

RICE UNIVERSITY

**Archaeological Investigations of Early Trade and Urbanism at Gao
Saney (Mali)**

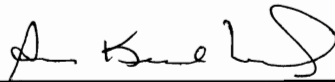
By

Mamadou Cisse

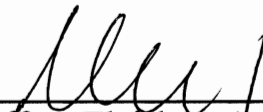
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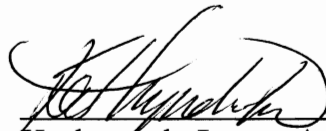
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Abstract

Excavations at the mound site of Gao Saney, located near the historic town of Gao eastern Niger Bend, Mali, revealed over six meters of domestic deposits and debris from secondary processing of glass and copper dating to the period 700–1100 A.D. This is 200-300 years earlier than anticipated and points to the early development of long distance trade networks. Lead isotope analysis of copper and glass samples using LA-ICP-MS points to multiple sources areas, including copper ores in Tunisia and glass production areas in the Middle East. Secondary processing of copper and glass took place at the site, and a substantial portion of the sequence comprised mud brick structures and associated domestic trash and wall collapse episodes. The distinctive polychrome pottery assemblage found in the Gao Saney deposits occurs along a 500 km stretch of the Niger Bend between Bentia to the south and Timbuktu to the west, where it appears suddenly and intrusively c. 650-700 A.D. This thesis documents the excavations and the material culture, chronology, subsistence economy and production activities at the site. It argues that the findings support the identification of Gao Saney with the trading town Sarneh mentioned in a tenth century Arab chronicle.

The relationship of Gao Saney to Gao Ancien, the putative "royal town" of Kawkaw, is considered through a comparison of material excavated from a massive stone building complex there with the material from Gao Saney. The first millennium pottery at both sites is identical, but elite goods and stone architecture are present in abundance only at Gao Ancien. The evidence supports the identification of a royal town linked to Gao Saney by market and trade relations linked to early long-distance trade.

This thesis is cordially dedicated to the memory of the late Tereba Togola, my mentor and boss in the *Direction National du Patrimoine Culturel* of Mali, and to my daughter, Bailo Cisse.

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Chapter 1

INTRODUCTION

This dissertation presents and discusses the results of the excavations conducted in 2001-2 and 2009 at the settlement mound of Gao Saney, located on the eastern Niger Bend, seven kilometers east of Gao (Figure 1.1). The research objectives focused on the recovery of basic data for understanding the chronology of settlement at the site and the role of Gao Saney in trade and exchange. The growth and development of the mound over time as part of an urbanizing landscape was also of interest. The three units excavated in the eastern half of the mound testify to rapid accumulation and site formation during the period 700-1000 AD. Gao Saney is thought to have been the market town of Sarnah, one of the dual towns of Kaw-Kaw (as Gao was known to Arabic chroniclers) mentioned by the tenth century chronicler al-Muhallabi (Levtzion and Hopkins 1981: 174; Cuoq 1975: 77-78). By the ninth century AD, Kaw-Kaw was already the seat of a polity described by the Arab geographer, Yakubi, as “the greatest of the realms of the Sudan” (Levtzion and Hopkins 1981: 21; Cuoq 1975: 52). In the tenth century, Sarnah, with its trading houses on the east bank of the river, was the market counterpart of the royal town, with its palace and treasure house on the west bank (al-Muhallabi in Levtzion and Hopkins 1981: 174; Cuoq 1975: 77-78). The importance of the

salt trade between Kaw-Kaw and the Berbers was emphasized in the eleventh century by al-Bakri (Levtzion and Hopkins 2000: 87; Cuoq 1975: 108).

Prior to the 2001 excavations described in this dissertation no major archaeological excavation had been conducted main settlement mound of Gao Saney. Previous investigations had primarily focused on the Gao Saney cemetery, located a half kilometer from the *tell*, and also at Gao Ancien in the current town Gao (Figure 1.1). These excavations targeted architectural structures and also graves with tombstones (often marble stele) engraved with Arabic inscriptions that refer to twelfth-thirteenth century dynastic rulers, who were presumed to have lived at Gao Saney (Flight 1975, 1981; Farias 1995; Insoll 1996, 2000). Because of the high status of the burials, and the inscribed imported marble from Al-Andalusia (Spain) in the Saney cemetery, it has received the lion's share of archaeological efforts. Little attention has been paid to the main habitation mound, which appears to lack monumental architecture.

Additionally, the mound of Gao Saney has been, for a number of years, subjected to heavy looting activities to recover old glass beads. The consequence of these looting activities is that we have lost many vital data necessary for reconstructing the past of this early urban site. The need to rescue by documenting what is left becomes very crucial.

Historical documents prior to al-Bakri in the eleventh century provide scant information on the origin and development of Kaw-Kaw as a trading kingdom. Generally, much of what we know of West African trade comes from Arabic authors, who illuminated the period roughly from the eleventh to the seventeenth centuries AD (Mauny 1961; Cuoq 1975; Levtzion & Hopkins 1981, 2000; Hunwick 1999). For the period prior

to the eleventh century AD in West African Sahel, archaeology is the primary source of data for reconstructing the origin and the development of early trading towns.

Nowadays, the understanding of the development of trade and urbanization along the Middle Niger during the first millennium AD is seen as essential in West African archaeology. We already know that urbanization and trade have been developed at the first millennium site of Jenne-jeno, located on the western part of the Niger River (McIntosh & McIntosh 1980; McIntosh 1995). Additionally, the development of first millennium trade has been recently documented at Es-Souk, a major trading entrepot town situated in the borderland between the Sahel and the Sahara (Nixon 2007; 2009). Because of its strategic position between the Sahara and the savanna along the Niger River, both Gao Saney and Gao Ancien are ideal places for archaeological investigation of early trade networks. The pioneering investigations of Insoll (1996, 2000) at Gao Ancien shed light on the development of urbanism and trade particularly during the first half of the second millennium AD. By comparing the bulk of data (architectural remains and material culture) from the excavations at Gao Ancien and Saney, this dissertation will help to assess the function of these sites and also contribute to filling the gap in our understanding about trade interaction and early complex societies in the West African Sahel. This study opens a new avenue for better understanding of the past of Gao, and also advances our knowledge of the development of early trade and exchange networks between this early trading *entrepôt* and other trading centers in West Africa.

Since the *tell* of Gao Saney was largely unstudied from an archaeological perspective, this dissertation also considers other basic data for understanding the site chronology, the circumstances and chronology of changes in material culture and

subsistence economy. The compositional analyses of the samples of various trade items recovered in the course of excavations not only expand our knowledge of the regional exchange networks of early urban sites but also illuminate our understanding of the long-distance trade networks within which Gao operated during the first millennium AD.

Controlled excavations were used in the course of investigations in order to collect the following basic types of information:

1. ***Change in cultural sequences.*** The establishment of reliable stratigraphic sequences describing major change through time in material culture was one of the major objectives of this study. The rigorous stratigraphic control in the course of excavations permits to achieve this goal particularly at the deeply stratified site of Gao Saney. The recovery of pottery and other materials throughout the depositions were of particular interest.

2. ***Connection between architectural features.*** The understanding of various kinds of construction techniques (for instance: the mud brick construction and coursed mud architecture) was also very important. It is interesting to know whether the different construction techniques appear simultaneously or there is a shift from one to another.

3. ***Site chronology and growth.*** Charcoal samples for radiocarbon dating were collected in order to have absolute dates for the excavated areas. The radiocarbon dates and seriated ceramic data were used to anchor the archaeological sequence in absolute time. Comparison among excavated units permitted an understanding of both vertical and horizontal aspects of site formation over time.

4. ***Subsistence economy.*** The recovery of basic subsistence data (faunal and floral remains) during the excavations was important to illuminate the issues of the

consumption preferences, the access of resources, the distribution of foodstuffs in the settlement.

5. Trade and manufacturing activities. Imported items such as copper and glass provide valuable information on the participation of locals in regional and long-distance trade networks. The recovery of trade items allows us to understand consumption preferences and also to reconstruct the scale of the consumed materials in various contexts. The identification of the nature of the earliest trade goods and the provenance of the materials were of particular interest. The recovery of manufacturing debris provides significant detail concerning the level of production of various goods and the identification of the area in which the production activity took place at the site.

The data gathered in the course of excavations provide an answer to a number of questions concerning the nature and the scale of trade systems, the chronology and the processes of changes in material culture and subsistence economy. Through recovery of data relevant to these issues, it has been possible to make first tentative steps towards elucidating the urban past of Gao Saney from its foundation onwards with special focus on the development of trade at the site. This dissertation was intended to recover a set of baseline data that would make it possible in future work to frame specific hypotheses about the basic issues that the results of the various excavations have raised and devise appropriate methodology for evaluating them.

This study is organized as follows: Chapter 2 provides a background to the research. It discusses biogeography and environment, present-day ethnic groups, and historical sources. Chapter 3 discusses the prior archaeological research in and around Gao. Chapter 4 discusses archaeological approaches to the study of the multiple

components of trade and exchange systems in West Africa: production, distribution and consumption. Chapter 5 discusses the archaeological excavations at Gao Saney. In this chapter, the problem of orientation, the methodology and the results of excavations in the areas selected (GS1, GS3 and ACGS) are discussed. Chapter 6 presents the results of pottery analysis. Chapters 7 and 8 present respectively the recovered glass and metal, with associated appendices on compositional analyses. Chapter 9 discusses other small finds. Chapter 10 presents the conclusions drawn from the research and considers the site of Gao Saney in its larger regional and West African context.

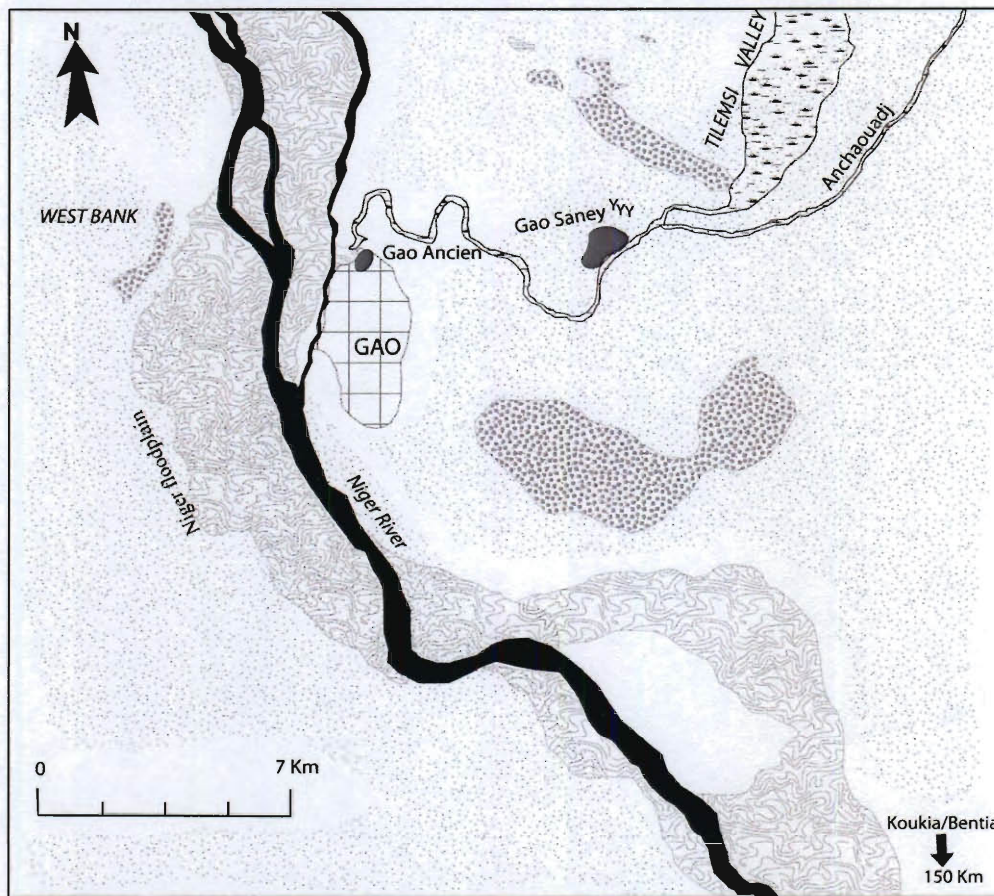
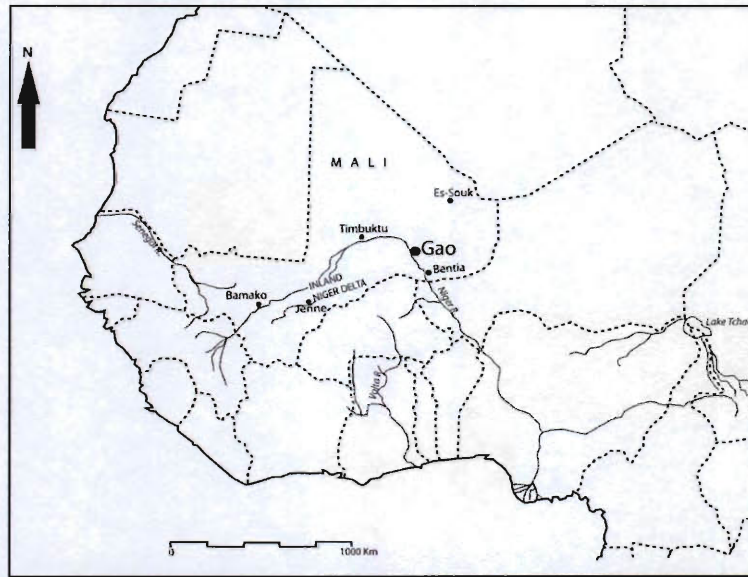


Figure 1.1. Maps showing Gao in West Africa (Top) and the location of Gao Saney and Gao Ancien (Bottom)

Chapter 2

THE GAO REGION: ENVIRONMENTAL CONTEXT, INHABITANTS AND HISTORY

ENVIRONMENTAL CONTEXT

Located in the northeastern part of Mali where the Niger River bends southwards, Gao lies within the Sahelian climatic zone (Figure 2.1). The Sahel is characterized by semi-arid tropical climate with high inter-annual variability and unpredictability, with which people must cope (McIntosh 1998: 69). Gao and its region receive an annual average of 300 mm of rain confined largely to July - September (Insoll 1996: 2; Togola et al. 2004a: 3). The maximal temperature often reaches 45°C, particularly during the long dry season stretching from October to June. During this dry period, the harmattan, a hot dry wind, blows constantly from the north, sometimes causing sandstorms that can significantly reduce visibility.

The region includes three major geomorphologic landforms and soil types: the floodplain of the Niger bend, the dunefield areas, and ancient channels and depressions (figure 2.1).

The floodplain zones. The floodplain of the Niger Bend is approximately 1–2 km wide near Gao. The soil types consist of clay and loam laid down during the annual floods. The area is extensively cultivated with rice as soon as the floodwaters rise in

December, fed by rain at source of the Niger in the Fouta Jallon highlands of Guinea. The floodplain zones are intensely occupied by the Songhay farmers who practice gardening of various products (carrots, tomatoes, peppers, squash, cabbages and papayas) alongside rice cultivation. Additionally, these sedentary populations keep small herds of cattle, sheep, goat and often camel. Floodwaters from the Niger produce a luxuriant growth of *borgu* (*Echinochloa stagnina*), a water weed harvested to feed cattle. Alongside the river, the vegetation also consists of some trees and spreading grasses including acacia type thorn trees and steppe strewn with Doum palms (*Hyphaene thebaica*) (Trimingham 1959: 2-3). The fauna includes antelope, buffalo and lion. The Niger River supports numerous aquatic animals including hippopotamus, crocodiles and manatee, and also many species of fish. The Songhay fishermen (the Sorko in particular) hunt these riverine animals in addition to fishing.

Since 1000 AD, drier climate periods have aggravated desertification and gradual atrophy of the river beds. In response to increasing desiccation, the floodplain becomes a natural refuge for populations. Nowadays, mobile sand dunes cover important parts of the river beds. Although still insufficient, many efforts have been made during the last decades to stabilize these mobile dunes by planting grasses and trees along the banks of the river. It is also noteworthy that many riverine mammals and also fauna in the riverside have become reduced in numbers due to over hunting and also the effects of the drought. It should be also noted that the laws now protect these endangered mammals by restricting their hunting.

Ancient channels and depressions. Among the ancient channels and depressions, there are the Wadi Gangaber, the fossil valley of Tilemsi, and the

Anchaouadj valley. The Tilemsi valley is a vast network of palaeochannels stretching over 700 km from the current city of Gao, on the Niger River to the Hoggar and the Adrar des Iforas mountains in the border between the Sahel and the Sahara. Gao Saney is located along the ancient channel, the Wadi Gangaber, which runs from the river at the Niger Bend up to the Tilemsi valley. Mauny (quoted in Flight 1975: 82) claimed that this ancient channel “may once have been navigable, so that Gao Saney stood then in the same relationship to Gao as Timbuktu to Kabara now”. It is likely that the Wadi Gangaber, now defunct, has been navigable for at least part of year with the improving wetter climatic conditions from c. A.D. 700-1100 (McIntosh 1998: 70 and 72; Insoll 1997: 12). The soil types in the paleochannel landform are generally clay laid down during the periods of improving rainy conditions by a succession of migrating courses of the Niger, which are now defunct and only filled with seasonal ponds. In certain areas, the deposits of these paleo-channels have recently been covered by shallow sheet of windblown sand. The vegetation consists of short spreading grasses and thorny acacias. During the short rainy season, grasses rapidly mature. The fauna comprises gazelle, ostrich, antelope, buffalo, giraffe and elephant (Smith 1980: 468).

The Tilemsi and Anchaoudj paleochannels have long been favored for occupation by millet-growing and stock-herding populations due to the seasonal presence of water. The Sahelian drought reduced this population to sparse villages of Bella and Harratine (servile populations of the Tuareg) around deep wells. These black sedentary farmers from the Tuareg groups practice small-scale cultivation of millet, wheat and sorghum. Generally, the Songhay communities inhabiting this area grow rice and other cereals in the interdunal depressions that are seasonally flooded.

The dunefield areas. The dunefield zones are located in the adjacent highlands to the floodplains and often occupied by stabilized sand dunes. The soils are generally thin and sandy with some laterite and sandstone exposures in certain areas. The presence of sand dunes, although many of them have been stabilized, is the evidence of the progression of the Sahara. The vegetation is characterized by the presence of discontinuous grass cover with cram-cram (*Cenchrus biflorus*) and acacia type thorn trees (*Acacia Senegal*, *Acacia radian*, *Leptademia pyrotechnica*, *Salvador persica* and *Grewia*) (Trimingham 1959: 2-3; Manning 2008: 15). Animal species include gazelle, ostrich, antelope, giraffe and desert fox (Smith 1980: 468). Unfortunately, many of these species are subject to local disappearance due to persistent drought and also hunting by local populations. Around the deep wells or near pools there are encampments of Moors and Tuareg /Tamashek nomads.

In this Sahelian region of seasonal and fluctuating rainfall, pastoralism is an important economic strategy (Galloy 1963: 11-34 in McIntosh 1998: 129). Each year, the nomadic Tuareg follow the annual transhumant cycle with their herds. This cycle is divided into three parts. During the raining season (July – September), the Tuareg and their herds move into the dunefield areas and the interdunal depressions. They go either to the north of the Niger Bend into the Azawad, Akle, Araouane and the Tilemsi regions or the south into the Gourma region to sustain their herds on the temporary grasses growing in these areas. During this rainy period, the Bella and Harratine, located in these zones, also collect wild plants such as fonio and cram-cram to supplement the milk-based diet of the nomadic Tuareg. At the end of the rainy season, the Tuareg and their herds move southwards to the lakes and rivers to coincide with the cold season flood. When the

flood starts to recede, they go to the Niger floodplain and the lake beds searching for the *borgu* that sustain the herds until the beginning of the rainy season. The Tuareg can go as far as the west to Macina in the Inland Niger Delta, where they compete with the Fulani groups for the *borgu*. When the rainy season begins, they return to their dune-fied zones and restart the transhumant cycle.

In sum, the diversity of geomorphologic landforms in the Gao Region is complemented by the extreme variations of climatic conditions over the last two millennia. Year by year variability, characterized by the oscillation of wet and dry episodes, has constrained the populations to develop strategies appropriate to this environment. The consequence of the inter-annual variability and unpredictability of the climate is that we saw a complex distribution of different ethnic groups (the Songhay farmers and Tuareg and Maure Nomads in particular) within the various landforms locating in the region. The development of agriculture, herding and fishing complemented with craft activities by the various ethnic groups of the region is of great importance in order to manage their socio-economic conditions.

ETHNIC GROUPS

The discussion of ethnicity is very complex because each group has many subgroups. It happens sometimes that some people of these subgroups can have contracted an intermarriage alliance with other different ethnic groups or abandoned most of their cultural practices and languages but still think that they belong to the original ethnic group. This discussion is not intended to reconstruct historically a given ethnic group. It mainly focuses on ethnicity through the lens of environment and occupation. The main

ethnic groups in Gao Region include the Songhay (sedentary farmers) and the Tuareg/Tamasheq and Moors (nomadic pastoralists) [Figure 2.2]. This discussion emphasizes the Songhay group because they are particularly associated with the historical development of Gao.

The Songhay. The Songhay-speaking populations (all groups) numbered over 3,000,000 in 1999 (PanAfriL10 web archive) (Table 2.1) presents the variations of Songhay speaking populations from 1930 to 2009.

Table 2.1. Population estimates for Songhay from 1930–2009

Period	Songhay population estimate	Songhay population in French Sudan/ Mali	Sources
1930	540,000		Urvoy (1942 in Rouch 1954: 6)
1950	652,500	192, 500	Rouch (1954: 6-8)
1975	620,000	200,000	Cuoq (1975: 177 in Insoll 1996: 3)
1998/1999	3,000,250	588,654	PanAfriL10n (1999)/ DNSI Mali (census 1998)
2009		871,030	DNSI Mali (census 2009)

Songhay populations generally live in both urban and rural areas, particularly in the Timbuktu and Gao regions. However, they are primarily urban dwellers in the Inland Niger Delta (e.g., Jenne and Ja).

Songhay society is highly stratified. The various sub-ethnic groups are mainly categorized according to their occupation, status and territory (McIntosh 1998: 126). They are Sorko (fisherfolk), Arma (noble), Gabibi (free farmers), banniya (captives and slaves), Gow (hunters) and Sohance (magicians) [Hunwick 1994: 254; McIntosh 1998: 126]. Fono Sorko of the Erg of Bara and Faran Sorko further down river are the most obvious territorial distinctions (McIntosh 1998: 126).

The Songhay communities are mainly sedentary farmers practicing rice, millet and sorghum cultivation. Villages along the Niger River contain also many garden plots in which are grown, for instance, carrots, tomatoes, peppers, squash, cabbages and papayas. Fishing and hunting (riverine mammals in particular) are also of importance. As Masters of Niger River transport (like the Bozo ethnic group in the Inland Niger Delta), the Sorko sub-group are well known as hunters of hippopotamus, crocodiles and manatees. Generally, the Sorko settlements were concentrated along the Niger in areas densely populated by these aquatic mammals (Rouch 1954: 21). Nowadays, due to laws restricting the hunting of these endangered mammals, the Sorko practice fishing with fishnets or farming activities alongside their traditional activity. Fishing is also the main activity of the Korongoy (a minority group similar to the “Somonos” in the Inland Niger delta) who practice netfishing. The Gow sub- group are hunters generally located in areas rich in elephant, ostrich, buffalo, giraffe, gazelle, antelope and lion (Rouch 1954: 23).

Craft activities are also of importance in Songhay society. Rouch (1954: 23) made the differentiation among artisan groups who are casted or not. Casted artisans include those who work with iron, wood, pottery, leather, and cotton. Among the artisans who are not considered as castes are masons, barbers, tailors and net makers. La Violette (2000: 21), who studied the Songhay artisan families in Jenne, mentions that, except for the masons, the majority of the Songhay artisans (goldsmiths, carpenters and blacksmiths, tailors and embroiderers, slipper makers) are linked to the Arma -- nobles who identify themselves as descended from Moroccan conquerors. According to La Violette (2000: 21 citing Abitbol 1979: 181-182), the Arma group had the monopoly on shoe-and slipper-making and embroidery of those items in Timbuktu from the seventeenth to nineteenth

centuries AD. Nowadays, they continue to practice this same activity in Jenne (La Violette 2000: 21). Generally, locals consider artisans other than slipper makers and embroiderers as “slaves of Arma”. La Violette (2000: 21) points out that the crafts of these later became “noble by association, and have become included in Arma artisanry over time”.

Occasionally, the Songhay farmers own small herds of cattle, sheep and goat, and also horse. These herds are entrusted either to the nomadic Fulani or to the young people from the village, who keep them in the pasture every day. Islam is the dominant religion in the region, although animism is still practiced in some areas (Insoll 1996).

The early history of the Gao kingdom is closely connected to the Songhay ethnic group, the origin of which is poorly known despite the presence of oral traditions and numerous historical documentations including the accounts of medieval Arab chroniclers and the two seventeenth century Tarikhs (Tarikh Es-Soudan and Tarikh El-Fettash) [Levtzion & Hopkins 1981; Cuoq 1975, 1985; Hunwick 1999; Kati 1913].

Many scholars have put forwards hypotheses for the origins of the Songhay. Rouch (1954: 8) claims that they originated from the east, perhaps in the Chad basin along the Benue. Boubou Hama (1968 in Cissoko 1996: 155) suggests that the Songhay came from the Sahara in the Air region, where they interbred with Berber Tuareg before migrating southward. Hunwick (1999: xxxiii), on the other hand, claims that they migrated from the south in the Dendi region (south of Niger and north of Benin and Nigeria).

However, according to oral traditions and various Arabic historical accounts, the cradle of the Songhay is situated along the Niger Bend, particularly in the Gao hinterland

(Kati 1913; Es-Sa'di in Hunwick 1999). The spread of the Songhay from their heartland (Niger Bend) happened during the apogee of the Songhay Empire (15th – 16th centuries AD) under the rule of the Sonni and Askia dynasties. In the conquered areas, particularly in the major trading towns (e.g., Jenne), Songhay military domination was followed by a massive occupation of these towns by the Songhay populations and the spread of Songhay language. However, Rouch (1954: 12) argued that the diffusion of the Songhay language was also due to its ancient use by the Sorko fishermen, who spread the language along the Niger.

The classification of the Songhay language long remained uncertain. Rouch (1954: 14) provided a summary of the various provisional classifications for Songhay prior to 1950. But a widely agreed upon classification was not forthcoming until Greenberg's (1966:130) assignment of Songhay to the Nilo-Saharan group. Within this group, the Songhay language has been further divided into two main dialect groups: northern and southern (PanAfriL10 web archive). The southern Songhay group is primarily distributed along the Niger River from Jenne in Mali through western Niger (where it is known mainly as Zarma or Djerma) to the north of Benin and the northwest of Nigeria (where it is called Dendi). It is also spoken in Agades (Niger), Humburi Mountains (Gurma, Mali), Dori (Burkina Fasso) and Salaga (Ghana). Nicolai (1981 in PanAfriL10 web archive) has found a total of six major dialects of Southern Songhay. Ethnologue website, on the other hand, mentions the presence of five major dialects (Dendi, Zarma, Songhay Humburi Senni, Songhay Koyra Chiini and Songhay Koyraboro Senni) [Figure 2.2]. The historical development of these dialects shows that they become a “mixed language” after contacts with other neighboring or commercial languages. For

instance, Jenne chiini, the Songhay variety spoken at Jenne is mutually intelligible, but presents significant differences with Koyra chiini spoken in Timbuktu and Lakes Region because of its borrowings from neighboring languages such as Fulfulde, Bozo and Bamanan. Similarly, Songhay Humburi Senni spoken in Humburi region, and also some of the Koyraboro Senni dialects, spoken roughly from Gao to the Mali–Niger border, have borrowed from Fulfulde (Ethnologue web archive). Dialects from Hausa and Songhay blend in Zarma (Rouch 1954: 12).

The northern Songhay group, on the other hand, is divided into two major dialects: Tadaksahak spoken by nomads in the Menaka region (Mali), and Tasawaq spoken by the sedentary populations in the region of In-gall, around Abala and Abalak (Niger). Additionally the sedentary peoples at the Tabelbala oasis (southern Algeria) speak an independent dialect called Korandje (Nicolai 1981 in PanAfriL10.webarchive; Ethnologue Web archive). These dialects present features of Songhay and Berber languages (Nicolai 2009). According to Nicolai (2009), the northern Songhay speakers integrate numerous Berber patterns in their dialects because of “their bilingualism and loss of contact with the traditional Songhay speaking communities”.

The Tuareg /Tamasheq. These Berber speakers are now distributed between Timbuktu (Mali) and Bilma (Niger), Kano (Nigeria) and In-Salih (Algeria) and southwest Libya [Insoll 1996: 4]. In 2009, the populations of Tuareg numbered approximately 1.5 million in Mali (DNSI Mali 2009). The Tuareg are a highly hierarchized society. They are *Imajaren* (nobles), *Kel Essouk* (holymen or marabouts), *Inadan* (free artisan), *Imrad and Debakar* (freemen), *Bella* (servile population), and *Harratine* (slaves) [Smith 1980: 468; Insoll 1996: 4; McIntosh 1998: 129]. The Tuareg communities are Muslim. They

are nomadic pastoralists practicing annual transhumance with their cattle and camels between the dunefields and the lakes and river. According to oral tradition, Tuareg were in the Adrar des Iforas during the collapse of Songhay Empire in the sixteenth century. They took advantage of the political disorder caused after this to move along the river and into the northern part of the Lakes Region.

The origin of the Tuareg is poorly known. They are of Berber origin, speak the Tamasheq language and use a Berber alphabet (*tifinagh*). Many scholars claim that the Tuareg are descendants of the Libyco-Berber groups in the Saharan rock art and inscriptions (e.g., Camps 1987: 48-91 cited in McIntosh 1998: 127). Camps (1980, 1974 in Blench 2001: 177), who originally uses the terms paleoberbers (ancestral populations of Berbers until about 4000 BP) and protoberbers (immediate ancestors of modern-day Berber populations), suggests that the Berbers were rooted in the “Caspian Neolithic”, livestock producers whose traces were evidenced in numerous north African sites including Haua Fteah (Libya), Relilai, Mechta-al-Arbi, Columnata and Ain Keda (Algeria) and also some Tunisian sites. However, Blench (2001: 176) argues that only small stock, not cattle have been found in the earliest phases at these sites, particularly at Haua Fteah, which is one of the most significant sites for understanding the development of livestock production. He also argues that linguistically, there is no evidence that the Garamantes (southern Libya) spoke Berber. According to him, the “Old Numidian” inscriptions, engraved on rocks in North Africa, provide the earliest concrete evidence for Berber since the script used was the Tifinagh of the Tuareg (Blench 2001: 176). He claims that the Berbers were “well established and widespread by 200 BC” (Blench 2001: 176). Blench’s claim needs more attention since the Tifinagh script is known as one of

the ancestors of modern-day Berber scripts. Until the discovery of new evidence, the origin of Berber needs to be associated with this Tuareg old script.

The Moors: The Moors are nomadic pastoralists herding generally camels. They belong to Berber groups, speak Arabic, and practice Islam. The Moors are found in the southern Sahara, the Middle Niger and the Middle Senegal. They are a minority community in the Gao Region.

In addition to these major ethnic groups, small communities of Fulani, Bozos, Dogon, Bambara and Hausa are found in the Gao Region.

HISTORICAL DEVELOPMENT

The Gao Region has been occupied since at least the Late Stone Age. We must look to archaeology for the data necessary to document the settlement history of Gao and its region from the Late Stone Age to the first millennium AD, when historical documentation first becomes available.

During the historical period (second millennium AD), our broad understanding of the early settlement of the Gao Region and its development has been provided by oral traditions and historical documents. Songhay oral traditions and the early historical sources including those written in Arabic in the Maghreb, Egypt and Andalusia during the medieval period and the two seventeenth-century Songhay chronicles written in Arabic (Tarikh Es-Soudan and Tarikh El Fettash) provide us with some details, and often contradictory descriptions of Gao, although these various sources provide some invaluable information about Gao and Songhay history. In the course of interpreting the bulk of information provided by these sources, several issues have been raised. They

include the area of origin of the Songhay, the origin of Gao and the settlement mound of Gao Saney, the location of the first settlement at Gao and its vicinity, the location of the dual towns of Gao, the ethnic composition of the first rulers, and also the settlement of the dynastic rulers commemorated upon some of the engraved steles of Arabic inscriptions in the Gao Saney cemetery. All these issues are challenging for both historians and archaeologists. Because of the presence of some contradictions in the accounts of historical chroniclers, archaeology provides valuable independent data that permits us to cross-check and reinterpret historical sources in order to reconstruct the history of Gao. It should be noted that archaeology also documents some aspects of the remote history of Gao, which pre-date historical records.

In this section, the origin and the development of Gao and the Songhay dynasties according to oral traditions and historical sources will be first outlined. The discussion of the issues concerning the ethnic identity of early rulers and the location of the Kings commemorated upon the inscribed steles at Gao Saney cemetery will follow.

The origin and the development of Gao and the Songhay dynasties

As already mentioned above, there are several versions concerning the origin of Gao and the Songhay (Kati 1913; Rouch 1954; Hama 1968; Lange 1994; Hunwick 1994, 1999). These versions were particularly based upon the Songhay oral traditions and the accounts of the seventeenth-century *Tarikh El Fettash* and *Tarikh Es-Sudan*. The interpretations of oral traditions with their cult legends, epic tales and myths have been a subtle art for historians. Although invaluable, the history recorded in local chronicles was intended to portray one facet of historical events incorporating early traditions, legends, wars and a

chronological history of a succession of rulers. Rouch (1953, 1954), who sticks closely to oral tradition accounts and the information provided by the local Arabic chronicles, mentions that the history of Gao and the Songhay are closely connected to the River Niger and the immigration of the Sorko fisherfolk. He argued that Sorko migrating from the Chad Basin along the Benue occupied the Songhay hinterland downstream of Gao (Rouch 1954: 8) [Figure 2.3]. In association with the Gow (riverside hunters), they assimilated the Voltaic-speaking autochthonous populations (Koromba and Do) and then became “masters of water, rulers of farmers and owners of the earth” in the Kukiya (Bentia) region (Rouch 1954: 8; Levtzion 1985: 150; Hunwick 1999: xxxiii). After dominating these locals, the Sorko fishermen established a settlement at Kukiya. In the seventh century AD, Lamta Berbers occupied Kukiya and founded the Za dynasty (Rouch 1954: 8; Delafosse 1972: 61-63). This later information, which was based on the accounts in *Tarikh Es-Sudan*, was mythologized in the legend of the Yemeni brothers who arrived at Kukiya and established relations with locals and became their chiefs (Es-Sa’di in Hunwick 1999: 6). As Trimmingham (1962: 4) correctly points out, the tradition that the rulers originated from Yemen, which generally means from the east, is associated with “the influence of Islam, which tends to dilute and often wipe out memory of pre-Islamic tradition”. The Sorko, under the leadership of Fara Makan Bote, were pushed out of Kukiya by the Za rulers, after which the Sorko founded Gao about AD 690 in collaboration with their allies, the Gow hunters (Rouch 1954: 9). The occupation of the Gao region extends well back in time before the first millennium AD chronology of the Sorko tol here, however.

By the eighth century AD, North African traders arrived on the western bank of the river at Gao, and initiated trading activities with local populations, Sorko in particular, located on the other side of the river (Hunwick 1999: xxxiv; Levtzion 1985: 150-15). This interpretation is based on the account provided from the “*Notice Historique*” in *Tarikh El Fettash* (Kati 1913: 329-331). This Notice also provides an account in form of legend in which it is mentioned that a giant stranger from Yemen settled on the left bank of Niger, intermarried with the local populations of Gao on the right bank and established the trade activities, and later became their chief. Hunwick (1999: xxxiv) argues that the claim of Yemeni origins in this narration was likely introduced through contact with the Sanhaja Berbers, who assert that their ancestry originated from Yemen. As we can see, there is a conflicting claim between the two *tarikhs*: *Tarikh Es-Sudan* mentions that the legend happened at Kukiya while *Tarikh El Fettash* places the events at Gao. A common ground concerning the presence of “Yemeni” strangers who established contacts with locals and later became their rulers exists in both of these tales, however. Based on the accounts provided in *Tarikh Es-Sudan*, some scholars (Hunwick 1999: xxxiv; Levtzion 1985: 151) mention that the Songhay rulers at Kukiya moved to Gao to dominate the trading activities between the inhabitants of Gao and the Berber traders. However, Hunwick (1999: xxxv) argues that the transfer of Za rulers from Kukiya to Gao occurred earlier (late eighth–early ninth century AD) than the period mentioned in *Tarikh Es-Sudan* (eleventh century AD). A close trading connection was established between the Gao kingdom and the Kharejjite state of Tahert (West Algeria) after the foundation of this later state in the late eighth century AD (Levtzion 1985: 151).

From the early ninth century, Arabic historical sources described the Gao kingdom (known as Kaw-kaw) as a powerful trading kingdom. The interpretation of these sources is difficult because many points in their narrations are confusing. They present only a partial account depending upon the type of information received and the author's judgment. The problems often encountered include, for instance, unrecognizable toponyms, confusion of sites, second-hand information and contradictory information (Levtzion & Hopkins 1981; Cuoq 1985).

The Mesopotamian geographer Al Khuwarizmi, who died in AD 846/7, provides the earliest mention of Kaw-Kaw (Levtzion & Hopkins 2000: 5). In AD 872, the Arab geographer, Yakubi, described the kingdom of Kaw-Kaw as "the greatest of the realms of the Sudan, the most important and powerful. All other kingdoms obey its king" (Levtzion & Hopkins 1981: 21; Cuoq 1985: 52). By the tenth century, the Gao kingdom flourished and established its hegemony over populations living on the trade routes from Gao to Tadmakkat, and also from Ancient Ghana to Air (Hunwick 1999: xxxiv). In AD 985, the Egyptian chronicler Al-Muhallabi attested the existence of the dual towns of Kaw-Kaw: the royal town with its palace and treasure houses filled with salt was on the west bank of the river, and the market town of Sarnah with its trading houses on the east bank (Levtzion & Hopkins 1981: 174; Cuoq 1985: 77-78). Al-Bakri (AD 1067/8) confirmed the presence of the dual towns of Kaw-Kaw (one royal and one Muslim), and also recorded the importance of salt, which was used as currency at Kaw-Kaw and its region. He also recorded the provenience of salt (the underground salt mine at Tutak) and salt trade between the Berber country and Kaw-Kaw (Cuoq 1985: 108; Levtzion & Hopkins 2000: 87).

The accounts concerning the location of the twin towns (West Bank and East Bank of the river) raise some questions because of the possibility that two rivers (Niger River and Wadi Gangaber) were in use during the periods of improving wetter climatic conditions from the first millennium AD to the beginning of second millennium AD (McIntosh 1998: 70 and 72). The consequence is that we may be wrong if we assume that the Arab authors meant the Niger. Many scholars claim that the residence of the King and the trading town of Sarnah are both situated on the eastern bank of the Niger (Lange 1994: 282–284; Mauny pers. Comm. 08/28/1990 in Lange 1994: 284). According to them, it was the Wadi Gangaber, and not the Niger river which separated these twin towns identified as Gao Ancien (Old Gao) on the right bank of Gangaber, and Gao Saney on its left bank. Gao Saney is a likely candidate for the trading town of Sarnah (Levtzion and Hopkins 1981: 174). Although the various archaeological investigations undertaken at Gao Ancien led us to believe that the site was the town of the early Gao rulers, its location on the left bank of the Niger poses a problem. However, if we admit that the medieval authors may have been referring to Gangaber instead of the Niger River, this problem is resolved.

It should be also noted that no major intensive archaeological investigations have been conducted on the western bank of the Niger River to search for sites. However, recent archaeological survey along the right bank (west bank) of the river has shown the presence of some large settlement sites such as Tchado located 2 km south from Koima (Togola et al. 2004a). Further investigations on the west bank of the river, particularly at Tchado may provide clues for searching the early royal city of Kaw-Kaw.

Based on the funerary steles in Almerian marble carved in Andalusian kufic script in the Gao Saney cemetery, Hunwick (1994: 253; 1999: xxxiv-xxxv) suggests that Berber Sanhaja inspired by Almoravid ideology conquered Gao and established at Gao Saney a short-lived domination over the kingdom in the eleventh century. The engraved marble steles in the Saney cemetery date to the twelfth century AD, and some of these came from Andalusia suggesting that the rulers of Gao had some contacts with Spain (Sauvaget 1949; 1950: 418-440; Vire 1959: 459-500; Levtzion 1985: 151; Farias 1990: 73- 77).

Lange (1994: 275, 283; 2004: 411) used the kinglists in the *Tarikhs of El Fettash* and *Es-Sudan*, and also the data on some steles in the Saney cemetery, to challenge Hunwick's suggestion. He argues that local Berber traders, in connection with certain local Muslims who affiliated with the ruling power, seized power from the Za kings of Gao Ancien – who he claims were not Songhay, but Mande – at the peak of the Almoravid movement in the eleventh century AD, and ruled as a continuation of the Za dynasty from Gao Saney. The cemetery of Gao Saney yielded inscribed steles of Arabic inscriptions naming the rulers of Za dynasty and their family (Sauvaget 1950: 418-440; Vire 1959: 459-500; Levtzion 1985: 151; Farias 1990: 73-74). This interpretation supposes that occupation at Gao Saney extended into the twelfth century if not later.

Except for the kinglist of the Za kings provided by *Tarikh Es-Sudan* and *Notice Historique* in *Tarikh El Fettash* (Es-Sa'di in Hunwick 1999; Kati 1913), historical sources tell us little information about the history of Gao from the period of the establishment of Gao Saney as the capital of the Gao kingdom (eleventh century AD) to the era of the domination of Gao by the Malian Empire (thirteenth century).

From the mid-thirteenth century to the end of the sixteenth century, when the Songhay Empire collapsed, the narration of the history of Gao is mainly based on the Arab historical sources, the local chronicles written in Arabic and the documentation of the early European travelers as well. In its attempt to control the active trading entrepôts located along the Sahelian corridor, the empire of Mali extended its hegemony over Gao and its region from the mid-thirteenth century (Figure 2.4). Gao was of particular interest to the Malians because of its links to North Africa, the copper mines of Tegidda, and Egypt (Levtzion 1985: 152; Hunwick 1999: xxxvii). About AD 1275, during a period of troubles in Mali, Songhay revolted under the leadership of Ali Kolon and founded the Sonni dynasty, replacing the Za dynasty. However, the hegemony of the empire of Mali in the Gao Region continued until the fifteenth century AD. This was attested by the visit of the Malian Emperor, Kanku Musa, to Gao on the way back from his legendary pilgrimage to Mecca in 1324 (Es Sa'di in Hunwick 1999: 10; Mauny 1961: 113). Ibn Batuta also visited Gao in 1353. He mentioned that it was “one of the most beautiful, biggest and richest towns of Sudan” (Cuoq, 1985: 316).

By the fifteenth century, Gao established its independence from Mali Empire under the Sonni dynasty. The 18th Sonni, Sonni Ali Ber (or Ali the Great 1464-1492), expanded Songhay kingdom into an empire with the aim to control the entire Middle Niger, and the gold trade passing through Jenne and Timbuktu (Levtzion 1985: 152; Rouch 1954: 9; Hunwick 1999: xxxix; Es-Sa'di in Hunwick 1999: 8; Kati 1913: 81-113). In AD 1493, after a brief reign by the last Sonni, Askia Muhammad took power and founded the Askia dynasty. Under Askia Muhammad (1493-1529), the Songhay Empire flourished and stretched from the river Senegal (west) to the Air massif (east), from

Borgu (south) to the salt pans of Taghaza (north) (Es-Sa'di in Hunwick 1999: 102-117; Kati 1913: 106-114) [Figure 2.4]. This territorial expansion (1,400,000 Km²) aimed to monopolize the gold-salt trade, which provided part of the fortune of the empire (Hunwick 1999: xli). Tarikh El Fettash mentions that the population of the trading entrepot of Gao numbered over 100,000 at that period (Kati 1913). Askia Muhammad died in AD 1538 and his successors (eight in total) failed to maintain the integrity of this vast Songhay Empire and the allegiance of tributary rulers fell apart (Rouch 1954: 10).

The Moroccans invaded the Empire in 1591 in order to have exclusive control over the Taghaza salt mines and also the gold trade. This invasion precipitated the collapse of Gao. However, Timbuktu, the city of the authors of the Tarikh El-Fettash and Tarikh Es-Sudan became one of the most prestigious cultural and intellectual centres in Western Africa during the seventeenth century (Es-Sa'di in Hunwick 1999: 52-90; Kati 1913).

Although the information provided by the various historical sources about Gao is invaluable, the picture they provide is incomplete. They focus more on the political development of Gao particularly under the Songhay Empire during the medieval period (e.g. Es - Sa'di in Hunwick 1999; Kati 1913; Levtzion & Hopkins 1981). In the course of their narration, these sources were often confused and provided much contradictory information. This is due to the fact that most of the medieval Arab chroniclers had never visited the places they mentioned in their documents, and relied exclusively on second hand data from informants. Even the narration of those writers who visited the areas (such as Ibn Battuta) was not clear sometimes (e.g. the name of some visited towns are unclear). Inevitably, such information written in these historical records provides a basis

of numerous conflicting claims. Among these claims, there are, for instance, the origin and the ethnic composition of early Kaw-Kaw rulers and the location of the Kings commemorated upon the inscribed steles at Gao Saney cemetery. These are discussed below.

The origin and ethnic identity of early Kaw-Kaw rulers and their location

In the course of interpreting the origin and the ethnic composition of early Kaw-Kaw rulers, a conflicting claim arises between Dierk Lange and John Hunwick. Their claims were based on the inscribed steles of the dynastic twelfth-thirteenth century rulers found in the Gao Saney cemetery and the medieval Arabic sources, particularly the Za (Zuwa) kinglist provided by the seventeenth century local Tarikhs. The kinglist and the individuals commemorated upon the Saney inscribed steles are provided in Table 2.2.

Lange (1991: 269; 1994: 276, 288; 2004: 404) argues that the origin of the rulers of early Kaw-Kaw (the Za kings) were Mande, and the Mande institutions of Gao called “the Kanta/Qanda dynasty of Gao Ancien” were changed only after the arrival of Sorko and Songhay ethnic groups in the first half of the fifteenth century. According to him, these Mande rulers settled at Gao Ancien on the left bank of the Niger until the eleventh century, the period during which the local Berber traders seized power in the name of Islam and ruled from Gao Saney under the Za dynasty (Lange 1994: 275, 283; 2004: 411).

Hunwick (1994: 253), on the other hand, argues that early Kaw-kaw belonged to Songhay-speaking world. The Songhay originated from the Dendi region (Niger–Benin–Nigeria borders) before migrating to the Kukiya/Bentia region. According to him, the Za

Table 2.2. List of the Za kings in the Tarikh Es-Sudan and El-Fettash; and names of individuals on the inscribed steles in the Gao Saney cemetery (Sources: Farias 1974a, 1990, Flight 1978, al-Sa'di in Hunwick 1999:3-4; Kati 1913)

King #	Za /Zuwa Kinglist (Tarikh Es-Sudan)	Zuwa kinglist (Tarikh El-Fettash)	Name of individuals on the epitaphs
1	Alayman	El-Yemen	Makkiya (?) ibn Hasan al-Hajj (1088)
2	Zakoi	Oua'ai	Al-malik Abu Abd Allah Muhammad ibn Abd Allah ibn Zaghi (494/1100)
3	Takoi	Kaien	Muhammad ibn al-Jumca (496/1103)
4	Ikoi	Takai	Al-malika Swa (502/1108)
5	Ku	Mata-Kai	Al-malik Abu Bakr ibn Abu Quhafa (503/1110)
6	Ali Fay	Mali-Biyai	Muhammad ibn Idris (?) (504/1110)
7	Zuwa Biyay Kumay	Biyai-Kima	Sulayman ibn al-malik (507/1113 or 509/1115)
8	Bi/Bay	Bei	A'isha bint al-malik Kuri (511/1117)
9	Karay	Kirai	Al-malika Msr (513/1119)
10	Yama Karaway	Yama-Kalaouai	Al-malik Umar ibn al-Khattab alias Yama ibn Kma ibn Zaghi (514/1120)
11	Yuma Dunku	Yama-Dombo	Muhammad ibn Muhammad ibn ...Sulayman (517/1123 Or 519/1125)
12	Yuma Kibu'u	Yama-Dianaa	Hawa bint Muhammad (534/1140)
13	Kukuray	Diatakore	Bariqa bint Kuri (534/1140)
14	Kinkin	Kotso-Moslem	.. Bint Knki ibn al-malik (536/1142)
15	Kusoy	Kotso-Daria	Layla bint Muhammad ibn Abdun (542/1147)
16	Kusur Dari	Hounabonoua-Kodam	...bint Nmi (540/1147)
17	Hin Kun Wunka Dum	Yama-Kitsi	Al-malik Fnda ibn Arbuni ibn Zaghi (600/1203)
18	Biyay Koi Kima	Barai	Zwa (648/1250)
19	Koy Kimi	Bibai-Keina	Yama Kuri ibn al-malik Zwa (?) (663/1264-5)
20	Ninta Sanay	Simanbao	Nmi bint Swa
21	Biyay Kayna Kinba	Fanda-Diaroa	Humayd
22	Kayna Shinyunbu	Yama-Daa	Muhammad Ibn Abu I-Qasim
23	Tib	Arkour-Dioua	
24	Yama Dao	Barai	
25	Fadazaw	Yassi-Bo'o	
26	Ali Kur	Baro	
27	Ber Falaku	Douro	
28	Yasiboy	Bitsi-Baro	
29	Duru		
30	Zunku Baru		
31	Bisi Baru		
32	Bada		

dynasty started its existence at Kukiya. In the late eighth century AD, the Songhay chief moved from Kukiya to Gao, on the right bank of the river, in order to control the trading activities conducted between North African traders and local Songhay populations. The Berber Sanhaja Masufa in connection with the Almoravids, seized power at Gao Saney briefly in the eleventh century to control the trade between Gao, Wargla and Almoravid Andalusia (Hunwick 1994: 253; 1999: xxxiv-xxxv).

Regardless of the arguments provided in these two claims, it is important to note that, strategically and economically, the trading town of Gao was of importance because it was situated on the main trans-Saharan crossroad linking North to South. Additionally, the Gao kingdom was located between Audaghust and Ghana, on one hand, and Tadmekka, on the other hand. All these major towns were already under the control of the Almoravids in the mid-eleventh century (Levtzion & Hopkins 1981; Cuoq 1985). Taking into account all these considerations, the trading kingdom of Gao had little chance to escape the turbulence caused by this vast Almoravid movement.

It is also noteworthy that scholars have classified the medieval epigraphs of the Saney cemetery into three groups: Almerian inscriptions, local imitations of those Almerian inscriptions and locally-manufactured with little or perhaps no connection with Almerian inscriptions (Farias 1990: 74; Sauvaget 1948: 5-6; Vire 1958: 368-76; 1959: 461, 471). According to Farias (1990: 73 – 74), the highly artistic Almerian inscriptions in relief were in use at the cemetery from AD 1100 – 1120. These marble steles were generally designated for Saney royalty. For instance, the marble epitaph of king Muhammad b. Abdallah b. Zaghi dated 494 A.H./ 1100 A.D was one of the earliest inscribed marble steles introduced into Saney cemetery from the Iberian Peninsula

(Sauvaget 1950: 419 in Farias 1990: 72-73). However, there is evidence that the marble steles from Almeria were used to commemorate non-royals, such as the judge, *qadi* Yusuf (Farias 1990: 74; Flight 1981: 100). It is undeniable that evidence of these imported marble steles from Almeria in the Saney cemetery is one argument in favor of the development of close relationship between Andalusia and the Gao Kingdom from the late eleventh century AD.

Since no earlier royal epitaphs have been recovered from Gao Saney cemetery before the apogee of the Almoravid movement, one can understand Hunwick's argument (1985: 9–11) according to which the inscribed Almerian marble steles reflect “ the emergence of a new usurper dynasty”, the Sanhadja Berber, supported by the Almoravids in the eleventh century. However, it is hard to assess whether the commemorated Gao kings at the beginning of the twelfth century belonged to the Sanadja Berber or other ethnic groups since their ethnicity is not clear from the inscriptions. There is also a possibility that some of the locally produced inscribed tombstones, dating to the thirteenth century onwards, were used to commemorate the Za kings and their family (for instance, the tombstone of the prince Yama Kuri b. al-malik Rwa/Z.wa dated to 663 A.H/ 1264-5 AD) [Farias 1974a: 516-517; Flight 1978: 16; Hunwick 1994: 268; Lange 1991: 277].

Where did these dynastic rulers commemorated on the Gao Saney cemetery steles, live? We know that many scholars (both historians and archaeologists) who conducted some investigations in Gao and its vicinity have put forward the hypothesis that the kings of the Za dynasty lived on the settlement mound of Gao Saney at least from the eleventh to thirteenth centuries (Flight 1979; Lange 1991, 1994; Hunwick 1994;

Farias 1990; Insoll 1997), based on the stele dates in conjunction with historical records. However, historical sources have only mentioned the beginning of the occupation of the tell (11th century AD) by the Gao kings, but they failed to mention the chronological length of the dynastic rulers at Gao Saney, and also the origin and the abandonment of the settlement.

In addition to these questions related to Gao Saney, historical sources can tell us very little about the origin of Gao as a trading kingdom. The challenge for archaeology is to clarify some important issues concerning the chronology, the types of activities and also the development of early exchange networks between Gao and other areas. To what extent are we able to reconstruct the origin and the development of early trade and urbanization at Gao and its region during the first millennium? This constitutes an issue that unfortunately has not been much investigated in the course of prior archaeological research in Gao and its vicinity. These investigations are discussed in the next chapter.

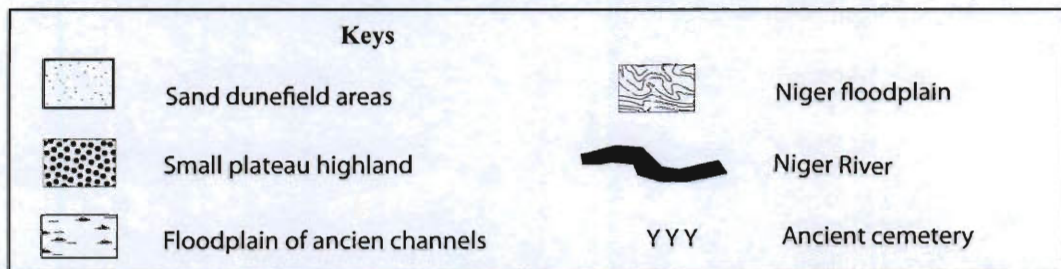
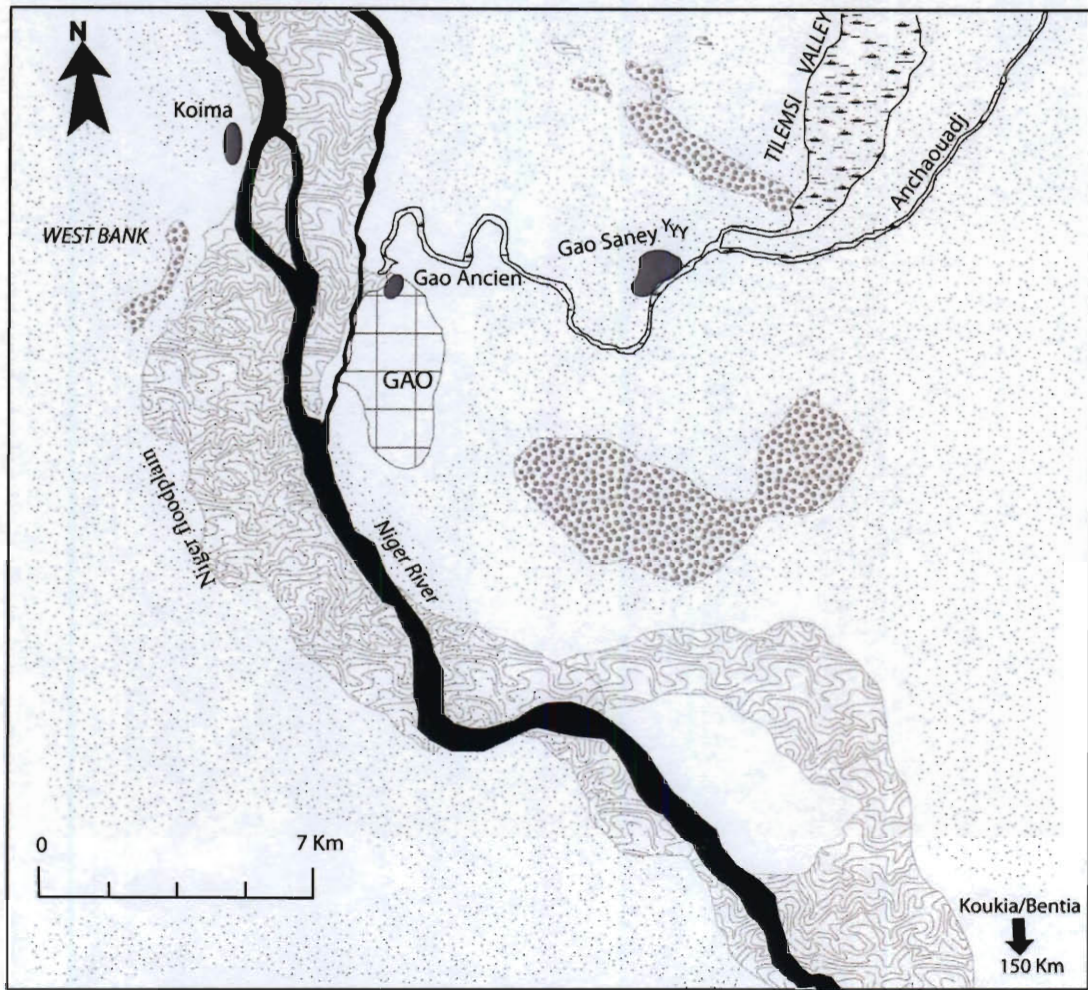


Figure 2.1. Map showing the major geomorphologic landform in the vicinities of Gao

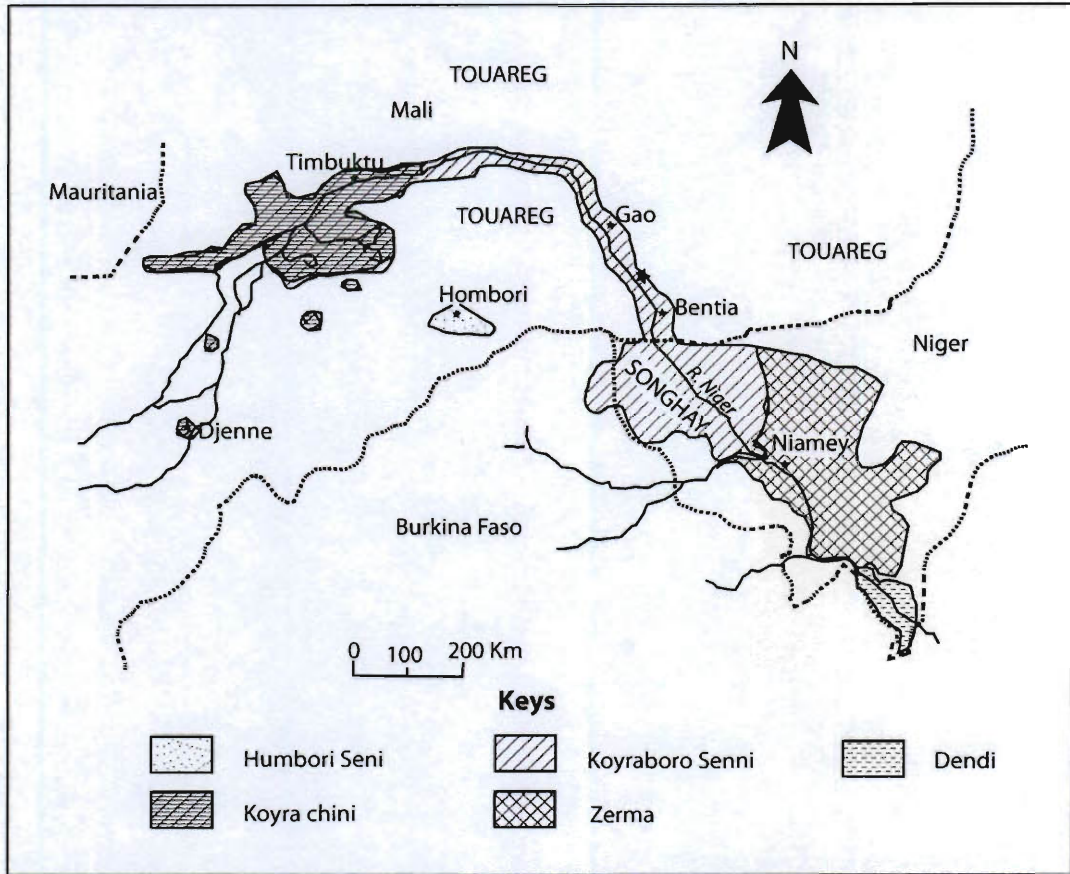


Figure 2.2. Map of the major dialects of southern Songhay language (Adapted from Nicolai 1981)

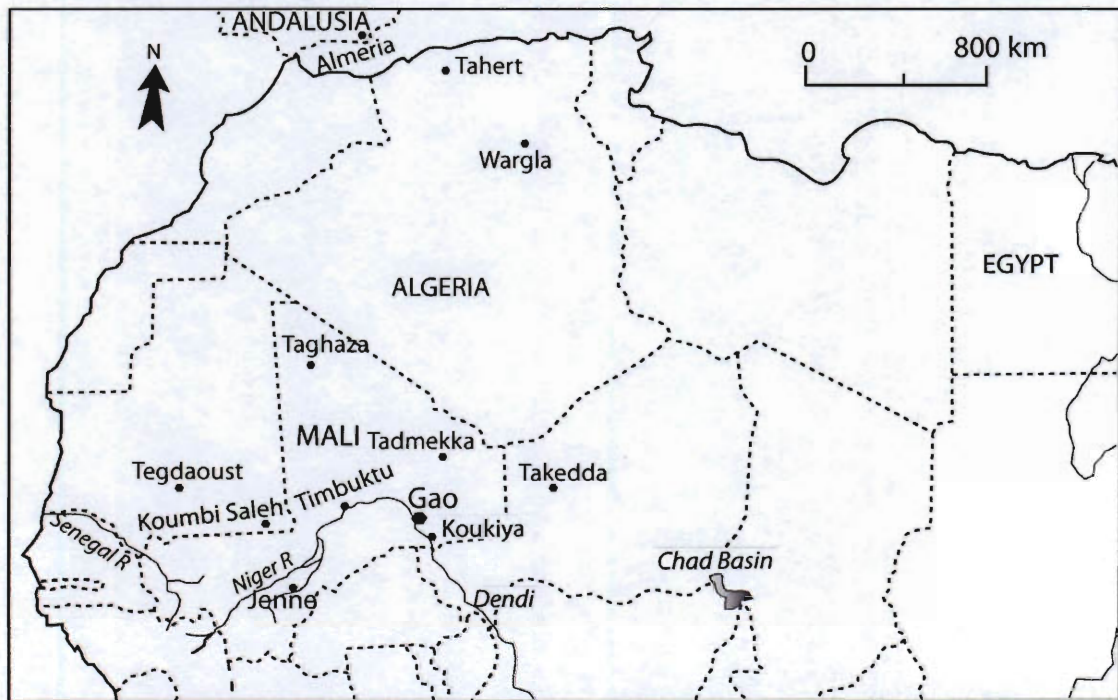


Figure 2.3. Sites mentioned in the historical documents (Adapted from Nixon 2007: 18)

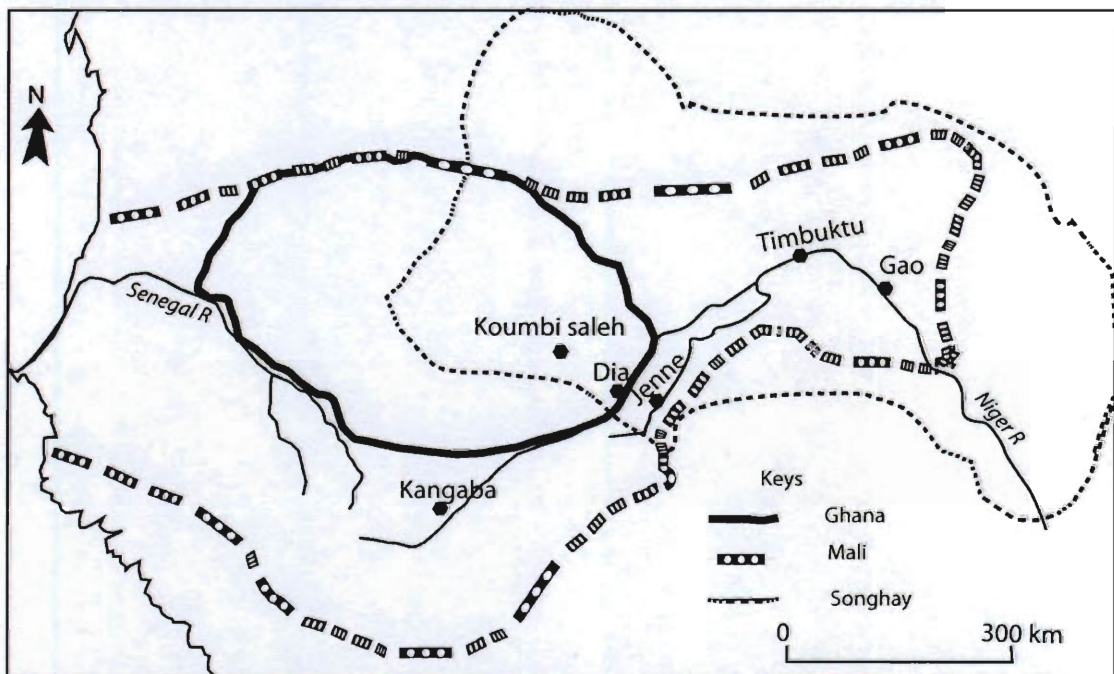


Figure 2.4. Map showing the maximal extension of the three successive Sudanese Empires (Adapted from Berthier 1997: 2)

Chapter 3

PRIOR ARCHAEOLOGICAL RESEARCH IN THE GAO REGION

INTRODUCTION

This chapter provides an overview of the archaeological research that has been conducted in Gao and surrounding areas (Figure 3.1). From the colonial era to the 1990s, archaeological excavations around Gao mainly focused on architectural remains, the role of Islam and the development of trade during the second millennium AD. Gao's deeper history, including the development of early trade and urbanism during the first millennium AD, is largely unrepresented in these previous archaeological investigations. These latter subjects are the focus of the present dissertation. Excavations at Late Stone Age sites, such as those carried out along the Tilemsi Valley, are beyond the scope of this study, and consequently, are not discussed here, although the broader survey is considered.

This chapter is organized as follows:

First, the archaeological surveys undertaken in Gao Region and then the various excavations conducted in this region prior to the 2000s will be discussed. Additional investigations at some outlying sites including Es-Souk (Mali) and Kissi in the Oudalan region (Northern Burkina Faso) will be outlined because these sites share some common

elements of material culture with Gao region. Throughout the discussions, these previous works are critically evaluated based on the available evidence they have provided.

For methodological convenience, the discussions of prior survey and excavation in Gao Region are divided into early (Colonial period) and recent (post colonial era).

ARCHEOLOGICAL SURVEYS IN THE GAO REGION

Early surveys

During the colonial period, the region of Gao was visited by a number of colonial officers and researchers including Lieutenant Louis Desplagnes, Georges R. De Gironcourt and Raymond Mauny. These colonial investigators visited particular historical sites in the region (Gao Ancien, Gao Saney and Koukiya in particular) rather than conducting regional survey.

In 1903, Desplagnes (1907: 42-76), visited Gao Ancien and Bentiya/Kukiya and provided first-hand observations concerning the surface finds at the ancient settlement of Koukiya, including potsherds, lithics and the remains of mud structures. However, no further information about the sites of Koukiya and Gao Ancien was provided beyond these observations.

Between 1908-1912, De Gironcourt mapped the Niger Bend, producing a 1:500,000 map of the region (De Gironcourt 1913; Farias 1992: 116). Additionally, he recorded and described 55 Muslim cemeteries in the Bentiya/Koukiya and Es-Souk regions, and also documented Arabic epigraphy along the Niger floodplain, the Tilemsi valley and the Adrar des Iforas (De Gironcourt 1920; Farias 1992: 16-17). De Gironcourt's investigations provide important information concerning the development of

Islam by producing 812 rubbings of Arabic and Tifinagh inscriptions within the investigated areas (Farias 1992: 17). The information provided by De Gironcourt provided insight into the geographical setting of the Niger Bend region and also the development of Islam (Muslim cemeteries and Arabic epigraphy).

Mauny's pioneering investigations at Gao Ancien and Gao Saney respectively in 1950 and 1952 follow the same trend by focusing on medieval architectural structures in particular. The investigations undertaken by Mauny will be discussed in the excavation section.

Recent surveys

Four major archaeological surveys were conducted in Gao Region during the post colonial period. These surveys, which were preliminary in nature, provided useful data for understanding the typology of many sites, their distribution across the region and broad chronological assignment.

Dawa's survey in the *Cercle de Gao* (1984). The archaeological reconnaissance undertaken by Seydou Dawa in 1984 was intended to inventory a range of sites located within the *Cercle de Gao* (Dawa 1985). The survey area included sectors located around Gao and Haoussa Foulane to the South-east of Gao (Figure 3.2). The size of the survey area is not provided. Surface visibility in the survey area was generally good, particularly in the Niger floodplain and along ancient valleys. Surface materials were less visible in the sand dune areas where they were covered by sand. Similarly, the survey zone was easily accessible in the floodplain, and difficult in areas covered by sand dunes. The survey methods were based on historical documents and the collection of oral tradition using questionnaires. On the basis of these sources, a local informant was hired to locate

sites (Dawa: 1985: 1). All recognized sites were recorded in terms of site types, characteristics, the presence of surface features and surface artifacts, and the type of landform on which they were located (Dawa 1985: 12-96). These sites were then marked on the *Institut Géographique National* (I.G.N.) 1:200 000 map sheet of Gao-East. The chronology of the recorded sites was determined on the basis of the types of surface material encountered.

It is worth noting that the exclusive use of local informant and oral tradition and historical sources to conduct the survey is problematic. By relying only on these sources, it is impossible to know whether the sites recorded are representative. Oral traditions and local informants can be an important component of an archaeological survey, but to rely on them exclusively is questionable because sites ignored by locals are then missed in the course of the survey. This method would seem to favor more obtrusive sites, like large habitation mounds, and underestimate smaller sites in the regions. Most problematically, the survey report contained no indication of sampling strategy and the way the survey areas were chosen (Dawa 1985). Another problem is that surface collections were not taken (Dawa 1985). Surface collections of pottery and other artifacts can help to have a relative chronology of settlement across the region. However, since there are no material culture sequences defined for the Gao area, only the broadest chronological placement was possible in any event.

During Dawa's survey, a total of 59 sites were recorded (Dawa 1985). They were classified into six site types: prehistoric sites, engraved rocks, caves, habitation mounds, ancient cemetery, and ancient mosque sites (Dawa 1985: 97-104). According to Dawa, this classification encompasses four periods: Paleolithic, Neolithic (Late Stone Age),

Songhay period (7th – 16th centuries AD) and Subactuel (contemporary) period (16th century onwards) [Dawa 1985: 12-96]. Insoll provides a distribution map of the sites recorded by Dawa (Insoll 1996; 1997: 5) [Figure 3.2]. Among them, there are Late Stone Age sites and “possible Late Stone Age sites”, Iron Age sites and “possible Iron Age sites”, recent sites and undated sites (Insoll 1996; 1997: 5). Most of the sites were concentrated along the Niger floodplain zones. Site sizes ranged from < 1ha to 30 ha.

Arazi’s Ansongo–Bentia survey (1996): The 1996 archaeological reconnaissance conducted around Ansongo–Bentia by Noemi Arazi (1999) aimed to collect basic data on the nature and distribution of archaeological sites and to establish a broad chronology of site occupation within the region. Arazi hoped to understand how various sites in the region varied with respect to their size, surface features, artifacts, and geomorphological placement. The survey was carried out in the vicinity of the town of Ansongo and the village of Bentia/Koukiya (Arazi 1999, 2005). Generally, visibility of surface materials and the accessibility of the survey areas were good. However, some parts of the sand dune areas were difficult to access. The method used for the detection of archaeological sites was based on the information provided by the inhabitants of the two towns. On the basis of this information, two transects totalling 40 km² were established (Arazi 1999: 25). The first transect extending 25 km² was placed northeast of the town of Ansongo and the second transect (15 km²) was located northeast of the village of Bentia (Arazi 1999) [Figure 3.3]. These two transects were covered by two persons using pedestrian tactics with 200 m spacing intervals (Arazi 1999). The width of the pedestrian pass along these transects is not provided, however. The survey area was limited in size due to time and

personal constraints. It did not cover all major geomorphological zones in the region. Consequently, the results cannot be used more broadly to estimate or predict site distributions and numbers within the region. Small surface collections were made at sites in order to understand the chronological distribution of the discovered sites.

A total of 32 sites (16 sites in each area: Ansongo and Bentia regions) was recorded during the survey (Arazi 1999: 30) [Figure 3.3]. These sites were categorized by function: settlement mounds, iron working sites and Islamic necropolises. The analysis of the surface collections of pottery resulted in recognition of five broad chronological periods extending from the second millennium BC to the Historic period (AD. 1600 onwards) (Arazi 1999: 30-41]. Site sizes ranged from <1 ha to 80 ha. Arazi (1999) suggests that sites ranging between 30 and 80 ha can be considered urban, sites between 10 and 25 ha were “intermediate” and sites of <1 ha to 10 ha were rural. For her, the urban sites were contemporaneously inhabited and clustered with intermediate and rural settlements. This phenomenon was particularly noted in Bentia area. In contrast, sites around Ansongo tended to be more isolated (Arazi 1999: 30-36).

Survey in and around Gao by the *Direction Nationale du Patrimoine Culturel* (DNPC) (2002). The 2002 archaeological reconnaissance in Gao and its surrounding areas by the *DNPC* (Mali) was intended to collect a variety of basic data on the range of sites present and to understand how these sites vary with respect to their size, surface features, artifacts, location on different landforms and soils (Togola et al. 2004a: 7; 2004b: 50). A research area covering 250 km² was defined after consulting the *Institut Géographique National* (I.G.N.) of Mali’s 1:20,000 map [I.G.N. sheets Gao (NE-30-VI),

Gao-East (NE-31-1), and Ansongo (ND-31-XIX)] and Dawa (1985). The survey was conducted both side of the river Niger and included three major landforms: the floodplain of the Niger, the sand dunefields, and the fossil valley of Tilemsi and its tributary valley, Anchaouadj (Togola et al. 2004a: 7; 2004b: 50).

Surface visibility varied from one landform to another. Visibility was good in the ancient valleys where sites were easily located. In the floodplain along the River Niger surface visibility was 90% clear; however, vegetation was found to be covering some small sites. Visibility was low in the dunefield zones where many sites were buried under mobile sand. The survey area was in general easy to access except the dunefield areas because of the sand and thorns, which made it difficult for the movement of the survey crews. The survey was conducted by vehicle with the assistance of local informants to locate sites (Togola et al. 2004a: 7, 2004b: 50). Small canoes were also used to reach certain survey units located in the west bank of the Niger. Many scholars argue that the conduct of surveys with the aid of vehicle is problematic. Plog et al. (1978: 390), for instance, argues that vehicle survey provides low intensity coverage and many small sites still could be missed compare to the pedestrian method of investigation. However, the survey with a crew of three people, for instance, using a vehicle at low speed can also give reliable results in areas of high site visibility.

Taking into account the three major landforms, eight transects (Two transects on the west bank of the Niger and six on the east bank) measuring one kilometer wide and 25 to 30 km in length were established (Figure 3.4). After finding any major archaeological site during the survey, the team (five persons) walked radial transects 1 km long out from the site center in order to locate sites that might be clustered. All the

recognized sites were systematically recorded in terms of the site type, characteristics, surface features and artifacts, and the topography of the area (Togola et al. 2004a: 7; 2004b: 50). Small surface collections of pottery (one or two bags depending on the site size) and lithics for Late Stone Age sites were taken at each site.

A total of 70 sites including Late Stone Age and Iron Age sites were recorded during the survey (Togola et al. 2004a: 1-24; 2004b: 50-60) [Figure 3.4]. Eighteen Late Stone Age (LSA.) sites were recorded primarily along the fossil valleys of Tilemsi and Anchaouadj, in the sand-dunefield areas and the inter-dune depressions. The size of these sites varied from < 1 ha and 10 ha. The majority of LSA sites (13 in total) were isolated from each other, especially along the two fossil valleys. However, certain sites such as the habitation mound of Hama Kouladji and its two satellites settlements in the inter-dune depression, and the site complex of Tagmart along the Anchaouadj valley were clustered. According to surface collection materials, these appear to be later Stone Age sites (Togola et al. 2004a: 8, 2004b: 52). Among the Iron Age sites, 42 ancient habitation mounds, seven ancient cemeteries and three iron smelting sites were recorded in the course of the survey. All these sites were found along the Niger floodplain and the two fossil valleys. Site sizes range from < 1 ha to > 50 ha. Certain habitation mounds such as Gao Saney, Tchado and Tianame are very large (30–50 ha in size), and can reach over six meters in height.

Based on the preliminary information provided by the analysis of ceramics from the recorded Iron Age sites and the radiocarbon dates from some excavated sites, three major chronological periods were established in the Gao region. These periods include Early Iron Age (the beginning of first millennium AD) sites such as Koima (Insoll 1997,

2000), Middle Iron Age (7th–16th centuries AD) sites such as Gao Saney and Gao Ancien (Insoll 1996, 2000, Takezawa et al. 2003, Cisse et al. 2007), and Late Iron Age (17th–20th century AD) sites such as the cemetery of Tafdit (Togola et al. 2004a & b).

Manning's survey along the lower Tilemsi valley (2006). The survey conducted along the lower Tilemsi valley (100 km from Gao) by Katie Manning in 2006 was intended to record and map the distribution of sites in the surrounding areas of Karkarichinkat, and also to identify a sample for test excavations (Manning 2008: 92). The study area covered 400 km² (20 km x 20 km) with Karkarichinkat Nord (KN05) at the center (Figure 3.5). In this survey area, there are two major geomorphological zones: the valley floor and the flanking dune system. The survey was mainly concentrated in the valley zone with the use of vehicle and local informants. Manning (2008: 93) argues that the flanking dunes were avoided because of the difficulty of vehicle transport in the dunes, also the low visibility caused by sandstorms. The survey was conducted into four quadrants, and all the archaeological sites encountered were recorded. Each site was given a name, assigned a GPS reading, and sketched. The presence or absence of surface materials (Stone tools, lithic debitage, ceramic, iron slag, human and animal remains) was recorded at each site. A total of 86 sites including Late Stone sites (52), Iron Age /Transition Tell sites (13), Iron-working sites (17) and cemetery sites (3) were identified (Manning 2008: 94) [Figure 3.5]. The Late Stone Age (LSA) sites were divided into LSA settlement sites, LSA workshop sites and LSA scatter sites. Radiocarbon dates from the test excavations at the LSA sites provide a chronology between the mid-3rd millennium cal BC and the beginning of the 2nd millennium cal BC. The site sizes range from < 1 ha (scatter sites) to

> 20 ha (settlement mounds) and with up to 3 m depth of cultural deposit (2008: 92). The Iron Age sites include mounds of iron slag, clusters of eroding furnace structures and small (<1ha) sites with pottery, iron slag and lithic debitage (Manning 2008: 96). An OSL dating conducted to a sample of one of the eroded iron furnace structures from the Er Negf furnace field provided a date of 1320 ± 110 bp (X3053; Manning pers. Comm. 06/15/2010). No dates were obtained from the cemetery sites or stone tumuli characterized by a ring of stones with little material culture (Manning 2008: 97-98).

Since the various surveys conducted in Gao Region were preliminary in nature, the discovery of 246 sites ranging from Late Stone Age to Late Iron Age within the various regions fulfilled the primary survey goals, which were to detect sites, to understand settlement distributions and to provide a preliminary chronology of sites across the region (Table 3.1). The recorded sites distributed across these various surveyed regions were quite diverse. They include habitation mounds, workshop sites and ancient cemeteries. The density and size of sites varied from one ecological zone to another. The large clustered habitation mounds were particularly concentrated in the floodplain zones and along the ancient river channels while small isolated sites and LSA workshop sites were usually found in the dunefield areas (Togola et al. 2004; Arazi 1999; Manning 2008). It is worth noting that no tobacco pipes were found during the surveys. This is very striking because some historical sites were found during the various surveys, and elsewhere along the Middle Niger (e.g. Timbuktu, Djenne) tobacco pipes are found in substantial numbers on post-16th century sites. The absence of tobacco pipes could be due either to sampling problems or religious prohibitions on smoking. Because of the preliminary nature of these surveys, it will be important to conduct further regional intensive surveys with

Table 3.1. Summary table of the surveys in Gao Region

Survey region	Surveyors	Landform	Survey area	Total of sites	Site distribution	Site chronology	Types of sites	Site sizes
Cercle of Gao (Gao and Haousa Fulani)	S. Dawa (1984)	Floodplain, dunes, Tillemsi fossil valley	Over 120 km length	59	Not reported	LSA - Late Iron Age (2 nd millennium BC-AD 1900)	Rock shelter sites, habitation mounds, ancient cemetery, and ancient mosque sites	>1<30 ha
South of Niger Bend (Ansongo – Bentia regions)	N. Arazi (1996)	Floodplain and dunes	40 km ²	32	Not reported	LSA - Late Iron Age (2 nd millennium BC-AD 1900)	Settlement mounds, iron working sites and Islamic necropolises	>1<80 ha
Gao and its vicinity	DNPC (2002)	Floodplain of the Niger bend, sand dunefields, fossil valley of Tilemsi, Anchaouadj	250 km ²	70	Floodplain and fossil valley (98%)	LSA-Late Iron Age (2 ^d millennium BC-AD 1900)	LSA habitation and workshop sites, Iron Age Habitation mounds, ancient cemeteries, iron working sites	>1<50 ha
Lower Tillemsi region	K. Manning (2006)	Valley floor and the flanking dune system	400 km ²	85	Valley floor	LSA (3 rd millennium BC-Iron Age (C. 7-10 AD)	LSA settlement, workshop, and scatter sites, Iron Age /Transition Tell sites cemetery sites, Iron-working sites	>1<20 ha

appropriate methods and techniques in order to augment the probability of site detection within various geomorphological zones.

EXCAVATIONS IN THE GAO REGION

Few excavations have been undertaken in Gao and its region. Past investigations were mainly concentrated in Gao, particularly at Gao Ancien, the presumed medieval capital of Songhay dynasties, and also in the cemetery of the twelfth-thirteenth century dynastic rulers at Gao Saney. Other small-scale excavations were mainly carried out on the complex settlement mounds of Gao Saney, and also at Gadei in Gao (Figure 3.6). These excavations focused on the investigations of Islamic architectural remains to retrace the political, religious and trading connections between the medieval rulers of Gao and the Islamic world.

The various excavations during the colonial eras are first discussed. The pioneering excavations of Colin Flight at Gao Saney and Timothy Insoll at Gao Ancien, Gadei and Gao Saney will then follow.

Early excavations

Gao Ancien. In 1949 and 1950, the first excavations at Gao Ancien were undertaken in an area with numerous stone and brick structures at the 2.5 km point on the road of Bourem. Among the exposed walls was an omega-shaped fired brick wall that attracted Raymond Mauny's interest as a possible mirhab (Mauny 1951: 842; 1961: 113). There is little information on the material recovered during the 1949 excavation.

In 1950, Mauny continued to excavate the omega shaped wall structure. Measuring 2 m in diameter, and oriented E - NE, the fired brick structure was interpreted as the mirhab chamber of the mosque (Mauny 1951: 842). Additionally, Mauny exposed the northern half wall of the mosque, which measured 21.8 m and was built out of banco. This wall was reinforced by 10 buttresses (90 cm thick and 50 cm high) at intervals of between 1.35–1.40 m (Mauny 1951: 842). The reconstruction of the dimensions of the eastern mosque wall provides a total of 43.4 m in length, which, according to Mauny, is identical to that of the Djenne mosque (Mauny 1961: 492). To the east of the mosque, there is a cemetery with tombstones, some engraved steles with Arabic inscriptions, one of which bore a date of 766 H/1364 AD (Mauny, 1951: 844; 1961: 492). On the basis of this date, Mauny believed that the structure also dated to the 14th century and was likely the mosque built in 1324 by the Mali emperor, Kanku Musa, upon returning from his legendary pilgrimage to Mecca (Mauny, 1951: 843-844; Mauny, 1961: 113). No independent dates are available to confirm or refute this chronology. Insoll suggested it might be 12th–13th century based on the use of baked brick (Insoll, 1996: 16; Insoll, 1997: 9-11), but the sample of baked brick from Insoll's excavations is too limited to know if it was used only in this time period, and is not directly associated with any radiocarbon dates. Mauny's excavations recovered potsherds, glass and stone beads and bracelets, copper and iron objects. Although there is no mention about the methodology used in the course of excavations, this investigation provided first-hand useful data in understanding the importance of this urban site during the second millennium AD.

Gao Saney. The cemetery near the mound of Gao Saney attracted interest relatively early. In 1931, largely undocumented excavations were conducted by Le Pontois during the “*Mission saharienne des cargos du désert*” (Mauny 1951: 845; 1961: 113). Strings of glass, stones beads and bracelets from the excavation are displayed in the *Musée des Arts Africains et Océaniens* in Paris (Mauny 1961: 113; Insoll 1996: 1919-20). But this is essentially all we know about these excavations.

In 1939, engraved tombstones and marble stele with Arabic inscriptions were discovered at the cemetery during the visit of Jean Chambon, Commandant de Cercle in Gao (Mauny 1961: 113; Flight 1981). Over two dozen of these, some with inscriptions dating to the twelfth century were recovered by Chambon. He also excavated a structure built out of fired brick, and recorded some tombstones on the surface of the cemetery (Insoll 1996: 20; Mauny 1961: 113). During the course of excavations the skeleton of a child was found as well as some special finds including a pottery incense burner and a gold bead along side the inscribed steles (Flight 1981: 93-94).

In 1950, Mauny visited the cemetery, and reported the presence of two structures built with fired bricks. The first structure called “*grand caveau*” measured 17 m long by 4.5 m wide (western side) and 6 m (eastern side), and the second structure (“*petit caveau*”) was 5 m by 2 m (Mauny 1951: 846). During his Gao trip, Mauny also examined all the stele previously found in the Gao Saney cemetery (Flight 1981: 101–104).

Mauny conducted also some excavations at the settlement mound of Gao Saney in 1952. Unfortunately there is no report about this investigation other than observations concerning the presence of potsherds throughout the site surface, and also noting the recovery of imported glazed pottery during the excavations (Mauny 1961: 113-114). The

tell was of little importance for Mauny because the durable medieval structures, which abound in Gao Ancien, were absent particularly on the main mound of Gao Saney.

As we saw, the earlier investigators at Gao Ancien as well as Gao Saney were interested in the medieval citadel and the inscribed stele which were considered as symbols of the achievement of the various medieval Songhay dynastic rulers. Mauny excepted, less interest was given to recording small finds (other than “special finds” such as Gold bead and chronology construction).

Recent excavations

From 1970s–1990s, the pioneering excavations conducted by Colin Flight at Gao Saney and Timothy Insoll at Gao Ancien, Gadei and Gao Saney have illuminated the history of Gao during the second millennium AD and back into the first. Flight mainly focused on the documentation of architectural remains at Gao Saney cemetery and the small Saney mound. As with many of the earlier investigators, small finds are not mentioned in his archaeological records. Insoll’s important excavations particularly at Gao Ancien have provided promising insights into understanding the role of Islam in Gao Region, the interaction networks and trade activities that linked Gao and the Islamic world primarily from the tenth to thirteenth centuries AD.

Flight’s investigations at Gao Saney cemetery. In the cemetery of Gao Saney, Colin Flight carried out his major investigations in 1972 and 1974 (Figure 3.7). In the course of his research, Flight documented 58 complete and fragmented inscribed gravestones, and also re-excavated the two structures of fired bricks (Flight 1975: 83-88, 1978; Insoll

1996: 17 - 24). The excavations were mainly focused on the architectural structures and stele with no special attention to recording small finds including potsherds and other artifacts found in the deposits (Insoll 1996: 21). A total of five structures were re-excavated and documented. They include the building complex F, G, H (the *grand caveau*) and the structure J (the enclosure) located to the north, and the structure K (the *petit caveau*) situated 20 m to the south of the building complex (Flight 1978: 3-8) [Figure 3.7]. On the basis of the dates of the inscribed steles, Flight proposes the provisional dates of c. AD 1100–1120 for the early structures (F, H, G and K), and c. AD 1200 or later for the late structure (J) [Flight 1978: 4-8]. Insoll revised Flight's chronology to be less precise. He argues that "the contexts of the steles are not secure, and the steles could be easily moved into the structures at a later date than that inscribed upon them" (Insoll 1996: 22). Based on the dates of the fired brick building uncovered at Gao Ancien, Insoll suggests the dates of late twelfth-thirteenth centuries AD for the structures F and H, and the dates of late thirteenth century AD onwards for the structures G, K and J (Insoll 1996: 22). However, Insoll's dates remain also provisional because no radiocarbon dates are associated with the fired-brick structure of Gao Ancien. More secure dates using radiocarbon dating or other dating method are necessary to date the fired-brick structures at Gao Ancien and Gao Saney.

Flight's investigations at Gao Saney southwest mound. In 1978, Colin Flight conducted some excavations at the small mound located at the southwestern edge of the main tell of Gao Saney (Figure 3.7). The main objective was to find the palace of the Kings whose funerary gravestones were located in the Saney cemetery (Flight 1979a: 2).

In the course of his excavations, a building structure of fired brick named structure Q was uncovered (Flight 1979b: 35). The external dimensions of the building were uncertain. However, based on the identification of the western point, which could be the outer edge of the structure, Flight assumes that the building must have measured 50 m W–E, and 30 m N–S (Flight 1979b: 36). Judging from the exposed features, the plan of the building shows an approximately square structure measuring 14.4 m N–S and 14.2 m E–W (Flight 1979b: 37; Insoll 1996: 25). The structure encompassed a central wall and three internal pillars on either side. A corridor measuring 1.9 m wide and over 10 m long provided access into the structure (Flight 1979b: 36). Various secondary walls were added to reinforce the structure before it was finished.

On the basis of the chronology of the inscribed steles in the cemetery, Flight (1979b: 36) claims that structure Q is dated to ca AD 1100. However, Insoll (1996: 25) again proposes a provisional date of 12th–13th centuries AD based on the period of the use of fired-brick in the Gao construction sequence. Although the function of structure Q is unclear, both Flight (1979b: 36) and Insoll (1996: 25) have suggested that structure Q could be used as a commemorative Kubba tomb.

It is worth noting that the compositional analyses of samples of fired-brick from structure Q of the small mound, those from Gao Saney cemetery and Gao Ancien show the differences in minerals present in the fired-brick from these three areas. This means that the sources of clay used to produce the fired-brick found in these various areas are different (Insoll 1996: 25). Additionally, the chronology of the use of fired brick at Gao Saney is not very clear for reasons noted earlier. Further excavations are necessary to

clarify the chronology of the fired-brick structures from the small settlement mound of Gao Saney.

Insoll's investigations at Gao Ancien. In 1993 and 1996, Timothy Insoll (1996, 2000) excavated three units totalling 87 m² in area in the sector near the structure identified by Mauny as Kanku Musa's mosque (Insoll 1996: 34, 2000: 3-8) [Figure 3.8]. The main objective was to retrace the past occupation of the Gao Region between ca. AD 900–1250 emphasizing the development of Islam, urbanism and trade (Insoll 1996: 1, 28). Many wall structures built of unfired and fired brick and stone were found. Additionally, a substantial quantity of materials including pottery, glass, beads, iron and copper objects and faunal remains including a cache of hippotamus ivory was recovered. Insoll (1996; 1997: 9; 2000, 2003: 233–250) proposes an occupation period for the site spanning the sixth to sixteenth centuries AD, and also suggests that Gao played an important role in the trans-Saharan trade and the diffusion of Islam during the period between the tenth and thirteenth centuries AD. For Insoll (1996: 39), the presence of numerous building construction remains and a large mosque with a fired brick mihrab attests that this part of the town is “the nucleus of the medieval trading center and royal capital of Gao Ancien”. He argues that such buildings in the centre of Gao Ancien might indicate as an adaptation of North African architectural buildings which are generally located in the centres of the towns (Insoll 1996: 39). Insoll's proposed periodization of site occupation in this sector is provided in Table 3.2.

The data about the lengthy occupation history (6th -16th c. AD) of Gao Ancien are invaluable. However, the first and the second occupation periods, spanning roughly from

Table 3.2. Summary of Gao Ancien occupation periods proposed by Insoll (1996: 36–41; 2000: 4–14).

Units	Occupation period	Structures and construction materials	Recovered objects	C ¹⁴ dates	Observation
MM 93 (A) MM 96 (B) MM 96 (C)	First (Period 5)	Banco floor, banco column/wall constructed using banco bricks	Sherds of locally made pottery, very few glass, beads, copper objects, and some faunal remains	1430 ±90 bp (Cal. AD 552–672), and 1470 ± 250 bp (Cal. AD 340 – 789)	The precise date of the construction of the wall is not reported
	Second (Period 4)	Banco floor and banco structures, dry-stone outer wall and “gatehouse” with a well	Cache of hippopotamus ivory (ca. 53 pieces) with two surviving slivers of wooden beam or plank, potsherds, knife and slag and copper	1105 ± 165 bp (Cal AD 727–1153)	In his revised chronology, Insoll (2000: 13) dates to mid 9 th –late 10 th centuries AD
	Third (Period 3)	Banco and banco bricks, a puddle mud floor, a possible fallen door, and a 2-3 cm thick piece of a white plaster floor	Pottery, beads, glass, copper objects and iron nails and studs.	1160 ± 75 bp (Cal. AD 784–881) and 1005 ±75 bp (Cal. AD 984–1156)	Revised chronology 11 th - 12 th centuries A
	Fourth (Period 2)	Fired-brick building, column and floor, enclosing banco walls and banco floor	Pottery, beads, iron and copper objects.	Provisionally dated to the early/mid 12 th –late 13 th centuries AD	The fired brick floor and column base were constructed out of mould-formed bricks commonly measuring 25 x 25 x 7 cm
	Fifth (Period 1)	Five walls (A, B, C, D and E) constructed out of re-used fired bricks and fragments of fired bricks, banco and banco bricks	Pottery, beads, iron, copper and faunal remains	Provisionally dated to between the Early 14 th –late 16 th centuries AD	Chronology based on the absence of tobacco pipes and fragments.

the sixth to tenth centuries, have not been investigated enough in order to understand early trade and urbanization in Gao. This is unfortunate because the data clearly show the beginning of urbanization (banco brick column/wall, stone wall) and also the occurrence of regional and long distance trade (glass beads and vessel fragments, copper, and even the cache of hippopotamus ivory) at this period (Insoll 1996: 36, 40; 2000: 4, 11).

Insoll's investigations at Gao Saney. In 1993, Insoll (1996: 41-42) conducted a brief excavation at the main tell of Gao Saney with the objective to understand its relationship with Gao Ancien, and also to explore whether Gao Saney is the trading center of Sarnat, one of the twin towns of Gao mentioned by Al-Muhallabi between AD 976-996 (Figure 3.7). The excavated unit measured 4 m². Unfortunately, this excavation, undertaken on the northwestern edge of Gao Saney, was stopped at a depth of 2.30 m due to the instability of the ashy deposits. Numerous materials including potsherds, copper and iron objects, beads, faunal remains were recorded in the course of the excavations. Based on the similarity of the local Gao Saney pottery with that of Gao Ancien, Insoll (1996: 42) proposed a provisional date for the midden ash deposits ranging from the tenth to thirteenth centuries AD. No radiocarbon dates were available to cross-check this proposed date. And no excavations had succeeded in reaching sterile.

Insoll's investigations at Gadei. In 1996, additional excavations were carried out by Insoll at Gadei in the city of Gao to elucidate the settlement history of Gadei and to understand whether this zone was "the first occupation area in left bank Gao or a continuation of Gao Ancien" (Insoll 2000: 4). The 4m² excavated unit (GAD 96 (A))

provided an occupation history, which was divided into four phases. Two radiocarbon dates from the samples taken from the second and the fourth occupation deposits have been used to build up the chronology of occupation at the site spanning from the early seventh to late sixteenth centuries AD (Insoll 2000: 4). A summary of occupation period at Gadei is provided in Table 3.3.

These data provide an insight towards understanding about the settlement chronology of Gadei. Based on the chronology of the settlement occupation of Gao Ancien and Gadei, it could be suggested that either these two sites inhabited simultaneously or Gao Ancien predated Gadei. However, further excavations are needed at Gadei to better understand the origin of this site.

Table 3.3. Summary of Gadei occupation periods proposed by Insoll (2000: 4, 18)

Units	Occupation period	Structures and construction materials	Recovered objects	C ¹⁴ dates
GAD 96 (A)	First (Phase 4)	No structural debris was found	Some potsherds, beads, iron and faunal remains	Provisionally dated to the early 7 th century or before
	Second (Phase 3)	Banco platform	Some potsherds, beads, iron and copper objects, faunal remains	1195± 205 bp (Ca. AD 654-1025)
	Third (phase 2)	Banco platform and roundhouse	Numerous beads, potsherds, copper, iron and faunal remains	Provisionally dated to between the early/mid 11 th – late 14 th centuries AD
	Fourth (phase 1)	Melted roundhouse and three hearth pits	Potsherds, beads, iron and copper objects and faunal remains	515± 70 bp (Ca. AD 1399-1445)

Insoll's investigations at Koima. A 1 m² test pit excavation (KO 96 (A)) was conducted at Koima located 4km northwest of Gao on the western bank of the Niger River. The excavation was ended at a depth of 90 cm, and produced a considerable quantity of locally made pottery (Insoll 2000: 19). Certain of these wares are different from those found at Gao Ancien, Gadei and Gao Saney. Based upon the decorations of this pottery (including cord wrapped stick roulette), Insoll (2000: 19) suggests that Koima dates to the first millennium AD. However, radiocarbon dating is necessary to ascertain this hypothesis. Except for potsherds, no other finds were recorded.

It is worth noting that during his visits in 1993 and 1996 at the site, Insoll (1996: 32) recorded six eroded animist burials alongside several Muslim burials on the site surface (Insoll 2000: 19). It should be noted that during our visit in 2002 and 2008, we did not notice any eroded burials, which certainly were covered by the sand dune. Adjacent to the site, there is a large red sand dune locally known as “la dune rose” which presently partially covers the site.

In sum these various investigations undertaken from the colonial era to the mid-1990s provide important data towards understanding the history of Gao during the second millennium AD. However, the data provided by these previous investigators have shown:

1. The primary focus on epigraphy (Arabic inscriptions) at Saney cemetery and durable structures (fired brick mirhab; the building complex F, G, H or *grand caveau*; structure K or *petit caveau*, structure Q).
2. The lack of reporting prior to the 1990s on non-architectural elements (little information on pottery and other finds).

3. Only one unfinished excavation at Gao Saney main mound
4. A paucity of information from the early period (first millennium AD) while the bulk of information is provided in the later period.
5. The lack of absolute dates (radiocarbon dates or other dating methods) for the contexts where fired bricks were massively used.

While focusing only on some aspects such as architectural remains, the role of Islam and trade in the development of Gao during this period, these investigations raised several unresolved issues, which need to be explored. Some of these issues of particular interest are as follows:

- a. The chronological relationship between Gao Saney and Gao Ancien (The use of series of absolute dates including radiocarbon dates and/or other lines of chronological evidence such as thermoluminescence or archaeomagnetic dates on fired bricks from controlled excavations at these sites crosschecked with the relative chronology of the ceramic sequences).
- b. The comparison of the data obtained through the study of material culture from the excavations at these sites.
- c. The assessment of the function of these sites by considering the bulk of data (architectural remains and material culture) from the controlled excavations.
- d. The understanding of the early development of Gao and its first millennium trading connections.

Because of the scarcity of these data in the previous archaeological records undertaken at Gao and its vicinity, this dissertation work aims to fulfill this gap by reconstructing Gao's deep history with a particular focus on trading connections with other areas.

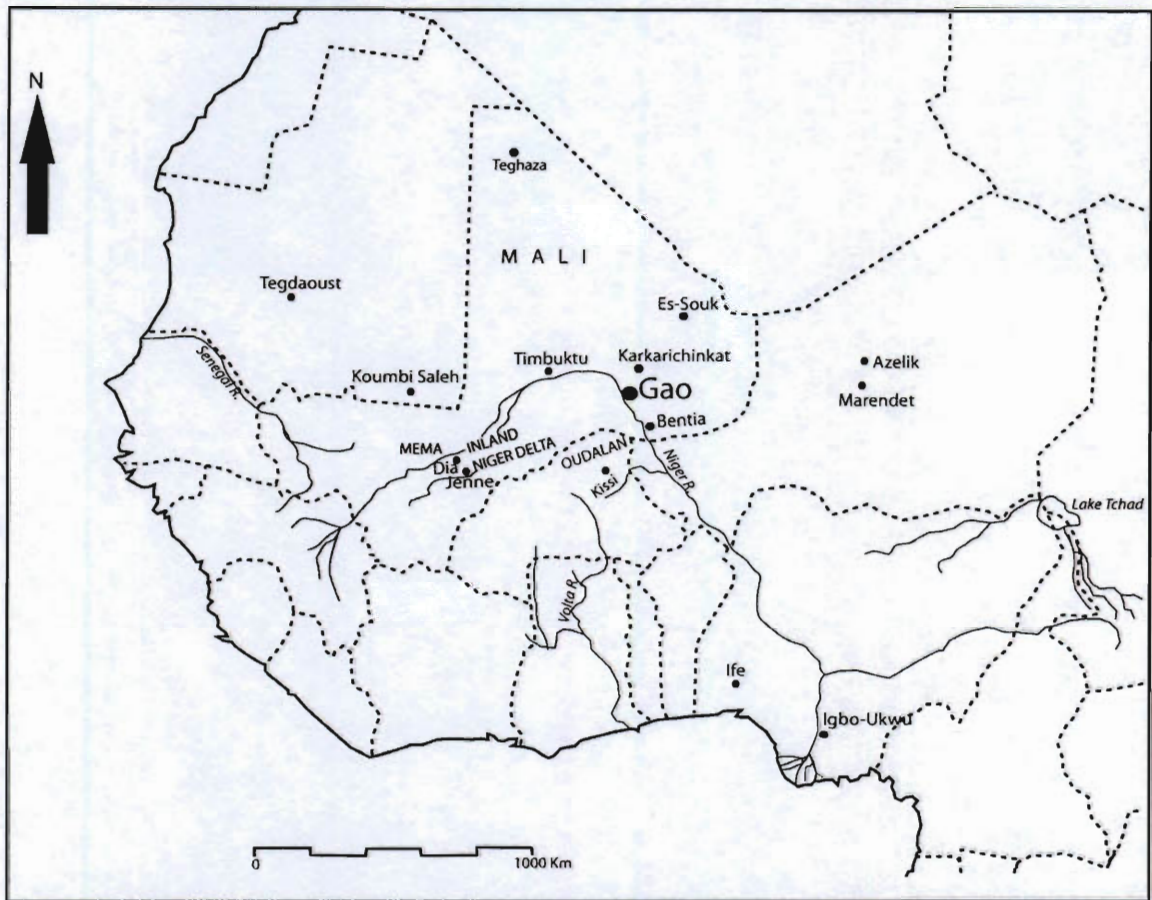


Figure 3.1: Location of the sites mentioned in the text (From Connah 2001: 114)

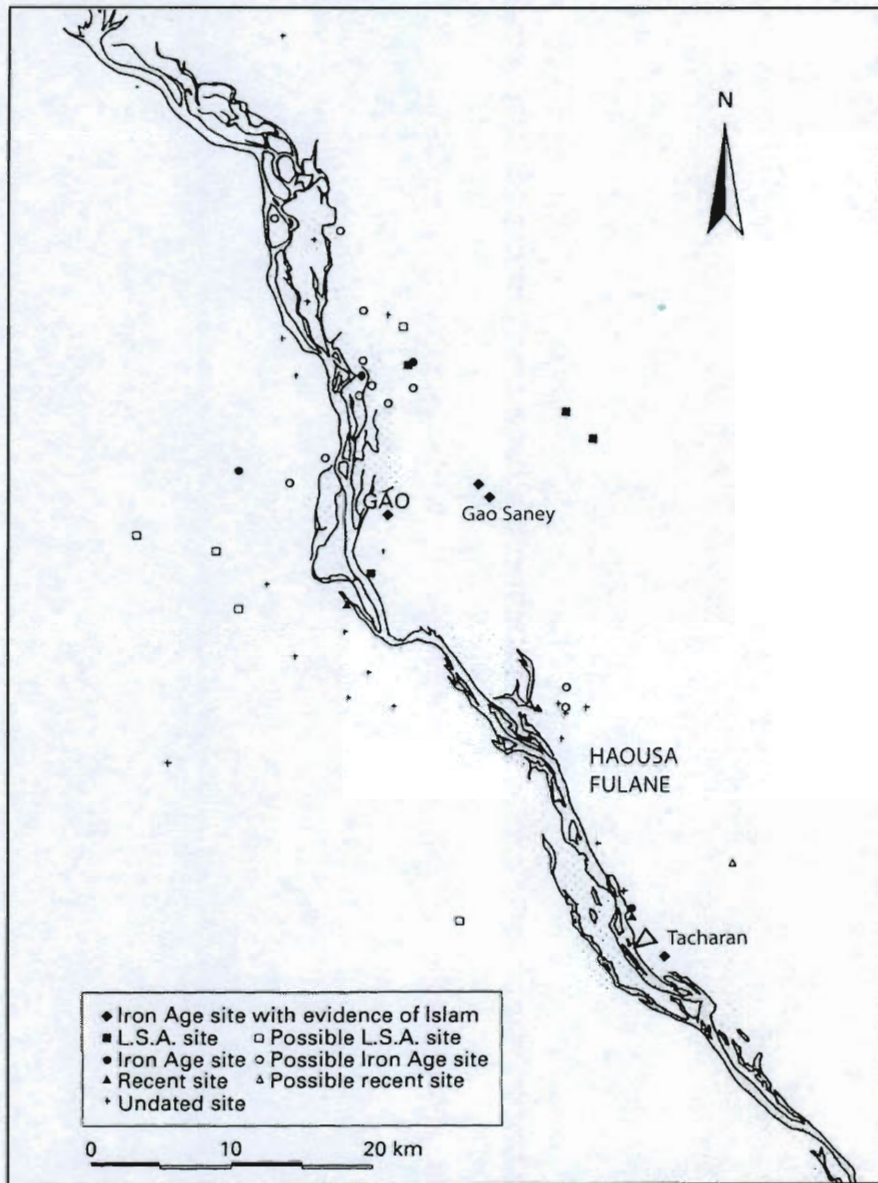


Figure 3.2. The site distribution map of Dawa's survey (Insoll 1996: 10)

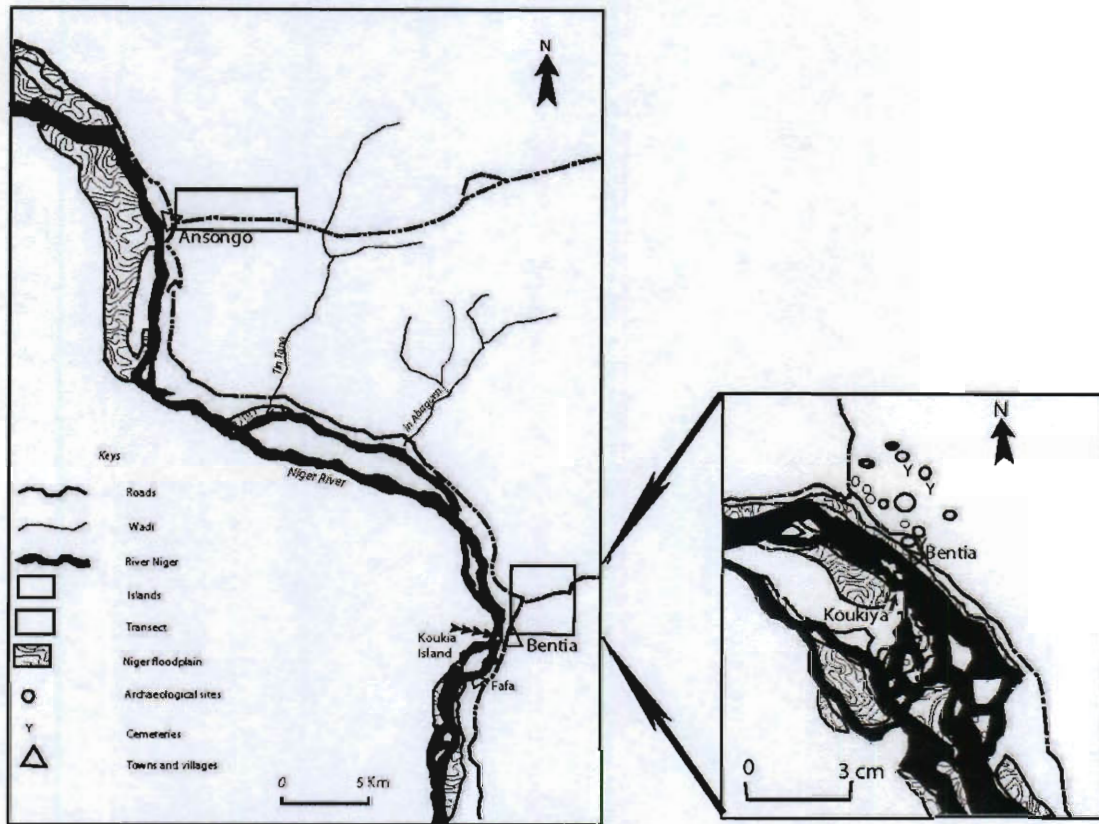


Figure 3.3. Arazi's survey in the Ansongo and Bentia regions (Adapted from Arazi 1999: 26, 40). Note that the distribution map of the sites recorded in the Ansongo region is not provided. Additionally, the Ansongo transect as shown does not match the transect size described in her text (Arazi 1999: 25).

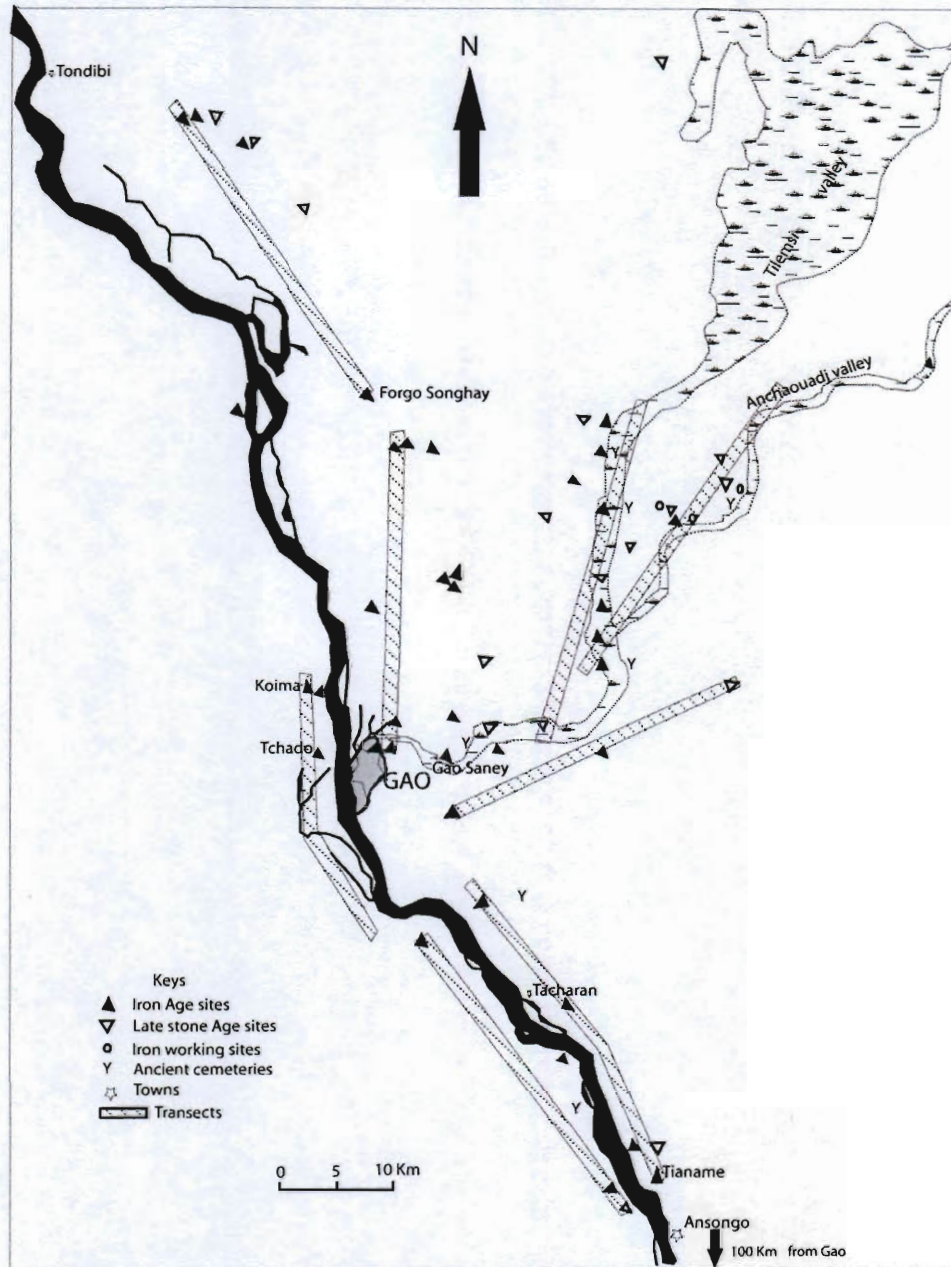


Figure 3.4. Site distribution map of the 2002 survey in Gao Region (From Togola et al. 2003: 16).

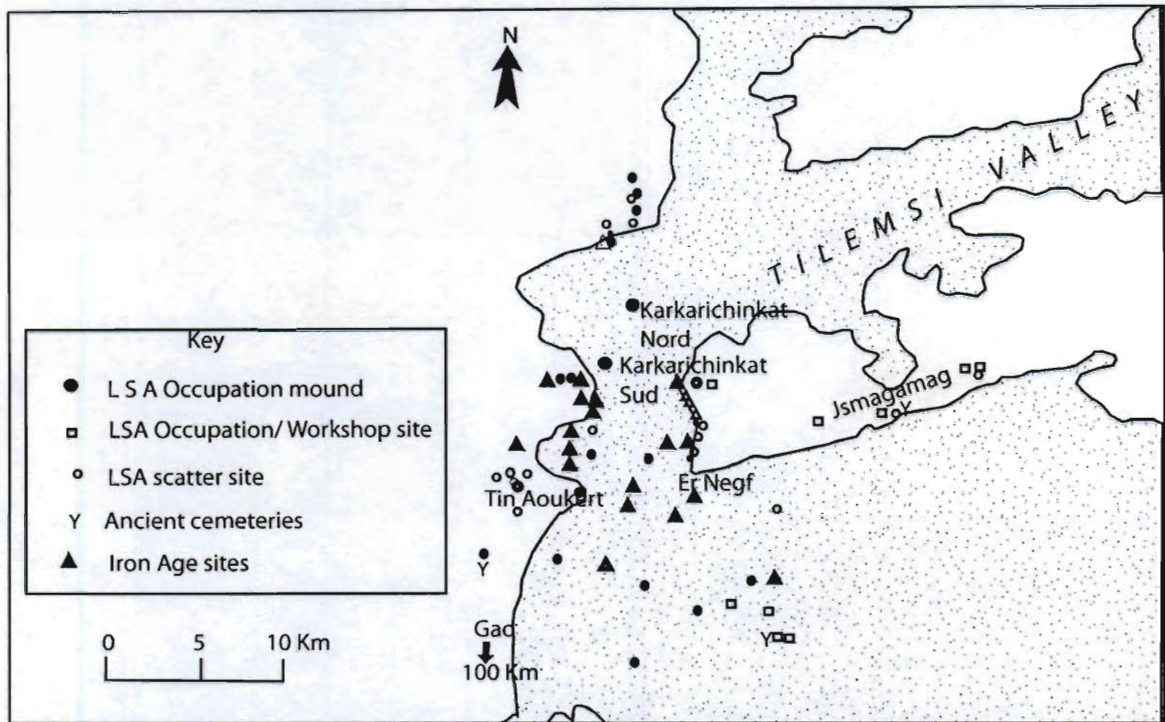


Figure 3.5. Manning survey along the lower Tilemsi valley (Adapted from Manning 2008: 95, 102, 105).

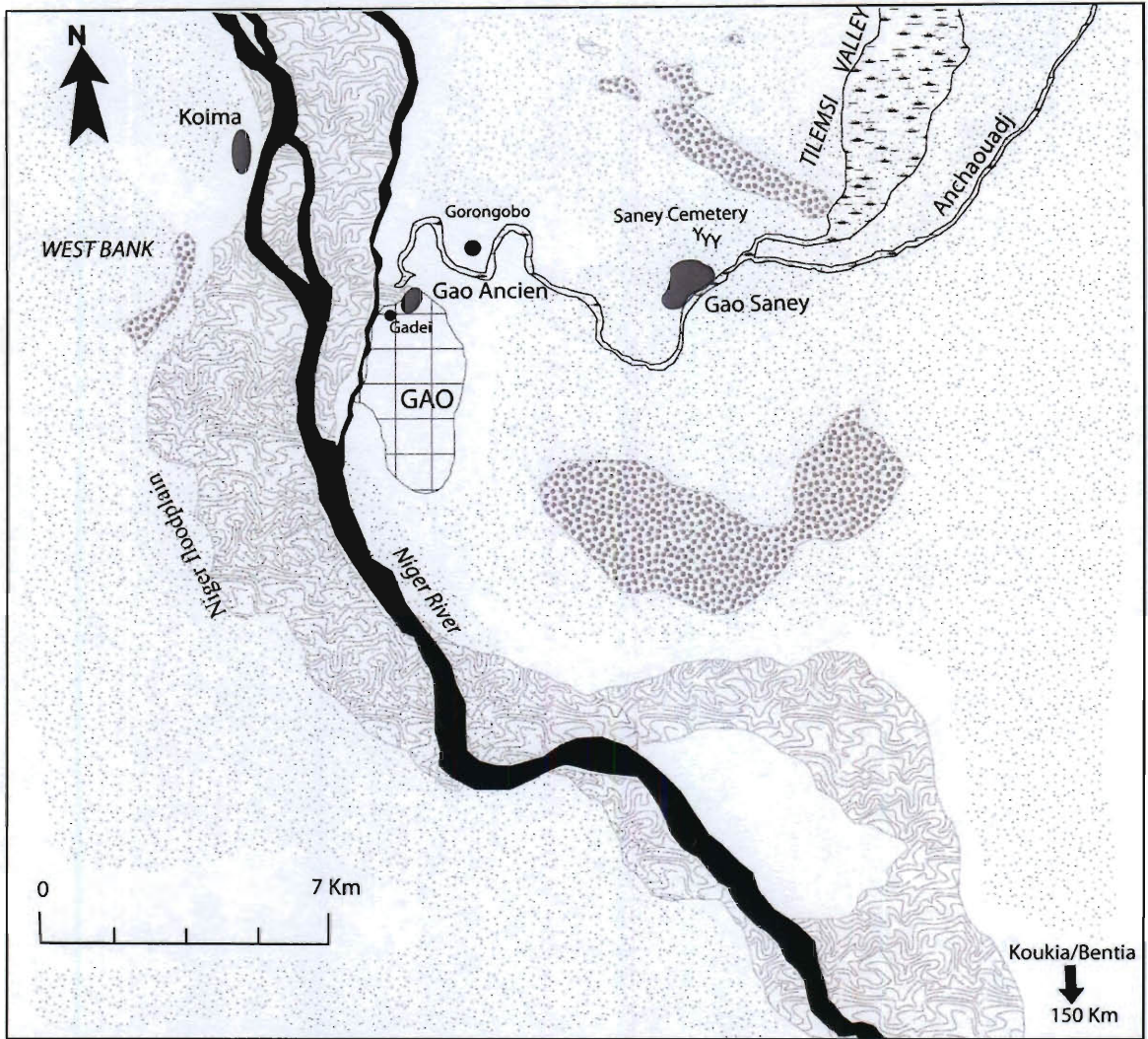


Figure 3.6. Sites located in Gao and its vicinities

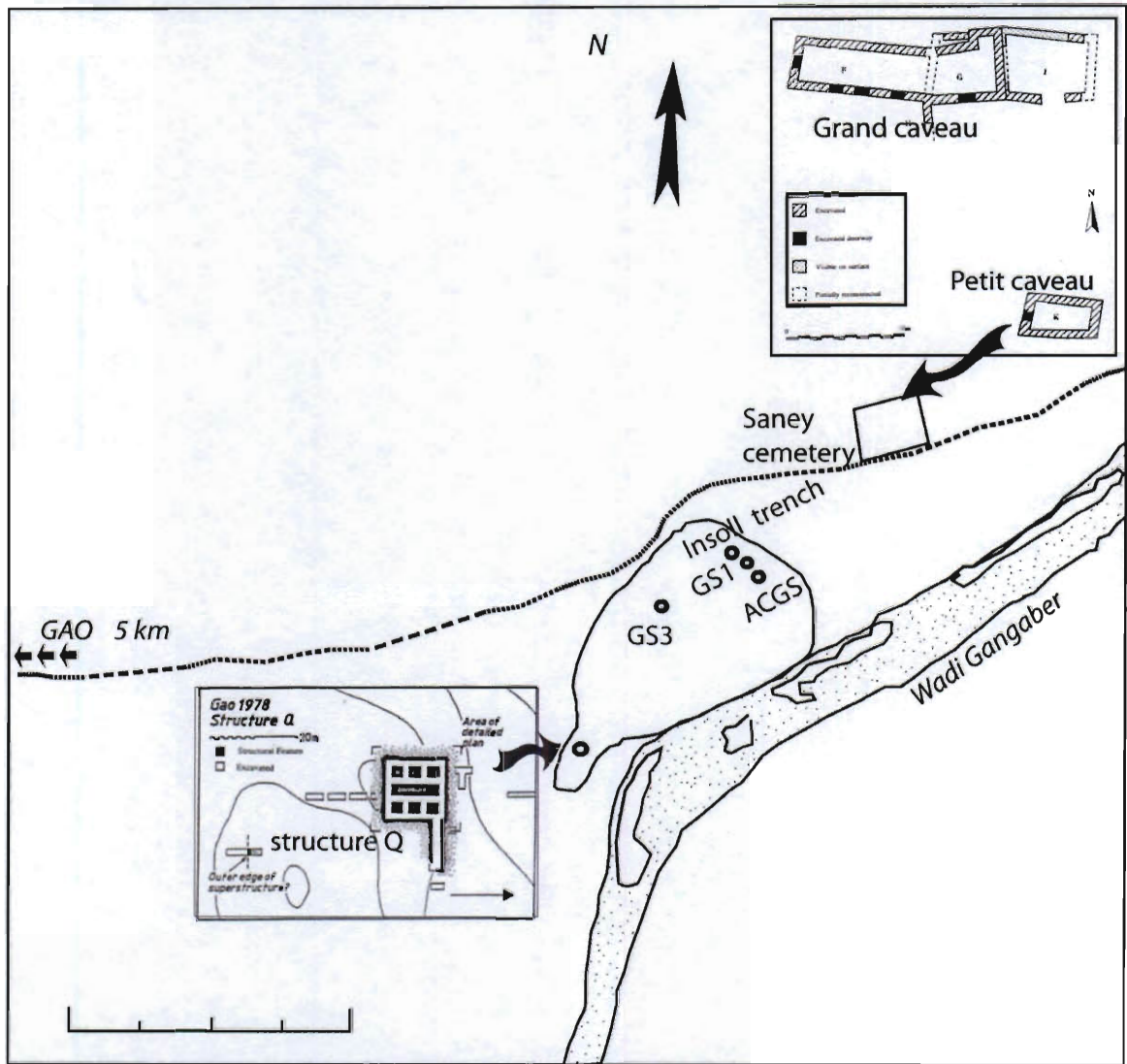
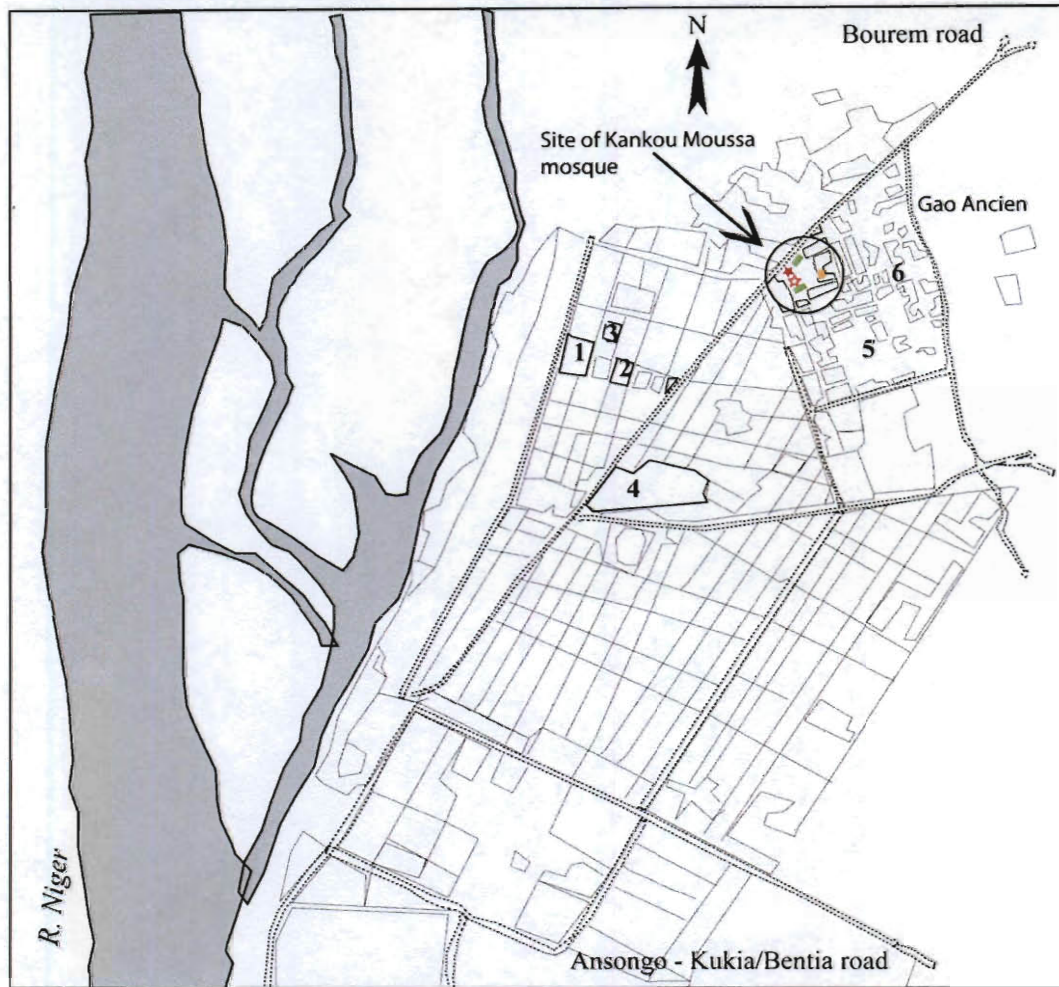


Figure 3.7. Excavated units and structures at Gao Saney (Adapted from Insoll 1996: 20, 26; McIntosh and Cisse 2008)



Keys	
1. Askia Mosque and Guirakandie cemetery	● Mauny's Mosque (1950)
2. unnamed cemetery	☆ Insoll excavation (1993)
3. Abakar Satta cemetery	★ Insoll excavation (1996)
4. Faranjirey cemetery	■ DNPC & Osaka Museum of Ethnology excavations (Since 2003)
5. Alzanabanja cemetery	
6. Burial pits (Slaves ?) and Muslim cemetery	

Figure 3.8. Map of Gao showing the excavated units at Gao Ancien

Chapter 4

PRODUCTION, DISTRIBUTION, CONSUMPTION: IRON AGE TRADE AND EXCHANGE SYSTEMS IN WEST AFRICA

INTRODUCTION

Evaluating the involvement of Gao Saney in trade and exchange is an important focus of this dissertation. Trade systems are challenging to reconstruct because they encompass many interconnected but spatially disparate elements of production, distribution and consumption. Without evidence for all three, understanding of the system remains incomplete. For this reason, trade and exchange systems known primarily from archaeological evidence may require many seasons of research in many different areas. Historical sources are an invaluable companion to archaeology, but they, too, have limitations.

This chapter begins with an overview of the kinds of evidence for production, distribution, and consumption that need to be assessed in order to build a case for particular systems of trade and exchange. It then considers what we currently know of the development of West African trade systems, with specific evaluation of the available historical and archaeological evidence for the production, distribution and consumption of copper, salt, gold and glass during the Iron Age. The evaluation concerns the comparative analysis of the available evidence of these trade goods from various sites for

understanding the nature and scale of the trade and exchange systems through time. Numerous questions are considered in order to assess the interpretation of the evidence reconstructing the trade and exchange systems. They include the types of production system, the scale of distribution of trade goods, the consumption patterns, the volume of the trade materials recovered at various sites across the regions, the available evidence for manufacturing activities, and the size of excavations. In addition, other important issues found generally in historical documents concern the identity of producers and consumers, the mechanism of distribution of goods and the actors involving in the distribution process.

The discussion begins with trade systems involving salt, gold, copper and glass in the period from the eleventh century, for which historical sources and archaeological data constitute the evidentiary basis. Then, the development of trade in the period preceding the eleventh century A.D is discussed. Because of the lack of historical documents, archaeological evidence is used to illustrate the trade systems at this time period. Some of the archaeological investigations carried out in West Africa are outlined in order to illustrate the evidence of early trade and to compare patterns of known systems to unknown ones. Finally, critical evaluations and a summary of existing evidence for these trade goods from historical documents and archaeological investigations are discussed.

TRADE SYSTEMS: PRODUCTION, DISTRIBUTION, CONSUMPTION

This section discusses the three intertwined elements of production, distribution and consumption, involving in the process of reconstructing the whole exchange system (unless otherwise indicated, this discussion is drawn from Costin 2001, pp. 273-308).

Production. The reconstruction of the production system is one of the major steps towards the comprehension of the exchange system. Important issues, including organizational processes (e.g., the type of compensation, the method of recruitment and the control over labor and means) and the social identity of producers (e.g., their status, gender identity, skill and efficiency), are harder to recognize and verify archaeologically, because of the limited amount of data. Consequently, the main focus will be on some basic issues, including the identification of areas in which production activities took place, the distinction between various kinds of production system, the identity of people involved in the production process, and the organizational systems of workers in the production areas (Costin 2001; Renfrew & Bahn 2004; Brumfield and Earle 1987).

In the study of production systems, the first issues to consider are the identification of primary and secondary production systems and the physical loci of these production activities. Primary production involves extraction of raw material. The exploitation area can be identified archaeologically by the evidence of ancient mines, quarries, and extraction debris. The recovery of various tools in situ used during the exploitation process and the presence of permanent features can provide some useful information about the nature of production. Also, source areas can be identified through chemical analysis of excavated materials (Renfrew & Bahn 2004: 365). Secondary production involves the fabrication of finished materials. The production area can be recognized archaeologically by the presence of features (e.g., smithing forges) manufacturing tools, and debris. Secondary producers such as smiths may be either locally situated or itinerant, or a combination of both.

Understanding the spatial organization of production permits its identification as domestic (occurring within the domestic space), non-domestic (occurring in a workshop spatially set off from the domestic space), or a workshop connected to the household. Domestic and workshop production can be recognized by the context in which the materials were found, the volume of the recovered manufacturing debris and the size of the manufacturing unit.

Because not everyone is a specialist, it is important to know who is producing the objects and also what was his/her motivation was in producing the objects. Indeed, primary or secondary producers can be independent specialists who may or may not be casted, or they may be specialists attached to social elites or political rulers. Slaves may be involved in primary production as well as in producing finished items for a patron. Independent specialists produce subsistence goods or wealth items for unspecified consumers . In contrast, attached specialists produce prestige and wealth items or provide services for particular elites or a political ruler (Brumfield & Earle 1987: 5; Costin 2001: 276). While they can produce utilitarian items, goods with extra-utilitarian function predominate in their production sphere. Attached production facilitates leaders' control of the political economy (Brumfield & Earle 1987: 5; Costin 2001: 276).

Archaeologically, the distinction between attached production and independent production is generally inferred from the physical context and scale of production of certain kinds of prestige and utilitarian goods . However, as Costin (2001: 299) has argued, identification can be problematic because attached production does not always occur in the elite zones or proximate to elite households. In some cases, producers of prestige goods may be members of the elite households. Furthermore, attached

specialists may work in part for specific elite consumers and in part independently for a wider market. In this case, it is very hard to distinguish them from independent specialists.

Determining intensity of production (part time or full time) is also challenging to assess, as are concentration, scale and output of production. Primary or secondary producers can be part-time specialists or full-time specialists. In general, most of the part-time specialists – either independent or attached -- were seasonally engaged in agricultural pursuits.. Full-time specialists might be independent, casted, servile or attached. Archaeologically, the spatial distribution of manufacturing debris and the volume of the recovered debris provides clues towards understanding the intensity, concentration ,scale and output of production. Concentration of production refers to a constellation of artisans at a given place. The scale of production of the manufactured product is associated with the amount of the materials recovered in the course of excavations. Output of production refers to the volume of manufactured objects recovered in a given unit or the whole material recorded during the excavations. Although output of production is relevant because it can provide information about the extent of production, it should be noted that it has some limitations as well. As Costin (2001: 291) has noticed in the organization of production, the recovery of a small quantity of material, for instance, is not synonymous with the occurrence of part-time or small-scale production because highly specialized workshops aiming to produce very limited prestige items can have low productivity.

In addition to these basic issues, the consideration of technological differences among various societies is also important. These can help distinguish between imported

objects and locally produced copies. For example, fragments of glass were often reused locally to reproduce various kinds of glass objects and glass beads imported from different production centers. Archaeologically, the technological differences can be recognized by the physical characteristics of the recovered objects and the discovery of tools used in the manufacturing process.

Distribution. This second element of the trade systems is defined as the processes by which goods were moved from makers to users (Renfrew & Bahn 2004: 374; Costin 2001: 304). Many scholars have proposed various mechanisms for the distribution of goods. Renfrew and Bahn (2004: 376) have schematized the mechanisms as follows: consumer goes to the source of the material without the intervention of any exchange mechanism; direct contact between makers and users; market exchange, acquisition of goods through intermediary or emissary; the exchange of goods down the line across successive territories; the use of the central place for their distribution. Goody discusses the social and political implications of exchange systems including gift exchange, taxation, tribute and market exchange (Goody 1982: 45-47 in Costin 2001: 305). In addition, goods can be acquired through “hand-to-hand exchange among various groups” (McIntosh 1995: 391). Some goods can be procured through warfare and stealing.

In the process of interpreting exchange systems, it is important to make a distinction between materials from regional, inter-regional and long-distance trade or exchange. In addition, knowledge about the identity of actors involved in the distribution of trade goods, such as merchants (locals or foreigners), nomadic pastoralists and political rulers, is very useful. In the absence of historical records, identifying the specific mechanisms of distribution is very hard. Where such documents exist, they can

provide helpful data for reconstructing some aspects of the distribution mechanisms of trade goods.

Consumption. The third aspect of trade systems is consumption. Manufactured products have certain values because people need and use them for various purposes. Issues in the reconstruction of consumption patterns include the identity of users, the scale of distribution, and the volume of the consumed materials recovered in various contexts.

In the consumption system, considering consumer identity is a key to understanding consumption preferences. Were particular types of goods used by the whole population or only small group of elites? Political leaders restrict the distribution of strategic prestige goods, which they use as currencies to finance their political and social ambitions and to create political alliances with other leaders (Brumfield and Earle 1987: 7). The degree to which they are able to control or monopolize these goods can be difficult to know without the help of historical sources.

The scale of the distribution of trade goods among the populations is inferred archaeologically by the amount of goods recovered within each household or household compound context. The comparison of the volume of consumed materials within these various households can provide useful information about the consumption preferences and the extent of consumption of the goods in question in each residential unit. Ritual contexts such as burials are also important, as grave goods can be unequally distributed. The recovery of a substantial amount of prestige or wealth goods in a burial context provides information about the social and political status of the person. Archaeologically,

the scale of distribution of goods in burial contexts is inferred by considering the volume of the recovered materials in each burial.

HISTORICALLY DOCUMENTED TRADE SYSTEMS IN WEST AFRICA

From the eleventh century onwards, many aspects of trade and exchange systems have been documented by a number of Arab authors including Al-Bakri, Al-Idrissi, Yaqut, Al-Umari, Ibn Battuta, Leo Africanus, and Al-Sa'di (Mauny 1961; Cuoq 1975; Levtzion & Hopkins 1981, 2000; Hunwick 1999). They have collectively illuminated the period roughly from the eleventh to the seventeenth centuries AD. For instance, these sources have provided numbers of production sources and producers of trade goods, retraced the mechanisms of distribution of these items and identified some major consumption centers across West Africa. Some sources provide brief references to the trade systems back to the eighth century AD as well.

This section discusses the various aspects of trade systems of salt, gold, copper and glass based on historical evidence. In the areas where historical evidence was recorded, archaeology crosschecks and interprets the information in order to reconstruct the trade systems of these items. Many areas remain outside the sphere of historical sources, however, leaving archaeology as the main source of evidence for trade in durables, such as gold, copper and glass. Table 4.1 illustrates the primary sources of production of salt, copper, gold and glass.

Table 4.1. Primary production sites of salt, copper, gold and glass

Trade goods	Production sites documented by medieval historical sources	Production sites documented by Archaeological sources	Production sites documented by other historical sources	Primary sources	Secondary sources
Salt	Gulf of Guinea (plant salt); Aftouth region (Sea salt); Tichitt (Amersel); Awlil, Ijil, Teghaza, Taouden (Rock salt)			Ibn Hawqal, Al-Edrissi, Al-Bakri, V. Fernandez, Leo Africanus, Bosman.	Levtzion & Hopkins 1981, 2000, Cuoq 1975, Mauny 1961, McDougall 1983, 1985, 1990
Copper	Ijil, Takadda (Azelik), Dkra (Diara)	Grotte aux Chauve-souris in Akjoujt region; Afunfun 162, Azelik 210, Ikwaten 193, and Azelik wan Birni in Agadez region, Marendet	Nioro – Sirakoro, Benue Rift	Al- Bakri, Ibn Battuta, Al-'Umari, Lambert 1983, Grébénart 1985	Mauny 1961, Levtzion & Hopkins 1981, 2000, Cuoq 1975, Herbert 1984
Glass	Maghrib	North Africa (Morocco and Egypt), Asia (India, Syrio-Palestinian region) and Roman origin. They were reported through the LA-ICP-MS analysis		Yaqut, Al-Idrissi	Levtzion & Hopkins 1981, 2000; Cuoq 1975; Brill in McIntosh 1995; Lankon in Nixon 2009, Dussubieux 2001, 2009
Gold	Ghana, Takrur (Galam – Bambuk), Wangara (Bure)			Al-Fazari, Yaqut, Al-Idrissi, Al-qazwini	Levtzion & Hopkins 1981, 2000, Cuoq 1975, Mauny 1961, Dévisse 1990, 1993

Historical Sources: Salt, Copper, Gold and Glass Production

Salt. Several kinds of salt were produced according to historical and ethnographic sources. They include plant salt, sea salt, rock salt and earth salt. All of them are important for West African populations, as salt is a necessary constituent in the diet of men and animals. Figure 4.1 shows the distribution of the sources of these various kinds of salt in West Africa. The four major kinds of salt are discussed, following the information provided in McDougall 1990, pp. 231–252 unless otherwise indicated.

Plant salt. Plant salt was produced particularly in the savanna and forest regions. In savanna regions, millet stalks were burned and the ash was used directly in water or boiled to get a crude salt residue (McDougall 1990: 225). Plant salts were essential for savanna and forest populations because rock and earth salts were lacking. They were used for culinary purposes, to cure tobacco, to make soap, and to feed animals (Pales 1950: 32-34 and also Knops 1970: 73-97 in McDougall 1990: 235).

Sea Salt. Sea salt was produced in the coastal zones, for instance in the Aftouth region of Mauritania and the mouth of the Senegal River. Sea salt is accessible to everyone, and generally local populations obtained crystals either by solar evaporation or by boiling brine. In the Sahel, where pastoralists and agro-pastoralists used salt in order to feed their animals, sea salt was not considered as good as earth salt or as medicinal as rock salt; it had to be mixed with earth before it could be given to animals.

Earth salt. Earth salt or amersel is generally available in certain arid areas where capillary action brings salt from shallow salt deposits to the surface during annual rains, forming a crust. The greater the rainfall, the more the soil became impregnated with salt. At Tichitt, for example, the crust could be as much as 20 to 30 cms thick. The crusts were

collected in pieces by pastoralists and agro-pastoralists from the Sahel region, bagged and transported to sahelian markets or further south. Herders bring their cattle to the salt deposits for salt cures; Tegidda N'tessemt (Niger) is a favored area for this.

Rock salt. Rock salt mines were exploited in the Sahara and Sahel. This type of salt is formed in layers beneath the ground and could be mined and transported in slabs. Rock salts are diverse in origin, number and thickness of their layers, and also in chemical composition. However, all these kinds of rock salts are more important because of their physical characteristics (resistant to breakage, impermeable to moisture) and their value (exchanged for gold). Because of this importance, in many areas, particular Berber groups have controlled rock salt deposits. Slave labor was generally used for extraction.

From the ninth century AD onwards, many sites are known to be associated with rock salt production including Awlil, Ijil, Teghaza, Toutek and Tatintal (Cuoq 1975; Levtzion & Hopkins 1981) [figure 4.1]. There is widespread agreement among researchers concerning the location of many of these production sources, such as Teghaza in Mali (Mauny 1961; McDougall 1990; Cuoq 1975; Levtzion & Hopkins 1981). In contrast, the location of some production sources, including Awlil and Tatintal, is subject to debate. For instance, Mauny asserted that the two most likely sites of Awlil are Aftouth and N'terert in Mauritania (Mauny 1961: 326). McDougall (1990: 242), on the other hand, argues that perhaps Awlil of the Arab geographers, like Ibn Hawqal, included all the known sources of salt between the Maghreb and Sudan. Indeed, a similar debate occurred between Mauny and McDougall concerning the location of the salt mine of Tatintal. Mauny (1961: 328) proposed that Tatintal described by Arab authors was in fact Teghaza where buildings were constructed with salt blocks. In contrast, McDougall

(1983: 277) argues that Tatintal, mentioned by Al-Bakri, was more likely the rock salt mine of Ijil, where the Lamtuna Berbers developed a salt industry from the tenth to eleventh centuries AD.

This discussion is focused on the salt mines of Awlil, Ijil, and Teghaza.

Awlil: Many Arab authors including Ibn Hawqal, Al-Bakri, and Al-Idrissi attested that the salt mine of “Ulil” (Awlil) was located “on the sea near the coast”, and “a day’s journey from the mouth of the Senegal” (Levtzion and Hopkins 1981: 46, 76, 106). Already in the tenth century AD, the salt deposits were exploited and controlled by the Banu Gudala tribe, one of the Sanhadja Berber groups who inhabited Awlil (Levtzion & Hopkins 1981: 76; McDougall 1983: 277). These Berber pastoralists were also the main organizers of the salt trade in the region. Al-Bakri and Al-Idrissi, for instance, noted that many caravans supplied a number of areas including Awdaghust, Takrur, Ghana and Kuga between the eleventh and twelfth centuries (Levtzion and Hopkins 1981: 46, 106-107; McDougall 1983: 276).

Ijil: In the fifteenth century, Cadamosto (cited in McDougall 1990: 246) noted that the Ijil salt mine was situated “six days inland from Wadan [Mauritania]” where a large amount of rock salt is exploited. However, Fernandes (in McDougall 1990: 246) was the first person to call the salt deposit by name in the early sixteenth century. He reported that “Yghild” is a large hill (80 km length and 10 km width) from which salt is extracted and cut in slabs from two areas (Mauny 1961: 327). Ijil has seven alternating layers of salt and clay, whose first salt layer is located at 0.90m below the ground. Slaves called “Maxabinnu” inhabited Ijil, and started the exploitation of the salt mine in the eleventh century AD. (McDougall 1990: 247-248). They extracted, transported and

marketed Ijil salt under the control of the Lamtuna Berber tribe. Competition between the Awlil and Ijil trading networks for the Awdaghust market led to a battle for the control of the Adrar in the mid-eleventh century (McDougall 1983: 277).

Teghaza: Located in the desert region of northern Mali, Teghaza was a major center for salt exploitation during the medieval period. The sebkha of Teghaza measures 3 km length, and 2 km width with rock salt deposits extending almost four meters in depth. Exploitation of Teghaza salt may have started around the eighth century AD (Mauny 1961: 328). Ibn Hawqal referred to Teghaza when he mentioned that salt came “from the land of Islam,” and via Awdaghust it was transported to Ghana and Kougha (Levtzion & Hopkins 1981: 282). In 1352, Ibn Battuta mentions that the houses and mosque are constructed with salt blocks and roofed with camel skins (Levtzion & Hopkins 1981: 282). According to him, slaves of the Masufa Berbers lived at Teghaza and exploited the salt mine (Levtzion & Hopkins 1981: 282); the Masufa tribe controlled the salt deposits and the main routes (Levtzion & Hopkins 1981: 42) and were the main organizers of the Teghaza salt trade.

From the fifteenth to sixteenth centuries, the Teghaza salt mine was controlled by the Askia dynasty of the Songhay Empire (Mauny 1961: 331). Leo Africanus visited Teghaza during this period and reported the transport of salt slabs to Timbuktu (Mauny 1961: 330). In AD 1585, exploitation of the Teghaza salt mines was abandoned to escape Moroccan attempts to monopolize the mines (Mauny 1961: 331; McDougall 1990: 252).

Copper. From the eleventh century AD, numbers of copper production centers, including Igli, Takadda, and Zkra, were recorded by Arab chroniclers.

Igli. Al-Bakri (in Levtzion and Hopkins 2000: 69) reported that “Igli” is located about “three days’ travel to the town of Nul in the land of the Gazula and Lamta.” According to him, copper was exploited and smelted at “Igli” and then transported to “the land of infidelity” (Levtzion and Hopkins 2000: 69). There was no detailed information about people who exploited and controlled the mining source.

Takadda. Takadda, identified as Azelik in Niger, is one of the major centers of copper production. Ibn Battuta, who visited the town in 1353, reported that the copper mine was located in the vicinity of Takadda and exploited by both male and female slaves (Levtzion and Hopkins 2000: 301-302). The raw material was transported to the town and then smelted in order to produce bar ingots of different sizes (Levtzion and Hopkins 2000: 301-302). The copper deposits were controlled by Berber merchants and the Berber Sultan of Takadda. Camel caravans transported copper ingots from Takadda to “Jawjawa” (Gao) and other Sudanese regions (Levtzion and Hopkins 2000: 302).

Zkra. The toponym of Dkra is associated with Diara, an ancient town located about eight kilometers from Siracoro, in the western part of Mali (Mauny 1961: 310). In the fourteenth century, Al-’Umari (in Mauny 1961: 308-9) reported on the mining, smelting and production of ingots by locals at Zkra (or Dkra). The mining was under the control of the King of Mali. The copper ingots were imported to the city of Niani (the royal residence) from where they were transported to other Sudanese towns (Mauny 1961: 308-9; Cuoq 1975: 280; Levtzion & Hopkins 1981: 272).

In addition to these production areas, some ethnographic sources (in Mauny 1961: 308) signaled the existence of copper mining in the Nioro-Sirakoro region in Mali. In this region, located in northwestern Mali and adjacent to southern Mauritania, eleven sites

appear to have copper and its alloys (Mauny 1961: 308). According to Mauny, some of these sites, such as Bouli Kadiere, the sites near Sirakoro, present traces of ancient exploitation (Mauny 1961: 308). However, none of the sites mentioned above in Niuro-Sirakoro region have been subjected to further investigations.

In addition to these West African sources, Arab authors mention the presence of copper mines in North Africa from where copper was distributed to the population of West African Sahel and Savanna. In the eleventh century, Al-Bakri, for instance, noted that worked copper was traded from Morocco to Awdaghust (Herbert 1979: 113). Additionally, Yakut provided further information according to which copper based objects (copper bangles, rings, and bracelets) were taken from Sijilmasa to Ghana (Levtzion and Hopkins 1981: 169).

Gold. The documentation of the gold production in the Sudan occupied a central place in the various historical records, particularly the medieval Arab chroniclers' documents. The first reference to early Ghana as "Land of Gold" was provided by Al-Fazari, well before AD 800 (Cuoq 1975: 42). Al-Idrissi made an important contribution by distinguishing the two main sources of gold in Sudan: one Western, the Takrur, and other, more eastern, Wangara, "Island of Gold" in southern Ghana (Levtzion & Hopkins 2000: 111). These two sources are identified respectively with Bambuk and Bure goldfields (Mauny 1961: 302). Both of them were controlled by the sudanic rulers (Mauny 1961: 303; Levtzion and Hopkins 2000: 272). Gold was extracted, transported and traded in the market by local populations, with tribute payments assessed by the ruler (Levtzion and Hopkins 2000: 272). Al-Omari noted that the miners dug pits up to a "man's height in depth" in

order to get gold (Levtzion and Hopkins 2000: 272). Additionally, Al-Idrissi reported that the inhabitants of Wargalan (Wargla) exploited the Wangara goldfields when the level of water from the river “Nile” (Niger) was low. They sold the gold to North African traders who exported and minted it into dinars (Levtzion & Hopkins 2000: 111). These are very different accounts! Locals vs. people from North Africa doing the mining! Al-Qazwini added some details by reporting that gold was transformed into bar ingots in Ghana and carried out to all other countries (Levtzion & Hopkins 2000: 177).

Glass. A number of Arab authors documented the provenience of glass materials as well. They reported that camel caravans transported numbers of glass objects (glass beads and glass vessels), alongside other trade items, from North Africa, Morocco in particular, to the south. Al-Idrissi, for instance, noted that different kinds of glass beads and other trade goods such as copper and perfume were transported from Maghrib to the Sudanese country (Levtzion and Hopkins 1981: 128). He also reported that the merchants from al-Maghrib al-Aqsa brought beads along with other goods, including copper and wool, to Takrur where they were exchanged against gold and slaves (Levtzion and Hopkins 1981: 107). Yakut added that Arab merchants carried blue glass beads from Sijilmasa (Morocco) to Ghana where they were exchanged against gold (Levtzion and Hopkins 1981: 169-170). The same information was relayed by Al-Qazwini, who reported that the merchants from Sijilmasa brought many glass materials along with salt, copper rings to the Sudanese regions (Levtzion and Hopkins 1981: 177).

Distribution

The mechanisms of distribution of salt, gold, copper and glass vary. They may include, for instance, market exchange, gift exchange, barter, hand-to-hand exchange, and also taxation and tribute payment. Among these various forms of distribution, I focus on market exchange because the marketplace is the main area specializing in the transfer process of goods from the producers to the consumers. Indeed, understanding market type exchange can provide useful information about the trade items, the people involved in the distribution of trade goods, and also the routes and means of transportation for the merchandise. However, it is also clear that gift exchange was an important strategy used by Ghana in the tenth century to assure the flow of salt from the Sanhaja of Awdaghust (Ibn Hawqal, Levtzion and Hopkins 1981:48, cited by McIntosh 2008: 367-8)

From various production centers, salt, gold, copper and glass were generally transported to the major trading centers, located particularly in the sahel and savanna. The major trading towns were the points of convergence for various goods from different regions. These market towns are considered the major consumption centers and also the trading points from which the trade goods were largely distributed across other consumption zones (Table 4.2). Historical sources inform us that goods were transported to the consumption centers using camels, boats and also slaves following various trade routes (Levtzion & Hopkins 1981, 2000; Cuoq 1975; 1985; Mauny 1961). Figure 4.2 shows the major trade routes used for the shipment of the merchandise and also the types of goods exchanged. The principal actors responsible for the distribution of trade goods were North African merchants (Arab and Berber groups), nomadic pastoralist

communities from the Sahara and Sahel (particularly various Berber groups), ruler emissaries, and also local merchants. Indeed, local traders (e.g. Wangara merchants in Levtzion & Hopkins 1981: 111) played an important role in the distribution process. Because most of the North African and Saharan merchants ended their trip in the major trading centers, the local merchants served generally as a relay by supplying these centers in gold and foodstuff and also transporting trade to other consumption areas, including the gold production zones. There is no information about the total volume of salt, copper, gold or glass transported to the consumption areas during the medieval period. However, some authors have reported useful information about the volume carried by an individual caravan. Al- Bakri, for instance, has noted that many camel caravans transported salt from Awlil to other countries (Levtzion & Hopkins 1981: 76). Al-Idrissi mentions the presence of 170 or 180 camels, with one load each, in the caravan of Berber merchants going into the Sudanese country (Levtzion & Hopkins 1981: 128). Towards the end of the fifteenth century, Diogo Gomes, probably speaking about the transport of Ijil salt, revealed that 400 or 500 camel caravans transported Ijil salt from “Aden” (Wadan) to Timbuktu and other Sudanese locations (Mauny 1961: 327). At about this same time, Fernandes specifies that the “Yghild” salt slabs were attached to camels “two by two with cords”, suggesting a load per camel of four slabs. (Mauny 1961: 327; McDougall 1990: 246).

In addition to the market exchange, Arab authors have reported the presence of a “silent trade” in Sudan. This form of exchange occurred by barter of trade goods without the intervention of language and money. The traders conducted their deals by placing the equivalent value of each item nearby one another without seeing each other. In the

thirteenth century AD, Al- Qazwini mentioned that Saharan salt and copper objects were exchanged against gold in some areas in Sudan using the “silent trade” (Levtzion and Hopkins 1981: 177).

Gift exchange was also common, particularly among political rulers from different regions. Ibn Hawqal, for instance, noted that the King of Ghana and the ruler of Kouga sent gifts to each other (Levtzion & Hopkins 1981: 49). It was also the case between the rulers of Ghana and Awdaghust. In the fourteenth century AD, Al-Omari reported that the King of Mali, Mansa Musa, distributed 100 loads of gold during his pilgrimage, and also sent 5,000 mithqals of gold as a gift to the sultan of Cairo after his return (Levtzion & Hopkins 1981: 269).

Consumption

Rock salt, gold, copper and glass were considered as prestige and wealth items used particularly by social elites and political leaders to show their social status. Because of their value, these items were used as medium of exchange and an important source of revenue for West African rulers through taxation and tribute. Al-Bakri noted that jewelry and necklaces of kings and princes of Ghana were gold (Levtzion & Hopkins 1981: 80). According to him, only the king of Ghana can have on the nuggets of gold found in the mines, other people can use only gold dust (Levtzion & Hopkins 1981: 81). In the twelfth century, Al-Idrissi noted that copper and various kinds of glass beads were used as personal adornments in the “Land of the Sudan” (Levtzion and Hopkins 1981: 108). Al-Qazwini added specific details by reporting that “wealthy women in Takrur covered their pubes with glass beads” while “poorer women use bone beads” (Levtzion and Hopkins

1981: 179). Rock salt was also an important import material used by the elite and rulers (McDougall 1990: 242, 255; Mauny 1961: 323). In the tenth century AD, Al Muhallabi mentioned that the major part of the King's treasure in KawKaw is salt (Cuoq 1975: 78).

Copper, salt and gold are also used as materials in ritual and social events. For example, they are used for the bride wealth payments and in the wedding ceremony. They gained this significance because they symbolized power within the closely integrated "political, religious, social and economic spheres" (Herbert 1984: 242; Bisson 2000: 112).

As mentioned above, salt, gold, copper and glass served as medium of exchange in many areas of West Africa. All these trade items were used as currency in certain kinds of transactions, according to the sources. The most common gold and copper currency was in form of ingots and wires of different dimensions. Additionally, gold dust, salt and glass beads were used as currency as well. According to Al-Bakri, the transactions of the inhabitants of Awdaghust were executed with gold wires (Levtzion and Hopkins 2000: 68). He also reported that the copper rings in Sila and salt in Kawkaw functioned as currency (Levtzion and Hopkins 2000: 78, 87; Herbert 1979: 113). In the fourteenth century, Al-Umari mentioned that glass beads and copper rings were used as currency in Kanim (Levtzion and Hopkins 2000: 260). Mauny and Thomassey suggested that copper wire at Koumbi Saleh and a copper ingot mold for copper at Tegdaoust may have been used in currency (Mauny 1961; Vanacker 1979: 116).

Saharan and North African copper, glass beads, and salt were commonly exchanged against gold in Sudan. Gold was the most valuable product for West African export. It was used by Saharan and North African populations for various purposes. For

example, as Al-Bakri has noted, Sudanese gold was minted into dinar coins in Tadmekka. It supplied also the mints of North Africa (Levtzion and Hopkins 2000: 85). In addition to gold, Saharan and North African goods were also exchanged for slaves, and locally-produced crafts and foods such as millet and sorghum, fish and beans (McDougall 1983: 275).

An important part of the Sudanese kingdoms' income was the control over salt, copper, gold and glass through taxation and tribute. Al-Bakri, for instance, noted that the King of Ghana imposed a levy of only five mithqals on each load of copper entered into the country against ten levied on other goods (Herbert 1979: 113; Levtzion & Hopkins 2000: 81). Concerning the taxation of salt in the Ghana territory, Ibn Hawqal and Al Bakri have mentioned that one dinar was charged for each load entering Ghana and two dinars was taken from that leaving the territory (Levtzion & Hopkins 2000: 49, 81; Cuoq 1975: 70). They also reported that one salt load could be sold in Ghana for between 200 and 300 dinars (Levtzion & Hopkins 2000: 49, 81).

Least visible to us in the sources is how these materials were used in ritual and prestige contexts.

In sum, historical sources provide valuable data for understanding the trade systems of salt, copper, gold and glass during the second millennium AD. These sources, particularly Arab chroniclers, shed light on numbers of production areas of these trade materials. We know, for instance, that particular Berber groups and their slaves controlled the exploitation and trade in rock salt and copper in the Sahara at sites such as Awlil, Ijil, Teghaza and Takadda. Through Arab chroniclers, we also know that gold was produced by locals in the sudanese regions, particularly at Bambuk and Bure, transported

by Wangara traders, with Sudanese rulers exerting control over distribution through taxation and tribute. Historical sources also mention that camel caravans of up to 500 camels transported various trade goods including copper, salt and glass objects from Sahara and North Africa to the Sudan.

Although historical records provide valuable information concerning the development of trade systems by documenting numerous production and consumption sites, it should be noted that they have some limitations as well. Indeed, numerous sites were absent in historical records although they appeared to be contemporaneous to medieval Arab chroniclers. In addition, historical accounts provide only a partial view (author's judgment) about the sites they covered. Archaeological data, however, is well placed to fill in these gaps (Tables 4.1 and 4.2).

Archaeological evidence for early historic period trade

Archaeological evidence at various production and consumption sites helps us flesh out aspects of the trade and exchange systems during this period. (Figure 4.2). The data obtained in the course of various investigations helps to crosscheck and complement the information provided by historical sources concerning the trade systems. Additionally, they illuminate some aspects of production and consumption systems in the areas missed by historical documents. Further clarification is provided by the chemical analyses of copper, gold, and glass-based artifacts in order to determine the sources of these trade goods.

Sites with copper, glass and gold

Mauritania. Evidence for manufacturing activities and consumption of gold, copper and glass was revealed in the course of the large-scale archaeological research at Tegdaoust/Awdaghust undertaken from 1960–1976 (Robert et al. 1970; Vanacker 1979; Dévisse et al. 1983; Polet 1985; Robert-Chaleix 1989). Several units totaling over 4,000 m² in area were excavated on the main mound (Dévisse and Robert 1983: 36; Polet 1985: 21; Robert-Chaleix 1989: 11). These excavations focused on stone-built residences located on this mound. Other units measuring over 1000 m² were also excavated in a small mound located at the southeastern sector of the main mound (Vanacker 1979: 8). These different contexts provide significant information about the production and consumption rates in a trade town.

At the small mound in the south east of the main mound, many households and workshops areas belonging to craft specialists were discovered during the large-scale excavation within a unit covering approximately 32m x 32m (unit size provided by the map scale; Vanacker 1979: 7-33). Four smelting furnaces and a large density of manufacturing debris (five crucibles, fragments of moulds for glass objects, slag and melted copper) were found in these deposits (Vanacker 1979: 105-110). Two radiocarbon samples from wooden charcoal collected in the trash deposit near furnace 3 and inside furnace 3 give respectively AD 933±100 and AD 1185± 122. Interpreting these two radiocarbon dates, Vanacker suggests that associated occupations could be dated from the ninth to eleventh centuries AD (Vanacker 1979: 136-139). Fragments of fired clay molds in these deposits were interpreted by Vanacker as molds for the manufacture of glass beads from imported glass cullet (Vanacker 1979: 168). It is, however, important to note

that Sam Nixon (2007, 2009) found the same kind of clay molds at Es-Souk, where adhering gold flecks suggested use as gold molds.

In the eastern part of the residential area at Tegdaoust, Robert-Chaleix reported the presence of numerous glass mold fragments, copper and iron slag from the occupation I to III deposits dated to the eighth to eleventh centuries AD. Some recovered mold fragments in occupation I presented traces of copper and gold (Robert-Chaleix 1989: 188). Evidence of manufacturing debris in domestic context shows that two kinds of production, household and workshop, took place at Tegdaoust from the ninth to eleventh centuries.

At Tegdaoust, numerous materials including 57 copper-based artifacts (earrings, ingots, rings, fragments of ringlets, bracelets) and glass objects (28 glass beads, fragments of glass vessels and glass weights) were recovered in the ninth to eleventh century deposits in the workshop area (Vanacker 1979: 110-144, 162-170). The analysis of samples of copper-based artifacts recovered in the course of excavations showed a high proportion of iron, lead and arsenic. The similarity of the copper composition of Tegdaoust with that of Akjoujt led Vanacker to emphasize a Mauritanian origin for the copper (Vanacker 1979: 143). The glass vessel forms and decors encountered in these deposits were similar to those from ninth-tenth century deposits at the site of Aghlabid Raqqada in Tunisia and Egyptian Fustat (Vanacker 1979: 166-167). Based on this resemblance, Vanacker concludes that Tegdaoust glass vessels were imported from North Africa, especially Ifriqiya and also Egypt (Vanacker 1979: 16).

In the residential sector of Tegdaoust, excavators reported the recovery of 311 copper-based artifacts and 63 glass objects (glass beads, glass vessels and fragments) and

10 gold-based objects during the extensive excavations of individual households (Robert 1970; Dévisse et al. 1983; Polet 1985; Robert-Chaleix 1989; Dévisse 1990). Most of the reported copper objects (260 in total) in this sector were recovered in the area documented by Robert-Chaleix (1989: 247). Dévisse et al. (1983: 129) noted that only “exceptional” beads were recovered, other beads remained uncollected, although “care was taken to describe them.” Unfortunately, “the field notes which served to record the recovered objects were not available by the time of analyzing materials and drafting” (Polet 1985: 14). The consequence is that we do not know how many copper and glass objects were encountered in the excavations. The recovered copper and glass materials were found in deposits dating from ninth to thirteenth centuries (Dévisse and Robert 1983: 214; Robert-Chaleix 1989: 247). Dévisse has also reported the discovery of five gold ingots, gold jewelry (two rings, one earring, and one gold bead) and gold wires prepared for filigree in the course of excavations at Tegdaoust (Dévisse 1990: 432-433). However, detailed information was not given about the period and the context in which the gold wires were found. Additionally, small fragments of gold were also recovered in occupation V (eleventh-twelfth century) (Robert-Chaleix 1989: 188). However, it should be noted that it is difficult on the basis of the published reports to assess the degree of stratigraphic control that was maintained during the excavation, and in the interpretation of the depositional sequences through time. There is a possibility of mixed deposits containing material from a different period, which can seriously affect to the reliability of the results (McIntosh 2000).

At Koumbi Saleh, evidence of copper and glass consumption was revealed during various excavations (Mauny 1961: 73-74; Berthier 1997). Mauny reported the recovery

of copper and glass objects (glass vessels and beads) inside various architectural structures (mosque, houses, and tombs) during the excavations undertaken in the 1940s and 1950s [Mauny 1961: 73-74]. The large-scale excavations (200m² in area extending over six meters deep) conducted by Sophie Berthier recovered 156 copper based artifacts (wires, rings, ringlet fragments, hand bell, beads and fragments of copper objects), 227 glass beads, nine glass weights, and 73 glass fragments (Berthier 1997: 73-95). Radiocarbon ranging from the ninth to fifteenth centuries (Berthier 1997: 28-30; 73-98). Analysis of five copper wires from Koumbi Saleh by Bourhis (1980) shows the presence of lead (8 to 10%), arsenic (2–4%), antimony, silver and nickel (Berthier 1997: 73). Berthier and Robert-Chaleix claim a Mauritanian origin for the ore used in manufacturing these copper wires (Berthier 1997: 73; Robert-Chaleix 1989: 265-266). Berthier hypothesizes that the quantity of copper wires attests to their monetary function (Berthier 1997: 74). The high-density of glass beads compared to the locally-produced ceramic and stone beads show that Koumbi Saleh was a major consumption center for exotic goods. Another important feature in the development of trade was the presence of glass weights, used particularly in the Arab world. Berthier asserts that this trade material attested to exchange with North Africa (Magreb, Ifriqiya) (Berthier 1997: 94-96).

The volume of the trans-Saharan trade in copper is suggested by the recovery of 2, 085 brass ingots from an abandoned caravan buried in the sand at Ma'den Ijafen in east-central Mauritania (Monod 1969). These ingots, dated to about the twelfth century, contain approximately 20-21% zinc by weight (Monod 1969: 304; Werner & Willett 1975: 151).

Middle Senegal Valley. Over 7500 copper based objects (viroles, bracelets, wires, ring fragments and copper fragments) weighing over 8100g were recovered from ninth to twelfth century deposits at Sincu Bara (Garenne-Marot 1993: 251; McIntosh & Bocoum 2002: 98, 176-181). Over 7000 of these were viroles (Thilmans 1980 in Garenne-Marot 1993: 216, 251). Garenne-Marot examined 98 Sincu Bara copper objects. Many of them were subjected to chemical analysis. The results show four main composition groups: brass, leaded brass, copper, and ternary alloys of copper-zinc-silver and copper-zinc-tin (Garenne-Marot 1993: 183-184). The analyses led McIntosh and Bocoum (2002: 101) to assert that “the chemical compositions of the analyzed copper-based metals from Sincu Bara and Tegdaoust are more similar to each other than to any other corpus of West or North African analyses available”. Other chemical analyses, undertaken by Thomas Fenn and David Killick on 38 copper based artifacts recovered at Cubalel, Sincu Bara and Siwre, show the presence of two categories of copper metal: “pure” (unalloyed) or arsenical copper and alloyed copper (Fenn and Killick 2009). Most of the samples were from the surface of these sites. Based on these results, T. Fenn and D. Killick argue that the alloyed objects containing zinc in appreciable amounts originated from trans-Saharan trade, probably from sources in North Africa, while the “pure” (unalloyed) copper metal originated from West Africa, possible in southern Mauritania (Fenn & Killick 2009).

Mali. Archaeological excavations at Jenne-jeno, one of the major trading centers in the Inland Niger Delta (IND), revealed evidence of smelting and smithing activities in Phase IV ranging from AD 900 to AD 1400 (McIntosh & McIntosh 1981; McIntosh 1995). Manufacturing activity was attested by the presence of five crucibles and crucible

fragments and slag in domestic contexts, particularly at the center of the site. Given the presence of traces of smelted copper inside some crucibles, it was likely that this metal was worked on the site during this period (McIntosh 1995: 275).

At Es-Souk, one of the major trading centers on the Saharan border, evidence for local craft production was revealed by the recovery of three gold coin mold fragments, crucibles and slag from AD 800–1400 (Nixon 2007, 2009). The fragments of the three gold coin molds containing microscopic traces of gold droplets were found in the deposit dated by association to c. AD 850–900 (Nixon 2007, 2009: 239–252). I already noted that Vanacker has found similar molds at Tegdaoust, which she claims to be glass bead molds (Vanacker 1979). However, according to glass specialist Jim Lankton, the Es-Souk fragments did not appear to have functioned as bead-molds. Having studied all the glass-beads from Es-Souk, Jim Lankton argues that the Es-Souk beads were all far too small to have been produced using these molds (Nixon 2007: 329). Additionally, there were traces of gold on the molds. Nixon assumes that Gao, acting as one of the main trade centers, supplied Es-Souk in gold coming from the south (Nixon 2009: 253).

At Toguere Doupwil (IND), fragments of one mold were recovered in the deposition dated between the eleventh to twelfth century (850 ± 45 B.P. in Bedaux et al: 1978: 146). The authors claim that evidence of this mold, designated for lost wax casting, shows that copper alloy artifacts were manufactured in situ (Bedaux et al.: 146). However, evidence of melted copper on the mold fragments was not reported. In his preliminary report, Bedaux reported that all the copper objects were collected on the surface (Bedaux 1976: 47). In addition to the copper presence at Toguere Doupwil, the recovery of some glass beads (amount not provided) on the surface of the excavated units

attests that these goods were also consumed at the site (Bedaux 1976: 47). Radiocarbon dating provided dates ranging from the eleventh to fifteenth centuries (Bedaux et al. 1978: 186-187).

At Jenne-jeno and Kaniana, evidence of copper (brass in particular) and glass consumption was attested during Phase IV period (AD 900 – 1400). Copper-based artifacts (copper nodule, ring, earring, bracelets and copper fragments totaling 70 g at Jenne-jeno, 25 g at Kaniana) and eight glass objects (glass beads and glass vessel fragments from Jenne-jeno) were recovered from the Phase IV deposits (McIntosh 1995: 265-266). The chemical analyses of copper based objects show the high percentage of zinc ranging from 3.5% up to 22% (McIntosh 1995: 264). Robert Brill (McIntosh 1995: 252-256) has conducted chemical analysis of the glass objects. According to him, Jenne-jeno has likely received glass materials from North Africa, particularly Egypt, which was considered an important production center for glass, particularly beads.

Excavations at Toguere Galia provided evidence of copper and glass beads dated between the eleventh and seventeenth centuries (Bedaux 1976, Bedaux et al. 1978). A 70 m-long section of eroded site section was studied. Seven copper objects (copper rings, needle, bracelet fragment, pendant), and some copper fragments and glass beads, along with iron objects and spindle whorl have been recovered in the course of the investigation. Most of the recovered glass beads (number not provided) and copper objects were collected on the surface, and associated with tobacco pipes (Bedaux et al. 1978: 186-187). Bedaux et al. (1978: 146-147) claim that the composition analysis of the single copper ring, found in the stratigraphic context and dated to the twelfth century AD, and those of the Ma'den Ijafen copper ingots are very similar (Bedaux et al. 1978: 146-

147). This comparative analysis suggests the same origin for Toguere Galia copper and Ma'den Ijafen items.

During the large-scale excavations conducted at Dia Mara and Shoma (IND), two copper fragments and 12 glass beads were recovered in the Horizon IV deposits dated AD 1000 – 1500 (Bedaux et al. 2005; Arazi 2005: 293, 302, 307). Given the extent of excavations and the number of site areas sampled, the small number of recovered copper artifacts is surprising and suggests limited consumption of exotics at the site. This could be due to a variety of factors including the geographical position of Dia located away from the major trade routes. Unfortunately, the chemical analyses of copper and glass beads have not yet been conducted. Arazi (2005: 293) claims that the origin of Dia glass beads was North Africa or the Near East (Asia). Chemical analysis might provide clarifications concerning the origins of the copper and glass.

In the Lakes region, evidence of copper and glass beads used as grave goods were recorded during the excavations at El-Oualadji, 10 km South West of the current town of Dire (Desplagnes 1907: 58 – 63; Mauny 1961: 96 – 97). Within two transects measuring 32.5 m long and 4 m wide each, one funerary chamber located at 10 m deep from the site surface were found. In this funerary chamber numerous copper objects including bracelets, rings, necklaces and ornaments (total amount not provided in the text) and also many glass beads along with other materials (iron spears and arrows, spindle whorls, animal figurines) were found near two skeletons. Additionally, other copper jewelry and glass objects along with iron objects and horse bones were recorded on the site surface (Desplagnes 1907: 59 – 60). Although the chronology of the excavated areas is not provided, Desplagnes claimed that the account of the eleventh century Arab author, Al

Bakri, concerning the indigenous funerary practices (dead being buried with his personal belongings) applied well into these tombs (Desplagnes 1907: 63). Although large parts of the site were disturbed because of this excavation (Mauny 1961: 97), further excavations are needed in the undisturbed area of the site (if it does exist) in order to have an idea about the site chronology. Chemical analyses of samples of copper and glass materials recovered during Desplagnes' excavations (located in the *Musée de l'Homme*, No 06 – 30, Paris, French) can also be undertaken in order to know their provenience.

At Es-Souk, 550 glass objects (168 vessel glass and glass fragments and 382 glass beads) and 80 copper based objects (jewelry and copper fragments) were recovered throughout the deposits from AD 800–1400 (Nixon 2007: 352-253, 2009: 239). The results of chemical analysis of Es-souk glass beads, conducted by James Lankton, show that there is a clear shift in the 'chemical types' of beads arriving at Es-Souk around the twelfth century indicative of a shift to northwest Africa (Nixon 2007: 295). The analysis shows also that there is no strong correspondence between glass from Fustat in Egypt and the glass recovered at Es-Souk after the twelfth century AD. This is important because Fustat is considered one of the most likely suppliers of the beads in this area of the western sahel (cf. Insoll & Shaw 1997; Dussubieux 2008).

Additionally, surface finds of copper and glass have been recovered in the course of archaeological surveys conducted in the Jenne, Gao and Mema regions in Mali, (McIntosh & McIntosh 1980: 479-510; Togola 2008: 104-110; Togola et al. 2003; 2004a: 50-60; 2004b: 1-24).

Niger. In Niger, primary and secondary copper production and consumption took place at Azelik during the second millennium AD. Azelik has been proposed as Takadda, the

centre of copper exploitation visited by Ibn Battuta in 1353 (Mauny 1961: 141). The main site, called Azelik wan Birni, has been subjected to the large-scale investigations in the 1970s and 1980s (Bernus and Cressier 1991). Systematic surface collection along two transects extending 20m x 15m and 12m x 12m provided evidence that native copper was extracted from dolomite by crushing the rock (Bernus and Cressier 1991:140). The raw material was then melted and cast in small crucibles inside the households (Bernus and Cressier 1991: 15, 140). Numerous crucible fragments and copper-based objects, including two copper ingots, jewelry, copper wires and 13 coins, were recovered. The site is dated between the thirteenth and fifteen centuries (Bernus and Cressier 1991:121). The chronology and the evidence of small-scale manufacturing activity are consistent with Ibn Battuta's account of copper production at Takadda.

As we have seen, archaeological investigations during the historical period shed light on some aspects of the trade and exchange systems at many sites across West Africa. They have provided additional evidence for the production and consumption of copper, glass and gold in many areas already mentioned in historical records and illuminated some major production and consumption areas missed in historical documents (Table 4.2).

Table 4.2. Evidence for production and consumption at West African sites

Sites	Production evidence	Copper artifacts	Glass artifacts	Gold artifacts
Historical mention: Azelik; Es-Souk; Tegdaoust; Koumbi Saleh	Four furnaces, slag, five crucible fragments, three gold mold fragments, and some glass mold fragments	619	947 (433 glass beads and 514 glass vessels and fragments)	10
No historical mention: Jenne-jeno (Phase IV); Kania; Sincu Bara; Dia (Horizon IV); Toguere Dupwil and Toguere Galia	57 crucibles and crucible fragments and slag	9675	20	

Summary and discussion of historic period trade

Historical evidence. We have seen that historical sources describe some major production sources of copper, salt, gold and glass; the main actors intervening in the production process; the mechanisms of distribution; some major consumption centers; and also consumption patterns. However, the interpretation of Arab sources is difficult because many points in their narration are confused as to site locations, names and spellings, often attributable to the use of second-hand information (Norris 2000: 428-429). The accounts are often not detailed enough to allow meaningful comparison between historical and archaeological evidence.

Arab sources informed us on different modes of primary production for desert-side salt and copper, extracted by slaves owned by Berbers, and savanna-side gold and copper, extracted by local workers seasonally. The highly localized salt and copper sources made control by those organizing the distribution possible. Savanna-side

Distribution mechanisms described by Arab authors include market exchange, “silent trade” and gift exchange (Levtzion and Hopkins 1981: 49, 177, 269), with long distance movement of goods organized by specialist traders in the south (Wangara) and north (Berber, Arab) (Levtzion & Hopkins 1981, 2000: 111). These specialists in long distance trade were generally responsible for distributing goods across the region. We know far less about regional trade in foodstuffs, for instance, and very little about volumes of goods transported. It is clear that distribution networks shifted through time, as political alliances for transport security and political centers rose and fell. For instance, the Ijil trading network, which competed with Awlil for Awdaghust market from the eleventh-twelfth centuries, started to compete with Teghaza for supplying the Timbuktu market from the thirteenth-fifteenth centuries (Mauny 1961: 354–367).

Consumption of copper, gold and glass beads as personal adornments marked social status and royal regalia. Rock salt was a source of wealth. Because of their value, these various trade goods were used as a medium of exchange, particularly in the major trading towns considered also as major consumption centers. Political leaders gained control over these strategic trade materials through taxation and tribute and used them in prestige systems of gift exchange to cement political alliances and to finance their political and social ambitions. For instance, the political alliance centered on salt and gold trade between Awdaghust and Ghana showed how important these trade items were

in the political and economical life of these two Kingdoms. (Levtzion & Hopkins 1981: 48). This lucrative trade, on one hand, ensured “gifts and goodwill” for Awdaghust, and, on the other hand, provided a necessary foodstuff, a profitable export and a source of taxation for Sudanese rulers (Levtzion & Hopkins 2000: 48-49, 81; Cuoq 1975: 70; McDougall 1985: 20-21).

Archeological evidence. While the archaeological record is mute regarding primary production, distribution and consumption of salt, there is good evidence for copper and some for gold. Primary copper production is attested at Azelik (probable site of medieval Takedda), and secondary production at Azelik, Tegdaoust, Jenne-jeno, and Sincu Bara. There is evidence for spatially distinct workshop production at Tegdaoust, while at Jenne-jeno, it is situated domestically (Vanacker 1979; McIntosh 1995). Secondary gold production of gold coins is proposed at Es-Souk. The total amount of manufacturing debris recorded from all these sites is small, but the figures may not account for all materials recovered, as some projects were predominantly focused on foreign imports.

The inter- and intra-site analysis of consumption at Es-Souk, Tegdaoust and Koumbi Saleh, Sincu Bara, and Jenne-jeno in the second millennium is hampered by the lack of a consistent recovery and reporting methodology at all these sites. described in the historical documents were also the major trading centers. For example, the reported volume of trade materials in the various reports from Tegdaoust and Koumbi Saleh represents only a part of the discovered materials during the various excavations, due to the preferential recovery of certain kinds of copper and glass objects and the loss of field notes subsequently. (Dévisse et al. 1983: 129; Polet 1985: 17). At Koumbi Saleh, because

of their large focus on the architectural structures, some excavators failed to report the volume of the recovered materials during the excavations (Mauny 1961: 73-74).

The volume of copper recovered at Sincu Bara (more than 7500 pieces) was astounding, by contrast. The excavation report does not allow a good understanding of the context of all this copper, much of it localized in one area. Was Sincu Bara perhaps “the town of Sila” mentioned in Arab documents as a center where copper trade along with other goods occurred (Levtzion and Hopkins 2000: 107). By contrast, glass at the sub-Saharan sites, including Sincu Bara, is fairly scarce (20 beads). Most of these glass objects were recovered at Jenne-jeno and Dia (McIntosh & McIntosh 1980; McIntosh 1995; Arazi 2005). This small sample of the recovered glass materials at these sites is surprising during the historical period under study. Further research is needed in order to elucidate this issue.

Chemical analysis of various copper objects from many sites dating to the historical period, including, for instance, Sincu Bara, Jenne-jeno in Phase IV period, reveals the high presence of brass and leaded brass. According to T. Fenn and D. Killick these alloyed objects, containing zinc in appreciable amounts, originated from trans-Saharan trade, probably from sources in North Africa (Fenn & Killick 2009). The analysis of some samples of copper-based objects of Tegdaoust and Koumbi Saleh shows the high proportion of lead, iron and arsenic (Berthier 1997: 73). Vanacker, Berthier and Robert-Chaleix claim the Mauritanian origin of the ore used in the manufacture of the copper objects from these last two sites (Berthier 1997: 73; Robert-Chaleix 1989: 265-266). However, lead isotope analysis is needed to crosscheck this claim.

Analysis of glass beads has confirmed Arab accounts of glass materials received from North Africa. Many authors claim that glass beads and glass vessels were imported especially from Ifriqiya and Egyptian Fustat (Vanacker 1979: 166-167; Berthier 1997; Brill in McIntosh 1995: 252-256). However, Nixon's claim concerning the shift in chemical types of Es-Souk beads from Northeast Africa to Northwest Africa around the 12th century AD needs more consideration (Nixon 2007: 295). This claim is important because it helps us to think about trading corridors different from Fustat, which was traditionally seen as the major supplier of glass beads to West Africa.

Although many aspects of trade systems during the second millennium AD have been illuminated by historical sources in conjunction with archaeological records, archaeology alone documents some aspects of the trade systems during the first millennium AD. In this following section, the archaeological evidence for trade in the first millennium and earlier is considered.

ARCHAEOLOGICAL EVIDENCE FOR EARLY TRADE AND EXCHANGE
For the first millennium and earlier in West Africa, archaeology furnishes our primary evidence for trade and exchange systems. In the absence of historical data, the organization of production systems and distribution mechanisms are very difficult to assess. Copper was produced and transported in the first millennium BC, but gold and glass date only to the first millennium AD. Evidence of these traded goods at a number of production and consumption sites excavated during the last three decades shows the development of early trade and exchange during this period.

Copper production and consumption

Mauritania. In Mauritania, evidence of copper production and consumption is present at Grotte aux Chauve-Souris, Touizigt, Dhraïna and Imbich-Est from the eighth to second centuries BC (Lambert 1983). The investigations at the Grotte aux Chauve-souris (Grotto of Bats) on the Guelb Moghreïn in the Akjoujt region provided evidence for malachite exploitation and smelting activity during this period (Lambert 1971, 1975, 1983; Vernet 1993). The chemical composition of the Akjoujt ores includes a high proportion of arsenic and iron (up to 50% of iron), and also traces of gold (Lambert 1970: 15–62, 1983; Vanacker 1979: 139–143). Numerous manufacturing debris and copper objects (one small copper ingot, arrow points, and copper fragments) were recovered at the site. During this same period, smelting and manufacturing activities on copper with the Akjoujt chemical signature occurred at other sites including Touizigt and Dhraïna (Lambert 1983; Vernet 1993: 333). Whether populations collected the ores directly from the mining sources or acquired them through exchange and trade is not known. Objects of Akjoujt copper have also been found at sites lacking any evidence of production – e.g., Imbich-Est, a semi-sedentary site located in the littoral region (Vernet 2000: 89), and Walaldé, a site on the Senegal side of the Middle Senegal Valley (Deme 2003, Deme and McIntosh 2006). The pattern of recovered surface artifacts suggests that pastoralists or agropastoralists were implicated in the distribution networks that spread copper over much of the southwest quadrant of Mauritania (Deme and McIntosh 2006).

Niger. In Niger, evidence for copper exploitation at a number of first millennium BC sites, has been recorded from the In Gall–Teggida-N-Tessemt region, west of Agadez

(Grébénart 1985: 175-246). More than 220 furnaces were attributed to the Copper II period; eighteen were excavated at three sites (Grébénart 1985: 189–220). Numerous artifacts including crucibles, slag (>60 m³), and 227 copper based artifacts (Pins, arrow points, knife blades, jewelry, small bar of ingots, and many fragments of copper based artifacts) were recorded as surface finds, along with iron artifacts (Grébénart 1985: 183-204, 217-225). The association between the surface finds and the furnaces remains a question requiring further investigation. Copper may have been smelted at different time periods and copper artifacts could be fashioned from either native copper (no smelting required) or smelted ores. The scale of first millennium BC copper production is therefore difficult to assess, but it is likely to be quite small. The distribution of copper beyond the In Gall–Teggida-N-Tessem region is poorly known. Few copper artifacts are reported from the entire southwest of Niger, for example (Vernet 1996:326).

Large-scale secondary copper production at Marandet has been the focus of archaeological investigation over time (Lhote 1972; Grébénart 1985; Magnavita et al. 2007). Over 6000 crucibles and fragments, abundant debris from copper casting and molds for casting ingots have been recovered (Fenn et al. 2008). Residues from the crucibles indicate that copper was alloyed with lead and some tin (Grébénart 1985: 371). Five new radiocarbon dates from refuse pits cluster in the period 650–900 cal AD. Lead isotope analysis on samples show two distinct lead isotope groups: one is likely from a Moroccan source, while the other may be from a Tunisian or a West African source (but definitely not Akjoujt). Further research and analysis need to be done in order to determine the most likely West African sources. This new research demonstrates that copper from more than one source was reaching Marandet for secondary processing quite

early. The extent of the distribution of Marandet copper products is not known, although the lead isotope group present in the crucibles and casting debris closely matches objects from Kissi and Azelik (Fenn et al. 2008).

Mali. Secondary production of copper-based materials is attested in the first millennium AD at a variety of sites. Seven crucibles, some with cuprous residues, have been recovered from domestic contexts at Jenne-jeno (McIntosh & McIntosh 1981; McIntosh 1995:275). Crucibles in far greater numbers have been found in trash deposits on the periphery of Gao-Saney, suggesting copper-working on a larger scale, perhaps in localized workshops (Takezawa and Cisse 2003; McIntosh and Cisse 2008). Also in evidence at Gao Saney is secondary processing of glass, possibly involving the heating of beads cut from drawn canes in order to smooth them. Remelting of glass cullet to make beads may also have occurred; further excavation is necessary to understand the range of secondary production activities and their scale.

Copper artifacts and glass are present but rare at excavated sites on the western side of the Niger Bend: Jenne-jeno, Ja Shoma and Mara, Galia and Doupwil, Akumbu (Arazi 2005; Bedaux et al. 2005; Bedaux et al. 1978; McIntosh and McIntosh 1980; McIntosh 1995; Togola 2008). In dramatic contrast, both are much more common on the eastern side, at Gao Saney and Gao Ancien, a pattern that continues near the river in Burkina Faso (Kissi) and much further south in Nigeria (Igbo Ukwu).

Copper was reaching Jenne-jeno by the fifth century AD, but the source area is not known (McIntosh 1995: 264). The chemical analysis of copper alloys from Jenne-jeno shows the presence of arsenic, tin, bronze, and iron (traces) [McIntosh 1995: 267].

The single gold earring recovered in the deposit was dated from AD 850-900 (McIntosh 1995: 391). The earliest exotic at the site is a glass bead with a potash-silica composition that is primarily known from China (McIntosh 1995: 254–6). Other beads from early deposits may come from the Mediterranean and Near East. A few glass beads reached Ja during this early period as well (Arazi 2005; Bedaux et al. 2005), but the number of glass beads dating to all time periods is surprisingly small, given the large-scale excavations. Copper was equally rare, consisting of one copper pendant in the shape of a chameleon from Horizon III dated AD 500–1000 (Arazi 2005: 302). No analysis has yet been conducted to verify the chemical components of this copper-based artifact to determine the source of origin. Similarly, the six glass beads in the first millennium AD deposits have not been subjected to compositional analysis (Arazi 2005: 293). As already noted, the limited number of exotics recovered from large-scale excavations at Dia suggests limited consumption.

In the adjacent region of the Mema, two bronze bracelets and five copper fragments were recovered in eighth century deposits at Akumbu. The two bracelets were found on each wrist of the extended burial in Unit AK3 (Togola 2008: 39). The result of the chemical analysis of one of the copper bracelets indicated that it was an alloy constituted of copper (92.29%), tin (2.12%), arsenic (5.35%) and antimony (0.03%) [Togola 2008: 39]. Lead isotope analysis by Tom Fenn is anticipated. The recovery of the copper objects in a burial context suggests that this metal was considered a prestige good designated for elite consumption. We have not seen this pattern in the Upper Inland Delta around Jenne-jeno and Ja. This may, of course, be an artifact of our limited sample.

The area of Gao Ancien was a major center for the consumption of glass, copper and gold (Insoll 1996; 2000; Cisse et al. 2007). Over 870g of copper-based objects (earrings, bracelets, nails, wires, ingot fragments, beads and copper fragments), 7200 glass beads, numerous glass vessel fragments and two small gold fragments (2.50g and 2.25g) alongside other goods were recovered throughout the deposits (Insoll 1996: 104; Cisse et al. 2007). The associated radiocarbon dates range from the seventh to thirteenth centuries AD (Insoll 1996; Cisse et al. 2007). The discovery of the two gold-based objects in the ninth to twelfth century deposits inside a building at Gao Ancien attests the development of inter-regional trade and exchange between Gao and other major centers, particularly the gold producing zones. The analyses of four copper objects and 17 glass beads from Gao Ancien show close correspondence of composition with artifacts from Gao Saney (Steven Laurie in Insoll 1996; Dussubieux 2009).

At Gao Saney, 725g of copper-based artifacts (rings and copper fragments) and 663 glass beads were recovered throughout the deposits of the different excavated units (144m³). The chemical analysis of four copper-alloy artifacts (Steven Laurie 1996: 107) shows the presence of large amounts of lead or zinc, and also antimony and chlorine.

Copper and glass consumption at Kissi (Burkina Faso) and Igbo-Ukwu (Nigeria).

Evidence of the elite consumption was better illustrated at Kissi and Igbo-Ukwu where copper and glass beads were found in burial context. At Igbo-Ukwu, more than 685 bronze materials and 165,000 glass beads were recovered in three structures: a shrine (Igbo Isaiah), burial chamber (Igbo Richard) and disposal pit (Igbo Johah) dated by radiocarbon assays to 782 to 1018 cal AD (Shaw 1970: 106-107, 260-261, 296-323;

Willet and Sayre 2006: 57). Copper-based artifacts are divided into leaded tin-bronze made by *cire perdue* casting and copper worked by smithing and chasing (Shaw 1970: 295; Chikwendu et al. 1989: 29). Willett and Sayre (2006: 57-61) undertook lead isotope analyses of Igbo-Ukwu copper alloys. The result shows the presence of two lead isotope groups: a Moroccan or Nigerian group and a Tunisian group. Concerning the first group, many of the analyzed Igbo-Ukwu objects correspond either to Moroccan or Nigerian ores. The second group shows the strong correspondence between the Igbo-Ukwu objects and Tunisian ores. Consequently, Willett and Sayre (2006: 77) argue that “some metal used in Igbo-Ukwu could well have come from a nearby source but at present it appears that the rest came from Tunisia or Morocco by camel caravan across the Sahara Desert.” Thomas Fenn et al. (2008) drew similar conclusions from lead isotope analysis of some Igbo-Ukwu materials. Some glass beads have been chemically analyzed as well. According to Brill (in Shaw 1970: 260), all the analyzed beads are “soda-lime-silica glasses.” From their compositions, not much information can be extracted because “they are the most common variety of glass made during virtually all periods of glass history,” (Brill in Shaw 1970: 260). Many researchers claim that Igbo-Ukwu beads originated from North Africa, particularly Egyptian workshops of Fustat (Sutton 2001; Insoll et al. 1997). However, further analysis of these beads is needed in order to know their origin.

At Kissi 3, more than 15 tombs were recorded (Magnavita et al. 2002: 26). A total of 26 copper-based objects (anklets, chain mail links, bracelets) were recovered in grave contexts (Magnavita et al. 2002: 27–36). Additionally, from the 4500 beads recovered at Kissi, more than 1000 glass beads were used as grave goods at Kissi 3 (Magnavita et al. 2002: 36; Magnavita 2003: 130). Two radiocarbon samples from the two richest tombs

and one sample from the occupation mound of Kissi 3 provide the following dates: 1495±45 BP or 445–653 cal AD and 1393±33 BP or 613–680 cal AD (respectively from tombs No 10 and 14), and 1250±40 bp or 673–886 cal AD (from the occupation mound) [Magnavita et al. 2002: 38]. This chronology is problematic and cannot be extrapolated to the other undated tombs because “the cemetery was used and reused during many centuries” (Magnavita et al. 2002: 25). The chemical analysis of two pairs of copper bracelets from two different tombs attests that the first pair (from tomb No 14) was an alloy of copper, lead and antimony while the second pair (from tomb No 10) was an alloy of copper and zinc (Magnavita et al. 2002: 33). Lead isotope analysis conducted by Thomas Fenn et al. (2008) in some Kissi 3 copper alloy materials shows two distinct lead isotope groups: Moroccan group and Tunisian groups. They argue that there is a strong correspondence between some Kissi objects and Moroccan ores by at least the seventh century AD (Fenn et al. 2008). This evidence sheds light on some North African imports to Kissi during the mid first millennium AD. Preliminary chemical analyses of some Kissi beads show that the amount of alkali such as soda and potash is extremely low (< 2%), although some of the beads have a moderate amount of lead (Magnavita 2003: 133). According to Brill (in Magnavita 2003: 133), they could belong to the “Silica-Lead Glass Family” originating from Asia, which was connected to North Africa.

The major presence of glass beads and copper objects accompanied by other trade goods in various graves from the fifth to ninth centuries AD at Kissi and the eighth to eleventh centuries AD at Igbo Ukwu illustrates a pattern of prestige goods for elite consumption. They also attest the development of interregional and long-distance

exchange and trade connecting these consumption areas to the production sources of copper and glass.

In sum, archaeological investigations across West Africa have revealed evidence of various production and consumption sites of copper, gold and glass pre-dating the second millennium AD. During the first millennium BC, the exploitation of copper ore in Akjoujt and Agadez regions and the manufacturing of copper-based objects in these areas were significant activities. Distribution of copper appears to have been regional, extending up to 400-500 kilometers from source areas. The organization of distribution is open to conjecture. Copper could have been used in gift exchange and prestige systems by seasonally mobile agropastoralists. There is evidence that glass beads occasionally reached sub-Saharan regions by the end of the first millennium BC.

The scale and volume of production and consumption increased during the first millennium AD. Secondary processing of copper on a large scale is attested at Marandet by the eighth century. Gold may have been cast at Es-Souk at about this period, and this dissertation will suggest that Gao Saney supplied copper-based objects and glass beads to Gao Ancien, one of the major consumption centers of the Gao Kingdom from the eighth to tenth centuries. This exchange connection was attested by the similarity of the chemical components of some analyzed copper and glass beads materials from the two sites (Insoll 1996; Dussubieux 2009). Glass becomes an important consumption category east of the Niger Bend, with thousands of glass beads recovered from first millennium contexts at Gao Ancien, Kissi, and Igbo Ukwu. Copper also functions as a prestige good at these sites, most spectacularly at Igbo Ukwu. Moreover, from the ninth to tenth centuries AD, gold is attested at several sites including Jenne-jeno and Gao

Ancien, Tegdaoust and Es-souk (McIntosh 1995; Dévisse 1990; Takezawa et al. 2007; Nixon 2009). The difference in the scale of consumption of glass and copper documented to date on the west and east sides of the Niger is unexpected and merits closer attention.

Archaeological evidence from these above-mentioned production and consumption sites sheds light on the occurrence of early regional and long-distance trade and exchange among various population groups. It also illuminates the presence of some major trading centers, for instance Jenne-jeno and Gao, where copper, glass and other goods from Sahel, Sahara and North Africa were exchanged against gold and foodstuffs from the south.

Summary and discussion: pre-second millennium AD

Archaeological investigations at the sites dating before the historical period shed light on some aspects of trade and exchange systems, including the level of production activity and consumption preferences. Table 4.3 provides a summary of the available volume of manufacturing debris and consumed materials, including copper, glass and gold through time. Archaeological investigations show that copper was exploited and consumed in the Akjoujt region and at various copper II sites in Agadez region (Lambert 1970, 1983; Grébénart 1985). At this period, evidence of the use of copper gained through exchange with copper makers is attested at Imbich-Est and Walalde (Deme 2003; Deme and McIntosh 2006; Vernet 2000). The presence of copper with the distinctive chemical signature of the Akjoujt mines at Walaldé suggests regional and inter-regional metallurgical exchange (Deme 2003; Deme and McIntosh 2006). Imbich-Est likely also

used Akjoujt copper (Vernet 2000: 84), but chemical analysis is needed to confirm this. Similar analyses from many more first millennium BC sites is needed to fully document the distribution of Akjoujt copper during this period.

Table 4.3. Summary of the excavated evidence of manufacturing debris and consumed materials in the first millennium BC and AD

Period	Number of manufacturing debris and associated features	Number of copper	Number of glass	Number of gold
1st millennium BC sites	235 furnaces and furnace parts; slag and crucibles	238	3	Not found
0 – 4th c. AD	Presence of some furnace parts, tuyere fragments and slag	Few copper	Few glass objects	Not found
4th – 7th c. AD	4 furnace parts (679g), slag, 2 clay crucibles and molds (including some Marendet crucibles)	29 (plus some Marendet copper)	Over 1000	Not found
7th -11th c. AD	Over 6000 crucibles at Marendet; furnace parts; manufacturing debris (over 22,300g) at other sites	Over 2000	Over 176,500 glass beads	3

Glass beads are extremely rare in the first millennium BC, even at sites with large-scale excavations (Jenne-jeno, Ja Shoma and Mara). This suggests that if the beads arrived by exchange, it was likely small-scale, “hand-to-hand” exchange (McIntosh 1995:391).

In the first millennium AD, the trade and exchange systems became more complex and the trade goods more diversified and voluminous. During this period, copper, gold and glass beads were produced and consumed at many excavated sites across West Africa . Although the scale of excavations at these first millennium sites was three times smaller than that at the sites dating from the historical period, the volume of

recovered manufacturing debris at these early sites was by far the most impressive. This evidence was illustrated at some major secondary production sites such as Marendet, and Gao Saney (Fenn et al. 2008; Grébénart 1985: 370, 378; Takezawa & Cisse 2003).

The change in the trend of the development of manufacturing activities is apparent during the first millennium AD, with a notable increase at sites in the latter part of the first millennium AD. A similar trend is observed concerning the consumption of copper, glass and gold through time. The increase in glass beads is particularly dramatic. The presence of numerous glass beads in early deposits of Gao Ancien and also in grave contexts at Ugbo-Ukwu and Kissi shows the importance of this in trade in a prestige good (Cisse et al. 2007; Shaw 1970: 260; Magnavita et al. 2002: 36; Magnavita 2003: 130, Fenn et al. 2009). While the dating of the earliest graves with glass beads at Kissi requires confirmation, there are suggestions that beads from the Mediterranean began to move across the Sahara to the eastern Niger Bend region in the first half of the first millennium AD (Fenn et al. 2009). Secondary copper processing on a large-scale is documented at Marandet from the seventh century AD. It isn't known whether the Akjoujt and Agadez copper sources were exploited between late first millennium BC and the mid to later first millennium AD. There seems to have been a hiatus.

The chemical composition of copper objects from various sites dating to the first millennium AD is very diverse. Analysis of some copper objects from Jenne-jeno Phase III and Igbo-Ukwu shows the presence of tin-bronze. Unalloyed copper is present at a number of sites. Some Igbo-Ukwu copper materials have lead as well. Lead isotope analysis of some Igbo-Ukwu copper alloys (lead, tin-bronze) attests that some of these bronze artifacts probably come from a nearby source and that the rest originated from

Tunisia or Morocco (Willett and Sayre 2006: 77; Fenn et al. 2008). At some other sites including Kissi, Gao Saney and Gao Ancien, the presence of copper alloys with a large amount of lead or zinc was noted in the course of chemical analysis of some samples of copper from these sites (Fenn et al. 2008; Laurie 1996: 107). Lead isotope analysis conducted on Kissi copper alloys (copper, lead and antimony, and copper and zinc) attests the strong correspondence between some objects from this site and Moroccan ores, although some objects have been associated with Tunisian ores (Fenn et al. 2008).

The LA-ICP-MS analysis of samples of Gao glass beads shows the presence of natron soda-lime glass and soda glass made from soda plant ashes (Dussubieux 2009). Some Jenne-jeno beads have natron and soda glass as well. At Ugbo-Ukwu, the analyzed beads are “soda-lime-silica glasses”, while the analyzed samples of Kissi beads belong to the “Silica-Lead Glass Family” (Magnavita 2003: 133; Brill in Shaw 1970: 260). Practically, most of these beads originated from Asia, except one bead (with natron) from Jenne-jeno, which has a Roman origin. Many researchers claim that many of these beads originated from North Africa, particularly Egyptian workshops of Fustat, which was connected to Asia and Europe (Magnavita 2003: 133; Sutton 2001; Insoll et al. 1997).

CONCLUDING REMARKS

Archaeological evidence for trade systems during the second millennium, when we have historic documents, is uneven. From the western side of the Niger, it is surprisingly sparse, given the size of excavations at Jenne-jeno and Ja, plus sites such as Galia and Doupwil. Even at Tegdaoust and Kounbi Saleh, the amount of trade goods reported is relatively small. Sincu Bara stands out as a site of major copper consumption, but the

concentration of material in a relatively small area of the excavations (Thilmans and Ravisé 1980) may indicate one reason for the uneven record: status goods such as glass and copper may have been deposited in very restricted contexts, so we do not often find them. Other problems include uneven recovery and recording procedures among sites, such that meaningful comparison of volume and context of deposition is difficult. Nevertheless, the value of archaeological studies of trade systems lies in its ability to go beyond the historical sources and identify details of production and distribution that their partial accounts do not provide.

East and south of the Bend of the Niger, there is a very different picture, with widespread occurrences of glass beads and copper in graves and in occupation sites, sometimes on a massive scale (e.g. Igbo Ukwu). We are entering a period when the compiling of comparative data bases of lead isotope analyses and other composition studies will permit a much more detailed appreciation of how goods moved at different periods. The usefulness of those data still rely ultimately on the quality of the excavations that produced the objects analyzed. Here, too, we are in a period permitting greater optimism. Still, reconstruction of trade systems will require many new excavations at many different kinds of sites to understand the systems of local primary and secondary production, the complex and likely shifting patterns of distribution, and the different contexts of consumption that different groups observed.

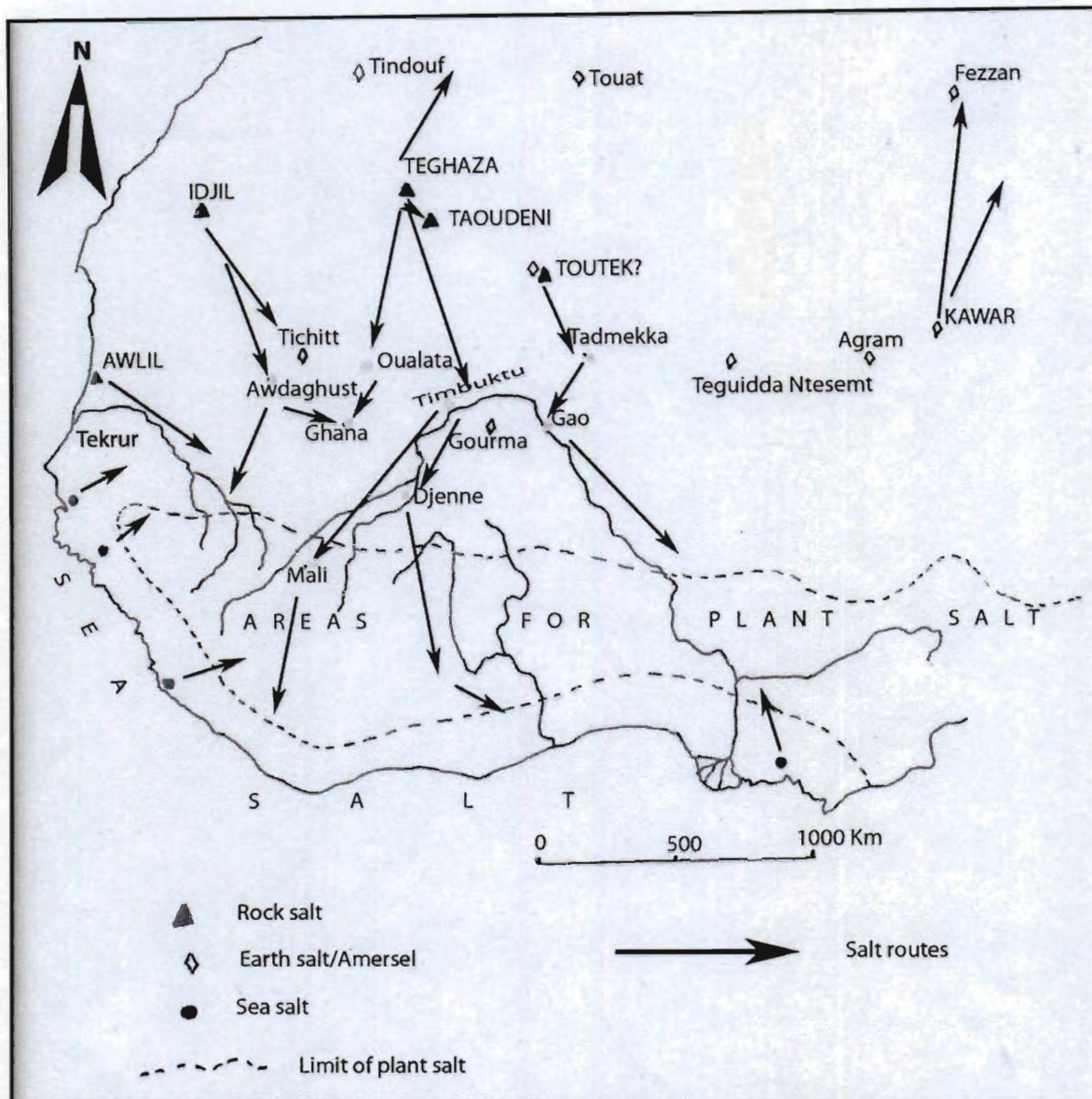


Figure 4.1. The distribution of salt sources in West Africa (From Mauny 1961: 322)

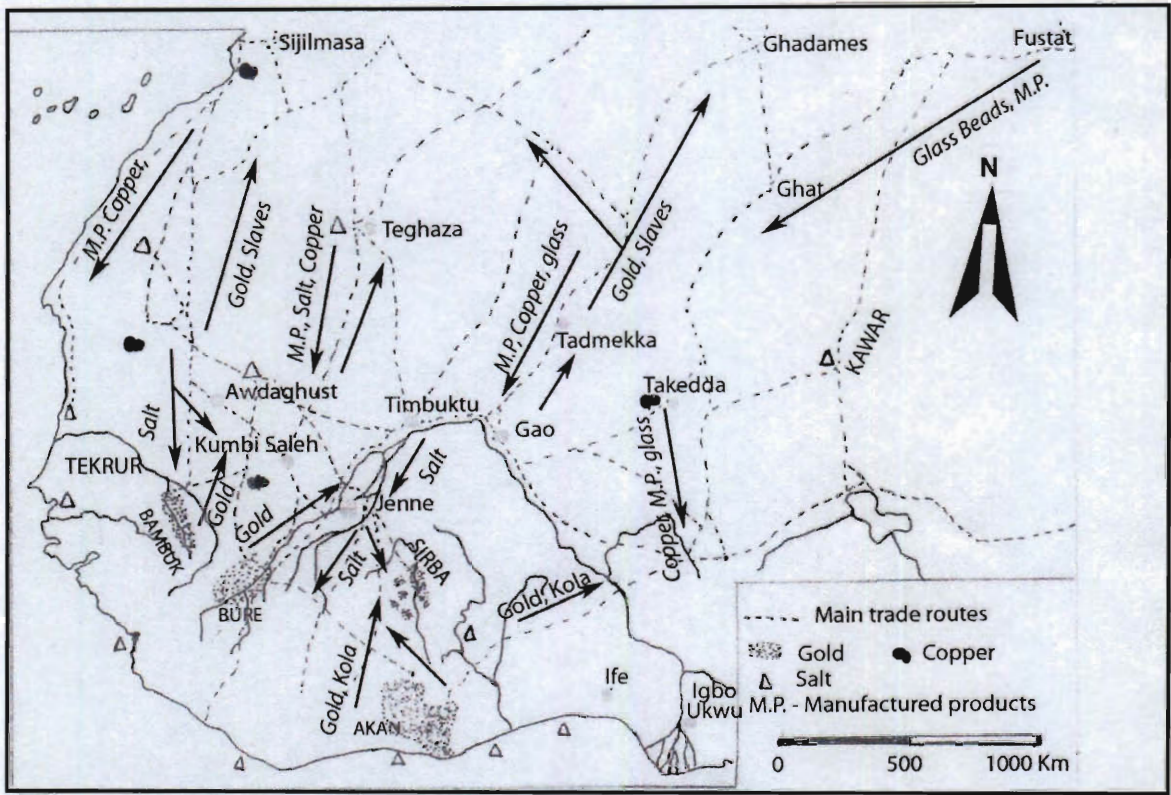


Figure 4.2. Trade routes and trade goods in West Africa (From Connah 2001: 140)

Chapter 5

ARCHAEOLOGICAL EXCAVATIONS AT GAO SANEY

INTRODUCTION

Gao Saney is a *tell* approximately 35 hectares in area and 6 to 7 meters high. The main mound covers 32 ha, and its southwestern border is connected to a much smaller mound up to 2 m high. Rescue excavations on the main mound were conducted by the *Direction Nationale du Patrimoine Culturel* of Mali in collaboration with the Museum of Ethnology of Osaka (Japan) in 2001-2002 in response to extensive looting in search of beads (Figure 5.1). The main goal was to gain a preliminary understanding of the chronology of occupation and the nature and depth of the cultural deposits. This rescue excavation was supplemented by my dissertation research at the same site in January 2009, financed by research funds from the Anthropology Department of Rice University. The objectives of this research were to improve data recovery by using upgraded excavation methodology with greater sensitivity to contextual details, to cross-check the radiocarbon chronology obtained in 2001-2, and to collect information on subsistence economy, diet, material culture and the development of trade and urbanization through time.

The massive looting activities at the site made locating areas of intact deposits suitable for excavation very difficult. In 2001, units GS1 (3m x 3m) and GS3 (3m x 2m) were excavated in the northwestern and center-western sectors, respectively, of the main

mound. The 2009 unit, ACGS, (3m x 3m) was excavated two meters distant from GS1 at the northwestern border of the mound.

The 2001-2 and 2009 excavations proceeded by natural levels down to sterile. The 2009 excavations were careful to maintain fine stratigraphic control over individual depositional levels/contexts. Each level was photographed and described in terms of depth, nature of soil, and type of material culture on a special Level Record Form. Each feature was drawn, photographed and described in a special Feature Form. Radiocarbon samples were collected and the contextual information for each sample was provided on a Radiocarbon Sample Form. The soils from each level were sieved with 0.5 cm mesh. All recovered artifacts and ecofacts were placed in bags according to their nature and labeled with the name of the site, excavation unit, level, level record number, and date. Flotation samples were taken in each excavated level. All the profiles were drawn and described according to the type of soil and the nature of the deposits. The forms for the 2001-2 excavations unfortunately could not be located in Japan. The descriptions for GS1 and GS3 rely on the detailed field notebook I maintained alongside the excavation forms.

STRATIGRAPHY AND FEATURES OF THE EXCAVATION UNITS

ACGS

ACGS was placed at the northwestern border of the main mound, 2m east of unit GS1, excavated in 2001-02. This placement was aimed at providing further documentation of the deposits in this sector, where domestic debris (potsherds, animal bones, and charcoal), structural features (brick walls) and manufacturing debris (iron slag, melted iron and copper and beads, and crucibles) had been encountered in the GS1 deposits during the

2001-02 excavations. With the GS1 excavation forms and profile drawings unavailable, a new excavation immediately adjacent was intended to amplify and assist the interpretation of the extensive field notebook documentation of the GS1 deposits, and to provide a larger sample of various categories of materials. Excavation and stratigraphy of ACGS revealed a number of discrete episodes of pit digging, trash fill and building construction, similar to the sequence of construction and trash accumulation episodes in GS1. In the description of the excavation unit I interpret and summarize the depositional processes and events represented by the various individual levels and features in the unit. The levels are discussed in order of discovery. The description of the excavated unit is accompanied by a summary table with levels and features in Appendix I.1 in chronological order, outlining the depositional events responsible for the layers (e.g., wall collapse, trash fill). Table 5.1 reconstructs the chronological relationships between strata and the probable depositional occurrences in ACGS. All the individual levels and features are described in detail in Appendix I.2. No sterile layers were encountered during the excavation; cultural deposits formed a continuous sequence overlaying reddish and homogeneous sand, which constitutes the sterile soil. This sterile layer was encountered at a depth of 6.33 m.

ACGS unit was excavated through 35 levels to a depth of 6.43 m. The point of origin, from which all the measurements during the excavation were taken, was placed 25 cm from the southwestern corner of the unit. In the course of excavation, 34 cultural levels and 11 features were recognized. The last level of the unit (Level 35) was a sterile layer. The cutting of steps along the eastern wall reduced the 3x3 m unit size by 0.5 m progressively from a depth of 50 cm to 2 m. At 2 m (Level 14), the unit size was further

reduced to 2m x 2.5m by leaving a 1 m wide unexcavated strip along the south wall. At the depth of 3 m, the unit was reduced again to 2m x 2 m (level 21). Step-cutting continued to diminish unit size to a final size of 1.5m x m at six meters depth.

Seven structural features constructed with large rectangular mud bricks or lumps of banco were encountered between 1.5 and 5.5m depth. Trash pits and fill deposits were encountered at the top and the bottom of the unit, and also between various structures. These fills primarily consisted of the accumulation of domestic debris (bones, potsherds, glass, glass beads, iron and copper objects), manufacturing debris (crucibles, melted glass, iron and copper) and fragments of *banco* bricks from the mud wall collapse.

The top of the unit consists of a large accumulation of trash extending to a depth of 1.84 m. Because of its depth, I have arbitrarily divided it into three parts: Upper, Middle, and Lower layers (Table 5.1).

The Upper trash pit layers, (levels 1, 2 and 3; 0.14 m to 0.93 m depth), and Middle layers (Levels 4–9; 0.93–1.49 m depth) are sandy loams intermixed with ashy layers and a large quantity of animal bones, glass beads, manufacturing debris and potsherds. At 0.37 m in Level 2, a concentration of iron slag was identified in the southwestern corner within ashy deposits. The quantity of archaeological materials (particularly manufacturing debris) decreased in the lower levels (7, 8 and 9) compared to the upper ones. The sandy and ashy texture of level 8 had a greenish color in some areas resulting probably from the contact of stagnant water and the decomposition of organic material. The Lower trash pit layer (Level 10; 1.37 m to 1.84 m depth), was a friable sandy loam layer intermixed with lot of bones, charcoal, iron and copper objects, beads, and potsherds. At 1.47 m and 1.57m respectively in the NW and SW of the unit, a

Table 5.1. Reconstruction of the depositional sequence in ACGS

Levels	Features	Depositional event	14 C sample #
1,2,3		Upper layers trash pit, rich in cultural material, including manufacturing and domestic debris.	1, 2 (L2), 3 (L3)
4,5,6,7,8,9		Middle layers trash pit, rich in cultural material, including manufacturing and domestic debris	4 (L4); 5 (L7)
10		Lower layer trash pit, abundant domestic debris	
11	2	Wall structure built with lumps of <i>banco</i>	6 (L. 11)
12		Accumulation, few cultural materials	
13		Accumulation, few materials	
14		Accumulation, some materials	
14		Accumulation, rich in cultural material	
	1	Wall structure built with lumps of <i>banco</i>	
15		Compact homogenous sand, rare domestic debris	7, 8, 9 (L.18)
16		Accumulation, rich in cultural material	
17		Interior of feature 3, poor in cultural material	
18		Trash fill, exterior of feature 3, abundant cultural material	10, 11 (Feat. 5)
19	3	Wall structure built with long <i>banco</i> bricks	
19		Accumulation, rich in material culture	
	4	Wall structure built with rectangular mud brick	
	5,7	Trash pit, rich in domestic debris	
20		Accumulation, abundant cultural material	10, 11 (Feat. 5)
21	6	Wall structure built with rectangular mud bricks	
21		Accumulation with cultural debris and fallen <i>banco</i> bricks	
22		Accumulation, rich in material culture	
23		Accumulation, presence of fallen bricks and some cultural materials	
24		Accumulation, many animal bones	
25		Possible floor or outside of Feature 8, few materials	10 (L. 26)
26		Possible floor or outside of Feature 8, few materials	
27		Accumulation, presence of some fallen <i>banco</i> bricks and some cultural materials	
	8	Wall structure built with rectangular mud bricks	
28	9	Accumulations/pit, abundant cultural material	13, 14 (L. 28),
29		Trash fill of animal bones and fallen <i>banco</i> bricks	
30		Accumulation, presence of domestic debris and fallen <i>banco</i> bricks	15 (L. 30)
30		Accumulation/pit, abundant cultural material	
31		Exterior of feature 10, few materials	
32		Interior of feature 10, presence of some materials	
32	10	Wall structure built with rectangular mud bricks	
33		Accumulation/pit, abundant cultural material	16 (L. 33)
34		Accumulation/pit, abundant cultural material	
	11	Trash pit, rich in material culture	
35		Sterile soil	

concentration of compact reddish sand was recognized. Later, this compact sand was identified as wall Features 1 and 2.

Features 1 and 2 initially appeared as a concentration of compact homogenous sand but after closer observation, it was clear that these structures were two walls built with lumps of sandy *banco* used as bricks. The high sand component in the bricks made it difficult to recognize them especially when they were in a matrix of eroded wall wash. Feature 2, located in the southwestern corner of the unit, was oriented SW-NE. Feature 1 was situated in the northwest of the unit. It was oriented NW-SE. The natural strata of the northern wall profile of the unit helped later to determinate the real length and the number of vertical layers of each wall. Feature 2 extended from 1.48 m to 1.68 m in depth. It has three layers of *banco* bricks. Feature 1 wall structure was recognized in excavation at a depth of 1.47 m, but in the unit wall profile it can be seen to extend higher, up to 1.18 m (Figure 5.2). This wall has ten layers of *banco* bricks. The thickness of the bricks is 15–18 cm. No artifacts were found in these two wall constructions. Levels 11, 12, 13, and 14 are interpreted as fill accumulated during the use and after the abandonment of these structures. The texture of these levels was sandy loam mixed with animal bones, charcoal and some circumscribed ashy deposits. Level 11 is an ashy layer, which became thicker in the southern part of the unit. The recovered materials were sparse and included some potsherds, one bead and one iron slag. In the central southeastern part of the unit, the sandy loam layer mixed with bones of level 14 became very thick (23 cm) and reached a depth of 2.17 m. In this sector of the unit, this deep trash deposit cut the compact reddish sand layer (level 15) located just below level 14 in the other parts of the unit at 1.96m depth and formed a sort of channel going from the

east to the center. In the northeastern corner, the layer with the greenish color (level 12), resulting from the contact of stagnant water, was noticed as well. Artifact density (potsherds, iron and copper objects) was low in these deposits.

Features 3, 4, and 6 constitute a second complex of structures. Level 15 reddish sand overlies the house wall structure of Feature 3, located in the western part of the unit. This rectangular wall construction was oriented NW-SE-SW. It was constructed with long *banco* bricks from 15-18 cm thick. Only its eastern wall was defined (NW – SE: 185 cm; SE – SW: 143 cm) the rest of the wall being outside the excavated unit. The wall structure of Feature 3 extended from 2.06 m to 2.56 m in depth (Figure 5.3). The interior floor of the structure (level 17) was filled by a compact homogeneous sand layer with sparse archaeological materials including potsherds, glass and ceramic beads and copper and iron objects. The trash fill deposits of Feature 3 included levels 16 and 18. These levels represented the exterior of the structure. These fill layers have a friable sandy loam soil mixed with bones, ash and charcoal. Some circumscribed green surfaces were noticed in the eastern part of the unit particularly in level 16. Many artifacts including potsherds, cowries, spindle whorl, glass, glass beads, copper and iron materials were found in these deposits.

Feature 4, located in the southern part of the unit, is a wall constructed with rectangular mud bricks (Figure 5.3). It was oriented SW – NE – SE. At the first view, it was hard to say whether the structure is a wall or a well-arranged pavement of bricks because of its shape. Indeed, this wall formed a conical shape in its northeastern part and its interior was filled with large rectangular bricks. However, the unit wall profile of shows that it was a wall of 10 layers of mud bricks. Feature 4 extended from 2.17 m to

2.84 m and 2.87 m in depth. Individual bricks measure 40 cm x 30 cm x 6 cm. No artifacts were found in this wall structure. The trash fill of feature 4 was level 19 located from the centre to the north of the unit. This fill level is a sandy loam intermixed with ash, charcoal and animal bones. Many archaeological materials including potsherds, ceramic and glass beads, shell, copper and glass fragments were recovered in the deposit. In fact in its southern and centre western parts, level 19 was bordered by Features 4, 5 and 6. Feature 5 is a disposal trash pit filled with sand, lot of bones, potsherds, copper, iron slag, glass and charcoal. This pit is 74 cm in diameter (Figure 5.4). The base of the trash pit (feature 7) has an oval form filled with sand and fallen *banco* bricks. Feature 5 extended from 2.84 m to 3.55 m in depth. It was dug into the accumulation of trash from the levels 20, 21, and 22.

Feature 6 was the last wall structure in this second wall structure complex before the interruption of structural construction activities by thick strata of accumulated trash. Indeed, this structure was confined in the southwestern corner of the unit. Only a small portion of its wall was discernible in the unit. It was constructed with rectangular mud bricks. At the top, it was difficult to define the bricks because they were melted and resembled as a compact sand layer. The top of the wall was defined after looking at the southern unit wall profile. Five layers of bricks were identified. This wall structure started 8 cm below level 17 (the interior of feature 3). It was oriented SW-W. Feature 6 extended from 2.61 m to 3.04 m in depth. In the southern wall profile of the unit, it is quite visible that Feature 6 structure was connected with the lower layers of the wall construction of Feature 4. Was this structure a continuation of Feature 4? However, it is important to underline that there is a well-defined uninterrupted vertical crack between

the two structures. No artifacts were found in this wall structure. The trash fill of Feature 6 was level 20 occupying the entire unit except the southwest, the location of the trash pit (Feature 5) and Feature 6 itself. The deposit of level 20 is friable and very ashy mixed with charcoal and sand. This ashy deposit produced many archaeological materials including potsherds, bones, copper fragments and some beads. Just below level 20, the reddish compact and hard sand appeared in the entire unit, except the centre western part where, as mentioned above, the trash pit of feature 5 was dug. This compact and hard sand layer, or level 21, yielded a substantial quantity of melted and fallen *banco* bricks suggesting wall collapse. It is hard to know whether level 21 is part of the trash fill of the wall structure of Feature 6 or it predated this occupation structure. This issue is very difficult to assess because, as underlined above, Feature 6 covered only a small portion of the unit (40 cm) which cannot help us to make a firm argument in favor of one or the other. Some potsherds, beads, copper, glass and animal bones were found in the deposit as well.

This second complex of structural features and trash fill were underlain by a thick layer of heterogeneous deposits consisting of a slow accumulation of alternating layers of very friable ashy deposit mixed with a substantial amount of bones (level 22), sand associated with bones, some fallen *banco* bricks and charcoal (level 23), and friable sand mixed with charcoal lenses and decomposed organic materials (bones in particular) [level 24]. This accumulation of trash (levels 22, 23 and 24) extended from 3.13 m to 3.80 m in depth. Archaeological materials uncovered from these various trash fill deposits included numerous potsherds and a significant amount of iron slag, iron and copper objects, glass and glass beads.

Below this trash accumulation, the wall structure (Feature 8) and the trash fills (levels 25, 26 and 27) connected with this structure appeared. Feature 8 is a wall structure built with rectangular mud bricks (Figure 5.5). This structure, located in the eastern part of the unit, was followed the direction NW – SE. The brick dimensions were 40-43 cm x 30-33 cm. Feature 8 had five vertical layers of bricks and extended from 3.87 m to 4.50 m in depth. As noticed above, this feature was connected with a thick layer of reddish brown sand mixed with fine gravels (levels 25 and 26) and a stratum of sand deposit with wall collapse (level 27). Artifact density in these deposits was very low. Only some potsherds, iron slag, copper object and few bones were recovered. In fact, it is hard to say that the first two levels were whether the floor or outside of feature 8 because the wall structure occupied all the eastern sector of the unit and continued in that part into the unit wall as well. However the presence of sand soil with fine gravels on one hand, and few materials encountered in the deposits suggest that levels 25 and 26 were the floors of the wall structure. On the other hand, the deposit of level 27 contained numerous fallen banco brick fragments and possible melted bricks due to the compactness and the firmness of the sandy soil texture. These mud bricks of wall collapse stratum represented parts of the wall structure of Feature 8 at some point of time. In addition, level 27 might be the basement floor of this structure because of the hardness and the homogeny of the soil texture. The archaeological materials uncovered in its deposit were restricted to a few potsherds and iron slag.

Feature 8 and the related fill levels were underlain by a thick layer of trash accumulation (levels 28, 29, 30) and pit fill (feature 9) [Figure 5.6]. These fill levels covered the entire unit and extended from 4.50 m to 5.50 m in depth. The accumulation is

marked by the presence of friable loamy sand and animal bones deposits (level 29) alternating with a mix of less compact sand deposit and fragments of fallen and melted *banco* bricks (level 30), and of a compact and hard sand intermixed with ash, bones and charcoal in some localized sector of the unit (level 30). A substantial amount of archaeological materials -- potsherds, glass and glass beads, iron slag, copper and iron objects -- was recovered from this large deposit, particularly level 28. Considerable numbers of glass beads were uncovered in the sandy deposit of level 30. The discovery of numerous fragments of fallen bricks and possibly melted bricks suggest that level 29 was a stratum of wall collapse. However, it is difficult to know from which wall structure these might have originated. Feature 9, the trash pit filled with an important quantity of animal bones, was mostly dug into levels 28 and 29. Some fragmentary bones were recovered in level 29 between the fallen *banco* bricks. The bones in this disposal pit was very friable and in a bad condition. This trash pit extended from 4.85 m to 4.92 m.

Below these thick layers of trash accumulation, another wall structure (feature 10) appeared and the trash fills represented by levels 31 and 32. Feature 10, located in the southeastern corner, is constructed with rectangular mud bricks (Figure 5.7). This wall structure was oriented SE-NW. It has four vertical layers of bricks. The brick dimensions are 36-44 cm x 34 cm. This structure extended from 5.44 m to 5.54 m in depth. As with other wall structures, no artifacts were uncovered within the wall. As mentioned above Feature 10 was associated with levels 31 and 32. These levels extended from 5.50 m to 5.65 m. Level 31 appeared to be the exterior fill of the structure. It is a reddish brown sandy loam intermixed with some localized ash deposits and charcoal lenses. Artifacts uncovered in this deposit included beads and potsherds. Level 32, on the other hand, was

considered as the interior floor of Feature 10 and made with a reddish sandy loam deposit associated with fine gravels. The northern sector of this level 32 was arbitrarily selected because Feature 10, going from south to northwest, stopped halfway in the middle of the excavated area. Some glass beads and potsherds were recovered.

Feature 10 was the last wall structure encountered in ACGS. This structure and the associated fill deposits were underlain by a thick accumulation of trash (levels 33 and 34) covering the entire unit and a trash pit (Feature 11). This accumulation and pit fill extended to a depth from 5.58 m to 6.33 m. Level 33 trash fill is ash intermixed with sand. At the top of this level, and just below feature 10, some fallen *banco* bricks were uncovered. Possibly, these bricks might still have originated from the basement wall collapse of feature 10. The ashy deposit of level 33 contained substantial numbers of glass beads, potsherds and some iron slag. Below this ashy trash fill, a thick sandy layer intermixed with powdered and completely disintegrated animal bone (Level 34) was encountered. The soil color of this fill tended to be between pale brown and green because of the high and compact concentration of this disintegrated bones. It is hard to tell whether this fill level is a trash pit or not. Anyway, it might be considered as a rapid accumulation of trash, bones in particular. At the bottom of this trash fill layer (around 6.10 m), a circumscribed oval trash pit was formed near the northwestern corner. The rest of unit, very sandy, compact and homogeneous, was sterile at this depth. This trash pit (Feature 11) was dug up to 23 cm into this sterile soil layer (Figure 5.8). It was filled with friable sand, ash, bones and potsherds. Some glass beads were uncovered as well. The question remains open whether this trash pit is the continuation of the accumulation of levels 33 and 34 or the sequential accumulation. In my first view, it appears that the

sequential accumulation of trash is much plausible because of the fact that these deposits contained various fill-textured elements (sand mixed with ash in the trash pit, animal bones in level 34, and ash layer in level 33). The sterile soil (level 35) was encountered at 6.33 m in depth at the bottom of the disposal pit. As noted above, this sterile layer of reddish, homogenous sand mixed with fine gravel was encountered in the rest of the unit at 6.10 m depth.

Excavated levels are shown in Figures 5.9 and 5.10. Natural strata are shown in Figures 5.11 and 5.12.

GS1

GS1 measured 3x3 m. It was placed on the northwestern periphery of the main tell, three meters east of the unit excavated by Timothy Insoll in 1993 (1996: 41-42). This placement was dictated by the fact that this area appeared to be less affected by looting activities and no pillaging holes were visible in the vicinity of the unit. The 2001 excavation in GS1 unit was intended to get a reliable chronological sequence of the site since Insoll's excavation was stopped only at 2.30 m in depth due to the instability of the ashy deposit (Insoll 1996: 42).

GS1 was dug through 15 levels to a depth of 6.35 m. The point of origin, from which all the measurements during the excavation were taken, was placed 50 cm away from the southwestern corner of the unit. During the excavation, 14 cultural levels and four features were recognized. Level 15 was sterile. At 0.9 m in depth, the unit was reduced to 2m x 3m by leaving 1 m wide unexcavated strip along the south wall. The cutting of steps along the southern wall further reduced the unit size by 0.5 m

progressively from a depth of 0.9 m to 4.5 m. At 4.5 m, the unit size was again diminished to 1.5m x 1.5m by leaving another 1m wide unexcavated bank along the western wall. Step cutting along the western walls continued to reduce unit size to a final dimension of 1.5m x 1m at 6.35 m.

The excavation was conducted by natural level down to the sterile soil, as described in the Introduction to this chapter. The details below are drawn from the field notebook documentation of the excavations. Table 5.2 reconstructs the chronological relationships between strata and the probable depositional process with related events. These levels and the related depositional events are discussed in order of discovery and thus in the reverse of correct chronological order. All the individual levels and features are described in detail in Appendix I.3.

In general, GS1 deposits consisted of the presence of wall structures, accumulation of domestic and manufacturing debris (potsherds, bones, beads, iron, copper, glass, crucibles, and iron slag) and mud wall collapse. The trash deposits were particularly encountered in various disposal pits from the top to the bottom of the unit.

The first four levels corresponded to a large accumulation of domestic trash and manufacturing debris extending to a depth of 1.60 m. Below the trash pit layers, the first wall structures (Feature 1A and Feature 1B) and their fill levels were recognized (Figure 5.13). Feature 1A was a curved wall constructed of elongated sandy *banco* bricks. The width of the wall was 75 cm. It extended from 1.57 m to a depth of 2.02 m. Feature 1B was a rectangular wall structure, 18–20 cm wide, constructed of elongated, sandy *banco* bricks. This feature extended from 1.65 m to 2.26 m in depth. These structures were

underlain by two other structures (Feature 2A and Feature 2B) and their fill levels (Figure 5.14).

Table 5.2. Reconstruction of the depositional sequence in GS1

Levels	Features	Depositional event	14 C samples #
1,2,3,4		Secondary trash deposit, rich in cultural material, including manufacturing and domestic debris.	1 (L2)
5 F1Ax F1Bx	IA IB	Accumulation and wall melt from Features 1A, 1B Interior fill of Feature 1A Interior fill of Feature 1B Curved wall of sandy banco lumps Rectilinear structure of sandy banco lumps	2 (L5)
6 7 7a, 7b 8 9	2B 2A	Accumulation and wall melt from Features 2A, 2B Accumulation from Features 2A, 2B Interior fills of Feature 2A Wall melt Rectilinear structure of mud bricks Trash pit, rich in cultural material Wall melt and wall collapse	3 (7b)
10 11		Accumulation, rich in cultural material, associated with wall melt of level 11 Wall melt and wall collapse	
12		Trash accumulation, heterogeneous, abundant cultural material	4 (L12)
13		Wall melt and wall collapse, some circumscribed ashy areas; few materials	5 (L13)
14		Trash accumulation, heterogeneous; abundant cultural material	6 (L14)
15		Sterile	

Feature 2B was a wall melt structure found below Feature 1B interior deposits, and extended from 2.33 m to 2.86 m in depth. Feature 2A consisted of two parallel rectilinear wall structures constructed with rectangular mud bricks. First recognized at a depth of 2.11 m, these structures progressively extended to the southeast from 2.37 m to a depth of 3.07 m. The brick dimensions, 40 x 20 x 4.5 cm, were uniform in these two structures. Below and outside of Feature 2A and its interior fill (Level 7b), the presence of a thick (57 cm) domestic refuse ashy trash pit (level 8) and the mixed materials from wall collapse and wall melt deposits (level 9) indicate an intense domestic activity. The

rich cultural material from the accumulation of trash (level 10) and the presence of a wall melt structure recognized in the course of excavation as a superimposition of fallen mud bricks (level 11) suggest that this domestic activity continued through time. The last 2 m cultural layers of the unit were characterized by the alternation between the accumulations of trash, rich in cultural material (levels 12 and 14) and the wall collapse and wall melt deposits (level 13). The accumulation of ashy trash fill (level 14) corresponded to the last anthropic accumulation in this sector of the site. Sterile, constituted by reddish and homogeneous sand layer (level 15), was reached at a depth of 6.10 m.

GS3

GS3 measured 2x3 m. It was placed in the center-west of the main mound, 300 m from GS1. This sector, one of the highest points of Gao Saney, was assumed to be the primary residential sector. In general, the central area of the mound was heavily affected by looting activities. After carefully surveying this sector, the unit was placed in an area that appeared to be undisturbed; no looter's pits were visible in its immediate vicinity. This placement was aimed to find evidence for the initial occupation of Gao Saney and to gain a reliable chronological sequence of the site.

GS3 was dug through 17 levels to a depth of 7.30 m. The point of origin was placed 50 cm away from the northeastern corner of the unit. In the course of excavation, 16 cultural levels and 10 features were recognized. The last level (level 17) was sterile. The cutting of steps along the southern wall reduced the 2m x 3m unit size by 0.5 m progressively from a depth of 0.40m to 6.20m. At 6.20m, the unit size was further reduced to 1.5m x 1.5m by leaving 50 cm wide unexcavated band along the western wall.

Step-cutting along the western wall continued to diminish unit size to a final size of 1m x 1.5m at 7 m depth. The same methodological approach used in GS1 was implemented in this unit. The information below is based on the field note documentation.

Table 5.3 presents levels and features listed in chronological order and outlines the probable events responsible for the deposition of each level. Each individual level and feature is described in detail in Appendix I.4.

Table 5.3. Reconstruction of the depositional sequence in GS3

Levels	Features	Depositional event	14 C samples #
1		Secondary trash fill and trash pit deposits, abundant domestic debris.	1
2		Accumulation from Features 1A and 1B, abundant cultural material	2 (L5)
3		Interior fill of Feature 1B	
4		Channel dug into Feature 1B	
	1A	Rectilinear wall structure of rectangular mud bricks	
	1B	Rectilinear wall structure of rectangular mud bricks	
5		Accumulation from Features 2A and 2B	
	2A, 2B	Curved structures of sandy <i>banco</i> bricks	
6		Accumulation from Feature 3	3 (L8) 4 (L9)
F3X		Interior fill of Feature 1B	
	3	Rectilinear wall structure of rectangular mud bricks	
7		Accumulation from Feature 4	
8		Accumulation and trash pit	
9		Accumulation from Feature 4	
	4	Rectilinear wall structure of rectangular mud bricks	
	1C	Rectilinear wall structure of rectangular mud bricks	
10		Accumulation, rich in cultural material, associated with Feature 5	
	5	Curved structure of elongated <i>banco</i> brick, abundant quantity of rice grains inside, storage space	
11		Accumulation, few cultural material	
12		Accumulation, abundant cultural material, associated with Feature 6	
	6	Pottery collection used for domestic or ritual purposes	
	7	Trash pit, rich in domestic debris	6 (F7)
13		Accumulation of trash, abundant cultural material	
15		Trash fill, abundant cultural material, accumulation from level 14	
14		Wall melt and wall collapse	
16		Trash accumulation and trash pit, heterogeneous and rich in cultural material	7 and 8
17		Sterile	

The deposits were characterized by the presence of a series of wall structures, accumulation of domestic debris (potsherds, bones, iron and copper objects and beads), trash pits, and mud wall collapse. This trash accumulation and trash pit digging activities became particularly important at the bottom of the unit.

Level 1 comprised abundant domestic debris from secondary trash accumulation and trash pit deposits extending to a depth of 0.35 m.

Below these trash deposits, the first wall complex (Features 1A, 1B, 2A and 2B) and their fill levels were recognized. Feature 1A was a rectilinear wall structure constructed with rectangular mud bricks measuring 40 x 20 x 4.5 cm (Figure 5.15). This wall had two horizontal layers of bricks, and extended from 0.35 m to a depth of 0.64 m. Feature 1B was also a rectilinear wall 70 cm wide constructed with the same kind of rectangular bricks (Figure 5.17). At 54 cm in depth, small channel (level 4) divided Feature 1B into two wall structures in the Southeast. At this depth, the southern part of Feature 1B was associated with Feature 1C wall structure, and the remaining wall of the feature continued up to 64 cm in depth. Feature 1C (Figure 5.16), the highest wall structure in GS3 deposit, was first recognized in the course of excavation at a depth of 0.54 m, and extended up to 2.40 m. This wall was constructed with rectangular mud bricks measuring 40-43 x 20-25 x 5-6 cm. Feature 1C was circumscribed by the south wall of the unit, and associated with Features 1A, 1B, 2A and 2B at its top. Below Feature 1B and its fill levels (levels 2 and 3 – rich in domestic debris), two curved structures c. 1 m in diameter (Features 2A and 2B – function unknown) and their accumulation (level 5) were identified. These features were constructed with elongated *banco* lumps between 15-20 cm wide (Figure 5.18). Below this first structure complex,

which ended at 0.96 m depth, a second complex of wall structures (Features 3, 4 and also the continued Feature 1C) and accumulation was identified. Feature 3 was a 20 cm wide rectilinear wall structure constructed with rectangular mud bricks (40 x 20 x 4.5 cm) and extended from 1.31m – 1.51 m depth (Figure 5.17). Part of this wall collapsed to the inside (F3X) attested by the presence of fallen bricks in this area. Below the accumulation from Feature 3 (level 6), another wall structure (Feature 4) was recognized at a depth of 1.80 m. Feature 4 was a rectilinear wall constructed with four ranks of mud bricks ranging in size from 40-42 x 23-25 x 5-6 cm (Figure 5.18). This wall structure was interrupted by a trash pit encountered in level 8 deposits at 2.15 m, and after 16 cm of interruption, it reappeared again and continued up to a depth of 2.37 m. As underlined above, Feature 1C continued up to 2.40 m in depth. This wall structure is a relatively long-lived structure that was still standing, apparently, while a succession of more ephemeral structures (Features 1A, 1B, 2A, 2B, 3 and 4) were built on the accumulating surface outside it. Beneath this second complex of wall structures and their fill deposits, two features (Feature 5 and 6) and a thick accumulation of domestic debris (levels 10, 11 and 12) were encountered. Feature 5 was a curved structure constructed with elongated *banco* lumps (Figure 5.19). It extended from 2.57 m to a depth of 2.74 m. This structure was used as a granary. At 3.55 m in depth, feature 6 -- a cluster of various kinds of pottery including long-necked jars, plates, vases, and pottery fragments -- was encountered (Figure 5.20). Other materials, including iron objects and a cup, were uncovered inside and near some of these pots. The presence of these two features and the abundant domestic debris in the trash accumulation including two entire earthen lamps and iron pendants indicates that this sector was intensively occupied.

Below this, a trash pit (Feature 7) and another accumulation consisting of trash fill deposits (Levels 13 and 15) and wall melt and wall collapse materials (level 14) were encountered. Feature 7, extending from 4.88 m to 5.10 m in depth, was dug into level 13 trash fill and part of level 14 (Figure 5.21). The rich cultural material, including domestic debris and a small quantity of manufacturing debris uncovered in the trash pit and the trash fill deposits, extended to a depth of 6.20 m. Possibly, part of these fill deposits (particularly level 15) represented the accumulation from the wall melt of level 14 extending from 5.00 m to a depth of 6.20 m.

The last 80 cm of cultural layer in GS3 was an accumulation of trash, rich in domestic debris (level 16). This continued to a depth of 7.05 m, at which point sterile soil, represented by reddish sand mixed with gravel, was encountered.

SITE CHRONOLOGY

The radiocarbon dating results of nine samples of wood charcoal collected from various levels within the excavated deposits are provided in Table 5.4 while the schematic summary of chronological relationships between units ACGS, GS1 and GS3 are shown in Figure 5.23.

The interpretation of conventional radiocarbon dates have been discussed elsewhere (see McIntosh & McIntosh 1986: 413-6). S. McIntosh has noted that advances in high-precision radiocarbon dating have lead to three major issues; “(1) the necessity of calibration, using the two-sigma range for confidence limits at the 95% level; (2) the frustratingly large calendar age ranges (200-500 years) that result from calibration; (3) the difficulty in dealing these calibrated ages ranges statistically, since the probability

distributions are complex and frequently asymmetrical“ (S. McIntosh 1995: 59; S. McIntosh & Bocoum 2002: 92). Due these problems, the use of series of dates and independent data from the stratigraphic information crosschecked with the relative chronology of the ceramic sequences remains necessary (McIntosh 1995: 59; McIntosh & Bocoum 2002: 92).

Table 5.4. Radiocarbon dates from Gao Saney 2001-02 and 2009 excavations

Unit	Level	Lab #	Sample depth (m)	Date B.P	Calendar years (calibrated)
ACGS	2	Beta 261360	0.35 – 0.45	950 ± 60	Cal AD 980 –1220
ACGS	33	Beta 261361	5.68 – 5.70	1170±40	Cal AD 770 – 980
GS1	2	Wk 12629	0.80 – 0.84	1083 ± 42	Cal AD 880 –1030
GS1	7b	Wk 12630	2.72 – 2.91	1297 ± 52	Cal AD 640 – 880
GS1	14	Wk 12631	5.60 – 5.80	1227 ± 42	Cal AD 680 – 900
GS3	1	Wk 12632	0.20 – 0.35	1124 ± 37	Cal AD 780 –1000
GS3	5	Wk 12633	0.96 – 1.26	1189 ± 54	Cal AD 690 – 980
GS3	12	Wk 12634	3.55 – 3.60	1126 ± 44	Cal AD 780 –1000
GS3	16	Wk 12635	6.40 – 6.50	1246 ± 37	Cal AD 680 – 890

Note: Calibrated dates for Beta are from INTVAL04 (2004) and Talma and Vogel (1993) at 2 sigma and the dates are reported with 12C and 13C fractionation. For Wk calibrated dates are from Stuiver et al (1998) and Ramsey (2002) at one sigma and the dates are reported with 13C fractionation.

Two sets of dates are available from Beta (for ACGS) and Wk (for GS1 and GS3) (Table 5.4). For the neighboring units ACGS and GS1, the dates at the bottom and top seem to differ by 80-100 years, with the Wk dates being older. The potential significance of this cannot be assessed at this time. The only other radiocarbon date available for Gao Saney is on a wood charcoal sample collected from the main mound of Gao Saney in the mid 1980s (Raimbault & Sanogo 1991: 520, 522). The sample was analyzed by J. F. Saliège from the *Département de Géologie dynamique, Université Pierre et Marie Curie* (*ibid* 1991: 522). The resulting date is 1000 ± 70 BP (Pa 412), calibrated to AD 975–1150

(*ibid* 1991: 520). However, it should be noted that this sample lacks any stratigraphic context; the circumstances under which the sample was collected are not reported. Possibly this radiocarbon sample was collected somewhere close to the site surface from a test pit since no scientific excavation was conducted at the main tell of Gao Saney at this time period.

The available radiocarbon dates resoundingly contradict Es-Sa'di's claim (Hunwick 1999: xxxiv-xxxv) indicated that Gao Saney was settled by North African Berbers during the second half of the eleven century. Only one date (Beta 261360) supports occupation of the site as late as this. The three dates provided by Wk (Wk 12630 for GS1, Wk 12633 and 12634 for GS3) for the first and the second complexes of features and their accumulation levels from both GS1 and GS3 form a coherent ensemble. These complexes of structures can be dated from ninth to tenth centuries AD. This period coincides with the prosperity of Gao Saney. Dates for the early accumulation of trash were given by Wk 12635 (Cal AD 680–890) for GS3 and Wk 12631 (Cal AD 680–900) for GS1. Even with the apparent gap that exists between these dates and that of Beta 261361 (Cal AD 770–980 for ACGS), it is reasonable to place the beginning of the settlement of the site to the early eighth century AD.

In sum the proposed calendar chronology for the occupation of the main mound of Gao Saney is situated between the 700 and 1100 AD.



Figure 5.1. The tell of Gao Saney



Figure 5.2. ACGS: Feature 1 banco brick wall structure



Figure 5.3. ACGS: Feature 3 long banco wall structure (right) and Feature 4 rectangular mud brick wall structure (left)



Figure 5.4. ACGS: Feature 5 trash pit



Figure 5.5. ACGS: Feature 8 rectangular mud brick wall structure



Figure 5.6. ACGS: Feature 9 trash fill of animal bones and fallen banco bricks



Figure 5.7. ACGS: Feature 10 rectangular mud brick wall structure



Figure 5. 8. ACGS: Feature 11 trash pit

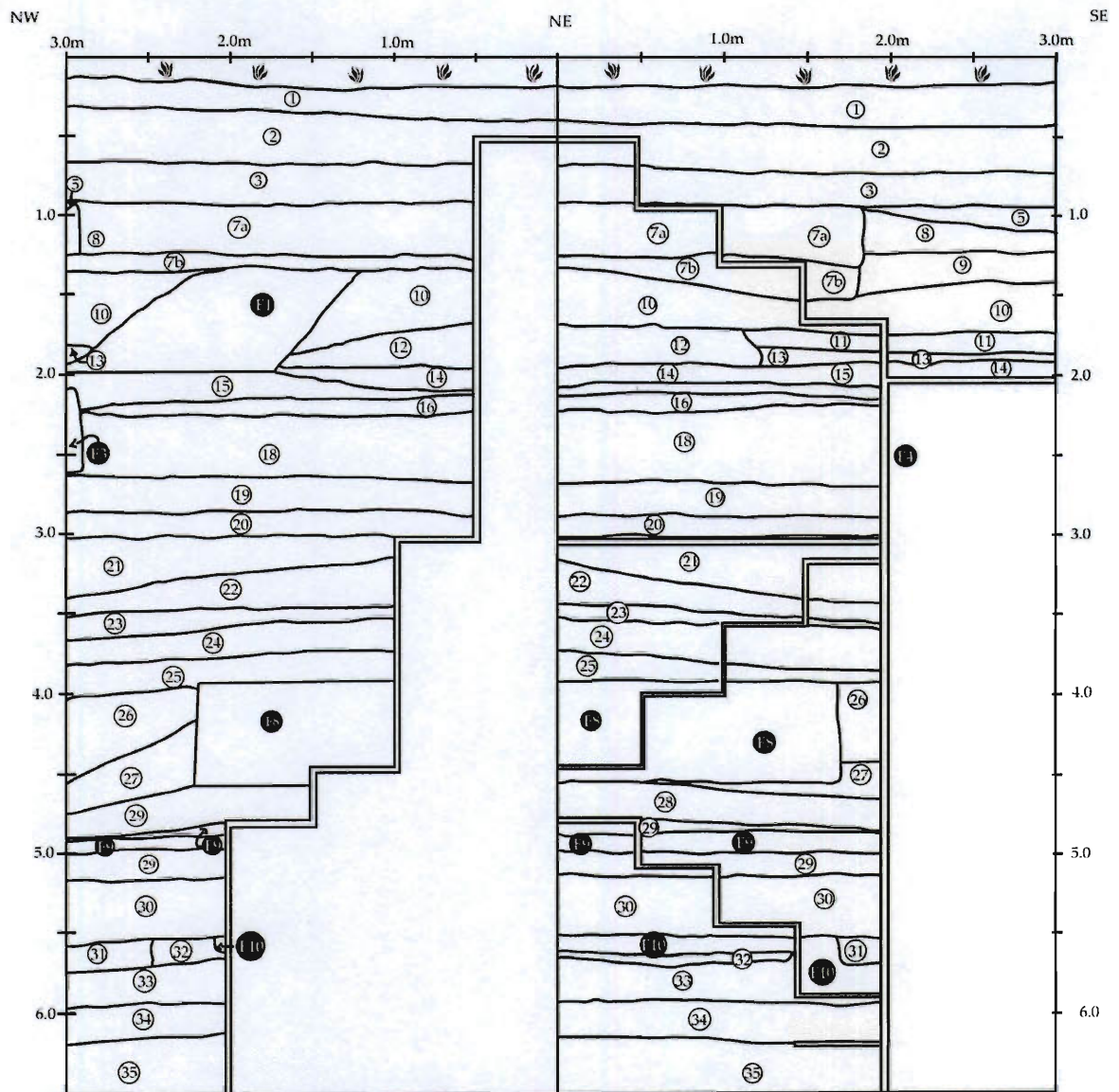


Figure 5.9 ACGS Excavated Levels, North and East

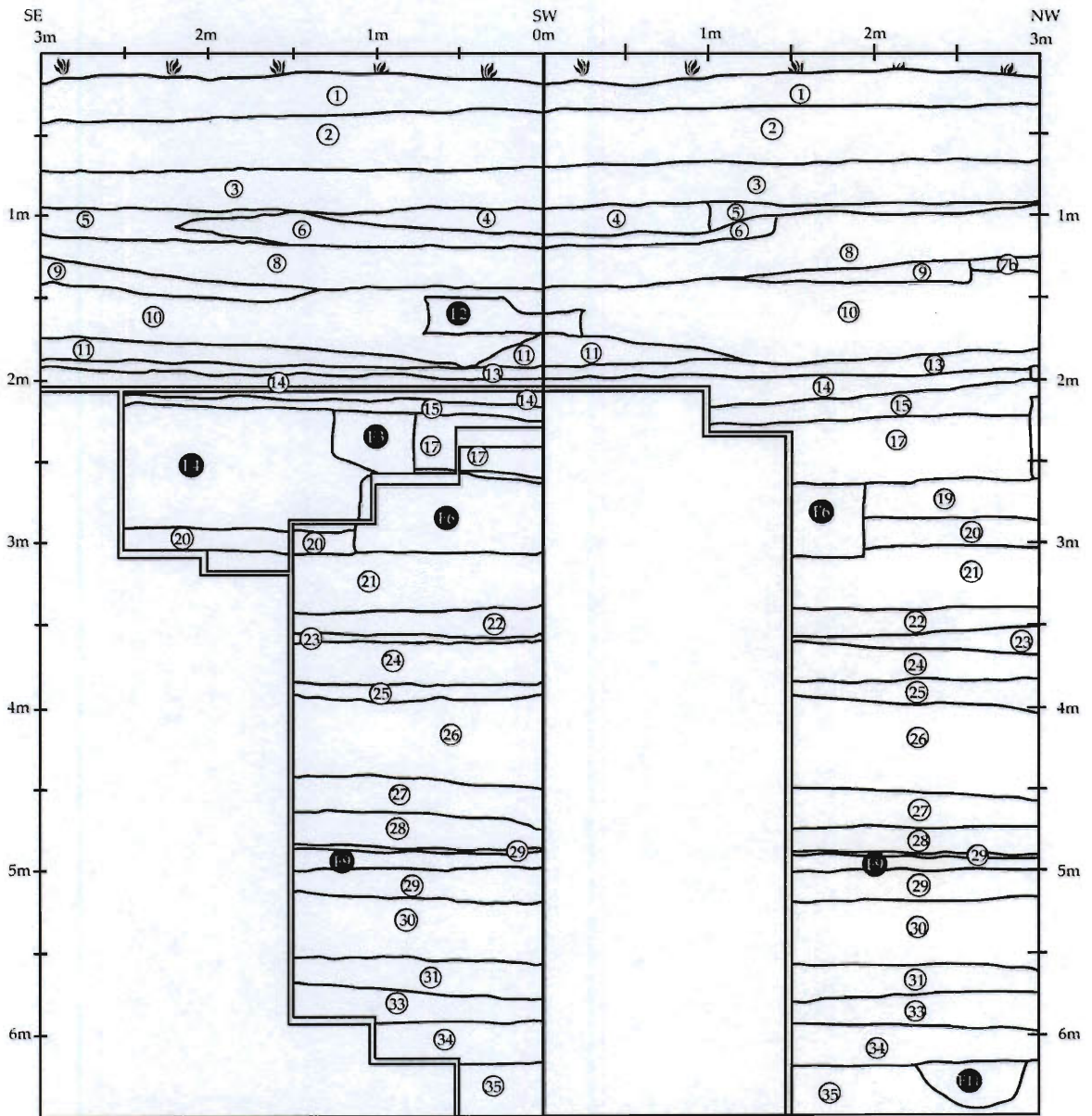


Figure 5.10 ACGS Excavated Levels, South and West

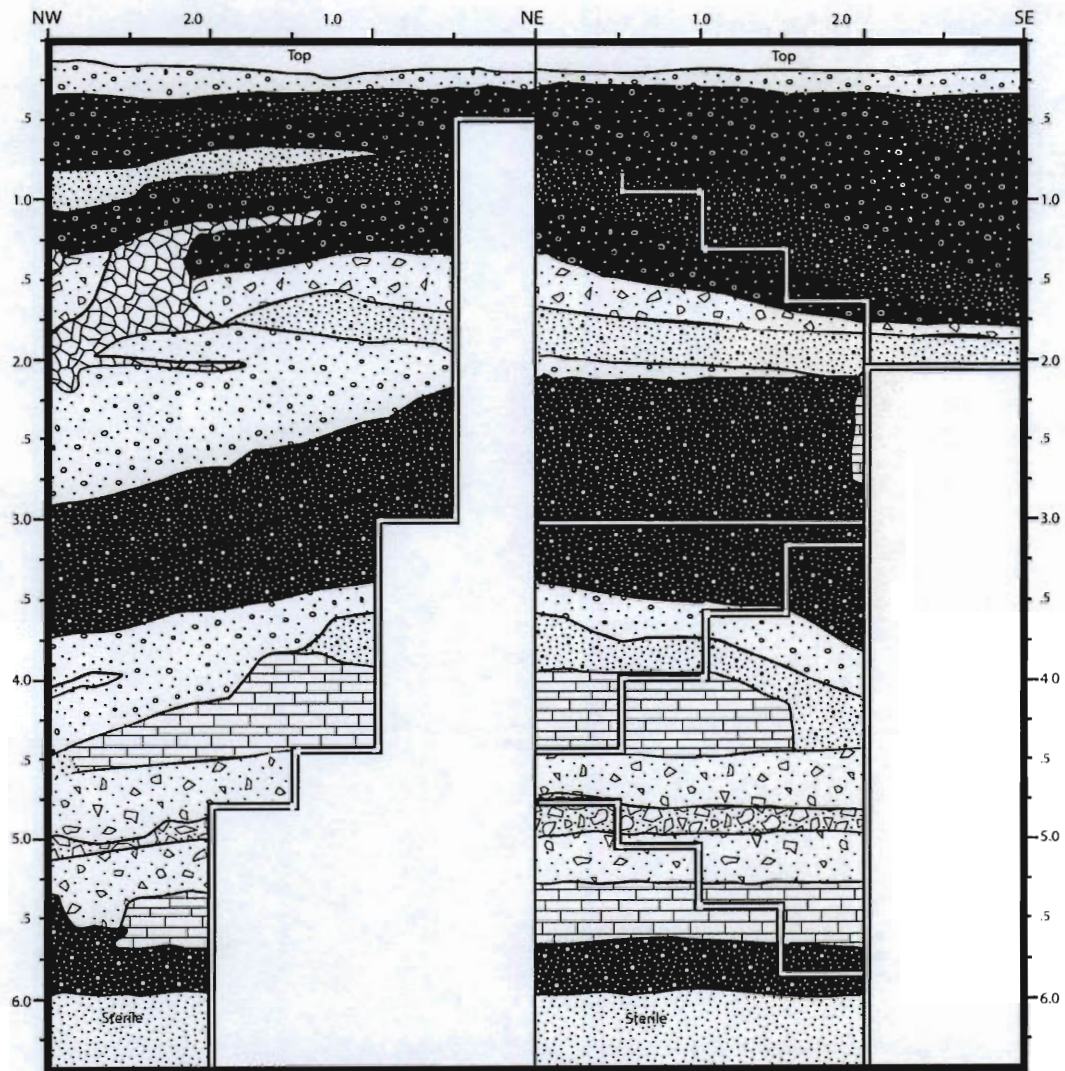
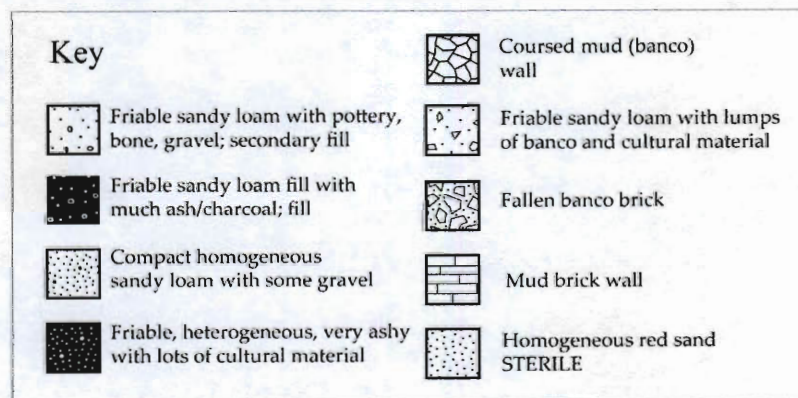


Figure 5.11 ACGS. Natural strata, North and East profiles



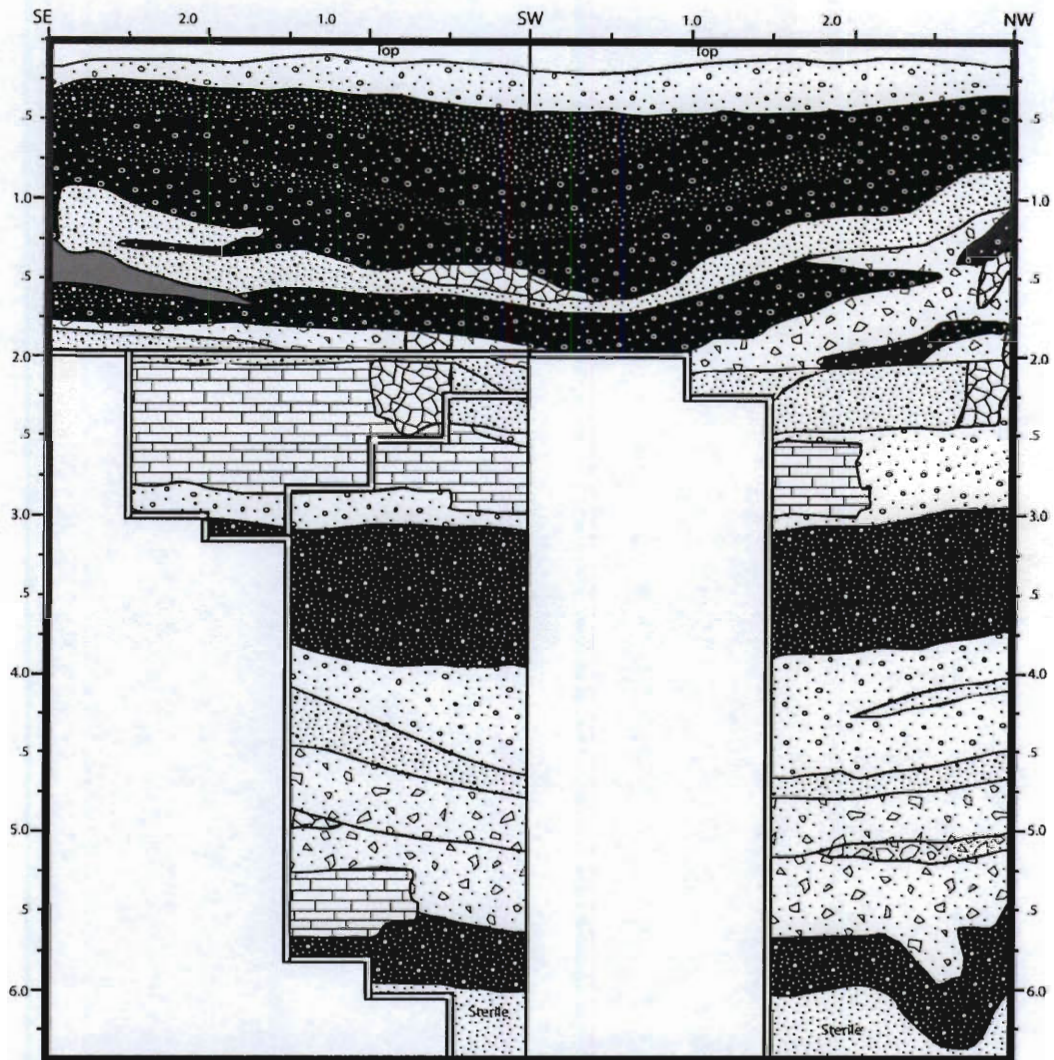
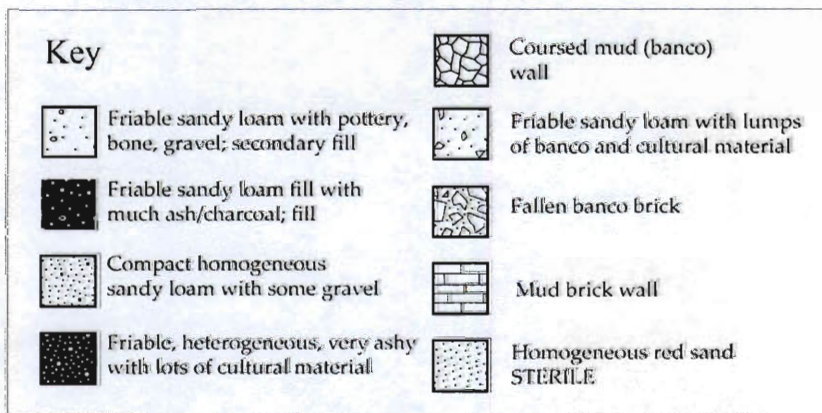
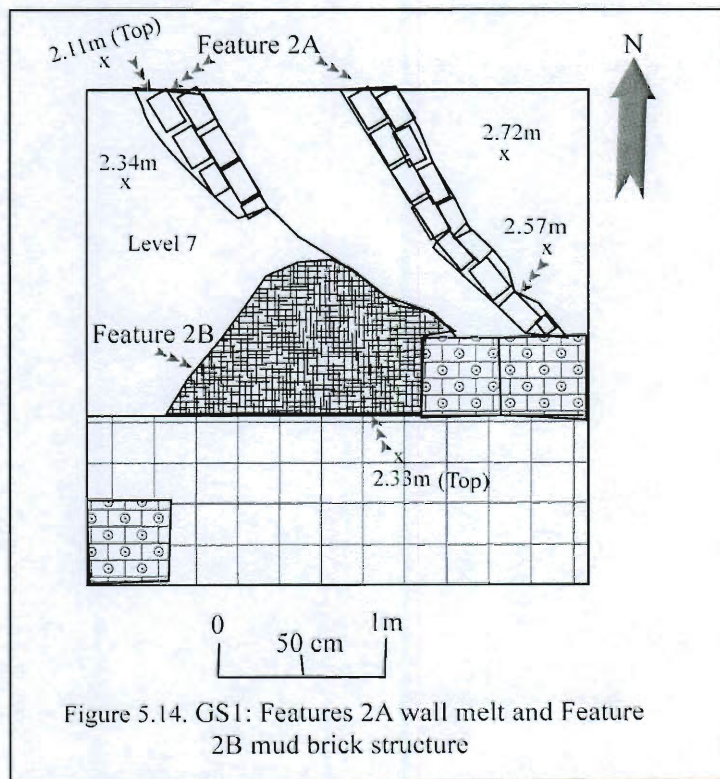
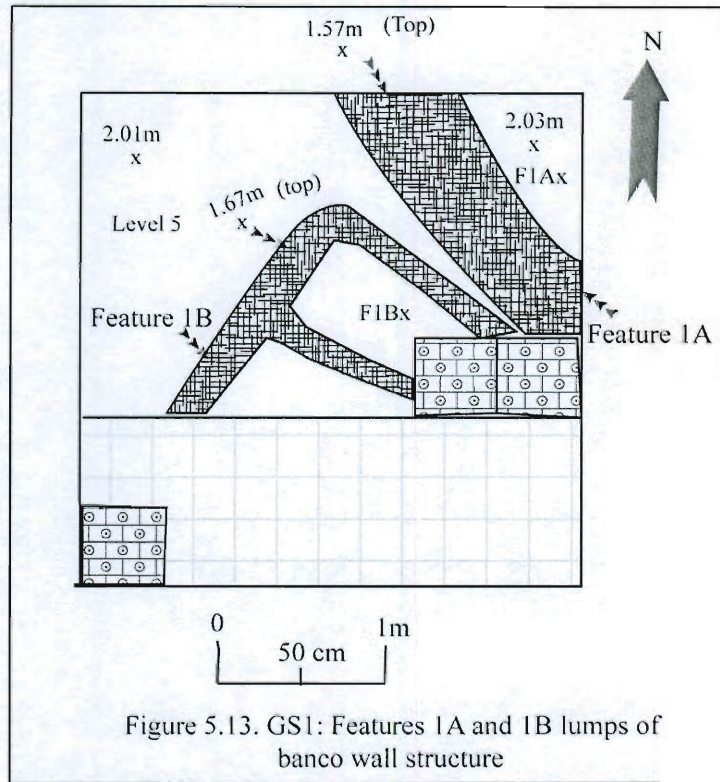


Figure 5.12 ACGS. Natural strata, South and West profiles





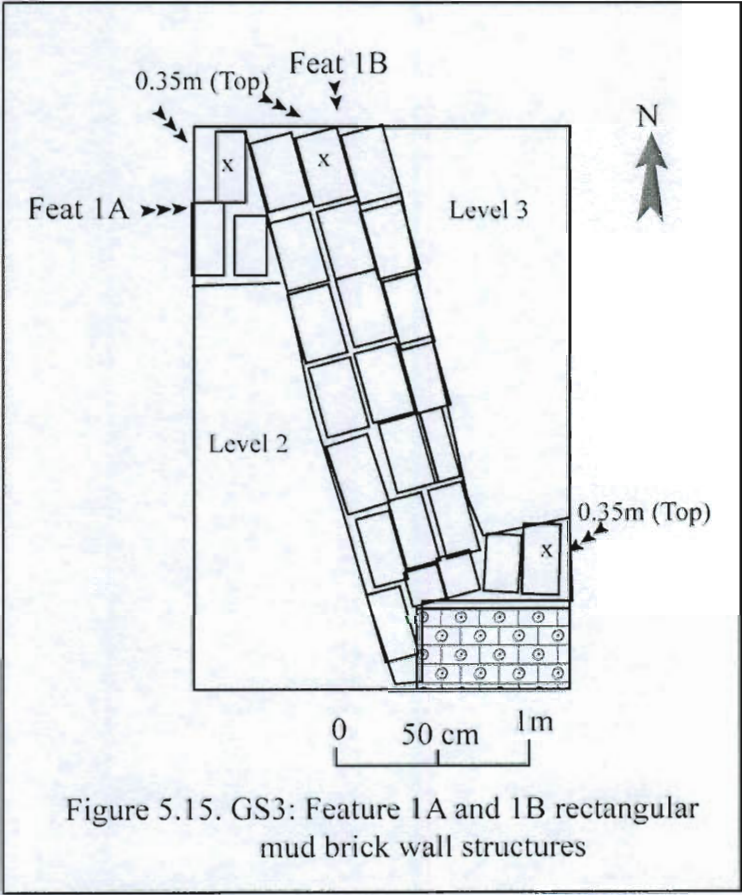
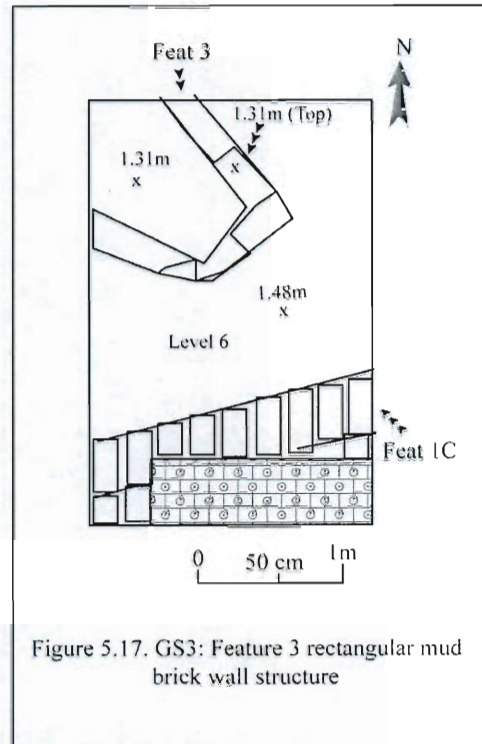
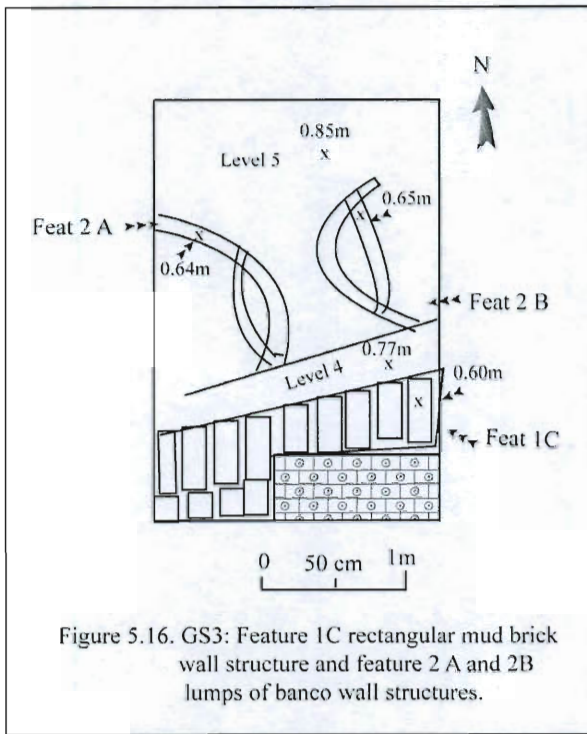


Figure 5.15. GS3: Feature 1A and 1B rectangular mud brick wall structures



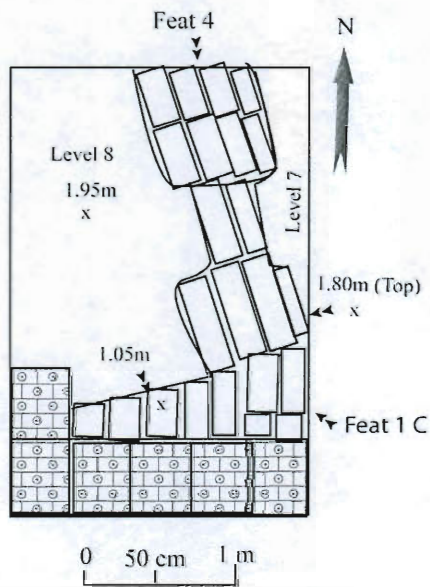


Figure 5.18. GS3: Feature 4 rectangular mud brick wall structure

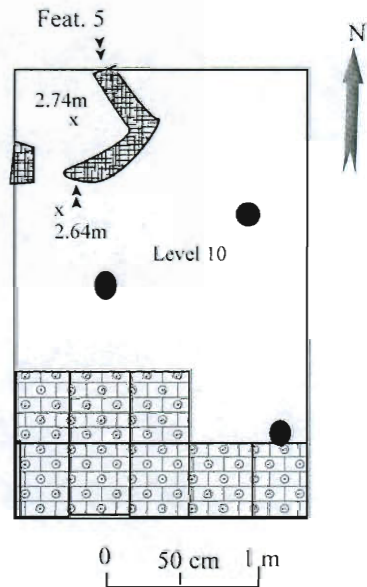


Figure 5.19. GS3: Feature 5 lump of banco wall structure

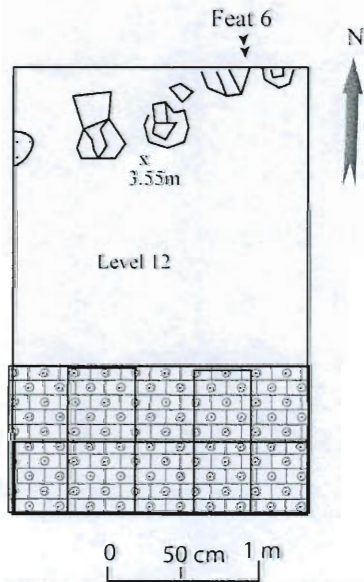


Figure 5.20. GS3: Feature 6 pottery alignment

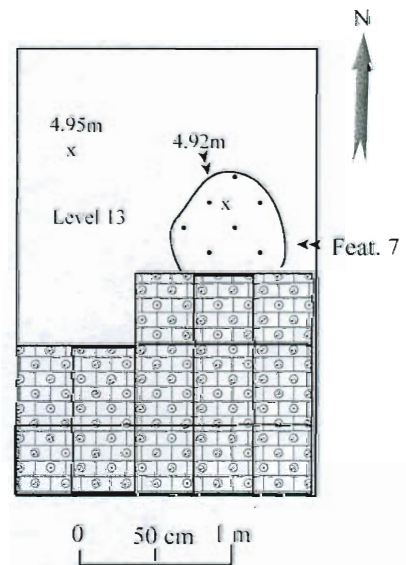


Figure 5.21. GS3: Feature 7 trash pit.

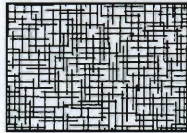
Figure 5.22. Keys to GS1 and GS3 features (Features 13-21)



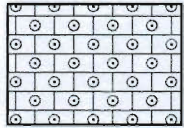
Rectangular bricks



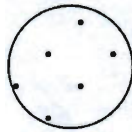
Unexcavated areas



Lump of banco and wall melt



Steps



Trash pit



Burnt areas

Figure 5.22. Keys for GS1 and GS3 Features

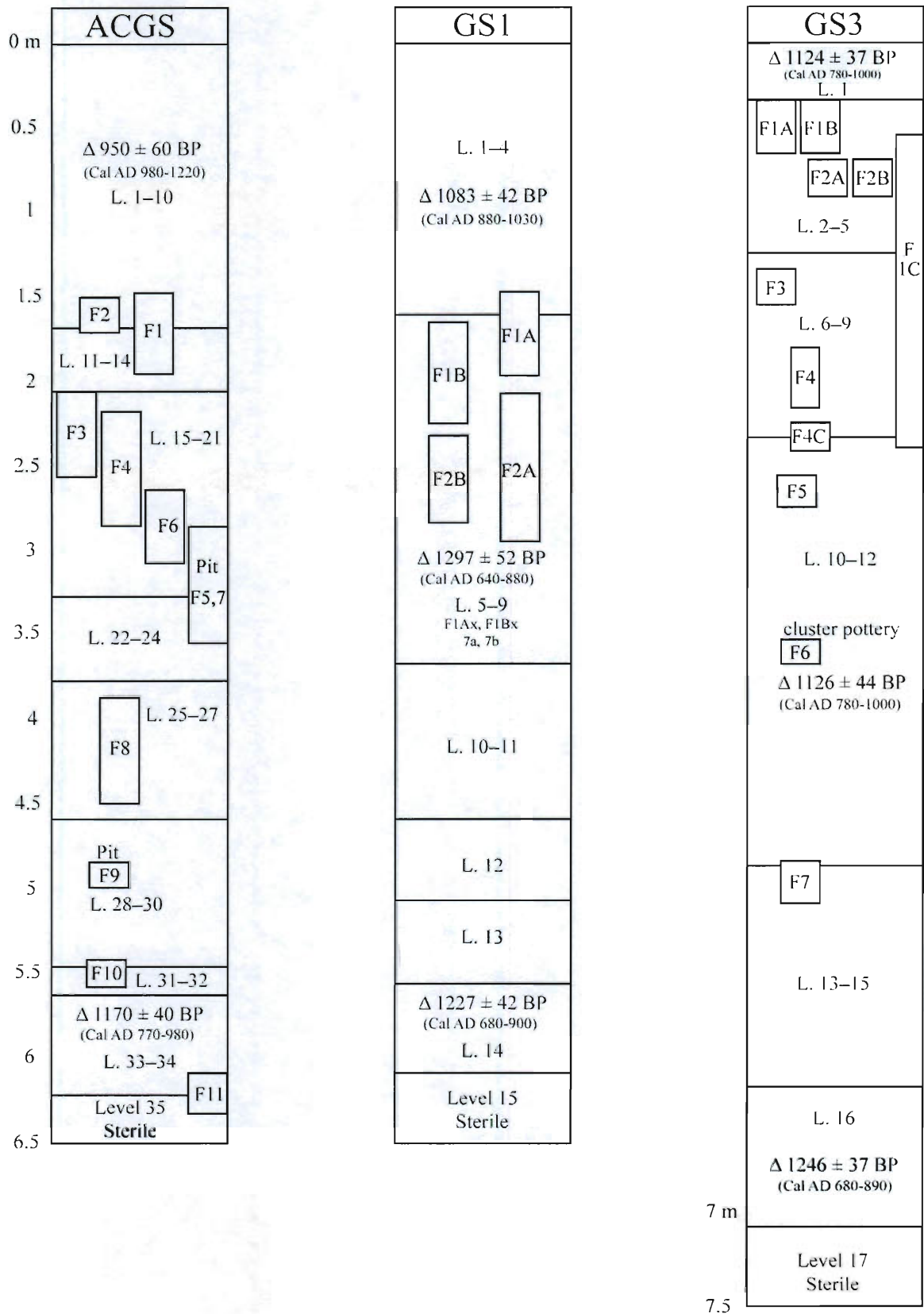


Figure 5.23. Schematic summary of chronological relationships between units

Chapter 6

POTTERY

INTRODUCTION

This chapter reports on the pottery assemblage recovered from the 2001-02 and 2009 excavations at Gao Saney, comprising 5,734 rim and body sherds. This is the first analysis of ceramics from the full depositional sequence at the site, as a previous excavation by Insoll was stopped at two meters depth because of the instability of the ashy deposit (Insoll 1996: 42). A handful of other pottery forms were recovered and are described at the end of this chapter.

In the course of this analysis, I profited from the multivariate methodological approach that S. K. McIntosh (1995) devised for the analysis of the Inland Niger Delta ceramic assemblages from Jenné-jeno and surrounding sites. This approach enables the pursuit of several objectives: detection of patterns of temporal change in a variety of formal attributes; understanding of spatial variability across Gao Saney and other Gao sites occupied contemporaneously; and comparison of Gao Saney pottery with other similarly recorded ceramic assemblages elsewhere (e.g., Es-Souk, Timbucktu, Akumbu, Jenne-jeno, Ja). It is flexible enough to accommodate new variables in new areas. I focused on variables of rim form, decoration, surface treatment, paste preparation and firing. This multivariate approach provides basic data for description and classification,

and permits multiple potential typologies and interpretations of the ceramic assemblage (McIntosh 1995: 131).

I begin by discussing the pottery recovery and recording procedures, including the definition of all the variables and attribute states recognized. Analysis proceeded by grouping related rim forms and excavated levels so as to reach adequate numbers for meaningful statistical analysis. I then discuss temporal patterns detected, and conclude with a comparison and discussion of the assemblage's most distinctive and time sensitive features with those of other Sahelian ceramic assemblages, including Gao Ancien, studied by Insoll.

RECOVERY AND SAMPLING PROCEDURES

The 2001-02 and 2009 procedures for pottery recovery were similar. In the course of excavations, all the recognized artifacts were recovered before putting the soil in buckets for sifting through 0.5 cm mesh and recovering the remaining sherds and other artifacts. All recovered potsherds were placed in cloth bags labeled with the site name, excavation unit, stratigraphic level, level record number and date. The few recovered intact pots were drawn and photographed *in situ* before their removal. Intact or nearly intact vessels were rare at Gao Saney. Consequently, the data gathered for the pottery analyses and assemblage description were essentially based on potsherds recovered during the excavations.

In all the excavated units, the quantity of recovered potsherds was such that sampling was necessary to speed the recording of all the necessary data. The manual mix-and-divide sampling method devised by McIntosh (1995:133) was used. This sampling

system showed its effectiveness in the past when I was recording the Jenne Site Museum (SMO) pottery assemblage in 1999. However, before applying it during the 2001-02 excavations in Gao I tested again the effectiveness of this method. I conducted the test with the assistance of two workmen and one colleague from the National Direction of Cultural Patrimony of Mali (DNPC). Six bags of pottery from the same level recovered the day were brought. Before washing the potsherds, two workers emptied these bags, mixed and divided the sherds into four approximately equal piles. They randomly chose two piles for washing and recording. First, I recorded the two piles of potsherds selected by the workers. Then, I washed and recorded separately the other two piles for a data comparison. After comparing the two datasets, I realized that the percentage in terms of relative frequencies of attributes was approximately the same. The result of this test convinced me of the validity of the manual mix-and-divide sampling system.

During the 2001-02 excavation campaign three types of sampling were used. For any level that had generated more than six bags of pottery in a day, a 25% sample was taken for that level. For any level that had produced between four and six bags in a day, 50% sample was taken. Finally, for any level that had produced less than four bags of pottery in a day, 100% sample was taken. In the course of the 2009 excavation, the sampling system was used only for potsherds from any level that had produced more than four bags in a day. A 50% sample was taken for that level. Like the 2001-02 excavation, a 100% of sample was collected for any level that had generated less than four bags in a day.

The sampling procedure was undertaken just after the day's excavation, before leaving the site and washing artifacts. The remaining sherds that were not selected for the

sample were used to back fill the excavated units. Although this sampling method cannot give the exact numbers of sherds in the sampled population, it speeds up the recording process without sacrificing data quality unduly. Since relative, rather than absolute, frequencies of attributes were of primary interest, we sought mainly to ensure a representative sample with an ample number of sherds. Sherd densities/m³ cannot be calculated from these data.

The bags of sampled and unsampled potsherds were brought to the project base camp, where they were later washed and left out to dry by workmen under the surveillance of my colleague from the DNPC or myself. The following afternoon, they were ready for sorting and recording.

RECORDING PROCEDURES

All the washed pottery from the same level or was first weighed. Small sherds (< 4 cm²) were counted; the total was marked on the recording sheet and the sherds were then discarded. The rest of the potsherds were sorted into body sherds, rim sherds, and feature sherds (bases, handles). Only one handle was found, and no recognizable base sherds were recovered. Apparently, Gao Saney pottery had exclusively rounded bottoms. Sherds were then divided into the following groups: body sherds with no or only a single decorative motif, Body sherds with multiple decorative attributes, and rim sherds. Rim sherds were weighed and then rebagged for later study. Body sherds were sorted into similarity groups defined by their decorative motif, and the number of sherds in each group was recorded.

During the 2001-02 campaign, I personally recorded all the recovered potsherds. In 2009, two colleagues assisted me during the recording process of the pottery assemblage, especially for body sherds. Because one of the goals of the 2009 excavation was to refine and crosscheck the 2001-02 pottery analysis, the recording procedures were thus improved to include identification of new decorative motifs proper to Gao Saney, and also paste, temper, and manufacturing technique. Additionally, rim types were adjusted in order to take better account of the range of vessel types. For two weeks, I was also assisted by Abigail Smith in the recording of rim sherds and multiple attribute body sherds.

In the next section, I discuss the variables and methodology used to record the body sherd assemblage.

Body sherds – single motif

For each provenience (unit, excavated level or feature, Level Record Form number), the body sherds were divided into decorative motif groups: no decoration; slip only; twine motif only (seven different twine motifs groups were identified and for each the number with and without slip was recorded), channeling (with or without slip, and/or paint); paint only; and plastic motifs (comb impression, rocker comb, single groove, incision and incised over twisted wine roulette). Sherds from the same pot were grouped and counted as a single vessel. The number of sherds from the same pot was recorded as *xfr*1 (as described in McIntosh 1995: 138). An example of a body sherd recording form is provided in Appendix II. The following variables were recorded for body sherds:

Provenience: Provenience variables include the site (Gao Saney), the excavation unit (GS1, GS3, ACGS), the Level (LVL) and Level Record Form (LRF) number or the feature number that together identify the context from which a sherd was recovered.

No decoration: The variable “No décor” refers to the absence of any decoration on the sherd (Figure 6.1).

Slip: Slip refers to the application of fine textured clay mixed with water and hematite (iron oxide) colorant to the pottery surface before firing. The use of slip permits the pot to be less permeable, particularly if it is well burnished. In addition to this function, slip can be used for decorative purposes and may be applied only to a specific part of the vessel such as rim or shoulder. The most common slip color is red and light reddish orange (Munsell values 10R 4/6, 4/8, 5/6, and 2.5 YR 4/6) [Figure 6.2]. Some black or gray slip colors were noticed as well (Munsell values 10YR 3/1, 4/0, 2.5 Y/5/0), probably as the result of a reducing firing atmosphere. The presence of slip was determined by comparing the color of the paste of the sherd immediately below the surface with that of the sherd surface.



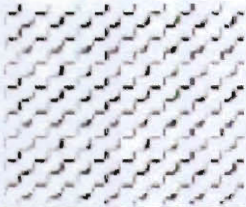




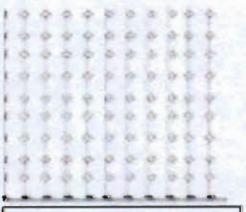

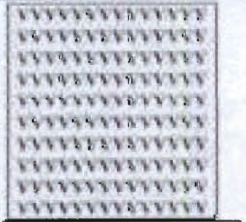
Twine Decoration: Four major twine motifs dubbed "sisal", "bird foot", twisted, and folded strip roulette were recognized. The most common twine roulette was twisted twine (Tw6, Tw7) and its variants including large twisted twine (Tw33) and very small twisted twine (Tw34). These twine variants all create a diagonal–indented pattern (McIntosh 1995: 136-37) [Figure 6.3]. "Sisal" (Tw30) had been identified as folded strip roulette (Tw4) in the first study of the 2001-2 pottery. However, the raised beads of this motif are lined up in straight rows, both horizontally and vertically, like a checkerboard, while the raised bead created by fold strip roulettes are offset in alternating rows, creating

a diagonal orientation of the beads (McIntosh 1995: 136-37). The new motif was dubbed "sisal", although it surely was not created with sisal fiber, and it is not known whether it was created by a mat or a roulette (Figure 6.4). Nixon (2008: 183) identifies this motif as a cord-wrapped stick. Often, the impression was smoothed over in the course of finishing or slipping the surface. In this case, it was recorded as Tw31. Folded strip roulette (Tw 4) is also present (Figure 6.5). Another decorative motif found at Gao but not in the Inland Delta is Tw32, which is dominated by V-shaped impressions, leading to the nickname "bird foot" (Figure 6.6). In 2001-02, twine 32 was recorded as a braided twine (Tw1 - McIntosh 1995: 135-137). In addition to these various twine decorations, unidentifiable twine impressions were encountered (coded as Tw 99). Table 6.1 shows the comparison of various twine classes recorded in 2001-02 and 2009 while Table 6.2 presents the available tools and terminology used for these impressions, plus correlations across excavation seasons.

Table 6.1. Comparison of twine classes recorded in 2001-02 and 2009

2009 Twine motifs recognized	2009 Codes	2001-2 Codes
"Sisal" --- Unknown tool: mat, cord-wrapped stick or other roulette	Tw 30	Tw 4
Sisal <i>effacé</i> (eroded sisal mat)	Tw 31	Tw 4
"Bird foot" - mat impression?	Tw 32	Tw 1
Large twisted twine	Tw 33	Tw 6
Medium twisted twine	Tw 6	Tw 6
Fine twisted twine	Tw 34	Tw 6
Folded strip roulette	Tw 4	Tw 4
Unidentifiable twine (eroded twines)	Tw 99	Tw 99

Table 6.2. Twine patterns recognized at Gao Saney. (English terminology from Hurley 1979, Soper 1985, McIntosh 1995, Haour et al. 2010, Nixon 2007; French terminology from Gallay et al. 1998, Czerniewicz 2004, Haour et al. 2010, Nixon 2007)

Roulette tools	Impression	Semiology	English terminology	French terminology
			Twisted string roulette/ twisted twine/cord roulette (Twines 6+7)	Cordelette simple/ cordelette torsadée
			Folded strip roulette, (Twine 4)	Roulette en fibre plate pliée
?			"Sisal" (Twines 30 + 31); Impressed Cord- Wrapped Decors (PFI-3 and PFI-5)	Vannerie ?; Peigne Filetée Imprimée
?			"Bird foot" twine (Twine 32)	Natte ?

Plastic Decoration. At Gao Saney, plastic techniques other than twine and mat impression were also widely used for decorating pots. Plastic decoration is any decorative technique that uses the plastic quality of clay by pressing into the clay surface or by adding new clay to the surface (Shepard 1974: 194, McIntosh 1995: 136). Channeling characterized by “U-section grooves” (Rye 1981: 67 from McIntosh 1995: 136) is by far the most common plastic decorations used at Gao Saney. Three channel motif classes were recognized in 2009: single groove; wide, deep channels; and wide, shallow channels (Figures 6.7–6.9). In the 2001-2 pottery analysis, all three were coded as “channeling”. Other variants included incision and narrow deep channels (Figure 6.10). Impressed comb was also widely used at Gao Saney. The numerous comb motifs recognized include impressed straight comb, impressed curved comb, rockered comb, and geometric comb impression (Figure 6.11 – 6.14). The coding system used for plastic decorative motifs is provided in Table 6.3.

Table 6.3. Codes for plastic decorative motifs

Code	Plastic motifs
0	None
1	Single groove
2	Wide deep channels
3	Shallow channels
4	Incision over twisted twine roulette
5	Incision
6	Impressed straight comb
7	Impressed curved comb
8	Rockered comb
9	Narrow deep channels
10	Geometric comb impression

Paint. Painted decorations were widely used at Gao Saney. The most common paint colors are red, black, white, with black and white, and white and red often occurring in combination (Figures 6.15 – 6.20). Paint was applied variously in a solid field, horizontal or vertical bands or stripes, vertical undulating bands and lines (see Table 6.4 for recording codes). These color motifs were frequently applied over single or multiple grooves (channels), or directly onto the pot's surface over unslipped or slipped areas. They were also applied over twine and comb impressions. The recording method used for such sherds with multiple decorative attributes is described in the next section, followed by methods used to record rim sherds.

Table 6.4. Codes for paint color and paint motifs

<i>Paint color</i>	<i>Paint color code</i>	<i>Paint motif</i>	<i>Paint motif code</i>
None	0	Solid field	0
White/cream	1	Horizontal band/stripes	1
Black	2	Vertical band/stripes	2
Red	3	Vertical undulated band	3
White, red and black	4	Line and dot over comb	4
Black and red	5	Cross-hatch	5
White and black	6	Dots	6
White and red	7	Geometric design (Checkerboard)	7
		Horizontal and curved line	8
		Bull's eye	9
		Curved band/stripe	10

Body sherds - Multiple attribute

Each body sherd having two or more decorative motifs on its surface was included in the category of multiple attribute sherds. All the sherds in this category were

recorded individually. Each sherd was recorded in terms of provenience and various decorative motifs already described, above, for body sherds. In addition, paste fabric (hardness, paste color, black core, NPI), and surface preparation were recorded; these are described below. Each sherd exhibiting novel decorative combinations was drawn. Additionally, sherds presenting other new features were described in the observation column as showing in the recording form for multiple attribute sherds presented in Appendix II.

Paste. Paste comprises clay and added materials. It differs from fabric because it does not include pores/voids. (Rice 1987: 479).

Non-Plastic Inclusions (NPI): Non-plastic inclusions are mineral or organic materials whether naturally present or added by the potter in order “to enhance workability or to improve properties after firing” (Rye 1981: 31; Rice 2005: 477). Temper is defined as non-plastic inclusions that were intentionally added to the clay (Shepard 1974: 25 in McIntosh 1995: 139). It differs from non-plastic inclusions whose presence cannot be directly attributed to human manipulation. Visual observation of a fresh break with a 10x or 20x loupe of the Gao Saney assemblage indicate that sand and organic material dominate. However, the paste of a few sherds has grog as an additional temper. Recording noted the dominant category of NPI and any additional categories:

- 1 - sand, shiny, brilliant and transparent inclusions
- 2 - organics, voids in the paste created by burning off of organics during firing
- 3 - grog, opaque, angular inclusions in the paste
- 4 - sand and grog
- 5 - organic and grog
- 6 - sand and organic

Hardness: The paste hardness was evaluated while creating a fresh break with pliers. The categories reflect the relative ease of breakage. Soft paste (1) was easily snapped by gentle pressure with pliers. With hard paste (3), sherds were extremely difficult to break with pliers alone. Medium paste (2) broke with moderate pressure.

Paste color: Paste color was identified after a fresh break of the sherd. This variable was recorded with the aid of Munsell soil color chart in order to make sure of the accuracy. The range of Munsell values are presented in Table 6.5.

Table 6.5. Color codes and Munsell values (Adapted from McIntosh 1995: 140)

Code	Recorded Color Categories	Munsell Color Categories
1	Dark orange	2.5YR5/6, 5/8; 5YR5/6, 5/8
2	Light orange	2,5YR6/6, 6/8; 5YR6/6, 6/8
3	Buff	10YR7/2, 7/3, 7/4, 8/2, 8/3, 8/4
4	Black	5Y3/0; 10YR3/1; 7.5YR3/0
5	Gray	2.5YR5/0, 5/2, 4/0, 6/0; 10YR4/0, 5/0
6	Light brown	5YR5/2, 5/3, 6/2, 6/3, 6/4; 7.5YR6/4

Black core: A black core results from unoxidized carbon remaining in the sherd interior. Like the paste color, the presence or absence of black core was evaluated after visual inspection of a fresh break of sherds:

- 0 - no black core; fabric fully oxidized.
- 1 - black core < ½ the thickness of the sherd
- 2 - black core > ½ the thickness of the sherd
- 3 - only the surface is oxidized
- 4 - sherd is black throughout

Surface preparation. Surface preparation refers to the character of the surface as it reflects the presence or absence of surface smoothing that consolidates and homogenizes the appearance of the surface. A smoothed surface has no voids and is smooth to the touch. An unsmoothed surface was characterized by the presence of voids (code 2) or a gritty feel (code 3) or both (code 4).

Rim sherds

The variables used to describe each rim sherd were: provenience, paste, surface preparation, part of vessel represented (rim only, rim and shoulder, rim, shoulder and body, and rim and body), rim type, rim angle (with the reference to a plane described by a the vessel mouth), rim diameter, lip shape, slip (presence or absence and position on outer surface; presence or absence and position on inner surface), twine impression (unslipped and slipped twine), paint (paint color, paint motif, paint position and paint application) and plastic (plastic motif, and plastic position) and thickness. The recording form and recording codes for rim sherds are presented in Appendix II. Additionally, a summary of all the attribute states and codes used on the recording forms is also provided in **Appendix II**. The variables specific to rim sherd recording are discussed below.

Part Represented: This variable provides an understanding about what portions of the original vessel were represented by the sherd under examination. The various parts of the pot recognized in the Gao ceramic assemblage were rim only coded as 1, rim and shoulder with code 2, rim, shoulder and body with code 3 and rim and body coded as 4, These categories can be useful for the purposes of analysis, since code 1 sherd (rim only) provide less complete information than rim sherds coded with 2, 3 and 4.

Rim form: Rim form is “the shape of a rim sherd in radial section” (McIntosh, 1995: 141). A total of 51 rim forms were identified in the Gao Saney ceramic assemblage (Figure 6.21). The coding system grouped similar rim forms together: simple rim (codes 10-18, varying by lip form), potlids (codes 20-21), beaded (code 30-35), thickened (code 40-46), ledged rim (code 50-54), vertical everted rim (code 60-64), short everted rim (≤ 2 cm) [code 70-77], medium everted rim (> 2 cm ≤ 5 cm) [code 80-83], and long everted (> 5 cm) [code 90-95]. This coding system can be expanded for new variants of rim type in the same category. The presence of bottles was noted in the comment section because bottle rims can belong to many rim groups, and are defined mainly by having a long neck and a small diameter mouth. It should be noted that the 2001-02 ceramic collection did not originally consider the length of everted rims. The assemblage was re-recorded in 2009 to take length into account.

Rim Angle: The recording of rim angle allows us to distinguish closed (restricted) vessels from opened (unrestricted) ones. It is recognized by using six angle groups, code 1-6 (Figure 6.22). For example, code 1 rim angle signifies that the vessel was firmly closed with very restricted mouth diameter. The higher the rim angle code, the more the vessel is open until the code 6 (used essentially for potlids) is reached (McIntosh 1995: 141).

Rim Diameter: The rim diameter is determined by the arc of the lip of the rim sherd. The lip surface of the rim sherd was placed in contact with the various drawn arcs with diameters from 2 cm to 50 cm to determine which gave the closest fit to the arc of the lip’s inner surface. The diameter of the circle described by that arc was then considered as the diameter of the pot at the lip.

Lip shape: Various lip shapes were recorded in the Gao Saney pottery assemblage. The lip form was straight, bevelled, squared, rounded or thickened. Only the lip shapes of everted rims were recorded because the other rim types including simple, thickened, beaded and ledged were identified by their lip morphology. The simple rim codes were used for recording the lip shapes of everted rims (Figure 6.21).

Slip outer surface: This variable records the presence of slip on the outside of the sherd and its color (Table 6.6). If the sherd surface was crusted with carbon due to direct contact with fire, this was noted in the comment column of the rim sherd recording form.

Table 6.6. Color and position categories for recording slip on the sherd exterior

<i>Slip outer surface</i>			<i>Slip outer surface position</i>	
Code	Color	Munsell values	Code	Position
0	None		0	Overall
1	Dark red/ orange slip	2.5YR5/6, 5/8; 5YR5/6, 5/8	1	Lip only
2	Light orange	2,5YR6/6, 6/8; 5YR6/6, 6/8	2	Rim only
3	Black	5Y3/0; 10YR3/1; 7.5YR3/0	3	Rim and shoulder
4	Dark red + light orange slip	Munsell values for 1 + 2	4	Rim, shoulder and body
			5	Shoulder and body
			6	Body

Slip Outer Surface Position: This variable recorded the position of slip on a specific part of the outer surface of the rim sherd. Table 6.6 shows the recorded attributes and their codes.

Slip Inner Surface: This variable was recorded to establish the presence or absence of slip in the interior surface of the pot. The absence of slip was coded 0. The presence of dark red/ orange slip was coded 1, code 2 for light orange, and code 3 for black slip.

Slip position, Inner Surface: This variable shows the position of slip on a specific part of the inner surface of the rim sherd. Code 0 was used if slip was present on the entire surface of the interior of the sherd, code 1, if it was restricted on the lip only, and code 2, if the slipped surface covered all but the lip.

Slipped and Unslipped Twine: These two variables were recorded to show respectively the presence or absence of slip on the sherd with twine motifs. The various twine motifs and their codes have been described in the body sherd section and summarized in Table 6.1.

Paint Decoration: The various paint colors and motifs recorded have been described above (Table 6.4).

Position of Paint Decoration: This variable recorded the position of the paint decorative motif on a specific part of the sherd surface (Appendix II). The paint motifs were used on the entire surface (code 0), lip only (1), rim (2), rim and shoulder (code 3), rim, shoulder and base (code 4), shoulder and body (code 5), body (code 6), rim and body (code 7), and inside the pot (code 8).

Application of Paint Decoration: This variable was used in order to show over which decorative motif the paint motif was applied (Appendix II). At Gao Saney, the paint motifs were applied over an unslipped surface (code 0), slip surface (code 1), channels (code 2), twine (code 3), and comb impression (code 4). Code 5 was recorded if the paint motif was applied over channels and a slipped surface, and code 6 if it was applied on top of twine impression and slipped surface.

Plastic decoration: The various decorative motifs used at Gao Saney were described in the body sherd section (Table 6.3). During the process of recording rim sherds, each plastic decorative motif encountered on the same sherd was recorded in a separate column (see Appendix II).

Position of Plastic Decoration: This variable was recorded using the same coding system as Position of Paint Decoration (Appendix II).

All the recorded data were entered into computer with Microsoft Excel program. A small collection of body sherd multiple attribute and rim sherds was brought to the archaeology laboratory of Rice University (Houston, USA) for further study and analysis with the permission of the Director of the National Direction of Cultural Patrimony of Mali.

ANALYSIS

The analysis of the recorded data was conducted using Excel software. The data for the three major categories of sherds (body sherds, multiple attribute and rim sherds) were grouped and collapsed in a variety way to facilitate their inspection. Grouping was necessary to allow meaningful analysis of levels with small numbers (< 100) of sherds.

It was also necessary in order to see patterning, which can help to understand changes in the ceramic sequence and the distribution of the pottery groups through space and time.. A table of body and rim sherds sorted into three stratigraphic level groups (Final, Upper and Lower) was created by grouping connected excavated levels that appear to be contextually related and/or chronologically close on stratigraphic grounds. The goal is to understand the similarity and difference between early and late materials in the three excavated units (Table 6.7).

Table 6.7. Corresponding levels and level groups in the excavated units

Level group	Final	Upper	Lower
ACGS	L1–10	L11–26	L27–34
GS1	L1–4	L5–9	L10–15
GS3	L1	L2–12	L13–16

Analysis began with the inspection of body and rim sherd assemblages for changing frequencies of particular variables that might indicate time-sensitive attributes. The trend of rim form in various level groups through time will be first discussed. It will be followed by the discussion of the frequency of decorative motifs, the paste fabric, the rim diameter, and finally the surface preparation of vessels.

Rim form. In each of the three excavated units (ACGS, GS1 and GS3), Rim Groups (RMGP) were created by grouping related forms, as indicated on Figure 6.21.

Long everted rims (Ev80 and Ev90) are the most common (over 60 %) in every excavated unit, and their frequency reaches as high as 90% in some level groups. (Figure 6.23). Potlids are relatively rare. Possibly the low frequency of potlids could be due to a failure to recognize potlids among simple open rim sherds during the recording

process. These problems are due to the similarity of the rim profile and decoration of these two rim groups (McIntosh 1995: 144).

Decorative motifs. Sherds with a single decorative motif dominate the body sherd assemblage (Figure 6.24). The remaining sherds are either undecorated or have multiple motifs. Twine impression occurs on 50–70% of the body sherd assemblage (Figure 6.25). In the ACGS assemblage, "sisal" and twisted twines occur on over 50% of body sherds (Figure 6.26).

In the rim sherd collection, twine motifs are rare (less than 5%), although they are visible in all level groups generally in association with other decorative motifs (Figure 6.27). Twisted twine and sisal were also the most common twine motifs applied on the surface of vessel rims. It should be noted that the frequency of unidentifiable twine decoration is high (15 -40%), in most of the level groups at all points in time, probably due to surface erosion.

Sherds decorated only with slip increase in relative frequency at all the excavated units through time. But slip in combination with other motifs (twine or plastic) is also important in the lowest levels. The frequency of plain sherds is low (over 5%) but constant through time.

Paint decoration is common at all points in time. It is usually applied over twine and channel motifs, and less often over comb motifs on the vessel body surface (Figure 6.28). In the rim sherd assemblage, paint is usually applied over channeling (Figure 6.27).

Plastic decoration - particularly channeling and comb impression - is very common at all points in time (Figures. 6.25, 6.27 and 6.28). The various comb motifs (straight and curved comb, rockered comb and geometric comb impression) are present

low frequencies throughout. These comb impressions were applied more often on the body surface of the vessels either alone, or in association with other comb motifs, or with paint decorations. In the rim sherd assemblage, comb impressions are present as well, although they appear low in frequencies (less than 10%) and are commonly located below the neck of the vessels (Figure 6.27).

Rim diameter. Rim diameter does not change detectably through the sequence. Vessel mouth diameter of 20 cm and more are the most common within the rim type assemblage (over 80% in the Long everted, beaded and thickened assemblage) [Figure 6.29]. Relatively small vessels with diameters < 20 cm are commonest among the simple rims.

Paste. Paste hardness shows an interesting trend from harder in early levels to softer in upper levels, but medium paste is the most common (Figure 6.30).

Sherd walls show varying degrees of oxidation, with no compelling chronological trends detectable (Figure 6.31).

Paste colors vary from dark orange to gray to light orange and light brown to black and to buff. The relative frequency of paste colors remains relatively constant through time (Figure 6.32). This tendency suggests that the most common fabric technique used was open-air firing. The firing technology provides conditions for oxidation or reduction. The dark/light orange and light brown colors suppose that the clay was fully oxidized at the firing temperature between 750°C and 850°C (McIntosh 1995:145). In contrast, the presence of black and grey colors indicates that the clay was partially or fully reduced at a lower temperature.

Non-Plastic Inclusions. Close visual observation with a 10x loupe of the paste of 97 rimsherds from ACGS reveals the consistent presence of sand at significant levels (Table 6.8). Whether sand was naturally present or deliberately added is impossible to tell. Only in rare cases was the amount of sand high enough to produce a "gritty" feel on the sherd surface. In approximately 15% of the sherds, sand was the only non-plastic inclusion detected. In three-quarters of the sherds, organic material, including plant stems and chaff (probably threshing and winnowing waste) that create distinctive tubular voids in the first case and flat, plaque like voids in the second, and possibly dung (creating a much finer network of voids) was used as temper. In most cases a moderate amount of organic temper was added, reflected in a moderate number of voids in the paste and on the sherd surface. Occasionally, masses of organics were added, resulting in a paste that was almost sponge-like in appearance (Figure 6.33).

Table 6.8. Non-Plastic Inclusions in the paste of a sample of ACGS rimsherds

Rim forms	Sand + organic (many voids)	Sand + organic (some voids)	Sand + grog	Sand only
Long Ev (80, 90)	3	44	7	
Short EV (60, 70)		2		2
Simple		10	2	9
Beaded	1	6	1	
Thickened	4	5		
Potlid		1		
Total	8	68	10	11

Around 10% of the sherds have grog temper, rather than organic. The sand only and sand+grog NPI groups most frequently occur in Simple and Beaded rims that have thin walls and are red-slipped and burnished and often decorated with comb impressions.

Sherd surface. The sherd surface is commonly gritty or smooth (respectively 60% and 35%). Some sherds show voids on their surface or present gritty surface with voids (Figure 6.34).

SUMMARY DESCRIPTION OF THE GAO SANEY POTTERY ASSEMBLAGE

The pottery from the three units excavated to a depth over six meters forms a relatively coherent ensemble, with few clear trends through time. The paste is sandy with organic temper as a frequent, and sometimes, abundant addition, creating numerous voids. The rim sherd assemblage is dominated in all levels by long (>5 cm) [Figure 6.35] or medium (2-5 cm) everted rims that are usually decorated with channeling above the neck, both inside and out, with deep red slip applied, and then white paint, sometimes with black, applied in a solid field or as a series of horizontal or vertical bands. Occasionally, everted rims were decorated with incised twisted twine roulette. Visual observation and magnifying examination of the paste of ACGS rim sherd samples shows that voids are particularly present in the fabric of everted rims. Long everted rims < 10 cm diameter are classified as bottles (Figure 6.36). These are usually slipped and may be decorated with a variety of plastic and paint elements.

The only other rim forms that comprise over 10% of the assemblage are simple (Figure 6.37) and beaded (Figure 6.38) rims. These have a variety of decorative motifs, including slip and channeling, with or without paint, and twine roulette. One particular subgroup of simple rims are small, well-made bowls with impressed comb decorations over burnished slip. The paste is fine-textured with sand NPI, and very few, if any, organic NPI.

The remaining rim groups are ledged and short everted (Fig. 6.39), potlids and thickened (Fig. 6.40).

The body sherd assemblage is characterized by the predominance of paint and also twine decorations at all the excavated units through time. Sisal and twisted twine roulette are the most common twine impressions, although bird foot and folded strip roulette are popular in the early assemblage. Paint colors (white, black, red, with sometimes white and black or white and red in association) were applied in a solid field, or as vertical or horizontal bands applied either alone or in conjunction with other motifs (twine roulettes, wide deep or shallow channeling, and comb impressions over the slipped or unslipped zones of the pot's surface). Black paint is generally common in the early deposits. Other decorative motifs such as comb motifs (straight, curved and geometric comb impressions), channeling and slip were also present as well. They were also applied either alone or often with paint, and rarely with twine motifs.

OTHER POTTERY FORMS

In addition to ceramic vessels, several other categories of pottery were recovered in small quantities: oil lamps, discs, a jar lid, couscoussiere and stove fragments.

Oil lamps: Two earthen lamps weighing over 400g were recovered from the lowest upper trash fill level (level 12) of GS3 dated between AD 780 – 1000 (Figure 6.41).

Pottery discs: Three discs created by chipping and grinding potsherds into a rounded shape were recovered from the Final trash pit layers (level 2 in both ACGS and GS1).

Some of these discs have their centre pierced (Figure 6.42). The function of these pottery discs is uncertain. It has been argued that they were used as weights conforming to

Islamic weight systems at Jenne-jeno, Begho and Gao (Garrard 1975: 66, 1980: 29-35; McIntosh 1995: 217). Ceramic discs could also be used as spindle whorls (Insoll 1996: 81), bottle lids (Czerniewicz 2004: 130), in potsherd pavements (McIntosh 1995: 217), and to decorate mud walls or other vertical features (Garlake 1977: 71).

Bottle lid: One pottery lid with small handle was recovered in the Final trash pit deposit (Level 1) of GS1 (Figure 6.43).

Couscoussiere and stove fragments: A big fragment of ceramic stove and *couscoussiere* were also recovered in the Final midden deposit (Levels 2 and 7) of ACGS (Figures 6.44 and 6.45). Similar finds were also found at Gadei (MacLean 2000: 73-76). The presence of a cooking stove and *couscoussiere* shows the use of wet technology, in which stewing, boiling and frying were of particular importance at Gao Saney.

IMPORTED CERAMICS

Three sherds of imported ceramics were recovered in the ACGS deposits (Figure 6.46). One specimen came from the Final midden layers (Level 2), and the remaining two ceramic fragments were found in the accumulation (Levels 20) of the Feature 6 mud brick structure and also in the fill deposit of level 22. The three specimens are described as follows:

1. SF 631 (ACGS L.2). Everted rim vessel fragment, green glaze (interior and exterior), sandy temper, cream hard fabric, wall thickness: 0.4cm from the lip, Islamic.
2. SF 632 (ACGS L.20). Vessel base fragment, Unglazed buff ware, sandy temper containing occasional quartz, hard fabric, wide shallow grooves inside, wheel made, 0.5 wall thickness.

3. SF 633 (ACGS L.22). Everted rim fragment, white cream glaze (interior and exterior), sandy temper, hard fabric, smooth surface, 0.5 cm of wall thickness.

Other fragments of imported ceramics were recovered from GS1 and GS3, but these are not available for description.



Figure 6.1. Plain sherds



Figure 6.2. Sherds with slip



Figure 6.3. Variants of twisted cord roulette.

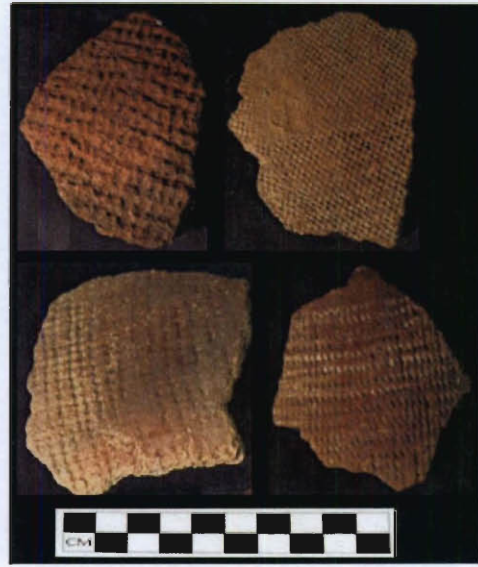


Figure 6.4. Variants of "sisal"



Figure 6.5. Folded strip roulette



Figure 6.6. "Bird foot" mat or twine



Figure 6.7. Single groove



Figure 6.8: Wide deep channels



Figure 6.9. Shallow channels



Figure 6.10. Incisions over Twisted twine



Figure 6.11: Straight comb impression Figure 6.12: straight and curved comb impression



Figure 6.13: Rockered comb



Figure 6.14: Geometric comb impressions



Figure 6.15: Solid field paint



Figure 6.16: Horizontal bands/stripes



Figure 6.17: Vertical bands/stripes



Figure 6.18: Vertical undulated bands



Figure 6.19: Horizontal bands and dots



Figure 6.20: Geometric bands

GAO SANEY

Rim Type

< Outside Edge

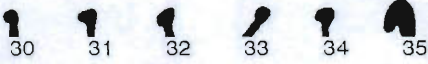
Simple



Potlids



Beaded



Thickened



Ledged



Vertical 60



Short Everted
(≤ 2cm)



Medium Everted
(> 2cm ≤ 5cm)



Long Everted
(> 5cm)



Figure 6.21: Gao Saney rim forms

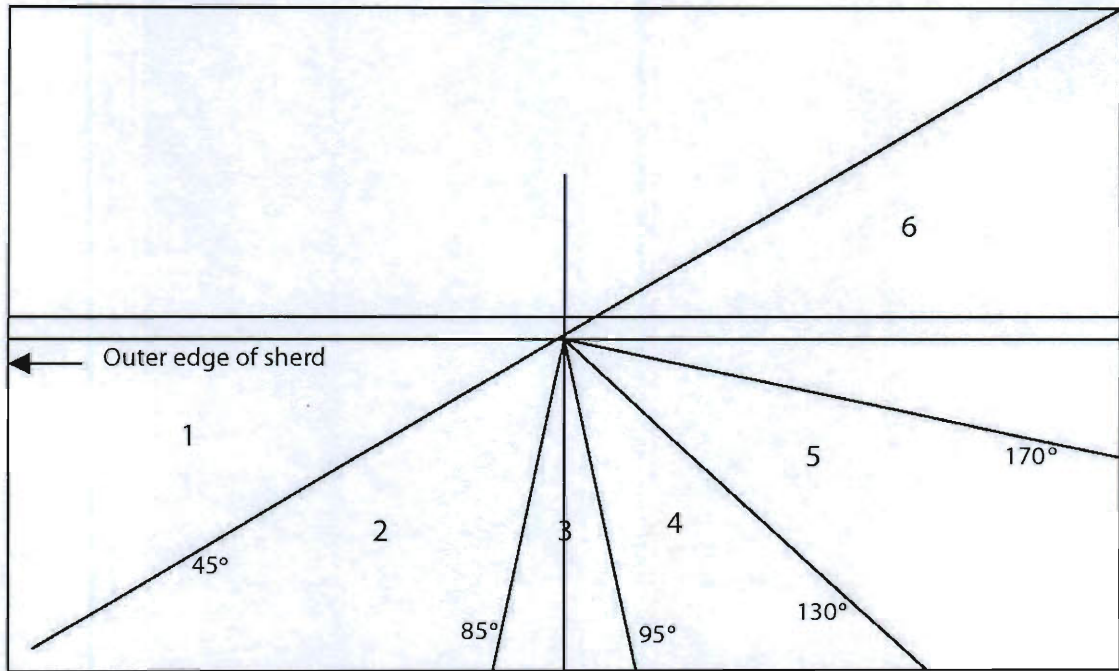


Figure 6.22. Drawing used to determine rim angle for coding (code 1-6) (From McIntosh 1995: 170)

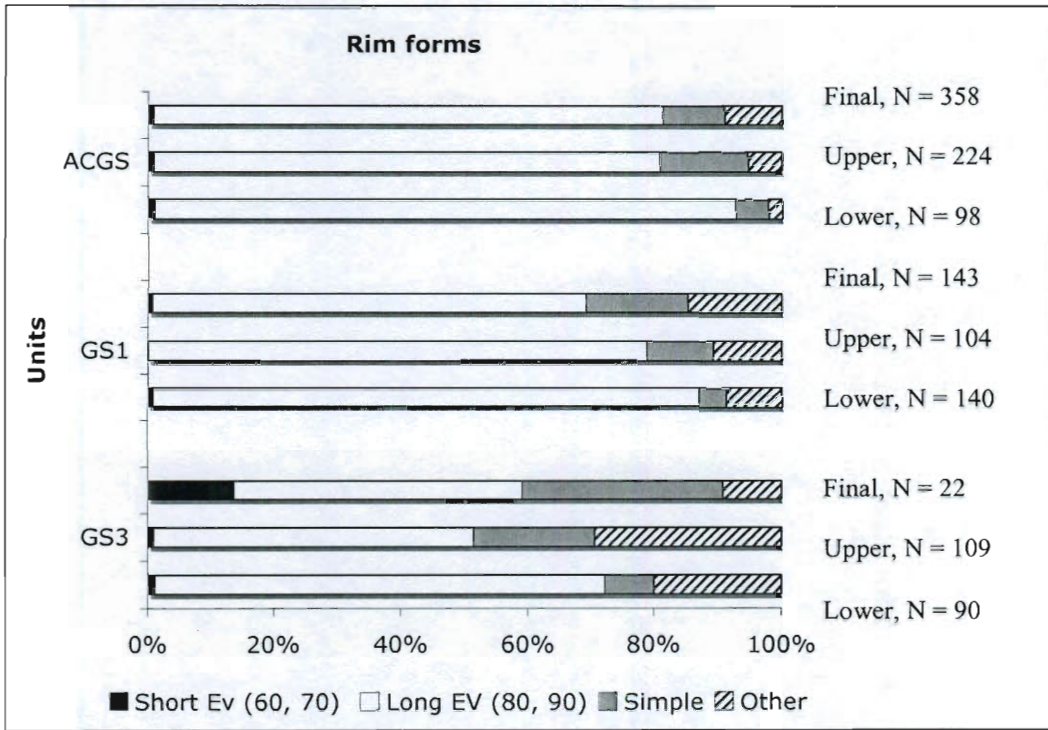


Figure 6.23. Frequency of rim types (Other: Thickened, Beaded, Potlids, Ledged rims)

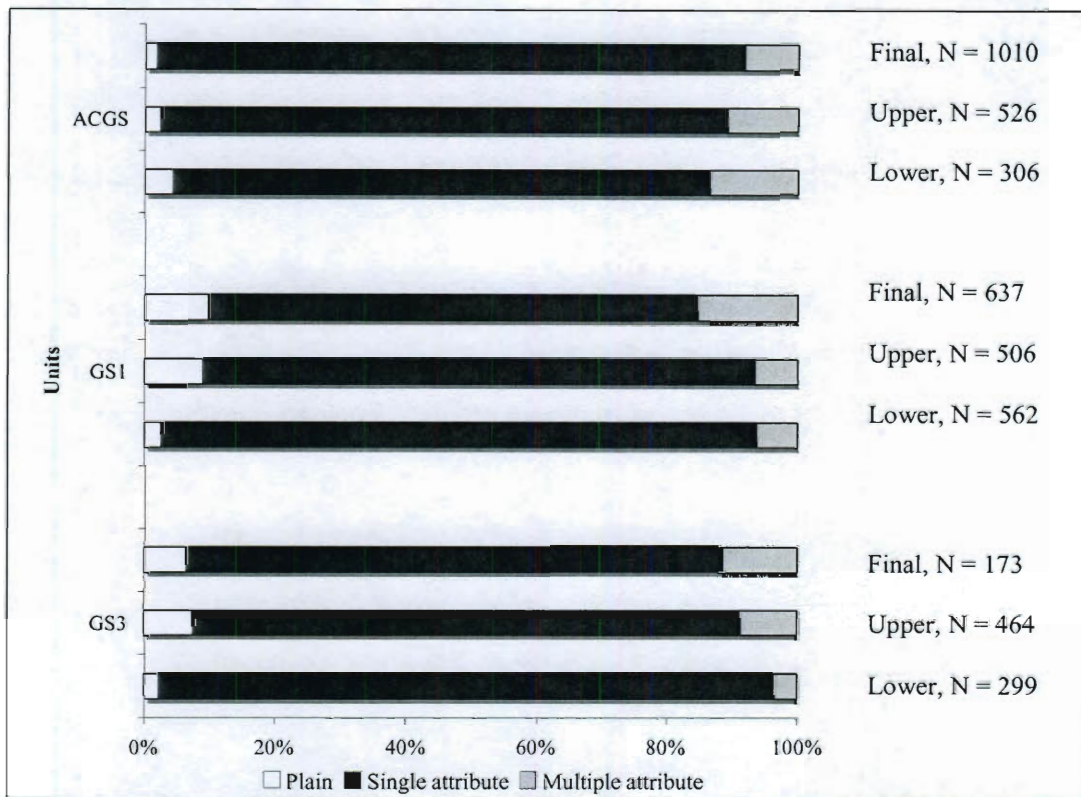


Figure 6. 24. Frequency of body sherds with a single, multiple or no motif

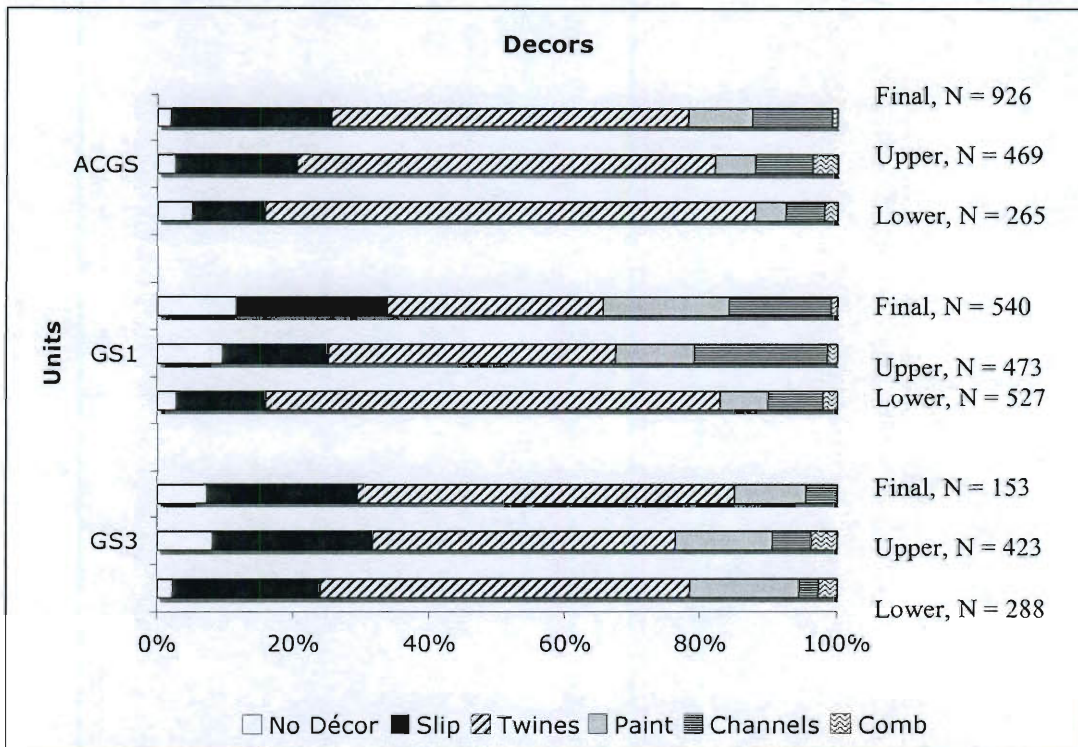


Figure 6.25. Frequency of motifs on body sherds decorative with a single or no motif

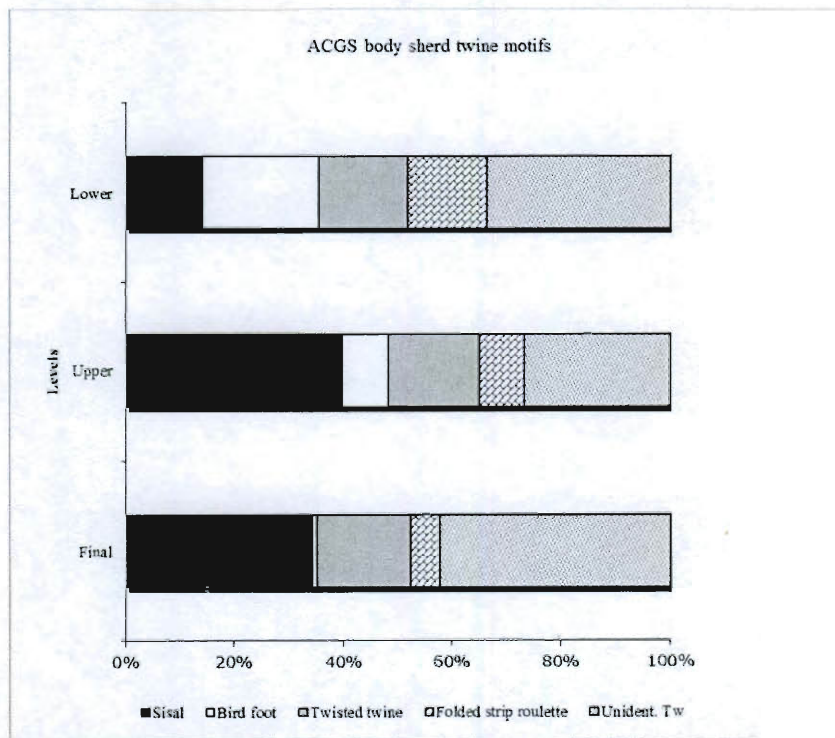


Figure 6.26. Frequency of twine decorative motifs on ACGS body sherds

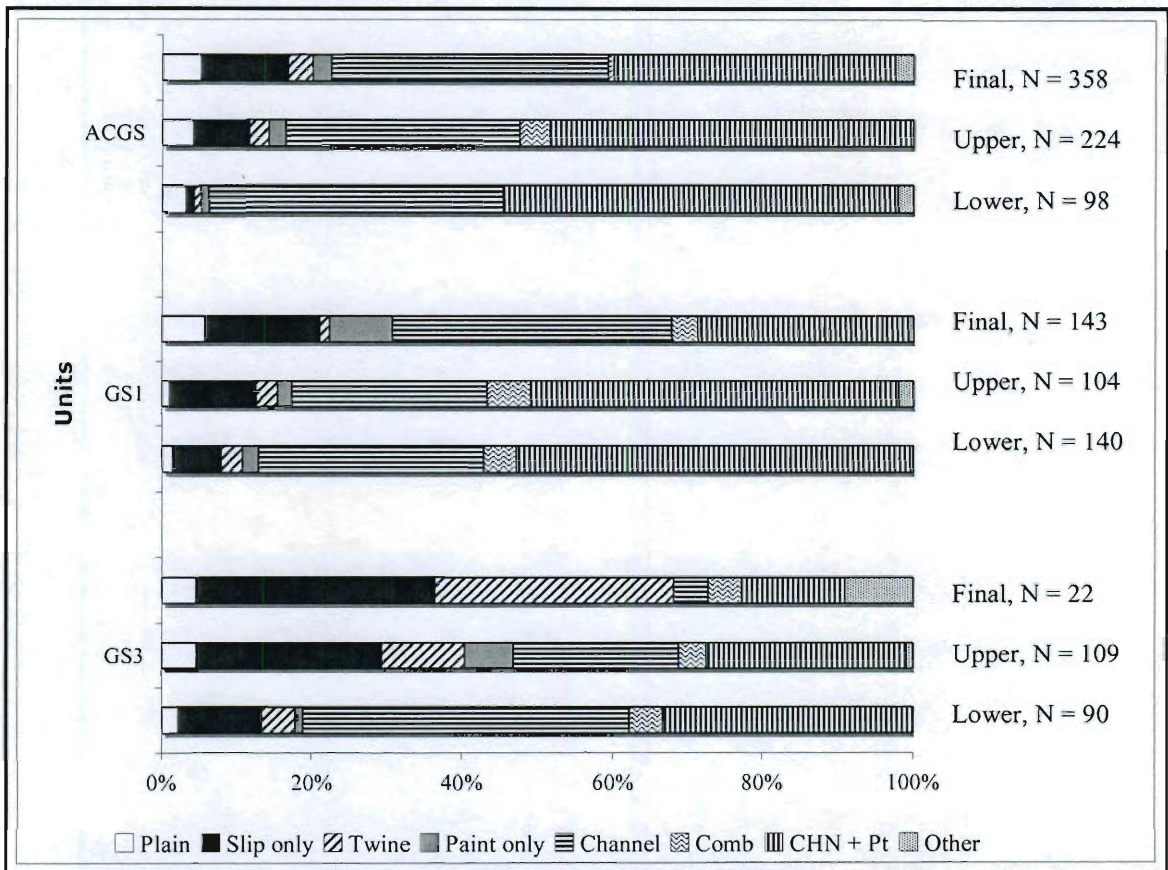


Figure 6.27. Frequency of motifs on rim sherds decorative with a single, no motif or multiple motifs (Other: Twine + paint, Twine + channel + channel, Twine + Channel + paint)

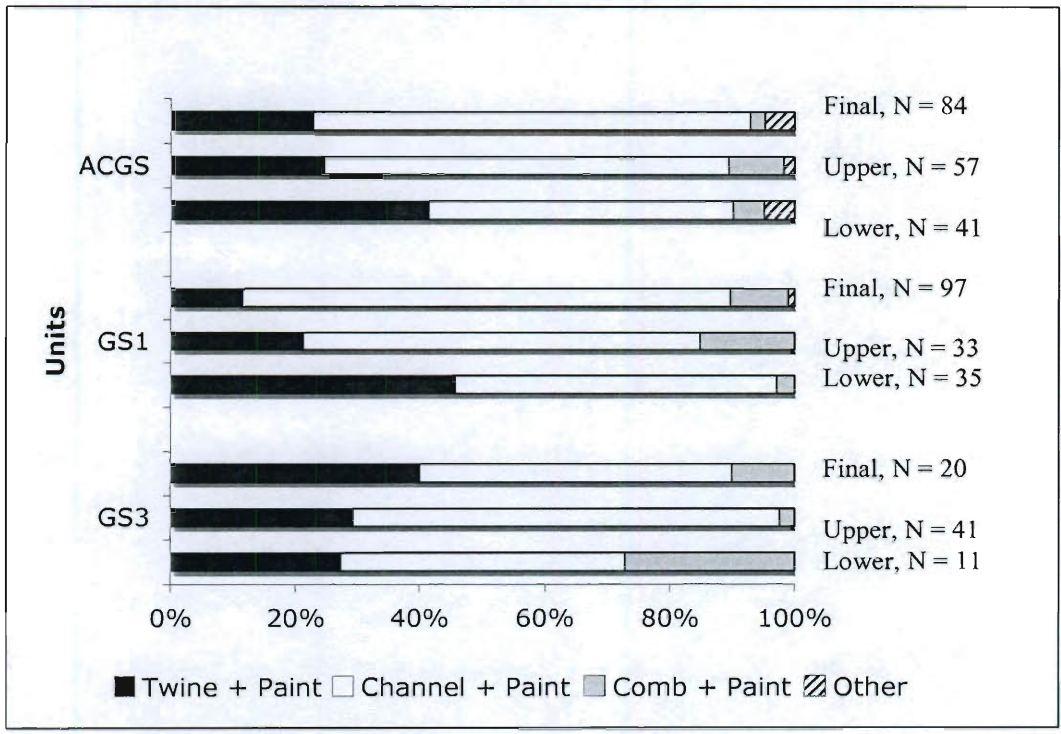


Figure 6.28. Frequency of motifs on body sherds with multiple attribute (Other: Twine + channel; Twine + Channel + Paint; Comb + Twine)

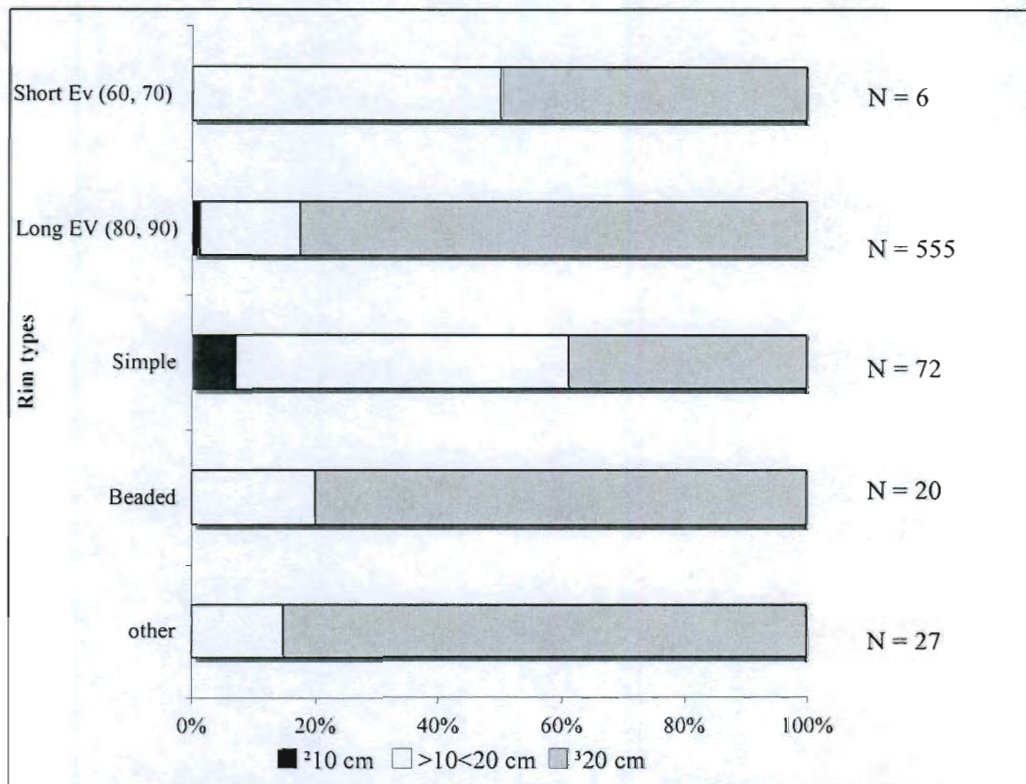


Figure 6.29. Frequency of rim diameter by rim types (Other rim types: Thickened, potlids, ledge)

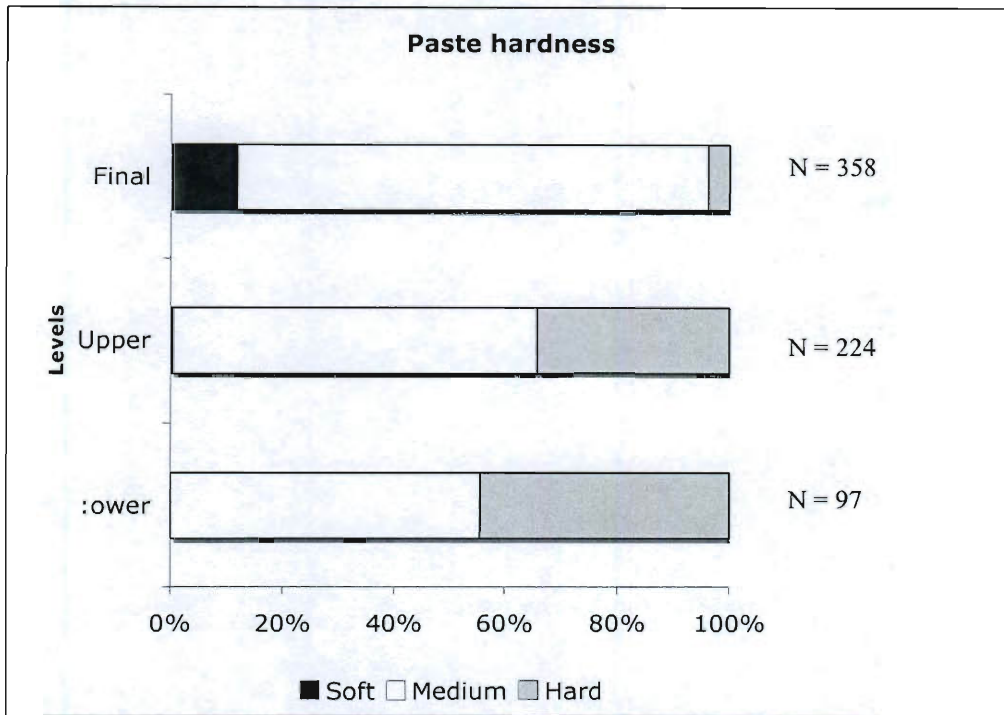


Figure 6.30. Frequency of paste hardness of ACGS rims by level groups

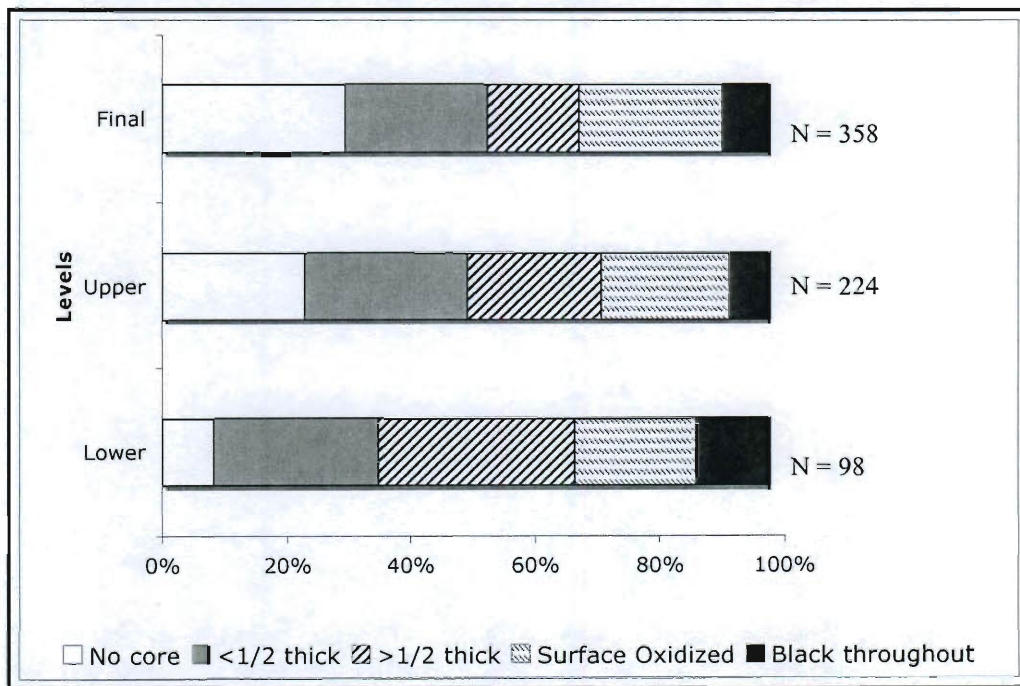


Figure 6.31. Frequency of the degrees of oxidation in the ACGS rim sherd walls by level groups

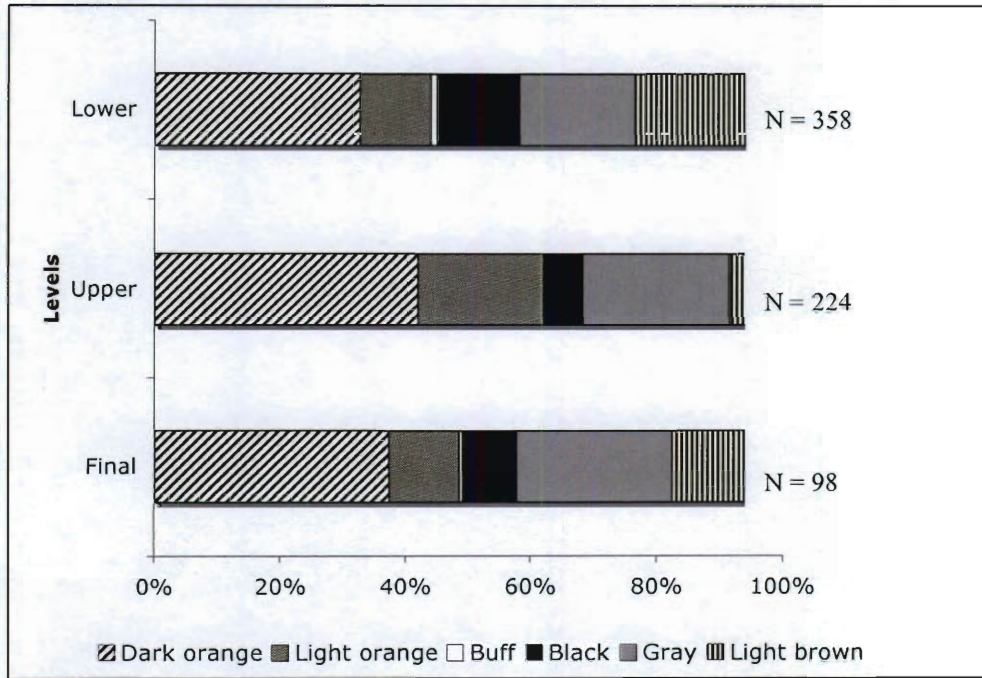


Figure 6.32. Frequency of ACGS paste color by the level groups

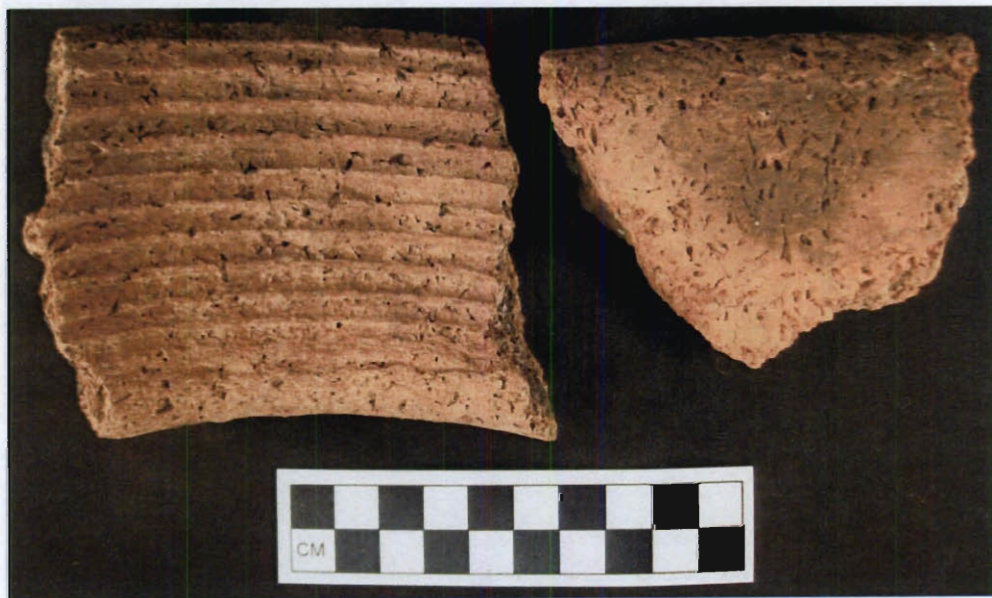


Figure 6.33. View of voids on the surface of the sherds

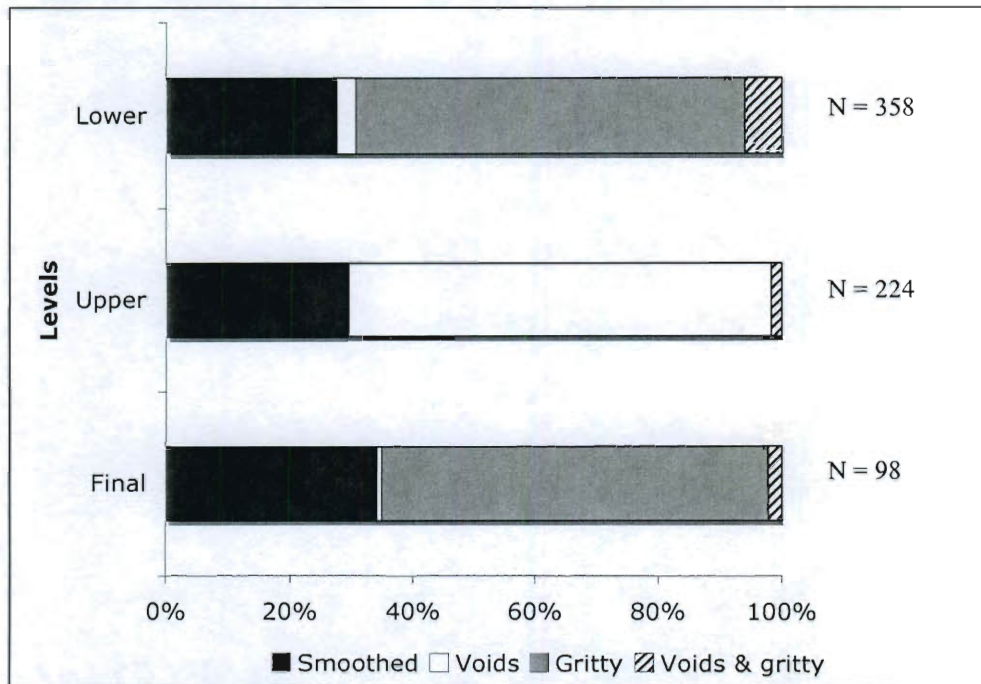


Figure 6.34. Frequency of the ACGS rim sherd surface preparation

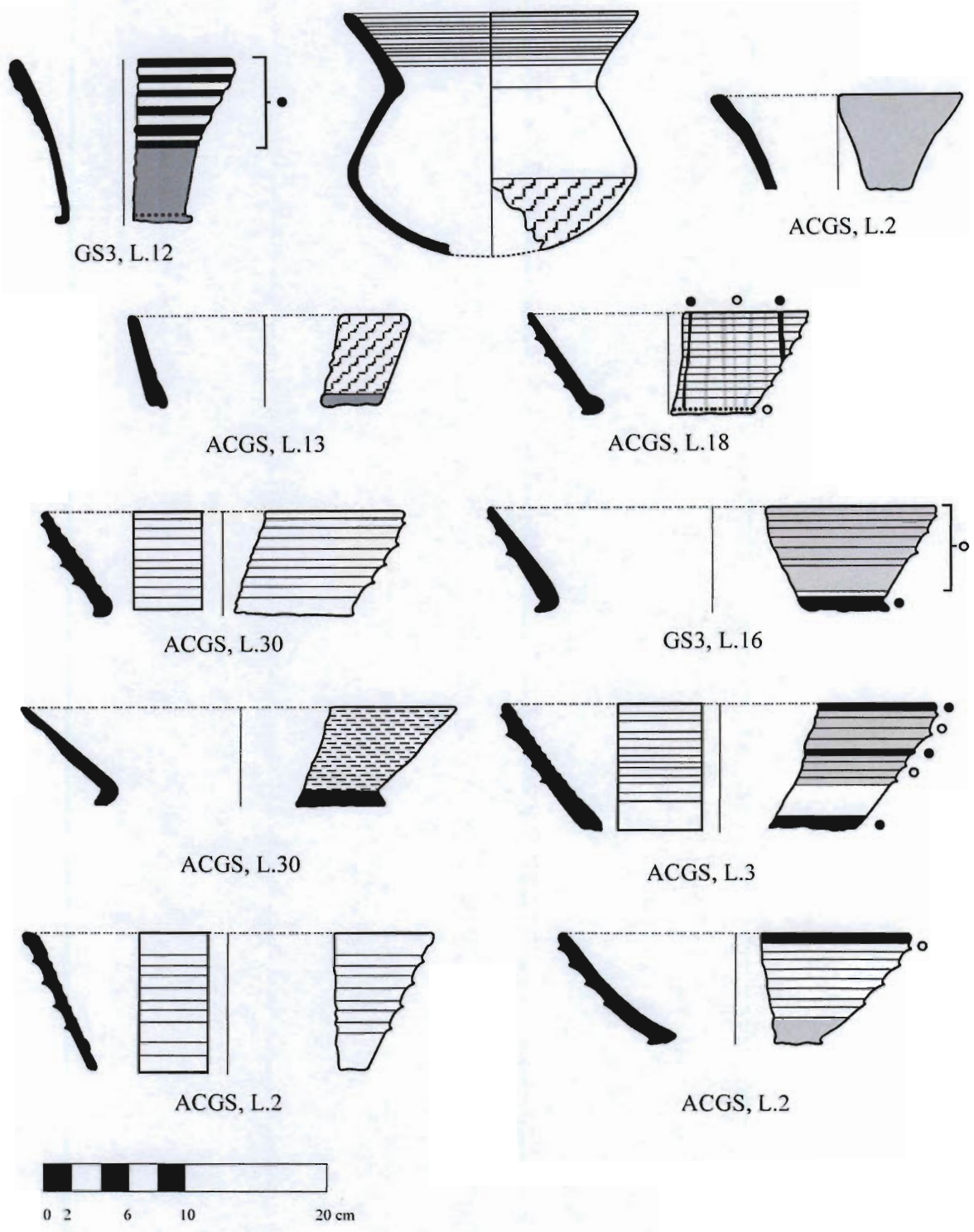
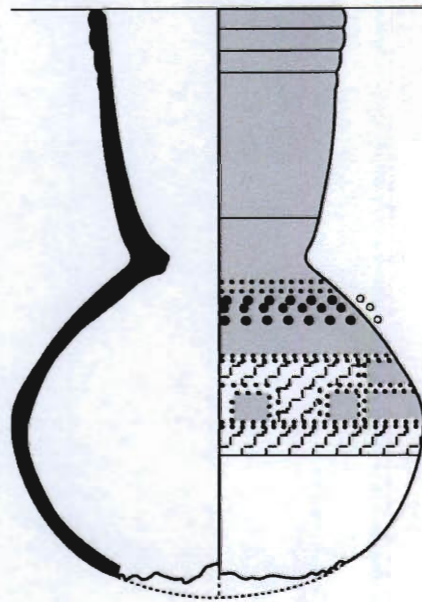


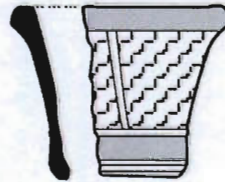
Figure 6.35. Long everted rims



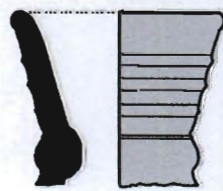
GS3, L12



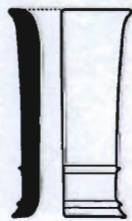
GS3, Feat 7



GS3, L.10



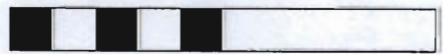
ACGS, L.1



ACGS, L.2



ACGS, L.1



0 cm 2 6 10 20

Figure 3.36. Bottles

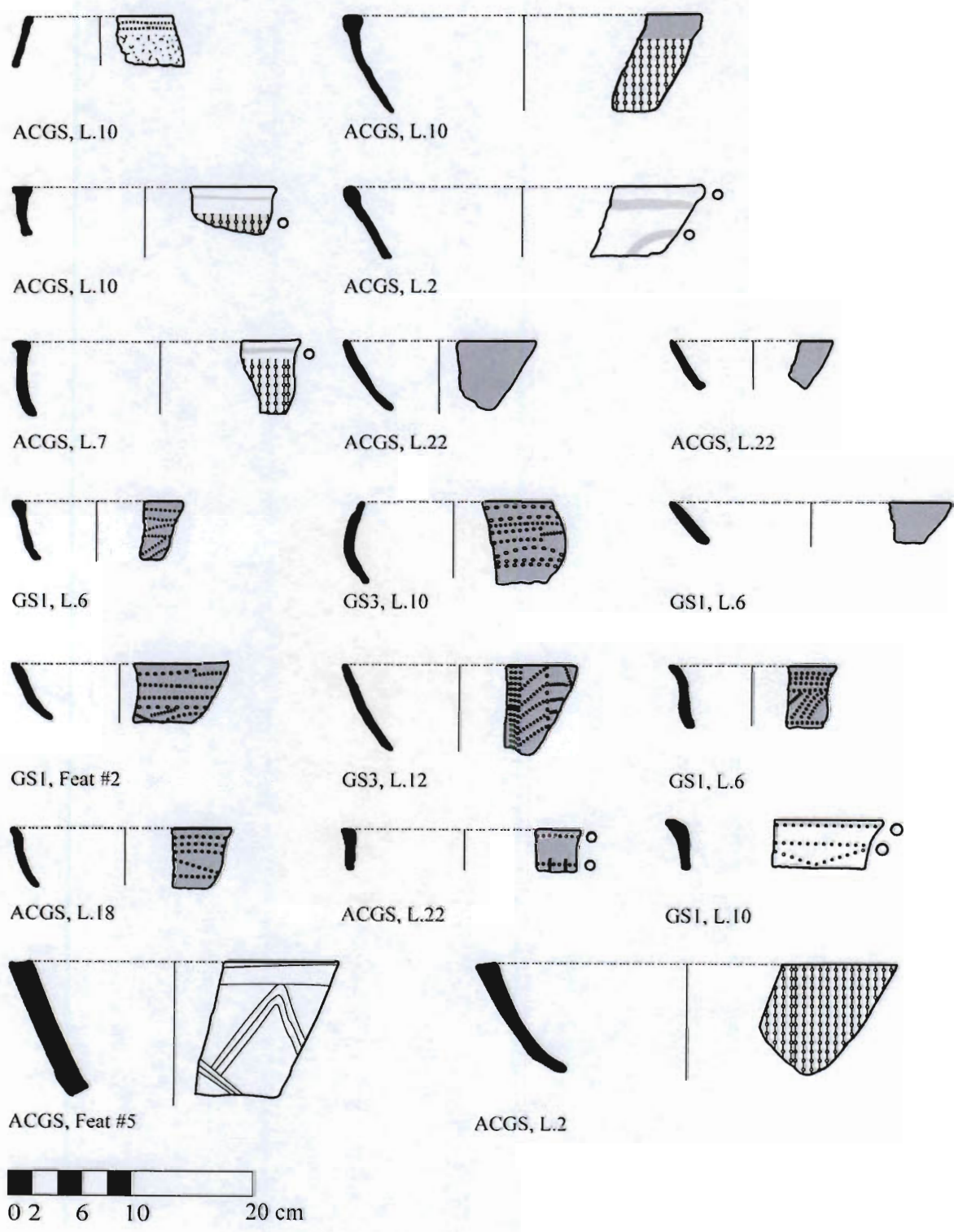


Figure 3.37. Simple rims

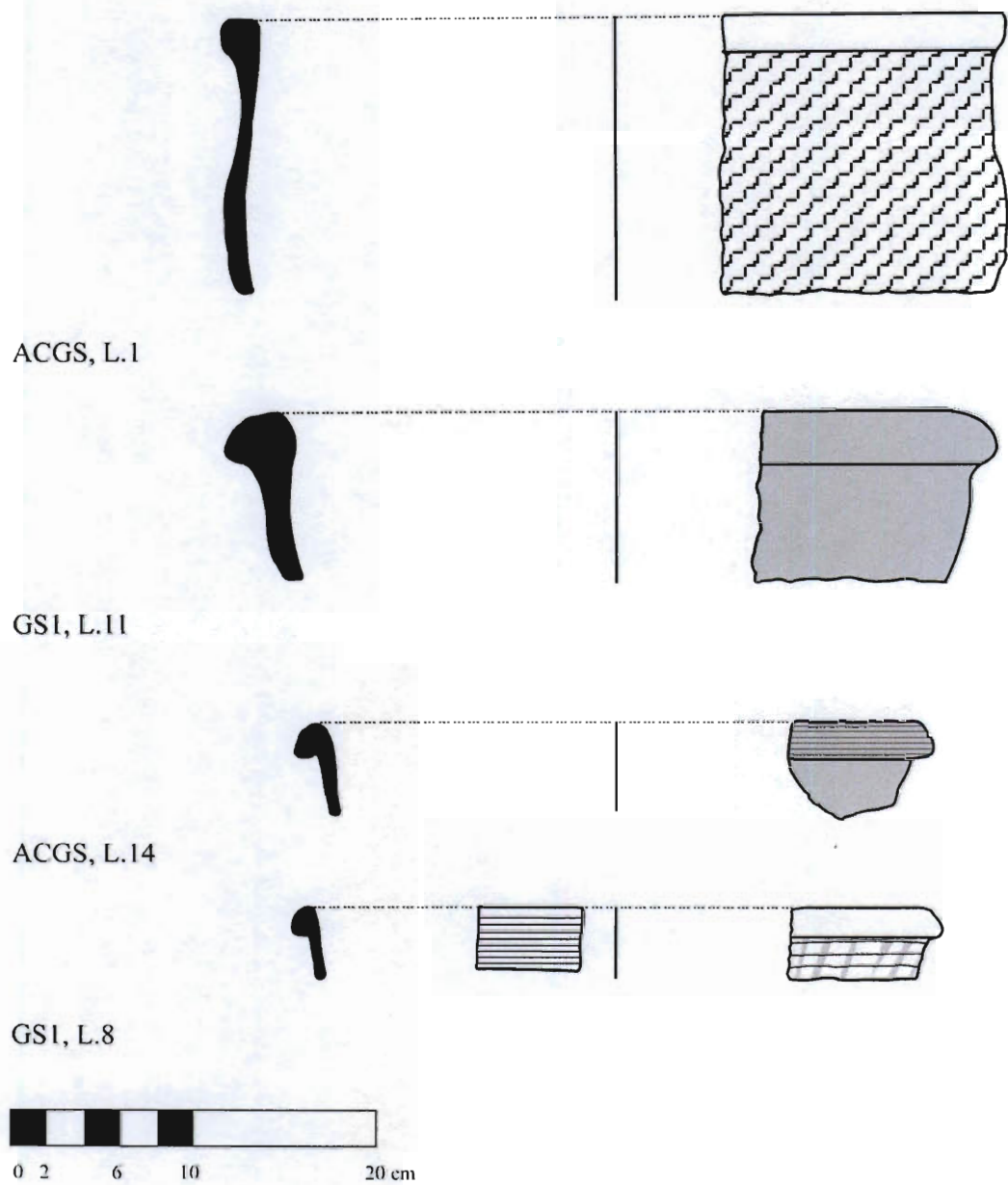


Figure 6.38. Beaded rims



ACGS, L.10



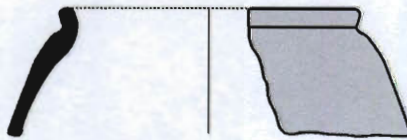
GS1, L.4



ACGS, L.1



ACGS, L.30



ACGS, L.10

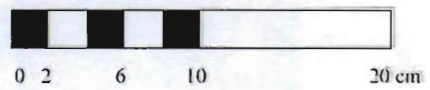
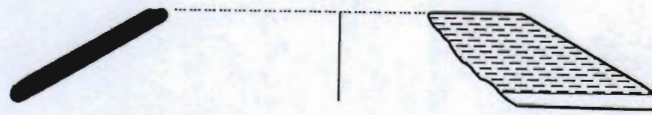


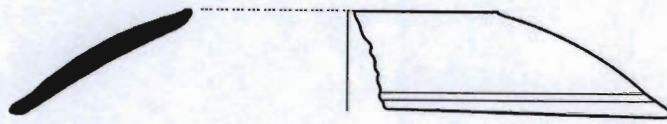
Figure 6.39. Ledged (top) and short everted rims



ACGS, L.2



ACGS, L.4



ACGS, L.7



ACGS, L.2



ACGS, L.10



ACGS, L.10

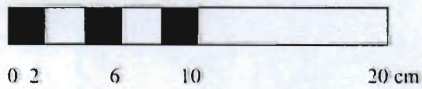


Figure 6.40. Pot lids (top) and thickened rims (bottom)

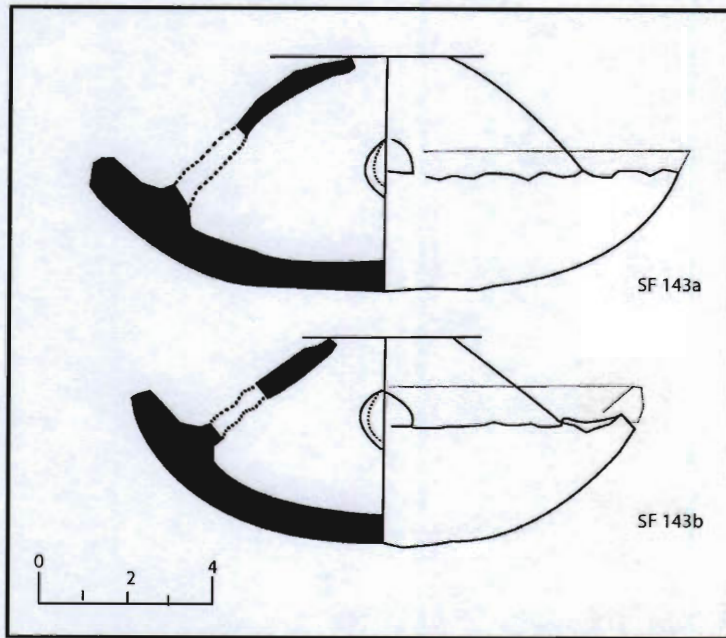


Figure 6.41. Earthen oil lamps recovered from the GS3 deposits.



Figure 6. 42. Ceramic discs at Gao Saney (Upper left: SF 624 [GS1]; right: SF 622 [ACGS]; bottom: SF 623 [ACGS]).

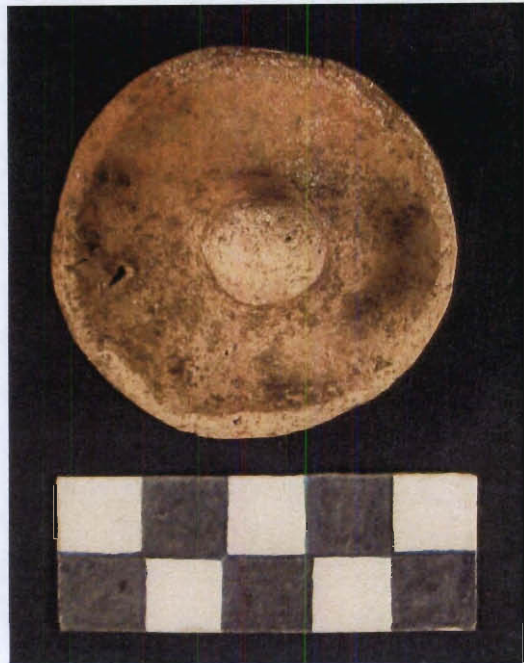


Figure 6.43. Bottle lid (SF 625 from GS1)



Figure 6.44. Couscoussiere fragment (SF 629 from ACGS)



Figure 6.45. Stove fragments (SF 630 from ACGS)



Figure 6.46. Imported ceramics (Left: SF 632, Middle: SF 633, Right: SF 631)

Chapter 7

GLASS

INTRODUCTION

The presence of a large number of beads – many of them made of glass – has attracted local looters for many years to Gao Saney, resulting in a terrible loss of archaeological potential at the site. Scientific investigation of the beads that can be recovered in archaeological context are therefore a precious source of information on glass consumption and the glass trade. Insoll was the first to recover and report on beads from a proper excavation, although the bulk of the beads (81 of 84) were surface finds (Insoll 1996: 68, 69, 104). These preliminary investigations at the site were important as they present the first useful information about color (blue, green and yellow), shape (cylinder, ring and barrel) and diaphaneity (opaque and semi-opaque) of the recorded glass beads.

Our 2001-02 and 2009 excavations produced hundreds of glass beads, over 85% of them from the two northwestern periphery units, GS1 And ACGS, and 168 vessel glass fragments. This represents the entirety of the glass recovered from ACGS, but some of the glass from GS1 and GS3 was taken to Japan for analysis. These items are not included in this study. One quarter of the beads almost all from GS1 and ACGS, were melted, malformed or unfinished and may represent glass manufacturing debris

In this chapter, the recovered glass assemblage is described and analyzed. Our aim is to have an idea about the kinds of glass present and their distribution in the deposits. Because of the presence of glass debris and melted beads, another objective is to evaluate the occurrence of manufacturing activity at the site. The question of glass sources will be approached through compositional analysis by LA-ICP-MS of a sample of beads. These results can be compared with a growing corpus of chemical analyses for glass from African and Near Eastern production and consumption sites with the goal of gaining some understanding of the distribution networks in which Gao Saney participated.

This chapter is organized as follows: The methodology for the glass bead description and classification is first discussed. The analysis and the discussion of the morphological characteristics of the recorded glass beads will follow. The result of chemical analysis of the bead samples will be then discussed. This will be followed by the analysis and the discussion of glass vessel fragments recovered in the three units. Throughout the discussions, the assemblages of Gao Saney glass beads and vessel fragments will be compared with those from other African sites sharing similar characteristics.

GLASS BEADS

Recovery and recording methods

During the excavations, glass beads were recovered in the 0.5 cm mesh screens. The collected beads were placed in plastic bags labeled with the site name, excavation unit, stratigraphic level, level record number and date. The quantity and weight of all beads from each level were recorded in the field on Excel data sheets. All the beads from

ACGS and the available beads from GS1 and GS3 were brought to the laboratory of Rice Anthropology Department for further analysis.

In approaching detailed recording and analysis of the glass beads, I profited from the work of Marilee Woods (2005; 2008), who generously spent two days at Rice sharing her knowledge and experience. In addition, Insoll's (1996; 2000) documentation of Gao beads was also helpful for the comparative purposes.

The recorded beads include entire beads and fragments larger than $\frac{1}{2}$ of the whole for which the original form could be recognized. Bead fragments representing less than $\frac{1}{2}$ of the whole bead were not recorded, other than by weight, in order to avoid multiple entries for fragments from the same bead.

Beads from the same level or feature were separated into monochrome color groups: blue, green, off white, yellow, white, red and black; and special beads (polychrome beads and beads with special features). The latter were put aside for later study. Number and weight were recorded for beads and fragments $\geq \frac{1}{2}$ of the whole in each color group for each level. These color groups were then subdivided and counted by shape (oblate, cylinder, sphere, tube, ellipsoid and melon), manufacture (drawn, wound), diaphaneity (opaque, opaque-translucent, translucent, translucent-transparent and transparent), and patination. In each level, the frequency of remelted beads was ranked (few, some, many) for that level. Special beads were individually recorded using the same variables such as provenience, shape, color (polychrome in particular), weight, manufacture and diaphaneity. The goal was to select meaningful variables in order to understand the characteristic of glass beads, the distribution of the variety of beads and

the development of manufacturing activity through time. A summary table of the bead variables and recording codes is provided in Table 7.1.

Table 7.1. Bead description variables and codes

Manufacture	Shape	Color	Patination
1- Drawn 2- Wound	1- Cylinder 2- Oblate 3- Sphere 4- Tube 5- Ellipsoid 6- Bicone 7- Disc 8- Melon 9- Barrel	1- Blue 2- Green 3- Off white 4- White 5- Yellow 6- Black 7- Multicolor (specified)	0- None 1- Light 2- Medium 3- Heavy
Diaphaneity	Remelting	Bead total	Bead weight
1- Opaque 2- Opaque – translucent 3- Translucent 4- Translucent- transparent 5- Transparent	0- None 1- Few ($\leq \frac{1}{4}$) 2- Some ($> \frac{1}{4} - \leq \frac{1}{2}$) 3- Many ($> \frac{1}{2}$)	Only for the entire bead and fragment more than $\frac{1}{2}$	For all beads and bead fragments

Further details on the variables recorded are provided below:

Manufacture: Practically all the Gao Saney glass beads are “drawn”. Only a few are “wound”. In the process of manufacturing drawn beads, a hollow is created by blowing or perforating with a metal tool in a glass matrix. This molten glass is then drawn out when hot to form a tube. Finally, it is cut into short length beads using chisels or other wedge-shaped tools. Sometimes, beads were reheated over fire to round the edges (Woods 2005: 28; Roy in Insoll 2000: 98). Wound beads are manufactured by

putting a rod into a molten glass and then winding around the rod. The glass, while still hot, is rolled (or “marveled”) into the preferred shape (Woods 2005: 29-30).

Color: The bead assemblage was divided into seven generic color categories: blue, green, off-white, yellow, white, and black (Figure 7.1). In general, the off white color is the result of significant weathering of formerly blue or green colors. Traces of the original color are still evident after careful visual observation. Most of the Gao Saney beads are blue, green or off white (90%). In addition to these monochrome beads, a few polychrome beads with different motifs were recorded. They are as follows: vertical black stripe motifs on white; vertical blue stripes on white; mosaic red, white and blue from center of eye; red on one end of the bead and other areas are blue.

Shape: Six shape categories were recognized: oblate, cylinder, sphere, tube, ellipsoid, bicone, disc and melon (Figure 7.2). During the course of recording, it was sometimes difficult to make a clear distinction between oblate and cylinder beads. These two categories of beads are the most common in the assemblage.

Remelting: The variable “remelting” was used to record the rank of bead debris and melted beads (Figure 7.3) within each level. The ranking system was recorded as follows: None, if there is no debris; Few, if $\leq \frac{1}{4}$ of the bead total within the level; Some, if $> \frac{1}{4} - \leq \frac{1}{2}$ and Many if $> \frac{1}{2}$. All the remelted beads recorded came from the ACGS and GS1 deposits.

Diaphaneity: This variable shows the degree of translucency of glass. Gao Saney glass beads are opaque, translucent, or transparent, with intermediate categories opaque-translucent and translucent-transparent. The determination of translucency is important because it can help to distinguish beads from different series.

Patination: This variable addressed the presence of a patina on the glass beads. According to Marilee Wood (pers. comm.), “the patina on the beads can be caused by the chemical conditions in the soil along with water or other moisture present in the ground in which the finds were deposited”. However, she also points out that “some glasses with elevated alumina (Al_2O_3) are often more resistant to corrosion than others”. Four levels from none to heavy (completely weathered) were recognized. Blue and green beads were more prone to weathering than other colors such as yellow and white.

Analysis

For purposes of analysis, the three stratigraphic level groups (Final, Upper and Lower) defined and introduced for pottery analysis (Chapter 6, Table 6.7) will again be used in order to assess change through time. The frequency distribution of beads by level groups shows the dominance of beads in the lowest levels in the northwest periphery units (Figure 7.4). Thirty to forty percent of the beads in these lowest levels are partially melted, unfinished and/or malformed beads interpreted as debris from secondary glass production activities, including the rounding of beads cut from drawn canes by melting (Figure 7.5). This production debris is concentrated almost exclusively in GS1 and ACGS.

Color: The various colors of beads recorded (blue, green, off-white, yellow, black, white and polychrome) were present throughout from the lower to the upper deposits of the excavated units (Figure 7.6). Beads with blue, green and off white colors were by far the most important (over 85%) followed by yellow beads (over 10%). The frequency of off-white beads tends to be high in the lowest levels, particularly in ACGS

(over 60%). These beads, to judge by the remaining traces of blue or green colors, turned to off-white possibly due to the soil conditions, including moisture, interacting with bead chemistry.

Shape: Four types of bead shape including cylinder, oblate, tube and sphere represent over 98% in the Gao Saney glass bead assemblage (Figure 7.7). The most common shapes are cylinder and oblate (nearly 80%).

Manufacture: Drawn beads are the most common and represent over 95% of the bead assemblage. Except for the spherical beads, which were wound, all the other bead shapes mentioned above were drawn and cut.

Diaphaneity: Beads are commonly opaque or opaque translucent (over 80% of the beads) at all the excavated units through time. The effect of the process of becoming off white is that it increases opaqueness.

Patination: Heavily and moderately patinated beads dominate the assemblage (50–70%) in all units and level groups. Nearly 80% of the heavily patinated beads are off white. The remaining beads with the patina are commonly blue and green. This is not surprising because, as I already mentioned earlier, the presence of off color was generally the result of intense weathering of blue and green attested by some visible traces of these later colors. If the patina is not on the beads, the colors can be easily identified.

Marilee Wood (University of Witwatersrand, South Africa) recorded 163 beads from the GS1 and GS3 assemblages in this study. Among these bead samples, 127 beads and fragments were recognized to belong to the Zhizo series. Zhizo beads are characterized by being drawn with the ends that are not reheated. The bead color is commonly blue,

green and yellow, with lots of air bubbles visible, especially under a 10x loupe. The glass is a potash glass with low alumina, often corroded (Wood, pers. comm.). However, the ends of Gao Saney beads were often reheated, which was likely done locally according to Wood (pers. comm.).

Chemical analysis of Gao beads

Two groups of glass beads were submitted to L. Dussubieux for analysis using LA-ICP-MS (Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry) at the Field Museum of Natural History. The initial group of 14 Gao Saney beads from GS1 also included 15 beads from Gao Ancien (Figure 7.8). Subsequently, 50 beads from ACGS were also selected analysis. Over half of these beads appeared to belong to Zhizo series. Unfortunately, seventeen of these proved to be too corroded for reliable chemical analysis, so results are provided only for the 33 non-corroded beads. Detailed information about this chemical analysis and results is provided in the two reports from Laure Dussubieux reproduced in Appendix III. Because glass was not made locally, one of the major objectives of this analysis is to determine the production source areas of the glass beads. Thanks to the available compositional data from several major production and consumption centers of glass (South and Southeast Asia, Near East, North Africa, and sub-Saharan Africa), it is possible to identify general source areas (Dussubieux et al. 2008; Henderson et al. 2004; Lankton and Dussubieux 2006; Woods 2005; Robertshaw et al. 2010; Lankton 2007; Robertshaw 2007).

The data from the analysis show that all analyzed Gao Saney beads are soda-lime-silica glasses . They are divided into two broad groups: plant-ash soda-lime-silica glass

(vNC) and mineral soda-lime-silica (mNC). Nearly all the analyzed beads belong to the great family of plant-ash soda-lime-silica glass with low levels of alumina. Plant-ash soda-lime glass, the most dominant early Islamic chemical type, was very popular in North Africa (Tunisia), Lebanon, Syria and Iran from 9th century AD onward (Henderson et al. 2004: 439, 454-464). This glass type was found at many West African sites including Gao Ancien, Es-Souk, Kissi and Igbo Ukwu (Robertshaw et al. 2007: 429-430; Brill in McIntosh 1995: 256; Robertshaw et al. 2010: 5). This glass type was also the most common among Zhizo bead series found in West Africa, at Kissi, Igbo Ukwu and Gao (Robertshaw et al. 6; Robertshaw 2010). Among Gao Saney plant ash glasses, three have high level of added lead (vNC-Pb) with higher tin.

Three Gao Saney beads belong to the second group, mineral soda-lime-silica (mNC) glass type. This glass type is characterized by its low concentrations of MgO (Robertshaw 2010). This recipe, characterized by the use of a lime-rich sand mixed to natron was the dominant recipe that was used in the workshops of Syro-Palestine until the eighth century A.D. However, the level of concentrations in MgO and K₂O of these Gao beads remains higher than those of glasses made with natron obtained from the Wadi el-Natrun (Egypt), used to manufacture Roman, Byzantine and early Islamic glasses (Robertshaw 2010). Around the mid-ninth century AD, mineral lime was replaced by plant ash (Robertshaw et al. 2010: 5). Since it appears that the Wadi el-Natrun soda was not used to manufacture Gao mineral soda glasses, the production source of these glasses remains unknown. In West Africa, mineral soda glass was found in the Gao Ancien, Igbo Ukwu and Es-Souk glass assemblages (Robertshaw et al. 2007: 429; Robertshaw 2010).

None of the analyzed Gao Saney glass belongs to the soda-lead-silica type of glass (Pb-Na-Si); a subgroup of plant ash soda glass with high lead with no tin (Robertshaw 2010) that has been found at Gao Ancien and the Al-Basra (Morocco) glass assemblage dated to the tenth-eleventh centuries AD (Robertshaw et al. 2007; Robertshaw 2010). Additionally, all the analyzed samples of Gao Saney beads have low proportion of alumina (< 3%, with the exception of GS0048, with 4.6%), unlike the earliest South and Southeast Asian "trade wind beads" which "distinctive feature is their high alumina content varying from 5% to 15% associated with low concentration of magnesium" (Dussubieux et al. 2008: 798, Popelka et al. 2005: 90). Nor do the Gao beads resemble the high alumina/high lime glass manufactured in Ife (Lankton et al. 2006: 122-123).

Dussubieux (2009) points out two areas as the likely production sources of many Gao Saney beads. The natron soda-lime glass was made in the Syro-Palestinian region while the soda plant ash glass was manufactured in the Middle East (Dussubieux 2009). Specifically, Robertshaw suggests that the soda plant ash glass "came from east of the Euphrates based on the high MgO and K₂O concentrations" (Robertshaw 2010).

OVERVIEW OF THE GAO SANAY GLASS BEAD ASSEMBLAGE

We have seen that glass beads are most common in the earliest levels of the two units in the North Eastern margin of the main tell. The presence of significant numbers of remelted beads and fragments suggests the occurrence of artisanal activity. The assemblage is generally monochrome. Over 90% are or once were blue/green weathering to off-white. Most of the beads are thin cylinders or oblate produced by drawing and

cutting a glass cane. Most of the 47 beads analyzed by LA-ICP-MS are plant-ash soda-lime-silica glass, likely from a source east of the Euphrates. Plant-ash soda-lime glasses are also found in North Africa and at many West African sites, including Gao Ancien, Jene-jeno, Es-Souk, Kissi and Igbo Ukwu (Robertshaw et al. 2007: 429-430; Brill in McIntosh 1995: 256; Robertshaw et al. 2010: 5). Three of the analyzed beads were fluxed with mineral soda, but the MgO and K₂O concentrations suggest that Wadi el-Natron may not have been the source. Numerous beads of the Zhizo series first recognized in the Shashe-Limpopo area of Zimbabwe are present.

GLASS VESSEL FRAGMENTS

As mentioned above, there is evidence that some glass beads were reworked at Gao Saney, but no evidence of raw glass production. All the glass vessel fragments recovered at the site were received through trade from distant production centers. A total of 171 glass vessel fragments weighing nearly 112g were recorded from the three excavated units; only a few of these were identifiable (but it should be recalled that glass samples were taken to Japan for analysis and selection may have focused on identifiable glass). The assemblage will be described in terms of major morphological characteristics, No chemical analyses of composition have been undertaken.

Glass fragments from the same level were first counted and weighed. They were, then, recorded in terms of color, part represented (rim, base, neck and fragment), diaphaneity, patination and wall thickness. In addition, rim fragments were also defined according to their forms. Three forms were recorded: thickened, simple and everted rims

(Figure 7.9). The approach used for describing and analyzing color, diaphaneity and patination of glass vessel fragments was the same as that adopted for glass beads.

Results

Glass vessel fragments were present throughout the deposits of the three excavated units. In contrast to glass beads, vessel fragments are not common in the lowest levels. However, over 2/3 of the assemblage was concentrated in the lower four meters deposits dated to the eighth to tenth centuries AD (Table 7.2.). Sample sizes are small for all level groups so interpretation of possible patterning must be exercised with appropriate caution. Forms were generally unidentifiable with the exception of nine bottle fragments (Figures 7.9, 7.10). Green glass constituted about 70% of the assemblage (Figure 7.11). The contrast in levels of patination and diaphaneity when compared with the bead assemblage is most interesting (Figure 7.12, 7.13), suggesting a difference in the quality of the two assemblages.

THE GAO SANEY GLASS ASSEMBLAGE: DISCUSSION

Glass beads are an important component of the Gao Saney glass assemblage from the earliest occupation. Two-thirds of the beads come from the lowest occupation level group, dated to the eighth to tenth centuries, suggesting that Gao Saney participated in trade networks connected to distant sources since its founding. Glass may have been received as cut beads ready for secondary processing by smoothing, or as cullet (broken glass) bulked for remelting to make beads (Nixon [2007:307] following Lankton [in Nixon 2007:448] suggests that cullet trade may have been significant in West Africa).

The presence of numerous broken, malformed and unfinished glass beads in GS1 and ACGS deposits suggest that one or both of these activities took place in the vicinity. Few locales with evidence of secondary glass processing have been documented in West Africa (the identification of the “glass bead mold” at Tegdaoust by Vanacker 1997:168 has recently been placed in doubt by Nixon’s demonstration that similar molds were used in gold casting at Es-Souk – Nixon 2007:329; 2009). Ife, with its many glass-making crucibles, may be a primary or a secondary production center (Lankton et al. 2006: 113-114).

Glass beads -- intact and well-formed -- are also found in domestic contexts at Gao Saney, so it was a place of consumption, and well as secondary production.

Glass vessel fragments show far less corrosion and patina than the beads. The reasons for this are unknown, but may be a reflection of differences in manufacturing technique and quality. The presence of similar good quality glass items is also documented at many other West African sites including Gao Ancien, Gadei, Es-Souk, Koumbi Saleh, Tegdaoust, Kissi and Igbo Ukwu (Insoll 1996: 103; 1998 and 2000; Nixon 2007: 307; Berthier 1997: 98; Vanacker 1979: 165; Shaw 1970).

Table 7.2. Frequency of Gao Saney identifiable glass vessel fragments

Unit	Lev/ Feat	ID #	Thickened rim		Simple rim		Everted rim		Base		Neck fragment		Observations
			Qty	Wt (g)	Qty	Wt (g)	Qty	Wt (g)	Qty	Wt (g)	Qty	Wt (g)	
ACGS	1	SF 1							1	1.9			White
	3	SF 2			1	0.4							Green
	12	SF 3	1	0.2									Green
	14	SF 4			1	0.2							Green
	18	SF 5									1	1.1	Black bottle neck with ridges
	Feat 5	SF6	1	1									Black
	20	SF 7			1	1.6							Black
	20	SF 8	2	1.9									Green
	21	SF 9			1	0.7							Black
	21	SF 10			1	0.3							Black
	21	SF 11	1	1.4									Green
	28	SF 12					1	1.4					Green
GS1	Feat 1	SF 13			1	0.4							Green
	7	SF 14	1	0.4									Green bottle rim fragment
	7	SF 15							1	2.2			Green bottle in convex form
	9	SF 16			1	0.2							Green
	10	SF 17			1	0.6							Green
	10	SF 18			1	1.5							Red
	11	SF 19	1	1.1									Green bottle rim fragment
	11	SF 20			1	0.7							Yellow geometric bands on the green glass
	11	SF 21			1	0.5							Green
	12	SF 22			1	1.1							Green
GS3	7	SF 23	1	1.2									Green bottle fragment
	10	SF 24	1	2.7									Green bottle rim fragment
	10	SF 25			1	0.4							Green
	12	SF 26			1	0.7							Green
	12	SF 27			1	0.2							Green
	13	SF 28			1	1.1							Green and Lip rounded



Figure 7.1. Gao Saney bead colors

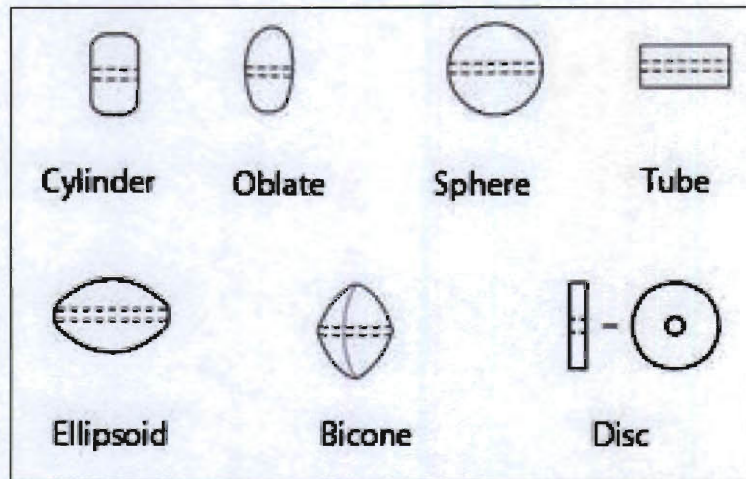


Figure 7.2: Bead shapes



Figure 7.3. Melted and unfinished glass beads

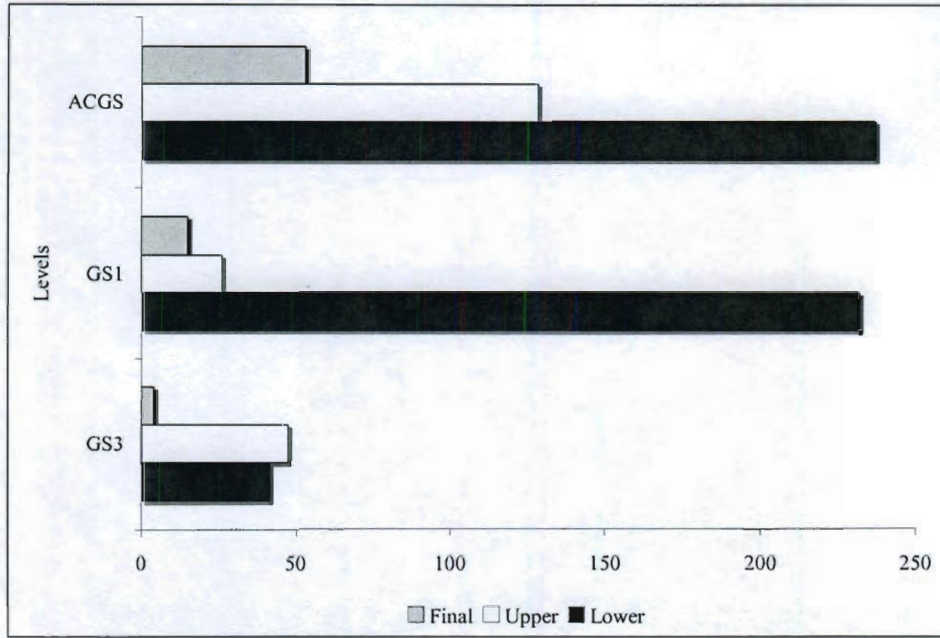


Figure 7.4: Frequency of Gao Saney glass bead total by level groups

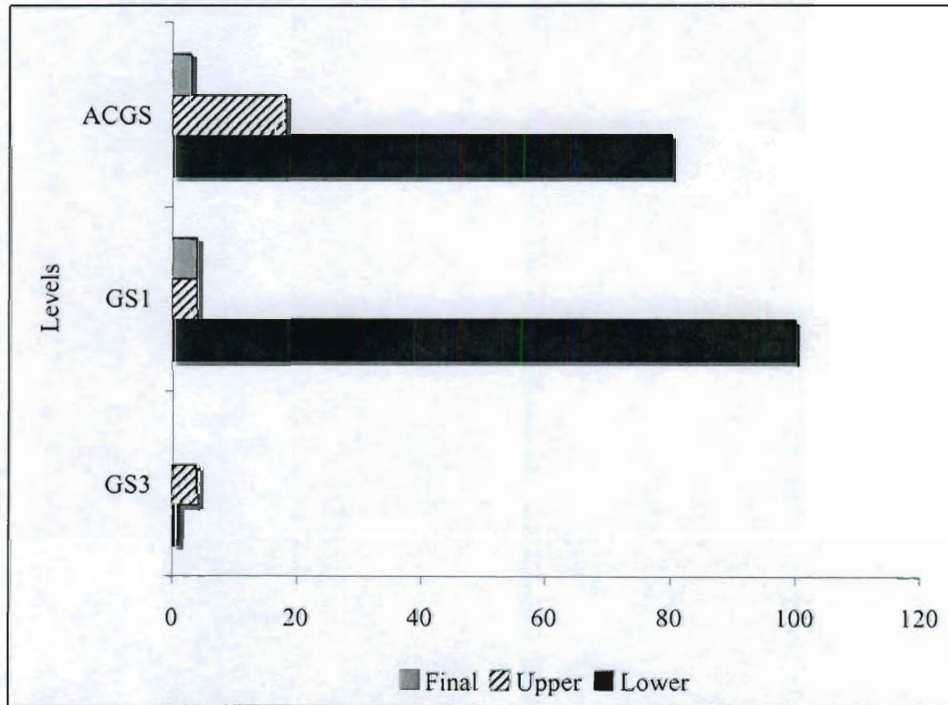


Figure 7.5. Frequency of Gao glass bead debris by level groups

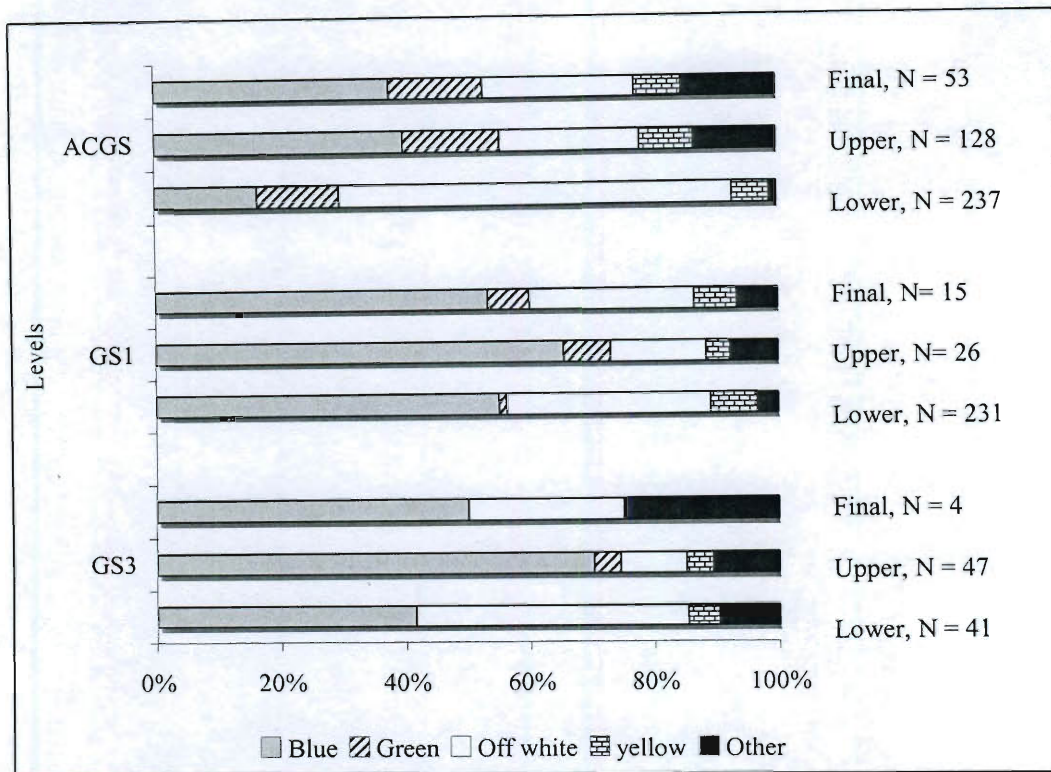


Figure 7.6: Frequency of Gao Saney bead colors by level groups (Other: Black, white, multicolor)

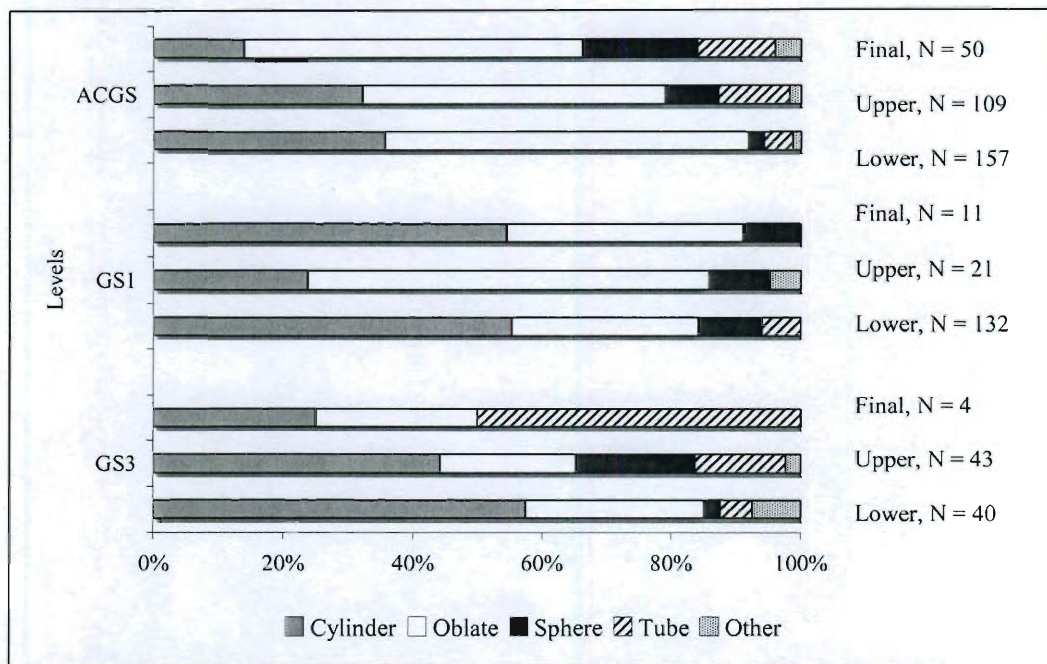


Figure 7.7. Frequency of Gao Saney bead shape (Other: Ellipsoid, bicone, disc, melon)



Figure 7.8. The analyzed samples of Gao Saney (GS) and Gao Ancien (GA) beads by LA-ICP-MS (Pictures from Marilee Wood)



Figure 7.9. Sample of vessel rims and bases



Figure 7.10. Sample of non-identifiable glass

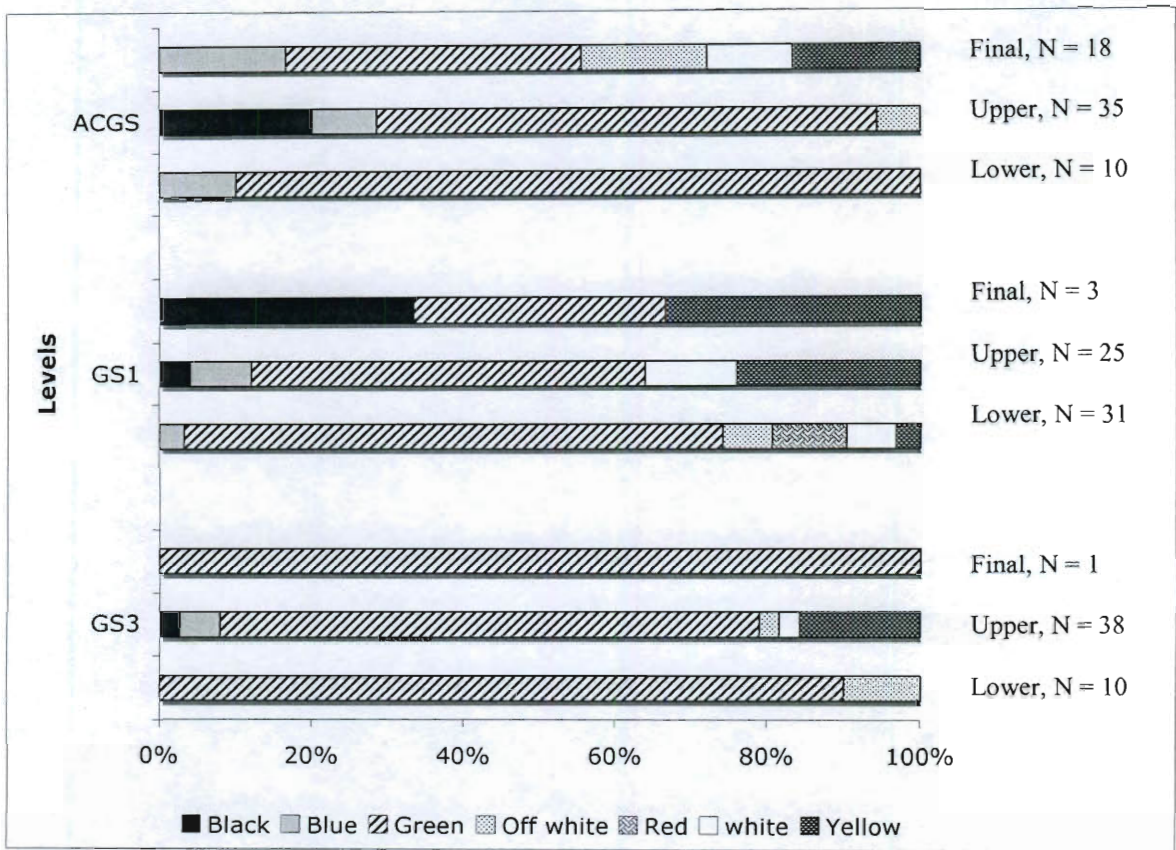


Figure 7.11. Frequency of Gao Saney glass colors by levels

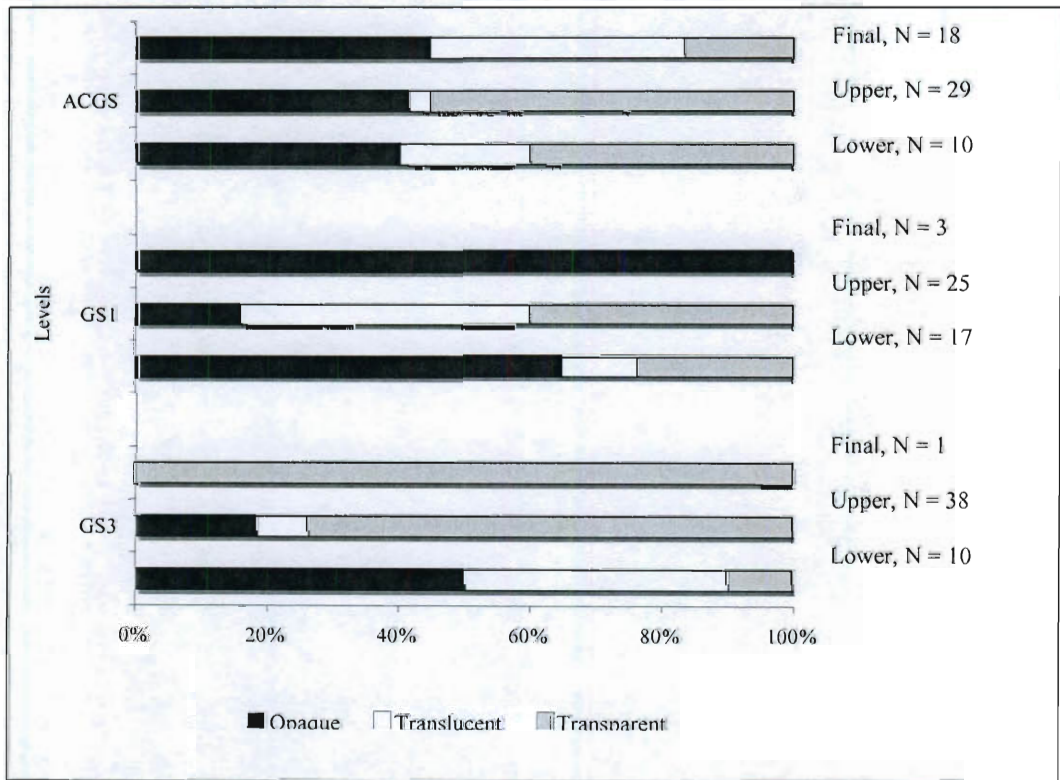
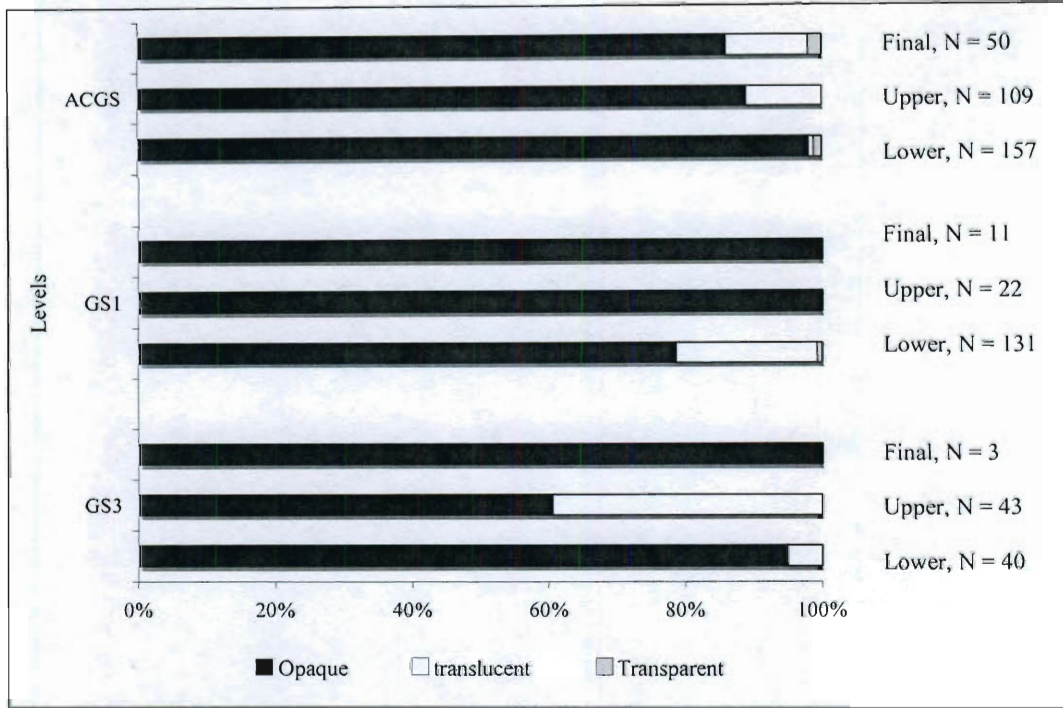


Figure 7.12. Comparison of diaphaneity of Gao Saney glass beads (top) and vessel glass (bottom)

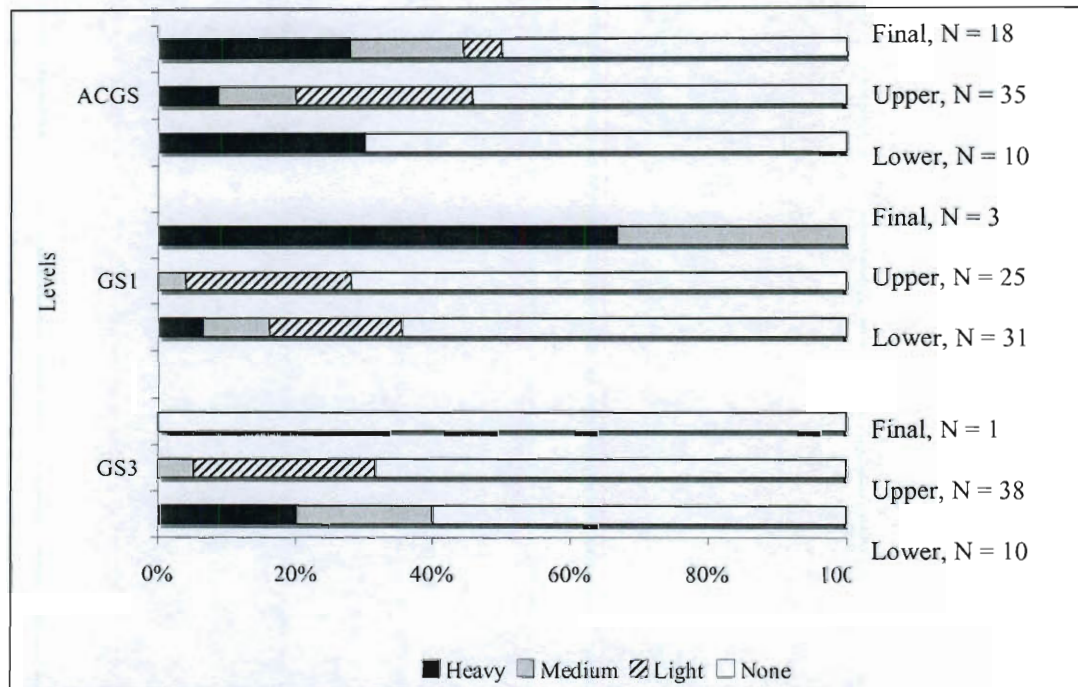
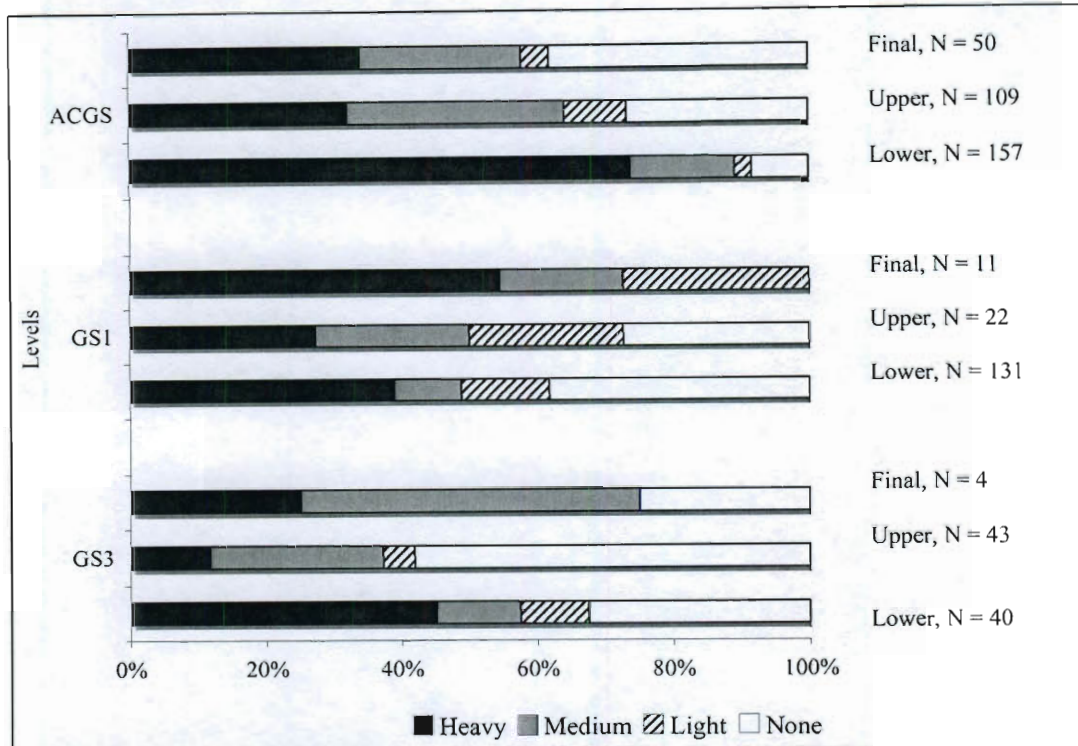


Figure 7.13. Comparison of patination of ACGS glasses beads (top) and vessel glass (bottom)

Chapter 8

METALS

INTRODUCTION

Iron and copper-based metals were present throughout the deposits of the excavated units at Gao Saney. The various surveys undertaken in the Gao region in the last two decades documented the presence of iron working sites with furnace structures, tuyeres and iron slag concentrations (Arazi 1999; Togola et al. 2004a&b; Manning 2008). It is likely that these sites supplied Gao with iron. While iron ores can be found locally, copper items could only be obtained through inter-regional or sometimes long distance trade. The medieval Arab chroniclers attested that copper items, in particular, were important commodities of inter-regional and long distance trade and exchange throughout the Western Sahel region. For instance, the fourteenth century Arab author, Ibn Battuta, mentioned that camel caravans transported copper from “Takadda” (Azelik) to “Jawjawa” (Gao) and to other Sudanese regions (Levtzion & Hopkins 1981: 302). The nature and origin of this trade are poorly understood, however. Additionally, little is known concerning the development of these trade items during the early Gao kingdom.

Insoll (1996: 63, 78) recovered eight iron and six copper-based artifacts in the course of his excavations at the tell of Gao Saney. He also reported the surface finds of 125 copper-based crescents by both Alastair Lamb in 1971 and himself in 1993 (Insoll

1996: 77). Because of their regular shape, Insoll (1996: 77) suggests that these were likely used as currency. Should these be shown to assort into standardized size and/or weight categories, this idea will have robust support. Nearly all the crescents recovered from excavation are fragmentary, however, making it difficult to assess the degree of standardization.

This chapter discusses the iron and copper-based artifacts and evidence for production activities recovered during the excavations at Gao Saney in 2001-02 and 2009. Over 240 iron artifacts weighing 1.5 kilograms and over 800 copper-based items weighing nearly 750g were recovered in ACGS, GS1 and GS3. In addition to these artifacts, considerable quantities of manufacturing debris (over twenty kilograms of iron slag, melted iron and copper, crucibles and crucible fragments) were recovered, providing evidence of production activities. This is an unusually rich metallurgical assemblage in comparison with other Niger River archaeological sites. These materials are described below. Compositional analysis, including lead isotope analysis, have only been done on a handful of the copper artifacts (Appendix IV), but a large number of copper objects and crucibles are in the hands of Tom Fenn, who is responsible for the analysis. The six analyzed artifacts include a variety of forms: crescents, wire, and a sheet fragment. All are unalloyed copper (Fenn 2011 in Appendix IV). The growing comparative database on copper artifact composition and lead isotopes permits important insights into source areas, trade networks and secondary processing. Ultimately, this analysis will help to reconstruct early inter-regional or long distance trade connections between Gao Saney -- as a destination for raw material, a center for secondary processing, and a major consumption site by elites -- and other West and North African sites.

METHODS

After recovery from excavation or screening through 0.5 cm mesh, metals were placed in plastic bags labeled with the contextual information (site name, excavation unit, level and level record number) and the date. Bag contents were first sorted into iron objects, copper objects, and manufacturing debris (melted iron and copper, crucibles and slag). For each provenience, copper and iron were counted and weighed. Small fragments <5mm were weighed only. Except iron slag, which was just weighed, all the other manufacturing debris (melted iron and copper lumps) from the same level was counted and weighed. In addition, crucibles were measured and described.

Contextually or chronologically related level were again grouped (see Table 6.7) for the purposes of analysis and reporting on frequency distributions.

COPPER

Of the 809 copper-based artifacts recovered, over 400 were crescent fragments of fragments (curved objects flat to sub ovoid in cross-section with tapering ends – Fig. 8.1). Fifty-four additional pieces were identifiable in form, and included rings, wires, vessel fragments, rods, nails, and bells (Figure 8.2; Table 8.1). The remaining 350 pieces were unidentifiable fragments and bits of copper sheet (Figure 8.3). The distribution of copper by weight in the various levels groups is presented in Figure 8.4.

Table 8.1. Identifiable copper objects

Unit	Lvl/ Feat	LRF	SF #	Description	Qty	Wt (g)	Length (mm)	Diam (mm)	Thick (mm)	ID # for analyzed samples	Observation
ACGS	1	1	SF 295	Wire fragment	2	1	12				
	1	1	SF 296	Vessel fragment	1	2	24.2	12.2			Beaded fragments
	3	3	SF 309	Ring	1	2		22.3	2		
	3	3	SF 310	Copper rod	1	1	17.9	5.9			
	5	5	SF 311	Rod	1	7	47.7	7.2			
	10	14	SF 315	Nail	1	3	30.9	4.4			
	13	17	SF 321	Ring	1	3		37.7	2.4		Earring; Copper traces washed
	15	19	SF 331	Ring fragment	2	1		11.2	2.1		
	18	22	SF 347	Ring	1	2		13.4	2.3		Possible earring
	19	26	SF 353	Ring fragment	1	9		32.6	6		
	26	33	SF 372	Bell	1	14	60	Head: 17.3; body 18.1	Body thick: 2.4; head thick: 2.6		Part of the bell is broken. The head is circular
Total					26	55. 1					
GS1	Surf		SF 382	Ring	1	1		4.1	3.6		Earring
	Surf		SF 383	Rod /nail	2	14	Rod: 26.6; Nail: 14.17.4		Rod 8.9; Nail: 4.3		
	4	9	SF 387	Copper wires	2	1	35.3 & 20.2		2		
	5	11 & 12	SF 389	Hook fragment	2	0.4				GS1-6-2	
	5	11 & 12	SF 390	Wire fragment	1	0.3				GS1-6-3	
	5	11 & 12	SF 391	Ring fragm	1	0.5		10	3	GS1-6-4	
	5	11 & 12	SF 392	disc	1	0.2		8.5		GS1-6-5	
	5	11 & 12	SF 393	Vessel rim fragment	1	0.6	11.7	13.2	2.1	GS1-6-6	Simple rim fragment
	5	11 & 12	SF 418	Ring fragment	1	0.5				GS1-6- 31	
GS1	Feat 1		SF 438	Wire fragment	1	0.1				GS1-7-4	
	7	16	SF 447	Wire fragment	1	0.1				GS1-9- 35	
	7	17	SF 453	Wire fragments	2	1	17.8 & 25.7	2.2		GS0060 (10)	

	8	18 & 20	SF 464	Wire fragments	2	6	Max. 36.8	Max. 4.9		GS1-10-(26-27)	
	9	19	SF 469	Wire fragments	2	0.2				GS1-12-(15-16)	
	10	22	SF 477	Weight	1	0.8	11.2	8.8	3.8	GS0063 (13)	
	12	29	SF 490	Wire fragment	1	1				GS1-17-15	
	12	30	SF 494	Bracelet fragment	1	3	34.9	5.3		GS1-17-3	
Total					23	30.7					
GS3	Feat 2		SF 504	Wire fragment	2	3					
	10	16	SF 505	Nail fragment	1	4	40.1	Shaft: 5.8; head: 12.8			Head oval shape
	11	17	SF 508	Wire fragment	2	1					
	12	18-22	SF 509	Bell with wire	1	4	Bell: 26.6	13			Wire attached to a bell
	12	18-22	SF 510	Pendant	1	2	21.5	12.3			The two ends are circular and pierced in the middle.
	12	18-22	SF 511	Wire fragment	1	1					
	16	26	SF 521	Ring fragment	1	0.2	12.8	8.2	3.5		
	16	26	SF 522	Virole	1	0.4		9	2.8		
Total					11	16.2					

IRON

Most of the 1500+ grams of iron recovered was a corroded and fragmentary state. Only 32 iron objects were identifiable (Table 8.2); these included nails, bracelets, pendants, ring, spikes, hooks, and wires (Figure 8.5). Notable among the iron objects were two pendants (Figure 8.6) from GS3 (Upper level group). These accounted for one-third of the identifiable iron by weight. The weight distribution of iron within the level groups of the excavated units is provided in Figure 8.7.

Table 8.2. Identifiable iron objects

Unit	Lvl/ Feat	LRF	SF #	Descript.	Qty	Wt (g)	Length (mm)	Width (mm)	Diam	Thick (mm)	Observation
ACGS	Surf		SF 122	Nail	1	2.5	46.7		5.5	5	
	2	2	SF 123	Nail	2	6.1	34	Max: 15	6.5		One has head width 15 mm
	2	2	SF 124	Bracelet fragm.	2	12			57.8	4.7	
	3	3	SF 125	Nail	1	30	122		9.6		Head width: 12.4 mm
	5	5	SF 126	Nail	1	2	33.8		5.7		Head width: 12.8 mm
	7	7	SF 127	Nail	2	8	38.5		10		half curved
	7	9	SF 128	hook fragm.	1	6	50.1	14.5		4	deep channel inside the hook
	8	8	SF 129	Bracelet fragm.	1	7					
	9	12	SF 130	Nail	2	16	Max: 67.3		Max: 14		
	10	14	SF 131	Nail	3	11	Max 66.5		10		1 with end slightly curved
	13	17	SF 132	Blade	2	30	90	14.6		5.9	
	13	17	SF 133	Spike	1	32	61.7	21.8			
	14	18	SF 134	Hook	1	12	50.7	17.8		2.5	
	26	33	SF 135	Spike	1	24	85.2		12.8		
	26	33	SF 136	Nail/ wire	1	12	116.3		6.9		
GS1	5	11	SF 140	Ring	1	2					
	6	14	SF 137	Nail	1	5.6	39.4		8.6		
	6	14	SF 138	Nail	1	12	63		8.1		
	7	15	SF 141	Nail	2	2					
	10	26	SF 139	Nail	1	3.3	29.5		6.9		
GS3	8	13	SF 142	Bracelet	1	4					
	12	22	SF 144	Iron pendant	2	35 0	175		Diam of rings: 30 &45	12	Each of the two pendants have two rings (one small and one big) connected each other with one annular ring.
	14	24	SF 145	Nail	1	1					
Total					32	59 0.5					

METALLURGICAL DEBRIS

Evidence for metallurgical production included over eighteen kilograms of iron slag, 1.8 kilograms of melted copper and iron, and over 170 clay crucibles. Most of this evidence was concentrated in the top ten levels of ACGS in a trash pit context: 146 crucibles, 9.9 kg of slag, and 650 kg of melted metal. Iron slag also occurred in nearby unit GSI (Figure 8.8). The large number of small crucibles with greenish vitrified residues recovered from the upper level trash deposits suggests that smiths were engaged in melting and casting copper in this area of the site (Figure 8.9; Table 8.3). Melted iron and copper are more widely occurring throughout the deposits, with a clear concentration in the upper ACGS trash deposits (Figures 8.10, 8.11, 8.12).

Table 8.3. Clay crucibles

Unit	Lvl	LRF	SF #	Object	Wt (g)	Qty	Base thick (mm)	Diam	Height (mm)	Observation
ACGS	1	1	SF 195	Crucible fragments	23	6				
	1	1	SF 196	Crucibles	78	16				4 slagged crucible fragments
	2	2	SF 197	Crucible fragments	160	50				
	2	2	SF 198	Crucibles	40	2		35	50	2 entire crucibles
	2	2	SF 199	Crucible fragments	20	6				
	3	3	SF 199	Crucibles	48	3	8.7	Max: 25	35	Diam: 23-25
	3	3	SF 200	Crucible	34	1	16.1	43.8	46.7	Copper trace in the interior
	3	3	SF 201	Crucibles	36	2	7.3	Max: 43	41	1 with Copper trace in the interior. Presence of several slagged crucible fragments
	3	3	SF 202	Crucibles	84	8	Max: 7.4	30	Max: 34	All have Copper trace in the interior
	3	3	SF 203	Crucible fragments	142	38				
	5	5	SF 204	Crucible fragments	100	9				
	5	5	SF 205	Crucibles	50	4				
	8	8	SF 206	Crucible fragments	30	1	10.5	42.6		External surface vitrified and presence of red traces
	11	15	SF 207	Crucible fragments	10	3	5.8			
Total					855	149				

GS1	1	3	SF 208	crucible	10	2				
	1	3	SF 209	Crucible fragments	8	2				Crucibles for copper melting/casting; three basal fragments (one in two pieces recent break), and one heavily slagged crucibles
	2	5	SF 210	Crucible fragments	100	12				4 crucible fragments, heavily slagged; 5 pieces of indeterminate ceramic/crucibles/metallurgical slag
	2	6	SF 211	crucibles	25	2				
	2	4 and 5	SF 212	Crucibles	32	6				
	7	15	SF 213	crucible	4	1				
	12	30	SF 214	Crucible fragments	10	2				One with copper trace inside and vitrified trace outside
Total					189	27				

OVERVIEW OF THE METAL ASSEMBLAGE

We have noted the presence of iron and copper-based artifacts from the earliest deposits of all the three excavated units, with the peak in the upper levels. Some of the copper is unalloyed, including four analyzed crescents. Most of the identifiable iron and copper-based objects have been recovered from trash pits and the fill deposits associated with the various mud brick and banco brick structures. The two iron pendants and one copper pendant fragment and bell with wire in the GS3 Level 12 fill deposits are associated with two earthen oil lamps and a cluster of many long necked jars (Feature 6) dated to 1126 ± 44 BP (Cal AD 780 –1000).

The presence of substantial amounts of metallurgical debris including iron slag, crucibles, melted copper and iron (particularly in the deposits of the two northeastern periphery units ACGS and GS1) suggests the presence of smithing in the vicinity, but it is not possible to say whether it was household or workshop-based.



Figure 8.1. Sample of crescent copper fragments from the excavated units at Gao Saney



Figure 8.2: Sample of identifiable copper artifacts



Figure 8.3. Sample of unidentifiable copper objects from the excavated units at Gao Saney

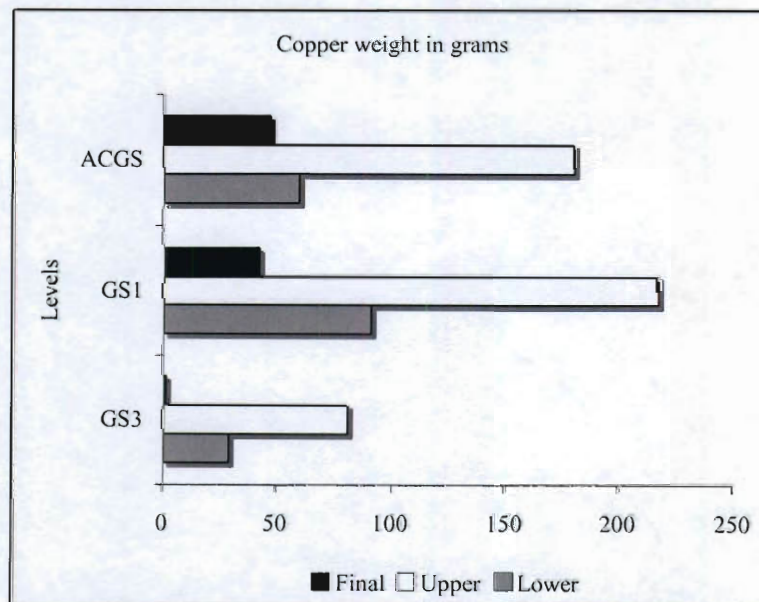


Figure 8.4. Weight of identifiable and unidentifiable copper-based artifacts from Gao Saney excavated units



Figure 8.5. Sample of identifiable iron objects from the excavated units of Gao Saney

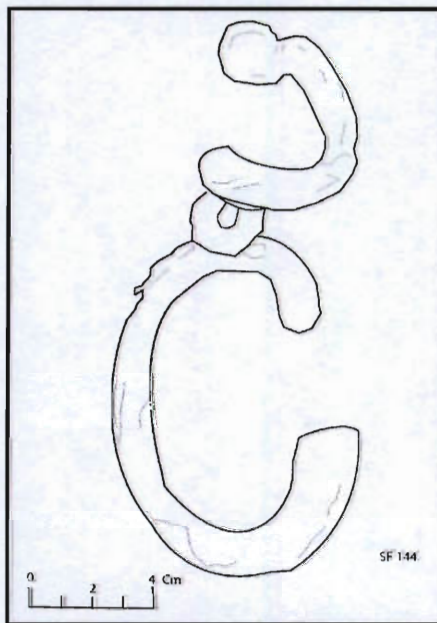


Figure 8.6. Pendant from the GS3 deposits

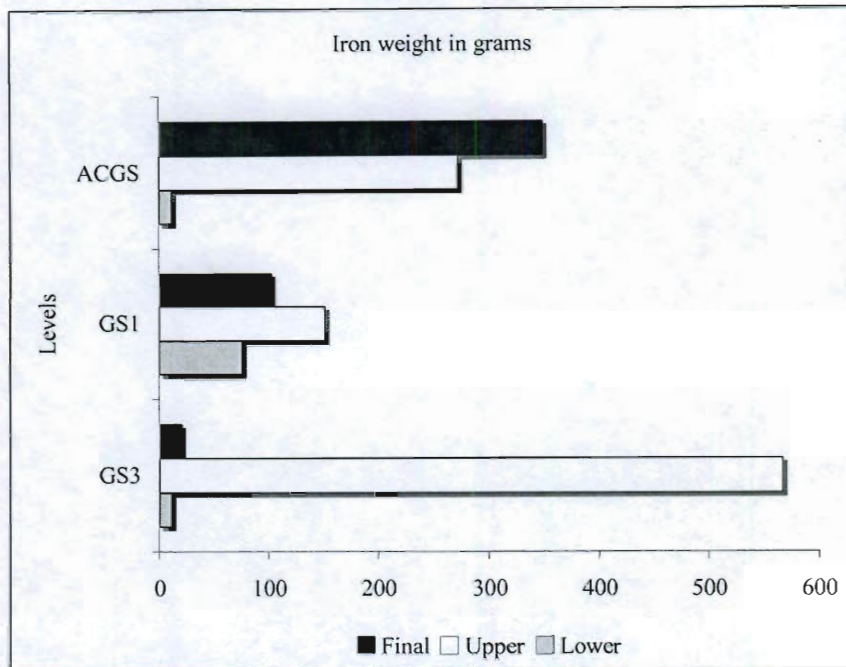


Figure 8.7. Weight of identifiable and unidentifiable iron from Gao Saney excavated units.

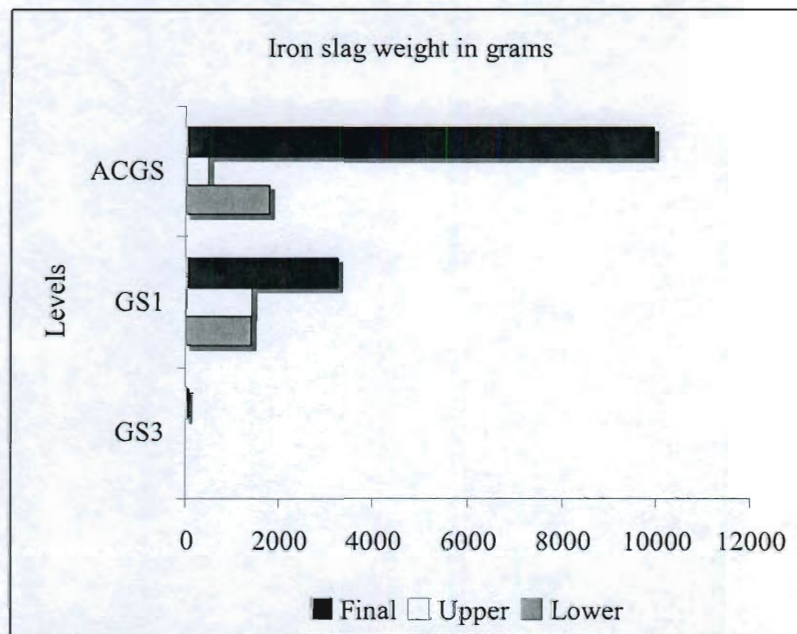


Figure 8.8. Iron slag weight from the Gao Saney excavated units

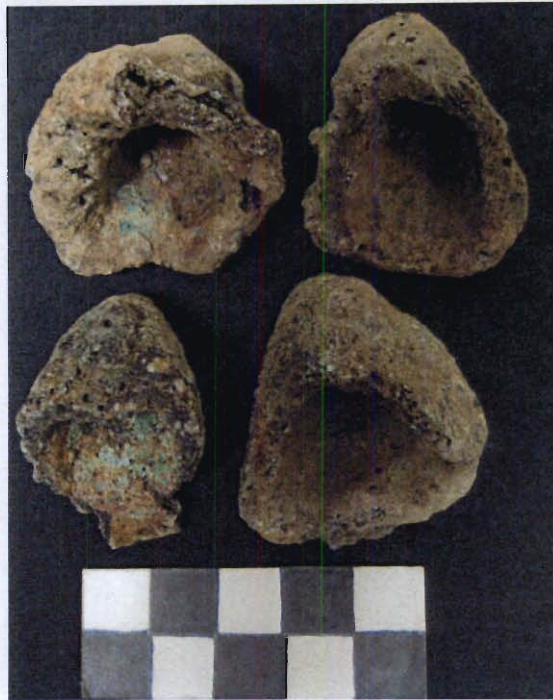


Figure 8.9. Sample of the recovered Gao Saney crucibles

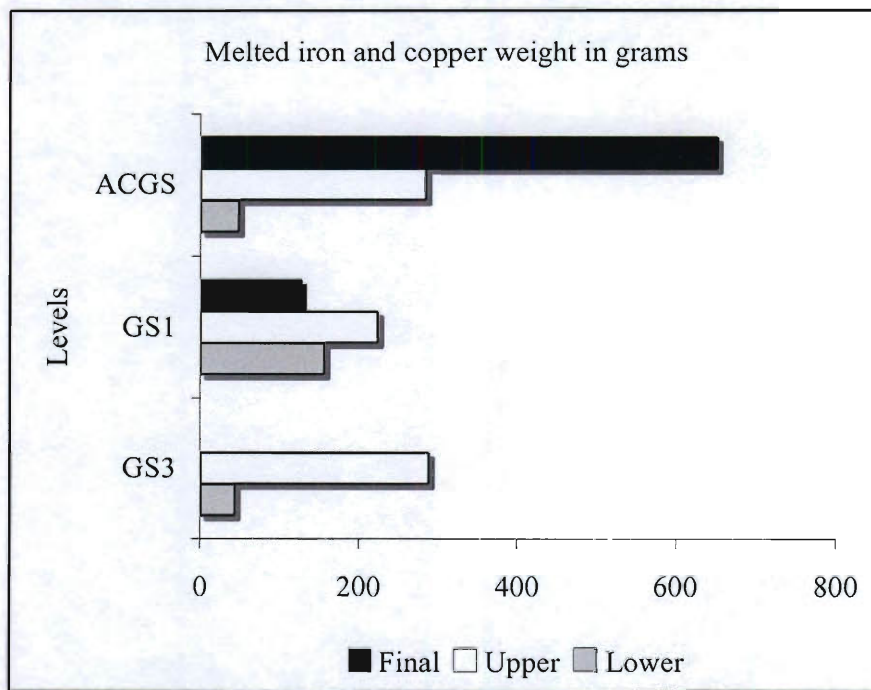


Figure 8.10. Frequency of melted iron and copper from the Gao Saney excavated units



Figure 8.11. Gao Saney iron manufacturing debris



Figure 8.12. Gao Saney copper manufacturing debris.

Chapter 9

OTHER SMALL FINDS: CERAMIC, STONE AND BONE ARTIFACTS

Numerous other small finds were recovered in the course of the various excavations at Gao Saney. They include ceramic, faience, bone and stone beads, spindle whorls, cowries, curved bone fragments, ostrich egg and shell fragments and other stone artifacts such as projectile points, debitage, flakes and grinding stones.

BEADS

Ceramic and Faience

A total of 265 ceramic beads were recovered and recorded in terms of their provenience and shape. Beads having the same shape were grouped, counted, weighed and recorded for each descriptive level. Frequencies are reported by stratigraphic level groups as in previous chapters (Figure 9.1). The bead shapes recognized at Gao Saney were segmented, bicone/ellipsoid, oblate/cylinder/sphere and tube (Figures 9.2). Segmented beads are the most common in the assemblage (nearly 70%) followed by bicone/ellipsoid and oblate/cylinder/sphere (over 25%). Tubular beads are rare (Figure 9.3).

These various ceramic bead shapes were also recognized at many sites throughout West Africa. Segmented ceramic beads (the dominant form in the Gao Saney assemblage) were also found at Gao Ancien, Gadei, Kissi and Azelik (Insoll 1996: 104,

128; 2000: 100-102, Magnavita 2003: 28; Bernus & Cressier 1991). At Kissi, many of the segmented beads were recovered from settlement zones (Magnavita 2003: 28). These segmented beads are an unusual form that likely copies glass bead prototypes obtained through long distance trade from North Africa (Insoll 2000: 102). Cylindrical, elliptical, sphere and tubular beads have been found, in addition to the sites mentioned above, at Jenne-jeno, Dia, Koumbi Saleh and Tegdaoust (McIntosh 1995: 216; Berthier 1997: 92; Arazi 2005: 284; Vanacker 1979: 168). Ten blue-glazed faience beads were recovered (Figure 9.4), eight in the Final trash levels of ACGS (Levels 1-3) and GS1 (Level 2); the remaining two beads were found in levels 11 and 12 of GS3.

Bone and Stone

The remainder of the bead assemblage consists of 38 small annular bone beads (Figure 9.5) and 21 semi-precious stone beads (Figure 9.6). Tubular beads are the most common (2/3 of the stone bead assemblage). Bicone/ellipsoid and oblate/cylinder are also present. Except for one black and white bead, all the recognized stone beads were red carnelian (Figure 9.7). All of them are opaque and fine textured beads. Carnelian beads were recovered at many sites throughout West Africa: Gao Ancien, Es-Souk, Dia, Igbo-Ukwu and Koumbi Saleh (Insoll 1996: 67; Nixon 2007: 299; Arazi 2005: 293; Shaw 1970: 237-238; Berthier 1997).

No chemical analysis on Gao carnelian beads was undertaken. Insoll (1996: 67) noted among the carnelian bead samples he recovered during the analysis the presence of both locally made carnelian beads and imported beads through long distance trade connections. According to him, the local production type is characterized by its simpler crudely-worked form while the “exotic” imported carnelian beads have fine texture

(Insoll 1996: 67). The existence of local production of these semi-precious items is based on the presence of one of the carnelian sources at 50 km north of Kidal in the Adrar des Iforas (Gaussen and Gaussen 1988:127), and also the recovery at the sites of numerous carnelian fragments which can be used to make beads. However, the close visual observation of the carnelian beads recovered from Gao Saney show that they are fine textured and well made suggesting their probable acquisition through long distance trade. The town of Cumbay (India), which is one of the major centers for carnelian bead production during the first millennium, could possibly be one of the suppliers for Gao through Egypt (Insoll 1996: 67; Nixon 2007: 299). There is also a possibility that beads could come from Egypt itself, which is one of the most cited sources for carnelian in sub-Saharan Africa (Insoll 1996: 67, Nixon 2007: 299; Arazi 2005: 293). However, only compositional analysis of samples of Gao carnelian beads can help to determine their source areas.

SPINDLE WHORLS

Three spindle whorls were recovered in the Final trash pit layers of ACGS (Level 1) and GS1 (Level 2) and also in the Upper trash fill deposit (Level 18) of the Feature 3 banco brick structure of ACGS (Figure 9.8). Spindle whorls are commonly found at West African sites from the ninth-tenth century onward (McIntosh 1995: 216; Berthier 1997: 92-93; Arazi 2005: 282; Togola 2008: 41; Cisse et al. 2007: 195; Insoll 2000: 128-129; Robert-Chaleix 1983: 449, 453). Spindle whorls were used for cotton working particularly spinning and weaving. According to Mauny (1961: 39), the widespread use of spindle whorls was the result of contact with North African traders.

COWRIE SHELLS

Four cowrie shells were recovered from upper levels of ACGS and GS1. All appear to be *Cypraea moneta* given the presence of bumps at the extremities of the Gao Saney four specimens (Figure 9.9). This is based on the expert observation of Es-Souk cowrie shells by Professor Ken Thomas (Nixon 2007: 322) who sees the bumps at the extremities of as a distinctive marker of *Cypraea moneta*.

Cowrie shells have been found at many West African first millennium archaeological sites. In addition to Gao Saney, cowrie shells were also found in Gao region at Gao Ancien and the site of Koima (Insoll 1996: 71). In the Mema region, these items were recovered at Akumbu in the grave context dating to between AD 600-800 (Togola 2008: 42). At Kissi, cowrie shells were also recovered in a tomb, dated to 445-653 cal AD (Magnavita et al. 2002: 33-34, 38). Additionally, cowrie shells were found throughout the Western Sahel during the early second millennium. They were identified at Koumbi Saleh (Thomassey and Mauny 1951: 451), Tegdaoust (Devisse et al. 1983), El-Oualadji (Desplagnes 1951: 1172; Mauny 1961: 97-98). At Es-Souk, numerous cowries were recovered in the deposits dated c.950-1200 (Nixon 2007: 322). Theodore Monod (1969: 309-10) has found thousands of cowries at the lost twelfth century caravan site in the Ijafen dunes (Monod 1969: 310).

Trade in cowrie shells and their use in Western Sudan have been mentioned in many Arabic sources. In the mid-eleventh century, Al-Bakri notes that cowries shells were imported into the town of Kuga, located West of Ghana, however, he does not specify their use. Al-Umari (fourteenth century AD) mentions that the merchants traveling from Sijilmasa to the Ghana Empire carried cargoes of cowries along with

copper, figs and salt. He also notes that “ all internal business transactions “ in the Mali Empire are “in cowries imported by the merchants at a considerable profit” (Levtzion and Hopkins 1981). IBn Battuta witnessed at first hand the use of cowrie shells as money in West Africa (Hogendorn and Johnson 1986: 9). *Cypraea moneta*, originated from the Maldive Islands, seems to have been one of the earliest species to enter in West Africa through long distance trade (Mauny 1961). Hogendorn and Johnson (1986: 9) suggest that the smaller and standardized size of the maldives *moneta* shells seems to be an important factor for their use as trade items because greater numbers could be easily shipped for less weight.

OTHER BONE AND SHELL ARTIFACTS

Worked curved bone fragments. Five very small, worked and polished curved bone pieces were found in the ACGS midden deposits (Levels 3 and 16). (Figure 9.10).

Ostrich egg fragments. Around 10g of ostrich eggshell fragments were recovered throughout the deposits of ACGS and GS1 (Figure 9.11). Ostrich bones were present in the faunal remains analyzed by A.C. Smith, suggesting that the shell was available locally.

Shell fragments. Over 28g of gastropod and mollusk shell fragments were recovered throughout the ACGS deposits, but they were too fragmentary for species identification (Figure 9.12).

STONE ARTIFACTS OTHER THAN BEADS

A total of 78 other stone artifacts weighing over 572g were recovered. They include carnelian stone-working debitage, flakes, a projectile point and grinding stones.

Projectile point. A single projectile point was recognized in the midden final deposits of ACGS (Fig. 9.13). This is a bifacial stemmed point with extensive retouch. During the survey in the vicinity of Gao, numerous points were found (Togola et al. 2004a & b; Manning 2008: 195-201). It is likely that this bifacial point was collected from one of Late Stone sites located probably in the vicinity of Gao.

Debitage. Stone debitage consist of waste fragments showing no signs of utilization. Numerous broken peaces of carnelian weighing 16g were recovered (Figure 9.14). Although there is no evidence of unfinished or simpler crudely-worked carnelian beads, the presence of these fragments is an argument for the possible manufacturing activity of carnelian at Gao Saney. In addition to carnelian debitage, other waste stones, commonly made with quartz, were recovered in the course of excavations.

Flakes. A total of 15 flakes weighing 54g were found in the midden deposits of the Final levels and the accumulations of the various structures of the Upper depositional contexts (Figure 9.15).

Grinding Stones (2) of granite were recovered (Figure 9.16).

In sum, the presence of carnelian and other semi-precious stones artifact plus cowrie shells are another indicator of the regional and long distance exchange in which Gao was involved. The presence of carnelian debitage may indicate that beads were being fashioned on site from imported raw material.

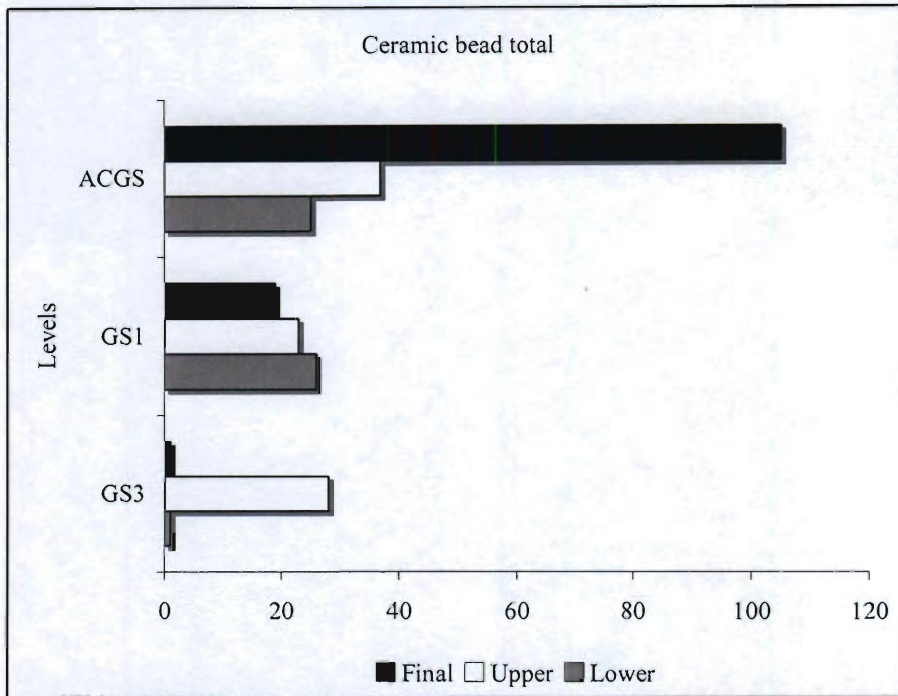


Figure 9.1. Ceramic bead counts in the Gao Saney excavated units



Figure 9.2. Sample of Gao Saney ceramic bead assemblage

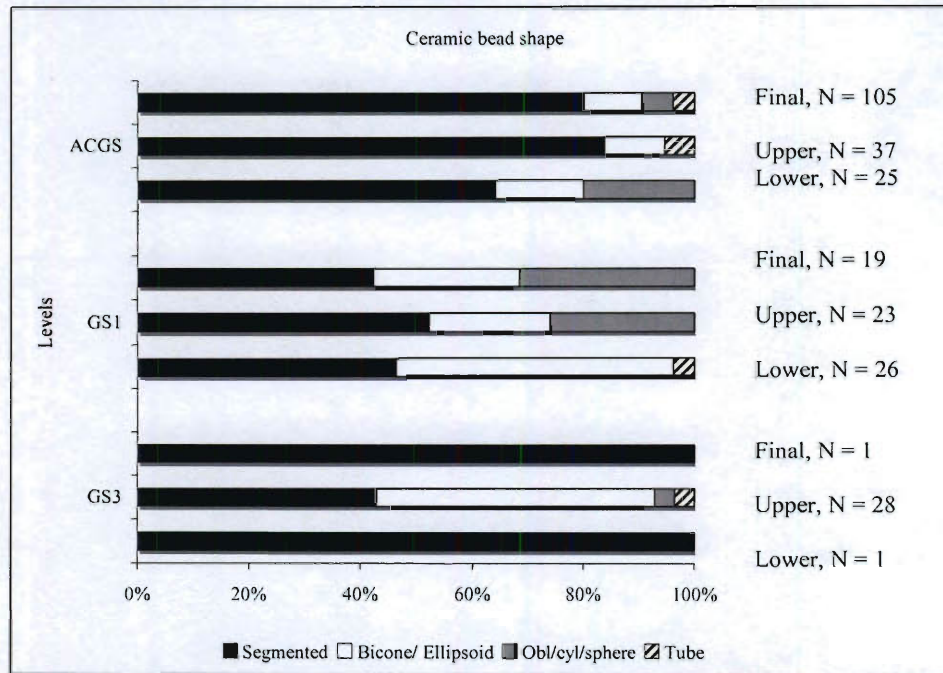


Figure 9.3. Frequency of ceramic bead shapes in the Gao Saney excavated units by level groups



Figure 9.4. Sample of faience beads from the excavated units (Upper left: SF 623 [GS3]; Middle SF 618 [ACGS]; right SF 619a [GS1]; Bottom left: SF 619b [GS1]; Middle: SF 616a [ACGS]; right: SF 616b [ACGS]).

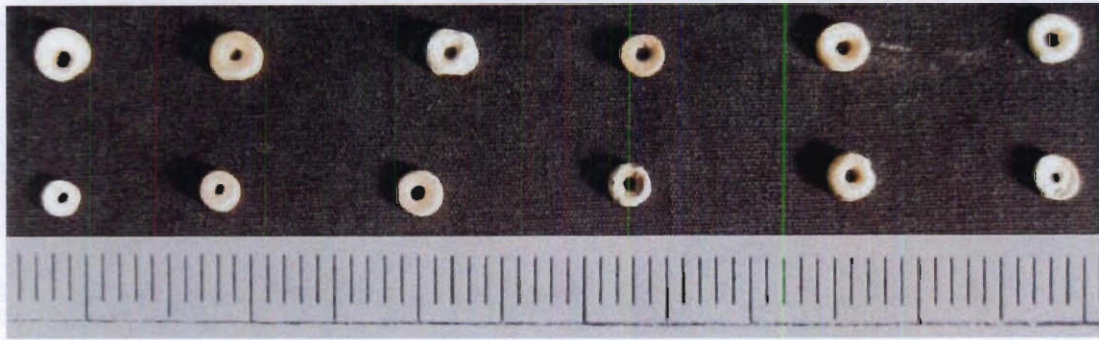


Figure 9.5. Samples of Gao Saney bone beads

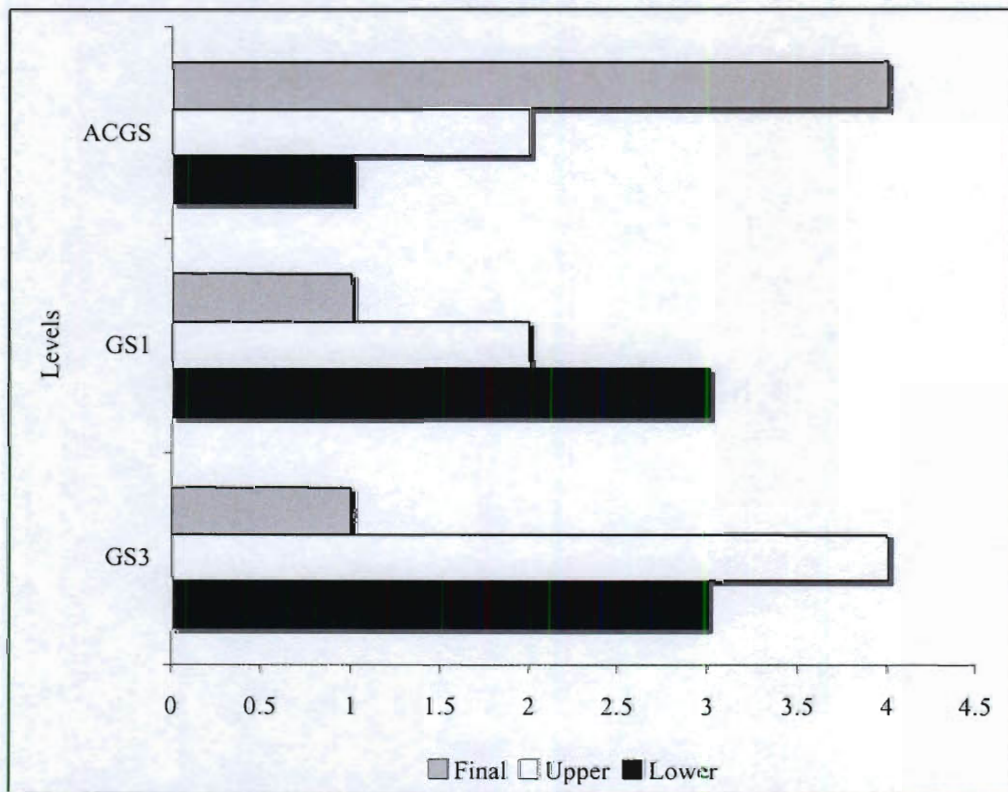


Figure 9.6. Semi-precious stone bead counts

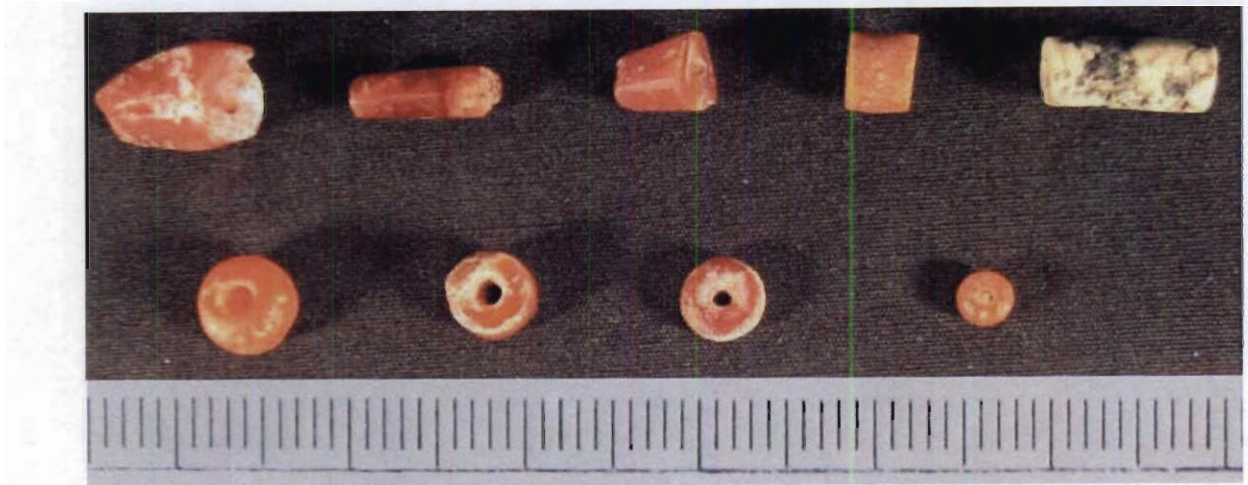


Figure 9.7. Semi-precious stone beads from Gao Saney



Figure 9.8. Spindle whorls recovered at Gao Saney (Upper left: SF 626 [ACGS]; right: SF 627 [ACGS]; bottom: SF 628 [GS1])



Figure 9.9. Cowrie shells from Gao Saney



Figure 9.10. Samples of curved bone fragments



Figure 9.11. Samples of ostrich egg fragments



Figure 9.12. Samples of shell fragments



Figure 9.13. Projectile point from the ACGS unit



Figure 9. 14. Samples of carnelian debitage from Gao Saney

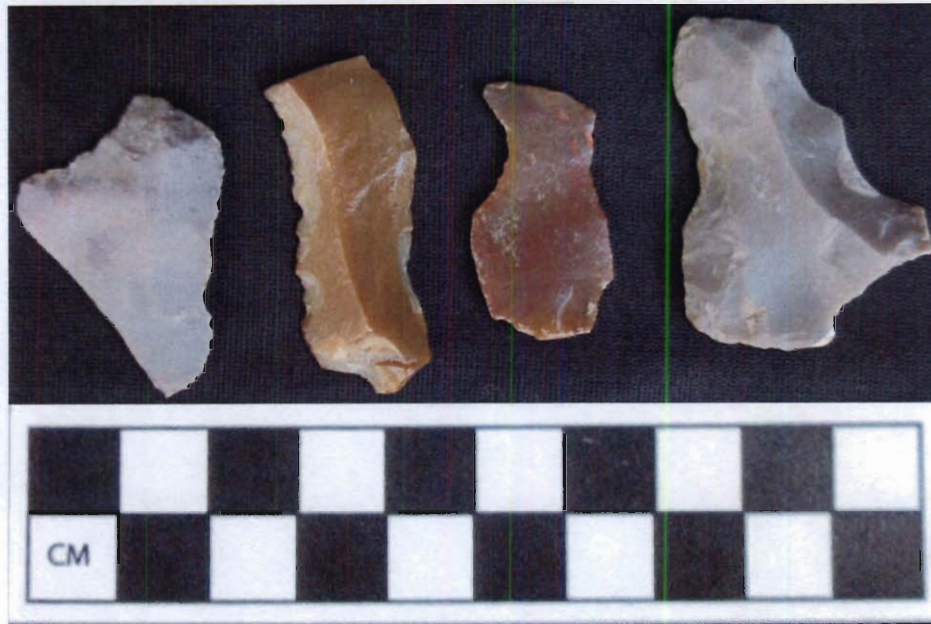


Figure 9.15. Samples of flakes from Gao Saney



Figure 9.16. Circular granite stone with big hole and grinding stones from Gao Saney

Chapter 10

CONCLUSION

The previous chapters in this dissertation have laid out the methods of data recovery and many of the essential elements of the evidence on which higher-level interpretations and conclusions can be developed. In this chapter, these conclusions begin at the level of the site of Gao Saney itself, reviewing the occupation sequence and nature and chronology of the deposits and the evidence for domestic, consumption, and production activities. The evidence for the subsistence economy provided by specialist analyses will be summarized.

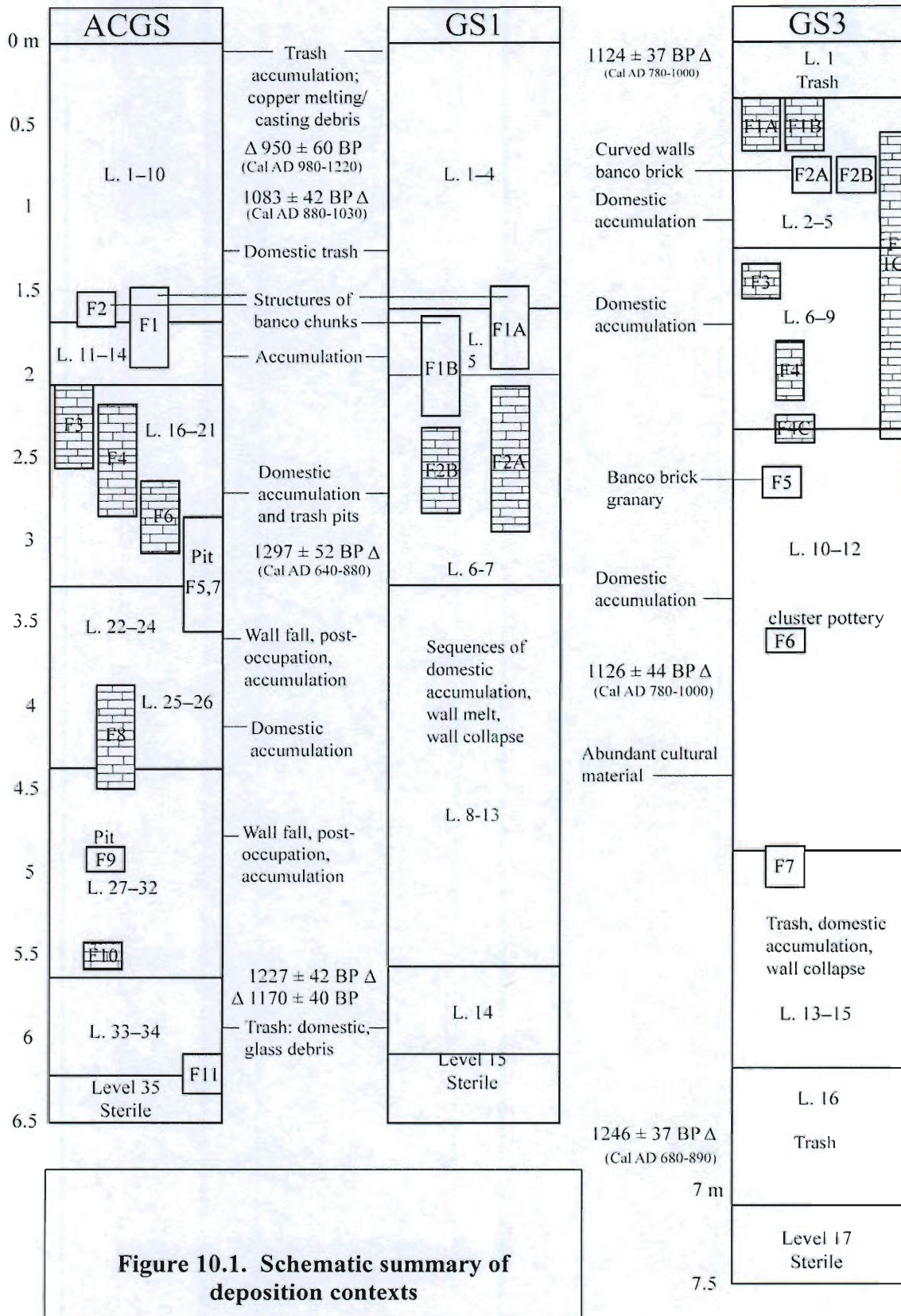
GAO-SANEY: AN OVERVIEW OF OCCUPATION AND SITE DEVELOPMENT

Site Formation

The lowest levels of all three excavated units indicate initial occupation in the eighth-ninth century A.D. This chronology is earlier than anticipated. These early deposits are all trash accumulations and pits, indicating that domestic contexts must be nearby (Figure 10.1). The adjacent northwest periphery units (ACGS, GS1) have significant glass-bead melting and processing debris in these earliest trash deposits. There is no evidence for this activity in the early GS3 trash level. We do not, however, have direct evidence for domestic structures until rectilinear mud brick structures appear 0.5–1.0 meter above

sterile. The next four meters of deposits in ACGS and GS1 consist of three sequences of rectilinear wall construction with rectangular mud bricks, occupation accumulations, wall fall and post-occupation trash accumulation, followed by structural remains fashioned of shapeless banco chunks, which may be quarried/salvaged from earlier wall fall. These are associated with low density cultural accumulation. This final construction sequence is separated from the earlier mud brick structural sequences by a thin, largely sterile layer of red sand. The final depositional event in these northwest periphery units is accumulation of 1.5 meters of trash containing abundant metallurgical and domestic debris. Radiocarbon dates indicate that the entire six-meter sequence accumulated very rapidly between c. AD 700 and 1100. Rapid mound accumulation of this type is also found in the first millennium AD – a wetter period – in the Lakes Region (Raimbault and Sanogo 1991) and the Mema (Togola 2008).

Three hundred meters away, in GS3, the same time period is represented, with wall material, domestic accumulation and structures of banco brick and rectangular mud brick extending for almost six meters after the initial trash accumulation. The final depositional event is a 0.5 meter accumulation of trash. The simultaneous development of these two widely separated areas – northwest and center west portions of the main mound – is evidence for the urbanizing character of Gao Saney from its earliest settlement.



Subsistence Economy

Summary of paleobotanical remains

Flotation samples collected from all levels at Gao Saney were analyzed by Daphne Gallagher using a low power binocular microscope for seeds, fruits, and other identifiable elements, most of which were carbonized. (Appendix V). There was some calcified grain chaff, likely from *Oryza* sp. Pearl millet (*Pennisetum glaucum*) is the major staple grain present, and it is found throughout the deposits of the unit (Table 10.1). No carbonized rice (*Oryza* sp.) was found; rice chaff occurred in only three contexts. The lack of rice in the ACGS deposits is very intriguing, as it is a staple in the region today. Rice grains were found in the putative granary structure in the Level 12 deposits of GS3; samples were not taken, but the identification is secure. Flotation was not undertaken in 2001-2. More excavation and systematic flotation will help reveal the pattern of grain processing and consumption at Gao Saney.

In addition to pearl millet, a large number of economically useful plants were recognized in the analyzed sample, including baobab (*Adansonia digitata*), desert date (*Balanites aegyptiaca*) (in the upper levels), and also *Grewia* sp. (Tiliaceae) throughout the deposits. These plants and also the seeds of Leguminosae occur as part of a diversified subsistence economy that also included wild species: *Ceratotheca sesamoides* (Pedaliaceae), *Cleome* sp. (Capparaceae), *Ziziphus* sp. (jujube/Christ's thorn), Paniceae, various (Graminae), *Portulaca oleracea* (purslane) (see Appendix VI). Some of the Graminae may have been fodder plants for sheep and goats that may have been tethered near houses.

Summary of Faunal Identifications

Over 50 kilograms of faunal remains were recovered from ACGS and analyzed by Abigail Chipps Smith (Department of Anthropology, Washington University in St. Louis – **Appendix V**). Domestic cattle, sheep and goat dominate the assemblage throughout, with faunal numbers especially high in the trash deposits of the middle and upper levels. The large bovids are likely to be cattle, and the medium bovids, caprines. Six camel bones were recovered from the middle deposits, an interesting finding because of the connection between camels and Berber pastoralists who are claimed by oral tradition to have played an important role in the development of the city of Gao Saney (Hunwick 1999: xxxv-xxxvi).

Table 10.2. Summary of taxa identified in the Gao Saney faunal assemblage

TAXA	1-10		11-26		27-34		TOTALS	
	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI
Wild Bovids	2	2	13	6	0	0	15	8
Domestic Cattle	19	6	20	14	6	7	45	27
	113	18	125	46	29	15	267	79
	0	0	6	6	0	0	6	6
Large Bovids	157	24	256	70	68	24	481	118
Medium Bovids	465	20	517	54	86	14	1068	88
Small Bovids	33	7	33	13	1	1	67	21
Equidae	0	0	1	1	0	0	1	1
Carnavora	3	2	15	9	0	0	18	11
Rodentia	0	0	1	1	0	0	1	1
	45	4	37	11	5	4	87	19
Aves	26	6	16	10	2	1	44	17

The presence in great quantity of domestic bovids from the Gao Saney assemblage is consistent with the earlier analysis of some Gao faunal samples by Chester Cain (2009) from Washington University, St. Louis. Fish were not very common at in these deposits. This may seem surprising in view of the hypothesis that the Wadi Gangaber was flowing and connected to the Niger for at least part of year during the wetter climatic conditions that prevailed c. AD 700 –1000 (McIntosh 1998: 70 and 72; Insoll 1997: 12). The scarcity of fish and other aquatic remains in the course of excavations suggests that, possibly, the site was not occupied by fishermen. Alternatively, it may be due to sample bias, or the consumption preferences of the inhabitants.

The typical Sahelian species *Hippotragus equinus* and *Gazella dorcus* were also recovered in the course of various excavations at Gao Ancien and Gadei and other West African sites including Es-Souk (Insoll 2000: 49-54; Nixon 2007: 350).

Overview of subsistence economy

The subsistence economy data (botanical and faunal remains) recovered from the excavated units at Gao Saney provide information for understanding the general economic picture and illuminate the issues of the consumption preferences. They provide a clue to understanding the kinds of animals and crops existing or consumed within the region. Fish and aquatic resources were minor elements in the ACGS deposits. In contrast, herding and millet farming appear to be the most consistent and dominant elements. Hunting is present on a small scale. Rice is present, but not well represented. Gao Saney is distant from the floodplain, however, so the immediate site catchment may

have been more suited to millet. Trade in staples especially by boat may have occurred if the Wadi Gangaber was navigable at this point in time, and herds may have been taken to local and regional markets.

Material Culture

Gao Saney pottery

The ceramic assemblage is remarkably stable throughout the sequence of all units excavated at Gao Saney. It is dominated to a remarkable degree by a single vessel form: organic-tempered jars with long (>5 cm), funnel-like everted rims decorated with broad parallel channels and often a combination of red slip, white and/or black paint. Black paint is commoner in the lower levels than the upper. There is another distinctive, but less common vessel type: small simple-rim bowls with fine paste, decorated with impressed comb in linear or geometric patterns and then slipped and burnished. Other forms are present, but these two are the most distinctive. A third paste group – well-consolidated with grog inclusions, is also found. This kind of diversity in paste raises the question of possible different sources for the pottery, or the presence of diverse potting communities. In order to explore this possibility in a very preliminary fashion, ten sherds (five organic-tempered, channeled and painted rims and five red-slipped, comb-impressed bowl rims) were analyzed by LA-ICP-MS by Laure Dussubieux of the Field Museum of Natural History. The sample size is too small to permit any conclusions, but the results do suggest that more than one compositional group may exist (Figure 10.2). They indicate that a larger program of analysis could be fruitful; large

samples of pottery and clay from different sources and sites will be necessary to build the comparative database that will allow substantive interpretations, however.

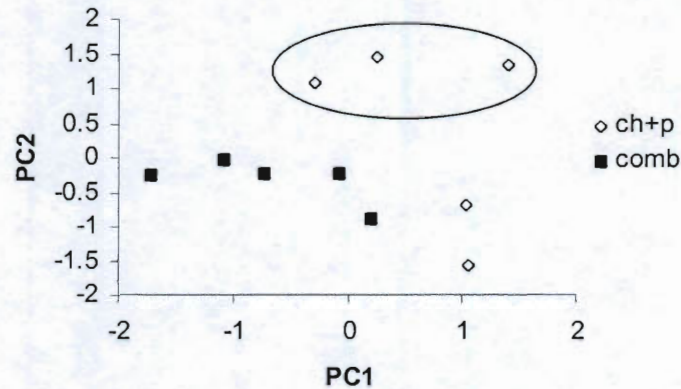


Figure 10.2. Principal component analysis including Ca, Mg, V, Sr, Zr, Ce, Pr, Y, Nd and Sm for the 10 ceramic samples. In the ellipse, GS489, GS482, GS466 (Dussubieux 2010).

The Gao Saney assemblage lies within the broad zone of first millennium AD polychrome pottery found along the Niger from the Inland Niger Delta (McIntosh 1995, Arazi 2005; Schmidt et al. 2005) and the Lakes region (Raimbault 1991), to Timbuktu (McIntosh and McIntosh 1986) and downriver past Gao to Ansongo and Bentia (Arazi 1999). Within this 'Niger River polychrome zone' (McIntosh and Cissé 2008), forms change from one region to another, but the dominance of red/black/white paint or paint and red slip combinations is a constant. Further away from the river, polychrome is present in the first millennium but relatively rare at Akumbu in the Mema (Togola 2008), Es-Souk (Nixon 2007), Oursi village and Kissi 3 in northern Burkina Faso (Magnavita et al. 2002: 44; Czerniewicz: 2004: 127-132) and in southwestern Niger (Vernet 1996).

The Gao assemblage is part of the *Niger Bend Eastern Polychrome zone*, where the assemblage of long, everted rims with channels and paint, plus slipped, burnished and comb-impressed bowls appears suddenly in the archaeological record, apparently replacing an earlier twine-impressed assemblage that is broadly similar at Bentia (Arazi 1997: Fig. 19), Gao Ancien (McIntosh and Cissé 2008) (Figure 10.3), and Timbuktu (S.K. McIntosh pers. comm.). This transition dates to between 650–770 AD at Tambouze 1, excavated just north of Timbuktu by Park (2011), where channeled everted rims almost identical to those at Gao appear in deposits directly above a twine-impressed assemblage dated to AD 430–650. Excavations at Gao Ancien likewise found the twine-impressed assemblage underlying the channeled rim assemblage (Cissé et al. 2007) present by the seventh-eighth century (McIntosh and Cissé 2008). The source area of this novel polychrome assemblage – which differs substantially from the earlier polychrome pottery of the Lakes region and Inland Niger Delta – is unknown. Pottery from contemporary sites presumed to be occupied by Berbers – Es-Souk, for example – is very different in form (large jars with strap handles) and decoration (mainly undecorated; paint is rare) from the Gao assemblage (Nixon 2007, 2009). Polychrome pottery is reported from Fezzan at Jarma and associated sites (Mattingly 2003: 229) but illustrated by only a small number of vessels and sherds, so we must wait to assess any potential similarities.

Metals at Gao Saney

In the metal assemblage at Gao Saney copper is as common as iron in most levels (Figures 8.4 and 8.7). This is unusual for West African sites. The assemblage has a

mixture of utilitarian and decorative copper items, and a dominance of unidentifiable, corroded iron. The most distinctive aspect of the copper is the large number of fragments of crescents, which Insoll believes to have functioned as currency.

Lead isotope analysis by LA-ICP-MS of four of the unalloyed copper crescents indicate that Tunisian ores from the Diapir zone seemed to be a strong match (Fenn 2011 in Appendix IV). Crescents come almost exclusively from household and domestic trash contexts in the Middle Level Groups of the excavation units. They are not particularly associated with the trash contexts at the top of ACGS and GS1 that have numerous crucibles for melting copper. The crucibles indicate that smiths were active at Gao Saney in the last phase of occupation on the northwest periphery. Molds have not been found, so it is not known what secondary products were being fashioned.

Iron slag is present as well, likely from smithing activities, since there is no ore source in the immediate vicinity. It has been suggested that Gao was supplied with iron from the north on the Niger Bend in the Gourma-Rharous region, and from the south along the River Niger in the Kukiya/Bentia and also the Gorwol regions (Insoll 1996: 78; 2000: 139; McIntosh & McIntosh 1986 in Insoll 1996: 78; Arazi 1999). However, in the course of the 2002 surveys conducted by the *Direction Nationale du Patrimoine Culturel* of Mali, some iron working sites including Tinagagia, Ewale I and Tagmart III were recognized nearby along the fossil valley of Anchaouadj, one of the tributary valleys of Tilemsi (Togola et al. 2004b: 21-22). There is also a massive laterite outcrop across the river on the West Bank, although its potential as an ore is not known.

Glass at Gao Saney

The glass bead assemblage at Gao Saney consists overwhelmingly (90%) of beads of blue, blue-green, and green, a considerable number of which have weathered to off-white mottled with the original color. Most of the beads are thin cylinders or oblate produced by drawing and cutting a glass cane. Among vessel glass, green dominated (70%). Most of the 47 beads analyzed by LA-ICP-MS are plant-ash soda–lime–silica glass, likely from a source east of the Euphrates. Such glasses are also found in North Africa and at many West African sites, including Gao Ancien, Jene-jeno, Es-Souk, Kissi and Igbo Ukwu (Robertshaw 2007: 429-430; McIntosh 1995: 256; Robertshaw et al. 2010: 5). Three of the analyzed beads were fluxed with mineral soda, but the MgO and K₂O concentrations suggest that Wadi el-Natrun may not have been the source. Numerous beads of the Zhizo series first recognized in the Shashe-Limpopo area of Zimbabwe are present.

Two-thirds of the beads come from the lowest occupation levels, dated to the eighth to tenth centuries, and they include numerous broken, malformed and unfinished glass beads in GS1 and ACGS. These appear to be the result of secondary processing activities such as the heating of beads cut from cane in order to smooth them, or the remelting of cullet (broken glass) to make beads.

LOCAL INTERACTIONS: GAO SANEY AND GAO ANCIEN

Early historical sources mentioned the existence of the dual towns of Kaw-Kaw: the royal town and the market town of Sarnah (Levtzion and Hopkins 1981: 174; Cuoq 1975: 77-78). The Gao Saney preliminary excavations have shown evidence that is consistent with

its identification as the trading town of Samah. From its original founding in the eighth century, Gao Saney was actively involved in secondary processing of imported copper and glass, presumably for trade as well as for local consumption. During this period, Gao Ancien (located in the heart of Gao) was intensively occupied and was also engaged in trade and exchange. The various excavations at Gao Ancien have proved that it was a likely candidate for the royal town of Kaw-Kaw from the ninth century AD. In this section, the functions and potential relations of Gao Saney and Gao Ancien are assessed through the comparison of the available evidence for architectural data as well as for material culture.

Architectural data. The excavated architecture at Gao Saney dates to eighth to eleventh century AD; rectangular mud brick, elongated rounded sandy brick, and coursed mud architecture were encountered in the excavated units. The stone walling and fired brick present at Gao Ancien were not encountered. Flight's excavation on the small western mound at Gao Saney and at the cemetery revealed structures (*grand caveau and petit caveau*; Structure Q) built out of well-fired bricks of uniform dimension (22 x 22 x 5.5 cm) (Flight 1975, 1978, 1979; Insoll 1996), but these are likely to be of later date (twelfth-thirteenth century).

The excavations at Gao Ancien revealed a large complex of structures in the area locally known as the site of Kankou Moussa's mosque. This site is tentatively dated from the mid-first millennium to sixteenth century AD (Insoll 2000: 4; Cisse et al. 2007: 200-201). The remains of numerous building constructions (house wall foundations, columns

and flooring) built in dry stone walling, mold-formed mud brick and fired brick were exposed particularly in the deposits dated from ninth to thirteenth centuries AD (Insoll 1996, 2000; Cisse et al. 2007; Takezawa pers. Comm. 05/31/2008).

Since 2003, excavations have been conducted at the site by the *Direction Nationale du Patrimoine Culturel* of Mali in collaboration with Osaka museum of Ethnology, and with financial support of Najan University and Japan Society for the Promotion of Science (Japan). African Archaeology Network and the U.S. Embassy in Mali have funded some excavation campaigns as well. In the course of these various excavations, two different buildings (Pillar house and Long house) were exposed (Fig. 10.4). The Long house, located at the southern part of the site, is built in laterite and schist dry stone-walling, fired brick and mud brick (Fig. 10.5). The exposed one wall (Western wall) of this southern building extends 37 meters. This building had many long narrow rectangular rooms of different sizes (7.8-9.8m long by 2.2 m wide) and a monumental decorative gateway made out of fired bricks (24 cm x 24 cm x 5 cm) [Fig. 10.6]. Inside the building, there are some fired brick pavements and also mud brick fills. Some mud brick walls have been possibly added later at some parts of the building. This long building appears to be an elite residence because of the size of the building and the materials used for its construction (Fired brick and schist slabs in particular). Unfortunately, this Long house is yet to be dated with precision.

North of the long house, the Pillar house, built of quite elaborate schist slabs, was excavated (Fig. 10.7). Inside this structure, two rooms, measuring 3.10m X 2.22m each, were exposed. The doors of these rooms lead to a central room (vestibule) with eight

circular stone pillars inside. Many areas of the house floor were painted in red ochre and white lime powder. Outside this pillar building, there are fired bricks (25 X 25 X 7 cm) used as flooring in certain areas. This Pillar house, built around 900 AD, was likely a royal building because of the exclusive use of the elaborate schist slabs for its construction, and also the presence of a considerable quantity of exotic goods such as glass beads and glass objects (glass weight and vessels), glazed ceramic and copper-based objects and gold fragments.

The construction of new schist walls atop the southern Pillar house wall (Figure 10.8), possibly using stone quarried from the Pillar House, offers an opportunity to understand how long the Pillar House was occupied. Charcoal from a trash pit in sealed deposits adjacent to the wall with the stadia rod in Figure 10.7 produced a date of 830 ± 60 BP (1180–1267 cal AD). Since the trash deposit occurred after the wall was built, a date of perhaps 1000-1100 AD may be a reasonable estimate for the abandonment of the Pillar House.

Material culture. While the Long house and its associated materials have not yet been analyzed and dated, the Pillar House at its base produced the same long everted, channeled and painted rims as at Gao Saney. Dates indicate a construction date of c. 900 AD. This same assemblage is also present in the nearby Gadei sector of Gao (MacLean in Insoll 2000: 72). Over 6000 glass beads were recovered from the Pillar House, in addition to copper and iron objects, carnelian beads and glazed ceramics (Fig. 10.9). This period was connected to the Early Kaw-kaw kingdom. The difference in the scale

of the glass assemblage at Gao Ancien compared to that from Gao Saney is impressive (Table 10.3). However, the scale of the excavations at the Pillar House was much larger.

Table 10.3. Counts of glass and imported ceramics from excavation at Gao Ancien and the 2001-2 excavations at Gao Saney

Unit	Glass beads	Glass	Spindle Whorls	Imported ceramic
Long House GA	687	76		12
Pillar House GA	6028	179	4	15
GS1	399	117	1	
GS3	167	8	1	

But the Gao Ancien beads were whole and well-formed, unlike the Gao Saney assemblage, where half were partially melted or malformed. The lack of manufacturing debris within the various excavated structures shows clearly that the excavated zone at Gao Ancien had no manufacturing functions (Figure 10.10). It was primarily residential and elite. By contrast, both manufacturing/secondary processing and domestic functions are in evidence at Gao Saney. Possibly copper artifacts and glass beads at Gao Ancien were supplied by Gao Saney.

PRODUCTION AND TRADE/EXCHANGE

The 2001 and 2009 excavations provide valuable data for understanding some aspects of the early development of trade at the site in spite of the limited number and horizontal extent of excavations. It should be noted that this present work is just a start because the reconstruction of trade systems is complex and will require much more excavation at a wide variety of sites in the region and beyond.

Primary production centers for copper and glass are discerned through LA-ICP-MS analysis. Fenn's (Appendix IV) analysis of four copper crescents suggests a source in Tunisia. A sample of copper wire and copper sheet metal did not compare well with any known African source (not all have been tested, however), but did exhibit similarities to ore analyses in Oman, Iran, and Sardinia.

Dussubieux's analysis of the glass beads indicates a source in the Middle East, probably from a source east of the Euphrates, where plant ash continued to be used as a flux in the first millennium A.D. (Freestone 2005, 2006; Robertshaw et al. 2009)). A very small number of tested beads from both Gao Saney and Gao Ancien are Mineral soda-lime-silica (mNC) . While Wadi-el-Natrun in Egypt is a well-known source of natron used a flux, the MgO and K₂O concentrations are somewhat higher than glasses made with soda from that source in Syro-Palesine workshops until the ninth century A.D. Could these come from a different, as yet unknown manufacturing center? Finally, all of the analyzed beads contain low levels of U₃O₈ and Al₂O₃ making it unlikely they originated in South or Southeast Asia. (Dussubieux 2009, 2010 in Appendix III; Robertshaw 2010).

Although no gold was found at Gao Saney, the recovery of two small gold fragments (weighing 2.50g and 2.25g) in the ninth-tenth century Pillar House deposits at Gao Ancien is of particular interest. Historical documents noted that the southern goldfields of Bure and Bambuk were the principal suppliers in gold to the major Sahelian and North African trade centres (Levtzion & Hopkins 2000: 111, 117, 170; Cuoq 1975: 42). However, Nixon (2007: 337) has suggested the Sirba goldfield as one of the major

suppliers of the Gao kingdom particularly during the first millennium AD because of the proximity of this gold source to Gao. According to him, Gao was seen as the major power in the ninth century AD, and “the control of the flow from this gold source was one of the reasons why Gao was perceived to be so strong in the ninth century” (Nixon 2007: 337-38). It is worth noting that little is known concerning the Sirba goldfield, located south of Gao. It has been little investigated and discussed in the literature. The trading town of Gao, situated on the main crossroad between the savanna and the Sahara, likely received gold from all the major goldfields. However, the compositional analysis of samples of Gao gold and those from the major goldfields (including Bambuk, Bure and Sirba) is needed to determine the possible sources of given Gao gold pieces.

Distribution networks may be postulated on the basis of compositional and stylistic similarities. Compositionally, the Gao Saney crescents are similar to contemporaneous materials from Es-Souk, Maradet and Azelik, Igbo-Ukwu and Kissi (although this last may pre-date the Gao-Saney material – Fenn 2011, Appendix IV; Fenn et al. 2008). There appears to have developed by the mid-first millennium AD an important copper distribution network from the north (Tunisia?) through Maradet and Gao (secondary processing centers) south to Igbo Ukwu. If the wire and copper sheet source lies to the northeast, trade networks may be linked through the Nile Valley. Interestingly, analysis of copper and brass from Gao Ancien suggests entirely different source areas, as yet unidentified (Fenn, Appendix IV). Apparently, distribution networks had changed. As Fenn points out, while the analyzed samples are few, the results

provide important interpretive value and will be expanded by additional analyses on copper and crucibles from Gao Saney.

Plant-ash-soda-lime glass dominates the glass bead assemblages at Kissi, Es-Souk, Igbo Ukwu, and Jenne-jeno as well as Gao Saney. Two beads from Gao have elevated lead, as do some beads from Kissi and Es-Souk. Monochrome beads (blue, green, and/or yellow) are the commonest with rarer white, black, red, or multicolor beads (Insoll 1996: 68, 2000: 98-99; Nixon 2007: 294; Magnavita 2003: 130-131; Shaw 1970: 225-231; Eluyemi 1987: 203-213; Berthier 1997: 91-94).). Blue beads were a favorite at many sites including Gao Ancien and Gadei, Kissi, Es-Souk, Koumbi Saleh, Ife and Igbo-Ukwu (Insoll 1996: 68, 2000: 98-99; Nixon 2007: 280; Magnavita 2003: 130; Shaw 1970: 225-231; Eluyemi 1987: 203-213; Berthier 1997: 91). This may be related to the availability of blue colorant, namely, copper. As mentioned earlier, many of the Gao Saney beads belong to Zhizo series This type of beads was recognized also in the Gao Ancien, Igbo Ukwu and Kissi bead assemblages (Robertshaw et al. 2010: 6; Wood 2009; Robertshaw 2010).

In spite of these affinities, there are also some differences between the bead assemblage of Gao Saney and that of other West African sites. Segmented glass beads were not recovered from Gao Saney but they are common (over 23%) at Tegdaoust (Vanacker 1984: 34), and have been recovered from Gao Ancien, Kissi, and Es-Souk (rare) [Insoll 1996: 128; Magnavita 2003: 131; Nixon 2007: 294]. The presence of segmented beads at these sites is interesting since the manufacture of this kind of beads requires additional work in order to create the segments of the segmented tube after

cutting and chopping. Fired clay copies of segmented glass beads are present at Gao Saney (see Chapter 9).

It must not be forgotten that salt, while archaeologically invisible, was a highly significant trade item at Gao, noted to have constituted a major part of the king's treasure (Cuoq 1975: 78; McDougall 1990). The importance of salt to the Sahelian populations and their domestic stocks has been already discussed in chapter 4. The major trade routes consecrated to the salt trade helped to connect the populations from the Sahara to those from the Sahel and Savannah. In addition, it provided a channel to exchange the Saharan salt against other more visible trade items in the archaeological record.

Consumption of glass and copper is significant at Gao Saney and Gao Ancien and is clearly linked to status and prestige. A pattern of great interest is the magnitude of the difference in the level of consumption in domestic contexts on the eastern vs. the western side of the Niger Bend. On the east, glass beads are abundant and seemingly ubiquitous. Copper is also recovered in substantial quantities. On the western side, finds are much less frequent. There may be several factors involved, including differential contexts of consumption, different patterns of recycling versus deposition, or differential recovery and reporting standards in excavation, but the pattern merits deeper investigation. Glass beads are truly infrequent at Jenne-jeno and Ja compared to Gao and Kissi.

Traders and long-distance trade: AD 700-1100

As we have seen, the traditional view (Devisse 1990; Insoll 1996: 62) according to which significant long distance trade developed mainly after the ninth century has been

challenged by the chronology of the various trade goods at Gao Saney. Many of these first millennium long distance trade goods (glass and copper in particular) were also found in mid-first millennium or earlier deposits at other excavations, including Gao Ancien, Jenne-jeno, Kissi, Marandet, and Es-Souk (McIntosh 1995; Magnavita et al. 2002; Nixon 2007; Cisse et al. 2007; McIntosh & Cisse 2008, Fenn et al. 2008).

Sustainability of this early trade would have been difficult without the intervention of camels. The camels were able to transport efficiently the merchandise, food and water, which were needed during the crossing of the desert; the traders usually walked all the way. In the Arabic historical records, Ibadi merchants were the first to establish contact with the populations of the Sahel. From AD 850-900, the trading connections were already well established between Gao and the Ibadi Imamate of Tahert using one of the major trade routes Gao–Tadmekka (Es-Souk)–Wargala–Tahert (Lewicki 1971: 119).

During this period, the main organizers of this long distance trade were particularly the Zenata groups in collaboration with the Sanhadja Berbers in the desert. According to Lewicki (1988:281), “they often served as guides for the caravans equipped by North African traders from Sidjilmasa, Tahert, Tlemcen, Kayrawan or Tripoli, and also escorted these caravans under the protection of the Sanhadja chiefs of Awdaghust, Tadmekka and other places”. The increasing use of the camel by Berber groups, and other nomadic pastoralist communities from North Africa, Sahara and Sahel made possible the transport of substantial salt, copper, and glass beads among other goods, from the desert to the river, where boats carried gold, ivory and foodstuffs to exchange (McIntosh 2008; 1995: 390-392).

It is interesting to consider whether the abrupt appearance of a new and distinctive material culture assemblage at Gao and Timbuktu in the seventh-eighth century, accompanied by the florescence of trade and local industry, was connected to a Berber, Songhay, or Mande group of newcomers to Gao Saney and Gao Ancien. These are the possibilities laid out by the various interpretations of the Tarikhs and the oral traditions (e.g., Hunwick 1994, 1999; Lange 1991; Rouch 1953). The different elements of that assemblage – the fine-paste comb-impressed bowls and the coarse, vegetable-tempered everted rim jars – would seem to open the possibility of a mixed community at Gao that integrates two different potting traditions. But the same two elements are present at Tambouze, near Timbuktu (Park 2011), and at Bentia (Arazi 1997), making it more likely that vessels were produced differently for different functions. Chemical composition is varied, however, suggesting a possible variety of source clays. One thing is clear, however: we now have a fairly good idea of what the mid-first millennium pottery in the northern parts of the "Mande zone" looks like – at Akumbu in the Mema (Togola 2008) at Jenne-jeno and Ja in the Inland Niger Delta (McIntosh 1995, Arazi 2005; Schmidt et al. 2005) – and the Gao assemblage looks very different, favoring vessel and rim forms as well as twine and mat impressed motifs that are absent on the western side of the Niger Bend. Nor does it resemble the Es-Souk assemblage, which has only a few sherds of painted Gao-type pottery (Nixon 2007). The presumably "Berber" pottery of Koumbi Saleh (Berthier 1997) does not resemble the early Gao assemblage, either. It is a question worthy of future research to ascertain where this new group of settlers and traders hailed from.

CONCLUDING REMARKS

The archaeological investigations at Gao Saney have shed light on an important site that was poorly known. The objectives of the research were to: establish the nature and chronology of the cultural sequence at the site; document building sequences and architectural technologies as part of interpreting site formation processes as well as culture change; establish the basis of the subsistence economy; and gather data on trade goods and production activities that may have supplied local or more distant markets.

As an exploratory research project, it has established an initial database toward understanding the development of early trade in Kaw-Kaw, particularly in its trading town of Sarnah. Additionally, the 2001 and 2009 excavations make some important contributions to understanding some aspects in relation with the tell of Gao Saney in spite of the limited number and horizontal extent of excavations. Some of these contributions are as follows:

Site chronology: the excavations at Gao Saney provide evidence that the main period of occupation (AD 700-1000) on the main mound predates the Saney cemetery, where engraved stele bear dates of the late 11th through 13th centuries. Before this present work, it was assumed that these later dates were also the main period of occupation at the tell of Gao Saney.

Site formation: Rapid mound accumulation was the result of trash deposition associated with multiple episode of buildings executed in sandy banco, elongated and rounded banco brick, and better-consolidated rectangular mud brick. Six meters of deposit built

up in this way over the course of just a few centuries. The excavations have demonstrated that areas 300 m apart developed simultaneously, suggesting that Gao Saney was urbanizing from its earliest occupation. Of course, more work will be required to understand the overall growth and physical expansion of the site through time; the spatial relationships of structures and the nature of functional differentiation across the site .

Material culture sequence: Small changes occurred within the Gao Saney sequence over the several centuries of occupation documented in the excavated units. It has been possible to recognize the distinctive suite of vessels, forms, and decorative modalities that define this ceramic phase, which is dominated by polychrome jars with funnel-like necks.

Subsistence economy: Millet-based with domestic cattle and caprines contributing equally .

The occurrence of manufacturing activities: the Gao Saney excavations also provide new evidence of the occurrence of secondary processing activities starting from the beginning of the occupation at the site. Imported glass and other glass items, and also copper were reworked and reused respectively for the production of finished glass and copper materials.

The early development of trade: A major contribution of this thesis is to demonstrate an early development of regional and long distance trade and exchange networks between Gao and other major production and consumption centers from Africa and Near/Middle East during the first millennium AD. It is worth noting that this present work is just a

start because the reconstruction of early trade systems is too complex and will require much more excavations at a wide variety of sites in the region and beyond.

Because the excavations at Gao Saney were limited in area, they can offer only a small insight into the history of the 35 hectare site, particularly in view of the heavy looting it has experienced, such that locating areas of intact deposits suitable for excavations is increasingly difficult. However, the careful survey of the various areas of the site makes it possible to find some undisturbed sectors and to conduct more excavations in order to understand many of the issues mentioned above.

Further work on the urban site of Gao Ancien is already in production. This work will generate further interest and future research at numerous sites within the Gao region in connection with the early Gao kingdom such as Gao Ancien, Gao Saney, Gadei, Gorongobo, Koukia/Bentia and other unexcavated sites including Tchado and Koima. Large-scale excavations with rigorous stratigraphic control at these sites will help us to have a better understanding about the origin and the development of the Gao kingdom. Additionally, an expanded program of chemical analysis of trade goods from these sites will provide a robust comparative database for reconstructing trade connections with source areas and other trading centers.



Figure 10.3. Samples of the earliest Gao Ancien pottery assemblage

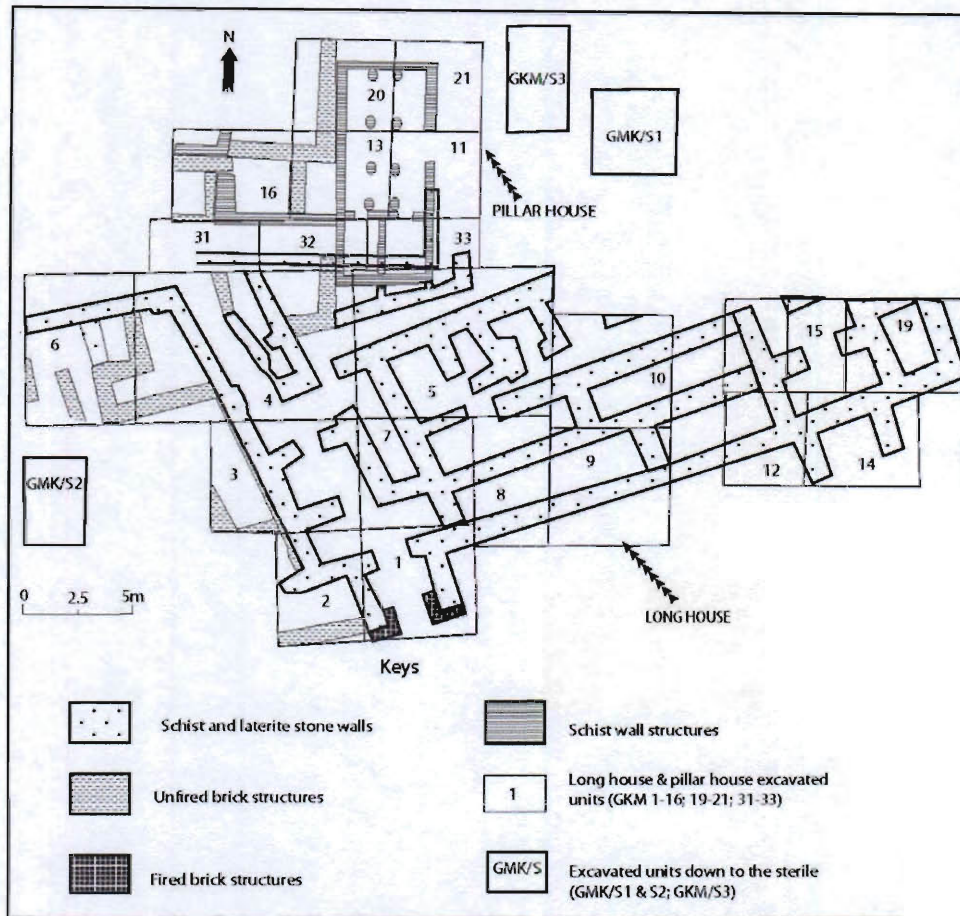


Figure 10.4. Plan of Long house and Pillar house at Gao Ancien



Figure 10.5. View of Long house walls



Figure 10.6. View of the walls of some Long house rooms



Figure 10.7. Pillar house walls



Figure 10.8. View of the Pillar house wall structures. Note the presence of two stone walls on the top of the southern Pillar House wall.

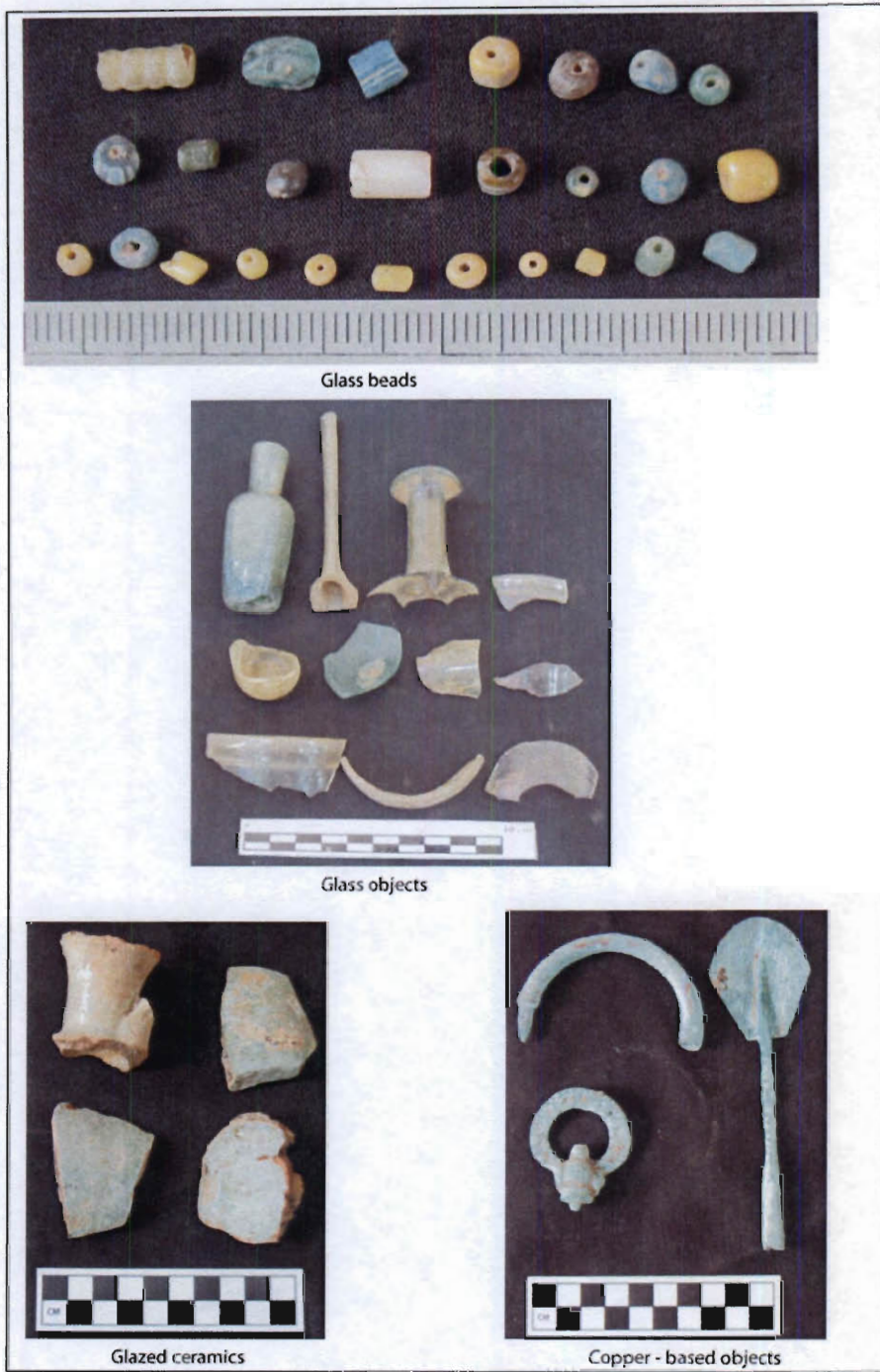


Figure 10.9. Samples of some Gao Ancien elite imports

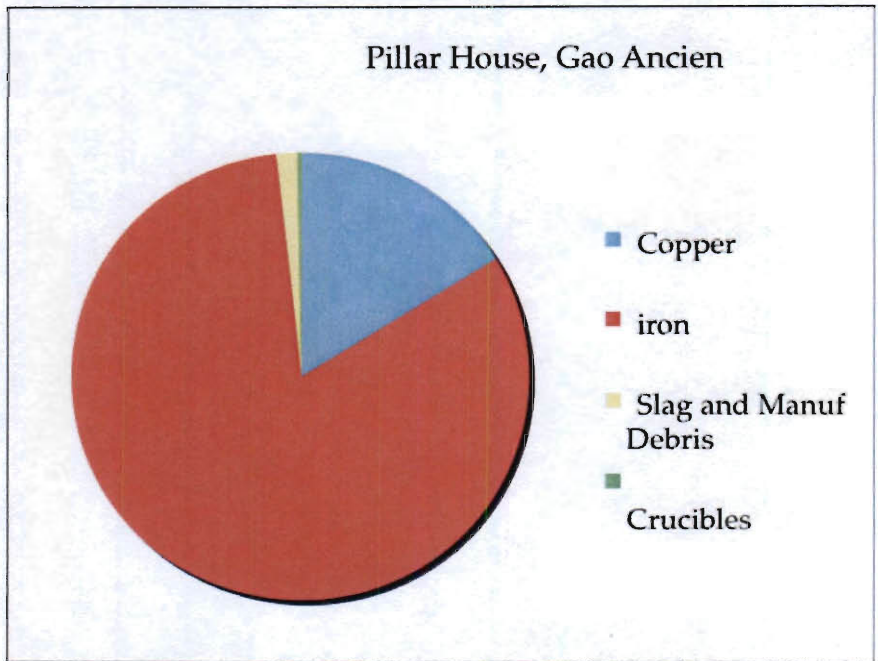
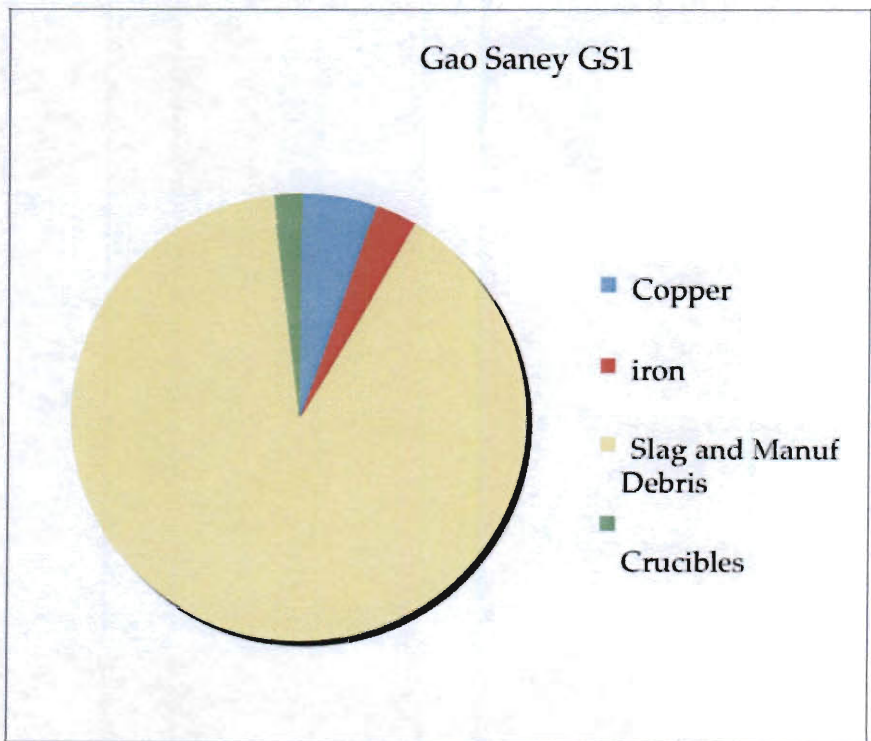


Figure 10.10. Comparison of artifact categories at Gao Ancien and Gao Saney.



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**APPENDIX I.1 ACGS: LEVEL AND FEATURE SUMMARY IN
CHRONOLOGICAL ORDER**

Level (L)/ Feature (Feat)	Depth		14C sample #	Ass. L/Feat	Description	Comment
	Top (cm)	Bottom (cm)				
L. 1	14	35			Sand, ash, potsherds and manufacturing debris	Cultural fill
L.2	35	68	1 and 2		Very ashy, sand, manufacturing debris and potsherds	Cultural fill
L.3	68	91	3		Sand, ash, lot of bones, manufacturing debris and potsherds	Cultural fill
L.4, 5, 7a (LRF 7, 9)	91	129	4 and 5 (from L.7, LRF9)	L.6	Sand, charcoal, ash, bones, manufacturing debris and potsherds	Cultural fill
L. 6	103	108		L.5, 7	Very ashy and few bones and potsherds	Cultural fill
L.8, 9, 7b (LRF10)	111	146			Sand, ash and few artifacts; Infiltration of decomposed organic materials (greenish color)	Cultural fill
L. 10	140	167	6 (from L.11, LRF 15)		Sand, Ash, bones, potsherds, beads, copper and iron objects, charcoal and infiltration of decomposed organic materials (greenish color)	Cultural fill
L. 11, 12, 13, 14	169	203		Feat 1	Sand, little ash, charcoal, some bones, potsherds and iron objects	Cultural fill
L.15	203	213		L. 16, 17, Feat 3	Compact homogenous sand, very few potsherds and bones	Top of level 17 and Feat. 3
L. 16, 18	216	258	7, 8 (L.18 LRF 22) and 9 (L.18, LRF 24)	L.15, 16, 17, Feat 3	Sand, ash, potsherds and bones	Cultural fill
L. 17	213	261		L. 15, 16, Feat 3	Compact homogenous sand, some fallen banco bricks, very few copper, iron, beads, potsherds	Interior of Feature 3
L. 19	264	284		Feat. 4, 6	Sand, ash, bones, potsherds, charcoal, beads, shell, copper and glass	Cultural fill
L. 20	284	299		Feat. 6	Very ashy, bones, few sands and many artifacts (potsherds, copper and iron objects, beads).	Cultural fill

Appendix I.1 (cont.). ACGS: Level description in time order

L. 21	299	328			Sand less compact and hard, fallen bricks, potsherds, beads, copper and glass	Cultural fill, wall collapse, melted bricks
L. 22	328	347			Very ashy, potsherds and bones.	Cultural fill
L. 23	347	355			Sand, fallen <i>banco</i> brick, few ash, potsherds and bones	Cultural fill, wall collapse
L. 24	355	374			Sand, charcoal, infiltration of decomposed organic materials (greenish color)	Cultural fill
L. 25	374	394		Feat. 8	Sand, fine gravels and few materials	Top of the floor of feat. 8
L. 26	394	430	12	Feat.8	Sand, fine gravels and few materials	Floor (possible interior of feat. 8)
L. 27	430	459		Feat. 8	Sand, fallen <i>banco</i> bricks and few materials (iron slag and potsherds)	Cultural fill, wall collapse
L. 28	459	481	13, 14	F.9	Sand, lot of bones, charcoal, potsherds, iron slag, copper, beads	Cultural fill
L. 29	481	511		Feat. 9	Sand, fallen <i>banco</i> bricks and few materials (potsherds, some bones)	Cultural fill, wall collapse
L. 30	511	546	15		Compact and hard sand, few bones, ash, and charcoal, many beads, glass and potsherds	Cultural fill
L.31	550	562		L. 32, Feat. 10	Sand, little ash, some beads and potsherds	Exterior of the wall of feat. 10
L. 32	550	560		L. 31, Feat. 10	Sand, fine gravels, some beads and potsherds	Interior of the wall of feat. 10
L. 33	562	588	16		Very ashy, few sands and fallen <i>banco</i> bricks, lot of beads, potsherds and 1 big iron slag	Cultural fill
L. 34	588	610		Feat. 11	Sand, powdered and disintegrated animal bones, potsherds	Cultural fill
L. 35	621	643			Reddish and homogeneous sand	Sterile soil

Appendix I.1. ACGS: Feature description in time order

Feature #	Depth		14C sample #	Ass. L/Feat	Description
	Top (cm)	Bottom (cm)			
1	147	196		L. 10, 11, 12 13, 14, feat. 2	Wall structure constructed with <i>banco</i> bricks. It has ten layers and was oriented NW – SE. The thickness of the brick is 15 - 18 cm
2	148	168		L. 10, Feat. 1	Wall constructed with <i>banco</i> bricks. It has three layers and was oriented SW – NE. The thickness of the brick is 15 - 18 cm
3	206	256		L. 15, 16, 17, 18, feat. 4	Wall constructed with lengthy <i>banco</i> bricks. It is a rectangular structure oriented NW – SE – SW. Only the eastern part of the wall was visible. The thickness of the brick is 15 - 18 cm
4	217	286		Feat. 3, 6	Wall constructed with rectangular mud bricks. It was oriented SW-NE-SE. The structure has 10 layers. The brick dimension is 40 cm X 30 cm X 6 cm
5, 7	284	355	10, 11 (feat. 5)	L. 19, feat. 4	Trash pit containing sand, lot of bones, charcoal, fallen <i>banco</i> bricks, copper, iron slag, glass
6	261	304		L.20	Wall constructed with rectangular mud bricks. The wall has five layers and was oriented SW-W. It is connected with the lower levels of feature 4. Could be a continuation of feature 4???
8	387	450		L. 25, 26, 27	Wall structure built with rectangular mud bricks. The wall direction is NW – SE. The brick dimensions are 40-43 cm X 30-33 cm. The wall has five layers of bricks
9	485	492		L. 28, 29	Trash pit containing a concentration of animal bones, friable and in bad condition
10	544	554		L. 31, 32	Wall structure built with rectangular mud bricks. The wall was oriented E-S-NW. It has four layers. The brick dimensions are 36-44 X 34 cm
11	610	633		L.34	Trash pit containing sand, ash, bones, and potsherds

APPENDIX I.2. ACGS LEVEL AND FEATURE DESCRIPTIONS

Level 1 [Munsell: 10YR 5/4; Ahn: B] Trash pit filled with domestic debris (potsherds, animal bones, and charcoal) and manufacturing debris (iron slag, melted iron and copper and beads, and crucibles). The soil is friable, ashy and sandy. There are many blackened areas throughout in the unit. Depth: 0.14-0.35 m

Level 2 [Munsell: 10YR 5/4 – 6/2; Ahn: B] This level is the continuation of trash pit. The soil is less friable, ashy and sandy. Domestic and manufacturing debris filled the trash pit. At 37 cm deep, there is a concentration of iron slag in the ashy deposit located in the SW corner. A radiocarbon sample 1 was collected from across the level between 35 and 45 cm in depth. The result is 950 ± 60 B.P. (Beta 261360). Depth: 0.35-0.68 m.

Level 3 [Munsell: 10YR 5/4; SW: 10YR 6/2; Hard surface: 7.5 YR 5/8. Ahn: B] The trash pit continues in this level. The soil is ashy and sandy. Many potsherds, animal bones, and manufacturing debris were found in the deposit. The ashy layer continues in the SW corner. The center of the unit is less hard and compact. In this area, the soil texture is reddish sand mixed with very little ash. At 20 cm, a concentration of ash and charcoal appeared in the NE corner. Depth: 0.68-0.91 m.

Level 4 [Munsell: 10YR 5/3; Ahn: B] This trash pit level is located in the SW corner of the unit. The soil is very friable, sandy mixed with very few charcoal and ash. This layer was under the very ashy deposit found in level 2. Very few objects including beads, potsherds, bones and charcoal were found. Just under this layer, the ashy deposit (level 6) comes up again. Depth: 0.93-1.03 m.

Level 5 [Munsell: 10YR 5/4; Ahn: B] Location: centre of the unit. Sandy trash layer less compact mixed with animal bones. The cultural fill included many potsherds, animal bones, iron and copper objects, beads and manufacturing debris. Depth: 0.91-1.11 m.

Level 6 [Munsell: 10YR 6/3; Ahn: C. Location: SW] Ashy trash layer mixed with sand. This layer was located below of level 4. Few objects including some potsherds and bones were found. Depth: 1.03-1.08m.

Level 7 [Munsell: 10YR 6/1; Ahn: C. Location: N and NE] Ashy trash layer, friable, mixed with charcoal and some circumscribed sand deposits. The ashy trash layer in this area is the continuation of the level 3 trash pit. In this deposit, many materials including potsherds, bones and some iron and copper objects have been found. Depth: 0.91-1.38 m.

Level 8 [Munsell: 2.5Y 5/4; Ahn: B. Location: Entire except NE (Level 7)] Sandy trash layer mixed with little ash and the poor decomposition of organic material, which

gave the greenish color. Very few materials including pottery, bones and metals were recovered. Depth: 1.18-1.32 m.

Level 9 [Munsell: 10YR 5/2; Ahn: C. Location: Centre and SE] This trash pit level is quite similar to level 8. The layer is sandy mixed with some ash. The soil is less compact and hard. Very few artifacts were recovered. Depth: 1.23-1.38 m.

Level 10 [Munsell: 10YR 5/4; Ahn: B] The soil is sandy mixed with lot bones and archaeological materials. Many artifacts including iron and copper objects, beads, and potsherds were recovered. Throughout the unit, there are some circumscribed ashy deposits. At 147 cm and 157cm respectively in the NW and SW of the unit, a concentration of compact reddish sand was recognized. No artifacts have been found in these compact sand layers. These two parts were considered as features 1 and 2. Depth: 1.40-1.167 m.

Feature 2 [Munsell: 10YR 6/6; Ahn: B; Location: SW] This feature 2 is a wall structure built with *banco* bricks. The wall is oriented SW – NE. It has three layers of *banco* bricks. Depth: 1.48-1.68 m.

Level 11 [Munsell: 10YR 5/2; Ahn: C; Location: Centre - South] This trash pit level is an ashy layer which became thick in the southern part of the unit. The ashy deposit is mixed with charcoal and very few animal bones. The recovered materials were less important: potsherds, one bead and one iron slag. Depth: 1.69-1.81 m.

Level 12 [Munsell: 10YR 4/4; Ahn: C; Location: NE] This trash pit level is sandy mixed with little ash and the poor decomposition of organic material (bones in particular). The soil color is gray and green. Potsherds and very few iron and copper objects were recovered. Depth: 1.70-1.90 m.

Level 13 [Munsell: 10YR 5/3; Ahn: C; Location: South and West] This fill deposit is a sandy layer mixed with very little ash and located below the ashy trash pit deposit. Some big bone fragments, potsherds and iron objects were recovered. Depth: 1.81-1.91 m.

Level 14 [Munsell: 10YR 5/2-3; Ahn: C; Location: entire except feature 1] At this level, the initial 3x3 m unit size was reduced to 2x2.5 m. The cutting of step had already reduced the unit size by 0.5 m progressively from a depth of 50 cm to 2 m. Additionally, 1 m wide unexcavated strip was left along the southern wall of the unit at 2 m in depth.

This trash pit level was sandy mixed with animal bones and charcoal. In the northeastern corner, the layer with the greenish color (level 12) associated with bones continued. Some ash existed as well in many parts of this level. The deposit of level 14 is very thick (23 cm) in the central southeastern part and reaches up to 217 cm depth where it formed a sort of channel going from the east to the centre. All the deposits of this layer were removed. At the end of level 14, the homogenous compact sand appeared at all the surface except the NE corner. Depth: 1.92-2.07 m.

Feature 1 [Munsell: 7.5 YR 5/6-8; Ahn: B; Location: NW] Feature 1 appeared at the beginning as a concentration of compact homogenous sand but after having closely observed it, it was clear that this structure is a wall built with lumps of sandy *banco* used as bricks. The wall structure has ten layers of *banco* bricks oriented NW - SE. The thickness of the bricks is 15 - 18 cm. Feature 1 was first recognized at 147 cm deep. The top of the structure (118 cm) was defined after observing the wall profile. Depth: 1.47-1.96 m.

Level 15 [Munsell: 7.5YR 5/4; Ahn: D; Location: entire except NE corner] This level is a concentration of homogeneous compact sand located below the trash pit (sand, charcoal and bones) and feature 1. The layer is thick (10 -20 cm deep) and it appears to be the top floor of the next wall structure called Feature 3. Very few potsherds and bones were recovered. These materials, certainly, belong to the trash fill deposit. Depth: 2.03-2.13 m.

Level 16 [Munsell: 10YR 5/2; Ahn: C; Location: East] This trash pit level, first circumscribed in the NE corner, expanded to the east below the homogeneous compact sand layer (level 15). The layer is sandy, friable mixed with ash and less charcoal, and has greenish color in certain areas. Many archaeological materials, potsherds and bones in particular, were recovered. Depth: 2.12-2.19 m.

Level 18 [Munsell: 10YR 5/2; Ahn: C; Location: Centre and East] This trash fill level represents the exterior of the house structures of features 3. The soil texture is sandy mixed with ash, charcoal and lot of animal bones. The layer is very thick, friable and gray. In the eastern part, the soil is predominantly ashy. Depth: 2.17-2.58 m.

Level 17 [Munsell: 7.5YR 5/4; Ahn: D; Location: West] This level, located below level 15, is also a concentration of compact homogenous sand located inside the house wall of feature 3. Some fallen *banco* bricks were found in this sand layer. It is important to note that the top deposit of this level was mixed with level 15 because it was very difficult to make a clear distinction between the two layers since the soil texture was the same. This level is very poor in archaeological materials. At 256 cm, the wall of feature 3 disappears. However, the sand deposit still continued in the southern part of the level and reached up to 270 cm deep in the SW corner. Depth: 213-2.61 m.

Feature 3 [Munsell: 7.5YR 5/8; Ahn: D; Location: West] This feature is a house wall structure oriented NW – SE – SW. The wall is constructed with *banco* bricks which thickness ranged from 15 - 18 cm. This wall started just below the floor of feature 1. It should be noted that during the excavation, the top of feature 3 was difficult to be recognized from the floor because the soil texture (compact reddish sand) was quite the same. Later, the wall profile helps to delineate the wall structure. Only part of the eastern house wall was defined (NW – SE: 185 cm; SE – SW: 143 cm). The interior of the structure was filled by a compact homogeneous sand layer, very poor in archaeological materials. The exterior of the structure, however, was filled by cultural debris such as potsherds, bones, metals, charcoal, and beads. Depth: 2.06-2.56 m.

Level 19 [Munsell: 10YR 5/2-3; Ahn: C; Location: Entire except South and SW] This trash pit level is a sandy layer mixed with ash, bones, and charcoal. It was located below feature 3 in the western part of the unit. This trash layer is much ashier in the east. Many artifacts including potsherds, iron and copper objects were recovered. After 5 to 10 cm deep, in the centre western part, a well-circumscribed trash pit filled with lot of bones, charcoal and sand was also found. It was considered as feature 5. Another structure constructed with lumps of *banco*, very compact and hard, was found in the SW corner. This structure was considered as feature 6. Feature 4 continued as well in the southern part of the unit. Depth: 2.64-2.84 m.

Feature 4 [Munsell: 7.5YR 5/4; Ahn: D; Location: South] This feature is a superposition of rectangular mud bricks. At the first view, it was hard to say whether the structure is a wall or a well arranged pavement of bricks. However, the profile of the structure shows that it was a house wall of 10 layers of mud bricks. The brick dimension is 40 cm X 30 cm X 6 cm. Depth: 2.17-2.86 m.

Features 5, 7 [Munsell: 10 YR 5/4; Ahn: B; location: centre west] Feature 5 is a trash pit filled with sand, lot of bones potsherds, copper, iron slag, glass and charcoal. This pit has 74 cm of diameter. The base of the trash pit (feature 7) has an oval form filled with sand and fallen *banco* bricks. Depth: 2.84-3.55 m.

Level 20 [Munsell: 10YR 5/3; Ahn: C; Location: Entire except SW] This trash fill level is ashy, very friable mixed with charcoal and sand. Many archaeological materials including potsherds, bones, copper fragments and some beads were recovered. Feature 5, a trash pit, exists in the South – western part of the unit. A rectangular mud brick wall structure is located in the same area as well near the trash pit. This wall structure is considered as feature 6. Depth: 2.84-2.99 m.

Feature 6 [Munsell: 7.5 YR 5/4; Ahn: D; location: SW] This structure is a wall constructed with rectangular mud bricks. Five layers of bricks were defined. This feature started at 8 cm below level 17 (the interior of the house wall of feature 3). At the top, it was difficult to define the bricks because they were melted and resembled as a compact sand layer. The top of the wall was defined after looking the profile of the structure. No artifacts were found in this wall structure. Depth: 2.61-3.04 m.

Level 21 [Munsell: 7.5YR 6/6; Ahn: C; Location: Entire except SW (Feature 5)] This fill level is sandy mixed with fallen *banco* bricks less compact and hard. In the deposit there are potsherds and bones. Depth: 2.99-3.28 m.

Level 22 [Munsell: 10YR 5/2; Ahn: C; Location: Entire except SW (Feature 5)] Ashy trash pit, friable layer associated with bones, potsherds, and very little charcoal. The layer is very thick in the eastern part of the unit. Depth: 3.28-3.47 m.

Level 23 [Munsell: 10YR 5/4; Ahn: D; Location: Entire except SW (Feature 5, 7)] This trash fill level is sandy, less compact and friable with very little ash. Some lumps of *banco* existed in some areas. In this layer there are some potsherds, animal bones and

charcoal. At this level, the base of feature 5 (feature 7) was encountered. Depth: 3,47-3.55 m.

Level 24 [Munsell: 10YR 5/3; Ahn: C; Location: Entire] This trash pit level is sandy and very friable mixed with animal bones and charcoal. The poor decomposition of organic materials (bones in particular) gave the greenish color in some areas of the unit. This layer contains also some laterite fine gravels. Many potsherds were recovered. Depth: 3.55-3.74 m.

Level 25 [Munsell: 7.5YR 5/3-6/3; Ahn: C; Location: Entire] This level contains sand and fine gravels. Some very tiny charcoals were also visible in the deposit. Very few potsherds were recovered in this layer. At 387 cm deep, a wall structure appeared in the eastern part. It was considered as feature 8. However, this layer still continues in the centre and the west of the unit. Depth: 3.74-3.94 m.

Level 26 [Munsell: 10YR 5/3; Ahn: C; Location: West and Centre] This level is the continuation of level 25. The soil is friable, sandy mixed with some fine gravels. Some charcoals exist as well. In the east, this sand layer was circumscribed by feature 8. On the other hand, it is very thick and can reach up to 50 cm deep in the western part. Very few materials were found in this layer. Only some potsherds, iron and copper object and few bones were recovered. It is hard to say that the bottom of level 25 and the entire level 26 were whether the floor or outside of feature 8. However the presence of sand soil with fine gravels on one hand, and the few materials encountered in the deposits suggest that part of level 25 and level 26 were the floor of the house wall structure. At the end of this level, around 450 cm deep, the soil became compact and hard. Depth: 3.94-4.30 m.

Level 27 [Munsell: 10YR 5/3; Ahn: C; Location: entire] This house fill level is sandy very compact and hard. Some fallen *banco* bricks were noticed as well. Very few potsherds and bones were recovered. Depth: 4.30-4.59 m.

Feature 8 [Munsell: 7.5 YR 5/4; Ahn: D; location: East] This structure is a wall built with rectangular mud bricks. The wall direction is NW – SE. The dimensions of the brick are 40-43 cm X 30-33 cm. The wall has five layers of bricks. Depth: 3.87-4.50 m.

Level 28 [Munsell: 10YR 5/3; Ahn: C; Location: entire] The soil texture of this trash pit level is sandy, very friable mixed with lot of bones and charcoals. Many potsherds were recovered in this layer. Some big fragments of bones in poor condition appeared at the end of this level. They were considered as feature 9. Depth: 4.59-4.81 m.

Feature 9 [Munsell: 10YR 5/3; Ahn: C] This feature is a trash fill of animal bones very friable. The bones were in bad condition and in a disorganized ways. They were found at the top of level 29 and maybe connected to level 28 as well. Depth: 4.85-4.92 m.

Level 29 [Munsell: 10YR 5/4; Ahn: C; Location: entire] This level is a mix of less compact sand and fallen *banco* bricks. Just at the top of this layer, there is feature 9,

characterized by the presence of big fragments of animal bones. It is possible that these bones were connected to level 28. After removing feature 9 trash fill, some unidentifiable bones were still found between the fallen *banco* bricks in the level 29 deposit. Possibly, most of these bones belong to feature 9. Some potsherds were also recovered in the deposit. Depth: 4.81-5.11 m.

Level 30 [Munsell: 10YR 5/4; Ahn: C; Location: entire] This trash pit level is sandy, compact and hard. In some areas, there are some fragmentary bones, ash and charcoal. Many potsherds and beads were also found. Just below this level, a wall structure was found. It was considered as feature 10. Depth: 5.11-5.46 m.

Level 31 [Munsell: 7.5 YR 5/4; Ahn: C; Location: West and South] This trash pit level is sandy mixed with little ash and tiny fragments of charcoal. Some beads and potsherds were found. This level appears to be outside of the wall structure of feature 10. Depth: 5.50-5.62 m.

Level 32 [Munsell: 10YR 5/2; Ahn: C; Location: East] This level is considered as the interior of feature 10. The soil texture is sandy associated with fine gravels. Some beads and potsherds were recovered in this layer. The northern sector of this level was arbitrarily selected because feature 10 going from south to northwest stopped halfway in the middle of the excavated area. Depth: 5.50-5.60 m.

Feature 10 [Munsell: 7.5 YR 5/4; Ahn: D] This feature, located in the SE corner, is a wall structure built with rectangular mud bricks. It was oriented E – S – NW. The dimensions of the brick are 36-44 cm X 34 cm. Feature 10 has four layers of bricks. Depth: 5.44-5.54 m.

***Level 33** [Munsell: 10YR 5/2; Ahn: C; Location: entire] This trash pit level is an ashy layer mixed with sand. At the top of this level, and just below feature 10, some fallen *banco* bricks were found. A lot of beads were found in this ashy trash layer. Some potsherds, and iron slag were also recovered. A radiocarbon sample 16 was collected from across the level between 5.68 and 5.70 m in depth. The resulting result is 1170±40 B.P. (Beta 261361). Below the ashy layer, there is a thick layer of completely disintegrated animal bones. It was considered as level 34. Depth: 5.62-5.88 m.

Level 34 [Munsell: 10YR 6/3; Ahn: C; Location: entire] This trash pit level is a sandy layer associated with powdered animal bones, completely disintegrated. The soil texture color tended to be between pale brown and green because of the high and compact concentration of this disintegrated bones. At the bottom, some isolated ashy concentrations were found. However, no charcoal exists in this layer. In the NW corner, this layer became thicker and formed a trash pit. This circumscribed trash pit was considered as feature 11 associated with this level. At around 608 cm, in the other areas of the unit, the soil texture became very sandy, compact and homogeneous. This soil was sterile. Depth: 5.88-6.10 m.

Feature 11 [Munsell: 10YR 6/3; Ahn: C; Location: NW] This feature is an oval trash pit found at the bottom of level 34, which was connected with it. This trash pit was very deep (23 cm) and contained sand, ash, animal bones, and potsherds. Depth: 6.10-6.33 m.

Level 35 [Munsell: 7.5YR 5/6-4/6; Ahn: C; Location: entire] This level is a reddish and homogenous sand layer. The deposit contains no archaeological material. It was a sterile soil. Depth: 6.21-6.43 m.

APPENDIX I.3. GS1 LEVEL AND FEATURE DESCRIPTIONS

Level 1 [Munsell: 10YR 5/3, Ahn: B] Friable sand mixed with ash and gravel. Large quantities of potsherds, animal bone, beads, copper and manufacturing debris (crucibles, melted iron and glass, iron slag). Depth: 0.05-0.29 m

***Level 2** [Munsell: 10YR 5/4, Ahn: B] Sandy and ashy, with continued presence of bone, potsherds, slag, charcoal and crucibles. A radiocarbon sample 1 was taken in the NW corner. The resulting date is 1083 ± 42 B.P. (Wk 12629). This level was interpreted as secondary trash deposit, continuing from Level 1. Depth: 0.29–0.84 m

Level 3 [Munsell: 10YR 5/3, Ahn: B] Sandy soil more compact mixed with charcoal and ash particularly at the south. Bones, slag, crucibles and potsherds still continued; interpreted as the continuation of secondary trash deposit. Depth: 0.84-0.90 m.

Level 4 [Munsell: 10YR 5/3, Ahn: B] Sandy mixed with gravel. Charcoal, bones, beads and potsherds continued as well; interpreted as the final layer of secondary trash deposit continuing from level 1. Depth: 0.90-1.60 m.

Level 5 [Munsell: 10YR 5/3, Ahn: B] Sandy soil mixed with gravel and less ash, with the presence of charcoal, bones, beads, iron and copper objects, slag and potsherds; interpreted as accumulation and wall melt from Features 1A and 1B. Depth: 1.60-2.11 m.

F1Ax [Munsell: 10YR 6/3, Ahn: B] Sandy soil, with the presence of charcoal, beads, some potsherds, and also some circumscribed greenish areas. This layer was interpreted as the interior fill of Feature 1A. Depth: 1.57-2.10 m.

F1Bx [Munsell: 10YR 5/4, Ahn: B] Sandy with the presence of some beads and potsherds interpreted as the interior fill of Feature 1B. Initially this interior fill was divided into two rooms (F1Bx1 and F1Bx2) separated by a mud wall, which disappeared at 2.05 m; and then the rooms were fused to one called F1Bx. Depth: 1.65-2.33 m.

Feature 1A [Munsell: 10YR 5/4, Ahn: B] Curvilinear wall structure constructed of elongated sandy banco lumps and located in the northeast. It was oriented N – E. The wide of the wall was 75 cm. Depth: 1.57-2.02 m.

Feature 1B [Munsell: 10YR 5/4, Ahn: B] Rectilinear structure of sandy banco lumps, with a wide comprised between 18 and 20 cm. Depth: 1.65-2.26 m

Level 6 [Munsell: 10YR 5/3-4, Ahn: B] Compact sand with the presence of charcoal, some circumscribed ashy areas and a considerable quantity of brick fragments. Some potsherds, beads and slag were uncovered. This level was interpreted as accumulation and wall melt from Features 2A and 2B. Depth: 2.11-2.33 m

Level 7 [Munsell: 10YR 5/3-2, Ahn: B] Friable sand and ash with the presence of charcoal, large quantities of animal bones, potsherds, beads, iron and copper objects; interpreted as a continuing accumulation from Features 2A and 2B. Depth: 2.33-3.04 m.

***Levels 7a and b** [Munsell: 10YR 5/4, Ahn: B] Sandy with the presence of animal bones, charcoal, potsherds, iron and copper objects. Some circumscribed greenish areas existed. A radiocarbon sample 3 was taken in level 7b deposit. The resulting date is 1297 ± 52 B.P. (Wk 12630). This layer was interpreted as interior fill of Feature 2A. Depth: 2.33-2.91 m.

Feature 2B [Munsell: 10YR 5/4, Ahn: B] Hard, compact and homogeneous sand interpreted as a wall melt structure. Depth: 2.33-286 m.

Feature 2A [Munsell: 10YR 5/4, Ahn: B] Two parallel rectilinear mud brick structures oriented N – SE. Initially located in the northern sector, these wall structures progressively continued up to the Southeast corner at 2.37 m. The brick dimensions were 40 x 20 x 4.5 cm. Depth: 2.11-307 m.

Level 9 [Munsell: 10YR 5/4, Ahn: B] Compact sand mixed with fallen brick fragments, with the presence of few potsherds, animal bones and copper objects; interpreted as wall melt and mud wall collapse. Depth: 2.86-3.67 m.

Level 8 [Munsell: 10YR 6/1, Ahn: B] Friable ash mixed with charcoal and large quantities of animal bones, potsherds, and some iron objects. This layer, located in the east, was interpreted as trash pit. Depth: 291-348 m.

Level 10 [Munsell: 10YR 6/1-2, Ahn: B] Friable sand mixed with some ash. Initially, this layer was encountered below level 8, but at 3.70 m it disappeared in this eastern sector of the unit. However, level 10 continued as well below level 9 in the western part from a depth of 3.67 m. Depth: 3.38-4.40.

Level 11 [Munsell: 10YR 5/4-3, Ahn: B] Compact sand, and presence of a superimposition of fallen bricks. No artifact was uncovered. This level was interpreted as wall melt. Depth: 3.70-4.50 m.

Level 12 [Munsell: 10YR 6/1, Ahn: B] Soft and friable sand and ash mixed with charcoal, and presence of some isolated burnt areas. A considerable quantity of animal bones, beads, and large pottery fragments was uncovered. Depth: 4.50-5.07 m.

Level 13 [Munsell: 10YR 5/4, Ahn: B] Compact sand mixed with fallen bricks, and presence of some circumscribed ashy areas in the northeast and southeast corners; interpreted as wall melt and wall collapse. Depth: 5.07-5.59 m.

***Level 14** [Munsell: 10YR 6/1, Ahn: B] Ashy mixed with sand. Large quantities of charcoal, potsherds, animal bones, and glass and stone beads. A radiocarbon sample

was collected inside of a large pot fragment filled with ash, charcoal and ground. The resulting date is 1227 ± 42 B.P. (Wk 12631). Depth: 5.59-6.10 m.

Level 15 [Munsell: 10YR 5/4, Ahn: B] Sterile reddish sand.

APPENDIX I.4. GS3 LEVEL AND FEATURE DESCRIPTIONS

***Level 1** [Munsell: 10YR 8/4, Ahn: B] Friable sand with the presence of some circumscribed ashy areas. Large quantities of potsherds, iron and copper objects, iron slag and beads were uncovered. From 20 cm to a depth of 35 cm, a trash pit filled with ash, charcoal, sand, potsherds, animal bones and beads was encountered in the southeast. In this pit, a radiocarbon sample was collected in one pot containing ash, charcoal and sand. This level was interpreted as secondary trash deposit. Depth: 0.06-0.35 m.

Level 2 [Munsell: 10YR 5/3, Ahn: B] Ashy with the presence of charcoal, and a considerable quantity of potsherds, animal bones, copper and glass beads; interpreted as accumulation from Feature 1A and 1B. Depth: 0.35-0.64 m.

Level 3 [Munsell: 10YR 5/4, Ahn: B] Compact sand mixed gravel, with the presence of two bottle necks; interpreted as the interior fill of Feature 1B. Depth: 0.41-0.69 m.

Level 4 [Munsell: 10YR 5/4, Ahn: B] Sandy with the presence of charcoal, potsherds, bones and copper. This level was interpreted as a small channel oriented E-W with a wide of 28 cm. Depth: 0.54-0.86 m.

Feature 1A [Munsell: 10YR 5/4, Ahn: B] Rectilinear wall structure constructed with rectangular mud bricks, and located in the northwest corner. Oriented N-S, this structure had two horizontal layers. The brick dimensions were 40 x 20 x 4.5 cm. One spindle whorl was found under the bricks. Depth: 0.35-0.64 m.

Feature 1B [Munsell: 10YR 5/4, Ahn: B] Rectilinear wall structure oriented N-S-SE, and constructed with rectangular mud bricks. These bricks had the same size as Feature 1A. The wide of the structure was 70 cm. At 54 cm in depth, small channel (level 4) divided Feature 1B into two wall structures in the Southeast. At this depth, the southern part of Feature 1B was associated with Feature 1C wall structure, and the remaining wall of the feature continued up to 64 cm in depth. Depth: 0.35-0.64 m.

***Level 5** [Munsell: 10YR 5/4, Ahn: B] Reddish compact sand with the presence of some circumscribed ashy areas. Few potsherds, animal bones, glass beads, copper and charcoal were uncovered. A radiocarbon sample was taken in the ashy deposits. This level was interpreted as accumulation from Feature 2A and 2B. Depth: 0.64-1.26 m.

Features 2 A and 2B [Munsell: 10YR 5/4, Ahn: B] Two curved structures constructed with elongated lumps of *banco*. Each of these two features was ended by an oval structure. The wide of these *banco* lumps was comprised between 15 and 20 cm. The diameter of the interior sector of the structures was 1–1.10 m. The interior was filled with homogeneous and friable sand. Depth: 0.64-0.96 m.

Level 6 [Munsell: 10YR 5/6, Ahn: B] Compact and hard sand with the presence of some potsherds, animal bones, glass and glass beads. From 1.31 m to a depth of 1.46 m, a well-oxidized burnt area, with some charcoal in the deposit, was encountered in the southwest corner. This level was interpreted as accumulation from Feature 3. Depth: 1.26-1.70 m.

F3X [Munsell: 10YR 5/4, Ahn: B] Compact and hard sand mixed with some fallen bricks; interpreted as interior fill of Feature 3. Depth: 1.31-1.51 m

Feature 3 [Munsell: 10YR 5/4, Ahn: B] Rectilinear wall structure located in the northwest and constructed with rectangular mud bricks. The brick dimensions were 40 x 20 x 4.5 cm. This wall was oriented NW–SE and had 20 cm wide. Depth: 1.31-1.51 m.

Level 7 [Munsell: 10YR 5/6, Ahn: B] Compact and hard sand continued with few materials including some potsherds, iron, copper and beads; interpreted as accumulation from Feature 4. Depth: 1.70-2.08 m.

Level 8 [Munsell: 10YR 5/4, Ahn: B] Continuation of compact and hard sand with few artifacts including one iron bracelet, beads, manufacturing debris and potsherds. An isolated burnt area filled with ash and charcoal was encountered in the southwest. This level was interpreted as a continuing accumulation from Feature 4. Depth: 2.08-2.28 m.

Level 9 [Munsell: 10YR 5/4, Ahn: B] Same texture as levels 6-8 with the presence of beads and potsherds. Three isolated burnt areas were encountered in the centre of the unit. This level was a continuing accumulation from Feature 4. Depth: 2.28-2.37 m.

Feature 4 [Munsell: 10YR 5/4, Ahn: B] Rectilinear wall structure located in the east and constructed with mud bricks. It was oriented N – SE. The two edges of the structure had 1m wide and four horizontal layers of bricks. The wide of the central part was 45 cm. The brick sizes were 40-42 x 23-25 x 5-6 cm. This wall structure was interrupted by trash accumulation (level 8) at 2.15 m, however, at 2.31 m it reappeared and continued up to a depth of 2.37 m. Depth: 1.80-237 m.

Feature 1C [Munsell: 10 YR 5/4, Ahn; B] Rectilinear wall structure located in the south and constructed with rectangular mud bricks. It was oriented E – W. The brick dimensions were 40-43 x 20-25 x 5-6 cm. Depth: 0.54-2.40 m.

Level 10 [Munsell: 10YR 5/4, Ahn: B] Friable sand mixed in many circumscribed areas with ash and charcoal. Large quantities of animal bones, iron, potsherds, manufacturing debris, two long necks jars and some beads were uncovered. Rice seeds were also collected in the ashy deposits. This level was associated with Feature 5. Depth: 2.37-2.96 m.

Feature 5 [Munsell: 10YR 5/4, Ahn: B] Curved structure constructed with elongated lumps of *banco* and located in the northwest. A substantial quantity of rice seeds was collected inside this structure, interpreted as cereal storage space. Depth: 2.57-2.74 m.

Level 11 [Munsell: 10YR 6/6, Ahn: B] Sandy mixed in the south with ash containing some potsherds, copper and beads. Depth: 2.96-3.13 m.

***Level 12** [Munsell: 10YR 4/4, Ahn: A] Friable ash with the presence of large quantities of potsherds, animal bones, manufacturing debris, beads, glass, copper and iron objects. Two earthen lamps and two iron pendants were uncovered. This level was associated with Feature 6. Depth: 3.13-4.90 m.

Feature 6 A cluster of various kinds of pottery including long neck jars, plates, vases and fragments of jar necks. Near and inside of some of these vessels, some iron objects and one cup were collected. Depth: 3.55-3.64 m.

Feature 7 [Munsell: 10YR 6/2, Ahn: B] Trash pit located in the south and filled with ash and sand very friable, charcoal, and large quantities of potsherds, animal bones, copper and manufacturing debris. The soil was greenish. Depth: 4.88-5.10 m.

Level 13 [Munsell: 10YR 5/4, Ahn: B] Friable sand and ash, with the presence of many potsherds, animal bones, copper, glass, manufacturing debris and beads. Depth: 4.90-5.00 m

Level 15 [Munsell: 10YR 6/1, Ahn: B] Ashy and sandy with greenish color. Materials included animal bones, charcoal and potsherds. This level was associated with Feature 7. Depth: 5.10-6.20 m.

Level 14 [Munsell: 10YR 4/4, Ahn: B] Reddish compact sand mixed with some fallen bricks. Artifacts included some potsherds, glass beads, copper and iron. This level was interpreted as wall collapse and wall melt. Depth: 5.00-6.20 m.

***Level 16** [Munsell: 10YR 6/4, Ahn: B] Sandy, with the presence of charcoal and some circumscribed ashy areas. Large quantities of animal bones, copper, beads, iron and potsherds were uncovered particularly in the ashy deposits. At a depth of 6.50 m, a trash pit filled with potsherds, bones, charcoal, sand and ash, were encountered in the northeast. This trash pit continued up to 7.02 m in depth. Depth: 6.20-7.05 m.

Level 17 [Munsell: 10YR 5/6, Ahn: B] Reddish sand mixed with gravel; sterile soil. Depth: 7.05-7.30 m.

Appendix II

II.1. Summary table of recording attributes and codes used for Body sherd multiple attribute and Rimsherds

<p>Paste Hardness 1- Soft 2- Medium 3- Hard to break with pliers</p>	<p>Paste Color (Other than black core) See color code and corresponding Munsell values in Table 5</p>	<p>Black core 0 – none (Fully oxidized) 1- < ½ thickness 2- ≥ ½ thickness 3- Surface oxidation only 4- Black throughout</p>
<p>NPI dominant 1- Sand 2- Organic 3- Grog</p>	<p>NPI other 1- Sand 2- Organic 3- Grog 4- Sand and grog 5- Organic and grog</p>	<p>Surface preparation 1- Smoothed (Void – free) 2- Voids 3- Gritty 4- Voids and gritty</p>
<p>Part 1- Rim only 2- Rim + shoulder 3- Rim + shoulder + body 4- Rim + body</p>	<p>Rim type - See Major rim group types in Appendix A</p>	<p>Angle - Record for simple, beaded, thickened, and everted (if not 4) - See figure A5 in Appendix A</p>
<p>Diameter - See figure A3 in Appendix A</p>	<p>Lip shape - Use variants of simple rim codes if lip shape sections to vary in everted rims (fig. 24).</p>	<p>Slip – Outer surface 0 - none 1 - dark red / orange slip 2 - light orange slip 3 - black slip 4 - white slip 5 – dark red / + white slip 6 - dark red / + light orange slip 7 – dark red / + black slip</p>
<p>Slip position - outer surface 0 - overall 1 – lip only 2 - Rim 3 - rim and shoulder 4 - rim, shoulder and body 5 - shoulder and body 6 - body 7 - rim and body</p>	<p>Slip – Inner surface 0 - none 1 - dark red / orange slip 2 - light orange slip 3 - black slip 4- dark red / + light orange slip</p>	<p>Position outer surface 0 - overall 1 – lip only 2 – Interior except lip</p>

II.1 (cont). Summary table of recording attributes and codes used for Body sherd multiple attribute and Rimsherds

<p>Unslipped and Slipped Twines Tw4 Tw6 Tw30 - Sisal weave Tw31 – Sisal efface Tw32 – Bird foot Tw33 – Large Tw6 Tw34 – Very fine Tw6 99 – Eroded twine</p>	<p>Twine position 0 - overall 1 – lip only 2 - Rim 3 - rim and shoulder 4 - rim, shoulder and body 5 - shoulder and body 6 - body 7 - rim and body 8 - inside</p>	<p>Paint color (codes used at Jenne jeno in McIntosh 1995) 0 - none 1 - white/cream 2 - black 3 - red/orange 4 - white, red and black 5 - Black and red 6 - white and black 7 - white and red</p>
<p>Paint motif If absent – “NA” 0 – Solid field 1 – Horizontal band/stripes 2 – Vertical stripes/ band 3 – Vertical undulates 4 – lines + dot combo 5 – cross-hatch 6 – dots 7 – geometric 8 – Straight and curved lines 9 – Bull ‘s eye 10 – Curved band/stripes</p>	<p>Paint Position - Same as Twine position</p>	<p>Paint motif applied over 0 – Unslipped surface 1- Slip 2 – Channels 3 – Twine 4 – Comb impression 5 – Channel + slip 6 – Slip surface + Twine</p>
<p>Plastic 0 – none 1 – Single groove 2 – wide deep channels 3 – Shallow channels 4 – Incision over twine 6 5 – Incision 6 – Impressed straight comb 7 – Impressed curved comb 8 – Rockered comb 9 – Narrow channels 10 – Impressed geometric comb 11 – Impressed zigzag comb</p>	<p>Plastic position Same as Twine position</p>	

Appendix II.3. Example of recording form of ACGS Body sherd Multiple Attribute

Lvl	LRF	Feat	Hard	Past CLR	Black Core	Surf Prep	Slip OS	OS Pos	Slip IS	IS Pos	Unsl Tw	Slip Tw	Tw Pos	Slp Tw2	Slp Tw 2 Pos	Paint C	Paint M1	Pt Pos	Applied over	Paint C2	Paint M2	Pt Pos2	Applied on top of?	Plastic M1	PI Pos	Plast M2	PI Pos2	Observ.	
1	1		2	2	1	3	1	0	0	0	0	31	6	0	0	1	1	6	3	0	0	0	0	0	0	0	0	0	
1	1		2	1	1	1	1	0	1	0	0	0	0	0	0	1	1	6	1	0	0	0	0	2	8	0	0		
2	2		2	1	3	3	1	0	0	0	0	34	6	0	0	0	0	0	0	0	0	0	0	4	6		0	vertical straight incisions over fine Tw 6	
5	5		3	5	2	1	1	0	0	0	0	0	0	0	0									8	6	5	6		
18	22		2	1	3	1	1	0	0	0	0	0	0	0	0	1	1	6	4	1	7	6	4	8	6		0		
25	32		2	1	3	1	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	0		
26	33		2	1	1	3	1	0	1	0	0	4	6	0	0	0	0	0	0	0	0	0	0			0	0		
27	34		3	8	1	1	1	0	0	0	0			0	0	1	1	6	4	0	0	0	0	6	6	0	0		
29	35		2	5	0	3	3	0	0	0	0	4	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	White paint on Tw 4 efface	
34	41		2	2	3	3	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	5	6	0			
		5	2	2	1	1	1	0	0	0	0	0	0	0	0	1	6	6	4	0	0	0	0	10	6	6	6	Cross hatch comb	

Key to recording form: LVL (Level); LRF (Level Record Form); Hard (Hardness); Past CLR (Paste Color); NPI dom. (Non Plastic Inclusion dominant); Surf. Prep (Surface preparation); Slip OS (Slip Outer Surface); OS Pos (Outer Surface Position); Slip IS (Slip Inner Surface); IS Pos (Inner Surface Position); Unsl Tw (Unslipped Twine); SlpTw (Slipped Twine); Paint C1 (Paint Color 1); Paint M1&2 (Paint Motifs 1 & 2) Pt Pos (Paint Position); Plastic M1&2 (Plastic Motifs 1&2); PI Pos (Plastic Position) Obsev. (Observation)

Appendix II.2 (cont). Example of recording form of ACGS body sherds

Lvl	LRF	Feat	Tw6			Unid Tw (eroded)	Channeled			Paint Only			Plastic		Total of sherds
			V. F	Med	Lg		NO SL	SL (see Plastic)	#NAME?	Color/ Motif 1	Color/ Motif 2	Color/ Motif 3	Motif 1 (with slip)	Motif 2 (with slip)	
1	1		2 sl	15 (9 no sl; 6 sl)	7 (2 no sl; 5 sl)	43	1pl. 2		2wt	1wt 7		8wt 1	1pl.1; 2pl 9	7pl.2, 2pl.3	148
5	5			2 sl	6 (1 no sl, 5 sl)	10	1pl.3		10wt	1wt8, 1red9	1wt4	1wt+R4	1pl.1, 12pl.3	1pl.9, 13pl.2	117
7	10		1sl			4	1pl3		3wt	3wt1			3pl.3		28
10	11		2 (1 no sl ; 1sl)		2 (1 no sl, 1 sl)	4	1pl3		1wt	3wt1			2pl3		33
18	24		3 sl	1 sl	1 sl	4				3wt1	1B1 1	1w + B1	4pl.2	2pl.3	40
26	33			1 sl		9	2pl.3	4pl.3	2wt + pl.2				1wt + B11 + Pl.2		54
		8			1 no sl	1		2pl.2	2wt0 + pl.3	2wt1	1B1 1				24
34	41			6 sl		11		1pl.3	1wt2 on Tw4						35

Key to recording form: V. F.: Very fine; Med: Medium; Lg: Large; Pt: Paint; Pl: Plastic; Wt: white

Appendix II.2. Example of recording form of ACGS body sherds

Lvl	LRF	Feat	Sac Weight	Rim Sac Weight	# < 4 cm ²	NO Dec	Slip	Sisal (Tw 30}			Bird Foot (Tw32)		Tw4	
								NO SL	SL	SL eff	NO SL	SL	NO SL	SL
1	1		*13000	5000	8	1	31		8	6	1		2	
2	2		*13000	5000	11	7	41	3	9	8				7 sl eff
5	5		*7000	2100	29	1	28	3	6 (3fr1)	1				
6	6		4100	1100	36	2	28	1	9					2 sl eff
10	13		11000	3100	15	5	27		25	26		1		4 (3sl, 1sl eff)
17	21		700	200	2		2			3				1 sl eff
18	22		2700	500	2		2		2			2		4(8fr1)
19	26		1600	500	2	1				10	1	1		1 sl
20	27		2300	750			2			4				
26	33		1900	500	1	2	15				6	2	6	3 sl
		8	600	100	2		4		2	4		1		2 sl
27	34		1200	500	2		3	4		6		3		
33	40		2200	500	32	10	9		2	1	4	2	1	8
34	41		1200	500	6		1				3	5		1 sl
		11	200	0								2		

Key to recording form: LVL : Level; LRF: Level record form; Feat: Feature; * : 50% of sherds were recorded; NO Dec: No decoration; Tw: Twine; NO SL: No slip; SL: Slip; Sl eff.: Slip efface; 3 fr 1: 3 sherds from 1 vessel

APPENDIX III.1

LA-ICP-MS analysis of glass beads from Gao

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Instrumentation and analytical parameters at the Field Museum

The analyses carried out at FM involved a Varian ICP-MS and a New Wave UP213 laser, for direct introduction of solid samples. The parameters for ICP-MS were optimized to ensure a stable signal with a maximum intensity over the full range of masses of the elements and to minimize oxides and double ionized species formation (CeO^+/Ce^+ and $\text{Ba}^{++}/\text{Ba}^+ < 1$ to 2 %). For that purpose the argon flows, the radio-frequency power, the torch position, the lenses, the mirror and the detector voltages were adjusted using an auto-optimization procedure. For better sensitivity, helium is used as a gas carrier in the laser. To be able to determine elements with concentrations in the range of ppm and below while leaving a trace on the surface of the sample invisible to the naked eye, the single point analysis mode with a laser beam diameter of 55 μm , operating at 70 % of the laser energy (0.2 mJ) and at a pulse frequency of 15 Hz was used. A pre-ablation time of 20 s was set up in order, first, to eliminate the transient part of the signal and, second, to be sure that a possible surface contamination or corrosion does not affect the results of the analysis. For each glass sample, an average of four measurements corrected from the blank is considered for the calculation of concentrations.

Isotope ^{29}Si was used for internal standardization. Concentrations for major elements, including silica, were calculated assuming that the sum of their concentrations in weight percent in glass is equal to 100 % (Gratuze, 1999).

Two different series of standard reference materials were used to determine the concentrations of major, minor and trace elements. The first series of external standards were NIST SRM 610 and 612. Both these standards are soda-lime-silica glass doped with trace elements in the range of 500 ppm (SRM 610) and 50 ppm (SRM 612). Certified values are available for a very limited number of elements. Concentrations from Pearce *et al.* (1997) were used for the other elements. The second series of standards were manufactured by Corning. Glasses B and D best match the compositions of ancient glass (Brill, 1999, vol. 2, p. 544). Glass Corning C is generally not one of the standards used for quantitative analysis but is measured regularly to check the reliability of our results.

Performance of the LA-ICP-MS protocol to determine the composition of ancient glass at the Field Museum

To evaluate the performance of our method, we determined its detection limits, reproducibility and accuracy (Dussubieux et al. 2009)

The detection limits are calculated as three times the standard deviation obtained from the measurement of ten blanks. Ideally, we should have measured these detection limits from multiple measurements on a pure silica material to take into account the contribution of the silica matrix to the background, but we did not have such a material. Therefore the limits of detection may have been slightly underestimated. Using the analytical protocol defined above, the detection limits range from less than 1 ppb to 2 ppm for copper and is generally under 1 ppm for most of the elements.

Accuracy for the elements of interest in this study is assessed by analyzing three standard reference materials, Corning glass B, D and C, under the same conditions as our samples. Accuracy is the relative deviation between the published concentrations and the average concentrations measured by LA-ICP-MS at the Field Museum. Accuracy is generally better than 10 %. For a few elements, the concentrations provided by Brill (1999) and our values did not coincide. Comparison with concentrations obtained by Popelka et al. (2005) shows a much better agreement, suggesting that the values published by Brill may have not been the best ones in a few cases.

For the standard reference materials Corning glass B and D, the reproducibility of results was calculated as the relative standard deviation (RSD) on the 20 measurements performed on the same reference materials over a period of approximately two years. Only five measurements were taken into account for Corning glass C.

Reproducibility is better than 10 % for most elements. Iron and lead may have a poor reproducibility. Because of the interference between $^{56}\text{Fe}^+$ and $^{56}\text{ArO}^+$, the isotope ^{57}Fe was selected with an abundance of only 2.2 %. For lead, the problem of reproducibility of the results is likely due to some slight contamination that occurs when too heavily leaded glass samples are measured.

Experimental results

All the samples are not made of glass. Indeed, the level of silica in GSO046 was very low and therefore this bead is not made of a silica-based material. The material this bead is made of could not be identified with LA-ICP-MS.

The other samples are soda-glass with compositions that vary in a wide range. Two glass groups were identified according to the magnesia and potash concentrations. Two samples have low concentrations (around 1.5 %) compared to the other samples (Figure 1).

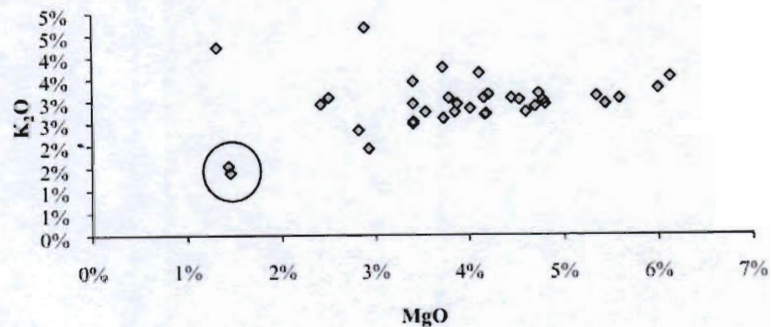


Figure 1. Binary diagram showing magnesia and potash concentrations for the glass beads from Gao.

These two samples are GAO022 and GSO016a. They are two dark blue beads. These two samples are soda-lime glass and the low concentrations of magnesia and potash indicate that the soda flux is quite likely coming from mineral deposit (e.g. natron). All the other samples have concentrations of potash and magnesia that range respectively between 1.9 and 4.7 % and 1.3 and 6.1 %. In this group, alumina is always below 4 % and lime concentrations vary from 4.7 to 10.6 %. This second group of glass was made from soda rich plant ashes and the different concentrations of magnesia and potash may indicate that different plants were used. This type of glass started replacing natron soda-lime glass around the 8th to the 10th c. A.D and was then dominant across the Islamic world.

The beads present different colors: dark blue, turquoise blue, red, green, yellow, white, colorless and black.

Samples GAO022 and GSO016a are dark blue and contain cobalt (~ 300 ppm) and also copper (~ 1000 ppm). Two other elements are present in abnormally high quantities in these glass beads: antimony (~ 1500 ppm) and lead (1900 ppm). It is quite likely that these different elements were not added to the glass batch with the cobalt but their presence maybe due to glass recycling. Indeed, copper, antimony and lead are three elements of importance in the coloring and the opacifying of natron soda-lime glass (Gratuze et al. 1996) and scraps of glass of different colors may have been mixed within the glass batch where cobalt was added.

Other dark blue glass beads belonging to the soda plant ash group contain also cobalt although associated with different suites of elements. Copper is present in all the samples (900 ppm < Cu < 1600 ppm). Only two samples contain significant quantities of zinc (GSO036 and GSO026a). GAO024 contains approx. 300 ppm of zinc and 1000 ppm of copper. It is quite likely that for this sample zinc was brought indirectly by copper added to the glass mix as brass. The same explanation could be used for GAO006. Approximately 200 ppm of nickel was detected in sample GSO035a. This element could be associated with cobalt.

Turquoise blue beads are colored by the presence of 1 to 1.4 % of copper. Other elements such as tin, lead and more rarely zinc are present in significant quantities. Two glass

beads contain particularly high concentration of lead: 60 % for GAO015 and 45 % for GAO016. Rather than turquoise blue, these two beads appear transparent green. Copper (as an ion Cu^{2+}) produces a green color in a glass when it contains lead. Bead GAO018 is also a glass containing high quantities of lead (26 %) but tin is also present in fairly high concentration (2.7 %). This bead is opaque. Tin oxide (SnO_2) is a white opacifier that the presence of lead renders more stable. Glass beads GAO020, GAO021 and GSO039 contains also significant quantities of lead and tin, although in different proportions compared to GAO018. Less lead was used for these last three beads. Tin and lead in the three beads may also have been added to opacify the beads. Other turquoise blue beads contain small quantities of tin, lead and zinc. These elements were quite likely introduced in the glass by accident with the copper.

Only one red sample was analyzed (GSO036R). It was part of a composite bead. The red glass was colored with copper (2 %). This glass contains more iron than any other glass from Gao (2.5 %) and very little tin, antimony or lead. Iron, tin, lead or antimony are elements that can potentially facilitate the red color produced by copper. In this case, it seems that iron was the element added as an internal reducer of copper (Ahmed et al. 1977).

Copper is also involved in the production of green glass in conjunction with a yellow opacifier. Green and yellow glasses contain both significant quantities of lead and tin. Lead stannate (PbSnO_3) is a yellow opacifier that may have been used in these glasses. Lead and tin are in the same proportions in the yellow and green glass (Figure 2).

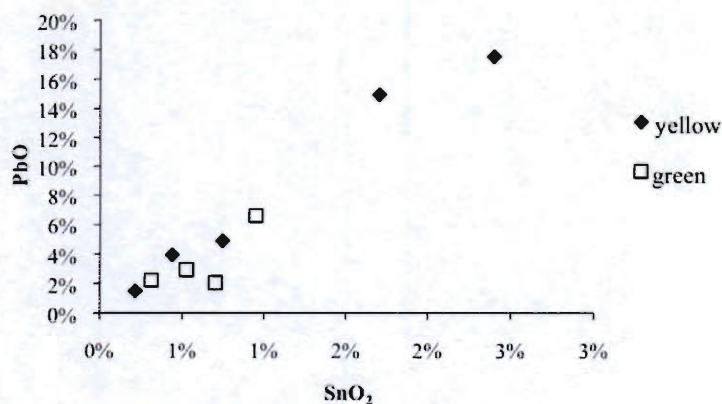


Figure 2. Binary diagram showing the tin and lead oxides concentrations for the yellow and green glass beads of Gao.

The use of a white opacifier was mentioned before in the case of the turquoise blue glass. White glass contains, like opaque turquoise blue glass, tin and lead. Bead GSO038, that is more translucent than really opaque, contains very small proportions of these two elements (0.3 % of tin and 0.5 % of lead). Several percents of both these elements were measured in samples GSO049 and GAO006. Sample GSO036W contains a fair amount of tin (3.5 %) but very little lead was detected in this bead suggesting that a different recipe was used to produce this white glass.

To produce colorless glass two recipes were identified. For glass bead GSO031, no discoloring ingredient could be identified. A good control of the furnace atmosphere must have been used to minimize the coloring effect due to the accidental presence of iron in the glass. Bead GAO005 is also made of colorless glass. This glass contains the highest concentration of manganese of all the Gao glass beads and this element quite likely was used to discolor the glass. Analyses performed with a portable XRF showed that the metal foil that is visible through the glass is made of silver.

Only one sample is dark (GAO006B1). The color is quite likely due to the presence of iron (1.1 %) and manganese (1.6 %).

Discussion

Two recipes were identified among the 30 glass beads from Gao. One of them is only represented by two samples. This recipe, characterized by the use of a lime-rich sand mixed to natron was the dominant recipe that was used in the workshops of Syro-Palestine until the 8th c. A.D. Then, natron was substituted to soda plant ashes and a sand with a higher silica content was selected (Freestone, I.C. and Gorin-Rosen, Y, 1999). Between the 8th and the 10th c. soda plant ash glass replaced progressively the natron glass. Most of the beads belong to this second type of glass. However, the composition of the soda plant ash glass at Gao varies a lot (Figure 1 and 3).

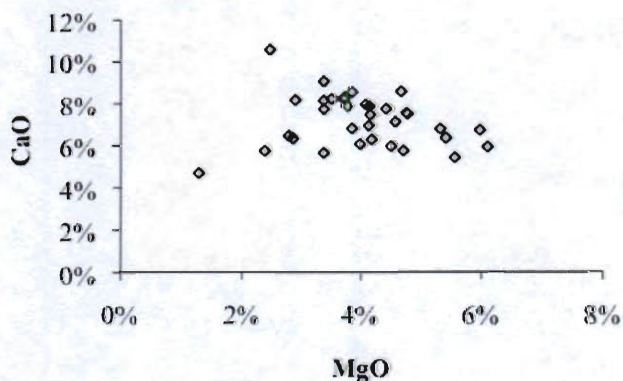


Figure 3. Binary diagram reporting the magnesia and lime concentrations for the soda plant ash glass.

Perhaps, different plant species were used; perhaps, different workshops produced the plant ash glasses from Gao. Henderson et al. (2004) noticed a wide variation in the composition of the soda plant ash glass at the site of Raqqa (Syria), where was identified a glass production workshop. Experimentation with raw materials and recycling were the two reasons that were proposed to explain such a dispersion of the compositions.

Colors were obtained according to different recipes or types of ingredient. For example, white was either produced by the presence of tin oxide alone or in conjunction with lead. Turquoise blue contains always copper but also other elements such as lead, tin and zinc

that are involved for different purposes or accidentally and in different proportions. Manganese was certainly used to discolor glass but the same effect was obtained by just controlling the atmosphere of the furnace without any addition of any discoloring ingredients. These observations suggest different origins for the Gao beads rather than a glass coming from a single workshop that was “experimenting”. Identifying provenance is however extremely difficult as very few data are available for glass beads. Most of the soda plant ash compositions correspond to glass vessels.

Green lead glass is very distinctive because so high quantities of lead are quite unusual at this period and in this geographic area. Brill (1999) identified a few green glass samples in the cargo of the Serçe Limani dated ca. 1025 but the compositions of the green lead glass from Gao and the Serçe Limani differ quite significantly (e.g. several percents of soda was measured in the Gao beads whereas this component is less than 1 % in the Serçe Limani glass). No acceptable match was found with European lead glass (Wedhepol et al. 1995).

Conclusion

Among the 30 glass beads from Gao, one is not glass and for the 29 others, two different glass types were identified. Only two beads are made of natron soda-lime glass and where quite likely manufactured in the Syro-Palestinian region. The others where soda glass made from soda plant ashes. If it seems that this glass is more recent than the previous one, both glass in some region persisted over long period of times. The soda plant ash glass was manufactured in the Middle-East but it is not possible to be more precise in terms of provenance.

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APPENDIX III.2

LA-ICP-MS analysis of glass beads from Gao Saney, Mali

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Experimental

The analyses were carried out at the Field Museum of Natural History in Chicago, USA, with a Varian Inductively Coupled Plasma - Mass Spectrometer (ICP-MS) connected to a New Wave UP213 laser for direct introduction of solid samples.

The parameters of the ICP-MS are optimized to ensure a stable signal with a maximum intensity over the full range of masses of the elements and to minimize oxides and double ionized species formation (XO^+/X^+ and $X^{++}/X^+ < 1$ to 2 %). For that purpose the argon flows, the RF power, the torch position, the lenses, the mirror and the detector voltages are adjusted using an auto-optimization procedure.

For better sensitivity, helium is used as a gas carrier in the laser. The choice of the parameters of the laser ablation not only will have an effect on the sensitivity of the method and the reproducibility of the measurements but also on the damage to the sample. To be able to determine elements with concentrations in the range of ppm and below while leaving a trace on the surface of the sample invisible to the naked eye, we use the single point analysis mode with a laser beam diameter of 55 μm , operating at 70 % of the laser energy (0.2 mJ) and at a pulse frequency of 15 Hz. A pre-ablation time of 20 s is set in order, first, to eliminate the transient part of the signal and, second, to be sure that a possible surface contamination or corrosion does not affect the results of the analysis. For each glass sample, the average of four measurements corrected from the blank is considered for the calculation of concentrations.

To improve reproducibility of measurements, the use of an internal standard is required to correct possible instrumental drifts or changes in the ablation efficiency. The element chosen as internal standard has to be present in relatively high concentration so its measurement is as accurate as possible. In order to obtain absolute concentrations for the analyzed elements, the concentration of the internal standard has to be known. The isotope Si29 was used for internal standardization. Concentrations for major elements, including silica, are calculated assuming that the sum of their concentrations in weight percent in glass is equal to 100 % (Gratuze, 1999).

Fully quantitative analyses are possible by using external standards. To prevent matrix effects, the composition of standards has to be as close as possible to that of the samples. Two different series of standards are used to measure major, minor and trace elements.

The first series of external standards are standard reference materials (SRM) manufactured by NIST: SRM 610 and SRM 612. Both of these standards are soda-lime-silica glass doped with trace elements in the range of 500 ppm (SRM 610) and 50 ppm (SRM 612). Certified values are available for a very limited number of elements. Concentrations from Pearce *et al.* (1997) will be used for the other elements. The second series of standards were manufactured by Corning. Glass B and D are glasses that match compositions of ancient glass (Brill, 1999, vol. 2, p. 544).

The detection limits range from 10 ppb to 1 ppm for most of the elements. Accuracy ranges from 5 to 10 % depending on the elements and their concentrations. A more detailed account of the performances of this technique can be found in Dussubieux *et al.* 2009.

Results

In 2009, 30 glass beads from Gao were analyzed using LA-ICP-MS. More beads were studied in 2010 with the same analytical method. Several beads were corroded and from the 50 beads selected for analysis only 33 will be discussed here. Compositions are in Table 1.

From a general point of view, results from the two studies conducted in 2009 and 2010 concur well and in both cases, the vast majority of the beads are made from soda plant ash glass (Figure 1). A few specimens with lower magnesia and potash concentrations are soda glass made from mineral soda (e.g. natron) instead of plant ash.

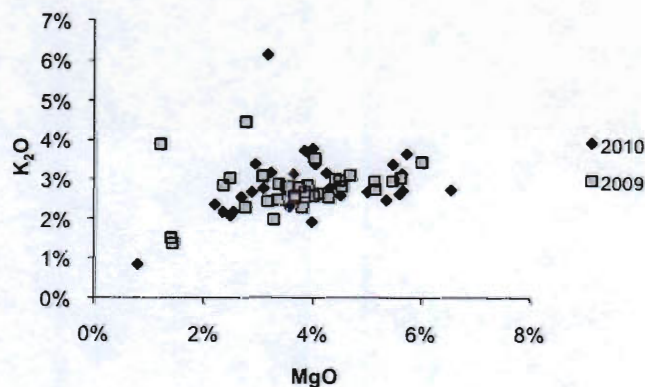


Figure 1. Concentrations of MgO and K₂O for the soda plant ash and mineral soda glasses from Gao analyzed in 2010 and 2009.

Sample GS0057, is the only glass bead in the 2010 batch with lower magnesia and potash concentrations. Two more glass beads analyzed in 2009 had the same compositions. The three glass beads are dark blue and were colored with cobalt. We noted in 2009, that higher concentrations of copper, lead and antimony were present in the dark blue mineral

soda glass beads. The same observation applies to GS0057 confirming a common origin for the three beads.

One sample, GS0065, contains a high concentration of lead (~ 90 %). Aside from lead, only silica is present in significant quantity in this bead with a concentration of 6 %. Copper (0.1 %) is quite likely the coloring agent in the glass.

Soda plant ash glass was identified for 31 beads. At the exception of GS0078, that has higher potash and alumina concentrations (as well as a different trace element signature), soda plant ash glass seems to fit in a same group. Average reduced compositions for the 2009 and 2010 studies are reported in table 2.

	2009	2010
SiO ₂	68.0 +/- 2.0	69.4 +/- 3.0
Na ₂ O	14.5 +/- 1.4	14.3 +/- 1.8
MgO	4.1 +/- 1.1	4.4 +/- 1.2
Al ₂ O ₃	2.3 +/- 0.8	1.9 +/- 0.5
K ₂ O	3.0 +/- 0.5	3.1 +/- 0.6
CaO	7.1 +/- 1.2	6.1 +/- 1.2
Fe ₂ O ₃	1.1 +/- 1.6	0.6 +/- 0.7

Table 2. Average reduced compositions for the soda plant ash glass groups identified in 2009 and 2010.

Colors for the soda plant ash glass are: dark blue, turquoise blue, green, yellow and white. Opacity is difficult to assess due to corrosion.

The dark blue glass is colored with cobalt that has concentrations ranging from 150 to 1200 ppm. Other elements are in significant quantities in the dark blue glass beads, such as copper, zinc or lead. One bead contains 300 ppm of nickel. Nickel is associated to cobalt in ore. Several cobalt sources may have been used. This may be an indication of different provenances for the dark blue glass, or a change in the cobalt ore supply or a difference in cobalt sources according to the chronology.

Turquoise blue glass beads contain copper in concentrations ranging from 0.2 to 1.9 %. As noted in the 2009 report, copper is associated with lead, tin and more rarely to zinc.

Copper is also present in green glass beads. Green glass beads are opaque and contain lead and tin that suggest the presence of lead stannate (PbSnO₂) that is a yellow opacifier.

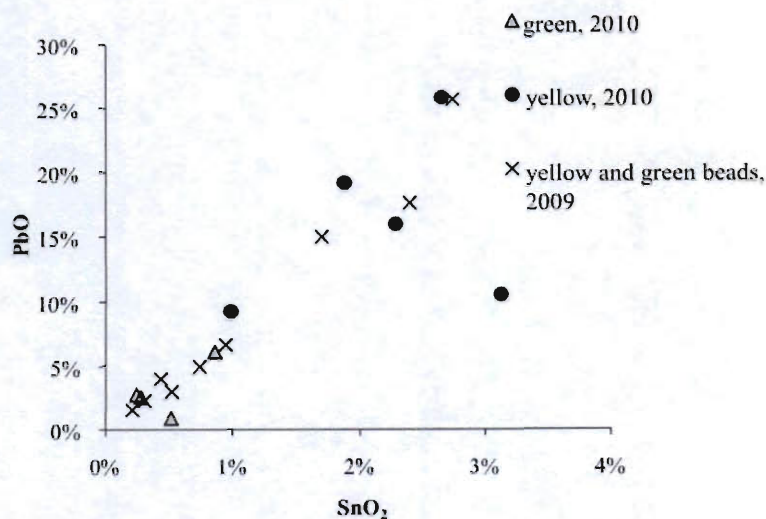


Figure 2. Tin oxide and lead oxide concentrations for the yellow and green soda plant ash glass analyzed in 2009 and 2010.

Green and yellow glass beads analyzed in 2009 and 2010 have the same proportions of tin and lead.

White glass contains small quantities of tin (0.2 to 1.4 %). Cassiterite (SnO₂) is a white opacifier. White glass beads contain also significant quantities of manganese (0.4 to 1.4 %) that may have been used to obtain a colorless base glass.

Discussion

Results obtained in 2009 and 2010 are similar and it is possible to confirm that soda plant ash glass is the most common glass at the site of Gao. Three beads are made from a mineral soda glass. This recipe, characterized by the use of a lime-rich sand mixed to natron was the dominant recipe that was used in the workshops of Syro-Palestine until the 8th c. A.D. Then, natron was substituted to soda plant ashes and a sand with a higher silica content was selected (Freestone, I.C. and Gorin-Rosen, Y, 1999). Between the 8th and the 10th c. soda plant ash glass replaced progressively the natron glass. It is not possible at this stage to determine a precise provenance for the soda-plant ash glass.

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**PRELIMINARY ARCHAEOMETALLURGICAL REPORT:
LEAD ISOTOPIC RATIO ANALYSES OF COPPER-ALLOY OBJECTS EXCAVATED FROM
THE ARCHAEOLOGICAL SITE OF GAO SANEY, MALI, WEST AFRICA**

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INTRODUCTION

A subsample of the copper-based metal artifacts recovered from the archaeological excavations at Gao Saney, Mali, West Africa, conducted by Mamadou Cissé were submitted for examination and selected archaeometallurgical analyses. The analyzed samples (Appendix Table 1), were subjected to a physical examination with the naked eye and enhanced by hand-held lenses (5x, 10x) as well as by a binocular microscope (5x, 10x, 20x, 40x), and a description of each, including metrics, was recorded. All specimens were photographed in color before further sampling for analyses.

Presented here are preliminary results of a pilot study of the Gao copper-based metals focusing primarily on the lead isotopic ratio analyses (LIA). A more detailed archaeometallurgical examination of the assemblage, including additional LIA, compositional analysis, metallographic examinations and typological characterization, is currently underway and will be published at a later time. The total sample size examined in this pilot study is small, but already interesting conclusions can be made. To augment the results, comparable analyses of unpublished copper-based metals from other archaeological research at Gao, as well as from other West African archaeological sites and West and North African ore deposits, also will be included in some discussions of the results.

Gao

Gao is an archaeological site located on the Niger River in Mali where the river has turned to the south and is heading toward the ocean. It played an important role in the distribution of raw materials and finished goods in sub-Saharan West Africa, both in east-west and north-south directions along the Niger River and Savanna, Sahel, and Saharan zones. Gao was being supplied from a variety of trade networks, especially in the late first and early second millenniums A.D., from such regions as Egypt and Tunisia, Morocco, the gold regions of Senegal, Mali and Burkina Faso, and the forest regions of southern West Africa. As such, analysis of copper-based metal artifacts from this site can be used as a proxy to understand movement of goods in general throughout these regions over the course of time.

LEAD ISOTOPIC RATIO ANALYSIS METHODS

A sub-sample of the Gao-Saney metal objects was subjected to lead isotopic ratio analysis in order to examine potential production sources for the metal used to manufacture the object. The lead isotopic analysis technique has been successfully applied to limit or identify sources of raw materials (typically, lead or copper ores) used in producing metals, glasses, and ceramic glazes (see for example Gale 1989; Gale and Stos-Gale 2000; Stos-Gale 2004; Stos-Gale 1992; Thibodeau, et al. 2007). Recent efforts to utilize this technique in Africa, and particularly West Africa, also have had success (see for example Fenn 2011 (in prep); Fenn, et al. 2009; Fenn, et al. 2011 (in prep); Skaggs, et al. 2011 (in prep)).

Sampling

A total of six (n=6) copper-based metal objects were sampled and isotopically analyzed during this preliminary stage of the archaeometallurgical research. Sampling comprised removal of a fragment of the metal object with sterile tools. Metal objects selected for this preliminary analysis were chosen based on condition (i.e., retaining intact uncorroded metal), and on their stratigraphic position (see Appendix Table 1). This was done to examine whether there appeared to be changes through time in metals at the site reflected by variation in isotopic ratios of the metals objects. One particular type of artifact, the small copper crescents, was a focus of the sampling as this also could reveal changes through time within a particular artifact type present in several stratigraphic contexts. The sampled metal fragments were then weighed and placed in acid-cleaned Teflon vials for complete acid digestion.

Sample Preparation and Instrument Analysis Methods

All sample digestion and chemical separation was performed in a clean chemistry laboratory using twice-purified ultra-pure reagent grade acids and waters, and solution blanks were generated throughout the sample preparation process and checked prior to instrumental analysis of the samples. The digestion and separation routine lead blanks (i.e., background levels of lead from the entire preparation and chemistry process) were below 1 part-per-billion (ppb), or less than 1 nanogram (10^{-9} g), and considered inconsequential with regards to contamination of the sample solutions, which all had lead concentrations more than 6 orders of magnitude greater than the blanks.

Samples were dissolved in a series of twice distilled acids beginning with a mixture of concentrated hydrofluoric and nitric, followed by concentrated hydrochloric, concentrated nitric and finally 8M nitric. Lead was extracted in anion exchange columns utilizing Eichrom Sr Resin and eluted with several molarities of twice distilled nitric and hydrochloric acid. Subsequent to extraction, sample lead was diluted with 2% twice distilled nitric acid to 50ppb and analyzed on a GV Instruments Ltd. - IsoProbe-P™ multicollector inductively-coupled plasma mass spectrometer (MC-ICP-MS) located in the Department of Geosciences at The University of Arizona, Tucson. Throughout the lead analysis run, National Bureau of Standards lead (NBS-981) was analyzed between unknown samples. All results were corrected mercury interference at mass 204 and empirically normalized to a thallium (Tl) spike using the exponential law correction (after Rehkämper and Mezger, 2000). Machine and inter-laboratory bias was corrected by normalizing all results to the values reported by Galer and Abouchami (1998), for NBS-981 standard ($^{206}\text{Pb}/^{204}\text{Pb} = 16.9405$; $^{207}\text{Pb}/^{204}\text{Pb} = 15.4963$; $^{208}\text{Pb}/^{204}\text{Pb} = 36.7219$).

Reproducibility on individual samples is reflected by the internal error, while long-term reproducibility of the NBS-981 lead standard reflect external errors and is partly the result of mass bias effects within the instrument. External errors exceed internal errors in all cases for lead isotope ratio analysis and are reported here at 2σ .

LEAD ISOTOPIC ANALYSIS RESULTS AND INTERPRETATIONS

The lead isotopic ratio analysis results for the six specimens analyzed in this research, and their corresponding margins of error, are reported in Appendix Table 2. In general, the Gao Saney materials divide into two groups in bivariate plots based on ratios of four stable lead isotopes (Appendix Figures 1a-1b and 2a-2b). One group is formed by four copper-based objects all of the same artifact type with two being so isotopically similar that the error bars overlap indicating that they are analytically indistinguishable. The other two objects in this group also are similar to each other and in one plot (Appendix Figure 2b) actually separate somewhat from the other two objects in the group at the plotted scale. The second group, also formed by two copper-based objects, is composed of artifact types different from the first group. These groupings suggest that at least two different sources of metal used to manufacture these objects are represented by these six samples.

Gao: the Bigger Picture

Since the six samples in this preliminary analysis (Gao Saney, Gao Saney-MC, and GS1 in graphs) do not represent a very large archaeological comparative dataset for Gao, additional unpublished analyses of four more objects recovered from different archaeological researches at Gao also are included for a greater understanding of Gao copper-based metallurgy. Two additional analyzed samples were recovered from excavations in 1993 by Timothy Insoll at Gao Ancien (Gao Ancien-TI and GA in graphs) and Gao Saney (Gao Saney-TI and GS in graphs), and two other samples came from test excavations by Susan McIntosh at the site of the Mosque of Kankan Mansa Moussa at Gao (Mosque of Kankan Moussa-SKM and GKM in graphs). It should be noted that the Mosque of Kankan Moussa is situated on the ruins of Gao Ancien.

Initial comparisons of these four additional analyses with the six original Gao Saney analyses illustrate immediate similarities and differences (Appendix Figures 3a-3b and 4a-4b). First is that the lone additional sample from Gao Saney plots with the group of two copper-based objects also from Gao Saney. Second is that the remaining three analyses form two new groups, well away from the Gao Saney groups, in all plots. A third observation is that the two analyses from the Mosque of Kankan Moussa plot separately, one by itself but the other plotting with the lone analysis from Gao Ancien. A final observation is that nearly all of the analyses, with the exception of one Mosque of Kankan Moussa sample, plot in a general linear array in most graphs; this could be significant for interpretations which will be discussed a bit later.

An additional variable for consideration which will quickly shed light on these groupings is by including the base metal type of the various analyzed samples. In some cases, the metal type is known from both visual and compositional analyses, while in other cases, such as for the six samples from Mamadou Cissé's Gao Saney excavations presented here, the metal type at this time is determined only by visual inspection. The

metals of the ten samples analyzed for lead isotopic ratios from Gao comprise two basic metal types: unalloyed copper¹ and brass (Appendix Figures 5a-5b and 6a-6b). As is clear from these figures, the two brass samples, one each from Gao Ancien and the Mosque of Kankan Moussa, form their own discrete isotopic group, while all the other samples, made of unalloyed copper, form three other discrete clusters. Therefore, an interpretation can be deduced from this that the brass metals share a similar source origin, which is distinct from the unalloyed coppers. One other detail indicated in these figures is that the single analysis from Timothy Insoll's excavations at Gao Saney (GS_Cu-crucible) was made on a copper prill (or metallic droplet) adhering to the interior of the crucible fragment. The analysis of this prill shares strong isotopic similarities with two of the copper objects from the current Gao Saney excavations. This suggests that the copper metal in these two objects may result from melting and casting of unalloyed copper metal in crucibles at Gao Saney.

Another variable for consideration of these isotopic groupings is the specific artifact type. When the lead isotopic analyses are again plotted including this information more distinctions can be made in the groupings (Appendix Figures 7a-7b and 8a-8b). First, the four crescents form their own isotopic grouping suggesting a common or similar origin for the metal used in their production. Second, the unalloyed copper sheet metal and wire samples from the current excavations at Gao Saney are similar and also share similarities with the copper prill from the crucible recovered during Timothy Insoll's excavations; the potential interpretation of this has already been mentioned. However, this also is interesting in that these two artifact types do not share similarities with the four copper crescents from Gao Saney, suggesting that these objects were made from different metals than the crescents. Third, the distinction of the brass strips from Gao Ancien and the brass bar from the Mosque of Kankan Moussa has already been mentioned based on the metal type, but these objects, one of which may be a remnant ingot (the brass bar), could have been manufactured as finished objects outside West Africa and imported in their finished forms.

Finally, the unalloyed copper ring from the Mosque of Kankan Moussa is distinct in object form and isotopic ratios from all other analyzed samples. Since both alloyed (e.g., brass) and unalloyed copper metal was imported to West Africa, it is possible that this ring also may have been produced outside West Africa and imported in its finished form. To better understand some of these potential interpretations and to examine more closely sources for the raw metal used to manufacture these objects, comparisons with comparable analyses from potential ore sources for the metals will need to be made.

Comparisons with Potential Ore Sources: Africa

From this point forward comparisons will be limited to only the six analyzed copper-based samples from Gao Saney recovered during Mamadou Cissé's excavations. In all ore data comparisons, an analytical error margin of $\pm 0.05\%$ is utilized for the published values as this is an approximate average of typical reported errors for a

¹ Unalloyed copper may contain minor or trace amounts of typical alloying elements, such as tin, zinc or lead, but the amounts are not enough to alter the color of the metal from that of pure copper. Even small amounts of zinc can produce a significant change in the color of the copper metal, so that lack of color change in the samples identified as "unalloyed copper" is indicative of very low concentrations of zinc, if it is present at all.

substantial portion of the published ore analyses. The analytical errors associated with the new analyses for Gao Saney presented here are smaller than the symbols used to plot the analyses, at the scales used to plot analyses in these figures. Since there is good reason to question the accuracy of some published isotopic ratios of ^{206}Pb , ^{207}Pb , and ^{208}Pb versus ^{204}Pb , I have chosen not to include ratios utilizing ^{204}Pb for the ore comparisons in this study. Therefore, for all further visual comparisons the ratio data are plotted in two graphs using three other lead isotopic ratios: $^{207}\text{Pb}/^{206}\text{Pb}$ for the x-axis, and $^{208}\text{Pb}/^{206}\text{Pb}$ and $^{208}\text{Pb}/^{207}\text{Pb}$ for the y-axes. The use of the same ratio for the x-axis on both graphs provides comparison in three-dimensional space using data plotted in two dimensions in the two graphs. Note also that the scales for the x-axes in both plots are the same.

The first criterion for comparison is to evaluate which ore deposits in Africa are geographically relevant. Therefore, analyses from deposits in places such as the Central African Republic, Democratic Republic of Congo, Angola, Zambia, Zimbabwe, South Africa and countries of East Africa, were excluded from the comparisons as being extremely unlikely potential source regions for the metals found at Gao Saney. Working with the remaining geographically relevant ore deposits from Africa, the number of available published analyses is limited. Initial comparisons with lead isotopic analyses on ores from Nigeria and Algeria, also demonstrated that these deposits presented no isotopic correspondence with the Gao Saney materials and so they are eliminated from the graphic comparisons presented here. The remaining African analyses comprise ore samples from Egypt, Tunisia and Morocco. Recent lead isotopic work on ore samples from Tunisia, many of which are still unpublished (Fenn, et al. In prep (2011); Skaggs 2007; Skaggs, et al. 2011 (in prep); Skaggs 2010), provide a disproportionately large comparative data set from that region. However, examination of the published analyses from Egypt and Morocco can still effectively serve to determine whether ores from these countries could be potential sources for the Gao Saney metals.

Appendix Figures 9a-9b clearly illustrate that both Egypt and Morocco are unlikely source regions for the analyzed metals from Gao Saney, even considering the large analytical errors associated with the ore analyses. However, comparison with the Tunisian ore analyses immediately reveals some potential source information. First, the four similar analyses from Gao Saney plotting on the left of the graphs represent the four copper crescents, while the two similar analyses plotting on the right of the graphs represent the copper wire and sheet samples, respectively. The four copper crescents clearly show strong correspondence with ore analyses from Tunisia, while the two other copper objects from Gao Saney show no correspondence with any of the African ores. To better examine the relationship of the four copper crescents from Gao Saney to the Tunisian ores, a detailed comparison of the Tunisian ores divided by geographical region is presented in Appendix Figures 10a-10b.

In this figure, the four copper crescents compare well with ore analyses from the Diapir zone, although some crescents also show similarities to ores from both the Nappe and Graben zones. The North-South axis and Massifs zones are eliminated as potential source regions. The Diapir zone is a linear band of ore deposits, beginning at the coast of Tunisia north of ancient Carthage, which runs northeast-southwest to the Algerian border and includes numerous lead-zinc deposits typically hosted in Triassic, Upper Cretaceous, and Eocene age rock formations (Skaggs, et al. 2011 (in prep); Skaggs 2010). A number

of ore deposits from this region are thought to have been mined since at least Roman times (Farquhar and Vitali 1989; Sainfeld 1956; Skaggs 2010), and may have had their greatest period of exploitation during the Islamic period of the Middle Ages (Gsell 1928). Therefore, these deposits seem like strong potential candidates for the raw metals used to produce the copper crescents found at Gao Saney. However, the potential sources for the raw metal in the other two Gao Saney objects probably originated beyond the shores of Africa.

Comparisons with Potential Ore Sources: Western Europe, the Near/Middle East and Arabia

Historical Background to Potential Source Regions

The analyzed metals at Gao Saney recovered in excavations by Mamadou Cissé originate from levels dating from as early as the first half of the 7th century to the first half of the 11th century AD, although the bulk of these materials probably date from contexts ranging from the late 7th to late 9th centuries AD. This span of time saw many changes in the polities governing North Africa and Egypt, the likeliest starting points of materials crossing the Saharan Desert to West Africa and ultimately to Gao Saney. Therefore, when considering potential metal source regions outside of Africa the likeliest sources for metals entering trans-Saharan trade routes in North Africa would be nearby regions with established historic contacts. However, to place the lead isotopic analysis results within the larger economic picture of the times it is necessary to briefly discuss events in these regions during those times and examine how they could influence the materials reaching Gao Saney.

Portions of Western Europe under Roman control had long histories of contact with Roman North Africa. Following conquest of the region by the Vandal, many of these regions were resorbed into the Byzantine Empire. In the late 6th century AD the Byzantine Empire controlled most of Mediterranean North Africa, including Tunisia, with only some of coastal Morocco being under Moorish control. Remnants of the Western Roman Empire also still under Byzantine control included southeastern Spain, Sardinia, Italy, and Sicily. However, due to a variety of attacks from a multitude of directions and forces the Byzantine Empire had shrunk significantly by the mid-7th century.

Rapid Arab Muslim expansion had already taken its toll on the eastern Byzantine Empire and a westward spread of Arab Muslims soon claimed most of northeastern Africa. By AD 641 Egypt was captured, and in AD 647 the Byzantine Exarchate of Africa, based at ancient Carthage, was defeated and the remaining territories were subjugated and swore fealty to the Rashidun Caliphate and the Islamic Empire. Further expansion was delayed by internal fighting between rival Arab factions and it wasn't until about AD 665 when the newly formed Umayyad Caliphate expanded across North Africa, taking Tunisia in AD 670, and reaching the Atlantic coast by the early AD 680s. By AD 698 nearly all Byzantine forces had been defeated in North Africa; the region was divided into three Islamic provinces and by AD 709 all of North Africa was controlled by the Umayyad Caliphate.

The North African province of Ifriqiya, with capital at Kairouan just south of modern Tunis, was controlled by the Umayyads until about AD 750 when again civil wars between rival Arab factions caused control of the region to shift to the Muhallabids,

a faction of the newly formed Abbasid Caliphate. However, a military rebellion ended the brief rule of the Muhallabids and by about AD 800 they were replaced by the Aghlabids who ruled in the name of the Abbasid caliphs. The Aghlabids developed a maritime component to their forces and made repeated incursions into southern Italy, conquered a number of southern Italian cities, briefly occupied Sicily and even sacked Rome. All of this disrupted Byzantine shipping and control of their former territories in the Western Mediterranean, including Sardinia. However, growing conflicts with the Berbers and internal conflicts left the Aghlabids ripe for a fall and they were supplanted by the Arabo-Berber Fatimid Caliphate in AD 909.

Initially established in Mahdia, Tunisia, the Fatimids grew in power, captured Egypt in AD 969, and immediately relocated there, building a new capital at Cairo. The Fatimids continued to rule most of North Africa, from Cairo, through the Zirid Dynasty based in Tunisia. Meanwhile, Fatimid Egypt flourished and from this core area the Fatimids developed an extensive trade network in both the Mediterranean and Indian Ocean. However, control of the North African territories west of Egypt gradually slipped from Zirid and Fatimid control and by the mid-11th century AD, the former province of Ifriqiya fell to various Berber tribes, while Morocco and the Maghreb were controlled by the newly formed Berber-Muslim Almoravid Dynasty.

Therefore, when considering likely non-African metal source regions supplying trans-Saharan trade to Gao Saney the likeliest areas were those actively in contact with North Africa at that time. Since the Byzantine Empire was effectively removed from North Africa by the late 7th century AD, about the time of the earliest contexts at Gao Saney with copper metals, regions still under Byzantine control would be unlikely suppliers of metal to North Africa. However, several regions in the Western Mediterranean were under Muslim control and traded with Muslim North Africa.

Initial comparisons with lead isotopic analyses of ores from France, Germany, Italy, and the United Kingdom demonstrated that these deposits presented no isotopic correspondence with the Gao Saney material, and so they are eliminated from the graphic comparisons presented here. Likewise, initial comparisons with all published lead isotopic analyses of ores from Spain and Sardinia demonstrated that many of the analyses had no similarities to the Gao Saney materials and thus numerous ore deposits and geographic regions could be eliminated. For example, none of the lead isotopic analyses on lead ores from Sardinia corresponded with any of the Gao Saney material, but lead isotopic analyses of copper ores, most of which originate from northwestern and northern Sardinia, have some similarities and are included here (Appendix Figures 11a-11b). Also, only analyses from southeastern Spain showed any similarities to the Gao Saney material and so they are the only Spanish lead isotopic ore analyses presented here. From these comparisons (Appendix Figures 11a-11b) it is evident that neither Sardinia nor southeastern Spain provided metals for the four copper crescents from Gao Saney which match Tunisian ores so nicely. Likewise, none of the ore analyses from southeastern Spain match the copper wire and sheet samples from Gao Saney. However, the copper sheet sample does plot near a few copper ore analyses from Sardinia.

Since none of the non-African western Mediterranean source regions seem to be strong matches with the copper wire and sheet metals samples from Gao Saney, relevant ore analyses from the Middle East are also included in the comparisons (Appendix Figures 11a-11b). Analyses from a number of potential ore deposits from this region

were compared to the Gao Saney materials and only ore analyses from Iran and Oman exhibited any potential. The similarity of the Iranian and Omani ores is not surprising since they share a common metallogenic background. The copper wire and sheet metal samples from Gao Saney plot with and near ore analyses from both of these regions, and share similar linear trends in the analyses. Likewise, the four copper crescents from Gao Saney plot near a few ore analyses from Iran, but this association is not as convincing as that with the Tunisian ores.

Comparisons with Published West African Archaeological Samples

Comparison of the Gao Saney materials with lead isotopic analyses from other West African archaeological materials, can provide additional information for their interpretation (Appendix Figures 12a-12b). These data include published (Fenn, et al. 2009; Goucher, et al. 1978; Goucher, et al. 1976; Joel, et al. 1995; Willett and Sayre 2006) and unpublished (by the author), analyses of metal samples, dating from the mid-1st millennium BC to mid-2nd millennium AD, from archaeological sites in Senegal, Mauritania, Mali, Niger, Burkina Faso, and Nigeria. Archaeological samples from several regions of West Africa compare well with some of the Gao Saney samples presented here. Some archaeological datasets which do not compare well, such as the Group 1 samples from Igbo-Ukwu, Nigeria, and samples from Koumbi Saleh and Ma'aden Ijâfen, Mauritania, can be eliminated as well.

For more detailed comparison, the regions of the graphs around the Gao Saney materials have been magnified in Appendix Figures 13a-13b. In general, the four Gao Saney copper crescents (four red triangles on the left) plot near analyses from Burkina Faso, Mali, Niger, and Nigeria (I-U_G2). The two Burkina Faso analyses plotting near the copper crescents are from bracelets found at the site of Kissi (Kiss 3, Grave 14), and have been interpreted as likely having been made with metals from Tunisia (Fenn, et al. 2009). The two Mali analyses plotting closest to the copper crescents also are from a bracelets (or possibly and anklet), one thought to have originated at Jenne (Willett and Sayre 2006), and the other from the site of Essouk (Fenn 2011, in preparation). Several of the Igbo-Ukwu Group 2 objects, from Nigeria, also plot near the copper crescents and have been interpreted as likely having been made with metals from Tunisia (Willett and Sayre 2006). The three Niger analyses plotting closest to the copper crescents come from the sites of Marandet (casting debris and metal bar fragment [ingot fragment?]) and Azelik (wire), both sites connected to 1st millennium AD copper metal production and trans-Saharan trade.

The Essouk sample dates from the 9th century AD (Nixon 2008), while the Igbo-Ukwu samples likely date from the 8th-11th centuries AD (Fenn, et al. 2011 in preparation); Shaw 1993, 1995), and new radiocarbon dates from Marandet date those samples from the 7th – 9th century AD (Fenn unpublished data). Therefore, all West African samples plotting near the four Gao Saney copper crescents share similar chronologies, and with the exception of the Igbo-Ukwu samples, are from the same general region of West Africa, and along established trade routes connecting these regions. Furthermore, the likely connection of the Gao Saney copper crescents with Tunisian ores is consistent with published evaluation of the similar archaeological analyses from Burkina Faso and Nigeria (e.g., Fenn, et al. 2009; Willett and Sayre 2006).

The Gao Saney copper wire and sheet metal (two red triangles on the right) plot near analyses from Burkina Faso, Mali, Niger, and Senegal in one of the plots (Appendix Figure 13a), but not in the other (Appendix Figure 13b), but not within the analytical error margins associated with those published analyses in either plot. It appears that these two Gao Saney samples do not match analyses from archaeological sites in West Africa. Therefore, the metal used to produce these two Gao Saney objects probably originated from a different source(s) than comparable archaeological samples from West Africa.

DISCUSSION

The six analyses of Gao Saney copper-based objects presented here have been compared to themselves, similar samples from other archaeological investigations at Gao, potential geological ores sources for the metals, and comparable samples from West African archaeological sites. From these comparisons several observations have been made, and interpretations can be drawn from those observations. However, before making those interpretations it is worthwhile to consider published archaeological information relevant to the Gao Saney samples.

Copper Crescents

A large number of small crescentic copper bars (over 400), with shapes reminiscent of a boomerang and typically with biconvex or plano-convex cross-sections, were recovered from excavations at Gao Saney (see Chapter 9, Figure 9.3). Visual examination of the metal in some of these crescents determined that they were produced primarily of pure copper, although minor amounts of lead, and possibly tin, antimony and arsenic may also be present. However, none of the examined crescents were made from brass, an alloy of copper and zinc; although the possibility exists that some unexamined specimens could be made from this alloy.

Elsewhere these crescents have been called “currency ingots” but whether they represent “currency” or not are debatable. Previous research at Gao, by Timothy Insoll (1996; 2000) in the mid-1990s, identified a variety of copper-based metal objects from surface collections and excavations. Insoll also apparently found copper crescents during surface collection and excavation at Gao Saney, Gao Gadei and Gao Ancien, although his published descriptions of these metal finds are filled with inconsistencies and confusion. He variously uses the terms “currency items” (Insoll 1996:45, 77; 1997:21-22, 24; 2000:134), “currency ingots” (Insoll 2000:137, 139, 140), “curved copper ingots” (Insoll 1996:45; 1997:24; 2000:134), and just “ingots” (Insoll 1996:69, 77; 1997:21-22, 24; 2000:137, 138), interchangeably to describe several types of copper-based metal objects, apparently including the small copper crescents.

Insoll also remarks that “[t]o the excavated material [from Gao Ancien] can be added the 125 copper-alloy ‘currency items’ collected from the surface of the tell at Gao-Saney by Alastair Lamb in 1971 and by the author in 1993 (Plate 6.1)”, but here references a plate clearly illustrating a large curved metal bar fragment which is not one of the small crescents (Insoll 1996:77, 98, Plate 6.1). Earlier in the same publication, Insoll also referenced this figure when discussing “20 curved copper ingots” recovered from the surface of Gao Saney, but notes that they are “reminiscent of the manilla” (Insoll 1996:45). Here again, manilla’s, the large curved copper ingots traded by

European maritime merchants along the West Africa coast (see for example Amogu 1952; Craddock and Hook 1995; Grey 1951; Herbert 1984:Chap. 6), bear no similarities to the small copper crescents. The same object pictured in Plate 6.1 of his 1996 publication, where it is called variously a “curved copper ingot” (p. 45) and a “currency item” (p. 77), again is illustrated in his 1997 and 2000 publication, where it is also called both of these terms (Insoll 1997:21, 24; 2000:134, 141, Figure 229). However, in this latter publication he makes a linkage between the two terms suggesting they are referring to the same types of objects.

Further confusing the issue, in a discussion of “copper currency ingots” at Gao, Insoll mentions an ingot mould fragment from Marandet reported by Lhote (1972a; 1972b), and suggests it “could have been used to cast the copper currency ingots found at Gao” (Insoll 2000:139). Similar mould fragments also have been recovered at Marandet by the author during fieldwork at the site in 2006 (Fenn 2006). However, in these cases the mold fragments again were for ingots which were straight and much larger than the small copper crescents. From all of this it appears that Insoll has conflated his discussion of “currency items” and ingots to include not only the much larger ingots, some of which were straight while others were bent or “curved”, but also the small copper crescents. This is supported by the fact that he illustrates fragments of three small copper crescents in his 1996 excavations at Gao Gadei and refers to them as small ingots (Insoll 2000:137, 142, 144, Figure 230). One final nail-in-the-coffin on this discussion are the classification definitions presented by Insoll before his metals catalog where he describes “‘Currency’ Ingots” as “Small (under 4mm width), Medium (4 – 7mm width), Large (over 7mm width)” (Insoll 2000:140). Thus, it would appear that the small copper crescents primarily fall into Insoll’s “small” currency ingot category.

Interpretations

The Gao Saney copper-based materials examined here were all composed of unalloyed copper; none were made of brass, although they may have had very minor amounts of some alloying metals such as lead and tin. Lead isotopic analyses are similar between the four copper crescents, with two falling within analytical error margins suggesting they were made from the same metals. These overall similarities in the copper crescents suggest that all were made with metals from similar ore deposits. However, the ire and sheet metal samples from Gao Saney were clearly made with metals different from those used to produce the copper crescents, but similar enough to each other to suggest they too may have been produced with metal from similar ore deposits.

Comparison of these six analyses with analyses from other archaeological investigations at Gao (Gao Saney, Gao Ancien and the Mosque of Kankan Mansa Moussa), also illustrate similarities and differences. The Gao Saney crucible analysis from Timothy Insoll’s work shows similarities with the wire and sheet metal samples from Gao Saney, although it is different in some comparison plots. However, the three analyses of materials from Gao Ancien and the Mosque of Kankan Mansa Moussa have no similarities to the Gao Saney materials. Part of this could be explained by the fact that two of those objects were made from brass, while the copper samples from the Mosque of Kankan Mansa Moussa plots away from all other analyzed objects from Gao. Comparison of the Gao analyses when considering object type also illustrates the similarity of the copper crescents, but no other obvious patterns are apparent.

When the six Gao Saney analyses are compared to ore analyses from potential ore deposits, no currently analyzed West African ore deposits are potential matches. However, Tunisian ores were a very strong match with the four copper crescents, and ore deposits from the Diapir zone of Tunisia seem a particularly good match. It appears likely, when considering the comparison with other potential ore deposits outside of Africa, that Tunisian ores were the likely sources for the metals used to produce the copper crescents. The Gao Saney wire and sheet metal samples did not compare well with any current analyses of ores from Africa. However, they do exhibit similarities with ore analyses from the Middle East, with Iran and Oman being the strongest candidates for source regions. Some copper ores from northern Sardinia also plotted near the Gao Saney sheet metal sample. These comparisons suggest that these metals originated from deposits outside of Africa and possibly from the Middle East. As discussed above, the Middle East and North Africa were in contact as parts of the Islamic Empire, and these contacts likely manifest in the movement of materials, including metals, in both directions from these regions.

Finally, comparison of the six Gao Saney analyses with metals from West African archaeological sites also reveals similarities. In particular, the Gao Saney copper crescents are similar to contemporaneous materials from Mali (Essouk), Niger (Marandet and Azelik), and Nigeria (Igbo-Ukwu). There also are similarities with metals from the site of Kissi, Burkina Faso, but these samples appear to pre-date Gao Saney material. Regardless, these similarities also suggest links to Tunisian ores for metals in the Gao Saney copper crescents, and suggest that metal from Tunisia was crossing the Sahara to West Africa by the mid-1st millennium AD, and continued to be part of that trade well into the early 2nd millennium AD. However, the Gao Saney wire and sheet metal samples do not compare well with other West African archaeological samples, and this may suggest that Middle Eastern metals may have had a limited role in trans-Saharan trade.

CONCLUSIONS

Gao is situated at a key geographic location and to play a significant role in the movement of materials into and around West Africa. Historic records on trans-Saharan trade indicate that Gao was a crossroads for north-bound materials arriving from North Africa and east-bound materials arriving from Egypt and the Nile Valley. Furthermore, Gao was integral in West African commerce as its location on the Niger River allowed for contacts with up-river regions, such as Timbuktu and Jenné-Jeno, and down-river regions in the forest states, such as Igbo-Ukwu in Nigeria. The similarities in lead isotopic analyses of the Gao Saney copper crescents and Tunisian ores suggests that metal used to produce these objects originated in Tunisia and crossed the Sahara from that region. Furthermore, the similarities between the Gao Saney materials and contemporaneous West African archaeological metals suggests that Gao may be linked to these sites, directly (potentially with Essouk and Marandet) or indirectly (potentially with Azelik and Igbo-Ukwu), and could have acted as a conduit to/from these regions for materials arriving from/entering into trans-Saharan caravan trade.

The similarities in lead isotopic analyses of the Gao Saney wire and sheet metal with Middle Eastern ores may suggest metals from those regions were being traded to Tunisia to enter trans-Saharan commerce there. Alternatively, those metals may have arrived at Gao from east-bound trade routes linking Gao with Egypt and the Nile Valley.

The lack of similarity between these objects and the other Gao materials, with the potential exception of the Gao Saney crucible from Timothy Insoll's investigations, indicates that materials from a variety of source regions were funneling into Gao. Furthermore, the lack of similarity between these objects and contemporaneous West African archaeological metals also supports this contention and suggest that these may have originated from regions not typically supplying metal to West Africa at this time.

Gao, in the late 1st millennium AD, was an important trade entrepôt and the analyses presented here support this observation. Materials arrived at Gao Saney from Tunisia and possible the Middle East, and likely were incorporated into regional distribution networks. While the sample size of this preliminary analysis of Gao materials is small, the results still provide important interpretive value. Additional analysis planned for the Gao Saney copper-based objects will shed further light on these preliminary interpretations.

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Appendix V. The Paleobotanical remain from Gao Saney

Daphne Gallagher

Methods

Light fraction samples were received in the lab and sieved into 2mm, 710um, and 212um samples, all of which were examined under a low power binocular microscope for seeds, fruits, and other identifiable elements (the sub-212um residue was not sorted). All samples were fully recorded, including a general description, sample weights, and sources of disturbance or contamination. Seeds and fruits were identified via comparison with modern samples when available, and otherwise with drawings and photographs from published botanical and/or paleoethnobotanical works (notably Kahlheber 2005, LeBourgeois and Merlier 1995, Murray 2005, and von Maydell 2003).

The light fraction samples from excavations at Gao-Saney were composed almost entirely of carbonized material with minimal sources of contamination (Table 1). In cases where more than ca. 5% of the sample was composed of non-carbonized material, the difference was generally due to the inclusion of lightweight dirt or clay concretions. The only exception is the calcified grain chaff, likely from *Oryza* sp. (rice), that is a major component of the samples from Levels 3 and 7 (see discussion below). Root penetration and insect disturbance at the site appear to have been minimal. While a few insects and roots do occur in most samples, the quantities of the former are low and the latter occur as small isolated fragments rather than matted balls. The few modern seeds (including cf. *Aristida* sp., *Boerhavia* sp., and members of the Paniceae tribe) are assumed to be intrusive and have not been included in the analysis.

Of particular note in the flotation samples are two additional classes of archaeological evidence: animal bone and beads. Archaeological animal bone, usually in the form of crushed unidentifiable pieces, is common in the samples. The bones are occasionally burned, and usually from larger animals. Small rodent bones occur with significantly less frequency. Beads are present in five samples; all were caught by the 2mm sieve.

Cultivated Species

The most frequently identified cultivated species at Gao-Saney is pearl millet (*Pennisetum glaucum*), which is present in the majority of examined contexts. Interestingly, rice (*Oryza* sp.), which today is a staple crop in the region, was present only as uncarbonized chaff in three contexts.

Staple Grains

Pennisetum glaucum (Graminae), pearl millet

Pearl millet is present in 18 of the 26 analyzed samples, and distributed throughout the unit, occurring in 16 of the 20 levels and features from which samples were taken (including both the bottom and top levels of the unit). In the majority of cases, the crop is represented by its distinctive teardrop-shaped carbonized caryopses, although the involucre is present in two samples. The latter are generally considered threshing waste, and the predominance of the former could indicate that the samples were drawn from a cooking rather than a processing context.

Pearl millet is a notably hardy crop (see discussions in Kowal and Kassam 1978, and NRC 1996). It grows quickly, and thrives in well-drained or sandy soils with little rainfall (a crop can be produced with as little as 250mm, depending on the distribution of the precipitation). As such, it is a reliable choice for circumstances in which rainfall is unpredictable and/or soil nutrients are low. Early varieties of pearl millet can mature in as little as certain days, although most varieties take many days.

Oryza sp. (Graminae), rice

Rice and Millet at Gao-Saney

One of the most surprising aspects of the botanical assemblage is the absence of carbonized rice caryopses and common occurrence of carbonized pearl millet caryopses. Today, Gao lies within the primary zone of rice cultivation and rice is the most frequently cultivated crop in the region.

Discussion of the ethnography of cultivation around Gao, Arab traveller's accounts.

It is possible that the absence of rice is simply the result of preservation bias. The two crops may be prepared in different manners; while rice is generally boiled or steamed whole, pearl millet is usually pounded into a coarse flour that is boiled to produce a thick porridge or steamed to make a couscous. These different preparation routes could have resulted in more opportunities for pearl millet carbonization. However, while the smaller grain of pearl millet carbonizes more easily than that of rice, at sites in the Inland Niger Delta (the most important rice-growing region in Mali) the latter is much more common in the paleoethnobotanical samples from Iron Age deposits. At Dia, 1376 grains were attributed to *Oryza* sp., while 184 grains were attributed to *Pennisetum glaucum* or cf. *Pennisetum* sp. (Murray 2005). Similarly, at Jenne-jeno rice was identified in the majority of analyzed samples while pearl millet was identified in only a few (McIntosh 1995).

Conclusions about how this result should be seen as tentative, but intriguing

Economically Valuable Plants

Cultivated species are rounded out by the presence of the fruits of intensively managed and protected tree species: baobab (*Adansonia digitata*), desert date (*Balanites aegyptiaca*), and grewia (*Grewia* sp.)

In addition to the species discussed above, several other economically useful plants were identified in the sample. Like the useful trees described above, these plants are often considered "wild" although they may be intensively managed or even cultivated.

Trees and Shrubs

Adansonia digitata (Bombacaceae), baobab

Evidence of baobab (in the form of fragmented pieces from the outer shell of the seed) is present in six samples from three levels. It was most frequently identified in Level 2, although it also appears in Levels 14 and 17. Baobab trees are strongly associated with presence of human populations, and their fruits are commonly identified in archaeological sites. While the sweet edible fruit can be eaten raw, made into a beverage, or used as a flavoring, it is usually the leaves of the baobab tree that are more significant in the diet. The leaves, fresh or dried, are a common ingredient of sauces served over rice or millet, and are an important source of numerous vitamins.

Additionally, the tree has many other uses from cordage production to medicinal applications.

Balanites aegyptiaca (Balanitaceae)

A complete carbonized nut from the desert date was identified in Level 2. These trees favor the drier parts of the West African savanna and sahel, and their sweet yellow fruits are traded widely (Burkhill 1985).

Grewia cf. *bicolor* (Tiliaceae)

Fragments of *Grewia* fruitstones, similar in size and shape to *Grewia bicolor* were identified in five samples, each from a different level and spanning the majority of the sequence. *Grewia bicolor*, like most *Grewia* species, is known for its sweet edible fruits and fibrous bark that is commonly used as cordage (Burkhill 2000). The tree is common in dry savanna habitats, and prefers rocky, low nutrient soils, particularly those of riverbanks (von Maydell 2003).

cf. *Grewia* sp. (Tiliaceae)

This fruit stone was among the more common finds at Gao-Saney, occurring in nine samples from seven levels throughout the sequence. The stone is small, only about 3mm in height, and bears a significant resemblance to *Grewia* sp. Type 2 identified by Kahlheber (2004:256) in northern Burkina Faso, although the depicted example is larger than the stones recovered from Gao-Saney. As described above, most *Grewia* species have an edible fruit and favor rocky habitats in dry tropical regions. (Burkhill 2000, von Maydell 2003)

Leguminosae B (Leguminosae)

This seed occurs in seven samples from six contexts at Gao-Saney. Based on the size and shape, it is clearly a legume from either the Mimosoidae or the Caesalpinoideae. Based on comparison with available reference material and photos of tree seeds in von Maydell (2003), the seed most resembles *Acacia nilotica* var. *tomentosa*. However, this attribution should be solidified through direct comparison with a wider range of species from these groups, in particular varieties of *A. nilotica*.

A. nilotica var. *tomentosa* would be an expected species in the region of Gao-Saney, as it favors riverbanks in the savanna and sahel environments. The tree has numerous uses, and is one of the few excellent firewoods identified in the seed assemblage (likely a wider variety occurs in the wood charcoal, which has yet to be analyzed). The pods have very high tannin levels and are valuable for both tanning leather and medicinal uses which take advantage of their astringent properties (Burkhill 1995). Burkhill does mention a case in Hausaland where the pods were roasted (a process which could result in carbonized seeds), although this does not appear to be common practice. More likely, the seeds would have been carbonized either accidentally or by burning the waste after decocting the pods.

cf. *Zizyphus* sp. (Rhamnaceae)

Two possible fragments of fruitstone from *Zizyphus* sp. were identified in Level 24. While the rugose pattern appeared too robust and the nut diameter too large for *Grewia* sp., both identified types of *Grewia* also occur in this level, and it is possible that these small fragments could be outliers within their range of variation. The common *Zizyphus* species of West Africa favor a dry savanna environment, and their occurrence would be expected at Gao-Saney (indeed, they were identified in previous excavations at

the site, see below). *Zizyphus* has a sweet, edible fruit which can be easily dried and stored. The tree's spiny limbs may also be used in fencing (Burkhill 1997).

Useful Trees at Gao-Saney

The management of woody species is an important element of the farming landscape in the Sahel region of West Africa. When clearing farmland, species valued for both their economic products (including food, fodders, cordage, construction wood, etc.) and their ability to contribute to soil fertility are frequently left in place. Firewood is important for both household purposes and to fuel pottery firing and iron smelting events, and some trees may be managed for this purpose. In addition to those trees that are protected when they occur naturally, some species are actively facilitated by the presence of humans. Baobab, in particular, is strongly affiliated with human settlements. Recent studies in southern Mali indicate that this affinity is a result not only of protecting seedlings but also of human use of the plant. In processing the fruits for consumption, they are often soaked; the thoroughly wetted seeds then germinate more easily than those seeds from plants in the wild (Duvall 2007).

The useful trees from Gao-Saney can be divided into two groups: baobab and desert date, which are confined to the upper levels of the site, and the multiple *Grewia* species, which occur throughout the deposits. Unsurprisingly, all of the identified nut fragments are from edible tree fruits. The *Grewia* species in general are not usually preferred firewoods, nor is baobab. In contrast

Grasses and Herbs

Ceratotheca sesamoides (Pedaliaceae)

One seed of this plant was identified in Level 22. *C. sesamoides* or "false sesame" is widely exploited for its nutritive mucilaginous greens, although its oily seeds are also edible. Both are commonly included in sauces. The plant may be collected in the wild, allowed to flourish when it occurs in agricultural fields, or actively cultivated. The leaves can be consumed fresh or dried, and may be traded or sold in local markets (Burkhill 1997).

Cleome sp. (Capparaceae)

Three seeds from the genus *Cleome*, all of which are likely representative of the same species, were identified in Levels 2 and 10 at Gao-Saney. Many species of *Cleome* occur in West Africa, most of which have an edible leaf valued for its sourness or acidity (Burkhill 1995). The leaves are also frequently used in various medicinal applications (Burkhill 1995).

Paniceae, various (Graminae)

Many of these grasses are collected a food, also weeds. Can occur in large natural stands, each kind has its own special unique features. Burkhill (1994)

Portulaca oleracea (Portulacaceae)

Poleracea (purslane) occurs in 2 levels from the upper parts of the excavations at Gao-Saney. This fleshy herb, which can be consumed as a sauce ingredient, also has the potential to become a noxious weed, particularly in drier regions. The plant has numerous medicinal uses, most notably as a diuretic (Burkhill 1997).

Portulaca sp. (Portulacaceae)

This seed, which occurs in two samples from Level 2, has a slightly different surface pattern than *P.oleracea*. There are numerous other *Portulaca* species in the dry savannas of West Africa. While some have edible leaves and/or similar medicinal uses, none is as widely exploited as *P. oleracea* (Burkhill 1997).

Other Identified Plants

Many of the other herbaceous species identified at Gao-Saney commonly occur as weeds of cultivation or ruderal species which colonize or favor disturbed ground, although many have economic uses as well. Consequently, they are common elements of anthropogenic landscapes, and can provide evidence of land use strategies. However, most species of this type also produce hundreds of seeds per plant; consequently, their representation in the sample may not be proportional to their role in the local environment. Finally, many plants included in this category are members of large, diverse genera which cannot be distinguished to species.

Amaranthaceae/Chenopodiaceae

Two seeds from two levels could be attributed to the Amaranthaceae/Chenopodiaceae. These seeds are not necessarily from the same genus or species. Both families have numerous representatives in West Africa, some of which have edible leaves.

Cyperaceae

Two different species of sedge were identified in two different samples at Gao-Saney. Given the sites proximity to the river, sedges would likely be common in the region. They can be weedy for rice fields, although neither co-occurs with the identified rice chaff.

cf. *Ficus* sp.

One seed from a ficus fruit was identified in Level 5. Ficus trees are common in the West African savanna and Sahel, and many different species can be present. While the fruits of most of these are technically edible, few are preferred fruits in the local environment- many are home to insects or not particularly tasty.

Glinus sp. (Aizoaceae)

These weedy herbs have very few recorded uses, none of which are widespread. Leguminosae-Papilionaceae, various (Leguminosae)

Several examples of Leguminosae, Common fodders, etc.

Spermacoce sp. (Rubiaceae)

Three seeds attributable to *Spermacoce* sp. occur in two contexts at Gao-Saney. There are numerous members of this genus in West Africa, all of which have very similar seeds and very few of which have economic utility.