate (n=1)	Natural, cylindrical (n=10)	Abrasion + drilling (n=1)	Incision (n=1)	Tilted (n=2)	Worn (n=7) Unused (n=1) Indeterminate (n=2)
Conus beads (n=2)	Cut-and-break? (n=1)	Grinding (n=2)	Conical indeterminate (n=2)	N/A	N/A	Not perfect disc, no evidence of modification on the outer face (n=2)	Worn? (n=2)

Frog-shaped (n=7)	Cut-and-break (n=3)	Grinding (n=4) Polishing (n=1) Absent (n=1) Indeterminate (n=1)	(Bi)conical with concentric scratches (n=7)	N/A	Incision + notching (n=7)	Roughly carved, mis-placed cut marks (n=2) Misplaced perforation (n=1)	Worn (n=4) Unused (n=2) Indeterminate (n=1)
Tinkler (n=26)	N/A	Grinding (n=6)	Side: Sawing (n=18) Conical 1 sided (n=2) Absent (n=6)	Apex: Percussion (n=12) Indeterminate (n=14)	Incision (n=4) Drilling (n=2)	Poor carving of a face (n=1)	Worn (n=7) Half product (n=6) Unused (n=5) Indeterminate (n=8)
Automor-phic (n=7)	N/A (n=6) Sawing (n=1)	Grinding (n=1) Absent (n=6)	Conical (n=3) Cylindrical (n=1) Percussion (n=2)	N/A	N/A	N/A	Worn (n=1) Unused (n=2) Half product (n=1) Indeterminate (n=3)
Flat nacre pendants (n=6)	Cut-and-break (n=3, likely used for all, but no evidence)	Grinding (n=6)	(Bi)conical with concentric scratches (n=6)	N/A	Notching (n=2) Drilling (n=1)	Medium carved (n=2) Perforations misaligned (n=1) Potential abandoned and ground over perforation cone on the edge (n=1)	Worn (n=2) Unused (n=1) Indeterminate (n=3)
Flat pen-dants/ inlays (n=26)	Cut-and-break (n=10) Flaking (n=1, shap-ing)	Grinding (n=17) Grinding + scraping (n=1) Grinding + polishing (n=4) Absent (n=1) Indeterminate (n=3)	(Bi)conical with concentric scratches (n=13) Cylindrical with concentric scratches (n=3) Absent (n=10)	N/A	Incision (n=8) Notching (n=6) Excision (n=1) Drilling (n=4) Fretwork (n=1) Absent (n=16)	Medium/roughly carved (n=5) Poorly aligned perfora-tions (n=3) Misplaced cut marks (n=1)	Worn (n=16) Unused (n=2) Half product (n=2) Indeterminate (n=6)
Three-di-mensional pendants/ plugs (n=9)	Cut-and-break (n=4)	Grinding (n=4) Grinding + scraping (n=1) Grinding + polishing (n=1) Indeterminate (n=3)	Biconical with concentric scratches (n=5) Three connected cones, con-centric scratches (n=1) Absent (n=3)	N/A	Incision (n=6) Notching (n=8) Excision (n=1) Drilling (n=3)	Medium carved (n=6) Slightly asymmetrical (n=1)	Worn (n=7) Half product (n=2)
Bone							
Vertebrae beads (n=5)	N/A	N/A	Cylindrical (n=3) Indeterminate (n=2)	N/A	N/A	N/A	Worn (n=3) Indeterminate (n=2)
Tubular bead (n=1)	Cut-and-break	Grinding	Natural	N/A	Three incisions	Irregular faces, tilted	Indeterminate
Highly mod-ified (n=2)	Indeterminate (n=2)	Grinding (n=2)	Conical with concentric scratches (n=1) Absent (n=1)	N/A	N/A	N/A	Worn (n=1) Unused (n=1)

Teeth							
Automor-phic (n=5)	N/A	Grinding (n=1)	(Bi)conical with concentric scratches (n=5)	N/A	Notching (n=1)	N/A	Worn (n=4) Indeterminate (n=1)
Ground in shape (n=4)	N/A (n=1) Indeterminate (n=3)	Grinding (n=2) Indeterminate (n=2)	(Bi)conical with concentric scratches (n=4)	N/A	N/A	N/A	Worn (n=3) Indeterminate (n=1)
Coral							
Beads (n=8)	Cut-and-break (n=8)	Grinding (n=5) Absent (n=2) Indet (n=1)	(Bi)cylindrical (n=6) Percussion (n=1) Percussion + drilling (n=1)	N/A	N/A	Coarse finish (n=5)	Worn (n=2) Unused (n=3) Half product (n=2) Indeterminate (n=1)
Disc (n=1)	Indeterminate	Grinding	Absent	N/A	N/A	N/A	Worn (n=1)
Ceramic							
Plain beads (n=3)	Modeling (n=3)	Polishing (n=3)	Modeled around a stick (n=3)	N/A	N/A	Poor shaping (n=2)	Worn (n=2) Indeterminate (n=1)
Decorated bead (n=1)	Modeling Application of a sec-ond layer of clay	Polishing	Perforation prior to firing and prior to the new layer of clay	N/A	Incision + punctu-ation	N/A	Worn
(Fossilized) Wood							
Disc (n=1)	Indeterminate	Grinding + polishing	N/A	N/A	N/A	N/A	Worn
Earplug (n=1)	Cut-and-break	Grinding + scraping + polishing	N/A	N/A	N/A	N/A	Worn
Resin							
Earplug (n=1)	Indeterminate	Scraping + grinding	N/A	N/A	N/A	N/A	Worn

Supplemental data 5: Use-wear presence according to ornament raw material

Use-wear	Present		Absent		Half products [a]		Indeterminate		Total of ornaments
	N	%	N	%	N	%	N	%	
Lithic	118	73.29	17	10.56	7	4.35	19	11.80	**161**
Ceramic	3	75	-	-	-	-	1	25	**4**
Shell	63	53.39	12	10.17	13	11.02	30	25.42	**118**
Coral	3	33.33	3	33.33	2	22.22	1	11.11	**9**
Dental elements	7	77.78	-	-	-	-	2	22.22	**9**
Bone	4	50	1	12.50	-	-	3	37.50	**8**
Wood	2	100	-	-	-	-	-	-	**2**
Resin	1	100	-	-	-	-	-	-	**1**
Total	**201**	**64.42**	**33**	**10.57**	**22**	**7.05**	**56**	**17.95**	**312**

[a] Use-wear presence/absence is not applicable to half products, as they are not finished ornaments.

6

Conclusion

The present research had, from the outset, two interconnected goals: to develop an approach for studying collections of ornaments from diverse origins and to assess the biographies of bodily adornment in the pre-colonial Caribbean. This resulted in the four chapters previously presented. Chapters 2 and 3 were aimed to address this first goal, designing an approach to the study of ornaments and their biographies. The second goal was broken down in three research questions: 1) what were the patterns in the ways people dealt with ornaments? 2) How did these patterns relate to the social roles of ornaments? 3) What new insights did technological and use patterns provide on our understanding of the exchange of ornaments across the Caribbean Sea? Two case-studies from the pre-colonial Caribbean were selected: the early part of the Early Ceramic Age in the Eastern Caribbean and the later part of the Late Ceramic Age in the Greater Antilles. They were chosen because they provide the contexts with the largest degree of ornament production and circulation known for the pre-colonial history of the archipelago. Chapters 4 and 5 thus focused on the application of the approach developed in the first chapters to the two case-studies. Each chapter ended with a discussion and conclusion that focused on the implications of the identified patterns for understanding ornament biographies in the relevant region and time period.

6.1. Bodily adornment through the lenses of the microscope: evaluating the approach

The approach to the study of bodily adornment used here was first outlined in Chapter 1, where it was connected to recent theories about its role in society. Microwear analysis was proposed as empirically-based avenue to assess the biographies of ornaments. This approach was further developed in the first two chapters, while Chapters 3 and 4 outlined the specific protocol of analysis used.

Chapter 2 singled out the specific challenges involved in the study of (old) collections, in particular from museums. Identified limitations were connected to the lack of detailed information about the archaeological context of the studied collection and to the poor state of preservation of certain artefacts. This chapter further dealt with the complexities of interpreting the palimpsests and micro-stratigraphies of traces formed on the surface of figurative ornaments as a result of multiple production stages, use episodes, post-depositional processes, and curatorial modifications. Despite challenges, we were able to successfully analyse the artefacts and generate new insights into their production and use in the Valencia Lake Basin. This study helped us set up the approach and protocol of analysis that was used for the case-study chapters. Chapter 3 reflected on archaeological interpretations of use in bodily adornment, dealing with questions such as reconstructing specific string configurations, establishing degrees of use, and making sense of the absence of use-wear. It delved into the wear-traces formed on individual artefacts made of diverse raw materials as a result of their incorporation into real (composite) objects of bodily adornment. We looked at a variety of ethnographic ornament types and with a broad range of attachment systems, including items directly attached to the body, with different string configurations, and involving contact between neighbouring beads. A unique reference collection was thus formed, which can be used by researchers interested in use-wear formation on ornaments or even on other artefact types that are subjected to similar conditions (such as being attached through a string). The chapter not only presented detailed descriptions of traces per raw material, but also was extensively illustrated through the use of three types of microscope. This study also provided us with the chance to reflect on the biographies of composite ornaments and on how they may differ from our archaeological expectations of homogeneity and complementarity.

Chapters 2 through 5 demonstrated the usefulness of the selected approach and method in assessing the different modifications ornaments undergo, in spite of the diverse nature of the collections they belong to. Having been (at least partially) conducted in the Caribbean, the research presented in Chapters 4 and 5 often had to deal with time and equipment limitations. Furthermore, other limitations in the research carried out in this dissertation should also be acknowledged. The lack of contexts of production or associated toolkits in most studied contexts has meant that all data concerning ornament making had to be generated from the study of the ornaments themselves. I have focused on multiple ornament raw materials, namely lithic materials with strikingly different physical properties (i.e. different hardness, toughness, and brittleness) and, for the Late Ceramic Age, also non-lithic materials (notably, marine shells). However, it is not common for a same researcher conducting technological, microwear, or experimental research of ornaments to focus on such a broad range of materials (although exceptions to this can be noted, *e.g.*, Alarashi 2016; Bains 2012; Gurova et al. 2013; Van Gijn 2006). But, as illustrated by many of the ethnographic ornaments studied in Chapter 3, multiple raw materials can and often coexist in composite objects. In this sense, the choice for this broad range of materials was guided by the desire to provide a more holistic view of adornment practices for each Caribbean case-study. This has, however, limited the breadth of insight that could be obtained concerning each material and the ways it was worked and more generally treated. In particular, more experiments need to be performed in order to provide greater insights into production technologies and modes of use. A more systematic comparison between archaeological traces and those experimentally-produced also needs to be done, for instance by focusing on the sequential grinding experiments in order to assess how the different ornament raw materials wear according to different conditions. The identified tool raw materials require new experimental assays that focus on their mechanisms of application and performance (*e.g.*, string sawing and incising/drilling with bone or wooden tools). In spite of the abundance of insights generated by the study of ethnographic objects as a use-wear reference collection, we could not reconstruct specific ornament compositions. This is largely due to the paucity of archaeological ornaments found in groups and in closed contexts. The recovery of groups of ornaments *in situ* remains essential for further interpretation regarding the arrangement of individual pieces and composite ornament types. Despite the identified limitations, the contributions of Chapters 4 and 5 for Caribbean archaeology are revisited in the following section. They are discussed in a broader perspective, with particular attention given to their impact on past exchange networks.

6.2. Exchange networks viewed through technology and use-wear

As stressed throughout this dissertation, a highly interconnected image of the pre-colonial Caribbean has emerged in recent scholarship (Boomert 2000; 2007; Breukel 2019; Cody 1993; Curet and Hauser, eds. 2011; Hofman et al. 2006; 2007; 2008; 2010; 2011; 2014; 2019; Hofman and Van Duijvenbode, eds.

2011; Keegan and Hofman 2017; Laffoon et al. 2013; 2014; Mol 2007; 2013; 2014; Morsink 2013; Rodríguez Ramos 2010; Rodríguez Ramos and Pagán Jiménez 2006; Watters 1997). Given the extensive contacts through mobility and exchange of people, materials, and ideas between communities in different islands and regions, one may expect a considerable degree of interaction between craft practitioners and the long-term exchange of technical knowledge. The movement of craftspeople within networks of exchange, inter-marriage, or other forms of interaction may have led to different degrees of transfer and transformation of technical knowledge (Brysbaert 2007, 333-335). Craftspeople may also have undertaken trips in pursuit of esoteric knowledge and materials from afar (as extensively discussed by Helms 1988). However, it remains to be demonstrated how this connectivity influenced the ways in which crafts were practised, transmitted, and shared across the Caribbean. Researchers in the region have indeed highlighted the importance of foreign and shiny materials among early colonial indigenous communities of the Caribbean, in particular for their exotic and supernatural character (Berman 2011; Helms 1987; Keehnen 2011; 2012; Oliver 2000; Saunders 1999). For instance, producing a highly developed polish on the surface of lithic and wooden artefacts has been noted as an important activity that would bring forth the inner characteristics of a material, both physical and ideational; and that, more importantly, involved polishing formulas that we do not entirely understand and that were most likely not widely shared across the region (Berman 2011, 130; Breukel 2019; Helms 1987, 75). This stresses that craft practice and technologies should be indispensable topics of investigation in contexts of circulation of people, ideas, and things. However, as argued previously, studies that focus on both craft technologies and the circulation of materials have been rather few in number, in particular when non-ceramic artefacts are considered (here I refer the reader to *e.g.*, Breukel 2019; Knippenberg 2007; Martinón-Torres et al. 2012; Rodríguez Ramos 2010). In the following, I discuss how the biographical approach, marked by its focus on technologies of production and use-wear, has contributed new insights to our understanding of the social roles and networks of circulation of bodily ornaments in the pre-colonial Caribbean.

6.2.1. Early Ceramic Age ornaments in the Eastern Caribbean (400 BC – ca. AD 400)

A detailed study of a large assemblage recovered from the site of Pearls on eastern Grenada was presented in Chapter 4. It entailed a typo-technological analysis of the entire assemblage (n=1273), in addition to the microwear analysis of a sample set (n=100). This study allowed us to characterize ornament making strategies at the site, in spite of limitations connected to the origins of the collection. We identified a wide range of lapidary materials being worked, which arrived at Pearls from different sources. In the same vein, we showed which technical procedures were most likely carried out locally and, by proxy, the stages in which each material likely entered the site. Acquisition and production logics of lapidary materials varied according to ornament raw material and type. Amethyst was brought as raw material to the site[1], worked locally, and redistributed to other eastern Caribbean islands. Pearls was not specialized solely in amethyst bead manufacture; instead, it should be seen as a workshop for the working of macro- and microcrystalline quartz varieties. However, it remains unclear whether amethyst and quartz were directly procured or acquired through exchange. Carnelian was sourced and primarily worked in the northeastern Caribbean, but arrived in large numbers and in different technical stages to Pearls. Diorite and turquoise ornaments were imported in large quantities, but largely as finished beads. Jadeitite was obtained in large quantities and accompanied by a large production output of, primarily, pendants. Carnelian, jadeitite, and diorite were brought to the site in different production stages, further modified, and possibly redistributed to the Windward islands. Based on the large numbers of materials arriving as raw materials or in early production stages, we can hypothesize that, in addition to being a lapidary workshop, Pearls was a central place (sensu Renfrew 1977, 85). This hypothesis is based on the evidence for directional trade of large amounts of materials towards the site from multiple source communities. In other words, the site was supplied preferentially in comparison to other settlements in the region (Renfrew 1977, 85). It is also based on the idea,

1 It was also brought in the early production stages, if we consider the evidence from the site of Grand Anse. According to Cody (1990), most early stages of amethyst working took place at this site on the southwestern coast of Grenada. Amethyst crystals and debitage were recovered there, suggesting that it was a “trading centre” for amethyst crystals believed to come from South America (Cody 1990, 10). However, the few units excavated at Grand Anse showed a highly disturbed stratigraphy (Hanna 2017, 105-106).

supported by our pilot use-wear study, that many of such materials were not locally used, but further exchanged (i.e. redistributed). In turn, the low numbers of finished and unfinished ornaments in most other lithologies, alongside high stylistic variability, suggest a different pattern of acquisition (*e.g.,* nephrite, other metamorphic rocks with tremolite, metamorphosed ultramafics). They were likely not obtained by direct procurement; rather, they seem to represent the acquisition of varied "greenstones" through down-the-line exchange. This would explain the presence of small quantities of various rock types in multiple production stages. Unfinished specimens were further transformed, often into pendants, by use of the local technical repertoire. Geographical distance between the geological sources of each of these materials may not have been known or may not have been conceived in a linear sense. This is to say that different mechanisms were in operation giving rise to the extremely diverse nature of the studied collection. However, we should be aware of the limitations intrinsic to the interpretation of patterns stemming from the study of a collection without documentation regarding specific contexts of recovery.

Here my aim is to illustrate how this evidence can be related to previous ideas about exchange mechanisms and the social contexts affording them. As mentioned in Chapter 1, Cody (1993) proposed the "gateway community" model to explain the patterns she noted when excavating and studying the materials from Pearls. She argued that the role of lapidary workshops in the Early Ceramic Age should not be regarded as that of "central places", because of the linear arrangement of the West Indies (Cody 1993, 210). This stepping-stone distribution of islands would be in opposition to the symmetrical arrangement of sites and uniform distribution of population and resources expected for the central place model—also considered to be rather unrealistic (Hirth 1978). However, I am here less interested in the specific conditions defined by the model; rather, I use the concept of central place to draw attention to the dynamics of preferential supply, redistribution, and maintenance of horizontal connections between similar centres. Connections between different lapidary workshops have been previously proposed, notably between Pearls and the site of Trants on Montserrat (Watters 1997). This pattern of differential distribution of exchanged materials across the eastern Caribbean would be the result of a hierarchy between exchange partners (Renfrew 1977). Our results show that Pearls was one of main lapidary workshops and trading centres of the Caribbean, but not only for amethyst. Its location on the opposite end of the archipelago in relation to the large workshops in Puerto Rico and Vieques further stresses its crucial role. However, this does not necessarily imply the presence of chiefs and a hierarchical system of socio-political organization during this period (see also Ibáñez et al. 2016). More recently, it has been suggested that lapidary workshops functioned as social hubs, where the display and redistribution of valuable materials took place as part of public competitive feasts between aspiring big men (Boomert 2000; 2001; 2007; Hofman et al. 2007; 2014; 2019). Ceremonial exchanges in small-scale societies are known to occur in feasting contexts (Dalton 1977; Mauss 2003[1925]; Spielmann 2002).

The patterns identified during our study indeed suggest that Pearls would be a centre not only for redistribution of ornaments made of multiple materials, but also for the gathering of people and the sharing of knowledge. This latter hypothesis can perhaps be illustrated by our evidence: the abundance of different styles[2] and of different techniques for working ornaments at Pearls may be a product of the arrival of materials from different origins to the site. In particular, we noted, on the same raw material, the use of different sawing techniques for blank acquisition and carving or of multiple types of grinding and polishing. This technological variability may have corresponded to 1) the (partial) production of some artefacts in other sites or 2) the co-presence of craftspeople belonging to different technological traditions.[3] In this latter scenario, craftspeople from different places would be gathering at Pearls on certain occasions to, among others, produce and exchange lapidary materials. In this period, lapidary making technical knowledge seems to have been present across the region. This is suggested not only by the presence of multiple sites that functioned as lapidary workshops, but also by more restricted evidence for lapidary working in other sites, such as Morel and Gare Maritime on Guadeloupe, Tutu on St. Thomas, and Hacienda Grande on Puerto Rico. We can speculate that ornament production in a site like Pearls was not exclusively connected to the production of surplus prior to and for ceremonial display and exchange; it was perhaps also carried out

2 A good example of this stylistic variability is the fact that no single frog carving is the same. This is probably the case not only for specimens retrieved at Pearls, but across the archipelago. While three different stylistic groupings have been defined (Cody 1991; Turney 2001), there is still considerable variability within each of them. The most homogeneous group seems to be the typically Huecoid "segmented frog" type, a few of which are found in the Pearls collection.

3 As mentioned above, the origins of the collection pose a severe limitation to such interpretations, in particular considering that the observed variability may be connected to a development taking place within the centuries of occupation of the site.

as ritual performance in such contexts of social gatherings (see also Hull 2014). Skill, creativity, and the esoteric knowledge associated to crafting colourful and shiny materials from afar may have been central elements in their valuation (Helms 1987, 74-75; 1988, 111-118). The importance of technical performance and variability in lapidary ornaments in Early Ceramic Age contexts can be further stressed by comparing them to any other ornaments of later or previous time periods from across the archipelago. However, we cannot, at this stage, distinguish between the two proposed scenarios, i.e. lapidary products from activities carried out in different sites coming to Pearls or a congregation of people at Pearls to work lapidary materials in the context of, for instance, a feast. It is also not unreasonable to think that both practices took place, as people could bring with them materials in different stages of modification.

The contexts of use and display of the lapidary materials retrieved from Pearls remain elusive in our study due to the lack of contextual information and the predominance of specimens associated to ornament making. Nevertheless, by providing insights on the distribution of lapidary materials in different technical stages across the Caribbean Sea, the *chaîne opératoire* approach demonstrated that production and circulation cannot be understood as discrete phenomena. They do not happen independently from each other. Instead, technological modifications happened at different stages along the life trajectories of certain lapidary materials. These insights feed directly into our understanding of the dynamics behind interaction and exchange networks. We demonstrate how these networks involved not only the circulation of valuables, but also the modification of materials at different locations after being received and prior to further exchange. Therefore, the exchange of lapidary materials in the Early Ceramic Age cannot be understood just as a linear movement of material from one place (the source community) to the other. In this sense, exchange, production, and use should not be regarded as discrete phenomena when it comes to Early Ceramic Age lapidary. In fact, if we look at lapidary materials as recurring elements in prestige-good exchange systems, their exchange is an intrinsic part of their use life, rather than just a mechanism for distribution of differentially available resources or products. As the artefacts can be exchanged prior to the completion of their production sequences, the transformations artefacts undergo at different points become part of their exchange/use life as well. New technological operations carried out on partially worked artefacts become themselves forms of inter-cultural dialogue performed on the surfaces of lapidary materials. Such activities are recorded in the micro-stratigraphy of stigma on their surfaces. While we placed greater focus on technologies of production when approaching the lapidary from Pearls, this approach allowed us to note important aspects of their emergent biographies as exchanged social valuables. In Chapter 1, I discussed the biographies of ornaments and the need for not imposing artificial linearity when reconstructing them through artefact studies. As Spielmann (2002) notes, social valuables are not finished (immutable) products, but may undergo changes during their lifetime. Such physical changes generally bring forth an object's particular biography and are thus associated to an increased value (also Gosden and Marshall 1999; Pollard et al. 2014). In this scenario, the performance of lapidary production (and not only its exchange or display) becomes a means of activating and enacting their social roles, perhaps providing at the same time grounds for competition between individuals.

6.2.2. Late Ceramic Age ornaments in the Greater Antilles (AD 800 – ca. 1500)

Assemblages of ornaments from five sites located on the Dominican Republic were studied in Chapter 5. While the number of studied sites was larger than in the previous chapter, the total amount of ornaments was smaller (n=312).[4] The sites were settlements, most of which presented no evidence of ornament making being a recurrent activity. In this sense, the narratives we can build around ornaments and their biographies are, as expected, rather different from the Early Ceramic Age. The chapter started by referring to the main ideas that researchers have put forward concerning bodily adornment in the Late Ceramic Age Greater Antilles. Such hypotheses have been built with marked reliance on ethnohistoric accounts about the early colonial "Taíno" peoples encountered by the Spaniards. Notably, a connection between certain types of bodily adornment and the figure of the *cacique* has been stressed. Primary attention has been given to materials that can be characterized as shiny, reflective, and/or colourful, such as mother-of-pearl, gold, *guanín*, feathers, and glass. Exoticness, generally equated with a distant source, is also presumed to have rendered materials laden with meaning and power. However, when faced with the studied Late Ceramic Age assemblages, one cannot fail to notice that these widely appreciated properties are not particularly conspicuous among them. First, their colours are

4 That said, the number of ornaments analysed through microwear analysis was larger, as all artefacts could be examined through microscopy.

rather monotone and dull in comparison to shiny metals or colourful feathers. Second, most lithic materials are available close to the studied areas. In sum, brilliance and exoticness do not appear to be important features of beaded constructions from the studied sites. One could still argue that combinations of beads from certain raw materials can result in a multi-coloured composite ornament, especially if including perishable materials (such as seeds, nuts, or feathers). The few studied ornaments displaying more varied colours, such as those made of greenstones, *Chama sarda*'s pink shell, and resin, are witnesses of a broad repertoire of ornament types and raw materials that would be placed on different sectors of the body (Alegría 1995; Lóven 1935). However, the evidence for such colourful materials among the material culture of the five sites is pale in comparison to the white and beige colours predominant in calcite, plutonic rock, shells, and skeletal materials. It is likely that there would be an important visual and aesthetic component to the placement of ornaments on the human body, particularly in combination with body paint. Nonetheless, as shown in Chapter 5, there are many other characteristics that contribute to the biographies of ornaments to which we should pay close attention.

Through careful examination of all recovered beads, pendants, plaques, and earplugs, we were able to define morpho-technical groups for each raw material. Microwear analysis allowed us to track the biographies of these ornament groups, in connection to their production, use, and deposition. When the patterns identified for each site are considered in combination, they provide us with insights on the circulation of ornaments across the region. The study of the site assemblages showed us that a certain degree of ornament making technical knowledge was present among the communities inhabiting each site and that suitable raw materials could often be locally found. Household-level production of certain ornaments seems to have happened occasionally, but it was not the primary mode of ornament acquisition. The absence of substantial evidence for ornament production is an indication that people chose to obtain ornaments through networks of exchange. However, the patterns identified thus far do not offer us insight into mechanisms of exchange, such as down-the-line or directional trade. Nevertheless, we can propose specific aspects of ornament circulation on the basis of our data. In particular, ornaments primarily circulated as "finished" products (in the case of lithic ornaments and shell beads) or raw materials (certain shells and coral). In this sense, it is possible that beads were exchanged already strung as composite ornaments, although we cannot truly assess this with the data at hand. There is no evidence for the circulation of rough-outs or preforms, which stands in stark contrast with the lapidary networks of the Early Ceramic Age. This can be an indication that *specialized* ornament making knowledge was not widely distributed across the region. If we consider only lithic ornaments, we note that locally produced specimens differ markedly from the most typical morpho-technical groups.[5] We suggested in Chapter 5 that double-perforated tubular beads presented some degree of standardization, being likely produced in still unknown archaeological sites functioning as workshops. In other words, technical knowledge necessary for the production of such recurrent ornament types was not widely shared among communities.

In conclusion, we can propose that ornament *making* did not have a performative role in the engagement between communities or in the act of exchange itself, in contrast to the Pearls case-study. The passing down of “finished” ornaments or unmodified non-local raw materials (mainly, marine shells and coral) seems to have been the norm. Furthermore, the existence of site specialization in ornament production does not seem to follow from the control over rare material resources, again in contrast to what has been generally observed for the Early Ceramic Age.[6] Therefore, other social mechanisms must have mediated the process, guaranteeing that specialized communities would hold this position. We can suggest that the exchange of ornaments and certain raw materials functioned as a mechanism for the creation and maintenance of social bonds between different communities, rather than resulting from a dependence on the supply of scarce resources (see also Morsink 2013). Ethnohistoric sources do mention the role of strings of beads in social prestations, particularly in the establishment of alliances between *caciques* and as bride price (Las Casas 1992, 611, 1288; Lóven 1935, 478-479). Among some indigenous communities of the lowlands of South America, village specialization in certain crafts or horticultural products is a necessary element of a complex system of regional

5 Even in Playa Grande, where ornament production was more recurring, the specimens produced not only do not match the most common ornament types in the region, but also seem coarsely made, displaying many technical errors.

6 This observation should be regarded with caution: availability of shell raw materials was arguably the main reason for the location of the shell bead making workshop sites in Grand Turk (Carlson 1995; Keegan et al. 2008). Furthermore, proximity to the San Juan River and accessibility to materials used for celt production, notably jadeitite, seem to have been relevant factors guiding the location of the site of Playa Grande (Breukel 2019; López Belando 2012; Knippenberg 2012). The issue of control over key raw material sources should be reassessed once other Late Ceramic Age ornament workshop sites are recognized in the Greater Antilles.

interdependence, involving marital alliances, reciprocal exchanges, feasting, and even conflicts (*e.g.*, Agostinho 1967; Butt-Colson 1973; Chagnon 1977, 100-102; Oliveira 2017). A similar scenario has been put forward regarding groundstone celts in the Dominican Republic, although both rough-outs and finished products were being circulated (Breukel 2019). This idea is based on a model of reciprocal exchange among egalitarian societies, which may be argued to be inadequate for conceiving of patterns among so-called late pre-colonial chiefdoms of the Greater Antilles. For instance, Sahlins (1963) refers to redistribution as a mechanism for material circulation in Polynesian chiefdoms, as opposed to Melanesian big men collectivities. Such an exchange mechanism based on the accumulation and redistribution of wealth would resound with ideas regarding storehouses containing the social valuables of a *cacique* (Mol 2007, 86-87; Ostapkowicz 2018). However, as discussed for the Pearls case-study, the direct association between an exchange mechanism and a type of socio-political organization may provide only a partial and static view of past practices. Furthermore, the production and circulation of valuables are also circumscribed by regional social and political hierarchies in the ceremonial exchange systems of the Upper Rio Negro (Hugh-Jones 2014; Oliveira 2017). Archaeologists have more recently shied away from a monolithic view of past societies of the Greater Antilles, stressing instead the existence of great ethnic and socio-political plurality (*e.g.*, Curet 2003; 2014; Ulloa Hung 2013; Wilson 2007). The studied ornaments from across the Dominican Republic can also be seen in such a light: they challenge dichotomous social stratification schemes and testify to greater plurality of social formations in the past.

Finally, discard patterns in this period also differ from those identified for the early part of the Early Ceramic Age. As noted in Chapter 5, there was a concern with not disposing carelessly of ornaments. We suggested that this was the outcome of care for and repairing of ornaments. In contrast, large numbers of lapidary materials, debris, and ornaments have been found in middens of the Early Ceramic Age. This earlier period is marked by the presence of large-scale production activities in lapidary workshops and of production of a smaller scale in other site types. Their large accumulation can thus be connected to such intense ornament making activities. Late Ceramic Age bead making contexts in Grand Turk also produced extremely large quantities of shell debris and ornaments in multiple production stages (Carlson 1993). In this case, site type and the corresponding activities that took place locally must not be overlooked.

In contrast with rich burial assemblages and production contexts, the low presence of ornaments in settlement contexts can be connected to people's will to keep usable ornaments with them when they leave a settlement (for instance, see Van Gijn 2006; 2008; 2017). Specimens retrieved at such sites would be the result of occasional loss or discard of broken and unusable pieces. In the studied contexts of the Dominican Republic, a similar dynamic seems to have been in place, even if recovered specimens were generally not broken or unusable.

We, therefore, note a different attitude towards ornaments in the final centuries of the Late Ceramic Age, as opposed to the Early Ceramic Age. Ornaments may have followed a dynamic of displaying and concealing: whenever not on display or not on circulation, they were hidden or stored away. This may have also been reflected in socially-prescribed practices of structured deposition. The caches of ornaments recovered from Puerto Rico and the Dominican Republic may be examples of this attitude, although it is not clear whether they were votive in nature or examples of safeguarding for future exchange (see also section 6.3.2 of the present chapter). This careful attitude towards bodily ornaments was likely connected to their perceived potencies and social role. Leaving them laying around or mishandling them in any way may have entailed severe consequences for the individual or community involved.[7] For instance, among the Maimandê from Central Brazil, beaded necklaces made of *tucum* nut are intrinsically connected to their owners: storing them incorrectly or loosing them may lead to illnesses and even death (Miller 2009). A careless attitude towards ornaments may have not been desirable or may even have been perceived as dangerous. This may also justify why ornament making in large scale was not a widespread activity outside of specialized sites. As discussed in Chapter 1, technology does not exist in an isolated form from other social phenomena (*e.g.*, Dobres 2010; Pfaffenberger 1988). Specialized technical knowledge may have not only been restricted to certain communities, but also accompanied by esoteric knowledge about the potencies (and dangers) of ornaments and materials.[8]

7 The practice of maintaining house areas as spaces clean of debris noted to have taken place regularly at El Cabo and El Flaco can perhaps also be understood in connection with such a concern (Hofman and Hoogland 2015; Hofman et al. 2016; Samson 2011).

8 Another parallel from the lowlands of South America is that of the production of ceremonial bodily ornaments in the Upper Rio Negro. Considered to be a dangerous task inherited from the gods and primordial ancestors, their production requires not only specialized technical knowledge, but also knowledge of sets of ritual procedures and other forms of prescribed behaviours (Oliveira 2017; also Hugh-Jones 2014).

6.3. Avenues for future research

In the remainder of this chapter, future research avenues are proposed, building upon the research that has been carried out in this dissertation. They aim to follow or expand the current approach, addressing at the same time some of limitations noted above. While all the proposed avenues relate to components of the present research, each of them requires further in-depth investigation in its own right.

6.3.1. Technological and microwear studies of other Early Ceramic Age sites

Different types of assemblages from each time period need to be investigated in order to provide a more thorough understanding of ornament biographies. In this sense, there are many avenues deserving further investigation that could be explored. First, as pointed out in Chapter 4, it would be interesting to apply a similar approach to collections from the other Early Ceramic Age lapidary workshops and contrast them to lapidary recovered in other types of sites or in contexts that are not connected to production, such as burials and domestic middens. A more holistic approach would aid us in moving from the exclusive focus on production technology and material exchange to modes and contexts of usage. This approach would also allow us to better assess the connection between lapidary materials and specific social events, such as feasting. In this sense, artefact research needs to be conducted on assemblages recovered in modern controlled excavations. While we hope to have demonstrated that collections without detailed provenience information can provide us with a wealth of information, addressing more complex research questions requires us to situate lapidary ornaments and materials in their spatio-temporal contexts. Second, it would be important to carry out more in-depth studies, enabling us to address specific questions regarding craft practice and technological sophistication in this time period. In particular, it would be important to develop further experiments to better understand craftsmanship and toolkits of production. The incorporation of other analytical instruments (*e.g.*, SEM, micro-CT scanning, and confocal microscopy) would be crucial for the systematic investigation of drilling and surface treatments. Third, an investigation of associated tools recovered at production sites could provide supporting evidence for interpretations concerning the contact materials used in ornament production, alongside a more thorough view of technical systems in this period.

6.3.2. Ornament caches from the Late Ceramic Age

In order to further investigate the ideas advanced in section 6.1.2 about the biographies of ornaments in the Late Ceramic Age Greater Antilles, the next step would be to examine groups of ornaments recovered from closed contexts, such as caches and burial assemblages. Some assemblages of hundreds of ornaments have been recovered from caches in Puerto Rico and the Dominican Republic, being now held at institutional repositories. While not the product of modern excavations, they generally present a certain degree of information concerning their contexts of recovery. Alongside such caches, studies of groups of ornaments from other closed contexts, such as burials, would also be relevant. The large number of ornaments from such contexts would provide insights into assemblages that perhaps match more closely the traditional ideas about ornaments in the region. Composite objects including thousands of beads have been studied, such as the Pigorini idol and the belt from Vienna (Ostapkowicz 2013; Ostapkowicz et al. 2017), but with a different approach and goal in mind. Our goal with such a study would rather be to assess issues such as modes of attachment, use duration, reuse, recycling, and perhaps even the maintenance of ornaments as heirlooms. It will be interesting to assess how the biographies of ornaments from caches and burials differ from those of the ornaments studied in Chapter 5, which were recovered from across settlement sites. This study would provide information on the processes through which certain ornament groups are removed from circulation and contexts of use in order to be deliberately deposited. In Chapter 1, I referred to studies in which detailed examination of assemblages of artefacts (among which, ornaments) provided unprecedented insights on how they were manipulated, assembled, and disassembled in order to perform socially (Gaydarska et al. 2004; Van Gijn 2017; Woodward and Hunter 2015). The data generated through such a study could also be compared to ethnographic objects studied in Chapter 3, providing a reflection on the biographies of ornaments both as composite and individual pieces. Finally, the interpretation of these ornament assemblages could be contrasted to descriptions and illustrations of composite ornaments in ethnohistoric sources.

6.3.3. Experiments on use-wear formation on (lithic) ornaments

A thorough experimental programme should be carried out to shed light on the formation and characteristics of use-wear on ornament materials that have not been extensively experimented with, notably lithic materials. Such a study could also encompass an investigation of use-wear development on figurative ornaments and beads with double perforations. In this sense, it would include calcite and diorite ornaments, but also the hard lithic materials typical from the Early Ceramic Age. Use-wear formation on ornaments in such materials remains understudied. Ornament use-wear studies have been largely focused on soft lithic materials or hard animal materials. It thus remains to be assessed whether harder lithic materials develop use-wear in similar ways when included in composite ornaments. The study of the ethnographic quartz pendant in Chapter 3 suggests they do. However, the low presence of use-wear on some of the studied ornament materials from Pearls in Chapter 4 could also be linked to the need for different use conditions or greater use lengths for the development of recognizable wear on harder and brittle materials. Such a reference collection would be useful not only for future studies of ornaments from the Caribbean, but also from other contexts worldwide where lapidary materials have been abundantly recovered, such as Mesoamerica, Lower Central America, the Middle East, and East Asia.

6.3.4. Investigating ethnographic collections of indigenous bodily ornaments

Another potential research avenue is an investigation of ethnographic and historical collections housed in museums as a means of pursuing indigenous histories (Ribeiro 1985; 1988; Ribeiro and Van Velthem 1992). Similar studies have been carried out with the intent of understanding indigenous responses to colonial processes, investigating the development of material repertoires over time, and/or assessing the function of objects *vis-à-vis* written records (*e.g.*, Akerman et al. 2002; Cristiani et al. 2008; Kononenko et al. 2010; Torrence and Clark 2016). The biographical approach we used in the present research for studying composite ornaments can play an important role in such an effort, especially if directed at more narrowly defined assemblages: specific artefact types and raw materials across a given region or ornament repertoires from a single ethnic or linguistic group. The object-based study would be combined with the reading of early ethnographies and/or ethno-historic sources for the studied region to shed light on their recorded use lives and contrast them to traces and residues observed.

…

The present research advanced an approach for the study of bodily ornaments from diverse types of collections, giving primary attention to the succession of traces formed on the surface of the artefacts themselves. The insights thus acquired were used to formulate new hypotheses concerning the ways ornaments were produced, dealt with, and regarded by people during the pre-colonial history of the Caribbean. This work demonstrates how the careful, yet time-consuming, study of each bead can provide us with a wealth of new information that help us build better-informed narratives that do some justice to the diversity of past indigenous societies.

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Appendices

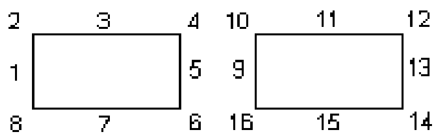
Appendix 1

Analysis form used for recording data during the macro- and microscopic examination of each studied ornament.

Use Wear Form: Ornaments

Site:________________________________ **Indiv. Nr:**__________

Analyst:__Catarina Falci________________ **Date:**______________

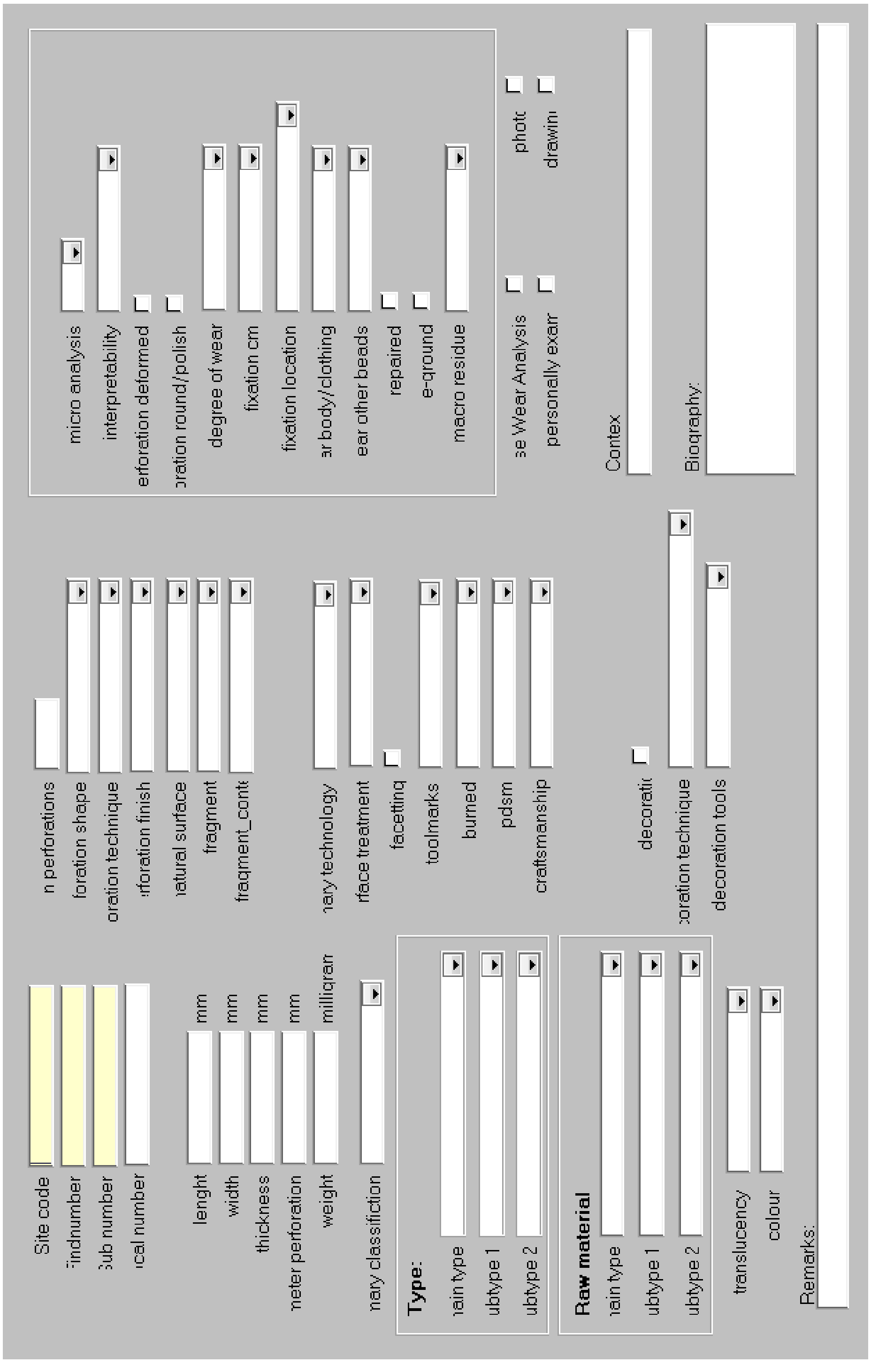


local number ____________________
length ____________________
width ____________________
thickness ____________________
diameter perforation______________
weight ____________________
prim classification________________
type ____________________
main type ____________________
subtype 1 ____________________
subtype 2 ____________________
context ____________________
raw material ____________________
translucency ____________________
colour ____________________
crossection ____________________
perf finish ____________________
natural surface____________________
fragment ____________________
fragm_context ____________________
prim technology__________________
surface treatment________________

facetted ☐
toolmarks ____________________
burned ____________________
pdsm ____________________
craftsmanship ____________________
micro analysis ____________________
interpretability ____________________
degree of wear__________________
fixation cm ____________________
fixation location__________________
wear body / clothing______________
wear other beads________________
repaired ☐
re_ground ☐
macro residue ____________________
use wear analysis ☐
personally examined ☐
photo ☐
drawing ☐

Appendix 2

Print-screen of the Access database used for registering contextual, typological, material, technological, and use-wear data pertaining to each studied archaeological artefact.



Site code
indnumber
ub number
cal number
lenght
width
thickness
neter perforation
weight
mm
mm
mm
mm
milligram
nary classification
Type:
ain type
ubtype 1
ubtype 2
Raw material
ain type
ubtype 1
ubtype 2
translucency
colour
Remarks:
n perforations
foration shape
oration technique
rforation finish
natural surface
fragment
fragment_conte
nary technology
rface treatment
facetting
toolmarks
burned
pdsm
craftsmanship
decoratio
oration technique
decoration tools
micro analysis
interpretability
erforation deformed
oration round/polish
degree of wear
fixation cm
fixation location
ar body/clothing
ear other beads
repaired
e-ground
macro residue
e Wear Analysis
personally exam
photo
drawin
Contex
Biography:

Appendix 3

Supplementary analysis form used for general description of the ethnographic objects studied in Chapter 3. This form was used for whole objects in addition to the form in Appendix 1, which was used for individual components (beads, pendants, and plaques).

Analysis form: Ethnographic ornaments **Object nº:**_________________
Analyst: Catarina Guzzo Falci **Date:**_________________

Identification number: _____________ __________ Number of use-wear forms: _______

Ethnic group: ____

Region: ____

Name of collector: ____

Type of object: ____

____

General object description

L: ___________ W: ___________ Th: ___________ Weight: ___________

String material: ____

Type of twist: ____

Number of different components: _______________________________ ________________

Type of attachment: ____

How are the components separated from each other: ________________________________

Are the components touching each other: ______________________________________

Order of components: ____

Method of closing: ____

Presence of residues: ____

Preservation: ____

Post-collection modifications: ____

Observations:

Analysis form: Ethnographic ornaments **Object nº:**__________________

Analyst: Catarina Guzzo Falci **Date:**___________________

Component 1			Component 2		
L:	W:	Th:	L:	W:	Th:
Type			Type		
Perf nº			Perf nº		
RM			RM		
Nº			Nº		
Broken			Broken		
Forms			Forms		
Obs.			Obs.		
Component 3			Component 4		
L:	W:	Th:	L:	W:	Th:
Type			Type		
Perf nº			Perf nº		
RM			RM		
Nº			Nº		
Broken			Broken		
Forms			Forms		
Obs.			Obs.		
Component 5			Component 6		
L:	W:	Th:	L:	W:	Th:
Type			Type		
Perf nº			Perf nº		
RM			RM		
Nº			Nº		
Broken			Broken		
Forms			Forms		
Obs.			Obs.		

Appendix 4

Complete list of experiments conducted for this research.

Experiment n°	Technique	Tool	Material worked	Additives	Time (min)
2475	Grinding	Coral grinding slab (*Acropora palmata*)	Calcite	N/A	45
2477	Sawing	Flint blade	Calcite	N/A	2
2479-1	Grinding	Coral grinding slab (*Acropora palmata*)	Calcite	Water	4
2479-2	Incising	Flint, shell, wood	Calcite	N/A	N/A
2488-2	Drilling	Bow drill, flint tip	Calcite	N/A	27
2488-3	Drilling	Palm drill, flint tip	Calcite	N/A	30
2484-1	Grinding	Coral grinding slab (*Acropora palmata*)	*Lobatus gigas* (lip)	Water	-
2484-2	Drilling	Palm drill, flint tip	*Lobatus gigas* (lip)	N/A	-
2486	Drilling	Bow drill, flint tip	*Lobatus gigas* (lip)	N/A	-
2487-2	Drilling	Mechanical drill, wooden tip	*Lobatus gigas* (lip)	Sand, Water	103
2490-1	Sawing	Flint blade	*Lobatus gigas* (lip)	N/A	-
2495	Grinding	Sandstone	Amethyst	Water	20
2500	Grinding	Coral grinding slab (*Acropora palmata*)	*Lobatus gigas* (lip)	N/A	24
2498-1	Grinding	Coral grinding slab (*Acropora palmata*)	*Oliva reticularis* (apex)	N/A	60
2498-2	Sawing	Flint blade	*Oliva reticularis* (body whorl)	N/A	60
3036	Grinding	Sandstone	Diorite	Sand, Water	60
3037	Grinding	Coral grinding slab (*Acropora palmata*)	Diorite	Sand, Water	60
3039	Grinding	Sandstone	*Acropora cervicornis*	Water	35
3054	Sawing	Flint blade	*Acropora cervicornis*	N/A	11
3055-1	Sawing	Flint blade	*Lobatus gigas* (lip)	Sand, Water	135
3058	Sawing	Flint blade	Serpentinite	N/A	126
3061-2	Drilling	Mechanical drill, bone tip	*Spondylus americanus*	Sand, Water	110
3062-1	Grinding	Sandstone slab	*Spondylus americanus*	Water	80
3063-1	Sawing	Flint blade	Diorite	N/A	26
3068	Drilling	Mechanical drill, bone tip	*Acropora cervicornis*	Sand, Water	90
3411-A	Grinding	Basalt slab	Calcite	N/A	60
3411-B	Grinding	Basalt slab	Calcite	Water	60
3414-A	Grinding	Limestone slab	Calcite	N/A	60
3414-B	Grinding	Limestone slab	Calcite	Water	60

3415	Sawing	Flint blade	Calcite	N/A	65
3417-A	Grinding	Coral grinding slab (*Acropora palmata*)	Calcite	N/A	60
3417-B	Grinding	Coral grinding slab (*Acropora palmata*)	Calcite	Water	60
3418-A	Grinding	Limestone slab	Diorite	N/A	90
3418-B	Grinding	Coral grinding slab (*Acropora palmata*)	Diorite	Water	60
3419-A	Grinding	Basalt slab	Diorite	N/A	90
3419-B	Grinding	Basalt slab	Diorite	Water	90
3421-A	Grinding	Coral grinding slab (*Acropora palmata*)	Diorite	N/A	60
3421-B	Grinding	Quartzite slab	Diorite	N/A	90
3422-A	Grinding	Basalt slab	Amethyst	N/A	120
3422-B	Grinding	Limestone slab	Amethyst	N/A	120
3422-C	Grinding	Quartzite slab	Amethyst	Water, Sand	120
3422-D	Grinding	Sandstone slab	Amethyst	Water, Sand	120
3423-B	Grinding	Basalt slab	Amethyst	Water	120
3426-A	Grinding	Limestone slab	Diorite	Water	60
3426-B	Grinding	Quartzite slab	Diorite	Sand, Water	90
3427	Grinding	Quartzite slab	Amethyst	N/A	120
3428-A	Grinding	Basalt	Calcite	Sand, Water	60
3429-A	Grinding	Quartzite	Diorite	Water	90
3429-B	Grinding	Sandstone	Diorite	N/A	90
3429-C	Grinding	Basalt	Diorite	Sand, Water	90
3430-A	Grinding	Limestone	Diorite	Sand, Water	90
3432-A	Grinding	Limestone	Calcite	Sand, Water	90
3432-B	Grinding	Sandstone	Calcite	N/A	90
3433-A	Grinding	Sandstone	Amethyst	N/A	120
3433-B	Grinding	Basalt	Amethyst	Water, Sand	120
3433-C	Grinding	Sandstone	Amethyst	Water	120
3435-all	Grinding	Sandstone	Calcite	Water	60
3436-A	Grinding	Sandstone	Diorite	Water	90
3436-B	Grinding	Sandstone	Diorite	Sand, Water	90
3438-A	Grinding	Sandstone	Calcite	Sand, Water	90
3438-B	Grinding	Quartzite	Calcite	N/A	90
3440	Grinding	Quartzite	Amethyst	Water	120
3441-A	Grinding	Quartzite	Calcite	Water	90
3444	Grinding/ Sawing	Sandstone	Calcite	Water	120
3445-all	Grinding	Sandstone	Calcite	Water	60
3445-A	Polishing	Cane section (*Sabal* cf. *domin-gensis*)	Calcite	N/A	30

3445-B	Polishing	Cane section (*Sabal* cf. *domingensis*)	Calcite	Water	30
3446-all sides	Grinding	Sandstone	Diorite	Water	345
3446-A	Polishing	Cane section (*Sabal* cf. *domingensis*)	Diorite	N/A	30
3446-B	Polishing	Cane section (*Sabal* cf. *domingensis*)	Diorite	Water	30
3447-A, B	Grinding	Sandstone	Diorite	Sand, Water	A: 45; B:30
3447	Sawing	Quartzite flake	Diorite	N/A	270
3450-all sides	Grinding	Sandstone	Amethyst	Water	-
3451	Grinding	Sandstone	Diorite	Water	210
3452	Grinding	Sandstone	Diorite	Sand, Water	490
3453	Grinding	Sandstone	Diorite	Sand, Water	30
3453	Drilling	Flint	Diorite	Sand, Water	172
3518	Grinding	Sandstone	Nephrite	N/A	90
3520-A	Grinding	Sandstone	Calcite	N/A	15
3520-A	Polishing	High-silica leaf (*Cecropia* sp.)	Calcite	N/A	25

Appendix 5

Form used for recording and analysing the experimental specimens.

Experiments use-wear analysis

Piece no. _________________
User name: _______________
Date: ____________________

Tool type: ______________________
Raw material: ___________________
Retouch: _______________________
Used edge: _____________________

Grain size: fine medium coarse
Hafting: _______________________________
Edge angle: ____________________________

Material:____
____
____

State: dry fresh soaked

Hardness: soft medium hard

Additives or pollution: ____
Type of surface worked on: ____

Motion: cutting sawing shaving scraping planing whittling graving
boring piercing chopping adzing wedging pounding grinding

Contact surface: _________________
Loading: static dynamic
Duration (in min.): _______________

Angle worked: ____________________
Depth of insertion (mm): ____________

Detailed description of experimental procedure and activity carried out:

____
____
____
____
____
____
____
____
____
____

Tool effectiveness (describe also its deterioration through time):

____
____
____

Cleaning procedures: soap alcohol acetone HCL KOH ultrasonic tank

Photographic documentation:____

Piece no.___________

Sketch of the way tool is handled and used.
Drawing (scale 1:1) of tool indicating used edge by red pencil and damage during work blue pencil:

Appendix 6

Table with the information gathered for 100 ornaments from the Pearls collection studied through microwear analysis (originally, Supplementary data 1 from Chapter 4).

Find number	Length	Width	Thick-ness	Diameter perf.	Technical stage	Type	Subtype	Raw material	Translu-cency	Colour	N perfo-rations	Perforation profile	Fragmenta-tion	Context of breakage	Blank acquisition / Shaping	Surface treatment	Faceted	Fire contact	Decoration techniques	Use-wear	Recy-cled
WPb001	27	15	45	4	Finished	Bead	Barrel-shaped	Amethyst	High	Purple	1	Biconical	No	NA	flaking + pecking	Polishing 1	No	No	NA	no use -wear	No
WPb002	18	16	42	4	Finished	Bead	Barrel-shaped	Amethyst	High	Purple	1	Biconical	fragmented	Recent	flaking + pecking	Grinding 1	No	No	NA	no use -wear	No
WPb003	14	14	36	4	Finished	Bead	Barrel-shaped	Amethyst	Low	Grey	1	Biconical	No	NA	flaking + pecking	Grinding 1	No	No	NA	no use -wear	No
WPb004	8,5	8	15	3	Finished	Bead	Barrel-shaped	Amethyst	High	Purple	1	Conical	distal	During production	flaking + pecking	Grinding 1, 2, Polishing 1	Yes	No	NA	no use -wear	Yes
WPb005	28	26	13	3	Finished	Pendant	Carved 3D	Nephrite	No	Dark green	2	Biconical	No	NA	Sawing	Polishing 3	No	No	Incising+-notching	worn	No
WPb006	40	33	6	NA	Preform 2	Pendant	Carved flat	Metamorphic with tremolite	No	Dark green	0	NA	fragmented	During production	Sawing	Polishing 3	No	No	Incising+-notching	half product	Yes
WPb007	42	40	12	3	Finished	Pendant	Carved 3D	Jadeitite	Low	Light green	2	Biconical	fragmented	indet	indet	Grinding 2, Polishing 3	No	No	Excisin-g+incisin-g+notching	worn	No
WPb008	10	9	15	2	Finished	Bead	Tubular	Carnelian	Low	Orange	1	indet	proximal	During production	flaked	Grinding 2, Polishing 3	Yes	Yes	NA	no use -wear	No
WPb009	9	8	33	2	Finished	Bead	Barrel-shaped	Carnelian	High	Orange	1	Biconical	No	NA	flaked	Grinding 2, Polishing 3	Yes	Yes	NA	worn	No
WPb010	5	5	4	1	Finished	Bead	Barrel-shaped	Carnelian	High	Orange	1	Conical	No	NA	indet	Grinding 2, Polishing 1	Yes	No	NA	no use -wear	No
WPb011	9	7,5	22	2	Finished	Bead	Barrel-shaped	Carnelian	No	Red	1	indet	No	NA	pecked	Grinding 1, Polishing 2	No	No	NA	no use -wear	No
WPb012	13	9	22	3	Finished	Bead	Barrel-shaped	Carnelian	No	Red	1	Biconical	No	NA	flaking + pecking	Grinding 1	Yes	Yes	NA	no use -wear	No
WPb013	16	13	28	3,5	Preform 3	Bead	Barrel-shaped	Carnelian	No	Orange	1	unfinished 1 sided	No	NA	indet	Grinding 1, 2	Yes	No	NA	half product	No

Find number	Length	Width	Thick-ness	Diameter perf.	Technical stage	Type	Subtype	Raw material	Translu-cency	Colour	N perfo-rations	Perforation profile	Fragmenta-tion	Context of breakage	Blank acquisition / Shaping	Surface treatment	Faceted	Fire contact	Decoration techniques	Use-wear	Recy-cled
WPb014	9	7	6	NA	Preform 1	Bead	Disc	Carnelian	Low	Orange	0	NA	No	NA	pecked	Grinding 1, 2	Yes	Yes	NA	half product	No
WPb015	6	5	15	2	Preform 3	Bead	Tubular	Carnelian	Low	Orange	1	unfinished 1 sided	No	NA	pecked	Grinding 1, 2	No	No	NA	half product	No
WPb016	30	24	10	3	Finished	Pendant	Carved flat	Nephrite	High	Light green	2	Biconical	fragmented	Recent	Sawing	Grinding 2, Polishing 3	No	No	Incising+-notching+-drilling	worn	Yes
WPb017	8	7,5	26	5,5	Finished	Bead	Barrel-shaped	Rock Crystal	High	Colourless	1	Biconical	fragmented	indet	pecked	Grinding 2, Polishing 2	Yes	No	NA	indet	No
WPb018	17	15	7	3	Finished	Pendant	Geometric (trapezoidal)	Rock Crystal	High	White and red	1	Biconical	No	NA	indet	Grinding 2, Polishing 2	Yes	Yes	NA	worn	No
WPb019	4	4	9	2	Finished	Bead	Tubular	Rock Crystal	High	Colourless	1	Biconical	No	NA	indet	Polishing 3	Yes	No	NA	indet	No
WPb020	7	6	16	2	Finished	Bead	Barrel-shaped	Rock Crystal	Low	White	1	Biconical	fragmented	indet	pecked	Grinding 1, 2	Yes	No	NA	no use -wear	No
WPb021	11	11	17	3	Finished	Bead	Biconical	Rock Crystal	High	White	1	Biconical	fragmented	indet	pecked	Grinding 2, Polishing 1	No	No	NA	indet	No
WPb022	13	12	27	3	Finished	Bead	Barrel-shaped	Rock Crystal	Low	White	1	Biconical	fragmented	Recent	pecked	Grinding 2	Yes	Yes	NA	no use -wear	No
WPb023	8	7	8	2	Preform 3	Bead	Tubular	Rock Crystal	Low	White	1	unfinished 1 sided	fragmented	indet	pecked	Grinding 1	Yes	No	NA	half product	No
WPb024	15	14	10	NA	Preform 1	Button		Rock Crystal	High	Colourless	0	NA	No	NA	flaking + pecking	Polishing 3	Yes	No	NA	half product	No
WPb025	10		27	4	Finished	Bead	Tubular	Amethyst	High	Purple	1	Biconical	medial	indet	pecked	Grinding 2	Yes	No	NA	no use -wear	No
WPb026	6	5,5	3,5	0,15	Finished	Bead	Disc	Calcite	High	White	1	cylindrical 2 sided	No	NA	indet	Polishing 3	Yes	No	NA	worn	No
WPb027	8	7	3	2	Finished	Bead	Disc	Calcite	High	White	1	Biconical	No	NA	indet	Grinding 1	Yes	No	NA	no use -wear	No
WPb028	63	25	6	2	Preform 3	Pendant	Carved flat	Plutonic rock	No	Dark green, black minerals	2	Biconical	fragmented	During production	Sawing	Polishing 3	No	No	Incising+-notching	half product	No
WPb029	30	23	7	3	Finished	Pendant	Carved flat	Jadeitite	No	Light green	2	Biconical	No	NA	Sawing	Grinding 2, Polishing 3	No	No	Excisin-g+incisin-g+notching	worn	No

Find number	Length	Width	Thick-ness	Diameter perf.	Technical stage	Type	Subtype	Raw material	Translu-cency	Colour	N perfo-rations	Perforation profile	Fragmenta-tion	Context of breakage	Blank acquisition / Shaping	Surface treatment	Faceted	Fire contact	Decoration techniques	Use-wear	Recy-cled
WPb030	32	22	10	2	Finished	Pendant	Carved 3D	Nephrite	No	Dark green	2	Biconical	No	NA	string sawing	Polishing 3	No	No	Incising+-notching	worn	No
WPb031	38	15	9	2	Finished	Pendant	Carved flat	Nephrite	No	Dark green	2	Biconical	No	NA	Sawing	Grinding 2, Polishing 3	Yes	No	Incising+-notching	worn	No
WPb032	22	24	25	3	Preform 3	Pendant	Multi-pen-dant preform	Plutonic rock	No	Dark green	2	Biconical	No	NA	string sawing	Grinding 2, Polishing 2	Yes	No	Incising	no use -wear	Yes
WPb033	22	21	19	NA	Preform 2	Pendant	Multi-pen-dant preform	Plutonic rock	No	Light green	0	NA	No	NA	string sawing	Polishing 3	Yes	No	NA	half product	No
WPb034	36	29	12	2	Preform 3	Pendant	Carved 3D	Metamorphic with tremolite	Low	Dark green	1	Biconical	No	NA	indet	Polishing 3	Yes	No	Incising+-notching	half product	No
WPb035	38	22	11	5	Finished	Pendant	Figure in profile	Jadeitite	No	Light green	2	V-shaped	No	NA	Sawing	Grinding 2, Polishing 3	Yes	No	Incising+-notching	worn	Yes
WPb036	29	16	11	4	Finished	Pendant	Figure in profile	Nephrite	Low	Dark green	1	Biconical	No	NA	Sawing	Grinding 1, 2, Polishing 3	Yes	No	Incising+-notching	worn	No
WPb037	33	22	12	4	Finished	Pendant	Carved 3D	Jadeitite	No	Light green	1	Biconical	No	NA	indet	Grinding 1, Polishing 2	Yes	No	Incising+-notching	indet	No
WPb038	32	23	15	NA	Preform 2	Pendant	Carved 3D	Ultramafic	No	Light green with black veins	0	NA	No	NA	indet	Polishing 3	Yes	No	Incising+-notching	half product	No
WPb039	31	14	10	3	Finished	Pendant	Carved flat	Ultramafic	No	Black	2	Biconical	fragmented	During production	indet	Polishing 3	Yes	No	Incising+-notching	worn	No
WPb040	24	15	10	2	Finished	Pendant	Figure in profile	Jadeitite	Low	Light green	1	Biconical	No	NA	Sawing	Grinding 2, Polishing 3	Yes	No	Incising+ex-cising+no-tching+-drilling	worn	No
WPb041	44	25	20	3	Finished	Pendant	Carved 3D	Plutonic rock	No	White and black	3	Biconical	fragmented	indet	indet	Grinding 1, Polishing 3	No	No	Excisin-g+incisin-g+notching	worn	No
WPb042	33	26	6	2	Finished	Pendant	Carved flat	Plutonic rock	No	Grey (sparkly)	2	Biconical	No	NA	indet	Grinding 1, Polishing 3	Yes	No	Incising+-notching	no use -wear	No
WPb043	19	15	5	NA	Preform 1	Pendant	Geometric (trapezoidal)	Jadeitite	No	Light green	0	NA	No	NA	flaked	Grinding 1	Yes	No	NA	half product	No

Find number	Length	Width	Thick-ness	Diameter perf.	Technical stage	Type	Subtype	Raw material	Translu-cency	Colour	N perfo-rations	Perforation profile	Fragmenta-tion	Context of breakage	Blank acquisition / Shaping	Surface treatment	Faceted	Fire contact	Decoration techniques	Use-wear	Recy-cled
WPb044	25	14	9	NA	Preform 2	Pendant	Carved flat	Jadeitite	No	Light green	0	NA	No	NA	indet	Grinding 1, Polishing 3	Yes	No	Incising+-notching	half product	No
WPb045	20	14	6	3	Finished	Pendant	Geometric (oval)	Jadeitite	No	Light green	1	Biconical	No	NA	indet	Grinding 2, Polishing 3	Yes	No	NA	no use -wear	Yes
WPb046	9	8	4	NA	Preform 1	Bead	Disc	Jadeitite	No	Light green	0	NA	No	NA	flaked	Grinding 1, 2	Yes	No	NA	half product	No
WPb047	5	5	3	2	Finished	Bead	Disc	Jadeitite	No	Light green	1	Conical	No	NA	indet	Polishing 3	No	No	NA	no use -wear	No
WPb048	22	19	5	2	Finished	Pendant	Geometric (plano-con-vex round)	Jadeitite	No	Dark green	2	Biconical	No	NA	indet	Polishing 3	Yes	No	Incising	worn	No
WPb049	18	13	6	1	Preform 3	Pendant	Geometric (trapezoidal)	Jadeitite	No	Light green	1	Biconical	distal/me-dial	During production	indet	Grinding 2	Yes	No	NA	half product	Yes
WPb050	7	7	3	NA	Preform 1	Bead	Disc	Jadeitite	No	Dark green	0	NA	No	NA	flaked	Grinding 2	Yes	No	NA	half product	No
WPb051	7	6	3	NA	Preform 1	Bead	Disc	Turquoise	No	Blue	0	NA	No	NA	split + flaked	Grinding 2	Yes	No	NA	half product	No
WPb052	13	12	4	2	Finished	Bead	Plano-convex	Turquoise	No	Blue	1	Biconical	No	NA	indet	Grinding 2, Polishing 3	Yes	No	NA	no use -wear	No
WPb053	5	4	11	3	Finished	Bead	Tubular	Turquoise	No	Blue	1	Biconical	No	NA	Groove-and-snap	Polishing 3	Yes	No	NA	worn	No
WPb054	7	7	6	2	Finished	Bead	Tubular	Turquoise	No	Blue	1	Biconical	No	NA	flaked	Grinding 2	Yes	No	NA	no use -wear	No
WPb055	7	6	13	3	Finished	Bead	Barrel-shaped	Turquoise	No	Blue	1	cylindrical 2 sided	No	NA	indet	Polishing 3	No	No	NA	worn	No
WPb056	5	4	2	1	Finished	Bead	Disc	Turquoise	No	Blue	1	Biconical	fragmented	indet	indet	Polishing3	No	No	NA	worn	No
WPb057	11	7	3	2	Finished	Pendant	Carved flat	Turquoise	No	Blue	1	Biconical	No	NA	indet	Grinding 2, Polishing 3	Yes	No	Incising+-notching	no use -wear	No
WPb058	13	6	4	NA	Preform 3	Pendant	Geometric (trapezoidal)	Turquoise	No	Blue	1	unfinished 1 sided	No	NA	indet	Grinding 1	Yes	No	NA	half product	No
WPb059	7	7	14	NA	Preform 1	Bead	Barrel-shaped	Diorite	No	White and black	0	NA	No	NA	indet	Grinding 2	Yes	No	NA	half product	No

Find number	Length	Width	Thick-ness	Diameter perf.	Technical stage	Type	Subtype	Raw material	Translu-cency	Colour	N perfo-rations	Perforation profile	Fragmenta-tion	Context of breakage	Blank acquisition / Shaping	Surface treatment	Faceted	Fire contact	Decoration techniques	Use-wear	Recy-cled
WPb060	16	16	8	3	Finished	Bead	Disc	Diorite	No	White and black	1	Conical	No	NA	indet	Polishing 1	Yes	No	NA	worn	No
WPb061	22	21	11	2	Finished	Bead	Disc	Diorite	No	White and black	1	cylindrical indet	No	NA	indet	Grinding 1, Polishing 3	No	No	NA	no use -wear	No
WPb062	6	6	23	2	Finished	Bead	Tubular	Diorite	No	White and black	1	cylindrical indet	No	NA	indet	Grinding 2, Polishing 3	No	No	NA	worn	No
WPb063	20	14	54	3	Finished	Bead	Barrel-shaped	Diorite	No	White and black	1	Biconical	medial	During production	indet	Grinding 1, 2	No	No	NA	indet	Yes
WPb064	7	7	27	3,5	Finished	Bead	Tubular	Diorite	No	White and black	1	Biconical	No	NA	indet	Grinding 2	Yes	No	NA	half product	No
WPb065	6	6	4	NA	Preform 1	Bead	Disc	Diorite	No	White and black	0	NA	No	NA	indet	Grinding 2, Polishing 3	Yes	No	NA	half product	No
WPb066	6	6	10	3	Finished	Bead	Tubular	Diorite	No	White and black	1	cylindrical indet	No	NA	Groove-and-snap	Grinding 2, Polishing 3	No	No	NA	no use -wear	No
WPb067	7	6	15	NA	Preform 1	Bead	Barrel-shaped (multi-bead preform)	Diorite	No	White and black	0	NA	No	NA	Groove-and-snap	Grinding 1	Yes	No	NA	half product	No
WPb068	7	7	22	3	Finished	Bead	Tubular	Diorite	No	White and black	2	Biconical	No	NA	indet	Polishing 1, 3	Yes	No	NA	worn	No
WPb069	7	6	11	2	Finished	Bead	Barrel-shaped	Diorite	No	White and black	1	indet	No	NA	indet	Grinding 1, Polishing 1	Yes	No	NA	indet	No
WPb070	10	9	5	3	Finished	Bead	Disc	Diorite	No	White and black	1	Conical	No	NA	indet	Grinding 2, Polishing 3	Yes	No	NA	worn	No
WPb071	10	10	56	4	Finished	Bead	Tubular	Diorite	No	White and black	1	Biconical	No	NA	indet	Grinding 1, 2	Yes	No	NA	no use -wear	No
WPb072	25	25	99	5	Finished	Bead	Barrel-shaped	Plutonic rock	No	Yellow/ white with black spots	1	Biconical	No	NA	indet	Grinding 1	No	No	NA	worn	No
WPb073	15	14	56	5	Finished	Bead	Tubular	Plutonic rock	No	Yellow/ white with black spots	2	Biconical	No	NA	indet	Grinding 1, 2	No	No	NA	worn	No

Find number	Length	Width	Thick-ness	Diameter perf.	Technical stage	Type	Subtype	Raw material	Translu-cency	Colour	N perfo-rations	Perforation profile	Fragmenta-tion	Context of breakage	Blank acquisition / Shaping	Surface treatment	Faceted	Fire contact	Decoration techniques	Use-wear	Recy-cled
WPb074	22	21	89	6	Finished	Bead	Tubular	Plutonic rock	No	Yellow/ white with black spots	2	Biconical	No	NA	indet	Grinding 2, Polishing 3	No	No	NA	worn	No
WPb075	15	14	55	6	Finished	Bead	Tubular	Plutonic rock	No	Yellow/ white	1	Conical	medial/ proximal	During production	indet	Polishing 3	No	No	Incising	indet	Yes
WPb076	11	11	11	3	Finished	Bead	Tubular, hour-glass shaped	Plutonic rock	No	Yellow/ white with black spots	2	cylindrical 2 sided	No	NA	indet	Grinding 1, 2	No	No	Notching	worn	No
WPb077	11	11	13	5	Finished	Bead	Tubular	Plutonic rock	No	Yellow/ white	1	cylindrical indet	No	NA	Sawing	Polishing 3	No	No	NA	worn	No
WPb078	9	7	11	2	Preform 3	Bead	Barrel-shaped	Amethyst	Low	Purple	1	unfinished 1 sided	No	NA	pecked	Grinding 1	Yes	No	NA	half product	No
WPb079	10	10	5	NA	Preform 3	Bead	Disc	Amethyst	High	Purple	1	unfinished 1 sided	No	NA	pecked	Grinding 2, Polishing 1	Yes	No	NA	half product	No
WPb080	7	7	5	2	Finished	Bead	Disc	Amethyst	High	Purple	1	Biconical	No	NA	pecked	Grinding 2, Polishing 1	Yes	No	NA	no use -wear	No
WPb081	12	11	24	2	Preform 3	Bead	Barrel-shaped	Amethyst	No	Purple	1	unfinished 1 sided	No	NA	flaking + pecking	Grinding 1	Yes	No	NA	half product	No
WPb082	11	10	7	2	Finished	Button		Amethyst	No	Purple	1	Biconical	No	NA	pecked	Grinding 2, Polishing 1	Yes	No	NA	worn	No
WPb083	13	13	8	2	Finished	Button		Amethyst	No	Purple	2	Biconical	fragmented	indet	pecked	Grinding 2, Polishing 1	No	No	NA	no use -wear	Yes
WPb084	14	14	4	2	Finished	Bead	Plano-convex	Nephrite	No	Dark green	1	cylindrical indet	No	NA	pecked	Grinding 1, 2, Polishing 1	Yes	No	NA	no use -wear	No
WPb085	31	27	8	3	Finished	Pendant	Geometric (lozange)	Indeterminate	No	Blank and white	1	Biconical	No	NA	indet	Grinding 2, Polishing 3	Yes	No	NA	worn	No
WPb086	14	13	24	NA	Preform 1	Bead	Barrel-shaped	Basement schist	No	Yellow mo-ttled with orange	0	NA	No	NA	indet	Grinding 2	Yes	No	NA	half product	No
WPb087	23	16	6	NA	Preform 2	Pendant	Carved flat	Plutonic rock	No	Dark green, black minerals	0	NA	No	NA	indet	Grinding 2, Polishing 3	Yes	No	Incising+-notching	half product	No

Find number	Length	Width	Thick-ness	Diameter perf.	Technical stage	Type	Subtype	Raw material	Translu-cency	Colour	N perfo-rations	Perforation profile	Fragmenta-tion	Context of breakage	Blank acquisition / Shaping	Surface treatment	Faceted	Fire contact	Decoration techniques	Use-wear	Recy-cled
WPb088	18,5	17,5	5,5	4	Finished	Bead	Disc	Low tempera-ture alteration product	No	Dark green	1	Biconical	No	NA	indet	Grinding 2	Yes	No	NA	no use -wear	No
WPb089	12	8	14	2	Finished	Pendant	Carved flat	Low tempera-ture alteration product	No	Light green	1	Biconical	No	NA	indet	Grinding 1, 2	No	No	Incising+-notching	worn	No
WPb090	25	15	5	NA	Preform 1	Pendant	Geometric (oval)	Ultramafic	No	Light green with black veins	0	NA	No	NA	indet	Grinding 1, 2	Yes	No	NA	half product	No
WPb091	22	22	7	4	Finished	Bead	Disc	Plutonic rock	No	Black	1	Biconical	No	NA	indet	Grinding 2	No	No	NA	no use -wear	No
WPb092	23	15	5	3	Finished	Pendant	Carved flat	Jadeitite	No	Dark green	1	V-shaped	No	NA	Sawing	Polishing 3	Yes	No	Incising+-notching	worn	No
WPb093	17	14	5,5	2	Finished	Pendant	Carved flat	Diorite	No	White and black	2	Biconical	distal	indet	indet	Grinding 1, 2	Yes	No	Notching	indet	No
WPb094	8	7	12	2	Preform 3	Bead	Tubular	Indeterminate	No	Light grey	1	unfinished 2 sided	No	NA	indet	Grinding 1	Yes	No	NA	half product	No
WPb095	11	13,5	33	5	Finished	Bead	Tubular	Plutonic rock	No	Yellow/ white with black spots	1	cylindrical 1 sided	No	NA	indet	Polishing 3	No	No	NA	worn	Yes
WPb096	18	13	11	NA	Preform 1	Pendant	Geometric (multi-pen-dant preform)	Jadeitite	No	Light green	0	NA	fragmented	During production	Groove-and-snap	indet	Yes	No	NA	half product	Yes
WPb097	15	12	4	2	Finished	Pendant	Carved flat	Jadeitite	High	Light green	2	Biconical	No	NA	Sawing	Polishing 3	Yes	No	Excisin-g+incisin-g+notching	worn	No
WPb098	19	12	6	3	Finished	Pendant	Figure in profile	Nephrite	High	Dark green	2	Biconical	No	NA	Groove-and-snap	Polishing 3	Yes	No	Incising+-notching+-drilling	worn	No
WPb099	22	13	5	4	Finished	Pendant	Carved flat	Jadeitite	No	Beige	1	Biconical	fragmented	Indetermi-nate	indet	indet	Yes	No	Incising+-notching	worn	No
WPb100	16	15	10	2	Finished	Pendant	Carved flat	Jadeitite	No	Light green	2	Biconical	No	NA	Sawing	indet	Yes	No	Incising+-notching	no use -wear	No

Acknowledgements

First, I would like to thank my supervisors, without whom this thesis would not have seen the light of day: Prof. Corinne Hofman and Prof. Annelou van Gijn. They have provided me with ideas, feedback, guidance, and support during the past four years. Corinne Hofman has kindly provided the funding that made this PhD trajectory possible. The research was funded by the Spinoza Prize from the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO) awarded to her in 2014. It has also been funded by the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ERC grant agreement n° 319209. I would also like to acknowledge the co-authors of the papers included in this dissertation for their contribution: Dr. Andrzej Antczak and Dr. Marlena Antczak from Leiden University (Chapter 2), André Delpuech from the Musée de l'Homme and Jacques Cuisin from the Muséum National d'Histoire Naturelle (Chapter 3), Prof. Gareth Davies and Alice Knaf from the Vrije Universiteit Amsterdam (Chapter 4), and Prof. Dominique Ngan-Tillard from the Technische Universiteit Delft (Chapter 5).

Many institutions and people made my research into Caribbean ornaments possible through their help, support, collaboration, or permission to access materials: from the Dominican Republic, the Ministerio de Cultura, the Museo del Hombre Dominicano, Dr. Jorge Ulloa Hung, Adolfo López Belando, and the Torrez family, especially Elia and Martin; from Grenada, the Ministry of Tourism, Civil Aviation and Culture, the Willcox family, Linnette Worth, and Angus Martin; from the Ethnologisches Museum Berlin, Dr. Manuela Fischer; from the National Museum of Denmark, Mille Gabriel, Casper Toftgaard, Anja Blok Jespersen, and Suzan Mefail; and from the Université de Bordeaux, Alain Queffelec. The research conducted in Chapter 3 received independent funding from the Musée du quai Branly-Jacques Chirac through the Bourse d'étude pour la documentation des collections 2016-2017. Furthermore, the museum granted me access to their collections and to the Atelier de Conservation et Restauration for carrying out the research. For their contributions and help during my research stay in Paris, I am indebted to Dr. Christophe Moulherat, Paz Núñez-Regueiro, Marie-Laurence Bouvet, Frédérique Servain-Riviale (Musée du quai Branly), André Delpuech, and Jacques Cuisin.

In regard to research implementation, there are a number of people whose help is deserving of mention. I want to acknowledge Eric Mulder, who often helped me with operating the facilities at the Laboratory for Artefact Studies. Wouter Kool helped me with issues regarding the analysis database. For their help with identifying raw materials, I should mention Dr. Andrzej Antczak and Dr. Menno Hoogland. Dr. Eduardo Herrera Malatesta provided me with the map from Chapter 5. In relation to the experiments carried out during this research, I am thankful for the help of Diederik Pomstra in 2014 and of the students that participated of the experimental fieldwork in 2016. Dr. Tom Breukel is thanked for his collaboration in the experimental programme (2014/2015), for designing the layout of the finished thesis, and for translating the abstract to Dutch. Likewise, I would like to thank the many people in the Caribbean Research Group and the Material Culture Studies Group who have provided me with feedback, suggestions, and a rich research environment over the last four years. The research groups also gave me the opportunity to have productive and helpful conversations with many specialists from outside Leiden University, among which I would like to mention Dr. Stéphen Rostain. I should also mention the colleagues with whom I shared tutorials, feedback sessions, discussions, and drinks. Among these, I especially wish to acknowledge Marlieke Ernst, Andy Ciofalo, Sony Jean, Jana Pesoutova, and Meliam Gaspar. Tom is thanked here for his support, patience, and companionship in moments of joy, worry, or frustration. At last, I want to end by thanking my family for always listening to me and providing me with kind words of advice that encouraged me to carry on and see this through.

Samenvatting

Inheemse lichaamsversiering in het Caribisch gebied
De productie, het gebruik, en de uitwisseling van ornamenten zoals gezien door de lenzen van de microscoop

Het versieren van het lichaam was als gebruik alomvertegenwoordigd onder voorkoloniale Caribische samenlevingen. Zowel vroeg-historische bronnen alsmede de overvloed aan collecties aan sieraden gevonden in archeologische sites in de regio suggereren dit. Ondands grote wetenschappelijke aandacht blijft er veel onbekend over zulke ornamenten. Eerder onderzoek schonk voornamelijk aandacht aan hun complexe iconografische afbeeldingen en aan de identificatie en preliminaire herkomst van exotische lithische grondstoffen. Dit proefschrift streeft om toe te lichten op welke manieren mensen met hun ornamenten omgingen en deze in ogenschouw namen. Het bijeenbrengen van de theoretische concepten van de *chaîne opératoire* en de biografie van een object resulteert in een integrale aanpak, in staat om licht te werpen op aspecten van de levensloop van sieraden die verder strekken dan alleen de functie van compleet voorwerp om te vertonen op het menselijk lichaam. Technologische analyse en slijtsporenonderzoek worden hiervoor gecombineerd om zodoende biografische informatie te verwerven van ieder bestudeerd artefact. De basis voor de interpretatie van de originele technieken en werktuigen gebruikt in de productie van ornamenten wordt gevormd door een reeks aan gecontroleerd uitgevoerde experimenten. Zodoende werpt deze integrale aanpak nieuw licht op de productie, het gebruik, en de uitwisseling van ornamenten.

De kern van het proefschrift wordt gevormd door vier artikelen, elk gepubliceerd in toonaangevende wetenschappelijke vakbladen. Het eerste deel ontwikkelt een onderzoeksstrategie voor collecties uit de Caribische omstreken, welke zeer divers zijn in hun herkomst, hedendaagse condities, de staat van conservering, soorten grondstoffen, en de types artefacten. Ten eerste wordt het potentieel van gedecontextualiseerde assemblages voor slijtsporenanalyse geëvalueerd (Hoofdstuk 2), door middel van de studie van een 'legacy' museumcollectie verkregen uit Noordcentraal-Venezuela vroeg in de 20ste eeuw. Vergelijkbaar met veel Caribische collecties bestaat deze uit figuratieve schelpen ornamenten in variabele staat van preservatie, zonder geassocieerd productieafval of gedetailleerde informatie over de vondstcontexten. Het daaropvolgende hoofdstuk verkent de mogelijkheden en limieten van gebruikssporenanalyse in de studie van lichaamsversiering (Hoofdstuk 3). Aldus is een etnografische museumcollectie geanalyseerd om als vergelijkende referentiecollectie te kunnen dienen voor de interpretatie van slijtagesporen op archeologisch materiaal. Hiervoor zijn voornamelijk samengestelde sieraden onderzocht, zoals kettingen, labrets (lippiercings), en armbanden afkomstig uit het laagland van Zuid-Amerika. Deze studie draagt onder andere inzichten bij aan hoe individuele componenten in een ketting ieder gebruiksslijtage ontwikkelen in relatie tot het geheel.

Het tweede deel van het proefschrift focust zich op archeologisch debat over sieraden in het Keramisch tijdperk (400 v.C. – ca. 1500 n.C.). Het belang van netwerksystemen voor de verbondenheid van Caribische samenlevingen in dit tijdperk is sterk benadrukt in het onderzoek van de afgelopen tien jaar, en blijkt het duidelijkst uit de uitwisseling van goederen, mensen, en ideeën tussen de eilanden en de nabijgelegen continentale massas. Ornamenten vormen een integrale bron van bewijs voor de herconstructie van interactienetwerken uit het verleden. De focus ligt op twee verschillende tijdsperiodes, welke beiden gekarakteriseerd worden door intensere mates van productie en circulatie van ornamenten door de Antillen. Het eerdere deel van de Vroeg-Keramische periode in de oostelijke Cariben vormt de eerste casus, gerepresenteerd door een grote collectie van de site Pearls op Grenada, toen gekenmerkt door een atelier voor edelstenen (Hoofdstuk 4). Deze collectie omvat kralen en hangers gemaakt uit verscheidene lithische grondstoffen, zoals amethist, carneool, dioriet, nefriet, jadeitiet, en anderen. De Laat-Keramische periode in de Grote Antillen vormt de tweede casus (Hoofdstuk 5), gerepresenteerd door de recentelijk opgegraven nederzettingssites El Cabo, Playa Grande, El Flaco, La Luperona, en El Carril uit de Dominicaanse Republiek. Deze diverse assemblages bevatten materialen zoals calciet, dioriet, schelpen, dierlijke skeletelementen, en fossiel hout, verwerkt tot verscheidene types kralen, hangers, en oorpluggen. De interpretatie hiervan hangt samen met de herkomst van de grondstoffen en de archeologische contexten van depositie. Voor iedere casus is het contrasterend voorkomen van zowel specifieke technologische producten alsmede vormen van gebruiksslijtage gecombineerd om inzicht te verschaffen in uitwisselingspatronen. Door middel van deze aanpak hebben we de data van iedere site geëxtrapoleerd, om zodoende begrip te verschaffen aan regionale processen van materiele uitwisseling die tot op heden onduidelijk bleven.

Het proefschrift concludeert met een overzicht van hoe de biografische aanpak, zoals toegepast op sieraden, voormalige ideeën over grootschalige interacties en de verantwoordelijke sociale mechanismes in heroverweging neemt. Voor ieder tijdsvak worden specialisaties in bepaalde grondstoffen, het delen van kunde en kennis, en het belang van technisch realiseren behandeld. Speciale aandacht wordt gegeven aan de veranderlijke manieren waarop mensen omgingen met sieraden, ermee betrokken raakten, en uiteindelijk hoe zij ornamenten bezagen door het Keramische tijdperk heen.

Abstract

Adorning one's body was a widespread practice among pre-colonial Caribbean societies. This is suggested by early historical accounts and by the abundance of ornament collections recovered from archaeological sites across the region. Despite the great scientific interest they have raised, much remains unknown concerning ornaments. Previous research has given primary attention to their intricate iconographic depictions and to the identification and tentative provenance of exotic lithic materials. This dissertation aims to elucidate the ways people dealt with and regarded ornaments. Bringing together the concepts of object biography and *chaîne opératoire*, an integrated approach is proposed to shed light on aspects of the life of ornaments beyond their role as finished items on display on the human body. Technological and microwear analyses are thus combined in a method for extracting biographical information from each studied artefact. A set of controlled experiments provides the basis for interpreting the techniques and tools used in ornament production. In this manner, the approach developed casts new light on evolving patterns in ornament production, use, and exchange.

The dissertation is composed of four articles published in peer-reviewed journals. The first half proposes a research strategy for studying circum-Caribbean collections, which are striking for their diversity in origins, present conditions, state of preservation, raw materials, and types. First, an evaluation of the potential of decontextualized assemblages for microwear analysis is carried out (Chapter 2). This is achieved through the study of a legacy museum collection retrieved from north-central Venezuela in the early 20th century. Similarly to many Antillean collections, it is composed of figurative ornaments made of marine shells in different degrees of preservation, with no associated production debris or detailed information on contexts of recovery. In the next chapter, the limits and possibilities afforded by use-wear analysis in the study of bodily ornaments are explored (Chapter 3). An ethnographic museum collection is analysed to provide reference for biographical and microwear interpretation. Composite ornaments are examined, including items such as necklaces,

labrets, and arm bands from across the lowlands of South America. Among the contributions of this study are insights into how individual components from a given necklace develop use-wear in relation to the complete assemblage.

The second part of the dissertation focuses on archaeological debates around bodily ornaments in the Ceramic Age Caribbean (400 BC–ca. AD 1500). Over the last decade, researchers have stressed the interconnected nature of past Caribbean societies, most clearly expressed in the circulation of goods, people, and ideas between islands and surrounding continental masses. Ornaments have been integral sources of evidence for reconstructing past interaction networks. Here, two time periods are the focus of inquiry, as they are marked by intense ornament production and circulation across the Antilles. First, the early part of the Early Ceramic Age in the eastern Caribbean is studied, being represented by a large assemblage from the lapidary workshop site of Pearls on Grenada (Chapter 4). This collection encompasses beads and pendants of several lithic raw materials, namely amethyst, carnelian, diorite, nephrite, jadeitite, among others. The next chapter centres on the Late Ceramic Age period in the Greater Antilles (Chapter 5). This period is represented by the recently excavated settlement sites of El Cabo, Playa Grande, El Flaco, La Luperona, and El Carril located across the Dominican Republic. Diverse raw materials are represented in the form of beads, pendants, earplugs, and ear-spools, including calcite, diorite, mollusc shells, skeletal materials, and fossilized wood. Furthermore, data concerning raw material provenance and archaeological contexts of deposition is incorporated. In each case-study, the differential presences of both certain technical products and of use-wear are combined to provide insights on exchange patterns. It is through this approach to the study of material exchange that we are able to extrapolate the data obtained for each site, in order to grasp regional processes that had thus far remained elusive.

The dissertation is concluded by an overview of how the biographical approach applied to bodily ornaments contributes toward a new assessment of previous ideas concerning large-scale interactions and the social mechanisms responsible for them. Raw material specialization, the sharing of technical knowledge, and the importance of technical performance are addressed for each time period. Particular attention is given to the changing ways people have handled, engaged with, and ultimately regarded ornaments over the course of the Ceramic Age period.

Curriculum Vitae

Catarina Guzzo Falci was born on June 15th, 1990 in Governador Valadares, Minas Gerais, Brazil. After finishing her high school studies at Colégio Ibituruna (2005-2007), she moved 300 km inland to follow a Bachelor's degree in Social Sciences at the Universidade Federal de Minas Gerais (UFMG). Throughout her study (2008-2012), Catarina has worked as both voluntary and paid intern at the Prehistory division of the Museu de História Natural e Jardim Botânico. In this context, she studied lithic and ceramic archaeological assemblages from Minas Gerais and eastern Amazonia. Furthermore, she participated in archaeological fieldworks in Central Brazil ran by different research groups. Catarina was also selected to attend the University of Texas at Austin for a semester abroad in 2011. She followed undergraduate and graduate-level courses in archaeology and anthropology, receiving *magna cum laude* honours. Back in Brazil, Catarina continued studying lithic technology. For her BA thesis (2012), she carried out a technological analysis of debitage associated to stone bead making from Serra dos Carajás, on the southeast of the Amazon Basin. The study resulted in a number of conference presentations and in the publication of two articles.

Her interest in pre-colonial interaction networks in northern South America led Catarina to move to the Netherlands in the fall of 2013. Here, she followed a Research Master's in Archaeology at Leiden University (2013-2015) as part of the Caribbean Research Group and the Material Culture Studies Group. Catarina graduated with *cum laude* distinction for her combined thesis and coursework. Directly after graduation, she was given the opportunity to expand her research as a PhD candidate at Leiden University (2015-2020). This research has centred on technologies of production, modes of use, and exchange of bodily ornaments from the pre-colonial circum-Caribbean. With a research grant from the Musée du quai Branly in Paris (2017), she expanded her research to ethnographic ornaments from across the lowlands of South America. Catarina's research during her six years in Leiden has resulted in the publication of multiple scientific articles in peer-reviewed journals and in many conference presentations.

Adorning one's body was a widespread practice in the pre-colonial Caribbean, notably during the Ceramic Age (400 BC–ca. AD 1500). Despite the abundance of ornament collections recovered from the region and the scientific interest they have raised, much remains unknown concerning their biographies. This dissertation aims to elucidate evolving patterns in ornament production, use, and exchange through technological and microwear analyses. It is composed of four articles published in peer-reviewed journals. The first half proposes a research strategy for studying circum-Caribbean collections, which are markedly diverse in their origins, raw materials, and types. A critical evaluation of the potential of decontextualized assemblages for microwear analysis is carried out. Furthermore, the analysis of ethnographic museum collections is conducted as basis for interpretation. In the second part, collections from two time periods marked by increase in ornament production and circulation are analysed: 1) the early part of the Early Ceramic Age in the eastern Caribbean; and 2) the Late Ceramic Age in the Greater Antilles. In each case-study, the differential presence of both certain technical products and of use-wear are combined to provide insights on exchange patterns. The biographical approach to ornaments contributes toward a new assessment of previous ideas concerning large-scale interactions and the social mechanisms responsible for them. The dissertation concludes by reflecting on the changing ways people have handled, engaged with, and ultimately regarded ornaments over the course of the Ceramic Age period.