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Shaping Kabambian Pottery: Identification and Definition of Technical Features

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Abstract: The excavation of a series of graveyards during the '50 and '70 in the Upemba depression (Katanga, DRC) led to the establishment of a cultural sequence spanning the 7th to the 20th century AD. This sequence consists in a succession of archaeological cultures displaying elements of rupture and continuity, particularly visible in the shape and decoration of pottery. To answer questions pertaining to population dynamics in central Katanga, we decided to check whether or not these variations where reflected in pottery roughing-out technologies. Because they are related to a strong interaction between master and apprentice and are associated to an essential step of pottery apprenticeship, pottery roughing-out methods are indeed considered to be more stable – i.e. related to deeply rooted forms of identity - than form or decoration. In this paper, we present the analysis and reconstruction of Kabambian pottery roughing-out methods - a first for central Africa. Our conclusion indicates, that Kabambian pottery (dated between the 13th and the 18th century AD) was made by cylindrical coiling with slab bottom.

Keywords: Central Africa, Katanga, Upemba depression, Archaeology, Kabambian, Pottery technology, Pottery shaping, Roughing-out, Identity.

INTRODUCTION

The link between archaeological cultures and present societies has often been a tempting, if difficult, question in sub-Saharan Africa. While pottery is but a fragment of the material culture of ancient and present societies, it provides a remarquable tool to explore this relationship. Kabambian pottery, named after one of the lake of the Upemba depression in central Katanga in the Democratic Republic of Congo is no exception [1]. Central Katanga is home to one of the great savannah kingdoms and Kabambian pottery is dated to a period ranging from the 14th to the 18th century, a time immediately preceeding the period where historians date the Luba kingdom with a reasonable degree of confidence (before 1700 AD, oral / historical sources are unclear). As Kabambian pottery presents some resemblance as well as differences with early Luba pottery, it provides an excellent case study to examine the connection between past and present technical behaviours. To do so we decided to examine some aspects of pottery *chaînes opératoires*, roughing-out technologies, to check whether they are related to those observed in the study area today or not [2].

Pottery manufacturing processes, and more specifically roughing-out or primary shaping techniques, are considered as a powerful tool for the study of past societies [see for instance 3-6]. In fact, the reconstruction of primary shaping techniques, advocated by several researchers since the middle of the 20th century [7-13], has known some important developments since the beginning of the nineties. Some of the methodological principles were established a long time ago, but systematic work undertaken on ethnographic material expanded the reference system to which archaeological samples could be compared [14-17] and opened the way for improved archaeological reconstruction [18-20]. This field of research has reached a critical stage, however. As an outsider in the mainstream of archaeometry, projects are few and far between. Although there is an informal agreement among specialists on some aspects of the methodology – for instance, the need to systematically combine different types of observations[1] – we still lack a systematic framework of descriptions, a sound nomenclature and a common method for the drawing of technical features [but see for example 15, 20][2]. Without a proper characterisation of the observations, interpretations in terms of technical behaviours are at best incomplete.

With these methodological challenges in mind and the exceptional opportunity offered by the archaeological sequence in the Upemba depression, our aim is twofold.

Firstly, we intend to present our analysis of the building methods of Kabambian pottery. This will be a first step in verifying the time depth of some pottery practices in south central Africa. Secondly, we intend to use this opportunity to promote and refine the methodology in the field of pottery manufacturing processes reconstruction, particularly regarding the analysis and description of X-radiographs. Indeed, Kabambian pottery is what one could call a fine ware, often

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[1]Such as surface observations, section observations (fresh breaks) and x-radiography.
[2]See also Lugli & Vidale as regards the graphic representation of use-wear on pottery [21].

Table 1. Content of the Tombs in which the Vessels where Found. Among the Kabambian A Tombs One Contains a Large Number of Classic Kisalian Vessels. The Kabambian B Tomb Includes an Iron Bell, a Symbol of Power in a Large Part of Africa Today. Vessels n° 79.180 (Attributed to Kabambian A) and Vessel n°79.150 (Attributed to Kabambian B) are Not Included as they were Not Found in Cemeteries

Ref n°	Tomb n°	Attribution	Position of the Squeleton	Pottery	Copper Objects	Iron Objects	Other
79247	T. 1	Kabambian A	S-N, on its right side, fœtal position	4 along the back (3 upturned) + 2 sherds	2 spiral fragments 4 small crosses	Fragments of small bracelet	Quartzite fragment
79253	T. 4	Kabambian A	W-E, on the back	2 pots. One inside the other (also includs some bone fragments and a stone) + potsherds (MNI = 5)	2 ankle bracelets, 1 ring, 3 points 20 crosses	1 spearhead, 3 ring fragments (?)	
79278	T. 6		S-N, on its right side, left hand under the head	3 pots + fragments	8 crosses	1 Knife	
79297	T. 12	Kabambian A	S-N, on its right side	2 pots. 1 trilobate (next to the hips) and 1 (behind the skull)	2 fragments of studded bands of copper 11 crosses	1 bracelet, 2 ankle bracelets	13 green glass beads, perforated oister shell
79419	T. 32	Kabambian A	Traces (child)	14 pots (13 kisalian, 1 kabambian)	20 small bracelets, 1 wire fragment 4 crosses	several tubular beads	
79466 and 79509	T. 42	Kabambian B	SE-N, on its back	9 pots. 5 around the head (1 with iron objects, 1 with bird bones and 1 similar to modern Luba pottery)bird bones and 1 similar to modern Luba pottery)	1 plate (function ?), 6 bracelets, beads 1 large cross et 80 small crosses	1 arrowhead, 1 bracelet, 1 bell, 2 plates, 22 tubes (belt)	1 ivory fragment (?), 29 beads (23 red flint, 1 malachite, 2 granite, 2 green and 1 opaque blue glass), 1 perforated cowry, 2 oyster shells

displaying a carefully smoothed or polished surface. This surface treatment has erased all traces of previous manipulation. Without X-radiography, we would have been unable to characterise the internal structure of Kabambian vessels and identify the technology used to build them.

In this paper, we will first summarise the archaeological context in which the material was found. We will then outline our analytical framework regarding the surface observations and x-radiography, before considering the results. In doing so, we will suggest a systematic way for the description of technical features on the surface and in the internal microstructure of pottery.

ARCHAEOLOGICAL CONTEXT

The cemetery of Sanga was used from the second half of the 1st millennium to modern times. It is important by both the number of men, women and children tombs[3] and the wealth of material buried with the deceased. The data concerning the tombs where the vessels under study were found is summarised in Table **1**.

To assess the potential of technical reconstruction on ancient pottery of the Upemba, we used a selection of 9 Kabambian representative vessels kept at the section of prehistory of the Royal Museum for Central Africa in Tervuren (MRAC-KMMA, Belgium) (Fig. **1**). They will be referred to according to their museum inventory numbers (i.e. 79.419). The sample is small, but roughing-out methods are known to be both stable through time and rather homogenous within a given social space [see for instance 26]. All the vessels may be safely attributed to the Kabambian stage of the archaeological sequence. Among these, 7 vessels collected by J. Nenquin in 1957 were found in 5 graves at Sanga (tombs 1, 4, 6, 12, 32 and 42) and 2 vessels were bought from villagers at Sanga and Katongo, but displayed clear Kabambian characteristics [23]. The tombs were attributed by Pierre de Maret [22: 189] to the Kabambian A (T.1, 79.247; T.4, 79.253; T.6 79.278, T.12, 79.297 and T.32, 79.419) and to the Kabambian B (T.42, 79.466 & 79.509). The Kabambian is dated between 495±105 bp (Sanga, Hv-6615) and 250±85 bp (Katongo, Hv-6621), thus from AD1350 to AD1800 [25:206]. Finally, although these vessels were found in graves, they are the representatives of usual pottery assemblages – indeed some of them appear to be used prior to burial. There is no reason, in sub-Saharan Africa, to believe that different roughing-out technologies were used to build pots for the dead.

METHODOLOGY AND ANALYTICAL PROCEDURE

First, we need to define the concepts we are using regarding the shaping process. Although there is no agreement on the details of technical behaviour definition, there is a general consensus since Shepard's work that the fashioning of a vessel may be divided into 2 distinct steps: forming or primary shaping (or roughing-out) and shaping or secondary shaping [9, 10, 16, 17, 27, 28]. During primary forming the artisans generally build a rough-out, usually a cylinder or a cone. During secondary forming, the vessel is given its final

[3]The necropolis yielded 177 identified burials [22, p. 189]. Nenquin [23] excavated 56 tombs (T 1 to 56), Hierneaux [24] 89 tombs (T 57 to 145) and de Maret [22, 25] 31 tombs (T 146 to 176).

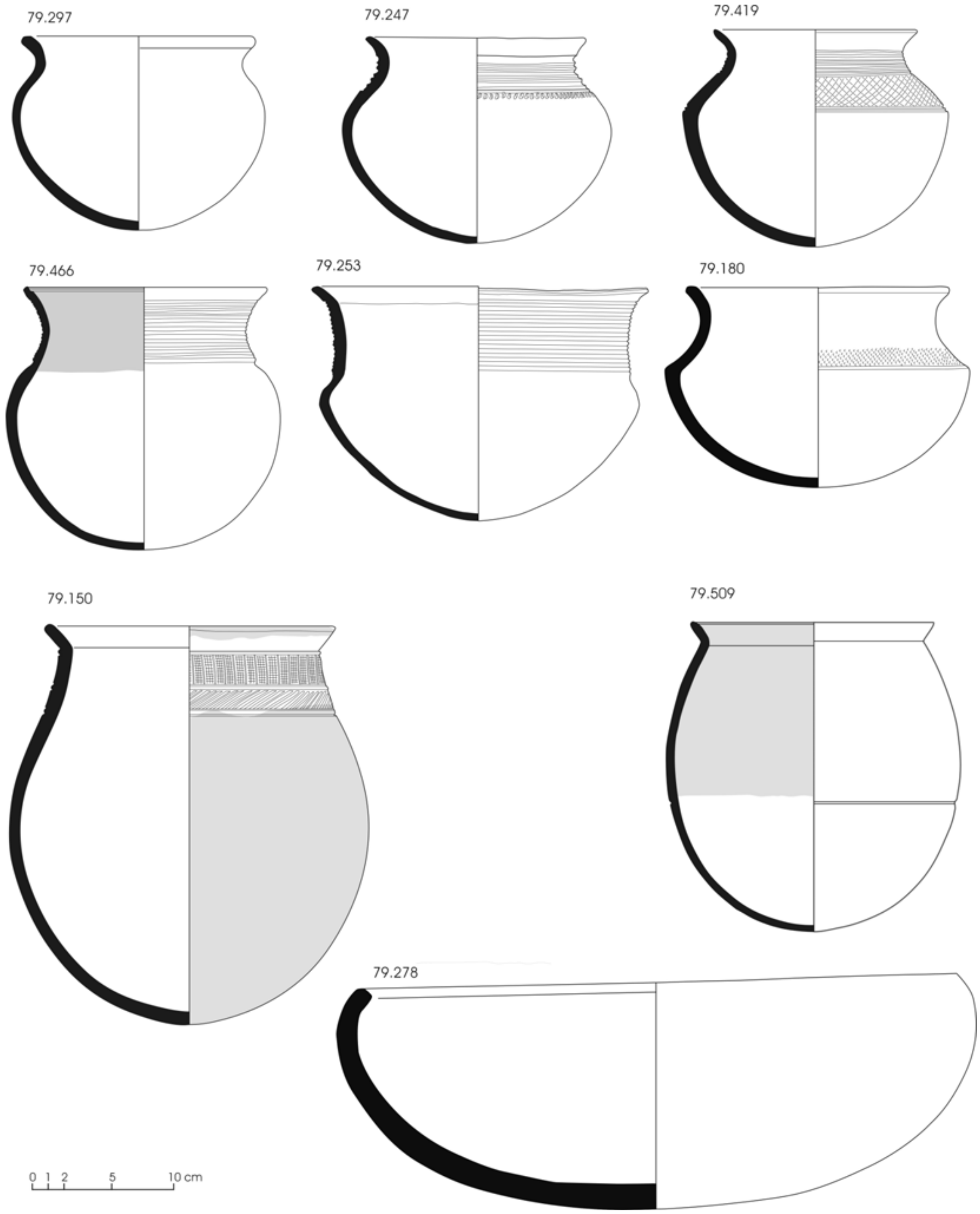

Fig. (1). Kabambian vessels from the Upemba depression selected for analysis (shaded areas polished with red ocre).

shape. Here we will focus on the roughing-out, or primary forming, stage of the process.

The methodology used in this paper was developed elsewhere on ethnographic [17] and experimental [20] reference material and was tested on archaeological material from African and European contexts [18-20]. Analytical methods range from simple eye observation to binocular and microscopic analysis or x-radiography. Because the material is part of museum collections, emphasis was put on non-destructive methods of analysis: 1) surface features (naked eye and binocular microscope examination), 2) internal micro-structures (tangential view by x-radiography[4]), and 3) other features (patterns of fracture, defective joints and variations in surface texture observed with naked eye examination or binocular microscopy). The spatial distribution of observed features and their combination, called configurations, are listed and described systematically (nature, type, morphology and position). Surface and structural configurations are then combined and interpreted in terms of technical behaviours. Finally, these interpretations are compared to documented contemporary pottery manufacturing processes of the Upemba area.

[4]Images were acquired thanks to a Siemens AXIOM Iconos R200 system and processed with Telemis image processing program and Adobe Photoshop 7.0. X-ray images for three vessels where acquired with a grid separating the vessel from (79.419, 79.180, 79.150). The use of the grid should be avoided as it produces an artefact that hinders further image manipulations aiming at the enhancement of technical features.

As regards radiography, although there is long history in using this method for the identification of pottery "building techniques" [see for instance 8, 9, 12, 17-19, 29-36], we are still faced with a number of problems. The main problem lies with the fact that it has mainly been used directly on archaeological material. Therefore, the results are always an interpretation based on speculations, rather than on a controlled comparison to a standard – be it experimental or ethnographic. The second problem is that there is no standardised descriptive method. Results are generally presented using the radiograph of a whole vessel, a rather difficult thing to apprehend for non-specialist as radiographs are difficult to read even in good quality publications. Here, we will advocate a standardised method of description, hoping to generate a much needed debate on the subject.

Concerning the descriptive vocabulary for radiographs, we will use a series of conventions defined by Whitbread [37] for argillaceous clasts visible in pottery thin sections. Several descriptive categories of the system that draws largely on the descriptive method of soil micromorphology [38], fit with the description of any visual objects.

One should also note that the scale of images is always an approximation, however. Vessels were always positioned in their "natural", bottom down, position. It is difficult to calibrate a real size for all parts of the image, as there is always a slight distortion between different parts of the vessel - the lower parts are closer to reality than the upper parts which are slightly enlarged [see 39 for questions related to image distortion].

From a general point of view (surface observations and radiographs), features are characterised and illustrated individually - a series of conventions was chosen to illustrate these observations in the plates (Figs. **19** to **27**). Surface and radiographic observations are summed up on the technological plates as follows. Firstly, one finds the illustrations and descriptions of the outer and inner surface. On both of them, surface observations are drawn according to conventions and descriptions are detailed on the right. Secondly, radiographic images are illustrated. The one on the left side is left as acquired, while the one on the right is modified to enhance features of interest. The position of the vessel during the radiography is represented schematically.

SURFACE OBSERVATIONS (MACROTRACES)

The aim of surface observations is essentially to identify *features*, technical traces, and there combinations, or *configurations*. We will also consider *surfaces*, like smoothing or polishing, because they erase all other traces and may explain the absence of other technical information.

Features

The various features observed on Kabambian vessels may be characterised by their topography (high or low relief), morphology (shape) and boundaries (sharp, diffuse or merging boundaries). Some of the surface features are related to finishing operations, rather than to primary forming techniques. Here all observable features are included, as their presence/absence may add to the interpretation, particularly with closed vessels. For instance, the fact that the upper part of a vessel is not smoothed may indicate that the potter did not have access to that part of the vessel when closing the vessel form.

Long Relief (Fig. 2)

Long relief is a horizontal feature mainly found on the external or internal surface of the belly (79.180). This feature is most of the time discontinuous, but it may stretch on an important section of the vessel (79.180). This feature is difficult to see without raking light. It may be associated with series of *finger impressions* or series of *open pores*. It is interpreted as a remnant of coil (as compared to ethnographic reference vessels), but may be related to secondary shaping by pinching [see 17, Fig. **V-44**].

Long Asymmetric Relief – Roll of Clay (Fig. 3)

This type of feature differs from other long horizontal relief by an asymmetric section. Generally, discontinuous, although they may run on a large portion of the vessel curve, they can be bordered by other features such as *finger imprints*. These features are found on the internal surface of the shoulder and neck of Kabambian vessels (79.180, 79.297, 79.419). They are interpreted as resulting from the scraping / smoothing of the surface (secondary shaping), rather than from primary shaping [see 17, Fig. **V-43**].

Sub-Circular Flattened Area (Fig. 4)

Sub-circular flattened areas are generally around 5 cm in diameter and their limits may be fuzzy or well defined (angular). They are located on the external surface of the bottom, belly and shoulder of vessels (79.150). This feature is difficult to see without raking light, but the difference in surface structure can also be identified by tactile examination. It is interpreted as marks left by the beating of the surface with a paddle during the secondary shaping of vessels

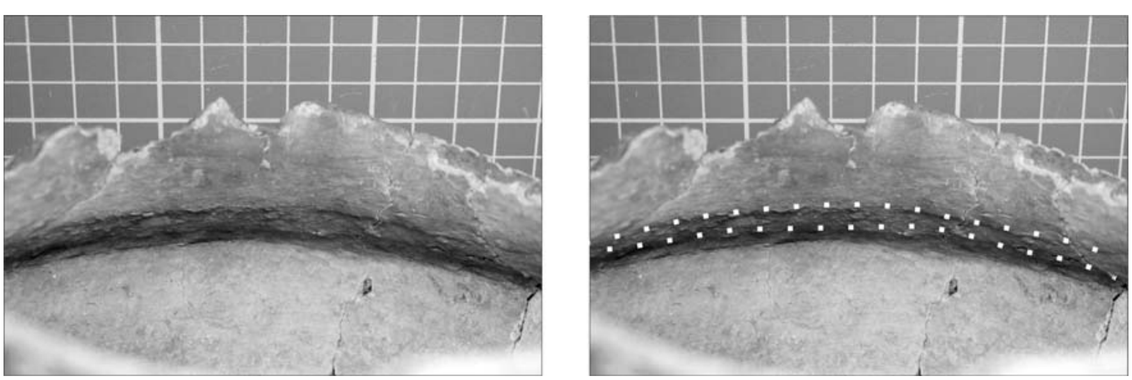

Fig. (2). Long horizontal relief may be found on the internal surface of the neck.

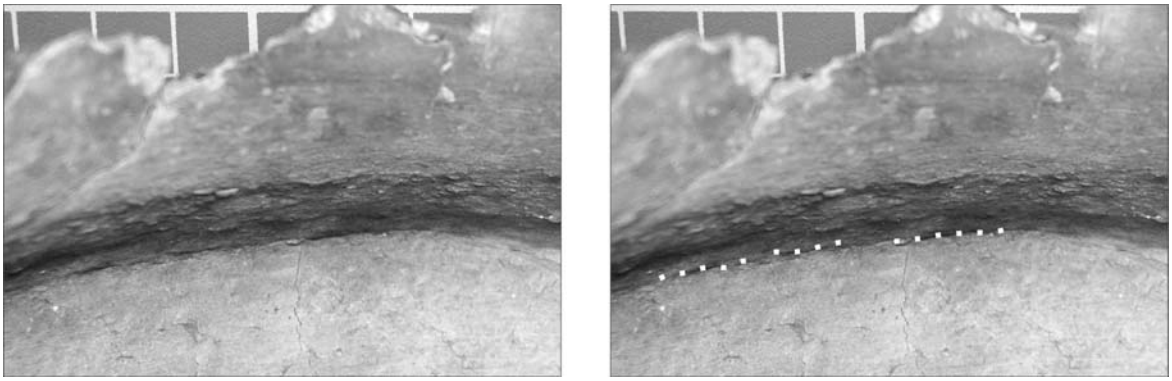

Fig. (3). Long asymmetric horizontal relief – or rolls of clay - are found on the internal surface at the junction between belly and shoulder.

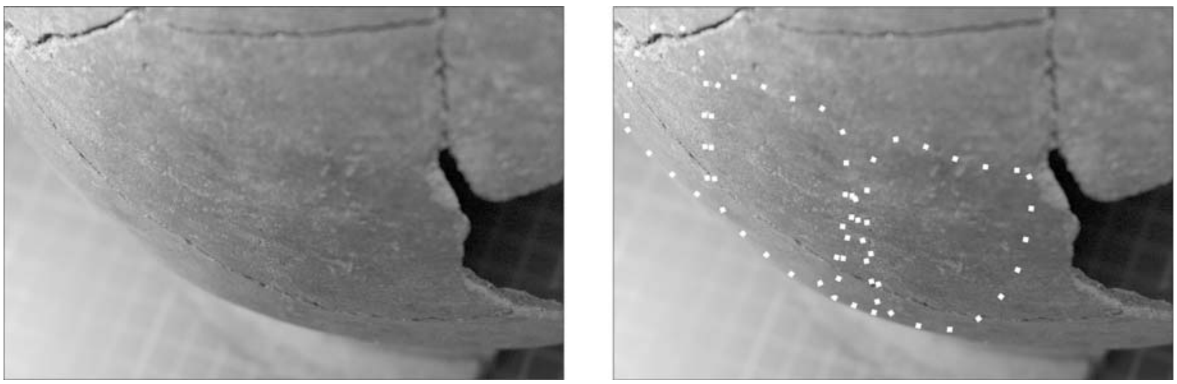

Fig. (4). Sub-circular flattened areas on the external surface are probably related to beating with a wooden paddle.

[15, p. 35]. The question remains whether this type of feature may not result from cutting + smoothing the surface or not.

Narrow Sub-Rectangular Shallow Depression - Polishing Marks (Fig. 5)

Narrow sub-rectangular shallow depressions typically display a shiny surface and sharp boundaries on the long sides. They are present as areas and cover specific parts of the vessels. In the case of Kabambian pottery, they can be found on the inside of the neck (79.297 and 79.466) and on the outer surface of the belly (79.297, 79.419, 79.509, and 79.150). They are interpreted as polishing marks left by a pebble and are thus related to surface treatments rather than primary or secondary shaping. This type of feature is common on modern ethnographic pottery all over Africa and erases all other traces.

Short Depression with Smooth Surface and Boundaries - Finger Tips (Fig. 6)

Short depression with smooth surface and boundaries are typically found in horizontal series. They are found on the internal surface of the neck and belly (79.180, 79.419 and 79.509), but can also be visible on the external surface of the neck (79.150, 79.509, and 79.419). These features are associated with *long relief*. They are interpreted as finger tip impressions related to pinching (during the roughing-out or shaping stages) [see for instance 17, Fig. **V-28**].

Long Depression with Smooth Surface and Boundaries (Fig. 7)

Long depression with smooth surface and boundaries is found in horizontal series (79.180). Each impression is

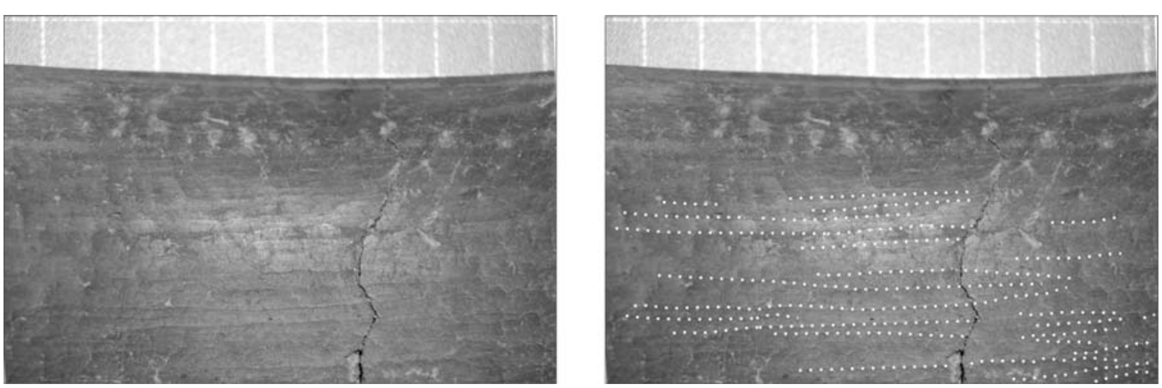

Fig. (5). Narrow sub-rectangular shallow depressions are interpreted as polishing marks. They are often found on pottery polished with a pebble.

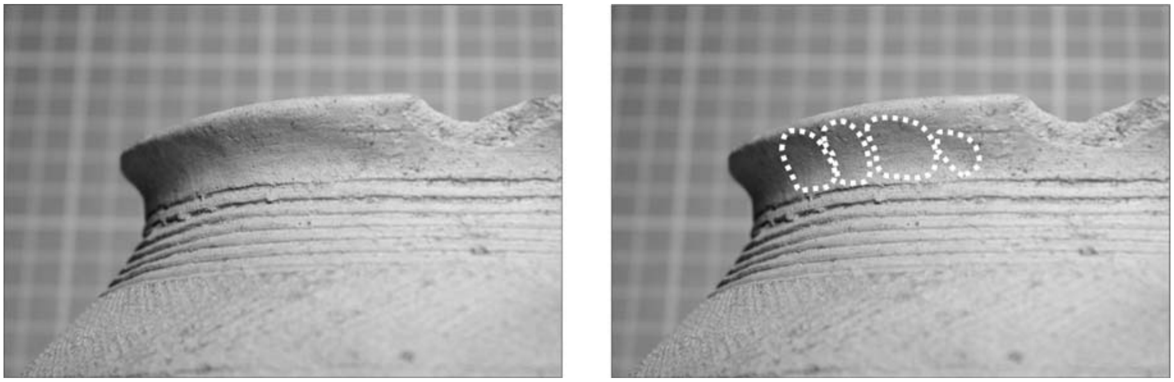

Fig. (6). Short depressions with smooth surface and boundaries are found on the outer surface of the neck. They are interpreted as finger tips impressions.

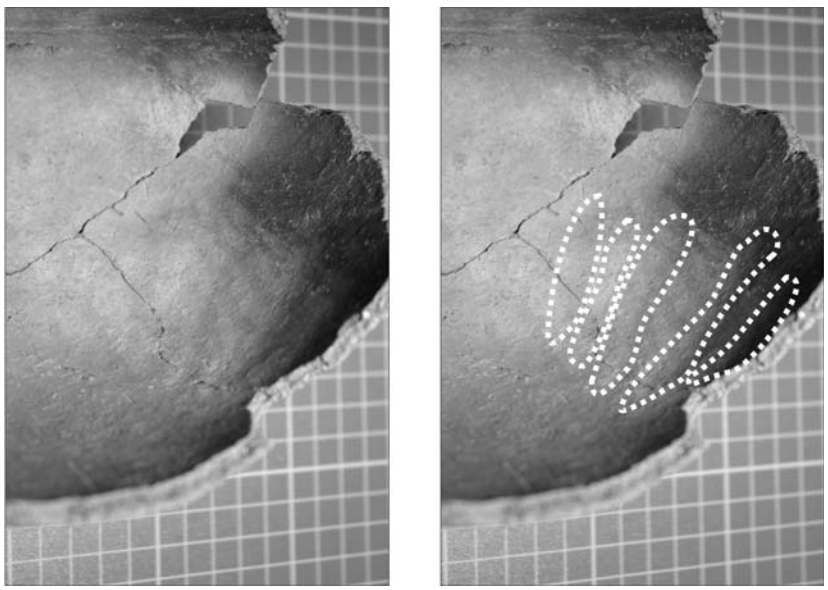

Fig. (7). Long depressions with smooth surface and boundaries are sometimes present on the internal surface of the belly.

slightly oblique in normal view. They are located on the internal surface of the neck of one vessel. These features are interpreted as finger impressions related to pinching.

Horizontal Rows of Open Pores (Fig. 8)

Several horizontal rows of open pores have been identified on two vessels (79.180, 79.278, 79.297). Open pores may be related to the internal microstructure of the vessel or to temper having been plucked out. Individual open pores are horizontal and are distributed on a horizontal axis. They are located on the external surface of the belly. This kind of feature has never been observed on ethnographic reference material, but we think that it may be indicative of junctions between long assembled pieces of clay such as rings or coils of clay.

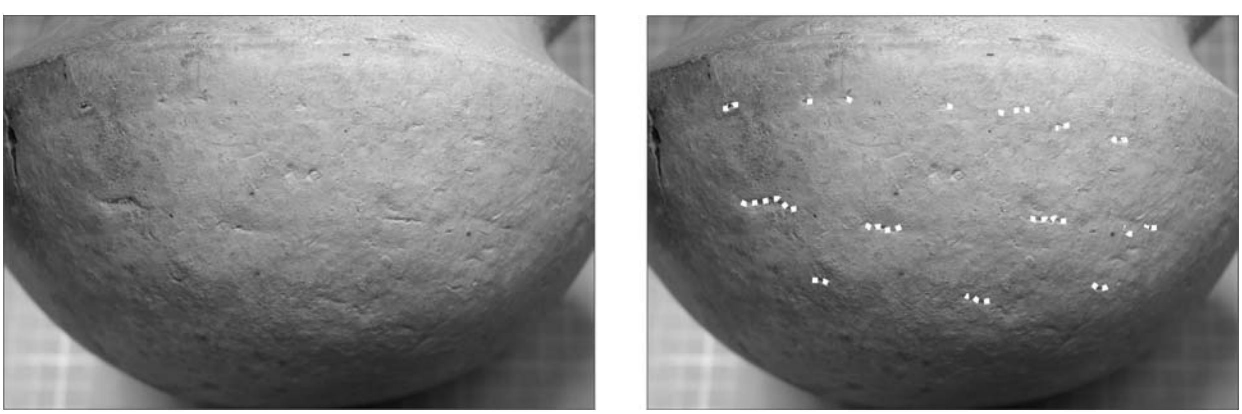

Fig. (8). Horizontal rows of open pores on the external surface of the bell may be related to the junction of assembled pieces.

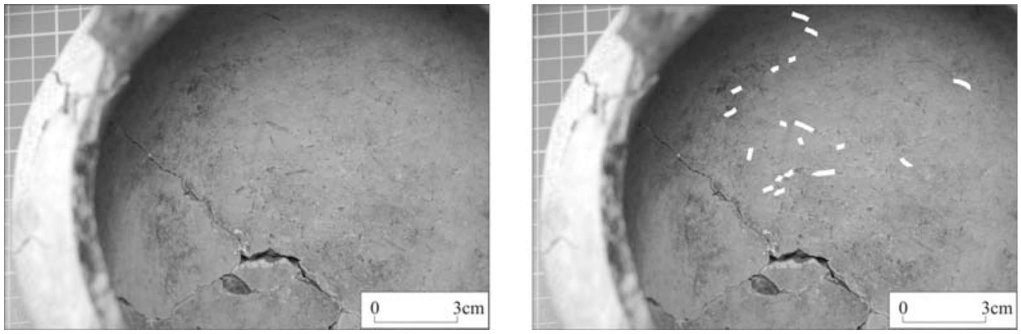

Fig. (9). Plant imprints showing as small rectangular depression – negative – may visible on the internal surface.

Strongly Oriented Long Plant Imprints (Fig. 9)

Elongated plant imprints may display a strong horizontal preferred orientation. They are found on the outer (79.180) and inner surface of the belly (79.180 and 79.419). This strong preferred orientation generally reflects the structure of the piece of clay in which it is included - in this instance, coils [10:68, 18:143].

Surfaces

Although this is not the case with Kabambian vessels, variations in surface treatment may give indications on the sequence of operations during shaping. For instance, the lower internal part of a vessel may be smoothed while the upper part may be gritty and irregular because the closed form of the vessel did not allow easy access of the internal part of the shoulder. This would not be the case if the upper part of the vessel was made first. Surface texture may be ordered from shiny to gritty, according to their general texture and topography.

Shiny Surface (Fig. 10)

Smooth shiny surfaces are always associated with the presence of red pigment (ocre). They are generally located according to the morphology of the vessel totally or partially covering the external surface of the bottom, body shoulder or neck. In the same way, internal surfaces may also be completely or partially covered (79.150, 79466 and 79.509). This feature is sometimes, but not necessarily, associated to the presence of narrow sub-rectangular shallow depression / polishing marks. It is interpreted as polished with a pebble or another type of tool (piece of leather, necklace of beads, etc.). This kind of surface generally erases all other features.

Fig. (10). Shiny surfaces are obtained by polishing. They usually obliterate any traces related to pottery building.

Gritty Surface (Fig. 11)

Like other gritty surfaces are, located according to the morphology of the pot. It differs from previous types of surfaces, as it does not necessarily erase all other features (79.466). We think that smoothing the dry surface with a wet cloth might produce this type of effect.

Fig. (11). Gritty surfaces are found inside vessels on the lower part of the belly.

CONFIGURATIONS

Horizontal Configuration in the Belly (Normal View)

Rows of open pores, long asymmetric relief and rows of short depression with a smooth surface and boundaries indicate a strong horizontal configuration in the belly and shoulder of a Kabambian vessel (Fig. **20**: 79.180). This configuration is related to the circular configuration at the bottom of the belly in vertical view. Other vessels do not display clear cut configurations of this type.

Circular Configuration in the Lower Part of the Belly (Vertical View, Internal Surface)

The orientation of vegetal imprints (open porosity), long asymmetric reliefs and rows of short depression with a smooth surface and boundaries delineates a circular configuration in the lower part of the belly of a Kabambian vessel (Fig. **20**: 79.180). This vessel displays a strong horizontal configuration in normal view.

INTERNAL MICROSTRUCTURE (RADIOGRAPHY)

Features

As we said above, to characterise the features we need to take into account their morphology and boundary. We have

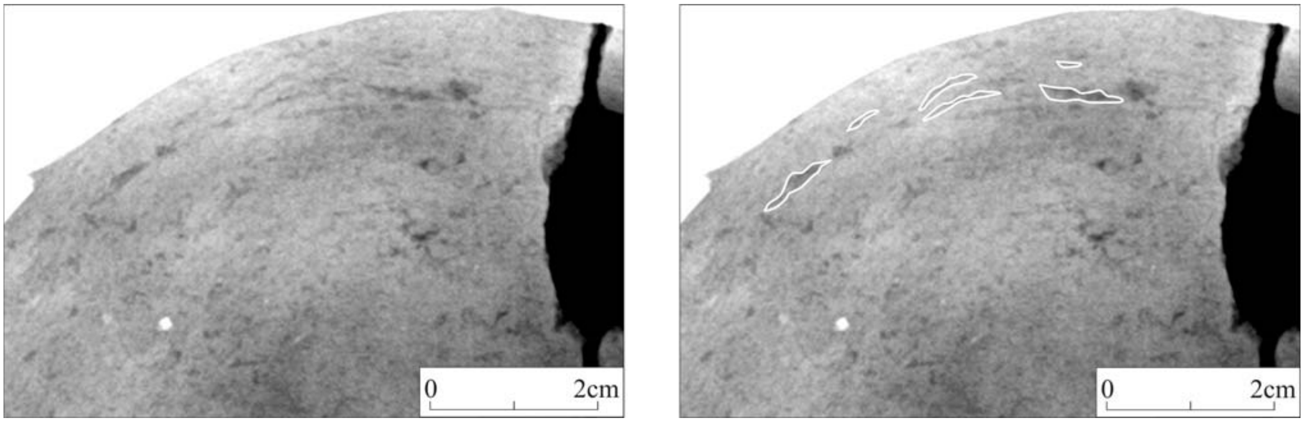

Fig. (12). Radiographic view. Elongated porosity. This kind of feature is related to the junction of assembled pieces.

added an element of interpretation concerning their origin. For example, a feature may be related to the structure of assembled pieces or the deformation that took place during shaping (referred to as structural) or may be related to use (use / depositional) or the presence of some inclusions (compositional).

Elongated Porosity (Structural) (Fig. 12)

Elongated pores are long features with sharpness to diffuse rounded boundaries (79.150, 79.180, 79.247, 79.253, 79.297, 79.419 and 79.466). These features are interpreted as remnants of the junction between assembled pieces of clay.

Irregular Porosity (Structural) (Fig. 13)

Irregular pores are shapeless features displaying sharpness to diffuse rounded boundaries (all vessels). It is present in all vessels.

Fissure (Use / Depositional) (Fig. 14)

Fissures may be characterised as long to very long features, generally with sharp boundaries and an angular morphology (79.247). They are generally well defined unidirectional features (cracks), but may appear as light multidirectional networks. Two kinds of fissures are observed here. The first type is visible to the naked eye and consists in very long cracks extending sometime from the rim to the lower part of the belly (Fig. **14A**, 79.253).

The second type is invisible (appearing only in the internal microstructure of the vessel through x-radiography) and consists of short fissures extending in a radial configuration from the bottom of the vessel (Fig. **14B**, 79.247). This type of feature may be due to shaping or to the use / wear of the vessel [17, Figs. **V-64** to **67**].

Elongated Inclusions (Compositional) (Fig. 15)

Elongated inclusions or imprints are long features, generally displaying sharp to diffuse boundaries. Their morphology varies according to the nature of the inclusion. They may display preferred orientation related to the internal structure of the vessel. Here vegetal imprints are characterised by a rectangular, or prolate, shape and an angular morphology. They are badly sorted, but that will probably vary with the composition of the paste. They may display a strong preferred orientation in the vessel walls, but are randomly oriented in the bottom (79.150, 79.180, 79.253, 79.297, 79.419 and 79.466). Some of these features are visible to the naked eye on the surface of the vessel.

Dark Elongated Areas (Fig. 16)

Dark elongated vertical areas display a rounded oblate shape with merging boundaries. A series of them are found in the vessel walls of one Kabambian vessel (79.253), (see configurations below). These features are partly visible on the internal surface of the belly.

Light Sub-Circular Areas (Fig. 17)

A light sub-circular area displays a rounded equant shape with merging boundaries. It is found at the bottom of several Kabambian vessels (79.150, 79.180, 79.253, 79.419, 79.466). Inside this sub-circular area, elongated inclusions

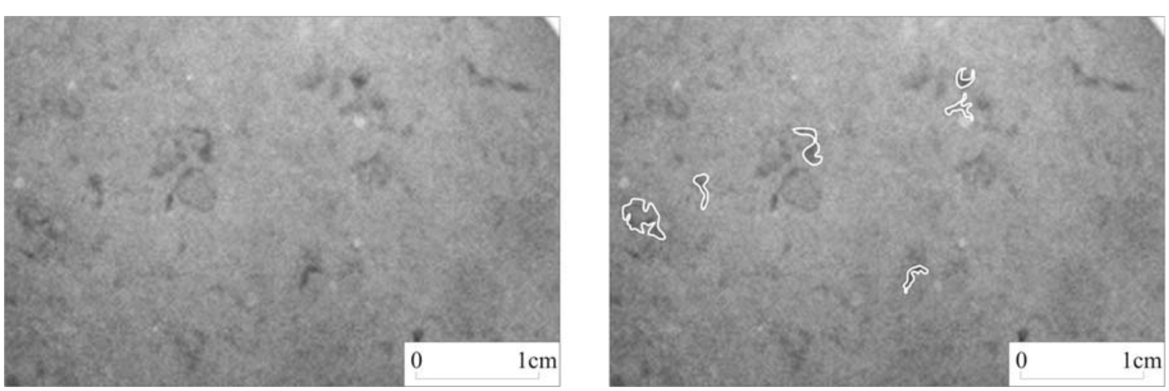

Fig. (13). Radiographic view. Irregular are shapeless features displaying sharp to diffuse rounded boundaries (structural).

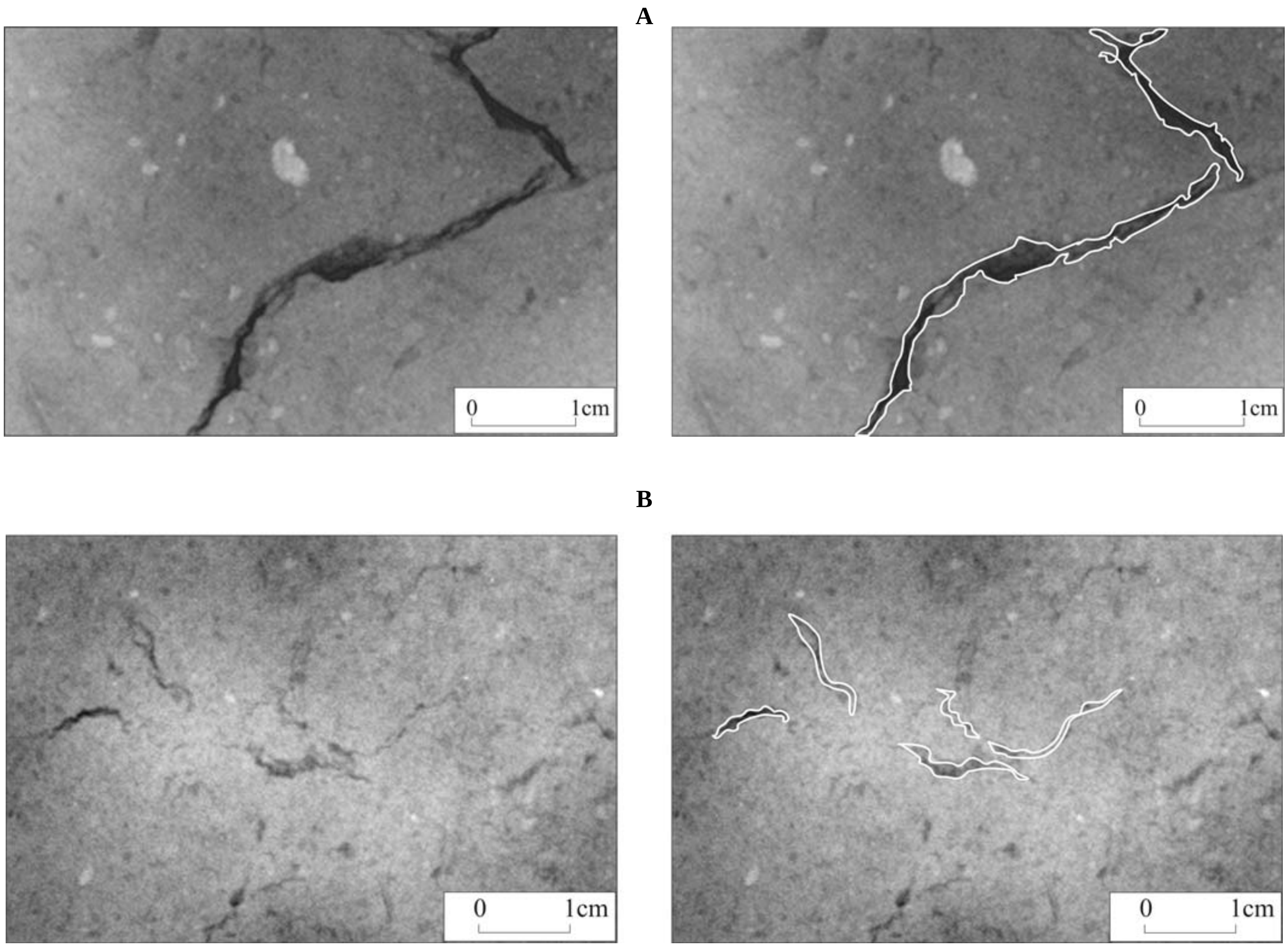

Fig. (14). Radiographic view. Fissure (use / depositional) **A** (vessel 79.253) and **B** (vessel 79.247).

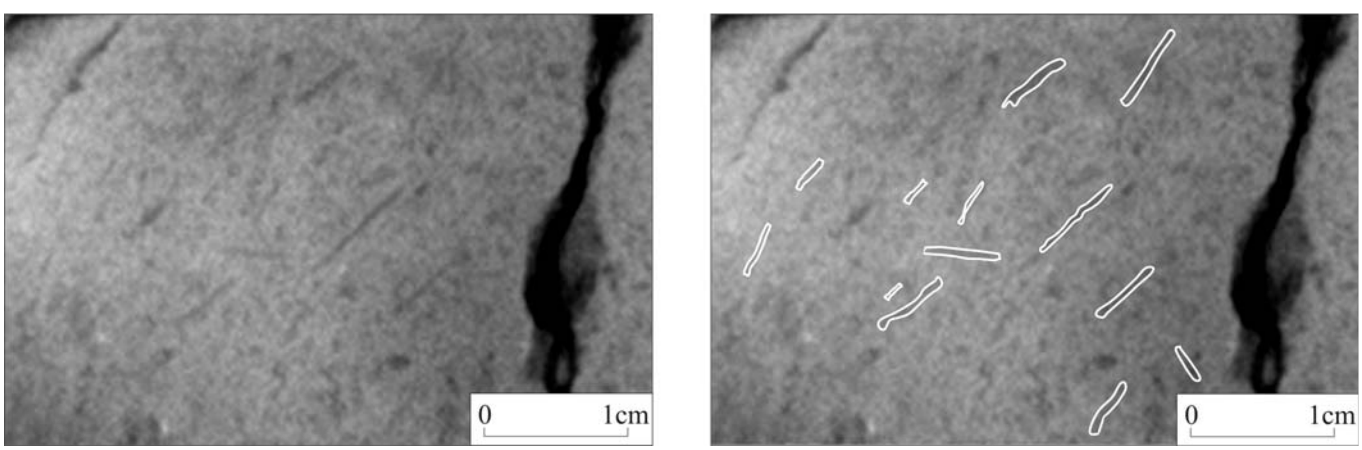

Fig. (15). Radiographic view. Discreet elements with a rounded oblate shape are interpreted as the phantom of vegetal inclusions (compositional).

display a random orientation. The boundary of this feature may be accentuated by other features such as elongated porosity or elongated imprints displaying a strong circular preferred orientation. It is invisible to the naked eye, but in one case it is surrounded by a diminution in wall thickness visible only in section (see below: annular areas).

Dark Annular Areas (Fig. 18)

This feature is characterised by its annular shape with merging boundaries (79.150, 79.180, 79.253, 79.419 and 79.466). When present, it is always found around the bottom (at the boundary between the belly and the bottom). Inside these annular areas, elongated inclusions display a strong

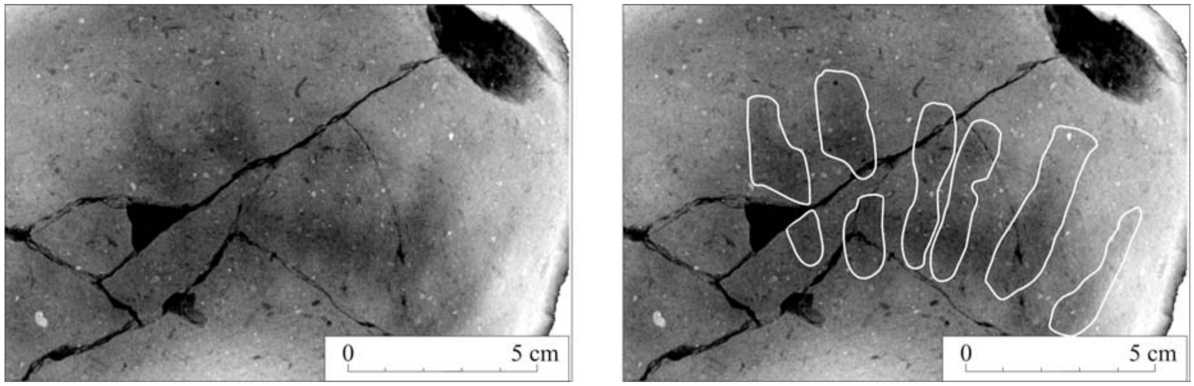

Fig. (16). Radiographic view. Some features do not appear as discreet elements, but as areas varying in tonality. Dark elongated vertical areas displaying a rounded oblate shape with merging boundaries result from the thickness variation of the vessel walls.

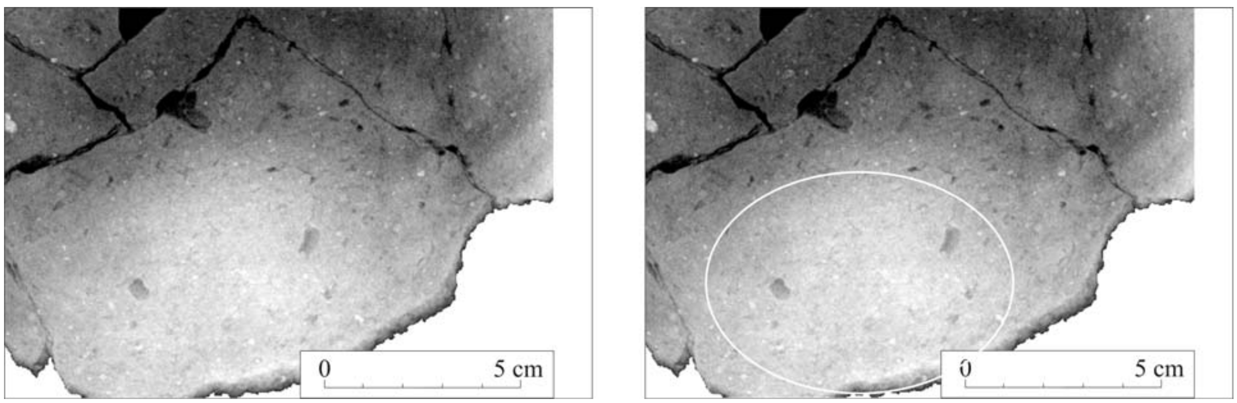

Fig. (17). Radiographic view. Light sub-circular areas displaying a rounded equant shape with merging boundaries are sometimes found on the bottom of vessels.

preferred sub-circular orientation. It is invisible to the naked eye, but in one case it is associated to a diminution in wall thickness visible only in section (see above: sub-circular areas).

CONFIGURATIONS

Series of Long Radial Dark Areas (View from Above)

One Kabambian vessel displays a series of long radial dark areas in the belly (Fig. **22**: 79.253). This configuration overlaps a horizontal configuration in the preferred orientation of elongated inclusions (see below). It is thus interpreted as indicative of pinching either during primary forming or during secondary forming.

Sub-Circular Configuration without Preferred Orientation in the Bottom (View from Above)

This feature may be characterised as a sub-circular area where the porosity is irregular and displays no preferred orientation (Fig. **19**: 79.150, Fig. **20**: 79.180, Fig. **22**: 79.253, Fig. **24**: 79.297, Fig. **25**: 79.419 and Fig. **26**: 79.466). It is encircled by features displaying a strong preferred orientation such as an annular area or elongated inclusions with a

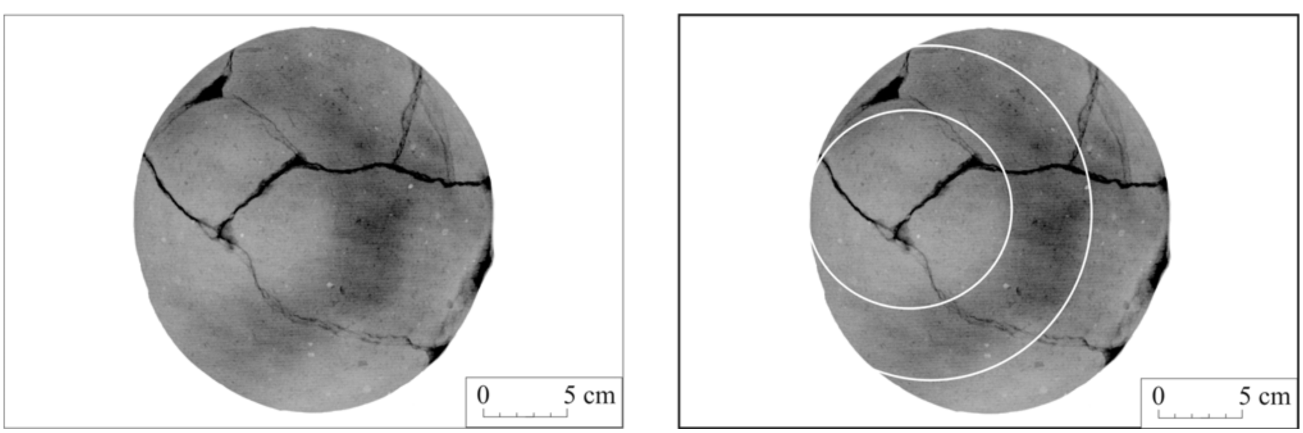

Fig. (18). Radiographic view. Dark annular areas, characterised by their annular shape with merging boundaries, are found surrounding the bottom of several vessels. They indicate a thickening of the vessel walls surrounding the bottom.

strong circular orientation. This disc-like configuration is interpreted as indicative of the bottom of vessels being made of a disc such as a slab of crushed clay.

Strong Sub-Circular Configuration in the Vessel Walls (View from Above)

This is the same configuration as the previous one, but as viewed from above (Fig. **19**: 79.150, Fig. **20**: 79.180, Fig. **24**: 79.297, Fig. **25**: 79.419, Fig. **26**: 79.466 and Fig. **27**: 79.509). It is characterised by the strong sub-circular preferred orientation of the porosity and elongated inclusions in concentric circles in the vessel walls. This configuration is associated to the disc like configuration of the bottom. It is interpreted as a result from the superimposition of pinched ring like coils.

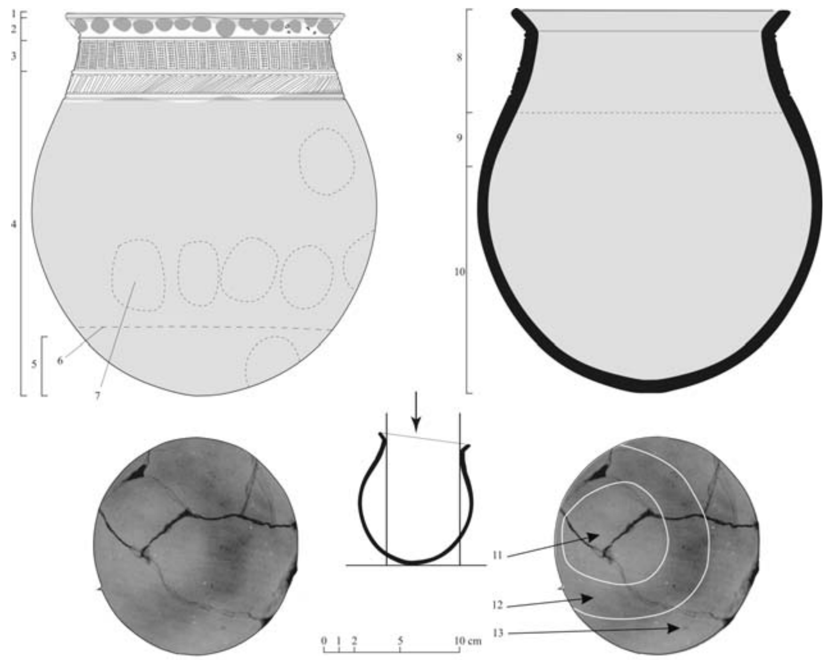

Fig. (19). Technical observations on 79.150 Part 1 and 2. (1) smooth surface ; (2) gritty surface, rows of open pores; (3) impressed decoration; (4) smooth shiny surface with narrow sub-rectangular shallow depressions (polishing marks); (5) eroded bottom; (6) long relief; (7) sub-circular flattened area; (8) smooth shiny surface, (9) gritty surface, (10) smooth surface, but eroded (use wear?).

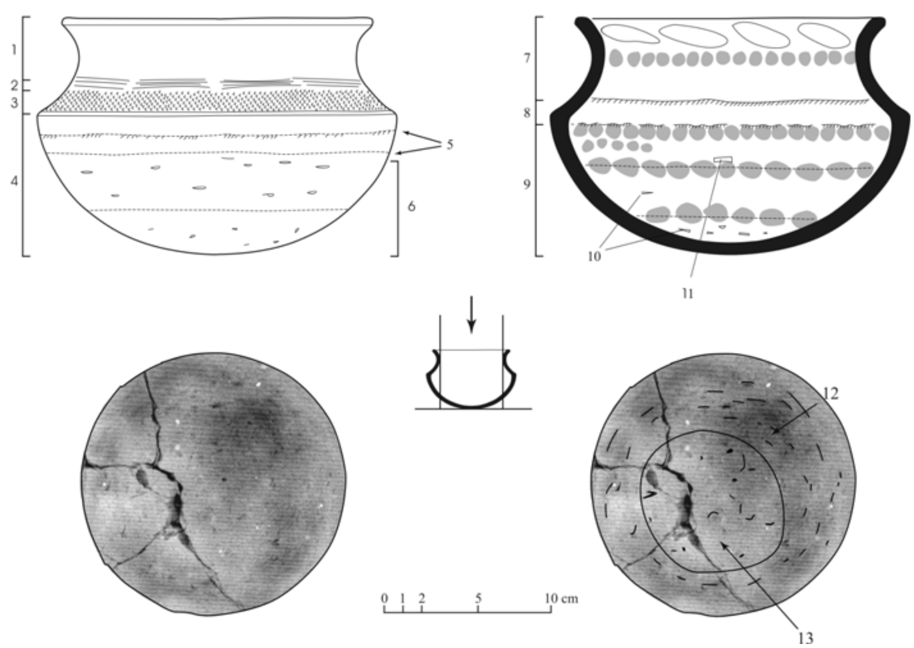

Fig. (20). Technical observations on 79.180. (1) smoothed scraped surface; (2) horizontal scratches; (3) impressed decoration (sometimes smoothed over); (4) gritty surface and open porosity; (5) long relief; (6) eroded area; (7) long relief and short depression; (8) gritty surface and long asymetric relief, (9) three areas separated by rows of short and elongated depressions with smooth surface and boundaries, (10) open pore left by vegetal temper, (11) burnt bone fragment, (12) strong sub-circular orientation in the walls (x-ray view from above), (13) sub-circular configuration without preferred orientation in the bottom (x-ray view from above).

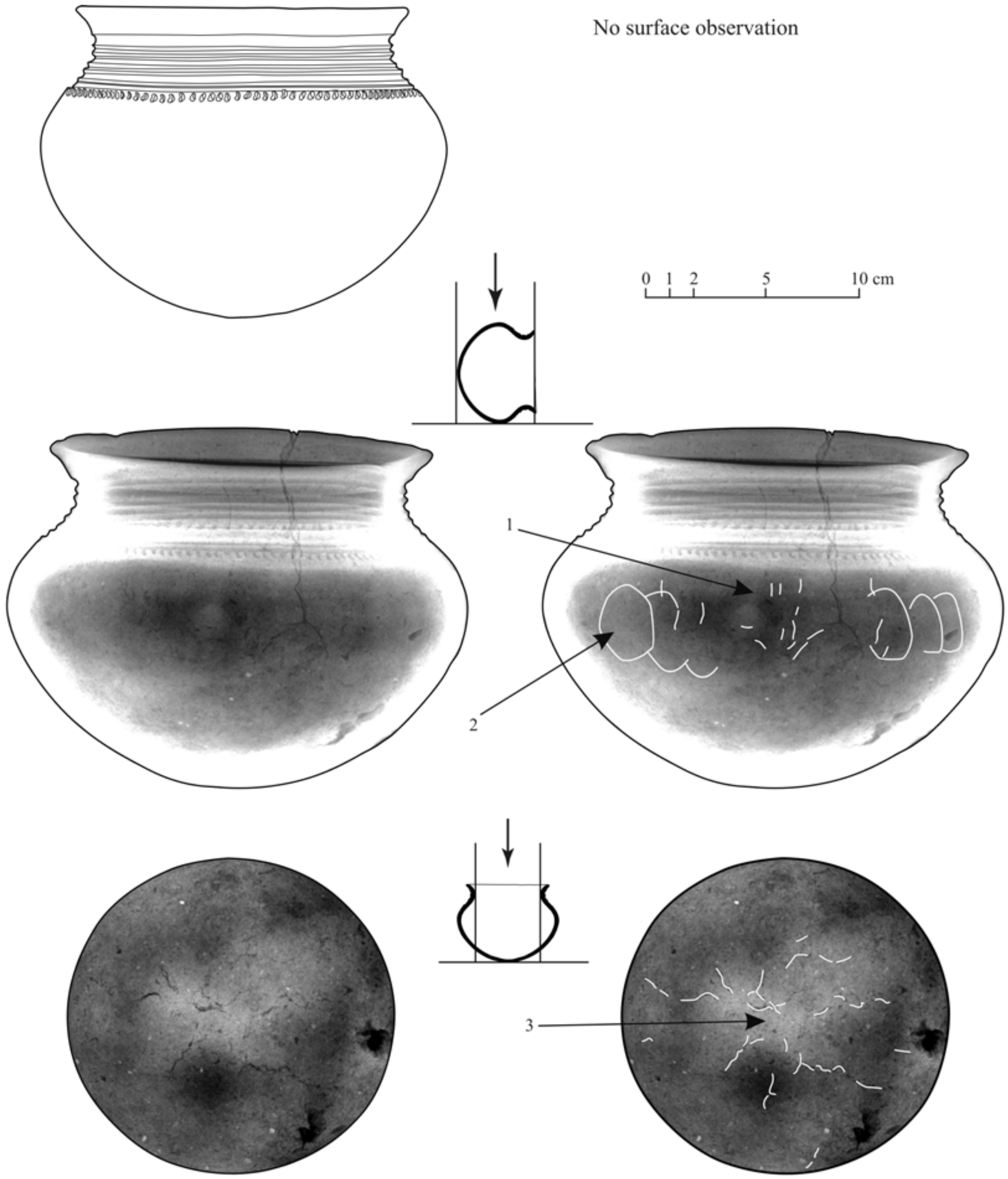

Fig. (21). Technical observations on 79.247. There are no surface observations. (1) vertical orientation of elongated porosity; (2) row of dark vertical areas; (3) radial configuration of fissures.

Radial Configuration of Fissures in the Bottom (View from above)

This configuration is present in one vessel (Fig. **21**: 79.247). As for the previous one, there are several plausible interpretations. The features appear to be structural rather than secondary (due to use-wear).

Strong Horizontal Configuration in the Vessel Walls (View from the Side)

This configuration is characterised by the strong horizontal preferred orientation of the porosity and elongated inclusions in the vessel walls (Fig. **22**: 79.253). It is generally associated to the previously mentioned disc like configuration. It is interpreted a result from the superimposition of, possibly pinched, coils.

Configuration of Vertical Fissures in the Walls (View from the Side, Superimposition of both Walls)

This configuration is present in the body and shoulder of only one vessel (Fig. **21**: 79.247). There are at least two interpretations at this stage. Fissures may appear when the clay is pushed during secondary shaping, but ethnographic data indicate that drawing the clay to rough-out the walls may produce similar effects [17, Fig. **V-75**]. Interestingly this configuration is prolonged in the bottom of the vessel (see next configuration).

DISCUSSION

The data presented here allow two levels of discussion concerning: (1) methodological issues pertaining to the identification and reconstruction of pottery primary shaping processes in general; (2) the history of pottery technology in Katanga (DRC).

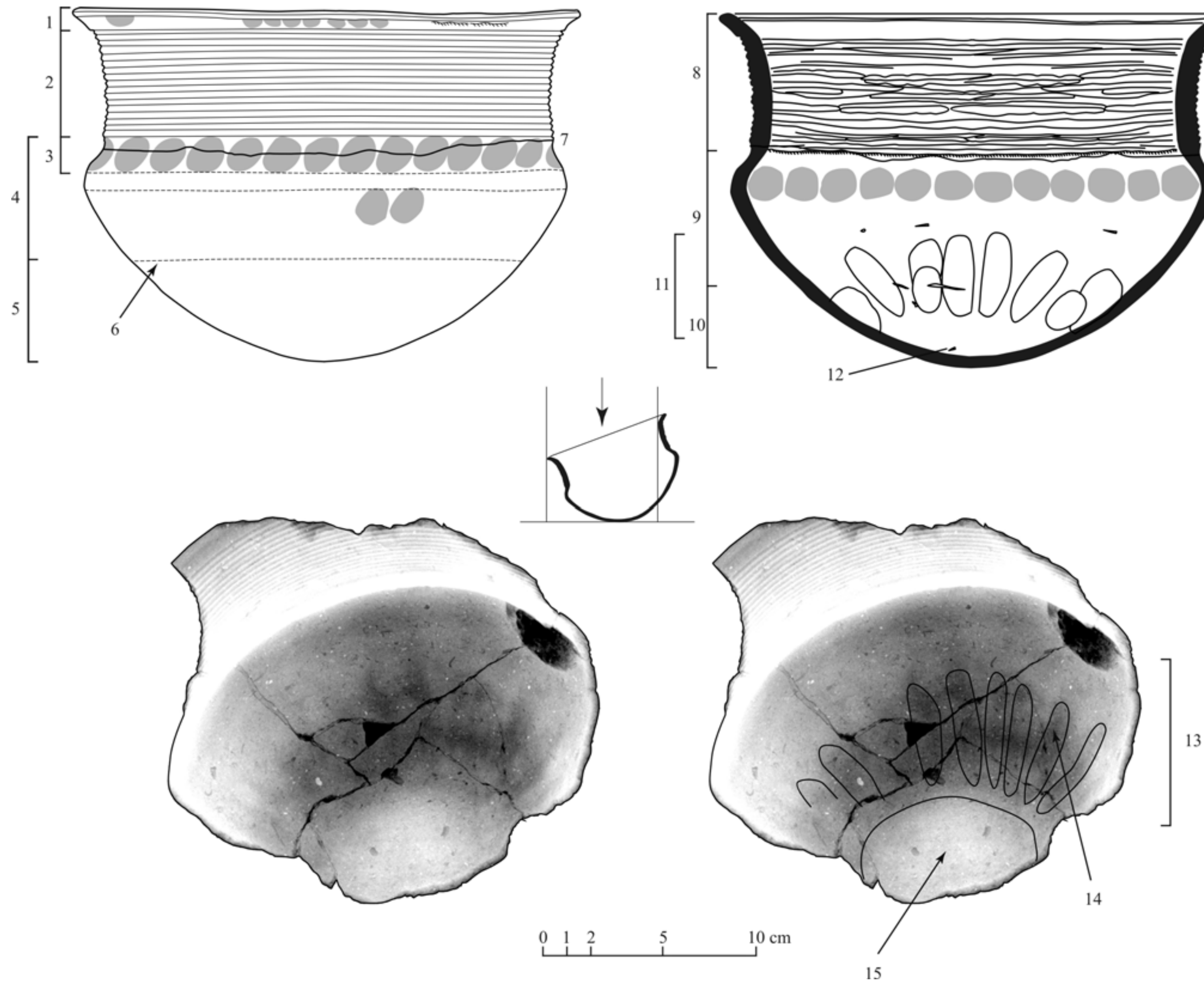

Fig. (22). Technical observations on 79.253. (1) short depression with smooth surface and boundaries; (2) impressed decoration (; (3) short depression with smooth surface and boundaries; (4) smooth surface (horizontal polishing); (5) smooth surface (diagonal polishing); (6) shallow elongated depression; (7) fracture pattern (horizontal); (8) very short depressions (?) under a shiny surface with long and narrow, shallow, depressions (polishing marks); (9) smooth surface (horizontal scraping), short depression with smooth surface and boundaries; (10) smooth surface (diagonal scraping), horizontal rows of open pores; (11) very shallow elongated depressions (radial); (12) open pore left by vegetal temper; (13) strong sub-circular configuration of elongated pores in the vessel walls (view from above); (14) vertical long dark areas (radial from the bottom); (15) sub-circular configuration without preferred orientation in the bottom (view from above).

Surface features are rare on Kabambian pottery. Of the 9 vessels considered here, only 3 bear features allowing for the identification of 2 configurations: (1) horizontal configuration in the belly (normal view); (2) circular configuration in the lower part of the belly (vertical view, internal surface). The examination of internal microstructures through x-radiography led to the identification of 7 features permitting the identification of 6 configurations: (1) series of long radial dark areas (view from above); (2) sub-circular configuration without preferred orientation in the bottom (view from above); (3) strong sub-circular configuration in the vessel walls (view from above); (4) radial configuration of fissures in the bottom (view from above); (5) strong horizontal configuration in the vessel walls (view from the side); and (6) configuration of vertical fissures in the walls (view from the side, superimposition of both walls). Combining the 2 modes of observations, several elements are apparent. Firstly, horizontal configurations in the vessel walls are attested in several vessels by both surface observations and x-radiography. The body of Kabambian vessels seems to have been roughed-out by superimposition of ring-like coils. Because of the spacing between features and their good preservation, it seems that these coils were, at most, pinched rather than crushed during imposition.

Secondly, radiographs show that the bottoms of most vessels were made of a flattened disc-like slab of clay. This element is not apparent from surface observations alone, although in one case (a fragmented vessel, 79.509) it corresponds to a slight thinning of the walls.

There are however no indications regarding the sequence of the operations (i.e. what part of the vessel was made first). This stage offers several options. Vessels could have been made starting with the flattened disc, than gradually adding rings of clay. Another possibility is that bottoms were made last, after the rest of the vessel was made by superimposition

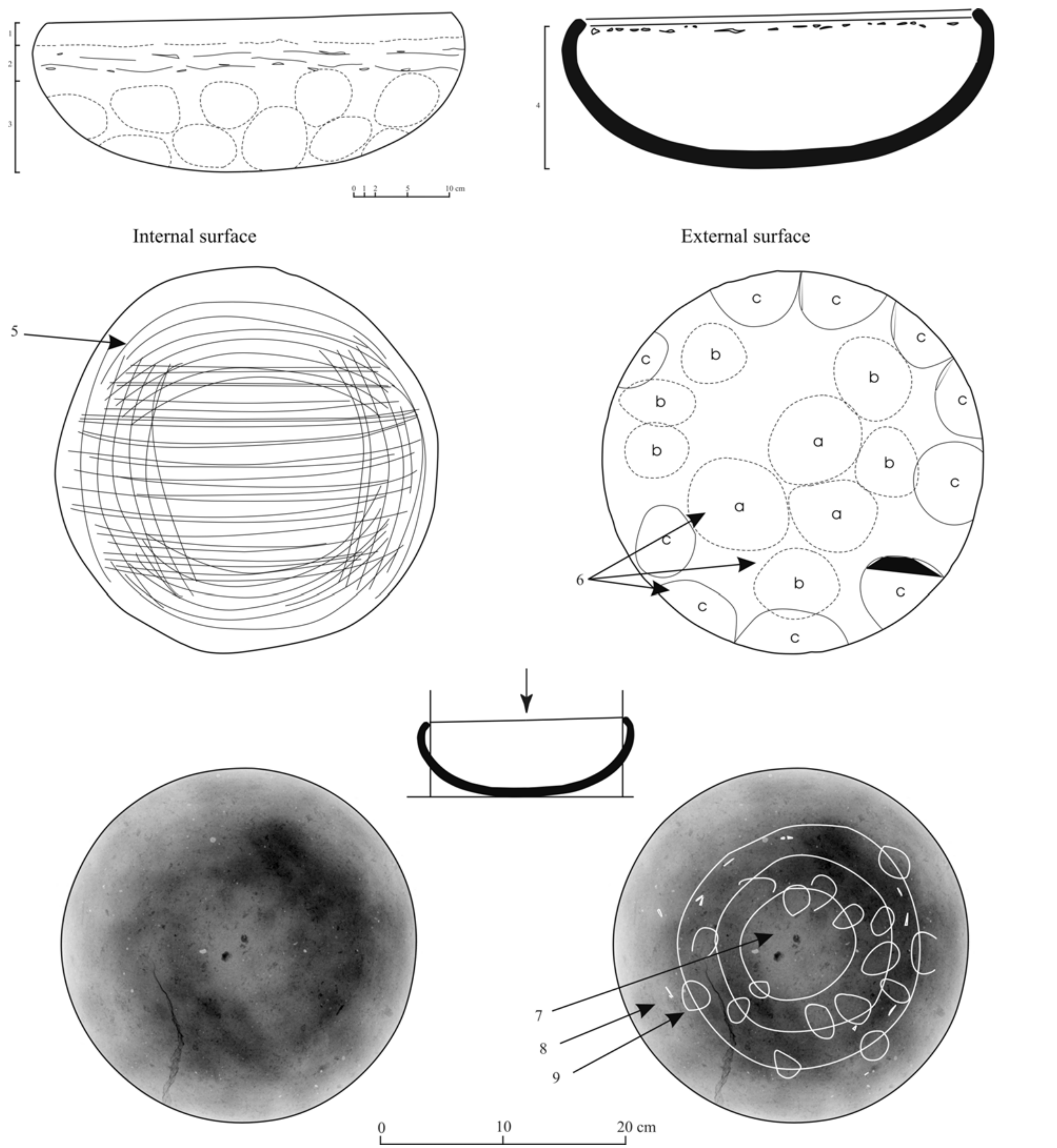

Fig. (23). Technical observations on 79.278 (note that scale is 20 cm): (1) gritty surface; (2) long relief and depressions (scrapped surface?), horizontal rows of open pores; (3) sub-circular flattened areas (beating facets?); (4) smooth shiny surface (red polish); (5) smooth shiny surfaces (four orientations of polishing); (6) sub-circular flattened areas distributed in three concentric zones – a, b and c (beating?); (7) light sub-circular area and sub-circular configuration without preferred orientation in the bottom (view from above); (8) strong sub-circular configuration in the vessel walls (view from above); (9) small sub-circular areas (beating?).

of ring like coils. Both methods are known in the area today [40].

Although not directly related to the question of primary shaping techniques, the presence of a few elements indicative of beating with a paddle were observed. Although flattened areas are visible on the outer surface of vessel 79.150, these features were not apparent of x-radiographs. Finally, one Kabambian vessel stands out as it does not bear any of the diagnostic features and combinations of the other (79.247). This vessel is characterised by the fact that although internal microstructures are present (it is not the absence of any traces that distinguishes it), there are no indications of ring-like coils.

Regarding the history of pottery technology in the area, it is striking that variants of the technique used to build Kabambian vessels, dated from 13th to the 17th century AD in

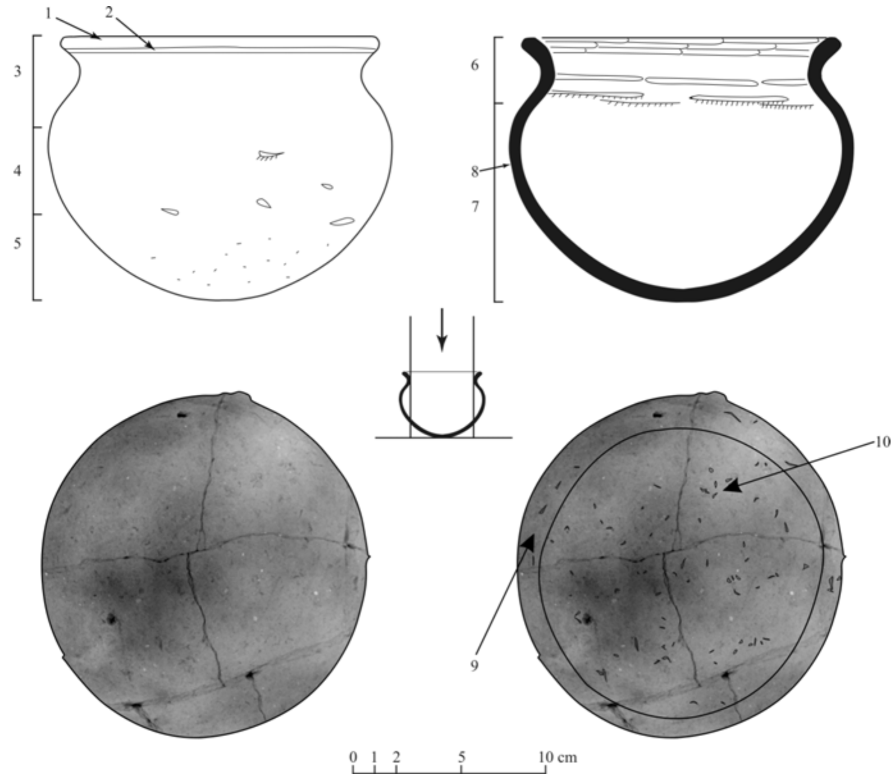

Fig. (24). Technical observations on 79.297. (1) smooth shiny surface ; (2) horizontal smoothing marks; (3) smooth shiny surface with narrow sub-rectangular shallow depression (polishing facets); (4) irregular surface; (5) scraped surface with open porosity; (6) smooth shiny surface with narrow sub-rectangular shallow depression (long polishing marks); (7) smooth shiny surface; (8) vessel walls are thinner, (9) strong sub-circular configuration in the vessel walls (view from above), (10) sub-circular configuration without preferred orientation in the bottom (view from above).

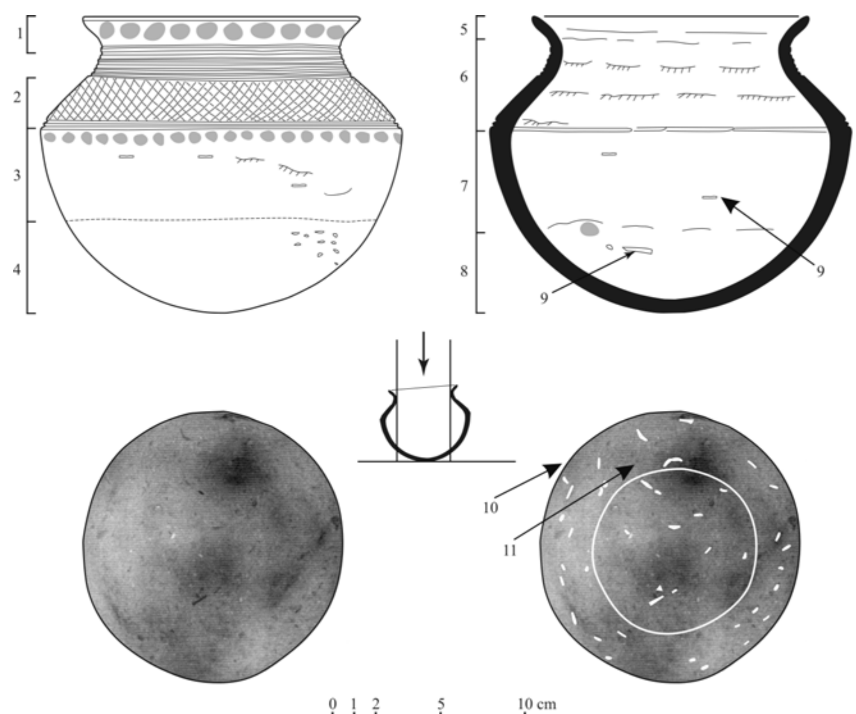

Fig. (25). Technical observations on 79.419. (1) short depression with smooth surface and boundaries (finger); (2) decoration; (3) horizontal polishing marks, horizontal elongated plant imprints; (4) scraping marks; (5) smooth shiny surface (horizontal polishing); (6) irregular surface, horizontal scraping; (7) horizontal elongated plant imprints ; (8) short depression with smooth surface and boundaries (finger impression), horizontal elongated plant imprints; (10) strong sub-circular configuration in the vessel walls (view from above); (11) sub-circular configuration without preferred orientation in the bottom (view from above).

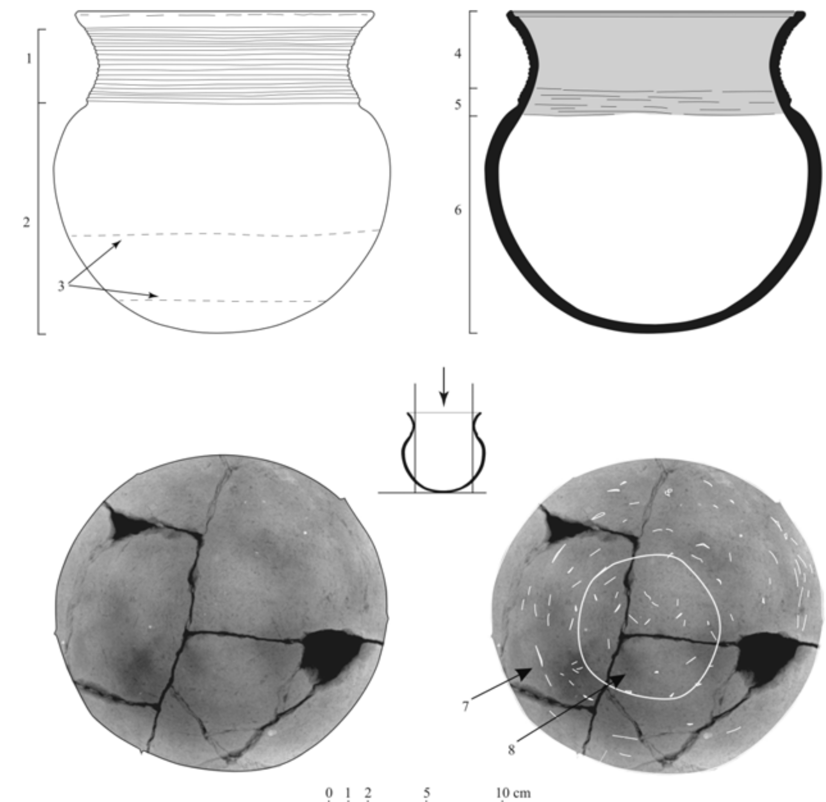

Fig. (26). Technical observations on 79.466. (1) decoration (grooves, four pronged implement); (2) gritty surface, small flattened areas (barely visible facets); (3) horizontal relief (barely visible); (4) smooth shiny surface (red polish); (5) smoothing (red); (6) irregular surface (smoothing and scraping); (7) strong sub-circular configuration in the vessel walls (view from above); (8) sub-circular configuration without preferred orientation in the bottom (view from above).

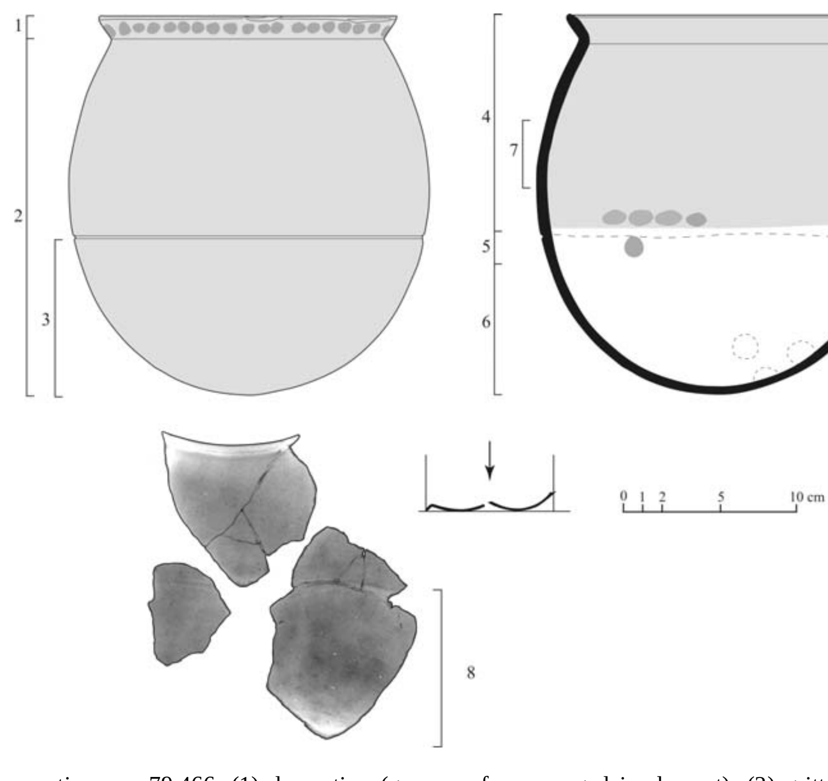

Fig. (27). Technical observations on 79.466. (1) decoration (grooves, four pronged implement); (2) gritty surface, small flattened areas (barely visible facets); (3) horizontal relief (barely visible); (4) smooth shiny surface (red polish); (5) smoothing (red); (6) irregular surface (smoothing and scraping); (7) strong sub-circular configuration in the vessel walls (view from above); (8) sub-circular configuration without preferred orientation in the bottom (view from above).

the Upemba depression, are still in use today in Kabongo, Lenge, Kabonbwe and Nkulu Majiba - Katanga, DRC [41, 42, 2, 40]. Indeed, today, some of the potters in the area fashion their vessel in the following manner. The belly, shoulder and neck are roughed-out with superimposed ring-like coils – a technique labelled *cylindrical coiling*. A disc of clay is then crushed and drawn to form the bottom. When the upper part of the vessel is shaped and decorated, the rough-out is upturned to shape the bottom by cutting the excess clay with a knife and beating with a paddle. This technology is different from the ones used by populations located to the south of the Upemba depression[5]. At least two hypotheses may be formulated to explain this relationship between past and present shaping processes. The first hypothesis is that there is an unbroken chain of transmission in potter's knowledge - meaning the stability of at least the pottery producing part of the population. In that case, the stylistic change between the Kabambian and modern Luba is mundane, related to change in the fashion of vessel shape and decoration. The second hypothesis would be to consider the connection as resulting from a common technical ancestry. Indeed, one may still envisage a change in population, but by bearers of the same technology.

CONCLUSION

The examination of surface features and the analysis of internal microstructures revealed by x-radiography, led to the first reconstruction of Kabambian pottery roughing-out processes. These observations allow at least two kinds of concluding remarks, first on the methodology and second on the history of the Upemba depression (Katanga, DRC).

From a methodological point of view, this study proves, once again, the need for a combination of analytical means. In this case surface features (or *macrotraces*) are rare and without radiography, no assessment of Kabambian pottery shaping technology would have been possible. The few observed surface features, however, are in agreement with the information collected obtained through x-radiographs. This relationship between modes of observation is a crucial point. Even though most of the diagnostic observations are made with medical imagery techniques, radiographs should always be compared to visual observations in order to improve the general interpretation. We also advocated for a more detailed and systematic identification of technical observations – systematically characterising features and their combination (configurations). While some elements may need further discussion, we believe that this kind of description may improve technical interpretations and allow for much needed cross-context comparisons. As regards definitions and nomenclature the problem lies in choosing labels for each of the observed facts. The names need to be easy to remember and straightforward enough to allow for a mental image, without inducing interpretation. For example, there are different types of cracks, varying in morphology, size, orientation, etc. Different types of cracks may be caused by the same movement or accident, while similar features may have different origins. Thus not only do we need to analyse pottery with the proper combination of analytical method, but we also need to develop the systematic description and definition of features. In this paper we hope to have made a step in this direction.

Considering the history of techniques in the Upemba depression, our study shows that some Kabambian vessels dated between the 13th and the 18th century AD, were most probably made using disc shaped slab for the bottom and superimposed ring-like coils for the vessels walls. This is valid for vessels belonging to the Kabambian A (tombs 4, 12 and 32) and Kabambian B (tomb 42, vessels 79.466 & 79.509) at Sanga[6]. To come back to our questions on cultural variations in the archaeological sequence and the relationship between present and past populations, our observations unveil a strong relationship between Kabambian A & B pottery tradition Modern Luba pottery traditions [43] and contemporary luba pottery technology [2, 40]. Although our sample is small, we can attest to the historical existence of these pottery building techniques. Thus, in spite of changes in pottery shape and decoration through time, there appears to be a continuity in the transmission of knowledge related to pottery making, or pottery learning networks, over the past six centuries in central Katanga.

Finally, it is interesting to note that this "history" of pottery technology appears to be in an agreement with the data provided by oral history. Indeed, this stability in technical behaviour may be correlated to the oral tradition according to which the Luba polity existed in the area before the 17th century. This constitutes an interesting correlation between two radically different sets of historical data, on one hand oral history and, on the other hand, technical reconstructions on archaeological pottery.

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[5] Indeed the sanga located just south of the Upemba depression or the bemba located further south and east respectively use the superimposition and drawing of several rings and the drawing of a single ring [for an overview of these technologies see 40]. The first technique, superimposition and drawing of several rings, consists in the superimposition of several, doughnut or wheel shaped, rings of clay to build the walls of the vessels. When the upper part of the vessel is formed, shaped and even decorated, the rough-out is turned upside down and the excess clay is drawn to build the bottom of the vessel. The second technique, drawing of a single ring, consists in drawing a single doughnut shaped ring of clay upwards to build the walls, shoulder and neck of the vessel. As in the first case, when the upper part of the vessel is finished, the bottom is made by drawing excess clay.

[6] Only one vessel, attributed to the Kabambian A, seems to have been made in a different way (tomb 1, vessel 79.247). Although the technology used in this case remains to be identified, it may attest to the co-existence of other shaping technologies as early as the Kabambian archaeological culture.

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