# THE SOURCE
# CLAY SELECTION AND PROCESSING PRACTICES IN SUB-SAHARAN AFRICA

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Résumé : Partant d'un exemple illustrant la complexité et la variabilité des comportements techniques relatifs à la sélection et au traitement des matières premières, cette contribution explore les mécanismes qui sous-tendent les variations spatiales et temporelles de ces deux étapes de la chaîne opératoire céramique. Notre objectif est de poursuivre le travail entrepris par Arnold sur la variabilité des pâtes céramiques et sur la signification sociale de cette variabilité, en utilisant notre banque de données sur la céramique de l'Afrique subsaharienne. L'article est divisé en trois parties. Dans la première, nous passons en revue les outils, les techniques et les recettes observées en Afrique subsaharienne. Dans la seconde partie, nous examinons les stratégies développées par les potières et potiers à ces deux étapes de la chaîne opératoire. Pourquoi et comment sélectionne-t-on une source? Pourquoi les argiles sont-elles traitées ? L'idée est d'explorer le savoir des artisans de l'intérieur, afin de mieux comprendre leurs choix. Dans la troisième partie, nous abordons la dynamique et la distribution des techniques relatives à la sélection et au traitement des matières premières. Ici, l'objectif est de documenter la façon dont les comportements sont reproduits dans le temps et dans l'espace, et de voir jusqu'à quel point ils peuvent être modifiés par les artisans.

Abstract: Starting with an example illustrating the complexity and variability of behaviours related to clay selection and processing, this paper explores the mechanisms underlying the spatial and temporal variations of technical traditions pertaining to these steps of the manufacturing process. Using a large databank on pottery in sub-Saharan Africa, our aim is to follow-up on Dean Arnolds work on pottery paste variation and their social significance. The paper is divided in three parts. In the first one, we examine the diversity of technical practices as regards raw material selection and processing. The aim is to give an overview of the tools, techniques and recipes observed throughout Africa. In the second part, we examine the strategies developed by potters at these two levels of the manufacturing process: Why and how are specific clay sources selected? Why are clays processed in specific ways? The idea is to examine potters' knowledge from the inside, in order to understand their choices. In the third part, we consider the dynamics and distribution of technical traditions pertaining to clay selection and processing. Here, we want to explore how behaviour are reproduced through space and time and to which extent they may be altered by individual potters.

## INTRODUCTION

At the end of the 20th century, in a Zarma village of south-western Niger, a woman discovered a new clay source while digging earth to repair her house. She was not a potter, but she felt that the clay was good and told her friends about it. They were delighted to hear the news: in fact, they had been hoping to relocate their extraction sites for a while. Until then, they mainly collected their clay in fields and gardens, but arable land is scarce in the region and occasional conflicts arose with the farmers. Having made a batch of vessels to test the new clay and seen that no problem occurred during or after firing, they decided to return to the site. Soon enough, all the potters in the village were frequenting the new source. And its reputation continued to spread. When meeting fellow potters at marketplaces, women vaunted the quality and accessibility of the clay. Some even turned it into a selling point: the material was so « strong » that vessels were said to last longer. In the following year, potters of three other villages in the vicinity were using the site as a main source.

The sharing of a common clay source did not however lead to a homogenisation of processing techniques. Nor did the fact that similar types of vessels were produced and similar shaping and firing techniques used throughout the area. In the village were the clay was discovered, for instance, potters crush the dry material on a mat, shake the powder in a calabash to sort it into two fractions[1], soak the coarse fraction, knead the fine one with water, and mix the two, adding coarse grog to the part used for shaping the body and medium grog to that used for the neck. Some potters use one or two other clay(s) from time to time, but they explain that it is essentially to liquidate old supplies.

In two villages situated at some 6-7 km from the source, women potters do not crush or sort the clay. As in most parts of the Zarma country, they simply soak it for the night, knead the wet material on a mat, and add coarse or medium grog, depending on the part of the vessel to be shaped. Some of them simply use coarse grog for the whole body, however, explaining that it was the way they were taught in their home village. They stress that it is not a very important difference, but mainly a matter of habit.

In another village distant of 6-7 km from the source, the situation is even more complex. In one part of the village, members of three kin families usually mix three different clays: one from the new source, one from one of the above-mentioned villages and one from two other sites that they frequent sporadically.

[1] A technique also used for sorting crushed millet.

During processing, they mix the three clays, crush them on a mat, sort the powder into two fraction with a calabash or a basin, soak the coarse fraction, knead the fine one, mix the two, and add a mix of medium-sized grog and crushed millet husks to the paste. These potters explain, however, that they only mix three clays if the vessels are to be sold outside the village, and especially in the neighbouring town. They stress that one should always be careful about the quality of the products if wanting to maintain a reputation on marketplaces. That is why they prefer to use a paste made of three clays. But when they produce vessels for themselves or for any other person in the village, they just use the clay extracted at the new source. In another part of the village, potters always mix three clays and follow the same recipe as described above, with the exception that they do not add crushed millet husks to the paste. One of them explains that « she just doesn't like the consistency of the clay when it contains millet husks ». Finally, in a third part of the village, potters mix two clays (one from the new source, the other from one of the sources mentioned above), process them in the same way as the rest of the village, but add a mix of coarse-sized grog and millet husks to the part of the mixture used for shaping the body and a mix of medium-sized grog and millet husks to the part used for shaping the neck.

Thus, in an area of some 100 km$^2$, inhabited by people who speak the same language, potters frequent one main extraction site and three secondary ones (one of which is situated in a village whose potters only frequent the main source), and process the raw materials according to six different recipes, with variations observed *between* as well as *within* village communities.

While obviously complex, the situation described above should not be deemed exceptional. In fact, this example illustrates a series of mechanisms that underlie much of the spatial and temporal variations in clay selection and processing: accidental discovery; competition over land use; competition between artisans; individual or collective conceptions regarding the quality of raw materials; habits and traditions in technical behaviour; and social interactions at a local or regional level (see Arnold 1971, 1985, 2000 and this volume; Bowser 2000, 2002 and this volume; De Boer 1984; Gosselain 1994, 2001; Herbich and Dietler 1991; Livingstone Smith 2000; Neupert 2000; Nicklin 1979; Sall 2001; Stark 1999; Stark *et al.* 2000). Yet, despite being consistently observed in the field, such mechanisms are seldom taken into account in archaeology, variations in paste composition continuing to be used mostly as chronotypological markers or interpreted in techno-functional terms.

We think that it is possible to do better. Indeed, the complexity of behaviours pertaining to clay selection and processing - while certainly confusing at first glance - should not be perceived as an obstacle but as a source of considerable potential for exploring social issues. Indeed, if the selection of clay sources is embedded in broader social strategies rather than governed by the least-effort principle (i.e. De Boer 1984: 530-549), paste analyses may open the way to previously unexplored areas of the archaeological record. The same may be true for clay processing recipes as well. To reach that goal, however, as much effort must be spend on the minute reconstruction of individual ways of doing as on the understanding of the nature and dynamics of pottery traditions. What, for instance, are traditions in clay selection and processing ? How do individua ls inherit, use, and transmit them to other individuals ? Are such traditions affected by change ? And what, if anything, do they tell us about the people who use them ?

In a recent paper that explores the issue of standardisation and specialisation in pottery production, Arnold has addressed some of these questions. Specifically, he has tried to identify the causes of paste variability in ceramics and the way such variability relates to potters' behaviour (Arnold, 2000: 334). Reconsidering the ethnographic data that he collected in Peru, Guatemala and Mexico since 1965, he has shown that behaviour pertaining to the collection and preparation of ceramic pastes are highly variable, rather unstable, and governed by a number factors, among which the geology of local settlement, individual perceptions of raw materials, settlement and land tenure patterns, religious concerns, intended use of the vessels, and techniques used at other steps of the manufacturing process.

While his conclusions are rather pessimistic regarding the possibility to explore social and political aspects of production through paste analyses, he provides elements that help shifting from a static perception of potters' behaviour to a more dynamic and realistic one. This is clearly the path that we want to follow. Yet, we would like to expand the archaeological implication of Arnold's findings in broadening the ethnographic data base from which the comparison was made, in systematising and organising the analysis of the factors that underlie variations in pottery traditions and, above all, in redirecting the study toward an understanding of *technical behaviour* rather than *paste composition*.

The data that we will examine come from our wide comparative study of Sub-Saharan pottery traditions. Since 1990, members of The *Ceramic & Society Project* developed at the University of Brussels, and research associates have conducted fieldwork in Senegal, Gambia, Mali, Niger, Burkina Faso, Togo, Benin, Nigeria, Cameroon, Chad and D. R. Congo, collecting information about some 1000 potters in nearly 100 linguistic groups (Gosselain 2000, 2001; Gosselain *et al*. 1996; Langlois *et al*. 1998; Livingstone Smith 2001a; Petit 1998; Sall 2001; Wallaert 2001). Field observations have been strengthened by a systematic perusal of the ethnographic literature, allowing us to gather data on more than 600 populations south of the Sahara. The whole database constitutes a useful

tool for exploring diversity in technical behaviour. It also helps in identifying cross-cultural tendencies that may be used subsequently to explain why potters make certain choices and to build models of interpretation transposable to archaeology.

The paper is divided into three parts. In the first one, we examine the diversity of technical practices as regards raw material selection and processing. The aim is to give an overview of the tools, techniques and recipes observed throughout Africa. In the second part, we examine the strategies developed by potters at these two levels of the manufacturing process: Why and how are specific clay sources selected ? Why are clays processed in specific ways ? The idea is to examine potters' knowledge from the inside, in order to understand their choices. In the third part, we consider the dynamics and distribution of technical traditions pertaining to clay selection and processing. Here, we want to explore how behaviour are reproduced through time and space, and to which extent they may be altered by individual potters.

## TECHNICAL PRACTICES

### Clay extraction

Available data indicates that most African potters collect their clay within a 3 km radius from the place where they live and/or practice the craft (see details in Gosselain 2002: 40-1). Those who go farther generally use animals, cars, trucks or pirogues to carry the clay. Also, they usually make stocks that may last several months or a whole potting season.

The actual processes through which potters extract the clay are tremendously variable across Africa, which renders all attempts at categorising extraction practices quite difficult - and probably pointless. Some tendencies may however be pointed out.

As regards the extracting tools, one is faced with a collection of unspecialised items: hoes, spades, crowbars, dibbles, pickaxes or even machetes dominate the picture, and such tools are used in a way similar to that observed in other contexts (fig. 2, fig. 4). While obvious from practical reasons, this connexion with agricultural techniques or other activities involving the extraction or breaking of earth materials is also related to the context within which clay sources are discovered and exploited, as we will see in the next section. Only in rare instances are specialised tools observed in the field. This is the case notably, among Tukulor of Senegal (Gueye 1998; Sall 1996) and Soninke of Mali (Gallay and Sauvain-Dugerdil 1981) who use spear-like bars with a flat end.

As for extraction modes, at least four categories are identified: *surface collection*, *pit extraction*, *underground gallery*, *underwater extraction*. One must note that except for the later, none of these categories are clearly connected with specific environment, each being recorded in the driest areas of the Sahel as in the tropical region. Also, there does not seem to exist a relationship between the scale or intensity of the production and the extraction mode. Surface collection, for instance, is observed in specialised centres were dozens of potters work all year round (fig. 1) as among part-time and isolated potters.

Figure 1. Due to the intensity of production, clay extraction site may extend over large stretches of land, such as in the Hausa village of Jiratawa, Niger (Photo O. Gosselain).

In the first case, *surface* collection, the raw material is extracted just below the surface, either on the ground (plain, fields, riverbeds), a hill (fig. 2), or the wall of a slope (fig. 3) or an embankment. Having cleared the superficial organic and mineral layer, the potter extracts clay without really digging underground. The operation may be described as « peeling » a clay bed.

Figure 2. Famed for the quality of its clay, the quarry at the Hausa village of Tasmaske (Niger) is also used by potters from neighbouring villages (Photo O. Gosselain).

Figure 3. « Surface collection » may correspond to a variety of case figures. Here, potters « peel » the wall of a slope in Southern Niger (Photo O. Gosselain).

The second category, *pit* extraction (fig. 4), consists in digging the ground vertically or diagonally until an appropriate layer is reached. Most pits are some 1 or 2 meters deep, and 2 or 3 metres in diameter. But they may sometimes be as large as quarries. Nicklin (1979: 349) observed unusually big pits in Ikot Ekwerre Itam Uyo (Nigeria): « The work requires the co-operation of many women, who work as a team in digging the clay, passing it from hand to hand in baskets to the top of the pit, which may be up to 50 ft deep. The sides of the pit have to be re-dug after each wet season and new steps cut, to facilitate access to the bottom of the pit ». Variations are also observed in the way potters exploit and manage these structures. For instance, some use them until the clay layer is completely exhausted, while others use the pits until a specific depth is reached or as soon as it shows risks of collapsing. The rise of water in the structure or the presence of impurities is also a frequent cause for abandoning a pit. In most cases, new pits are excavated near the old ones.

Figure 4. Zarma potter extracting clay from a pit at the village of Kabé, Niger. This technique is probably the most usual way of exploiting clay beds (Photo O. Gosselain).

Raw materials may also be extracted from *galleries* (fig. 5). This type of structure generally starts with the excavation of a vertical shaft. When the access shaft reaches the clay bed, the structure is extended horizontally. Galleries, like pit*s*, are generally abandoned at the end of the potting season, but some may be used several years in a row. In the latter case, only the access shaft is re-excavated each year.

Figure 5. Gallery extraction is favoured among the Bissa potters of Luanda (Burkina Faso). As the superficial layer is considered inadequate for pottery making, clay is exploited in galleries below it (Photo A. Livingstone Smith).

Finally, a rather uncommon technique, *underwater extraction* (fig. 6), consists in extracting raw materials from river bottoms. The simplest procedure is to wait for the dry season, when water recedes - a process

Figure 6. The unusual technique of underwater extraction. Here, among the Tikar of Akouen (Cameroon), clay extraction is associated to fishing practices (Photo O. Gosselain).

commonly observed along the Niger river. But artisans may also build two small dams in a river, bale out the water and, before the upstream dam gives way, dig the clay as described for surface collection (see examples in Gosselain 2002; Pinçon 1985).

**Clay processing**

As in most places around the world, African potters never use the clay in its raw state but prepare it in a way or another. While processing pratices are usually very simple, they may also involve complex combinations of techniques. These may be grouped into four main categories: pre-treatments, removal of non-plastics, addition of non-plastics, and homogenisation.

*Pre-treatments* usually involve leaving the raw materials to *dry*, to *soak* or to *sour* for one or several days.

When the clay is appropriately dried or soaked, a series of techniques may be used to remove undesirable *non-plastics*. The most common way, by far, is *hand sorting*. Indeed, potters always remove coarse impurities such as pebbles, roots or leaves at some point during the process. Other ways of keeping the characteristics of the material under control involves the *crushing*, *pounding* or *grinding* of raw materials. Both the tools and the movements involved in these processes are very variable. For example, potters may pound the clay with a stone or wooden hammer on a stone (fig. 7), they may simply pound it in wooden mortar (fig. 8), grind it with grinding and upper grinding stones (fig. 9) or grind it on a rock. Finally, non-plastics may be removed by *sieving* with baskets (fig. 10), pierced calabashes, or imported nylon meshes (fig. 11). Potters may also remove the coarser fraction of non-plastics by *shaking* the crushed raw materials in a calabash (fig. 12) or by *winnowing* it with a winnowing basket or a calabash (fig. 13) on a goatskin. There are also occurrences of potters who *dilute* a part of the raw material in water to produce a thick solution that they add to the pottery paste**.** Finally, although the technique seems rare in Sub-Saharan Africa, clay may also be purified by *levigation*. In that case, potters mix clay with water in order to get a colloidal solution, retrieve the larger particles at the bottom of the container and let the water evaporates (David 1983; Gallay and Sauvain-Dugerdil 1981).

Figure 7. Pounding the clay on a large rock among the Kabye of Pia Pita, Northern Togo (Photo A. Livingstone Smith).

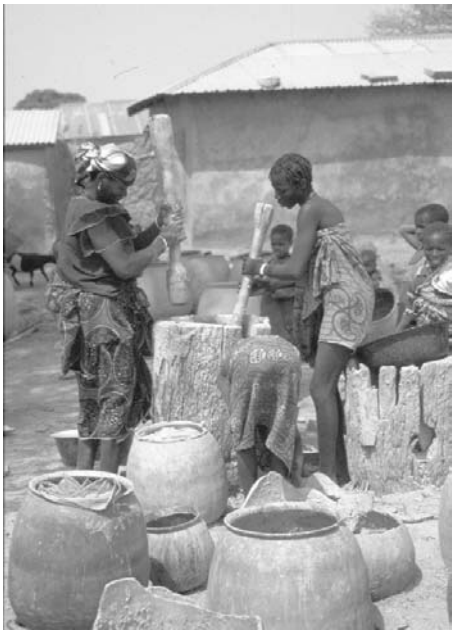

Figure 8. Pounding clay in a wooden mortar among Bariba of Sékougourou, Northern Bénin (Photo O. Gosselain).

Figure 9. Food staple and pottery raw materials are grinded in the same way among the Kepere of Deng Deng, Cameroon (Photo O. Gosselain).

Figure 10. Sieving the pounded raw material with a basket among the Kongo Ndibu of Kimpanada, R. D. Congo (Photo P. de Maret).

Figure 11. Sieving the pounded raw material with an imported nylon mesh among the Ewe of Kpalime, Southern Togo (Photo A. Livingstone Smith).

Figure 12. Among Zarma of Dinara (Niger), pounded raw materials may be shaken in a calabash to sort coarse and medium fractions (Photo O. Gosselain).

Figure 13. Among the Bobo of Vy (Burkina Faso), the coarse inclusion are extracted from raw materials by winnowing it with a calabash (Photo A. Livingstone Smith).

Generally called *tempering*, the addition of materials to the clay is well known by archaeologists. It must be stressed that many potters do not add anything to the clay (*untempered clay*) or add a dried and grinded part of the same raw material (a technique we choose to call *simple clay addition*). When they add something, they may use a great variety of materials: another clay (or *clay mixing*), dust, organic rich earth (soil), mud, termite heap clay, sand, gravel, rocks (calcareous rocks, gneiss, schist, asbestos), iron stone, *grog* (crushed, grounded and/or sieved potsherds - by far the most common material, fig. 14), fired earth

Figure 14. Grog, like raw materials, may be crushed in various ways. The Songhai potters of Torodi (Niger) grind the grog with upper and lower grinding stones. Both the potsherds and the tools are 'recycled' from a nearby archaeological site (O. Gosselain).

(untempered raw material fired along with pottery), ash, straw, cereal husks (millet, fonio or rice), grass, stems, bark, dung (horse, cow, goat or donkey), shells, clay solution (clay mixed with a large quantity of water), calcareous solution (grounded and sieved calcareous rock mixed with a large amount of water, Sall 2001), or bark decoction.

The last processing step generally consists in a thorough homogenisation of the paste. This may be done in various ways: kneading with the hands, trampling with the foot (fig. 15) or pounding with various kinds of tools and supports.

Figure 15. Among the Bozo speaking *Nama* potters of Dia (Mali), the prepared clay is homogenised by trampling on a mat (Photo O. Gosselain).

If one considers the various combinations of these four categories of treatments, as well as the diversity of behaviours, postures and tools, there are probably hundreds of ways of preparing the clay. Such a diversity in clay selection and preparation strategies has often been explained in terms of technical or functional constraints. In order to improve the physical performance of raw materials, artisans would be constrained to modify its characteristics, their choices being restrained to a limited number of technical possibilities (see Tite 1999 for a review). Several studies have shown that clay selection and preparation strategies are, in fact, much more flexible than previously envisaged (Gosselain 1998, 2002; Livingstone Smith 2000, 2001a; Sall 2001). This flexibility, however, does not mean that artisans act randomly. Several factors contribute to guide potters' behaviour, as detailed below.

## TECHNICAL STRATEGIES

### Selecting and exploiting clay sources

A first thing to note when trying to understand how and why individuals come to exploit particular clay sources is that a wide variety of raw materials may be used to make pottery. Textural analyses reveal, for instance, that materials whose content range from 5 to 40 % in clay and 40 to 70 % in sand are commonly used in Sub-Saharan Africa (Gosselain 1994, 2002; Livingstone Smith 2000, 2001a; Mercader *et al*. 2000). Interestingly, no relationships seem to exist between the physical and chemical properties of these clays and the techniques used for shaping and firing the vessels, or the intended functions of the finished products (Gosselain 1994, 2002; Livingstone Smith 2000, 2001a, 2001b; Sall 2001). In theory, potters should thus be able to exploit any clay available to them without having to modify their usual behaviour.

Yet, individuals have a much narrower perception of what « appropriate materials » are. When discussing the matter with them, one gets the feeling that each clay used locally is thought to be so « appropriate » as to be non substitutable. First, artisans do not consider that extraction may be done « just anywhere », but rather in specific locations: riverbeds, swamps, alluvial plains, hillsides, etc. The chances to find appropriate clay in such locations are probably quite high, but this is not the sole reason why individuals favour them. The habit of frequenting specific categories of sites seems to alter potters' perception of their environment, as they eventually consider some environments to be more likely than others to yield clay. Moreover, it weights on the way individuals think of the process through which new sources may be discovered. A potter will consider, for instance, that the best way to do so is to locate crab holes on the ground, since the animal prefers to burry in wet clayish soils. Another potter will say that one has to check the colour of puddles after the rain, or to look for the presence of cracks in the soil during the dry season, or to observe the rate to which water level fluctuates in swampy areas (see examples in Gosselain 2002: 43-45). Such criteria tend to narrow the choices pertaining to the selection of clay sources.

Another type of over-determination stems from the fact that clay sources are mostly discovered by accident. Potters have their own criteria for identifying new sources, as shown above; yet, they are aware that clay beds are situated at tremendously variable depths from one place to another, with the consequence that they could dig test pits for months without success. Moreover, some people think of clay as a living material that travels under the ground - with or without the help of spirits - and may remain hidden as long as it chooses to. This is the case among some Bariba potters of Northern Benin, Bafia of Cameroon (Gosselain 1992) and Luba of D.R. Congo (Petit 1998), who pre-

fer to wait for the clay to « reveal itself », rather than to engage in a prospecting expedition with uncertain results. Usually, it is while performing other activities, and especially activities which force them to dig the ground (e.g. tending fields, building houses, digging wells) or to frequent places such as riverbeds or swamps, that potters, members of their family or any of their acquaintances may « discover » a new source and get the process leading to its possible exploitation under way. For several factors must indeed be assessed before starting to frequent a new location.

A first requirement is that the clay must have the « right » physical properties; i.e. that its plasticity, texture, colour, and even its taste and scent fit with the personal requirements of the potter (e.g. Barbour 1989; Drost 1967; Frank 1998; Gosselain 2002; Krauze 1985; Livingstone Smith 2001a; Sall 2001; Woods 1984). Each individual has a clear-cut - yet completely subjective - opinion about these qualities, to the extent that one frequently observes people disdaining clays that are used successfully by others, event though they process it, and shape or fire the vessels in the same way. In the field, most of our attempts to exchange materials between artisans of the same area - and sometimes the same neighbourhood - were met with strong refusals. The clays that we brought along were said to be unsuitable, and potters who finally accepted to give them a try were clearly amazed to see test vessels come intact from the fire (Gosselain 2002). Thus, the physical characteristics of the material alone do not allow one to predict, *a priori*, whether or not a site will be exploited.

If newly discovered clay is judged suitable, a second requirement is that it must be located nearby the potter's main occupational areas and / or working place. Since pottery making is usually subordinated to other activities, such as farming and domestic tasks, potters tend to restrict their investment in time and energy or, at last, to avoid scheduling conflicts between their different activities. Sources located nearby living or working sites, fields, rivers frequented for fishing, roads, or tracks, are therefore more likely than others to be selected and subjected to long term exploitation. In fact, about 90 % of the hundreds of sources that we visited in Sub-Saharan Africa were situated nearby or within sites used primarily for other activities. Such a situation has an obvious impact on clay exploitation strategies. More importantly, it shows that clay extraction sites are not distributed randomly or according to a specific logic, but are an integral part of the overall territory frequented by both potters and non-potters. The « exploitable threshold model » developed by Arnold (Arnold 1985: 35-57) should thus be conceived in terms of geographical compatibility and time schedule of various activities, rather than geodesic distance or transportation means alone. Clearly, the fact that more than 80 % of sources exploited in Sub-Saharan Africa lies within a 3 km radius is anecdotal at this level.

Finally, the selection and exploitation of clay sources is also surrounded by a series of rituals and taboos (see examples in Drost, 1967, Gosselain, 1999, 2002). For instance, certain persons are systematically kept aside from the extraction site or the places were the potters store and manipulate the clay: men if the craft is practised by women, women in other contexts, uninitiated people, members of other social groups than the potters, little girls or boys, pregnant women, menstruating women, twins, warriors, etc. Likewise, artisans must avoid to do particular things on the eve of extraction, during the trip to gather clay or at the site: e.g. having sexual intercourse, talking, singing, swearing, urinating, manipulating certain objects, eating particular food, etc. Rituals and sacrifices may also be performed at the extraction site (e.g. Arua and Oyeoku 1982; Frank 1998; Herbich and Dietler 1991; Lawton 1967; Petit 1998; Sall 2001; Traoré 1985). Despite their tremendous variability, all these practices aim at preserving the quality and availability of clay. Yet, if they act essentially upon the way artisans behave when performing extraction, they may also have an impact on clay selection strategies and the lifespan of individual sources. For example, Serrer potters of Senegal tend to abandon their sources when it has been frequented by Wolof potters of the blacksmith caste, for they believe that blacksmith' sweat spoils the clay (Sall 2001). Among Luo of Kenya, Herbich and Dietler (1991) observed that several sources were abandoned due to the occurrence of accidents, which are usually explained in terms of witchcraft, or transgression of taboos. Reversely, potters may be very reluctant to relocate their sources, either because spirits are thought to dwell in them (e.g. Quarcoo and Johnson 1968; Smith 1989) or because it is thought that someone has to die in compensation for discovering or opening a new source (e.g. Livingstone Smith 2001a; Petit 1998).

One sees, therefore, that while potting clays are theoretically widely available, their actual pattern of selection is not merely a matter of geographical distance or ownership of the land, but stems from a series of other considerations: individual perception of the places liable to yield clay, criteria allowing one to locate clay beds, types of activity during which clay may be discovered, personal conceptions of clay suitability, socio-economical status of the craft, religious beliefs and practices. In other words, clay selection strategies involve a series of skills and representations that fall within the technical and economical fields as well as the social and symbolic ones.

**Clay processing**

As for the selection of clay sources, artisans have a rather narrow view of what are suitable recipes for preparing clay, their definition of *suitability* being based, once again, upon technical as well as non-technical conceptions. The range of local conceptions is such that a tremendous variety of recipes are actually

used - most of them appearing as equally suitable from a technical and functional point of view (Gosselain 1998; Livingstone Smith 2001a, Sall, 2001). Yet, potters do not think in terms of « choice ». Rather, they consider what they do as the sole way to proceed. When trying to untangle the underlying logic behind local practices and representations, four aspects seem to play a major role: *tradition*; *techno-functional constraints*; *relationships with other realms of activity; symbolic conceptions.*

As a general rule, potters explain that they act according to *tradition*; i.e. that they use the same tools and recipes as the person(s) from whom they learned the craft and that they never changed since then. « We were born doing so », they say, stressing the affiliation between their own behaviour and that of their parents and more distant ancestors. This line of explanation should not be considered as a convenient way to answer silly questions from ethnographers. Referring to « tradition », notably, is a way of asserting individual identities and social ties (Gosselain in press).

Another frequent explanation is that processing recipes stem from *technical necessity*. If clay is not prepared in a specific ways, potters say, vessel will not pass through the drying and firing stages, or will break during utilisation. Such conceptions may sometime drive potters to change processing techniques according to the function of vessels, or to the vessel parts. Among Koma-Gimbé of Librou and Kassina (Cameroon), for example, potters use a simple clay technique for small vessels, but add sand when making large beer brewing jars. They explain that jars would crack when drying if they did not do so. The Bozo-speaking *nama* potters of Dia (Mali) prepare two types of clay: « male » and « female ». Male clay is used for the bottom, belly and shoulder, while the female clay is used to fashion the neck and to cover the outer surface of the vessel. It is also used to make small vessels such as those used to wash babies or to prepare medications. According to the potters, the reasons for using different clays are very obvious: smooth clay « catch the eyes » of consumers and prevent babies from scratching their skins while bathing (for other examples of the use of different processing recipes, see Bedaux and Lange 1983; Delneuf 1991; Gallay and Sauvain-Dugerdil 1981; Herbich and Dietler 1991; Martinelli 1994; Nicholson 1929; Raimbault 1980; Tobert 1984; Trowell 1941). Most commonly, however, potters insist upon the necessity of preparing the clay in a certain way, but use the same preparation technique, whatever the intended function of the vessel: storing, transport or cooking.

Another factor acting upon local definitions of « suitable recipes » stems from the connection between techniques used in pottery making and those used in *other realms of activity*. There exists, obvious relationships between clay processing techniques and food processing (Gosselain 1995, 2002) or agricultural practices (Sall 2001). In the case of food processing, both staple foods and clay are prepared with the same tools, the same gestures and the same recipes. In the Bariba village of Tourou (Benin), for example, potters pound the clay in a wooden mortar and separate the fine and coarse fraction by shaking the material in a calabash. Then, they pound the coarse fraction a second time, and let it to soak in a jar under the sun. When the liquid is viscous enough, it is sieved through a pierced tin can and added to the fine fraction of the raw material. Potters explain that this mixture acts as « cement » and that the best millet porridge is obtained in a similar way. Another example comes from Vute potters of Mangay (Cameroun), who specifically compare clay processing to the preparation of cassava porridge (Gosselain 1995). Clearly, it is more convenient for women potters to use the same tools and recipes that they use daily for processing food, and one should not view these examples as an univocal materialisation of « deep symbolic » or « structural » connections between pottery making and other activities. The fact is that such connections, as mundane as they may be, condition the way potters act upon raw materials.

More explicit *symbolic reasons* may influence clay-processing strategies. For example, some Boko potters of Benin take great care in extracting all rootlets from the raw material. This is because rootlets are used to prepare a medication that prevents potters from « swelling » when fashioning vessels. In the area, many people think that making pottery may cause individuals to suffer overall swelling and possibly die from it; yet, potters have « secret practices » to prevent that disease (O.G. personal observation; see also Lombard 1957). Grog addition may also be regarded as both a technical and a symbolic improvement of the raw material. For instance, Fulani / Gurma potters of Yacouta in Burkina Faso (Livingstone Smith 2001a), Nama/Somono potters of Dia in Mali (Da Silva Gaspar 2003) or Songhay and Zarma potters in Niger (Gosselain in press) recycle archaeological sherds into grog, explaining that it is « good » to tie new vessels with those of the ancestors, because « they knew how to make strong pots ». Considering the use of grog made from the eating bowl of deceased women, Smith (1989) also concluded that « [t]he sherds preserve a link between the woman and her family on the one hand, and the Earth on the other. (…) In this capacity, they are renewed, becoming part of another cycle of life. »

We see, therefore, that within a very broad range of appropriate processing techniques, the selection of « suitable recipes » is based on both specific and general knowledge, pertaining to the way individuals situate themselves in time and space (notion of « tradition »), local conceptions of technical and functional constraints, relationships with non-potting activities, and the symbolic meaning of particular materials and behaviour. In other words, potters do not act randomly, but navigate throughout a narrow channel of culturally defined and shared practices.

## DYNAMICS OF TECHNICAL TRADITIONS

The preceding gave us an idea of *what* constitutes « traditions » pertaining to the selection and processing of clay in modern-day Africa. In summarising the various factors that contribute to guide potters' behaviour, we have show that « traditions » may be considered as local definitions of « what is possible » and « what is not » within specific context, such definitions (or « rules ») being embodied by individuals through practice, tacitly shared and, most often, non explicit (for a theoretical discussion, see Dietler and Herbich 1998; Dobres 2000: 136-141). As true as it may be, this conception remain too static - a classical pitfall of ethnography. If societies and social practices are irreducibly historical, to paraphrase N. David (1992: 332), and if culture is always in motion, we must seek a more dynamic perspective on traditions. That is, we must know a bit more about their temporal and spatial evolution or, at last, about the processes liable to induce change in individual practices. The following section is a step in that direction, although it remains very tentative.

As mentioned above, potters asked about the origin of their behaviour generally insist upon its inherited nature. « I do as my mothers did », « I found that at birth », « It is the way of our ancestors » are typical answers to such question. Field observations and interviews indicates that most knowledge and know-how pertaining to the selection and processing of raw materials - including social and symbolic prescriptions - are acquired informally, at an early stage of the learning process (for in depth studies; Gosselain, 2001, in press, Herbich 1987; Wallaert 1999). But an important thing to note is that people do not perceive this part of the process as an actual « learning »: they assist in the domestic chores of the household, which may include fetching and transporting raw materials, preparing the clay and temper, and setting up the firing. In other words, individuals learn how to select and prepare raw materials « by impregnation », in a participation framework that involves specific social relationships and is part of the wider process of becoming a community member. This process of « legitimate peripheral participation », as defined by Lave and Wenger (1991), has two important implications. First, it means that the acquisition of particular knowledge (« traditions ») cannot be dissociated from the strategies through which individuals interact with one another and, more generally, from the construction of the self. As an example, children may adopt specific techniques without questioning them, because their adoption is part of the process through which they will acquire a status of professional and adult. But they may be inclined to change these techniques later, as they settle into other communities or negotiate new social relationships. Second, learning by legitimate peripheral participation means that traditions are not simply transmitted « vertically » - e.g. from mother to daughter or from father to son - but both vertically *and* horizontally. Indeed, most teaching experts do not practice the craft in isolation, but belong to peer groups that may include siblings, friends and neighbours. Similarly, apprentices belong to their own peer group. In Waraou (Niger), for instance, Hausa Katsinawa male specialists explain that they inherit the craft from their father, but add that they usually train with children of the same age (friends and siblings) in a context generating emulation and cooperation. Acquiring a tradition, therefore, is not simply a matter of inheriting information from a biological parent only, but to fit and participate in a « community of practice » (Wenger 1998).

Accordingly, the most explicit examples of change come from situations where artisans relocate into new communities of practice - other neighbourhoods or villages - according to marriages, divorces and widowhood, or for a series of personal and economic reasons. Whether permanent or temporary, these relocations have several implications in regard to the dynamics of clay selection and processing traditions. Indeed, if a potter arrives in a place where nobody produce vessels, s/he may have to relocate her clay source if the distance is too important, but s/he will not be inclined to change her/his habits regarding processing techniques. As a matter of fact, accidents occurring after having relocated clay sources are mainly imputed to clay quality rather than preparation recipes (Livingstone Smith 2001a). On the contrary, potters moving to a place where pottery is already produced may be confronted to other ways of doing, in working with kin or neighbours, or meeting potters at the source or at marketplaces. Becoming aware that other techniques are successfully used for making pottery forces them to *think* about their own practices and, occasionally, to question and justify them. Through comparison and discussion, for example, peer pressure may drive potters to adapt to their new social environment. Reversely, they may keep up their practice for reasons pertaining to their perception of the link between technical practice and identity, or more mundanely, because they think that modifying their behaviour will alter the quality of their products. Examples of conservative behaviour include the situation described by David and Hennig (1972) in the village of Bé (Northern Cameroon), where Lame and Fulbe potters stick to their respective processing recipes, even if they share the same extracting site. Delneuf (1987) observed a similar situation in other villages of the same area. Reversely, Herbich (1987; see also Herbich and Dietler 1991) has given a detailed account of the way Luo women undergo a process of re-socialisation under the supervision of their mother in law and are consequently forced to abandon former knowledge in order to conform to local norms. In a similar manner, Livingstone Smith (2001a) observed a Mossi potter, married to a Bobo blacksmith from Boromo (Burkina Faso), who had changed the way she prepared the clay and decorated the vessels to fit with local tastes. Market pressure may also induce

change. We have seen in the introduction of this paper how potters may rapidly switch clay sources or modulate processing recipes to meet customers' demands. Similar preoccupations were observed in Senegal, where Tukulor potters having settled in Soninke country stop adding dung to the paste because those who buy and use the vessels consider dung unclean (Gelbert 2000).

Among other factors likely to induce change are the social position and notoriety of those among whom other ways of doing are observed. Although we have little actual data on potters to support this assumption, the role of individual agents in the spread of innovation has been observed elsewhere, for example among Ashanti sculptors of Ghana (Silver 1981) or American (Henrich 2001) and African (Reij and Water-Bayer, 2001) farmers. Recent fieldwork in Niger revealed that practices considered as « new » by Zarma, Songhai, or Hausa potters are usually attributed to a single individual who settled in the village and taught it to local potters. Interestingly, most of these individuals are said to come from, or to have sojourned in particularly renowned pottery producing centres. Here, one has the feeling that borrowing a clay processing recipe - or any other emblematic practice - from such places was both socially and economically interesting. Such behaviour could explain why processing techniques are often more homogeneous around major pottery centres than in areas comprising a scatter of small centres.

Keeping the preceding in mind and looking at the spatial distribution of technical practices, it is not so surprising to see that behaviours tend to homogenise at regional scale and that, within these geographical units, variations ever occur within a limited number of possibilities. This situation may be illustrated by looking at the continental and regional distribution of tempering techniques in Sub-Saharan Africa.

At a continental level, techniques such as grog and sand tempering — certainly the most popular recipes in Africa — are widely distributed. Others have a more restricted, but also more discreet, distribution. This is the case of shell tempering, reported among a few coastal groups in Senegal, and dung tempering, mainly observed in the Sahelian zone, from Senegal to Sudan. Notwithstanding the historical or ecological reasons underlying the distribution of the later, it is interesting to note that dung is used as fuel by potters from Senegal to Sudan, but also by many eastern and southern African populations (Gosselain 2002; Livingstone Smith, 2001b). Thus, even if a lot of people have the possibility to exploit this material for processing clay, only a few do so actually. In other words, we are faced with cultural practices rather than the exploitation of an ecological opportunity, which means that the distribution of this processing recipe results from historical relationships or, if one prefers, the interconnection of different community of practices. The fact that other processing techniques - such as simple clay or sand and grog tempering - are also used within the distribution area of dung temper reinforces this interpretation. Indeed, the spread of clay processing recipes is not likely to proceed from an « unavoidable contagion » but from socially and culturally mediated relationships between potters; hence the discrepancies in the pattern of distribution.

At a regional level, it is easier to observe « technical pools », within which variations are restricted to a number of options. In the Faro region of Northern Cameroon, for instance, we identified four technical zones based on the characteristics of tempering techniques alone. These areas differ both in terms of the temper selected and the degree of technical homogeneity. In some areas, sand tempering is the only technique used by potters, while in others potters use a panel of techniques. There seems to be a clear relationship between these technical pools and the spatial patterning of settlements, « technical boundaries » coinciding with discontinuities in the spatial density of communities (Livingstone Smith 2000). As for differences in the degree of technical homogeneity within each zone, we still lack convincing explanations. It must be noted, however, that areas where pottery is in the hand of the endogamous sub-groups of blacksmith/potters - designated as « the masters of pottery » - display a greater homogeneity of practices. The reason could be that, as stated above, renowned specialists shape group conceptions pertaining to clay tempering and consequently induce a process of technical homogenisation. The possible influence of endogamous sub-groups on the regional distribution of clay processing techniques was noted elsewhere (Gueye 1998; Sall 2001). In a large part of the Tukulor area of Senegal, clay tempering practices are essentially distributed according to the social status of the artisans (Gueye 1998). But there are also cases, although rare, where regional distribution seems to be related to the ethno-linguistic affiliation of the potters. In Southern Senegal, for instance, Diola potters are the only ones using burnt and crushed shell as temper (Linares de Sapir 1969; Sall 2001), while Serrer potters of the same area, use a calcareous solution (Sall 2001).

## CONCLUSION

In this paper, our aim was to analyse the factors underlying variations in to clay selection and processing pratices. Following a paper from Arnold (2000), the idea was to provide archaeologists with a realistic description of potters' practices, using ethnographic data collected in Sub-Saharan Africa. To that aim, we have considered *technical practices*, the *strategies* that underlie them, and the *dynamics* of technical behaviour.

We have seen that clay exploitation and processing are both characterised by a wide variety of tools and techniques in Africa. While materialist reasons have often been used to explain such diversity, field observations indicate that physical and technical constraints are more flexible than considered initially. Yet, it was shown that the theoretical flexibility of choices does not mean that artisans act randomly. Several factors - or *technical strategies* - contribute to direct potters toward specific choices. They correspond to an inextricable combination of inherited habits, technical and functional constraints, personal representations, tools and postures used in other activities, as well as symbolic prescriptions. What potters do, to summarise, is negotiating a path across a patchwork of knowledge and experience that are both inherited - and thus widely shared - and constructed through their daily practice.

As the ingredients of technical traditions are often heavily associated with a notion of heritage, we have considered their *dynamics* and *distribution*; that is, the way knowledge is transmitted through time and space as well as the way it may be altered. We have seen that novice potters learn processing recipes « by impregnation », without paying much attention to their particularities or the possibility that they may be modified. Yet, while they - and master potters - emphasise the ancientness and stability of their practices, field observations reveal that individuals *do* change processing recipes through time, for reasons related to their own social trajectory or fluctuations in customers' demand.

The reason is that traditions pertaining to clay selection and processing are not mere technical acts but culturally defined practices, that are brought into play within socially bounded communities. As such, social interactions and local definitions of appropriateness are keys to understand the evolution of behaviour through space and time. And while the examples given above may appear as a random collection of individual strategies, they all underline the importance of the social context within which potters practice their craft. If traditions are clearly unstable and if one should not expect their distribution to coincide with salient boundaries - as the notion of « community of practice » suppose actual and recurrent contacts between people, not just the sharing of an identity tag -, they should inform us, at last, about actual interactions between potters.

The situation is complex and one may wonder what we have gained from this overview of African data on the selection and preparation of raw materials. Firstly, since Constantin and Courtois (1980, 1985) said that tempers were « cultural », little has been done to explain what lays actually behind clay selection and processing practices. Decomposing traditions and their dynamics, we hope to have provided archaeologist with a realistic outline of how clay selection and processing works.

Secondly, the idea that technical behaviour varies essentially within a narrow set of possibilities fits very well with archaeological data on clay selection and preparation or paste variation. For instance, reconstitutions of early Neolithic pottery manufacturing processes in Belgium or France (Bosquet *et al.* this volume), show an extreme variability as regards the raw materials and their processing. Within a single site or even a single structure, one may witness dozens of variations at these steps of the manufacturing process. This situation has led some archaeologists to believe that detailed reconstruction's were pointless (Constantin, pers. comm.). We know, however, that in the archaeological record, as in Africa today, variations only ever occur within a limited number of possibilities. It is within that relatively narrow cultural path that variations appear chaotic. To go further and disentangle micro- from macro-social interaction networks, we need detailed reconstruction of complete manufacturing processes, going as far as the identification of artisans' hands.

Thirdly, it seems probable that a series of conceptions associated to pottery practice may also be transmitted in a fashion similar to technical behaviour. The approach developed in this paper may be extended to other steps of the manufacturing process and to other cultural practices, from technical knowledge to symbolic beliefs. For instance, the mechanism of transmission envisaged in this paper could provide an explanation for a phenomenon such as « symbolic reservoirs » (MacEachern 1994, 1998; MacIntosh 1989, 1992; Sterner 1992).

Finally, a major aim when starting this paper was to pay tribute to Dean Arnold's outstanding contribution to ceramic studies. It is only fit that using new methodological tools and data collected on another continent, aspects of our interpretation match some of Arnold's view on pottery technology. The concept of « community of practice » used in this paper, notably, is clearly close to the concept of « community of potters » used by Arnold throughout his work (Arnold 1981, 1983, 1984, 1993, this volume). Like potters, we go back to the source.

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**AKNOWLEDGEMENTS**

The authors wish to acknowledge the following institutions for the financial and logistical support: ULB, MRAC-KMMA (Belgium), Communauté Francaise de Belgique, MESRS (Bénin), MINREST (Cameroon), IRSH and Université Abdou Moumouni (Niger), ISH (Mali), MENRS (Togo), MESSRS and Université de Ouagadougou (Burkina Faso), The Mali Project and the City of Andenne (Belgium). Our also thanks go to Els Cornelissen (Section de Préhistoire, Musée royal de l'Afrique centrale); Renaud Zeebroek (ULB); Dominique Bosquet, Ivan Jadin, Anne Hauzeur et Micheline De Wit « Préhistoire » (Section de Préhistoire, Institut royal des Sciences naturelles de Belgique), Rogier-Bedaux and Annette Schmidt. Last but not least, we thank the artisans for their kind welcome and their extraordinary patience..

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