The manufacturing process of the Neolithic ceramic from Central Sudan and of the modern pottery tradition in the Nuba Mountains: A comparative study

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1 Introduction

Ethnographic and experimental archaeological studies have provided a lot of information about early methods of pottery production in the archaeological field. Therefore, this paper attempts to establish a link between the studies of Neolithic pottery in Central Sudan and modern traditional pottery industries in the Nuba Mountains, using the concept of *chaîne opératoire*. This concept provides a good understanding of the process techniques used to produce the ceramics of the late prehistoric period in Central Sudan. It is a term that refers to the reconstruction of all the technical processes of the ceramic industry, that is, collecting the raw material, clay preparation, forming, finishing, surface treatment, decoration and firing (Roux 2019). The principle of *chaîne opératoire* is based partly on ethnographic studies of traditional ceramic production methods in different modern societies and partly on the subtle traces left by each process on archaeological ceramics, which can be reconstructed by examining micro-traces.

FIGURE 1: Wheel-made versus hand-made (Roux 2019: 47, 49)

In general, the ways in which ceramics are formed are divided into two groups: wheel-made, with RKE 'rotary kinetic energy', and hand-made without RKE; see FIGURE 1 (Roux 2019: 47, 49). In the cases of late prehistoric ceramics, most of the examples discovered around the world show the hand-made techniques, such as the following (see also FIGURE 2, from Roux 2019: 56, 59, 62).

a) In the coiling technique, a long or short coil of clay is shaped and rolled around itself into a vertical spiral and can then be used for forming walls and/or a horizontal spiral for the base (see Roux 2019: 56).

b) The slabbing technique consists in roughing-out a complete vessel or parts of the vessel with parallel slabs of variable dimensions made out of large coils or lumps (see Roux 2019: 59).

Coiling Slabbing Moulding

Hammering Modelling

FIGURE 2: Hand-made techniques (Roux 2019)

c) The moulding technique consists in roughing-out and forming the vessel by spreading a clay mass onto a convex or concave mould (see Roux 2019: 62).

d) The modelling technique by drawing consists in forming the walls of a vessel by thinning a lump of clay by discontinuous finger or inter-palm pressure, vertically from the bottom to the top (see Roux 2019: 62).

e) The hammering technique consists of roughing out a hollow volume from a clay mass by percussion, without using a mould (see Roux 2019: 62).

Considering the archaeological dimension, the prehistoric period and the divisions of this era are associated with environmental changes that affected human behaviour and economic activities (for an overview see TABLE 1).

The Late Pleistocene, which lasted between 23,000 and 11,000 BC, and is part of the Palaeolithic, includes the first human achievements in the manufacture of stone tools and primitive adaptations to geographical conditions and the environment. The early Holocene, associated with the Mesolithic and covering the period between 11,000 and 6,000 BC, is characterised by a stone industry known as micro-lithic and by the discovery of fire, also associated with the manufacture of pottery, which appeared in Central Sudan around 8,000 BC in hunter-gatherer societies. During the Middle Holocene, which is part of the Neolithic, dated to 6,000-2,000 BC (Sadig 2013: 29-50), there was a revolution in food production; at this time, the ancient human started to domesticate animals and cultivate plants, which had a direct impact on the system of life, on economics, on the size of settlements and on the relationships between members of the same community, where the phenomenon of work appeared.

The economic system shifted from hunting and gathering in the Mesolithic to the domestication of animals and plants in the Neolithic, leading to stability for these groups instead of a life of movement in search of food.

The stability of settlements was reflected in their size and in the emergence of different activities carried out by specific individuals. Thus, the characteristic of specialisation appeared in work, as evidenced by the type and form of cultural materials, the development of the quality of specific materials such as pottery, the lithic industry, the availability of large quantities of grinding-stone tools due to the production of crops and the increase in the number of consumers, and other evidence.

ENVIRON-MENT	CULTURAL PERIOD	ECONOMIC SITUATION	CULTURAL MATERIAL
Late Pleistocene 23,000-11,000 BC	Late Palaeolithic 18.000-9.000 BC	Small human groups along the Nile. They hunted large animals such as hippopotamus and wild bulls, and gathered wild plants and fruit.	Stone tools as hand axes
Early Holocene 11,000-6,000 BC	Mesolithic 7.000-5.800 BC	Human groups had seasonal settlements near the Nile and near various water resources far from the Nile. The economy was based on hunting small animals, fishing and gathering plants and fruit.	Micro-lithic tools and the discovery of fire, associated with the manufacture of wavy-line pottery (see FIGURE 3) Appearance of grinding stone tools
Middle Holocene 6,000-2,000 BC	Neolithic 5.000-2.000 BC	Permanent settlements An economy based on animal domestication, alongside hunting and gathering	Micro-lithic tools with different manufacturing techniques Production of high-quality pottery known as Neolithic ceramics Appearance of religious manifestations such as statues and funerary furniture in cemeteries

TABLE 1: Chronology of the prehistoric period in Central Sudan

2 Studies on Late Prehistory in Central Sudan

The first researcher to study the Late Prehistoric period in Sudan was Anthony J. Arkell, the director of the Sudan Antiquities Authority from 1938 to 1949, who recorded the first sites of the Late Prehistoric period in Central Sudan and produced the first chronology of the period. Arkell began with the discovery of the Khartoum hospital site, known as "early Khartoum" (Arkell 1949), where he recorded and classified all the archaeological finds.

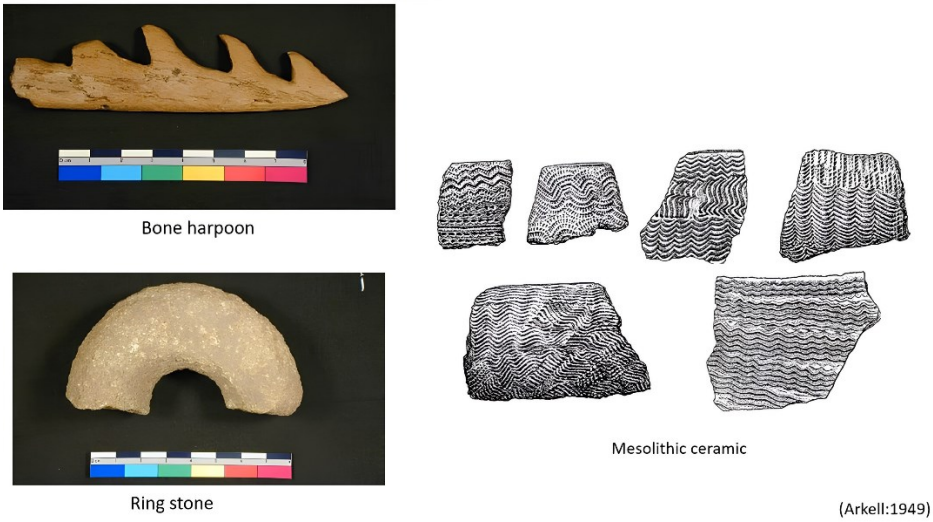


FIGURE 3: Mesolithic, Early Khartoum material, Khartoum hospital site (Arkell 1949: PL 35-46, 63)

The most outstanding find was the discovery of ceramics dated to 6,000 BC. Arkell believed this to be the oldest dated evidence of ceramic production in Africa at that time. His study focuses on visible elements such as decoration and surface treatment, and pays less attention to other variables such as manufacturing techniques and/or vessel shapes (Arkell 1949: PL 35-46, 63; see FIGURE 3). Recent studies at Saggai site (Caneva 1983), Sorourab 2 site (Khabir 1985: 40) and East and West Sabaloka (Sukova 2017: 23-49) (Nassr 2015: 1-45) have shown that other archaeological sites have been dated to a period of pottery production prior to 6,000 BC.

MAP 1: Mesolithic and Neolithic sites in Central Sudan (Nassr 2016: 116)

FIGURE 4: Neolithic material, Shaheinab site (Arkell 1953: PL 25-27-29)

Later, Arkell transferred his work to the site of Shaheinab, where a completely different material from that at the Khartoum hospital site was found. He called it "Khartoum Neolithic" or "gouge cultural"; it included different types of material such as bone harpoons, lip plugs made of bone, various tools from the stone industry like the gouge tool, and pottery from Shaheinab (see FIGURE 4). He adds that this pottery is a polished red pottery with different types of decoration from the materials found at the early Khartoum site (Arkell 1953: 68 – 80. PL 25-27-29).

After his work at El-Goz, south of Khartoum, Arkell added a stratigraphic sequence of material between early Khartoum and Shaheinab. The lower layers of the excavation contain material similar to early Khartoum Mesolithic, while the upper layers contain material similar to Shaheinab Neolithic. His hypothesis established the first chronological sequences between the Mesolithic and Neolithic periods in Sudan (Arkell 1953: 97-101). By now many studies have been carried out at many Mesolithic and Neolithic sites in Central Sudan and today more than 30 sites have been discovered (see MAP 1, from Nassr 2016: 116). I present here two studies that mention the technical process of pottery production.

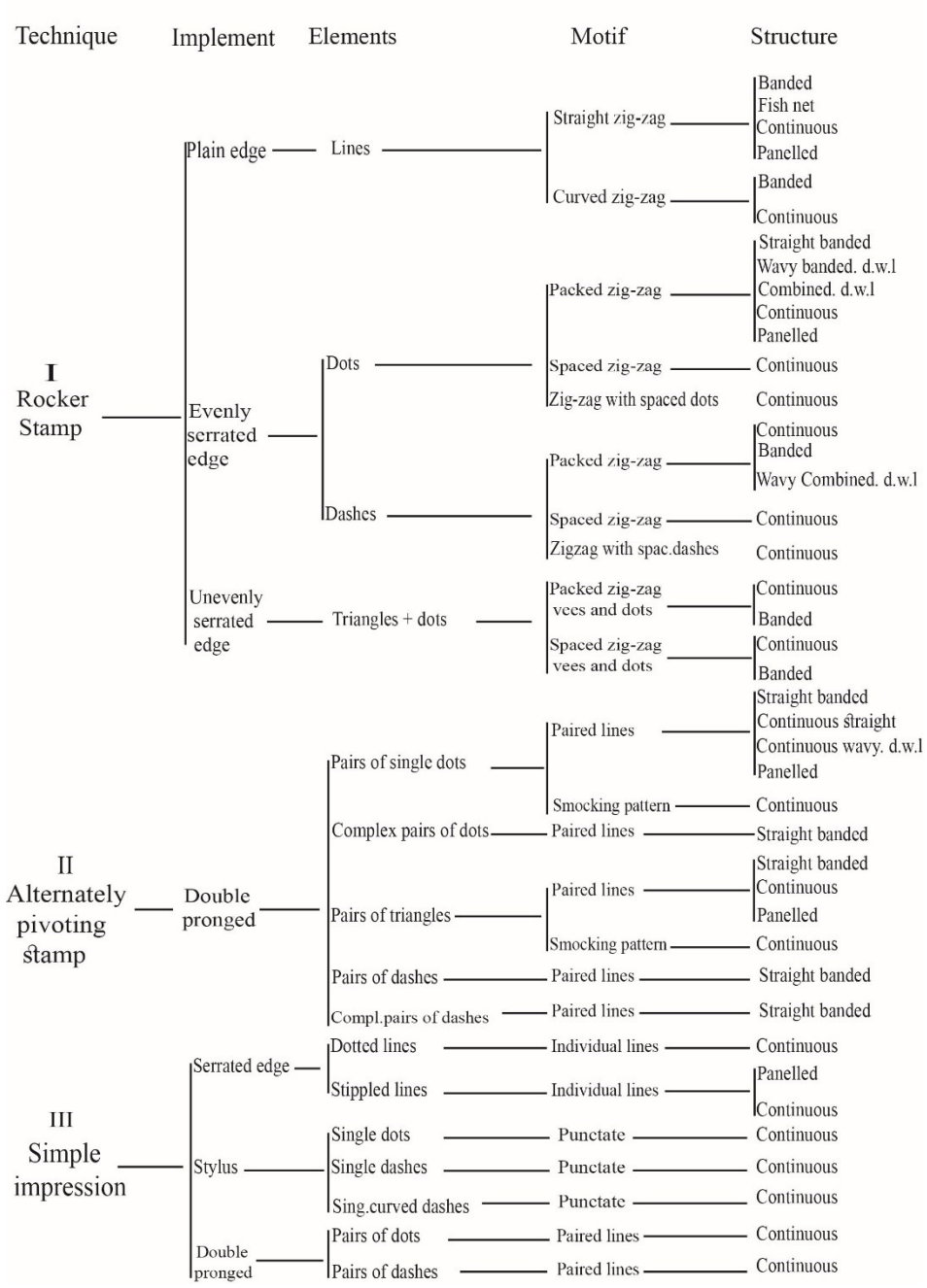


FIGURE 5: System of decoration classification (Caneva 1988: 83)

The Geili site is located 36 km north of Khartoum. It was studied by the University of Rome to investigate the late prehistoric period. The result of their work on ceramic production concluded that the ceramic clay, mixed with grains and quartz, was related to the geological structure present in this region. Caneva (1988) pointed out that there was no evidence of the use of the coiling technique, as is the case with Mesolithic pottery in Central Sudan. The shape of the sherds indicated a simple form of pots and bowls. The thickness of the sherds ranged from 3-6 mm and the surface was polished. Her classification focused on refining the chronology of the site based on decorative motifs, and she created a practical classification of the material. The methodology was based on decorative patterns, as it divides the stages of decoration production into five. Using the classification elements "technique, implement, elements and motifs, structure" (Caneva 1988: 83; see FIGURE 5) with a description of surface treatment, she indicated that the classification of decorative motifs was linked to geographical and temporal differences. Firstly, there is a difference between pottery from the Nile Valley and pottery found in the desert. Secondly, there is evidence of the difference in pottery production between the Mesolithic and Neolithic periods both in terms of the techniques used to produce decorative motifs and in the composition of the clay material.

The material from Geili has been dated to the Early Neolithic, similar to the Shaheinab culture, and the Late Neolithic, similar to the Kadero site. The ceramic material is part of the ceramic tradition that appeared in the Middle Nile region and developed from the Mesolithic (Caneva 1988).

The Shaheinab site was re-examined by Tigani el Mahi (1979) and Haaland (1981) and the material they collected was deposited in the National Museum in Khartoum in 2005-2006. Elena Garcea studied this collection according to the *chaîne opératoire* concept. This study showed that the pottery consists mainly of Nubian sandstone, which is common in Neolithic ceramics in Central Sudan, with only a few samples containing minerals, due to the geological nature of the Shaheinab region, where Nubian sandstone is present. They note that the Late Neolithic ceramic paste is similar to that of early Khartoum, in which the ceramic paste contains potassium and feldspar. As for impurities, the Early and Late Neolithic ceramic contained minerals and organic inclusions such as plant remains and animal dung. This was found only in the Early Neolithic material. The shape of the rim sherds indicated different diameters ranging from 9 to 42 cm; the thickness of the sherds ranged from 5-10 mm, with burnished surfaces. The decorative motifs were an impression technique in which bands of packed zigzags with evenly serrated edge tools 'fish spine' (see FIGURE 6) (Garcea 2006: 95-102).

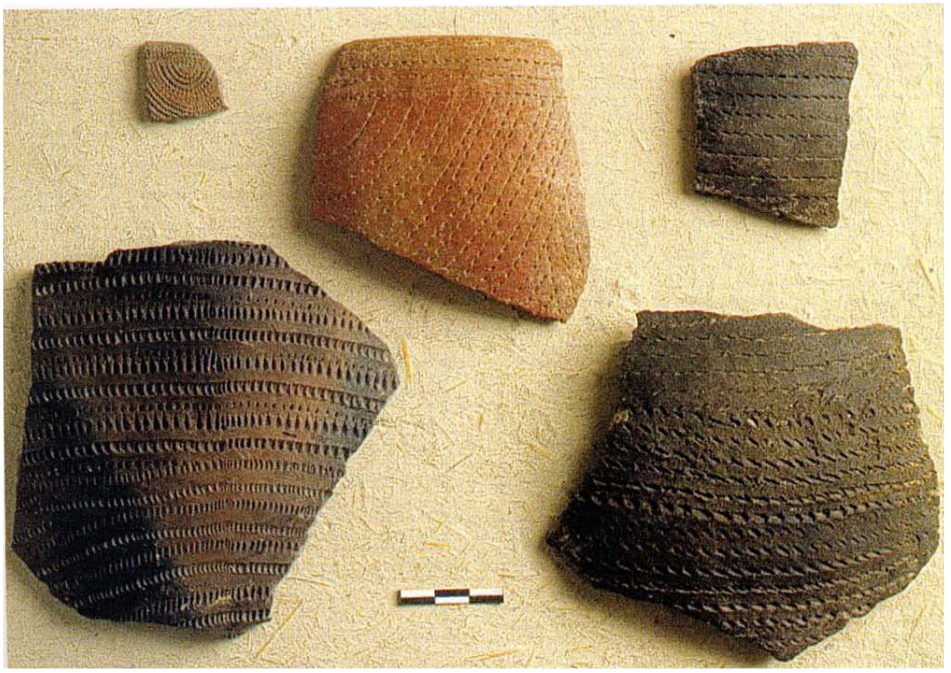


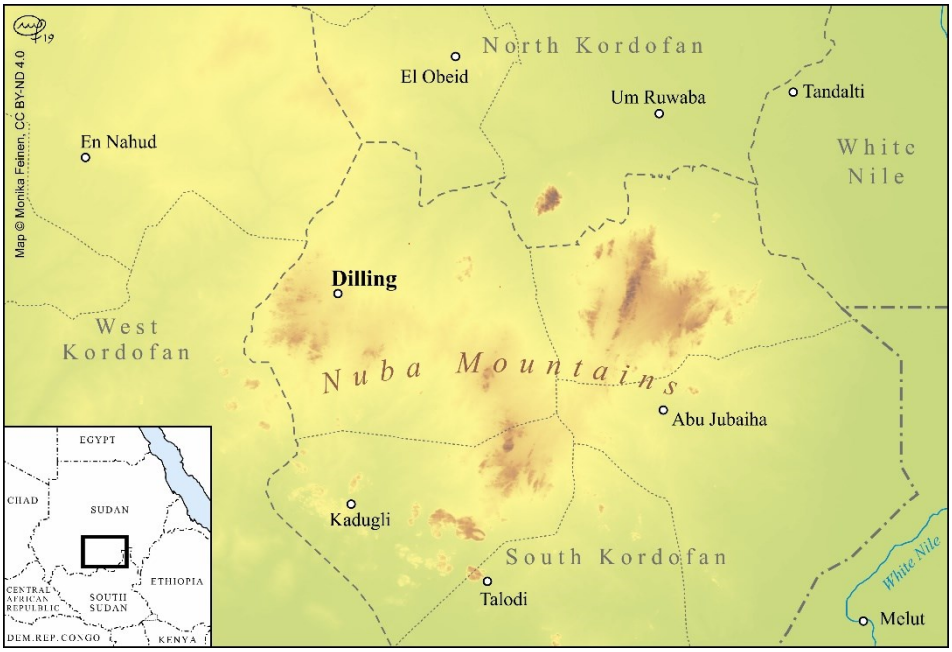
FIGURE 6: Shaheinab material, with packed zigzags made with evenly straight tools (Garcea 2006: 100)

To sum up, most Neolithic clays consisted of Nile silt or sandstone silt with quartz temper and organic or mineral inclusions. The forming technique used for the hand-made pottery was mostly the coiling technique. The shapes of the vessels were mostly simple: bowls, pots or dishes with a simple flattened or globular rim. Ornamentation is the main variable used to determine the chronological sequence of pottery sherds from late prehistoric societies.

Since the pottery techniques of the past remain to a certain extent unclear, it seems sensible to have a look into modern pottery manufacture. The idea is that the ethnography of pottery workshops can provide a wealth of evidence on the stages of the manufacturing process, and the association of this study with Neolithic pottery micro-traces imparts a feasible picture of the technical manufacturing process during the Neolithic period in Central Sudan. The examples from the Nuba Mountains thus provide a good basis for this study, in particular because this community still uses simple traditional ways of making hand-made ceramics.

3 Modern pottery manufacture in the Nuba Mountains

Dilling is a town located in the state of South Kordofan, 160 km south of the town of El-Obeid (see MAP 2). In 2020, one of the authors carried out an ethnographic study of the ceramics workshop in the Dilling region. This study provides an overview of craft production and the work stages in a modern ceramics workshop.



MAP 2: The Nuba Mountains and Dilling

The Dilling area was named after the Dilling ethnic group, whose language is one of the Ajang languages, belonging to the Nilo-Saharan phylum. Apart from pottery making, there are other handicrafts in Dilling, such as the traditional manufacture of ropes, baskets, mats and beds. The potters in Dilling are all women; there are no male potters.[1] Pottery making is mostly a family tradition handed down from one generation to the next, but some women learn the trade from other potters. The information gathered for this study comes from two workshops in the Kajang region, on the outskirts of the town of Dilling. The potters interviewed are Umjuma Bashir, aged 35 years, Amadiya Hamad, 38 years, and Husna Altoum Alihaimir, 50 years old.

[1] See also Bentley and Crowfoot (1924: 19): "The making of pots among the Nuba is the work mainly of the elder women."

The area of Kajang is generally characterised by black, muddy and sticky soil, with the exception of the al-Karaka pit (Hufrat al-Karaka), which is located at the foot of Bela Hill in the west. This is the only source of clay in the Dilling area, meaning that it is difficult to obtain raw material for pottery production. The potters dig the clay from the al-Karaka pit (see FIGURE 7) and transfer it by donkey to their workshops.

FIGURE 7: Al-Karaka pit (photo by Hamdan 2020)

The potter's workshop is attached to the potter's house near the living room. It is a small wooden grass-thatched shelter. Once the clay has been fetched to the workshop, it is first cleaned of small stones and trash, to avoid cracking of the pots when they become hot. Then the raw material is placed on a mat (sack, plastic or cardboard) on the floor and sprinkled with dry leaves or dried donkey dung (see also Bentley and Crowfoot: 1924: 19), then mixed with water (see FIGURE 8). To produce water pots, only dry leaves are mixed in; for other pottery, such as stoves, flower pots or incense burners, the potters use dried donkey droppings. When the clay is well mixed, it rests for a while before the wet modelling clay is pressed with the hands to form a solid mass.

To form a vessel, the potter may use different techniques for different parts of the vessel: one to shape the base, another for the body and yet another for the rim. This is also attested for prehistoric and historic pottery, as archaeological evidence shows. In what follows, I will briefly describe how water pots and stoves were made in the Nuba Mountains.

FIGURE 8: Preparing the clay (photo by Hamdan 2020)

The forming of water pots (Arabic: *ziir*) is done by a mixture of moulding and coiling techniques and can be summarised in three steps: moulding for the lower part (base), then applying the coiling technique to form the upper part (body), and finishing up with the hammering technique to smooth the surface using a small stone (FIGURES 9 and 10). The decoration process takes place before kilning, as is also the case for flower pots.

FIGURE 9: Forming the base of the water pot by making use of a negative mould dug into the ground; the base and a smoothing stone (photos by Hamdan 2020)

FIGURE 10: Forming the body of a water pot (photos by Hamdan 2020)

The forming of stoves (see FIGURE 11) usually begins with the production of the rim by using the modelling technique. That is, the clay is put on an upside-down deep plate so that it gains its bell-mouthed shape.

FIGURE 11: Forming a stove: rim; body; joining rim and body; forming the base; final shape of the stoves; decorated stove (photos by Hamdan 2020)

The forming of the body is done with the slab technique. Then the potter joins rim and body with a coil of clay. The base is formed by stretching the clay of

the cylindrical body. Stoves and incense burners are decorated after kilning. The decoration consists of colouring, not carving, and the motives are, for example, (dotted) lines, leaves and flowers.

Once the vessels are formed, they are dried for two days and are then ready for firing. As fuel, the potters use grass and firewood, as well as dried cow dung that comes from nearby forests and cattle pens. The potters build an open kiln dug into the ground. The pit is 140 cm in diameter, 40 cm deep and can hold five to ten pots (see FIGURE 12). Inside the pit, the pottery is placed on a layer of grass, then the pots are covered with a layer of dried cow dung. When all the gaps are filled, the whole pit is covered with mud bricks and clay before the firing process is started.

FIGURE 12: The burning kiln (photos by Hamdan 2020)

4 Conclusion

In the case of the Neolithic sites in central Sudan, studies have shown that the source of the raw material is clay from the Middle Nile region. As the study on modern pottery at Dilling shows, the raw material comes from a site close to the houses of potters. Thus, past and present communities made use of the natural resources around them.

Organic inclusions in the ceramic samples from Central Sudan show that animal dung and plants were used in the process of pottery making in the Neolithic period. This is also evident in the manufacturing techniques at Dilling, where potters relied on adding organic inclusions to pottery clay.

Ethnographic studies in the Dilling area show a similarity with one of the techniques used by the Neolithic groups. This is the coiling technique for forming pottery, of which, thanks to the ethnographic studies, we now have a clearer picture.

The archaeological investigations in Central Sudan did not reveal any clues as to the locations of the pottery workshops (places of manufacture and firing).

Probably this industry took place near the houses, as we can assume from the manufacturing workshops in Dilling. Usually, local communities carry out this type of craft in or near the house. This saves time and effort, since one has to leave the house only to fetch the raw material and to take the final product to the markets for sale.

FIGURE 13: Examples of modern Nuba Mountain and Neolithic ceramics (left courtesy of Claude Rilly; right from Salvatore et al. 2016)

To sum up, ethnographic studies at Dilling play an important role in identifying questions and information for which evidence may not be clear in archaeological studies. Particularly for the phases of pottery manufacture, we gain insights into whether the potter has to modify the raw material by adding organic or non-organic products, how the potter has formed the clay or how the potter may mix techniques to form one vessel. Comparing the modern pottery from the Nuba Mountains with historical pottery (see FIGURE 13 with photos from Rilly 2005 and Salvatori et al. 2016), one may wonder whether the similarity of forms implies a similarity of use. Thus, though certainly some questions remain to be answered, ethnographic studies help to clarify a number of questions concerning the past and they support archaeological findings, as we have tried to show here.

Postscript

The aim of this article was to present archaeological and ethnographic data, including linguistic information around pot-making. Unfortunately, due to the civil war in Sudan, we could not achieve our aim but had to satisfy ourselves

with what we had when the fighting started in April 2023. Thus, for instance, the linguistic information that we wanted to include remains to be collected.

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Earthenware in use (Tima, Nuba Mountains)
(photos: Gertrud Schneider-Blum, 2008-2011)