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Research Article

The other side of the mirror. Maya Late Classic iron-ore artifact production: an insight from Cancuen

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Abstract

Although iron-ore mirrors are commonly found in the Maya area, very few workshops are known to date. Cancuen, Guatemala, is one of the few sites to show evidence of iron-ore production during the Late Classic (A.D. 600–800). This article reviews all the available data on this material in Cancuen in light of the recent excavations, and, by combining spatial and technological analysis, proposes to shed new light on the spatial organization of this production. By comparing the composition and the social context of production in Cancuen with that of Aguateca (Inomata and Eberl 2014), we suggest that there was a division of tasks between sites in which Cancuen's artisans were involved in the first stage of the production of luxury goods, whereas other stages, such as the arrangement of the tesserae on the supports and their repolishing, were more socially invested and made by elite artists at the recipient sites.

Resumen

Aunque los espejos de mineral de hierro se encuentran comúnmente en el área maya, a la fecha se conocen pocos talleres de producción de estos objetos. Cancuén, Guatemala, es uno de los pocos sitios que muestra evidencia de trabajo de este material durante el clásico tardío (600–800 d.C.). Este artículo revisa los datos disponibles en este sitio en el marco de las recientes excavaciones y, combinando análisis espacial y tecnológico, brinda nuevas luces sobre la organización espacial de esta producción. Se evidencia que son siete los contextos de producción de mineral de hierro, que concentran el 73% de la colección total de este material en Cancuén. La revisión de tales contextos muestra que los trabajadores de la pirita eran posiblemente artesanos con acceso a diversas materias primas exógenas y cerámicas importadas, pero que no eran miembros de la nobleza. La abundancia de nódulos de pirita en la colección parece indicar una participación de estas personas al menos en las primeras etapas de producción, pero destaca la escasez de soportes sobre los cuales hubieran sido colocadas las teselas. La mayoría del material de mineral de hierro fue encontrada en basureros y la ausencia de espejos en contexto ritual indica que el uso local de pirita era relativamente bajo. Esto podría indicar que la mayor parte de la producción no estaba destinada al consumo de los habitantes de las estructuras ni a otros habitantes del sitio, sino a la exportación.

Por el contrario, en Aguateca, un sitio contemporáneo ubicado a 50 km de Cancuén, la colección de mineral de hierro estudiada por Zamora Mejía (2002) e Inomata y Eberl (2014) parece indicar que los artesanos pudieron haber estado involucrados en etapas más avanzadas del proceso de producción de los espejos: el pulido y reelaboración de las teselas para adaptarlas a los distintos soportes.

Así, si comparamos los datos de estos dos sitios contemporáneos y vecinos, observamos varias diferencias bastante marcadas. Los dos sitios muestran restos claros de una producción de objetos de pirita. Sin embargo, las etapas de producción, así como la escala y el nivel de producción, son muy diferentes. Esta comparación también destaca una posible diferencia en el abastecimiento de materia prima entre los dos sitios. Cancuén recibió la materia prima en forma de nódulos, y la escasez de los soportes hace poco probable que los artesanos hubieran dispuesto y pulido las teselas localmente. Por el contrario, la escasez de nódulos en Aguateca indica que los artesanos de Aguateca no recibían la materia prima bajo esta forma, pero que probablemente reelaboraban las teselas, puliéndolas y colocándolas sobre los soportes. Esta etapa del trabajo de los espejos es probablemente la más difícil y la que más conocimiento y aprendizaje requiere. Finalmente, el contexto social de producción es diferente también. En Aguateca, todo apunta que los artesanos eran élites reales o de muy alto rango (Inomata 2014), mientras que en Cancuén, el estatus social de los trabajadores de mineral de hierro era mucho menos prestigioso.

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Esta posible complementariedad entre las etapas del trabajo observadas en Cancuén y en Aguateca, recuerda lo ya percibido para el jade, con los mismos contrastes entre las etapas y los contextos sociales de producción. Esto permite sugerir que hubo una división de tareas entre los sitios en los que los artesanos de Cancuén participaron en la primera etapa de la elaboración de artículos de lujo, mientras que otras etapas—como en este caso, la disposición de las teselas sobre los soportes y su pulido—fueron más invertidos socialmente y hechos por artistas de la élite de los sitios receptores. Tal organización parece ser específica de Cancuén y del final del clásico tardío. Parecería que a finales del clásico tardío, Cancuén inventó una forma—nueva para las tierras bajas—de producir bienes fuertemente invertidos socialmente, trabajando las materias primas valoradas a la manera de los talleres ubicados cerca de las fuentes, trabajándolas sin terminarlas.

Introduction

Iron-ore mirrors occur frequently in Maya archaeological records and are often found in the highest contexts of power in the Classic period (A.D. 250–950). They are markers of social status, worn in headdresses or on belts (Taube 1992), often staged in the representations of royal courts (Blainey 2016:182) and used as ritual instruments, probably for divination (Healy and Blainey 2011; Matsumoto 2012; Miller and Taube 1993; Taube 2016), or funerary offerings (Freidel et al. 2024). Their production therefore raises the question of the manufacture, not only technical, but also ideological, of a good linked with the world of non-humans, as well as how the value of luxury goods was acquired. We know that the difficulty and the distance involved in acquiring the raw materials contributed to the singularity and the distinction of the objects produced from them (Flad 2012:311; Helms 2013). Yet this is clearly not the only criterion, and numerous studies show that working time and technical investment also played an important role in the process of creating precious goods (Flad 2012:311; Peregrine 1991). In some cases, knowledge was required that Inomata qualifies as esoteric (Inomata 2001), the transmission of which was restricted to members of the elite (Inomata 2007; Inomata and Triadan 2010; McAnany 1993), with the production of an object sometimes forming part of a ritual (Hruby 2007; McAnany 2010:213–216; Reents-Budet 1994; Wells 2006; Wells and Davis-Salazar 2007). Numerous data show that luxury goods were often produced in palatial contexts by elite artisans (Coe and Kerr 1997; Halperin and Foias 2010, 2012; Inomata 2001; Inomata and Houston 2001; McAnany 2010; Reents-Budet 1994; Reents-Budet et al. 2012), and that the prestige of these high-ranking artists contributed to that of the artefacts they produced (Ball and Taschek 1991; Inomata 2001; McAnany 2013; Widmer 2009). However, those data concern artistic production involving a high degree of know-how, and raise the question of the supply and the form in which the raw materials worked by these elite craftspeople were received (McAnany 2010:287; McAnany 2013), the stages in which they were involved, and possible ways they were connected with the other stages of production. The question is all the more pertinent in the case of mirrors, as these are composite objects requiring the arrangement of several materials and distinct production processes (Gallaga M. 2016a), undoubtedly disconnected in space.

The production of mirror elements in the Maya area

Mirrors are, in fact, composite objects, shaped by a support, with polished tesserae fixed by adhesives (Gallaga M. 2016a).

These objects therefore combine a variety of raw materials: first, the reflective part, mostly using tesserae made of pyrite, a mineral composed of iron and sulfur (FeS₂). However, archaeological materials generally identified as “pyrite” may also correspond to other minerals, such as hematite, magnetite, limonite, and marcasite. Considering that the chemical composition of the mineral was not central to the Mayas, who sought the ability to produce a reflective surface (Blainey 2007:165), we use iron ore here to refer to all metallic material used in the production of mirrors. There are numerous sources of iron ore in the Maya area, largely concentrated in the Highlands, in the region of Cotzal, Quiche (Blainey 2007:168). Blainey locates others in the department of Chiquimula, on the border between Guatemala and Honduras, as well as between the departments of Izabal and Zacapa (Blainey 2007:173), on the Polochic fault and in the Quirigua region (Blainey 2007:174). However, no workshops have yet been identified in any of these regions.

As for the mirror supports, these are predominantly produced in shale (Blainey 2007:196, Appendix A), although there are examples in wood (Blainey 2007:112), limestone, sandstone, or even in ceramics (Inomata and Eberl 2014:103). To date, only one workshop has been found at Pacbictun (Figure 1), in an elite structure dated to the end of the Late Classic, which produced a variety of shale artifacts, presumably intended, in part, for export off-site (Healy et al. 1995:343–345). Analysis of the context showed that although artisans produced mirror supports, no pyrite fragments were found there. This would indicate that the production process of the supports was, in certain cases at least, separate from that of the other stages of mirror production. Finally, research on adhesives has yet to be carried out. It has been assumed that these were mixtures of clay or organic glues (Kidder et al. 1946:126), or even stucco (Keochakian 2001, cited in Gallaga M. 2016b:13), the exact composition of which is still unknown, but the preparation of which undoubtedly required complex knowledge (Salgado et al. 2024).

Regional syntheses show that the vast majority of mirrors recorded in the Maya area come from the highlands of Guatemala, and in particular from Nebaj (Smith and Kidder 1951), Chama (Kidder et al. 1946), and Zaculeu (Woodbury and Trik 1953; Figure 1), indicating that this was probably a production area (Healy and Blainey 2011:229–230). Iron-ore mirrors are known from Preclassic contexts (Chase and Chase 2006), but most date from the Early Classic (Blainey 2007:62–75; Healy and Blainey 2011:232). They are fewer in number during the Late Classic, and more widely distributed in the Lowlands (Blainey 2007:197). Interestingly, however, this is the period that corresponds with the few workshops

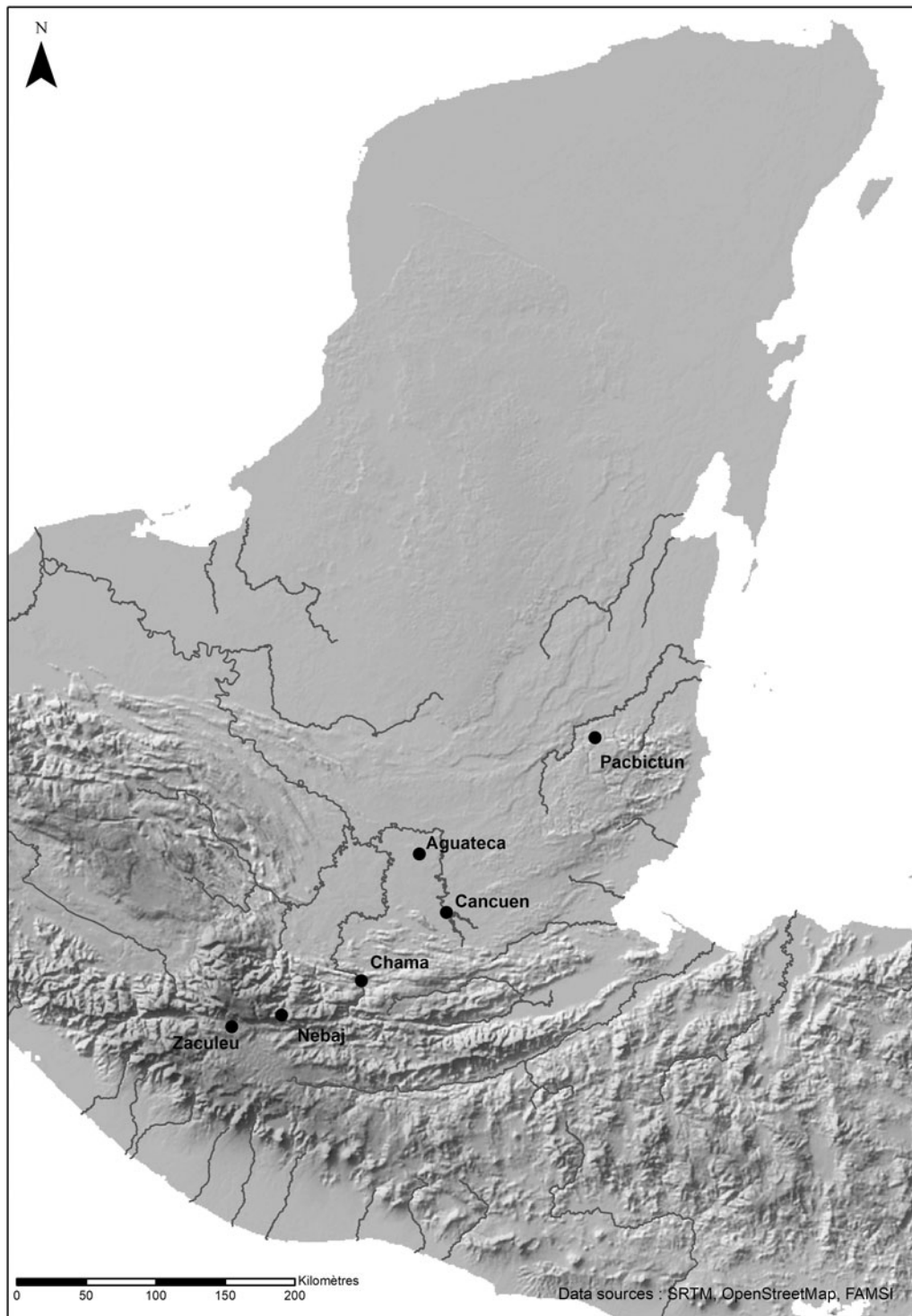


Figure 1. Map of the Maya area, indicating the sites mentioned in the text. Map by J. F. Cuénot.

known to date: either in Aguateca (Inomata and Eberl 2014; Zamora Mejía 2002), in Cancuen (Demarest et al. 2014), or in Pacbictun (Healy et al. 1995). Thus, the available data on the production of these objects date from a period during which mirrors became quantitatively less numerous in the global register, but more widely distributed in the Lowlands. This raises the question of a possible change in the way in which these objects were exchanged at the

time, but also that of the particularity of this production, the involvement of craftspeople in the different stages of their manufacture, and their respective status.

Cancuen and its representativeness in the Lowlands

Cancuen is therefore one of the few known Maya sites showing signs of iron-ore work. The occupation of this city,

situated at the border area between Highlands and Lowlands (Figure 1), was very short, being limited to the Late Classic (A.D. 600–800), and it was abandoned in around A.D. 800 (Demarest et al. 2020b; Forné et al. 2011). One of the characteristics of this site is that numerous workshops and signs of craft activity areas were found in the epicenter itself. Thus, a jade workshop was found in the northern part of the site (Kovacevich and Pereira 2002, 2003) containing more than 60 kg of jade production waste (Andrieu et al. 2014). Furthermore, many indirect indices converge to show that other artisanal activities occurred in the epicenter, as indicated by the presence of pigments concentrated in certain structures (Kovacevich et al. 2003), the abnormal concentrations of several hundred drills discovered in others (Andrieu and Quiñonez 2011), the quantity of obsidian cores, and the deposit of 681 cores under a stele 4 km from the epicenter, all of which correspond to a larger production of goods than merely for local consumption (Demarest et al. 2014). This clearly shows that there was a concentration of artisans in Cancuen who worked, in part, with raw materials from the Highlands and therefore took advantage of Cancuen's strategic position on the border between these two regions (Demarest et al. 2020a).

Cancuen is not, however, a representative site for the activities of the Maya Lowlands. Indeed, overall there are relatively few workshops of known and studied manufactured goods in the Lowlands in comparison with the quantity of cities excavated there. This is the source of considerable debate and controversy about the organization of artisanal production and the economic functioning of classical societies (Andrieu 2013, 2020). We frequently observe a distinction between the context of luxury goods produced in epicenters by royal artisans, nobles, or people of high rank (Halperin 2008; Inomata 2001; Reents-Budet et al. 2012) and more common goods, which tend to be produced in relatively modest and small structures, located in residential areas outside epicenters or in secondary centers (Andrieu 2013; Barrett 2004; Hester and Shafer 1984; Lewis 2003; Potter 1993; Potter and King 1995; Shafer and Hester 1983; Whittaker et al. 2009). Cancuen would therefore be an exception in comparison with the rest of the Lowlands, since the nature of the artisanal production that took place there seems to go beyond the distinction between everyday goods and luxury goods. Indeed, both jade and obsidian cores have been found there in very large quantities, and even jade work does not appear to have been carried out by members of the elite or people of very high status (Andrieu et al. 2014; Demarest et al. 2014, 2020b).

It was ascertained very early on that there was also evidence of pyrite working at this site. In her doctoral thesis, Kovacevich (2006) suggested the presence of local production of this material in Cancuen, based on analysis of the material collected between 1999 and 2003 representing 88 pyrite fragments (Kovacevich 2016:90). Her argument is based on the relative abundance of iron ore in trash middens, and the presence of tesserae in both the manufacturing process and in nodules ($n=17$). A study of the distribution of the material enabled her to suggest that this material was worked by members of the non-elite for

members of the elite; work she attributes to an emerging category of middle-class craftspeople, as with the working of jade at the same site (Kovacevich 2016:95).

Problem and method

Since this study, four new iron-ore concentration contexts have been discovered in Cancuen, all located in the northern part of the site (Arriaza et al. 2008; Belches 2009, 2011; Rodas and Quiñonez 2011), which allow us to question the organization of the production, both at the site level and its regional integration; but also to question the specificities of the production of luxury goods in the Late Classic, compared with other sites.

However, the study of iron-ore production is difficult, since the high degree of decomposition of this raw material complicates its recognition, and all the more so since this material is worked by cutting, abrading, and polishing, therefore leaving very few traces in the archaeological register (Gallaga M. 2016a; Melgar et al. 2016; Taube 2016). The only accurate way to determine the production process and techniques used in iron-ore work is therefore through microscopic studies (Gallaga M. 2016b; Melgar et al. 2016), but no such work has been carried out in Cancuen on iron-ore artifacts to date. Furthermore, pyrite, in particular, is not a stable mineral, and, under the action of water and oxygen, it deteriorates into iron oxide or brown limonite, thus either losing its characteristic luster and taking on a yellowish color, or decomposing. These alterations to the pyrite surface complicate the macroscopic estimation of underpolished parts and make it difficult to distinguish between a finished but weathered artifact and one that would be in the process of being manufactured.

These specificities complicate both the recognition of a workshop and the estimation of the intensity or scale of production (Costin 1991, 2001, 2007). Indeed, if we take the usual definition of a workshop, which is the place where specialized production was carried out—in other words, production in greater quantities than for the consumption needs of a residential unit (Clark 2003; Costin 2001; Inomata 2001)—this implies a very specific methodological apparatus, and, in particular, quantitative criteria (Clark 1986, 1997) or criteria that would make it possible to determine the degree of know-how involved in such production (Clark 1986, 2003; Roux 1990) and to estimate the quantities produced. In order to recognize possible iron-ore workshops or manufacturing areas in these circumstances, we have therefore identified several criteria to be used, namely:

- Concentration: a few isolated tesserae do not indicate on-site production.
- Contexts of concentration: once broken, a mirror will leave a concentration of tesserae, but will not indicate a production area.
- Presence of unworked raw material, raw or modified nodules, and their context, depending on whether they may be considered offerings, deposits, or areas of rejection.
- Presence of unfinished artefacts or production waste and their context.

- Relationship between the presence of production indices and consumption indices of the artefact (Andrieu 2013): if a structure has pyrite nodules, but no tesserae in the burials or associated deposits, this could be a clue that inhabitants were not producing for their own consumption.

In light of these elements, we tried to understand the organization of iron-ore production at this site in terms of space, work organization, types of production, and the quantities produced and consumed. To this end, we reviewed the entire Cancuen iron-ore collection (88 pieces from the 1999–2003 excavations that have been analyzed previously, as well as 91 from recent excavations), so as to contextualize all of these productions and determine their representativeness in relation to the rest of the Lowlands during the Late Classic. To this end, we made bibliographical comparisons between this collection and that from Aguateca excavated by Inomata and Triadan (2010; Inomata 2014) and analyzed by Zamora Mejía (2002) and Inomata (Inomata and Eberl 2014).

Composition of the collection and spatial distribution

Between 1999 and 2016, 179 iron-ore elements were collected in Cancuen's epicenter (Table 1). Among these, the tesserae (Figure 2) were the most represented artifacts, with 100 pieces (48 complete, 14 lateral fragments, 38 mesial fragments). The complete shapes ($n=48$) are polygonal, with between four and seven edges, measuring 1.2–4.0 cm in length and 0.15–0.40 cm in width. There are 61 nodules (Figure 3) that measure 1–5 cm, 47 of which have a cubic form, and 14 an amorphous one. Finally, the collection also comprises different types of finished objects, such as beads ($n=10$) and ear flares ($n=2$), in pyrite or iron-ore material, as well as six dental inlays (Belches 2009; Quintanilla 2013:103; Figure 4). In addition, there are 13 possible fragments of sandstone support (12 fragments and 1 whole), all of which were found in the same structure (K6-34). The only complete element is circular, 8 cm in diameter, worked on both sides and with two perforations. The degree of fragmentation in the others makes their attribution to the mirror-making production process quite speculative and is based on their flat morphology, and, in two cases, on the presence of rounded edges.

The iron-ore objects are distributed in an interesting way. On one hand, some tesserae are scattered around the site, without any concentration. Thus, we find tesserae in a trash midden at the back of structure J7-7 (Barrientos et al. 2001:129), on the surface above the palace, or in L9-3; in the construction fill of M9-18 or in that of L7-28 (Arriaza et al. 2008); three others were scattered on the steps of structure N10-1, which could be part of an abandonment deposit (Kovacevich et al. 2004b). Others could correspond to a deposit, but of unclear context, as, for example, in the case of the concentration of 10 tesserae in a layer of collapsed construction in the L9-8 structure (Ohnstad et al. 2003:325), or the discovery of 10 tesserae in a looting hole in the palace, which could correspond to a mirror deposited as an offering (Barrientos et al. 2004).

None of these, however, constitute a clear ritual context, and the absence of iron-ore material in a funerary context is notable, apart from the two cases of burials with dental inlays (Belches 2011; Quintanilla 2013:103). This dispersion of scattered tesserae at the site, in structures of diverse rank, could indicate that these pieces did not have the same status as the complete mirrors, since their distribution was relatively even; but perhaps they had a domestic ritual use (Inomata and Eberl 2014:110; Moholy-Nagy, with Coe 2008:56–57). Moreover, their distribution does not indicate any significant consumption of this material in Cancuen. Conversely, the remainder of the collection is concentrated in seven different contexts which alone account for 73% of the iron-ore elements at the site (Table 1). Three of these have already been described in previous publications (Kovacevich 2016); the other four are from more recent excavations. They all come from structures associated with the Chaman phase (Forné et al. 2011), namely the end of the Late Classic.

K6-34

This structure, of small dimensions (2 × 2 m) and very simple construction, is shaped by a base of stone wall and an access by small steps giving onto a patio, which revealed large quantities of materials indicating various artisanal activities (Barrientos et al. 2001:124). Almost all of the pyrite was found on this floor and inside the structure (Figure 5), and comprised 5 pyrite nodules, 31 tesserae, a bead, as well as 13 possible support fragments (Barrientos et al. 2001:127) and 39 chert drills (Barrientos et al. 2001:126). The traceological analysis of a sample of 20 of these showed that they had been used to drill ceramic, wood, and a soft rock of the soapstone type. In the same structure, the following were discovered: a figurine, an eccentric, 12 pieces of greenstone (9 small beads, 1 figurine fragment, and 2 axe fragments), and a stone anchor. A burial in poor conservation condition was also found there, with no associated offering (Barrientos et al. 2001:117; Quintanilla et al. 2015:246). All of these elements, combined with the proximity of this structure to the palace, indicate that it was undoubtedly a residence belonging to relatively wealthy craftspeople (Barrientos et al. 2001:126).

M6-12

Another concentration in a single residential structure was discovered at M6-12 (Figure 5). It is a structure of larger dimensions than the previous one, on an earthen platform with low retaining walls, associated with a patio of slabs on the north side (Kovacevich et al. 2004b:303). As in the previous structure, the ceramic material indicates a construction at the end of the Late Classic (A.D. 760–800). Inside, two complete pottery vessels were found on the floor (Kovacevich et al. 2004b:310), but most of the pyrite was concentrated in a trash midden, located in the exterior patio of the structure, between the slabs. Here, 13 iron-ore artefacts were found: 3 nodules, 2 non-perforated beads, and 8 tesserae, together with sandstone fragments,

Table 1. Composition and distribution of Cancuen's iron-ore collection.

	Tesserae	Nodules	Beads	Dental inlays	Ear flares	Total
K6-34	31	4	1			36
M6-12	8	3	2			13
M10-4			1			1
M10-6		1				1
M10-7	2	1				3
M10-9		2				2
M9-24	9	6	1			16
M9-25	3	1				4
N9-1	4					4
N9 patio	5	31	3	2	1	43
Northern group patio	5	11			1	17
N10-1	3			4		7
J6-5	2					2
K7-24	1					1
J7-7	1					1
J6-3		1				1
L9-3			1			1
L9-8	10					10
L7-27	13					13
L7-28	1					1
M8-19	1					1
Without context (surface)	1		1			2
Total	100	61	10	6	2	179

fragments of figurines, 6 axe fragments, 3 small jade beads, 12 chert drills, a block of jade, 6 cm wide, as well as large amounts of pigments and cinnabar (Kovacevich et al. 2004b:312–313). Use-wear analysis of the drills showed that they were used for working ceramic and wood. Analysis of the exterior soil shows iron concentrations, which could correspond to the working of pyrite (Kovacevich et al. 2004a).

The jade workshop group

The group of structures housing the jade workshop revealed several scattered elements of pyrite, in particular on the slab patios of M10-7 and M10-6 (Kovacevich and Pereira 2003:284). The 2011 excavations uncovered two more on the slab floor of M10-9 (Quiñonez and Hernández 2012; Figure 5). Altogether, the group designated as the Cancuen jade workshop comprised seven iron-ore fragments dispersed in the various trash middens discovered on the exterior floors (four nodules, one bead, and two tesserae), all associated with jade production waste (Andrieu et al. 2014) and dating from the end of the Late Classic (Demarest et al. 2014; Forné et al. 2013). In addition, six

burials were found in this group, all very simple and associated with one or two pottery vessels (Quintanilla 2013).

M9-24

However, the highest concentration of iron ore in this area was found in a structure 40 m south of the jade workshop and excavated in 2010 (Rodas and Quiñonez 2011; Figure 5). This building, dating from the end of the Late Classic was better-constructed than the others in the same sector, with well-defined slab walls (Forné and Torres 2011). Here were found 16 pyrite fragments (six nodules, nine tesserae, and a bead), most of them made in the interior of the building. A cist burial was found in that structure, which included a small block of jade, as well as a jade ear-flare fragment and a pottery vessel (Rodas and Quiñonez 2011:33). Since few artefacts were found in this structure, archaeologists assumed it was a habitation area.

N9-1

This low structure, built of earth and also associated with a patio of slabs (Díaz García 2012; Kovacevich and Pereira

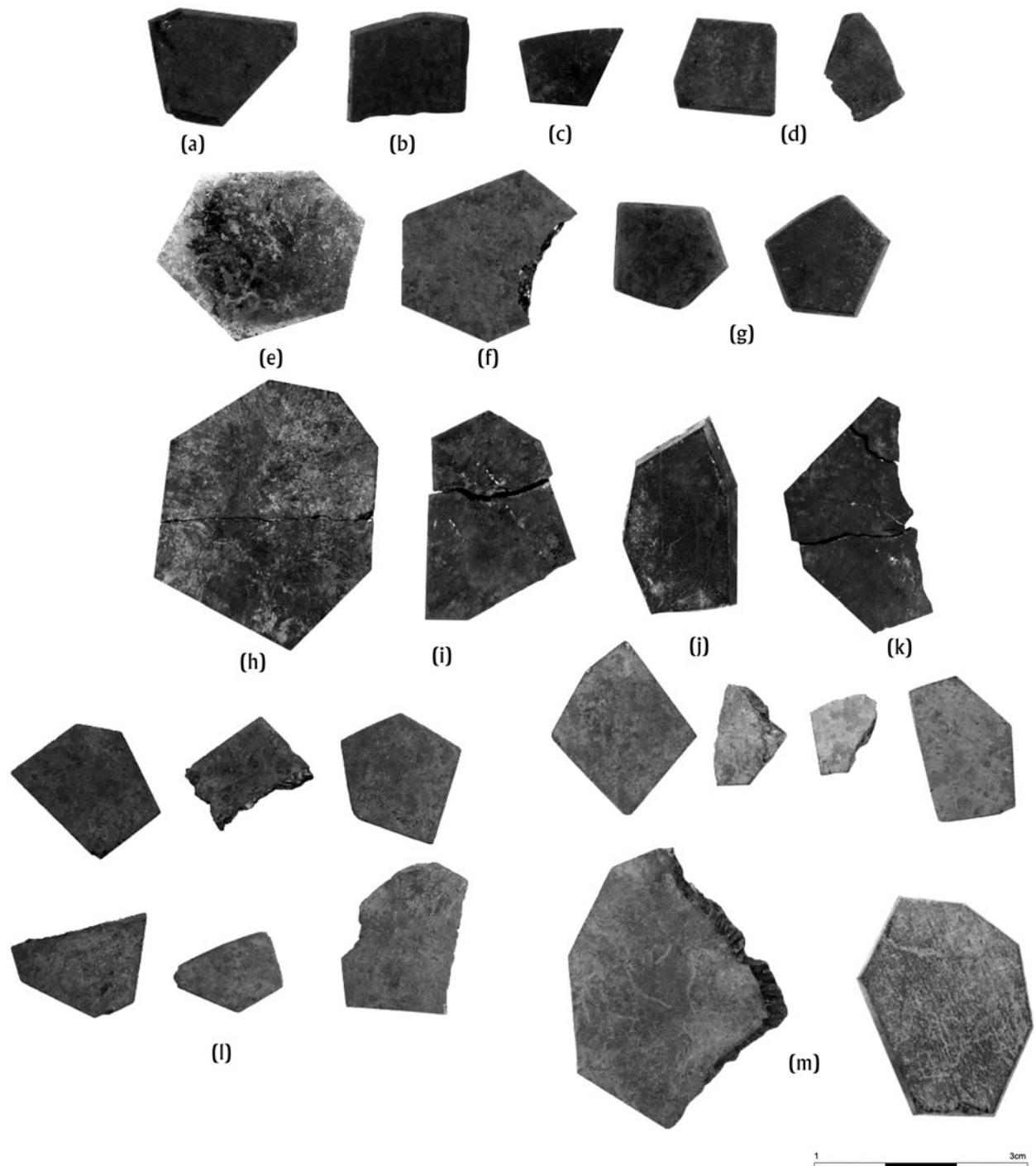


Figure 2. Iron-ore tesserae from Cancuen: (a) N9-7; (b) M10-7; (c) K6-24; (d) M6-12; (e) M9-24; (f) northern group platform; (g) M9-24; (h) J7-7; (i) N10-1; (j) northern group structure D; (k) N9-7 platform; (l) L7-28; (m) L9-8. Photographs by Andrieu; layout by S. Eliès.

2002), revealed two simple burials, one associated with a pottery vessel (Kovacevich and Pereira 2002:188), but the other without any offering (Díaz García 2012). On the outside floor, four fragments of iron ore were found, all between the slabs (four nodules and a fragment of tessera). This quantity is too low to correspond to the concentration criterion that we defined; however, the proximity to the structure M9-24 (Figure 5) allows us to suppose that

the activities of the inhabitants of these buildings were linked.

Patio N9-6, N9-7

To the south of this group, on an earthen platform, is a group built in perishable materials and framing a central patio made of limestone slabs (Figure 5), which has been

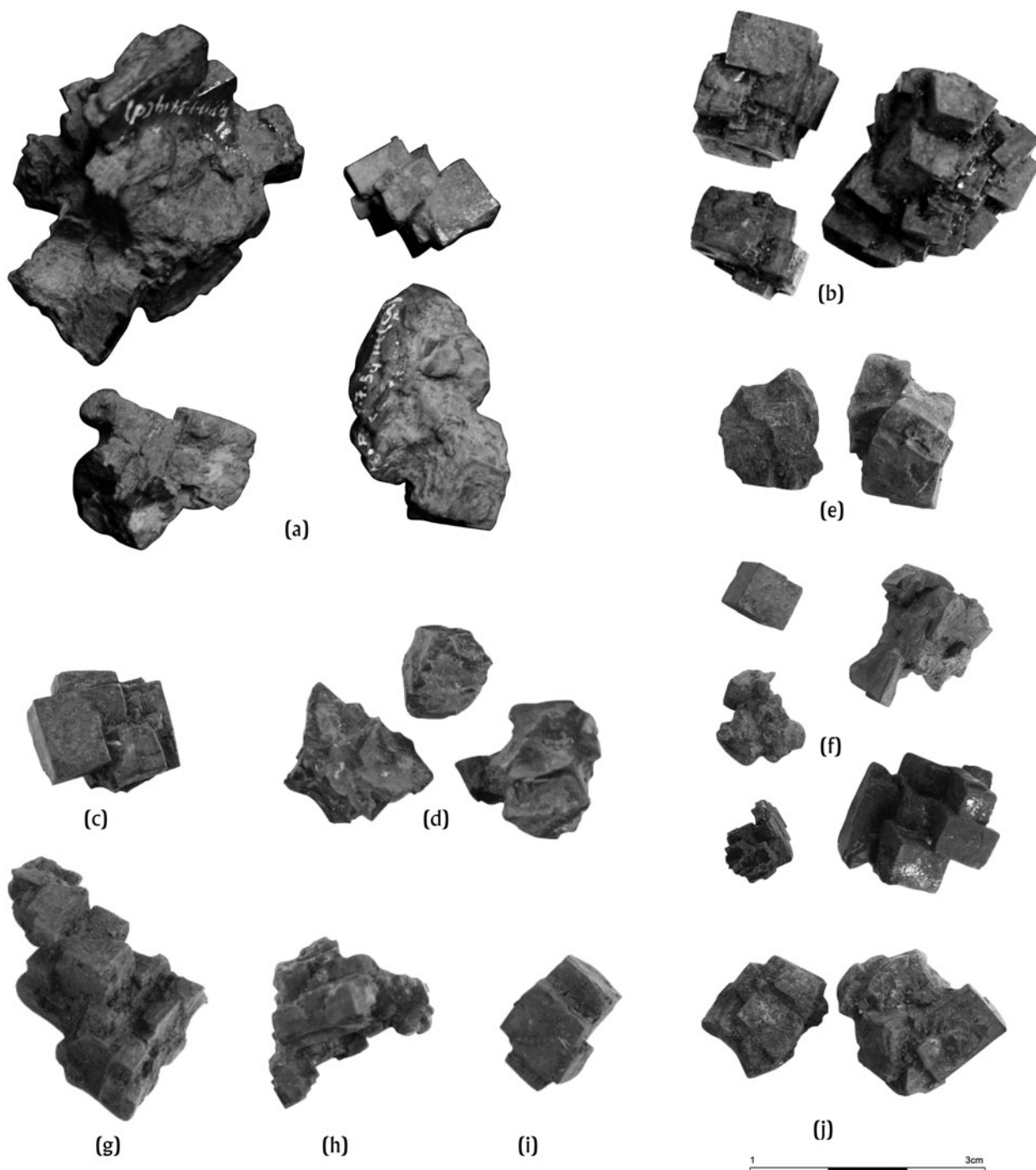


Figure 3. Iron-ore nodules from Cancuen: (a) geometric and amorphous blocs from K6-36 (Museo Nacional de Arqueología e Etnología, Guatemala); (b) M6-12; (c) K6-36; (d) M9-24; (e) N9-7; (f) N9-6; (g) N9-6 platform; (h) M6-12; (i) northern group platform; (j) northern group platform. Photographs by Andrieu; layout by S. Eliès.

interpreted as a work area dating from the last phase of occupation of Cancuen, the Chaman phase (Belches 2011; Torres and Tuyuc 2012). In this context, on the outdoor patio mainly were found 42 fragments of iron ore, including 31 nodules ($n = 18$ of geometric shape; $n = 13$ amorphous), beads ($n = 3$), tesserae ($n = 5$), and an ear flare, associated with small fragments of greenstone, a fragment of alabaster, several fragments of figurines, as well as very large

quantities of drills ($n = 752$; Belches 2011:110). The traceological analysis of a sample of these showed that they had undoubtedly been used to work a hard mineral, but none of the pieces analyzed worked iron-ore material. In this group there were seven burials, most of them in a rather poor state of conservation, very simple, placed directly in the construction fill of the platform or on the sterile layer, and which include between one and four pottery

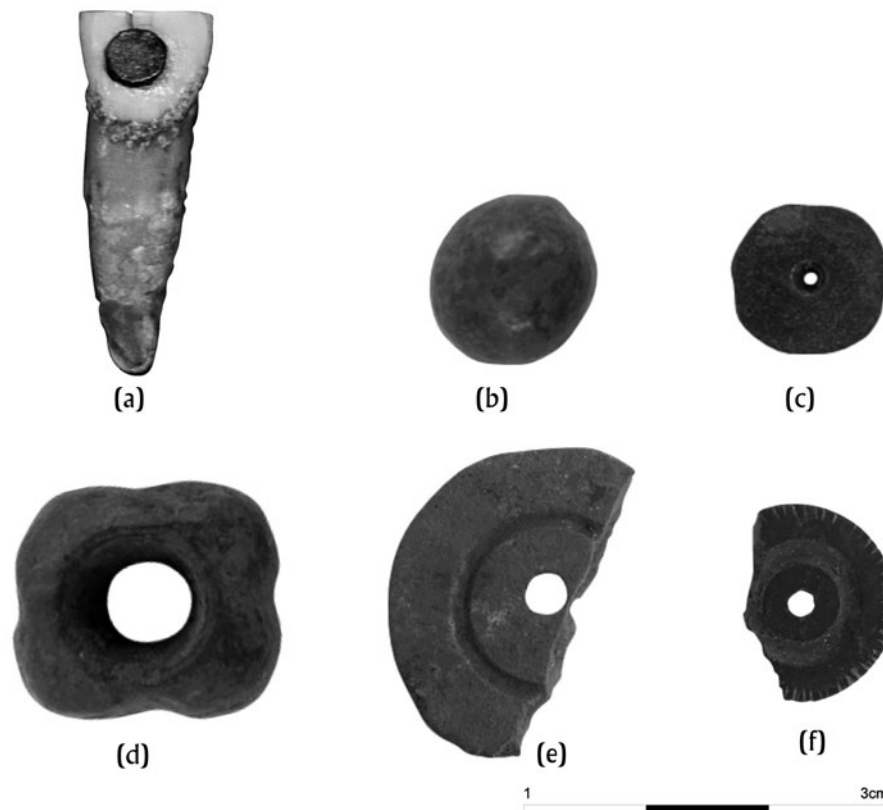


Figure 4. Other iron-ore artefacts: (a) dental inlay N10-1 (Museo Nacional de Arqueología e Etnología, Guatemala); (b) possible unperforated bead M6-12; (c) bead M9-24; (d) globular bead L9-3; (e) incised bead N9-7; (f) ear flare N9-7. Photographs by Andrieu; layout by S. Eliès.

vessels, few chert flakes and obsidian blades, and a shell offering (Belches 2011:111–112; Quintanilla et al. 2015:260; Torres and Tuyuc 2012). Only two burials stand out from the others. Burial 110 revealed a greater quantity of offerings: four fragmented pottery vessels, a *mano*, a fragment of raw greenstone, a fragment of figurine, and, most notably, a large quantity of drills ($n = 83$). Interestingly, the buried person had iron-ore encrustations in the teeth (Quintanilla et al. 2015:261). Screening of the fill that covered this tomb revealed a concentration of 276 other chert drills, as well as a pyrite nodule (Belches 2011:110). Burial 115 only contained two small complete pottery vessels, but was covered by a fill in which a tessera was also found (Torres and Tuyuc 2012:220).

The northern group

This group is located further north, on the other side of a temporary river (Figure 5). It was constructed, like most buildings in the area, on a vast earth platform, with simple rows of stones undoubtedly serving as a retaining wall for structures of perishable materials and associated with a slab patio (Arriaza et al. 2008; Belches 2009). Most of the archaeological material collected came from the trash middens on this outer floor, where large quantities of ceramic material from the Late Classic were found (Arriaza et al. 2008), together with fragments of anthropomorphic

figurines, worked bones (including a flute), 9 small jade beads, a jade ear flare, 4 axe fragments, and 17 pyrite fragments (11 nodules, 5 tesserae, and an ear flare). Three burials were found there: two simple ones, placed in the platform, without any associated offerings (Arriaza et al. 2008), and another, in the patio, in a very well-built cist, which included two pottery vessels, possibly of Highlands style (Belches 2009:122). Under the slab patio was another floor, probably indicating that this residential group had a slightly longer occupation than the others, but still from the Late Classic (Arriaza et al. 2008).

Discussion

These contexts account for 73% of the iron-ore collection from Cancuen. Although the epicenter has been the subject of intensive excavations (Demarest and Barrientos Q. 1999, 2001, 2002, 2003, 2004, 2006; Demarest and Martínez 2008, 2009, 2011, 2012, 2013, 2014, 2015, 2016), no similar concentrations have been observed in other parts of the site. In most cases, the material was found in trash middens on exterior slab patios, and, to a lesser extent, on the interior floors of the structures. In all cases, the presence of nodules and the type of context in which they were discovered indicates that these were places of production, or areas of production refuse. No element that could be classified as percussion waste was discovered, and none of the nodules

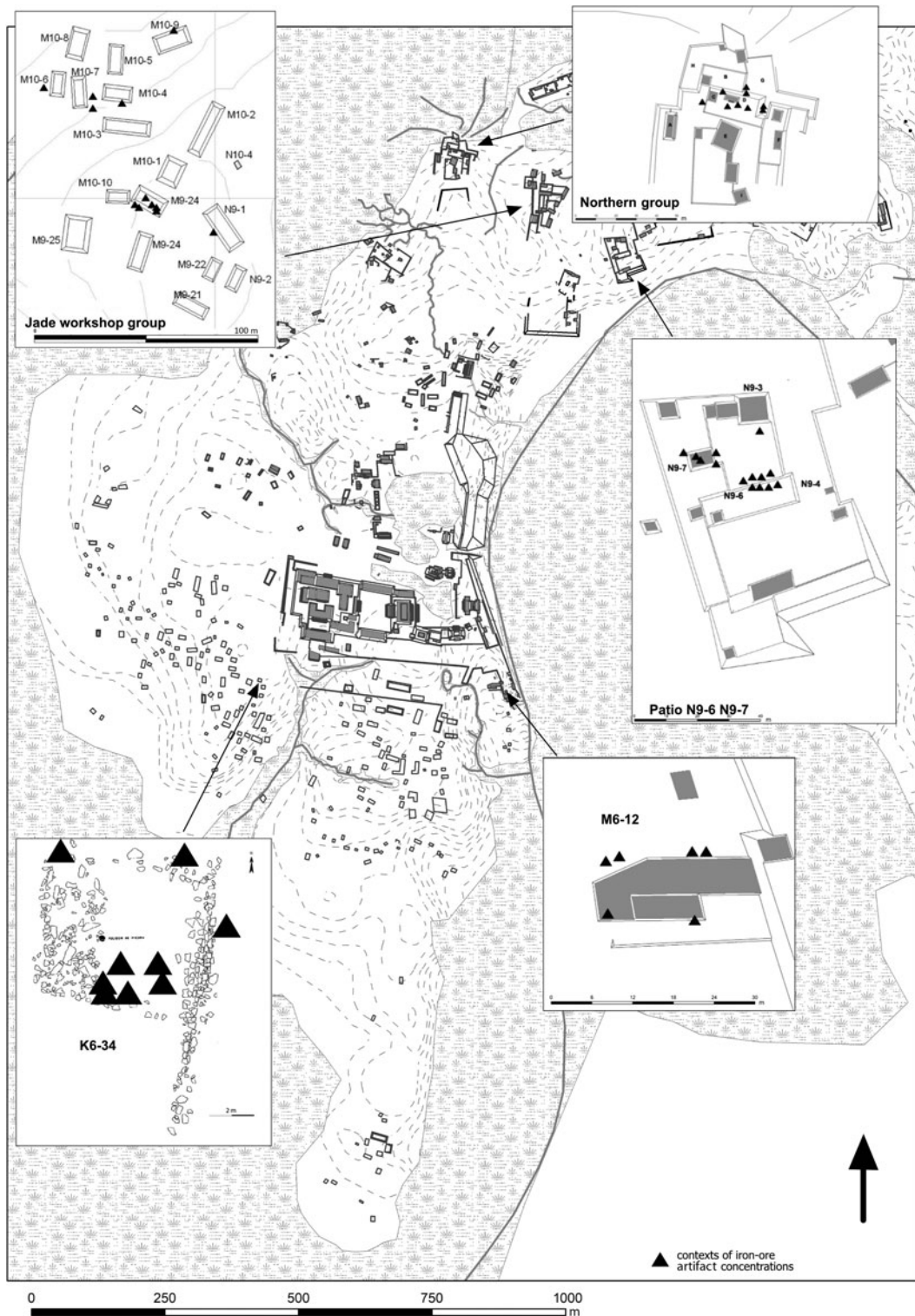


Figure 5. Distribution of the iron-ore artefact concentrations in Cancun. Map by M. Wolf; layout by S. Eliès.

found on the site show any percussion marks, although three of them show traces of possible sawing. However, the experiments carried out by Zamora Mejía (2002:22) and Gallaga M. (2016a:37) show that the use of percussion creates very irregular surfaces that would entail a very

long period of abrasion and polishing of the tesserae. It is therefore probable that the tesserae were sawn and cut with chert or obsidian flakes (Melgar et al. 2016), which would not leave very visible traces in the archaeological register. The abundance of nodules also indicates that the raw

material was imported in this form. This data clearly sets Cancuen apart from other sites in the Lowlands (Blainey 2007; Zamora Mejía 2002).

The production is always of very low intensity: in fact, there are never more than 42 pieces concentrated in the same patio or in the same group of structures. Nor is the social context of production particularly high: seven groups or structures can be considered relatively wealthy, either due to the presence of exogenous goods, or the quality of the building in the case of M9-24, but the associated burials were not elite burials. And although two were burial cists and one has iron-ore inlays, it would appear that this pattern is not necessarily a hallmark of the elite in Cancuen (Quintanilla 2013:106–117). The N9 group is undoubtedly the most interesting in this respect, since it comprises both the highest concentration of pyrite waste and two possible artisan burials. The presence of tesserae in the fill above burials 110 and 115 could indeed be intentional and would correspond to a form of offering related to the activity of the deceased. The fact that the individual in burial 110 had pyrite inlays could indicate a certain distinction related to his office. However, while the differences observed between the burials of these different groups probably indicates different statuses within these craftspeople which still needs to be studied in greater detail, they still do not correspond to the high elite contexts in Cancuen.

The association of iron-ore work remains, and pigments, figurines, jade, or even the concentration of drills indicates that other materials were worked in the same structures, and that their inhabitants were therefore undoubtedly involved in multicrafting (Feinman and Nicholas 2000, 2004). From the present state of the data, it would appear that the pyrite workers were, arguably, relatively wealthy artisans, with access to various exogenous raw materials and imported ceramics, but that they were not members of the nobility.

While it is difficult to determine the stages of iron-ore work handled at the site, one can stress the absence of mirror supports in most of the structures, and, conversely, the relative abundance of nodules. The only steps that appear to have taken place in these structures were the cutting of tesserae from nodules and, perhaps, the assembly of mirrors in K6-36, given the presence of one complete support element and several fragments in this building. At the site level, however, it is the abundance of nodules that prevails and that seems to indicate an involvement in at least the early stages of production.

If we estimate the quantity of mirrors produced from the size of the single complete support element (8 cm in diameter), and the shape and dimensions of the tesserae, we can conjecture that each mirror required the use of 10 tesserae. Based on this estimation, we suggest that the complete collection of pyrite from Cancuen would correspond to the production of 10 complete mirrors. That is, however, a very conservative estimate, based on the assumption that the supports were small in size. At Caracol, for example, a support of 11 cm in diameter comprised 41 tesserae (Chase and Chase 2010:Figure 84). That being the case, the entire Cancuen collection would correspond to only 2.5

complete mirrors. In all cases, the data indicate that this production was both dispersed and of low intensity.

The local consumption of pyrite is also very low, since, apart from one context of looting in the palace, which could correspond to an offering, and two tesserae scattered in the fill above two burials, no mirror was found in a clear ritual context on the site. This could indicate that most of the production was not intended for consumption by the inhabitants of the structures or by other inhabitants of the site, but for export. Interestingly, the only other known pyrite production center in the entire Maya Lowlands is Aguateca (Inomata 2014; Inomata and Triadan 2010; Inomata et al. 2002), a site contemporary with Cancuen, located in the neighboring region of Petexbatun, just 50 km away.

Cancuen and Aguateca: two different contexts of pyrite working in contemporary sites

Aguateca has been studied in the context of a huge excavation project led by Inomata and Triadan (Inomata 2014; Inomata and Triadan 2010; Inomata et al. 2002), which showed that it had been abandoned around 810 (Inomata 1997, 2003; Inomata et al. 2001, 2002)—that is to say, shortly after Cancuen. The rapid abandonment of the site enabled archaeologists to find remains of activity corresponding to a short period, without the material having been cleaned or taken away by its inhabitants (Inomata and Stiver 1998; Inomata et al. 2002), thus making it the reference site for the study of elite production activities.

The Aguateca pyrite collection was the subject of a detailed study by Zamora Mejía (2002) and by Inomata and Eberl (2014), whose data we have compared bibliographically with that of Cancuen. In this site, 591 pieces of pyrite were collected (Inomata and Eberl 2014:96; Zamora Mejía 2002:Annexes), of which 90% was from structures M7-32 and M8-4 (Zamora Mejía 2002:Tables 11 and 12). M7-32 is a structure of the royal palace (Inomata et al. 2001) in which nine mirrors were found, some directly associated with tesserae glued together (Inomata et al. 2001). Given the type of context, the abundance of supports and the absence of nodules or artifacts in the process of being manufactured, these tesserae could correspond to mirrors stored in the room where they were used for rituals in the palace (Inomata 2001; Inomata and Eberl 2014:101). This context could, therefore, be considered as a storage place for mirrors, presumably for ritual purposes, rather than a production space (Inomata et al. 2001:294). The other concentration of pyrite relates to structure M8-4, a noble residence near the royal palace (Triadan 2000), which contained 60% of the site's total pyrite collection (Inomata 2014:Figure 14.2), which has earned it the designation “the House of the Mirrors” (Inomata 2001:328). In this building and, more specifically, in the southern chamber, 356 pieces of pyrite were found (Zamora Mejía 2002), together with 10 pallets and 3 pestles, 8 polished axes and numerous lithic artefacts (Aoyama 2009:79–85), as well as 2 carved bones representing the glyph emblem of Aguateca, and a huunal, symbol of royal power (Inomata 2001:328; Inomata and

Eberl 2014). The south chamber of structure M8-4 was therefore the location of a high dignitary's residence, probably a scribe and his family (Inomata 2014:285; Triadan 2000; Triadan and Inomata 2020), and it contains more iron ore than was found in the entire Cancuen site.

However, if we look at the composition of the collection, there are only 20 nodules for the whole site (Inomata and Eberl 2014:96), including 5 in structure M8-4 (Zamora Mejía 2002). There is also a wide variety of tesserae morphologies that do not appear in Cancuen. Indeed, the authors identified mosaics with round, straight, annular, cylindrical, oval, conical, square, and rectangular edges in large proportions (Inomata and Eberl 2014:96; Zamora Mejía 2002:42–44, 66), but also an unpolished tessera, a plaque in the process of polishing, and indices of recycling (Inomata and Eberl 2014:96; Zamora Mejía 2002:67), which suggests that the inhabitants of this structure were in charge of assembling the mirrors and reworking some tesserae in order to integrate them into other types of artifacts (Inomata and Eberl 2014).

They were most likely associated with the production of pyrite ornaments from mosaic pieces. All the stages of reworking were represented by the excavated samples. The manufacturer first made incisions on mosaic pieces and then snapped them along the incisions to make two longer sides of rectangular pieces. The snapped sides were then polished. Finally, the manufacturer cut or polished the shorter sides of the rectangle and further polished the longer sides to give them rounded edges. When the mirror mosaic parts were not large enough to make a rectangular shape, two pieces were combined (Inomata and Eberl 2014:107).

This diversity of tesserae forms, which also distinguishes this collection from that of Cancuen, would be consistent with the idea that the palatial craftspeople mainly received iron ore as tesserae, which they then reworked to adapt them to the desired supports. Indeed, each tessera had to be adapted precisely to the shape of the support so that they could be perfectly joined. It was therefore necessary to rework them once they were placed together. These data, as well as the presence of 13 supports of the same structure, seem to indicate that the craftspeople of Aguateca may have been involved in a more advanced stage of the production of the mirrors: the polishing and reworking of the tesserae in order to adapt them to the various supports. The presence of pallets and pestles could indicate that, in addition to pigment production, the preparation of certain mirror adhesives also took place on the site. Iron concentrations in the soil outside this structure may indicate that the polishing occurred outside the dwelling (Inomata and Eberl 2014:108; Terry et al. 2004).

Consequently, the final steps in the crafting of these objects must have occurred in this elite residence, unlike in Cancuen, where artisans appear to have been more involved in working the raw material that they received as nodules. Thus, if we compare the data from these two contemporary and neighboring sites, we observe several quite marked differences. The two sites show clear remains

of a production of pyrite objects and, more specifically, tesserae, and in both cases, we observe some other productions, such as beads and ear flares (Inomata and Eberl 2014:Figures 6.16 and 6.12). Multicrafting clearly occurred in the case of Aguateca, since the craftspeople of M8-4 were also dedicated to the working of bone and shell, textiles and figurines (Aoyama 2007, 2009; Inomata 2014:282). However, the social context of production, as well as the scale and level of production, were very different: in Aguateca, a single structure comprised far larger quantities of pyrite than in all of Cancuen, while in Cancuen the production was of less intensity and dispersed over seven different loci. This comparison also highlights a possible difference in the supply of nodules between the two sites. Cancuen received the raw material in the form of nodules, and the scarcity of the supports makes it unlikely that the craftspeople would have arranged and set the tesserae there.

Conversely, the artisans of Aguateca, who had less access to the raw materials, probably reworked tesserae by polishing them and arranging them on supports. Finally, the social context of production also differs. At Aguateca, everything indicates that the artisans were royal elites or very high-ranking individuals (Inomata 2014; Inomata et al. 2001), whereas at Cancuen, the social status of the artisans was less prestigious. The K6-34 structure was perhaps the most elite one, due to its proximity to the palace; or possibly N9-24, due to its construction quality. However, in all cases, while it is very difficult to apply the usual criteria for the hierarchical classification of structures in Cancuen (Demarest et al. 2014), nothing indicates that the Cancuen workshops housed royal elites, and, while all show signs of wealth, none exhibit the characteristics of the high elite residences of Cancuen (Jackson 2013). All of this allows us to suggest a possible complementarity between certain sites at the end of the Classic period. Indeed, it indicates a system whereby some cities were more involved in working the raw materials, while others focused more on polishing and adjusting the tesserae on the supports. That would explain the important differences in social status between contemporary craftspeople, located in the same region, and involved in working the same material.

Some technical actions more valued than others?

While the contrast between the social context of the collections at these two sites has already been observed (Zamora Mejía 2002), it has never been interpreted in terms of the complementarity of tasks, which could explain the social differences between the iron-ore artisans of Cancuen and Aguateca. Indeed, the skill and expertise of the M8-4 artisans lay in the most difficult part of working with mirrors, namely the step of fitting the tesserae together. These need to be re-polished so as to give the illusion of a completely smooth surface (Nelson et al. 2009; Smith and Kidder 1951:44; Woodbury 1965:172). The fit between each of the tesserae must be perfect, and therefore needs to be reworked when it is attached to the supports to ensure that perfect fit. "But this was as nothing compared to the

work of cutting and grinding to exactly equal thickness, and of beveling for accurate edge-to-edge fit, the many polygonal plates of refractory pyrite crystals with which the face of each was incrustated" (Smith and Kidder 1951:44). This probably also entailed re-polishing once the tesserae were fixed on their support (Beaubien 2014:225). These stages would therefore be more difficult, longer, and, undoubtedly, much more socially invested than the preceding ones. Kidder noted the very high level of craftsmanship required for this work (Kidder et al. 1946), and several authors have suggested that it was handled by royal artisans (Blainey 2007:107, 186; Healy and Blainey 2011). The Mesoamerican attraction to brilliance has often been emphasized (Stuart 2010; Taube 2016), a quality that is acquired through polish. As in the case of jade, it is the abrasion and polishing stages that take the longest (Melgar et al. 2016) and which require the highest levels of skill. As noted previously (Andrieu et al. 2014), the cultural importance of polishing is demonstrated by the fact that the Florentine Codex lists more than 29 different verbs in Nahuatl to designate the action of polishing (Thouvenot 1986:184). These elements converge to indicate that the polishing stages would be the most socially invested, since they require the longest training and would therefore be more likely to lie in the range of esoteric knowledge or knowledge restricted to elite artists. As in the case of jade, it is clearly the polishing of the material that confers on these mirrors their power and value.

Indeed, this possible complementarity between the stages of the work observed in Cancuen and in Aguateca recalls what has already been perceived for jade, with the same contrasts between the social contexts of production. The jade debitage activities in Cancuen were held in fairly modest residential structures, focused on the preliminary stages in the working of the material, namely the selection of raw materials and the production of preforms probably intended to be exported and worked outside of the site (Andrieu 2019; Andrieu et al. 2014).

Although the presence of polishers in Cancuen clearly indicates that certain final stages were also held on site, the scarcity of finished jade objects there (in comparison with the abundance of the raw material), as well as the absence of cutting waste specific to the intermediate stages of ear-flare and bead production, indicates that the majority of the production consisted of preforms that were exported to other sites (Andrieu et al. 2014). Moreover, if jade-cutting waste is rare in the Lowlands, or mostly found in cache contexts, such as in Caracol (Chase and Chase 2015, 2020) or Tikal (Moholy-Nagy, with Coe 2008:31–32), polishers are relatively frequent. Interestingly, the majority date from the Late Classic and have been found in palatial contexts. For example, apart from Cancuen (Barrientos et al. 2004), they have been found in Naachtun (Andrieu 2014:509), Nohmul and Caracol (Landry 2008), El Peru Waka (Marken 2011:268), Calakmul (Domínguez Carrasco et al. 1999), and La Corona (Andrieu and Roche 2014), indicating that the polishing of beads, ear flares, and buttons was carried out in the recipient sites. This method of exchanging preforms, if confirmed, indicates that, in the Late Classic at least, part of the jade corresponding to these specific production processes was

exchanged this way (Andrieu et al. 2014; Rochette 2009:234), produced by non-elite workshops, exported to consumer sites and worked locally by royal artisans.

This type of division of work is reminiscent of what is observed for iron ore and would confirm that Cancuen's artisans were more involved in the early stages of several luxury crafts that would be exported to other sites where the last stages were carried out. Indeed, the rare production indices in the epicenters have mostly been those of highly skilled artisans (Aoyama 1999; Inomata 2001; Inomata and Houston 2001; McAnany 1989; Reents-Budet 1994) involved in artwork (Arnauld 2005; Reents-Budet 1994:164–223), to the extent that it has been suggested that palatial production could be considered as production for own consumption (Webster 2001:148), or that it challenges the notion of attached specialists (Inomata 2001), since it was a matter of production *entre-soi*, by the elite, for the elite.

Conversely, nothing allows us to say that this was the case in Cancuen, where, from our current state of knowledge, the production of jade and pyrite, two of the most valued materials of the Maya area, do not benefit from any particular treatment and, above all, do not seem intended for the artisans' consumption, or for that of their residential group, or possibly even for the rest of the site, given the scarcity of pyrite elements in a funerary context or ritual deposits. Neither the 60 kg of jade from the workshop (Andrieu et al. 2014), nor the fragments of pyrite discovered mainly in construction fill and trash middens in Cancuen, indicate a special status for unworked raw material. Unlike Aguateca, there is nothing to show that the artisans of Cancuen did produce tesserae for themselves, but rather than that their production was mainly intended for social categories other than their own.

Conclusion: a change at the end of the classic?

These data therefore confirm what was observed for the work on jade in the Late Classic and indicate that the final stages of manufacture—in this case, the polishing and the adjustment of the tesserae on the supports, were carried out by high-ranking artists, endowed with esoteric knowledge (Inomata 2001, 2007). The previous stages, namely the production of tesserae, probably by sawing from nodules, do not seem to benefit from the same prestige, if we are to believe the contexts of their discovery in Cancuen, and were not produced by artisans with comparable social status to those of Aguateca.

The work observed in Aguateca is undoubtedly more representative of the work on luxury goods in the Maya area, since numerous data converge to show that artistic work requiring a very high level of know-how was often produced by high-ranking artisans. The scarcity of pyrite nodules in the Lowlands could indicate that these palatial craftspeople received tesserae from sources in the Highlands, which then had to be adjusted to the desired supports and polished over to make them shine. It is probable that, in general, the first stages of production of the items imported from the Highlands were carried out near the sources, be they the preparation of obsidian cores (Clark 1988; Clark and Lee

1990), the preformed pyrite tesserae, or even the jade preforms (McAnany 2010; Rochette 2009:234), which were then all worked locally in the Lowlands. Interestingly, the ethnohistorical data indicate that different titles were used among the Mexica according to the specializations: the *tlatecque* designating the stonemasons, and *chalchiuhtlatecque*, those who finished the precious objects (Sahagún, cited in Gallaga M. 2016a:43). These data correspond to the Postclassic, but support the idea that there was a division of labor between cutting and finishing a work, which applies very well here.

Both Cancuen and Aguateca are located along an ancient trading route connecting the Highlands to the central Peten via the Río Pasion. It has been suggested that this had been under the control of the Kaanul kingdom in the seventh century (Martin 2020:347); in this case, the iron-ore production and exchanges may therefore have relied on earlier networks. However, it is significant that data concerning the working of jade, pyrite, or even obsidian in massive quantities in Cancuen, dates from the very end of the Late Classic, after the fall of the Kaanul kingdom, and no elements indicate that there were similar quantities or modalities of production for periods prior to the Chaman ceramic phase. It would therefore seem that at the end of the Late Classic, Cancuen invented a form—new for the Lowlands—of producing strongly socially invested goods, by working the valued raw materials in the manner of the workshops located near the sources (Demarest et al. 2017a, 2017b), by cutting them without finishing them. This would explain why, although the Cancuen craftspeople were involved in luxury production, the work was not actually carried out in elite structures, as has usually been observed for these types of goods in the rest of the Lowlands. This could indicate the emergence of new modes of production in this region at the end of the Late Classic, and the appearance of new economic strategies implemented at that time which would be based on more interdependence between the Lowlands sites than during previous periods (Demarest et al. 2020a, 2020b).

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