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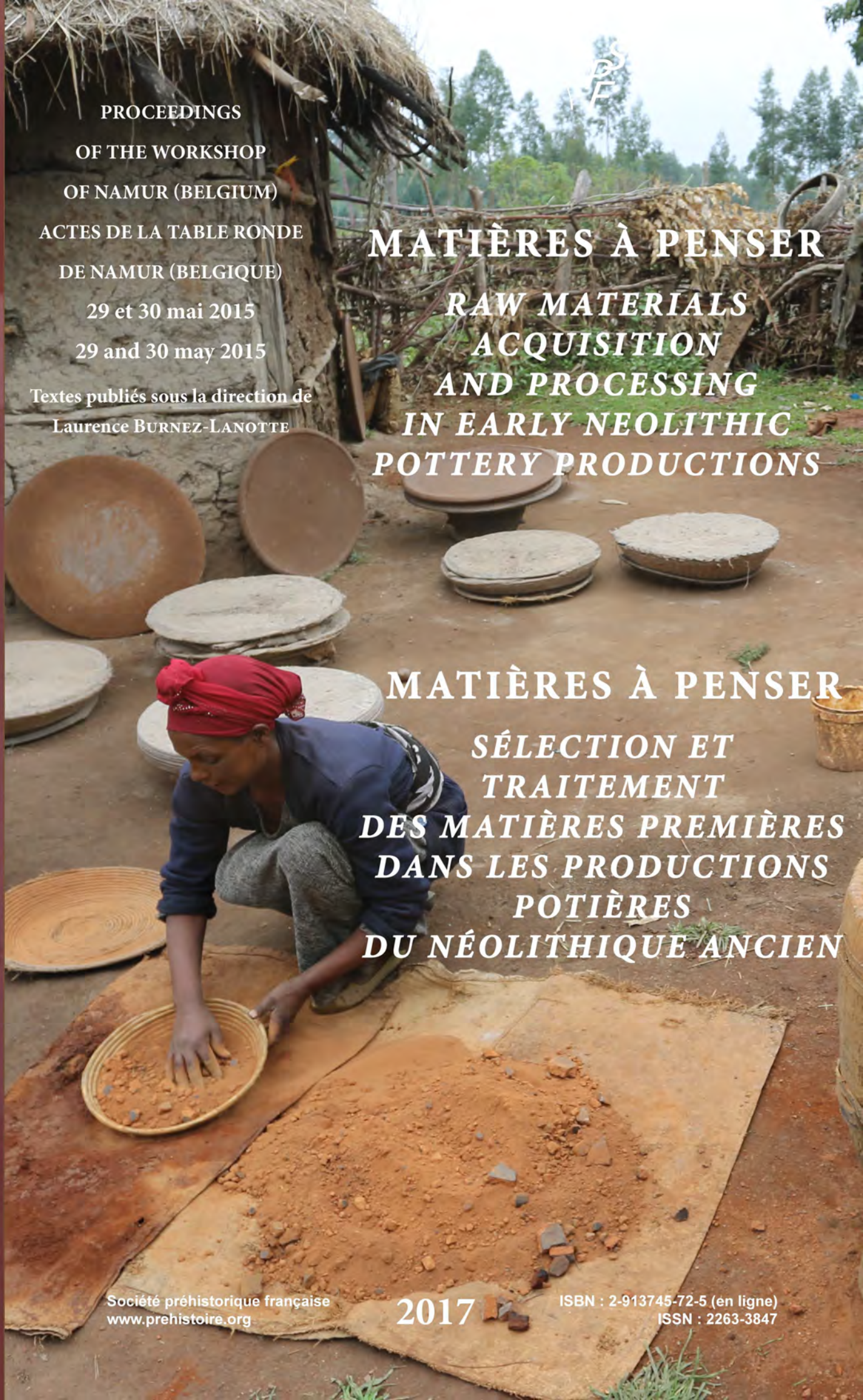
PROCEEDINGS
OF THE WORKSHOP
OF NAMUR (BELGIUM)
ACTES DE LA TABLE RONDE
DE NAMUR (BELGIQUE)
29 et 30 mai 2015
29 and 30 may 2015

Textes publiés sous la direction de
Laurence BURNEZ-LANOTTE

MATIÈRES À PENSER

RAW MATERIALS ACQUISITION AND PROCESSING IN EARLY NEOLITHIC POTTERY PRODUCTIONS



MATIÈRES À PENSER

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Technical traditions and pottery craftsmanship among the Woloyta and Oromo groups in Ethiopia

Actualist references for refining prehistoric ceramic analytical protocols

Jessie Cauliez, Claire Manen, Vincent Ard, Joséphine Caro, Ayed Ben Amara, Anne Bocquet-Liénard, Laurent Bruxelles, Nadia Cantin, Xavier Savary, Fabien Convertini, Victoria Borgen

Abstract: In prehistoric archaeology, any examination of the clay raw materials used for producing ceramics brings us back to the question of the supply sources and the localization and extent of the exploited territories. It also involves working on the technical traditions of the first stages of the operational chain as an identity marker of a social group, tracking the technological mixing of attributes from one group and techniques from another, assessing the diachronic development of technical procedures and evaluating the physical and chemical constraints of the raw material in the artisan potter's choices.
For the Neolithic, our team focuses on the north-western Mediterranean zone and the Horn of Africa, and aims to record three types of complementary historic processes, for which it is essential to carry out research on raw materials and how they were processed.
First of all, these consist of diffusion processes during the emergence of the first productive societies. Work on Mediterranean Neolithisation involves the consideration of diffusion mechanisms for new techno-economic characteristics and of the long-distance transfer of ceramic know-how. From an economic viewpoint, (domestic?) production structures are also examined, as well as the use of tempers as cultural signatures. At the end of the Neolithic, processes linked to movements of communities outside their boundaries are also clearly observed; they sometimes lead to the gradual re-composition of the operating system of neighbouring societies, as is the case with the extension of the Languedoc group of Ferrières in the Jura on the lakeside sites of Chalain, or in the heart of Provence where unequivocal Italic cultural filiations are observed in ceramic productions and demonstrate strong circulation currents linked to copper metallurgy. For diffusion processes, the analysis of raw materials (localization of sources, unique or multiple supply sources? etc.) is indispensable in order to evaluate whether aesthetic and technical standards spread first and were then adopted or whether, conversely, these processes resulted from human mobility.
Next, we look at cohabitation processes, for example at the end of the Neolithic, when the Bell Beaker culture spread throughout the whole Mediterranean region. Situations involving mixing have been observed throughout the South of France: for example, we find vases affiliated to local groups (such as Fontbouisse) but which contain *chamotte* tempers, which was the dominant Bell Beaker technique, and at the same time, we find Bell Beaker containers presenting calcite tempers, which is one of the main characteristics of regional style Provence products. These situations denote the existence of borrowing and assimilation and can only be analysed through the study of clay paste preparation conditions.
Lastly, we observe processes where cultural isolation is maintained, in marginal, conservative zones represented by the resistance of hybrid communities rethinking their products over time, while at the same time retaining typical characteristics considered as standard during the preceding period. Again, it is vital to take account of actions on materials in order to answer this question.
One of the ways of developing our archaeological reflection with regard to these historic processes and refining our discourse and interpretations of our Neolithic ceramic assemblages is to refer to actualistic data. In this article, we present research conducted since 2011 with Ethiopian potter communities in the Oromiya region in the Rift Valley. The aims of this research include: building up reference collections of the technical procedures in order to increase the efficiency of analytical protocols on prehistoric archaeological series, and working on occurrences of the borrowing or non-borrowing of technical and stylistic ceramic traits, as part of the ANR project led by V. Roux (UMR 7055 Préhistoire et Technologie, Nanterre). The aim is to construct models for interpreting processes of archaeological diffusion in prehistory and to assess the dynamics at work in the development of cultural traits and societies. In keeping with the

theme of the workshop, we will concentrate on the first area of our research and on observations of the first stages of the operational chain. This is, above all, a way of presenting our study protocols and our archaeological investigation of these ethnographic reference collections to the wider scientific community.

Keywords: ethnoarchaeology, technical traditions, Neolithic, ceramic artefacts, Ethiopia, Lake Region, Oromo and Woloyta ethnic groups.

Résumé : En archéologie préhistorique, s'interroger sur les matières premières argileuses employées dans le façonnage des céramiques revient à questionner les sources d'approvisionnement et par suite la localisation et l'étendue des territoires exploités, à travailler sur les traditions techniques aux premières étapes de la chaîne opératoire comme marqueur identitaire d'un groupe social, à pister les phénomènes de mixités techniques entre attributs typologiques propres à un groupe et techniques spécifiques à un autre, à mesurer l'évolution des procédés techniques dans la diachronie, et enfin à évaluer les contraintes physiques et chimiques de la matière dans les choix de l'artisan potier.
Pour le Néolithique, notre équipe, sur ses terrains en Méditerranée nord occidentale ou dans la Corne de l'Afrique, vise la documentation de trois types de processus historiques complémentaires, pour lesquels les travaux sur les matières premières et leurs traitements sont des informateurs essentiels.
Tout d'abord, des processus de diffusion au moment par exemple de l'émergence des premières sociétés de production. Les travaux sur la néolithisation méditerranéenne nous entraînent en effet à s'interroger sur les mécanismes de diffusion des nouveautés techno-économiques et sur les transferts à longues distances de savoir-faire céramique. Sont également questionnées d'un point de vue socio-économique, les structures de production (domestiques ?) de même que l'usage de certains dégraissants comme signatures culturelles. A la fin du Néolithique, des processus liés au déplacement de communautés hors de leurs limites sont également clairement avérés ; ils aboutissent parfois à la recomposition progressive du système de fonctionnement de sociétés voisines comme c'est le cas avec l'extension du groupe languedocien de Ferrières dans le Jura sur les sites lacustres de Chalain ou au cœur de la Provence lorsque des filiations culturelles italiques sont sans équivoques dans les productions céramiques et témoignent des puissants courants de circulation liés à la métallurgie du cuivre. Pour ces processus de diffusion, l'analyse des matières premières (localisation des sources, sources d'approvisionnement uniques ou multiples ?, etc.) est indispensable afin de mesurer si ce sont des canons esthétiques et techniques qui ont diffusé, et qui par la suite ont été adoptés ou au contraire si il y a eu mobilité de personnes.
Ensuite, des processus de cohabitation, par exemple à la fin du Néolithique, lorsque le phénomène Campaniforme inonde toute la Méditerranée. Des situations de métissages sont en effet avérées dans tout le sud de la France avec des vases affiliés aux groupes locaux (comme le Fontbouisse) fabriqués à l'aide de dégraissant à la chamotte, technique dominante dans le Campaniforme et, dans le même temps, des contenants campaniformes présentant du dégraissant à la calcite, caractéristique première des produits des styles régionaux de Provence. Ces situations traduisent des phénomènes d'emprunt et d'assimilation que seule l'analyse des modalités de préparation de la pâte est susceptible de documenter.
Enfin, des processus de maintien d'isolats culturels, dans des zones en marges, conservatrices qui vont se traduire par la résistance de communautés hybrides réinterprétant leurs produits selon les codes de leur temps, tout en faisant perdurer les caractéristiques typiques de ce qui était la norme à la période précédente. Là encore, la prise en compte des actions sur la matière est fondamentale pour régler cette question.
Un des moyens d'alimenter notre réflexion archéologique sur ces processus historiques et d'affiner notre discours au moment de proposer des interprétations de nos assemblages céramiques néolithiques est sans aucun doute de faire appel à des données actualistes. Dans le cadre de cet article, nous proposons de présenter les recherches que nous conduisons depuis 2011 avec des communautés de potières en Éthiopie, dans la vallée du Rift, en région Oromiya. Cette recherche poursuit plusieurs objectifs parmi lesquels : constituer des référentiels des procédés techniques pour décupler l'efficacité des protocoles analytiques sur les séries archéologiques préhistoriques et, dans le cadre d'un projet ANR piloté par V. Roux (UMR 7055 Préhistoire et Technologie, Nanterre), travailler sur les phénomènes d'emprunt ou de non-emprunt de traits techniques et stylistiques céramiques. Il s'agit ici d'offrir des modèles pour interpréter en Préhistoire les processus de diffusion archéologique et, dès lors, les dynamiques à l'œuvre dans l'évolution des traits culturels et des sociétés. En accord avec la thématique du workshop, nous concentrerons notre présentation sur le premier axe de notre recherche et sur les observations réalisées sur les premières étapes de la chaîne opératoire. Il s'agit surtout de soumettre à la collectivité nos protocoles d'études et nos questionnements archéologiques sur ces référentiels ethnographiques.

Mots-clés : ethnoarchéologie, traditions techniques, Néolithique, vestiges céramiques, Éthiopie, région des lacs, groupes ethniques Oromo et Woloyta.

INTRODUCTION

Pottery, the expression of a complex craft, the reflection of cultural identity and social strategies

All the technical acts necessary for manufacturing an object (the acquisition of raw materials, their transformation, manufacturing techniques) are established on knowledge learnt in a sociological niche. Each stage of the *chaîne opératoire*, i.e. 'the series of operations that transform raw material into finished products, either consumption object or tool' (Creswell, 1976, p. 13) varies according to constraints related to both the properties of the material and cultural factors. These cultural factors are cultural heritages, traditions, customs, taboos and exchanges, but are also based on political and professional rules. This methodological background allows us to consider the production of an object according to different interactive analytical levels; from cognitive processes related to learning to processes of transmission and the evolution of practices, and thereby attain the cultural expression of a society. The correlation between 'technological traditions' and "social groups" exists all over the world. It is a theory applied by members of the research community focusing on ethnographical and ethnohistorical studies (Creswell, 1976; Rye and Evans, 1976; Rye, 1981; Mahias, 1993; Dietler and Herbich, 1994; Bowser, 2000; Gosselain, 2000, 2002 and 2008; Roux, 2003; Pétrequin and Pétrequin, 2006; Stark et al., 2008; Gallay et al., 2012). This research showed how the study of the ways of doing and manufacturing processes of traditional societies are invaluable for interpretative constructions related to the description and understanding of archaeological artefacts.

Our project focuses on one of the most important manual skills in the world for several millennia - pottery manufacturing - in order to collect different data relating to cultural traditions. Today, the combined study of technological processes and objects (shapes and decoration) is essential for an anthropological interpretation of ceramic assemblages (for an overview see Albero Santacreu, 2014). The cultural value of the manufactured ceramic product no longer needs to be proven. It is a marker of individual (the emblematic person of the potter craftsman) or of collective differentiation (interactions between social groups, exchanges, social boundaries).

In 2011, we began an ethnographic research program in Ethiopia [(1)]. Here, the fabrication of pottery (without a potter's wheel) is still widely practiced. The fabrication techniques and the social status of craftsmanship vary considerably depending on the different regions and ethnic or linguistic groups involved. Studies have rarely been conducted on technical pottery traditions in Ethiopia (Silverman Raymond, 2000; Arthur, 2006; Lyons, 2007 and 2014; Lyons and Freeman, 2009; Harlow, 2011; Wayessa, 2011; Kaneko, 2014).

The diverse aims of our research include increasing the effectiveness of analytic protocols on prehistoric archaeological assemblages by building up ethnographic references in order to refine our interpretation and understanding of technical traditions. The purpose of this is to achieve a better evaluation of technical behaviour and the organization and distribution of production. The main objective is to provide answers to the sociocultural and techno-economic problems of interpretation of Neolithic archaeological assemblages in Africa and Europe (apprenticeship 'niche', codification of social relationships, transmission, transfer of techniques between groups, standardization, and social boundaries). Ultimately, this project aims to understand the complex links connecting material ceramic productions, the identity of the producers, the management of territories and resources, and exchange networks of objects and ideas.

This ethnographic study serves fundamental research, but its main objective is to focus on the conservation and promotion of this singular skill and knowledge, which is an integral part of traditional cultural heritage in Ethiopia, in a global context where ceramic traditions are progressively disappearing as a result of material cultural change or mechanized production. In the neighbouring countries of the Horn of Africa, potters have already totally disappeared from the Republic of Djibouti (Cauliez et al., 2008; Cauliez et al., in press) and are increasingly rare in Somalia (Belkin et al., 2006).

Ethnographic references to refine our interpretation and understanding of prehistoric technical traditions

Our archaeological research at the TRACES laboratory in Toulouse, France, focuses on the Neolithic. Our specialized study zones are located in the north-western Mediterranean area and the Horn of Africa (Manen et al., 2010a; Cauliez, 2011; Ard, 2013 and 2014; Caro, 2013; Gutherz et al., 2015; Defranould and Caro, in press). Our work concentrates on the reconstruction of the historical and social dynamics of Neolithic societies, assessed through the prism of ceramic production analysis. As each project member is specialized in a specific period, the comparison of our different fields enables us to cover a wide chronological scale - ranging from the Early Neolithic to the Final Neolithic - and thus to consider the main issues:

- based on the study of very diverse sites (ranging from more or less large scale permanent habitation sites to temporary stopovers, defensive sites, aggregation sites, and funerary sites),

- based on the study of ceramic assemblages presenting wide variability as regards production modes, styles and conservation status.

In order to assess the different anthropological questions characterizing the Neolithic, such as processes of diffusion and circulation of people and ideas, assimilation

and acculturation processes or, conversely, cultural resistance, we analyse technical traditions because they reveal the mechanisms of social identity assertion, human group mobility or transfers and cultural mixing. Our respective studies correspond to a multi-angled approach to our assemblages, highlighting a global approach to the *chaîne opératoire*. During the course of these studies, several difficulties arose for each of us, regarding the interpretation of certain aspects of these ceramic productions. In keeping with the theme of this workshop, we will focus here on raw material processing, from extraction to use, as our ethnographic studies in Ethiopia can provide new data on this topic. However, it is clear that the reference collection built up here responds to questions incorporating the different stages of the *chaîne opératoire*.

OUR ARCHAEOLOGICAL QUESTIONS

Issue 1: tempers – the case of grog (also known as firesand and *'chamotte'*)

Many studies, particularly in the domain of petrography, have shown the importance of identifying non-plastic inclusions, i.e., tempers, and especially grog, added to clay by potters (Echallier, 1984; Constantin and Courtois, 1985; Whitbread, 1986; Sénépart and Convertini, 2003). In our studied assemblages, analyses carried out in collaboration with F. Convertini have identified different issues related to this subject.

First of all, the study concerns the Early Neolithic on the French coastline, i.e., ceramic productions made between 5,800 and 4,800 BC, in a domestic production context with significant individual variability, in spite of common cultural norms.

In a research program entitled 'non emprunt Organization and development of first farmer societies. Structure of ceramic productions from Liguria to Catalonia' (Manen et al., 2010a), we studied about forty settlements, mainly located in the South of France but also in Liguria and Catalonia, and more than 800 ceramics/sherds (fig. 1). From a methodological point of view, we tried to conduct global observation of ceramic productions but we were sometimes limited by the characteristics of our assemblages: for example, the problem of fragmentation hampers observations concerning shaping and the organization of decoration on the pot. Questions relating to raw material management, clay modification and the structure of decoration were more detailed. Raw material management was studied through the petrographic analysis of thin sections. The location of raw material sources was investigated following a specific protocol (Convertini, 2010) which also involves geomorphological analysis around settlements and studies of natural soil samples. This work has shown that clay preparation relies on a set of technical practices, ranging from the most simple to the most complex, and in particular, the use of tempers. To summarize these results, which have been published elsewhere (Binder et al., 2010), potters did not add tempers to 40% of the corpus, whereas for the remaining 60%, various types of tempers were added. Of these, the best-represented tempers are grog (including dry clay), crushed calcite, and, more occasionally, bone. As part of this study, by comparing these observations with all stages of the *chaîne opératoire* (from clay acquisition to the decoration stage), we were able to study the geographic distribution of these practices and their chronological evolution. At this scale of observation, we deduced that grog, crushed calcite and bone had strong cultural connotations, in so far as these contributions represented technical traditions and thus distinct, but permeable, social groups.

Nonetheless, in many assemblages, 40% of the pots do not contain tempers, and this technical choice is difficult to interpret. Indeed, these productions are generally very fragmented and do not enable us to determine whether the presence or absence of tempers can be correlated to specific morphofunctional types, for example.

Let us now take as an example the site of Chauve-Souris Cave at Donzère, located on the bank of the Rhone and dated to the end of the Neolithic in southern France (Vital, 2007, 2010 and 2011). Excavations at this site were directed by J. Vital and the chronometry of the stratigraphic sequence is well established. The composition of the assemblage presents exceptional typological variability (fig. 2). Ceramics are related to a micro-local sphere of production, as well as an extra-regional sphere, in the same way as productions with north Italian and Bell-Beaker influences.

For this site, petrographic studies were carried out in order to identify provisioning sources and any possible specific raw material processing (see Convertini, in Cauliez, submitted). These studies enabled us to:

– determine that aesthetic canons may have been diffused and adopted, since Italian-style productions are not exogenous productions (imitation; Colas et al., 2007; Rouillard et al., 2007);

– reveal cultural transfer phenomena since pots of Italian tradition are tempered with grog, and this "way of doing" appears to have been inherited from the Bell-Beaker culture. If both productions are contemporaneous, this could represent a case of technical borrowing which is likely to indicate reinterpretation processes (Colas et al., 2007; Rouillard et al., 2007; Manem, 2008). Unfortunately, in this case, petrographic data related to trans-Alpine productions are still lacking and it is still not certain whether or not grog was used in the area;

– identify provisioning sources; these are never less than 10 km away and can be over 50 km from the site;

– estimate the diversity of acquisition networks: the same finished products (Bell-Beaker or Italian shaped productions for example) were made using clay from various sources, separated by distances of nearly 100 km.

F. Convertini deduced from these observations that the pots were not produced on site: clay extraction sites can provide information on the location of the origin sites of the different occupants of the cave and, given the diver-

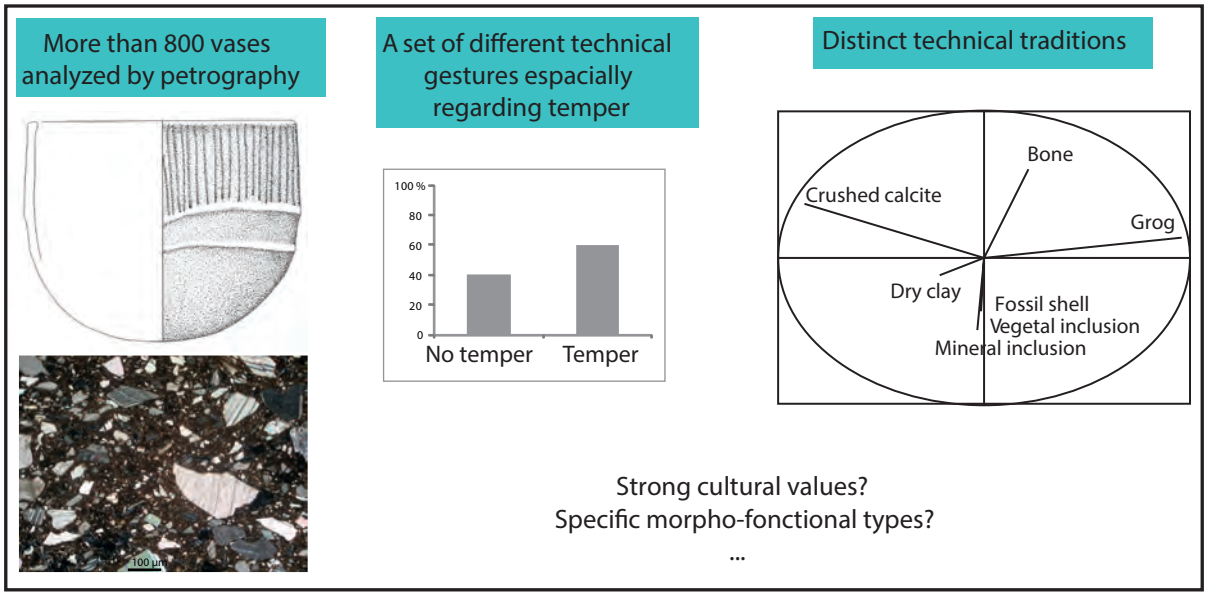

Fig. 1 – Early Neolithic pottery productions (5,800-4,800 cal. BC), Southern France.
***Fig. 1** – Productions céramiques du Néolithique ancien dans le Sud de la France (5800-4800 cal. BC).*

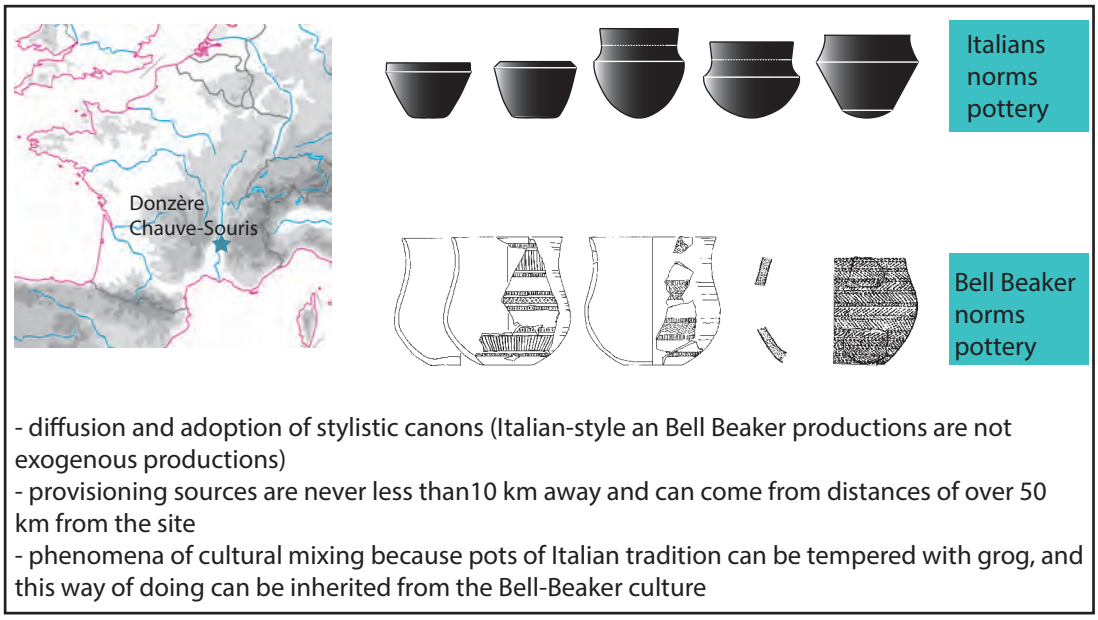

Fig. 2 – Final Neolithic pottery productions (2,800-2,200 cal. BC), Southern France (Drawings of pottery J. Vital *in* Vital, 2007 and J. Cauliez, in Cauliez, submitted).
***Fig. 2** – Productions céramiques du Néolithique final dans le Sud de la France (2800-2200 cal. BC; dessins J. Vital in Vital, 2007 et J. Cauliez,* in *Cauliez, submitted).*

sity of the clays, several different social groups could have acquired them. Thus, the site where these productions with varied stylistic and techno-petrographic attributes are gathered together cannot have been a habitation site. Complementary studies by one of our project team members (Cauliez, submitted) suggest that the cave may have functioned as an aggregation site (Manem, 2010; Roux et al., 2011; Roux and Courty, in press). This obviously implies that the chronology of the occupation is very constrained, as this diversity could denote the simultaneous meeting of several social groups, or a succession of visits to the cave at an unknown rhythm, whereby the different groups did not meet each other.

In this site, ceramic productions with grog tempers are Bell-Beaker forms and conform to Italian-style pots. These are always very small pots, which are either ornately decorated, or very black in colour with no decoration and fine walls with a complex morphology and surfaces subject to intensive burnishing. These productions reflect a high degree of technical investment and are socially very “visible” (in the sense of the term used by C. Perlès: Perlès, 2007, p. 321).

Consequently, with these two examples from the beginning and the end of the Neolithic, we observe a technical practice which involves the addition of grog. This practice may be a response to distinct situations governed either by a technical practice determined by the physical and chemical constraints of the raw material, or by cultural practices, or both, as these two factors are not incompatible. Therefore, we now need to establish reference collections in order to proceed with an in-depth analysis of this technical practice. Let us consider the second question raised by our Neolithic assemblages in relation to raw material processing.

Issue 2: influence of clay paste preparation on the 'quality' of the finished products

Let us now take another Early Neolithic example, but this time in a more continental region, located a considerable distance from the coast (fig. 3). For a long time, the aesthetic aspect of Early Neolithic ceramic assemblages from these regions incited archaeologists to consider these productions as lesser quality productions, resulting from mediocre *savoir-faire*. They finally attributed them to populations with low technical skills, and in this particular case, to hunter-gatherer groups in the process of acquiring Neolithic innovations (Niederlander et al., 1966; Roussot-Larroque, 1977 and 1990; Arnal, 1995 and 2006; Van Willigen, 1999).

It is true that these continental productions provide evidence of less intensive work as regards certain technical or stylistic aspects, such as the scarcity of decoration and gripping elements, thicker walls, less stretched coil junctions (Costantini and Maury, 1986; Maury, 1997; Boboeuf, 2004).

However, two recent site studies (Le Clos de Poujol and Combe-Grèze in Aveyron, France), when compared to data from classic Early Neolithic sites (Le Taï in Gard, France), have shown that technical and stylistic convergences exist between Early Neolithic coastal productions and those from the Early continental Neolithic (Caro, 2013; Defranould and Caro, in press). They are part of the same morphological and ornamental range, with the same buffing type finishing procedures and the same

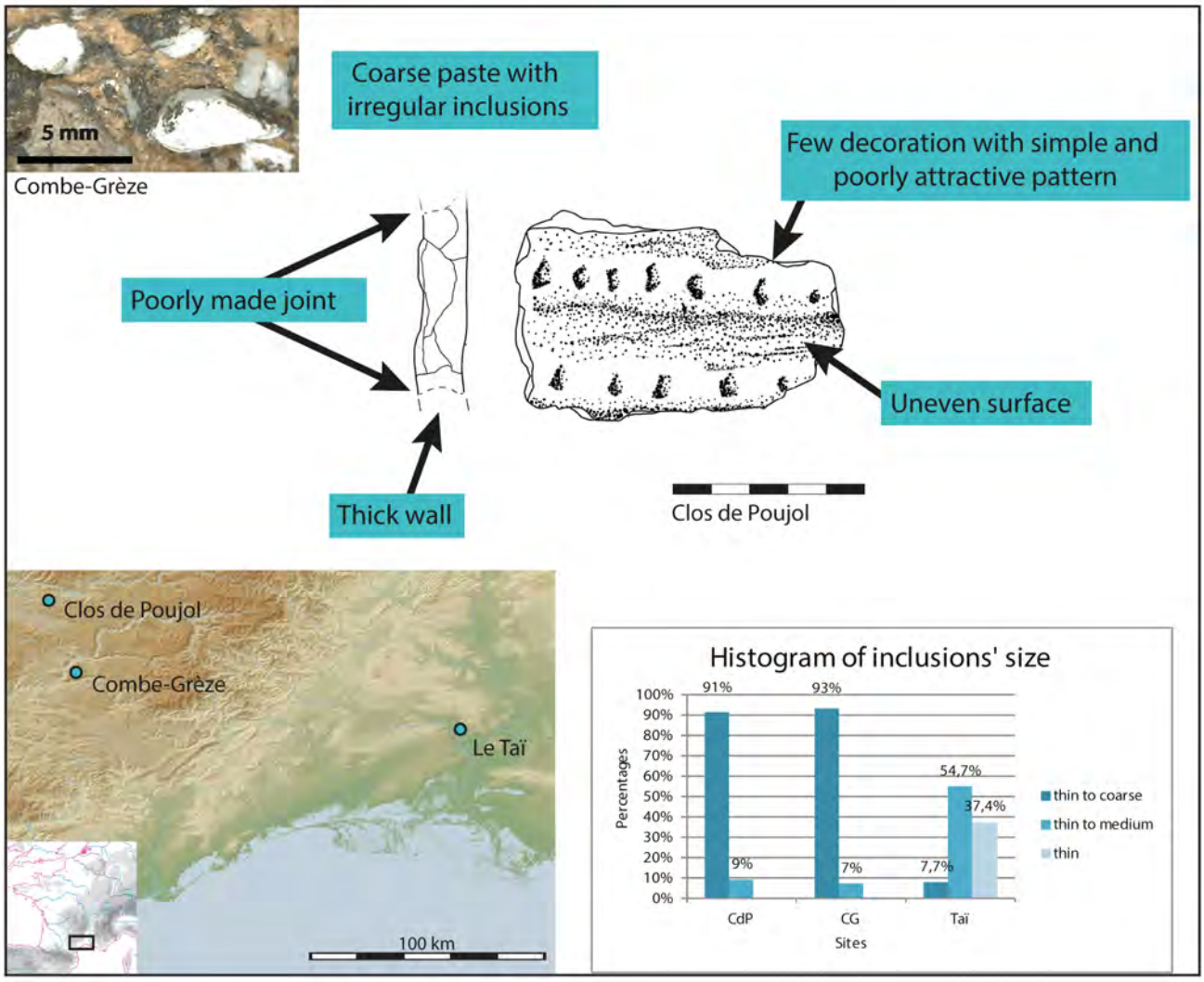

Fig. 3 – Early Neolithic pottery productions (5,800-4,800 cal. BC), Southern France.
***Fig. 3** – Productions céramiques du Néolithique ancien dans le Sud de la France (5800-4800 cal. BC).*

coiling methods. This is also the case for the raw materials: petrographical studies carried out by F. Convertini have revealed evidence for the addition of calcite as a temper (Convertini, 2010; Manen et al., 2010b). These convergences between products from the Early coastal and continental Neolithic point to similar skill levels, and have contributed over the past few years to mitigating the binary interpretation whereby the last hunter-gatherers were associated with products of mediocre quality and the first Neolithic populations were assumed to have produced good quality products. These are important data for understanding Neolithization mechanisms involving demic diffusion based on native networks or cultural transfer processes (Mazurié de Keroualin, 2003).

However, there are differences between coastal and continental productions. Indeed, these new analyses focusing on the first stages of the *chaîne opératoire* show that continental Early Neolithic clays often contain heterometric inclusions with a high proportion of coarse inclusions. This leads us to believe that there was less investment in crushing the clay, sorting inclusions and/or mixing. What might be the significance of this practice?

Productions from the end of the Neolithic in west-central France, between 3,400 and 2,200 cal. BC, raise similar questions (Ard, 2013 and 2014). They are also characterized by 'crudely'-made ceramics: thick walls, clays with a high content of coarse inclusions, slightly smoothed or unsmoothed walls, etc. These ceramics are generally considered to have demanded little technical investment (fig. 4). This type of production is represented during the same period in most contemporaneous cultures, such as the Horgen culture in eastern France and Switzerland or the former Seine-Oise-Marne complex in the Paris Basin. For all these groups, the main problem is our incapacity to define ceramic styles based solely on morphological criteria. For this reason, recent studies take into account all stages of the *chaîne opératoire*, from the choice of raw materials to firing operations (Martineau, 2000; Martineau et al., 2000; Augereau et al., 2007; Ard, 2014; Cottiaux and Salanova, 2014).

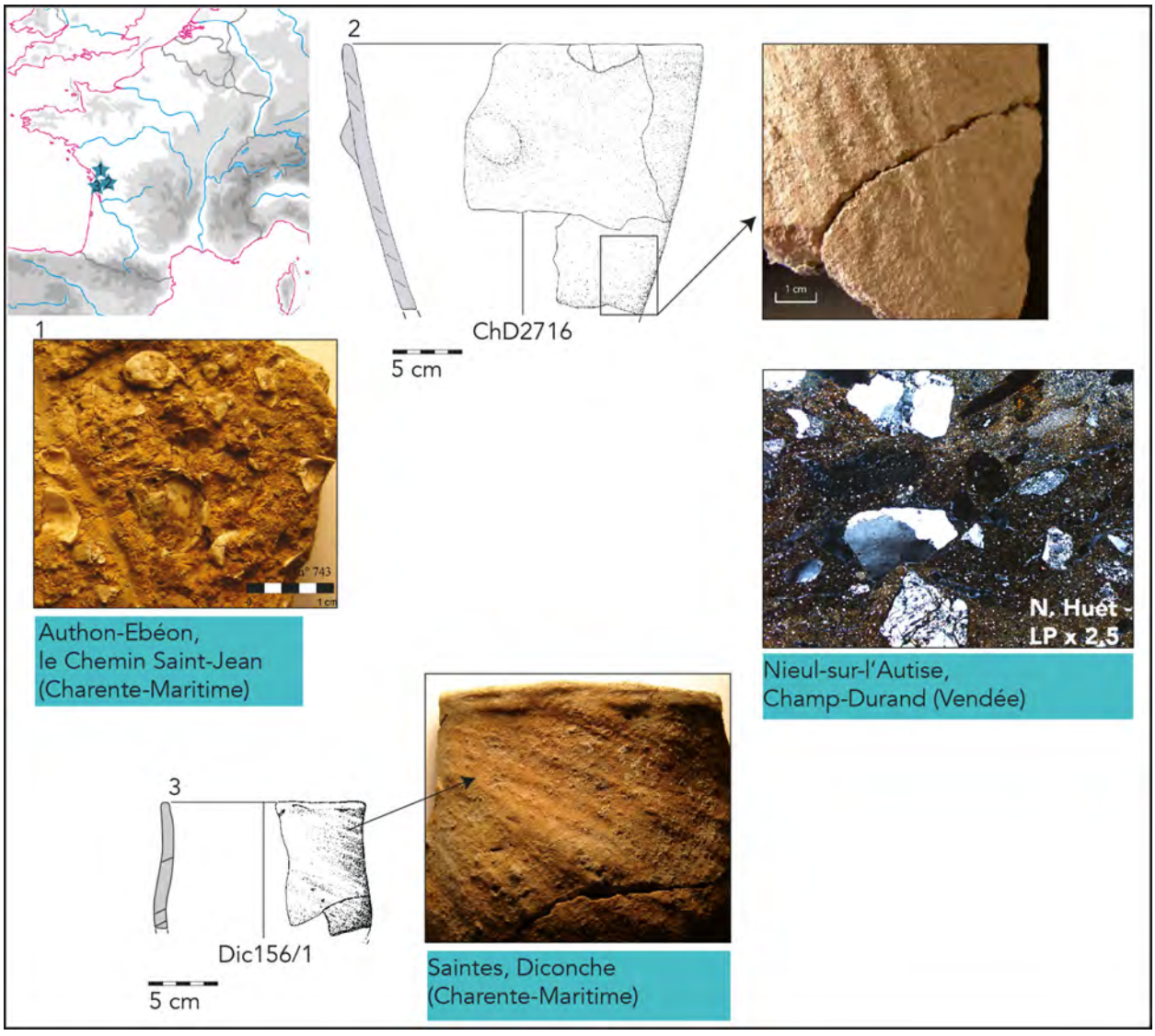

Fig. 4 – Late and Final Neolithic pottery productions (3,400-2,200 cal. BC), West-central France.
***Fig. 4** – Productions céramiques du Néolithique récent et final dans le Centre-Ouest de la France (3400-2200 cal. BC).*

In west-central France, the properties of these ceramic pastes raise several cultural and functional questions. Culturally, unlike for shaping methods, we do not observe any preferential choice of a specific material in the different contemporaneous groups, apart from the use of clay with fossil shell inclusions in certain ceramics from the Seuil du Poitou group. Productions from this period are thus characterized by the quantity rather than the type of inclusions. The use of such materials inevitably raises questions as to the properties of the finished products, particularly in terms of resistance to mechanical and thermal shocks, and thus to the duration of the service life of the pots. Petrographic analyses of several assemblages by F. Convertini and N. Huet show that there was a deliberate choice to use ceramic pastes with a high concentration of inclusions, either by using clays with a naturally high proportion of inclusions, or by adding tempers (sand, plants and grog), in order to obtain pastes with inclusion proportions at times representing more than 30% of the clay matrix (Convertini, 1996 and 1999; Huet and Ard, 2012; Ard, 2014). Therefore, this choice might indicate that most of these ceramics were intended for daily use, like cooking and food storage, and that they required high resistance to thermal and mechanical shocks.

In this context, like for the Early Neolithic, several questions are raised:

- what impact does the use of pastes with high proportions of inclusions have on the shaping, finishing and firing stages of the manufacturing process?
- is it possible to define the preparation process of the paste and the "recipes" used (proportion of added inclusions *vs* natural inclusions, for example)?
- how can we evaluate the hardness and the resistance of ceramics to mechanical and thermal shocks during the use of pots? What is the respective influence of the degree of preparation and the type of material on these properties?

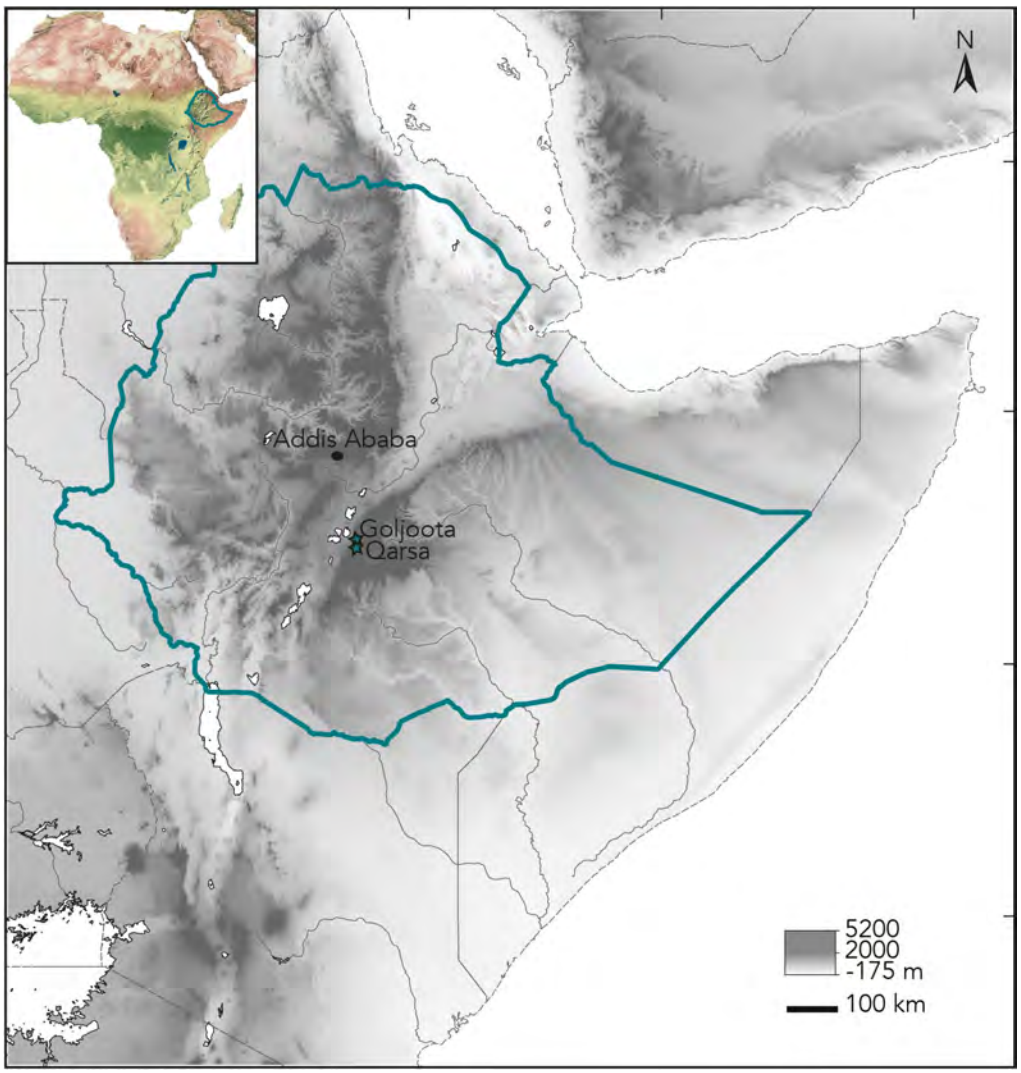

Fig. 5 – Location map of the ethnographical survey area in Ethiopia. Arsi and West Arsi Zones. Oromiya Region, with locations of Goljoota and Qarsa townships.
***Fig. 5** – Carte de localisation de la zone d'enquêtes ethnographiques en* Éthiopie*. Région Oromiya, zones Arsi et West Arsi, avec signalisation des localités de Goljoota et Qarsa.*

- beyond what proportions of inclusions and/or tempers used, can we consider that ceramics are weakened during use?

ACTUALIST REFERENCES FOR ENHANCING THE ANALYTICAL PROTOCOLS FOR PREHISTORIC CERAMICS

In Ethiopia, our work focuses on two localities, the townships of Qarsa and Goljoota located in the heart of the zone of large Ethiopian lakes, in the central-west zone of the Rift Valley within the region of Oromia (fig. 5). From an administrative point of view, the Oromia region or Oromia National Regional State is one of the largest federal regions of Ethiopia. Oromia is divided into 18 administrative zones. The two studied localities are an hour's drive from each other, in a landscape of plains and mid-mountain plateaux, with a climate conducive to agriculture and cattle and goat farming. The vegetation consists of shrubby savannas and rain forests with alpine vegetation on the mountain peaks.

Here, two ethno-linguistic groups make pottery: the Oromo and the Woloyta, alongside other ethnic tribes: the Guragué, Amhara, Kembattinia and Sidamo. Each of these two ceramic producing communities is represented by about thirty households.

Characteristics of the research area and survey methodology

Rural household economies in Arsi and West Arsi (2 of the 18 administrative zones of Ethiopia) are based on ox-plough cereal farming of wheat, barley, teff, millet, sorghum, maize and sometimes lentils and vegetable crops, with many farmers also keeping small numbers of cattle, sheep, goats and, occasionally, bees.

The level of dependency of these two groups on pottery varies, depending on whether or not they own their land. The Woloyta have been moved around over the past forty years and they do not own their own land. Consequently, they are full-time potters, whereas the time the Oromo spends on ceramics depends on agricultural and pastoral activities.

Pottery craftsmanship is a female activity, although the Woloyta men and young boys actively participate in the extraction of clay materials, as well as in the firing and sale of pottery.

The Oromo speak Afaan Oromo or Amharic and the Woloyta speak Woloytania or Amharic. From a general and demographic point of view, the Oromo represent the main group in the Oromia region. They are also in a majority in Ethiopia as a whole and they are present beyond its administrative borders (established in 1994 by the federal state). The Oromo people has split into a number of groups, characterized by cultural and linguistic variability (dialects). They nevertheless share a traditional socio-political, religious, economic and administrative system, the Gada system, which has been transmitted orally for hundreds of years. From a religious point of view, Christianity (Orthodox and Protestant) and Islam are the major religions. Wakefana (Waqeffannaa) is the traditional system of faith.

The Woloyta are migrants originating from the SNNPR region (Southern Nations, Nationalities, and People's Region). They owned no land and thus developed various types of crafts.

For these various communities, the system of filiation is patrilineal. Therefore, the transmission of property and family names by inheritance takes place within the male lineage. When a woman gets married, she leaves her hometown to join the village of her husband.

The Oromo and Woloyta have distinct technical traditions and their everyday products are easily identifiable. The identity of the social group- Oromo, Wataa Oromo or Woloyta- is clearly printed on each stage of the *chaîne opératoire*. These social groups have their own apprenticeship networks. Therefore, technical traditions remain stable in spite of intra-group knowledge of other procedures. These social groups interact at different levels and especially in places of redistribution (small markets), characterized by economic complementarity.

In this vast field of inquiry, using the ceramic technical system as an element of social group differentiation is valid: during the course of apprenticeship, potters from different groups construct their individuality on the basis of the collective model. When they practice their trade, they relate to the social identity of the group. By reproducing technical traditions, they thus perpetuate this identity.

In the field study, our methodology is based on standardized questionnaires, on the direct observation of manufacturing processes (from raw material extraction to product consumption), and on experimental work with potters. The protocol was established as part of the ANR program led by V. Roux and B. Bril.

In this way, over the past four years, we have collected data on:

- the social identity of potters and their families, networks of social relationships;
- the social status of this activity within a local cultural and economic context;
- the procedures implemented at each stage of the *chaîne opératoire* (photographs, questionnaires, films) and an evaluation of the physical constraints likely to influence potters' choices (inventory of sources, exploitation periodicity, clay sampling, purchasing finished products, etc.);
- apprenticeship networks;
- the degree of expertise and the level of technicality of each potter (questionnaires and experiments).

Fig. 6 – The different shapes of the Woloyta ethnic group production.
Fig. 6 *– Les différentes formes de la production du groupe social Woloyta.*

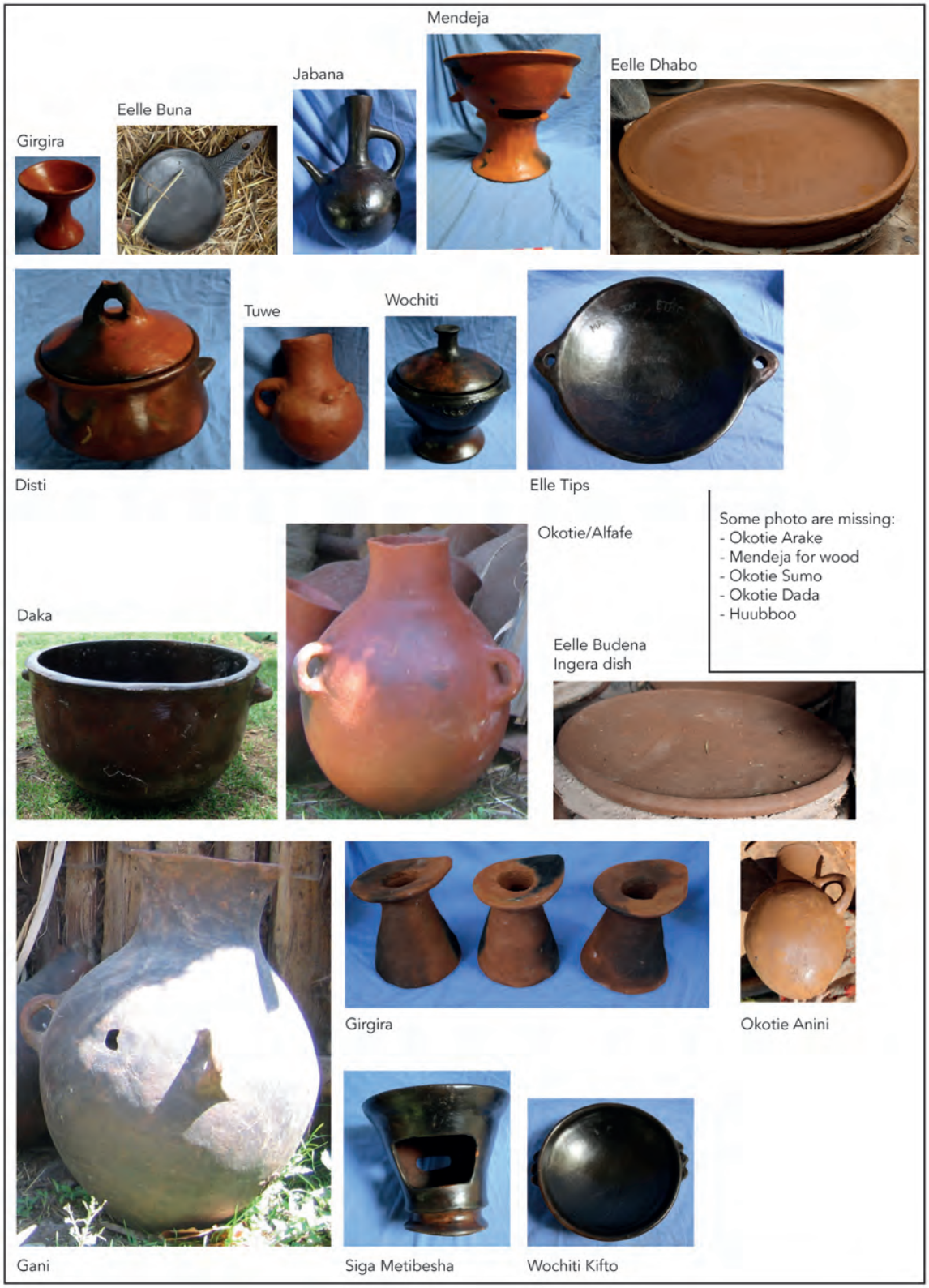

Fig. 7 – The different shapes of the Oromo ethnic group production.
Fig. 7 *– Les différentes formes de la production du groupe social Oromo.*

Fig. 8 – Woloyta social group at Goljoota. 1: source of white clay; 2 and 3: source of red clay; 4: stratigraphic section along the Arsi Negele road.

***Fig. 8** – Les Woloyta de Goljoota. 1 : la source d'argile blanche ; 2 et 3 : la source d'argile rouge ; 4 : séquence stratigraphique en bordure de la route menant de Goljoota à Arsi Negele.*

Oromo and Woloyta technical traditions

The Woloyta produce 18 different types of pottery (fig. 6), as opposed to 22 for the Oromo (fig. 7). These types correspond to productions for domestic use while surplus productions are sold at local markets. Pottery is a domestic activity: the work is carried out at home in workshops or in an annexe to the home environment. There are 15 different shaped pottery types but they are used for the same purposes by both groups (making coffee, carrying water, milk, food conservation, cooking meat, cereal processing, distilling local alcohol and making homemade beer, cooking bread and patties, etc.).

For both groups, clay sources are located near the dwelling places, i.e., between 500 m and 5 km away. Both groups use a mixture of different types of clay (Woloyta) or a mixture of clay and different types of temper (Oromo). Raw-material sources are not the same for both groups.

Fig. 9 – Woloyta social group at Goljoota. 1: drying of two clays; 2: sieving; 3: grinding with a pestle.
***Fig. 9** – Les Woloyta de Goljoota. 1 : séchage des deux argiles ; 2 : tamisage ; 3 : concassage avec un pilon.*

Fig. 10 – Woloyta social group at Goljoota. 1: incorporation of water into the clay once both clays have been mixed; 2: pots broken during drying, recycled, rehumidified and reused in matures clay; 3: mixing of clay.
Fig. 10 *– Les Woloyta de Goljoota. 1 : incorporation de l'eau dans l'argile une fois les deux argiles mélangées ; 2: pots cassés durant le séchage, recyclés, ré-humidifiés et réutilisés en argile maturée ; 3: malaxage de l'argile.*

Fig. 11 – Oromo social group at Qarsa. 1 and 2: red clay source; 3 and 4: white temper source.
Fig. 11 *– Les Oromo de Qarsa. 1 et 2 : la source d'argile rouge ; 3 et 4 : la source pour le dégraissant blanc.*

The proportions of the different types of clay and temper vary depending on the season – humid or dry – to ensure optimal drying and firing.

Woloyta raw material extraction takes place by pit extraction or quarrying. The Woloyta use a mixture of red (fig. 8, nos. 2 and 3) and white clays (fig. 8, no. 1). These clays are easily identifiable in profiles in the sector around the potters' homes (fig. 8, no. 4). They derive from the ferralitic alteration of ignimbrites; truncated by erosion and cut into by the hydrographic network. This gives the Woloyta direct access to the different levels of the alteration profile. The red plastic clays correspond to the Sk horizon, referred to as 'alteration with a pedological structure'. These clays, coloured by iron oxides, are made up of kaolinites and contain a considerable proportion of sand corresponding to residual sands from the original rock. The white clay is located in the lower part of the alteration profile. It coats blocks of ignimbrite in the process of deterioration. We also find it in horizon C where it may possibly be another type of mineralogical clay. However, we find the same sandy fraction corresponding to quartz initially contained in the ignimbrite.

In order to obtain a functional paste for making pots, it appears to be necessary to mix these two clays. This is clearly not linked to the presence of sand in stable proportions throughout the profile. It seems rather to be linked to the type of clays which are more or less well-suited to kneading and perhaps also to firing if they are not mixed. The less evolved white clay can also act as a clayey temper. Note that other tempers are available in the sector as run-off on these soils naturally accumulates large quantities of sand in ravines. The use of white clay thus represents a choice rather than a necessity.

To prepare the clay paste, the Woloyta conduct drying operations on clay floors, then crush both clays in different ways (fig. 9). The lumps of clay are subsequently broken up by striking them with large wooden sticks. The potters then mix both clays and sieve the dry mixture. The resulting granulometry is not particularly fine, but any undesirable elements are manually removed. This coarse fraction then requires large quantities of water in order to knead the clay and any impurities are extracted during this process (fig. 10). This clay mixture is hydrated by humectation. The Woloyta knead enough clay for their weekly production. This clay mass is made up of a portion of clay matured for several days which is mixed with freshly prepared clay. They thus work material gorged with water, with constant clay supplies, resulting from daily kneading.

The Oromo extract their clay and tempers differently: they use tunnel extraction or quarrying (fig. 11). Unlike the Woloyta, the Oromo mix red clay with a non-clay temper. These red to Burgundy-coloured clays derive from the ferralitic alteration of the ignimbrite substratum (horizon Sk). They are mainly composed of kaolinites but also contain numerous ferruginous pisoliths. In order to extract the clay, the potters exploit small ravines which cut into the

Fig. 12 – Oromo social group at Qarsa. 1 : sieving of white temper; 2: mixing of red clay and white temper; 3: shaping of small lumps of clay in preparation for roughing-out.
Fig. 12 *– Les Oromo de Qarsa. 1 : tamisage du dégraissant blanc ; 2 : mélange de l'argile rouge et du dégraissant blanc ; 3 : mise en forme de petites masses d'argile prêtes à être utilisées pour l'ébauchage.*

earth. Then they follow the plastic clays by undermining, without exploiting the upper horizons. Another type of clay in the same extraction site is not used by potters. This is a black clay in the same alteration profile but which probably contains more manganese. The red clay is mixed with an altered ignimbrite temper which is also exploited in small quarries, by tunnelling or undermining. Thus, unlike the Woloyta, the Oromo do not use a second type of clay, but incorporate this very white temper extracted from the ignimbrite substratum into the clay, when it is available. They use the slightly altered parts of the rock, which are softer. Note that the brown clay veins running down from the surface are carefully avoided during exploitation. This shows a clear resolve not to mix clays of different origin. The white clays at the base of the alteration profile (ignimbrite with clayey fraction), exploited by the Woloyta at Goljoota as second clays, are not used here by the Oromo.

The Oromo dry their clay, break it up quickly by striking it, but only sieve the dry white temper in order to obtain a finer granulometry (fig. 12). Once the red clay is broken up, it is moistened by humectation. The potters then incorporate the white temper by sprinkling it over the red clay and then mixing them together. The fine fraction (the white temper) is hydrated by impregnation when it is in contact with the coarse fraction (the red clay). The potters prepare small lumps of clay during the manufacturing process. The mixing time is not particularly long. They then work the clay directly, with no maturation phase. Primary and secondary shaping follow on directly after these transformation and homogenization operations.

Some Oromo potters add grog for a single specific type of vessel during the mixing phase. These are *ingera* dishes (called *elle budena*), and are used on a daily basis to cook teff flour flatbread. To make this grog, they recycle sherds of similar broken dishes (fig. 13). The Oromo potters break up sherds in a wooden mortar using a wooden pestle in order to obtain a relatively fine fraction. This is then added to the red clay, in variable proportions, while the white temper is excluded from this part of the *chaîne opératoire.* Some Oromo potters who only make these *ingera* dishes (*elle Budena*) do so in a very original manner (fig. 14). After shaping the dish, they systematically plane the lower surface of the vessel once it has partly dried, before firing it. The removed clay is then retrieved by the potters. This clay corresponds to a mixture of red clay and *chamotte* from ground and recycled *ingera* dishes. Potters subsequently rehumidify this retrieved clay and add straw to it. The obtained paste is then used to make small patties, about 20 cm long and about 3-4 cm thick, which are dried and fired. Once fired,

Fig. 13 – Oromo social group at Qarsa. 1: broken Ingera sherds used to make grog; 2: sherds are broken up using a wooden pestle; 3: the relatively fine fraction of grog, after sieving; 4: subsequent addition of the grog to the red clay; 5: ingera dish after shaping.
***Fig. 13** – Les Oromo de Qarsa. 1 : fragments de plats à Ingera utilisés pour fabriquer de la chamotte ; 2 : les potières les brisent dans un mortier au pilon ; 3 : la chamotte obtenue après tamisage est relativement fine ; 4 : les potières incorporent la chamotte à l'argile rouge ; 5 : le plat à Ingera après l'ébauchage et le préformage.*

Fig. 14 – Oromo social group at Qarsa. 1: sieving of red clay; 2: planing of the Ingera dish, after shaping; the removed clay is recycled; 3: potters then rehumidify this retrieved clay and add straw to it to obtain small patties which are dried and fired; 4: small patties after the firing; 5: the Ingera dish after shaping with red clay and the new *chamotte* temper.

***Fig. 14** – Les Oromo de Qarsa. 1 : s*échage *de l'argile rouge ; 2 : rabotage d'un plat à Ingera, après l'ébauchage ; les potières recyclent l'argile enlevée lors du rabotage ; 3 : les potières ré-humidifient cette argile recyclée en incorporant de la paille, de façon à obtenir des petites galettes de chamotte qui seront séchées et cuites ; 4 : les petites galettes de chamotte après la cuisson ; 5 : le plat à Ingera obtenu par un mélange de l'argile rouge à ce nouveau dégraissant de chamotte, après l'ébauchage et le préformage.*

Fig. 15 – 1: one of the extraction sources of red clay used to make red paint which is applied before firing by the Oroma at Qarsa; 2: extraction source of red clay used to make red paint which is applied after firing by the Woloyta at Goljoota.
***Fig. 15** – 1 : une des sources d'extraction de l'argile rouge utilisée pour réaliser les peintures avant cuisson chez les Oromo de Qarsa* ; 2 : *une des sources d'extraction (carrière) de l'argile rouge utilisée pour réaliser les peintures après cuisson chez les Woloyta de Goljoota.*

these patties are ground up like the initial *chamotte*. They are then sieved and the *chamotte* temper (following the definition of: Echallier, 1984, p. 14) is reincorporated into the red clay to recommence the fabrication process for *ingera* dishes.

Both the Oromo and the Woloyta potters sometimes use a third type of purplish-red clay. This clay is only used for the finishing stages to make coatings for certain types of pottery. This reddish clay is less sandy as, unlike the clays used for shaping, it is formed from basaltic outcrops. On account of its fine, soft (talc-like) texture, it possesses the qualities sought after by potters who wish to add colour and shine to their productions during finishing treatments. The Oromo extract this clay from sources slightly further away from the dwelling places (up to about 10 km away; fig. 15, no. 1). For the Woloyta, this clay comes from a neighbouring quarry within the potters' zone (fig. 15, no. 2). It is located on the flank of a former volcanic cone and here, again, the substratum is composed of basalts. The alteration clay derived from slag is fine and highly coloured by iron oxides.

The Oromo add this coating just before firing (fig. 16). The red clay is mixed with water and vegetable oil or diesel, before it is used to coat the vase using a piece of fabric. This mixture gives the ceramics a red and shiny aspect.

The Woloyta apply this coating just after firing (fig. 17). The red clay is mixed with water and vegetable fat from the enset (false banana). The surface of the pot is prepared before firing by burnishing with a pebble in order to facilitate the adherence of coatings.

The Woloyta shape rough-outs from a clay mass using two alternative methods: a conical mass hollowed out with the fist (used for practically all shapes), or a large stretched plate (*Bashe* or *Ingera* dishes; fig. 18). The Oromo make rough-outs using a large flattened coil rolled around itself (fig. 19).

For Woloyta and Oromo potters, the shaping stage usually consists of stretching and continuous finger pressure, particularly for the top of the pot. Then the surfaces are smoothed. Coils can be added to shape the bottom; this last technique is more frequently used by the Oromo group. The Oromo potters start decoration on wet surfaces, mainly by using a grooving technique, before the end of the shaping operation.

The Woloyta potters start the finishing treatments on a leather-hard surface. The technical processes vary according to the types of pots. Smoothing with water, planing and burnishing were observed. Usually, handles and decoration (relief decoration such as clay cords) are added during this stage.

The Oromo potters often carry out the finishing treatment on wet surfaces -planing, smoothing- or on dry surfaces: spreading red soil mixed with oil to shine the surfaces.

Fig. 16 – Oromo social group at Qarsa. 1: red clay is mixed with water and vegetable oil or diesel; 2: finishing stage used to create a shiny coating on Jabana (coffee pots).
***Fig. 16** – Les Oromo de Qarsa. 1 : l'argile rouge est mixée avec de l'eau et de l'huile de lin ou du gasoil ;* 2 : *cette étape de finition sert à faire briller les Jabana (cafetière).*

Firing is carried out in a kind of haystack installed on the ground, sometimes within a small pit. Firing conditions are broadly similar for Woloyta and Oromo potters: pots are installed on the ground and covered with combustible wood and embers. However, the Woloyta potters of Goljoota make use of straw, thatch and wood chips, whereas the Oromo potters of Qarsa use twigs and dried dung. Firing times also differ; the Oromo vessels are fired for shorter periods as they have thinner walls.

Fig. 17 – Woloyta social group at Goljoota. 1: spreading red slip or paint on the internal surface of an Ingera dish; 2: another extraction source of red clay used to make red paint which is applied after firing; 3: spreading animal dung on an Ingera dish edge; 4: spreading a mixture of Abyssinian banana tree roots and water on the internal surface of an Ingera in order create a shiny finish.
***Fig. 17** – Les Woloyta de Goljoota. 1 : peinture rouge sur la face inférieure d'un plat à Ingera ; 2 : une autre source d'extraction de l'argile rouge utilisée pour la peinture après cuisson ; 3 : étalement d'excréments animaux (bouse de vache) sur une partie du plat à Ingera ; 4 : étalement sur la face supérieure du plat à Ingera d'une matière obtenue à partir de racines de l'Ensète (ou faux bananier) mélangées à de l'eau, le tout pour faire briller la surface interne.*

Both groups can pre-fire pots by arranging them around the fire in order to dry the most recently produced pots more completely.

The Woloyta perform various post-firing treatments that differ depending on the types of vessels being produced. The most common is the application of cow dung to the base of the pot but other substances are also used, such as a 'white paint', made from ground limestone, a red clay slip and a coating made from crushed roots to makes the surface glossy (fig. 17). The main aim of these surface treatments is to enhance the appearance of vessels. However, they are also used to camouflage imperfections, as in the case of cow dung and red slip.

We observed a single post-firing treatment during the Oromo manufacturing process that can be, but is not always, performed on different types of vessels. This is the blackening of the outer surface, obtained by the creation of a reducing atmosphere at the end of firing by covering the pot with straw. Again, it seems that the purpose of this operation is aesthetic, to comply with consumer demand.

Based on this fieldwork, it is possible (like for others before us: Balfet, 1965; Rye and Evans, 1976; Arnold, 2005; Livingstone Smith et al., 2005) to:

– test and rationalize the different analytical methods, particularly archaeometric methods, to be used for studying ceramic assemblages in order to reconstruct the *chaîne opératoire* in a Neolithic context.

– build up a reference collection to be used in archaeology.

CONTRIBUTION OF OUR ETHNOGRAPHIC FIELDWORK

Back to issue 1: tempers – the case of grog

The differences observed between the Woloyta and the Oromo for the preparation of clay materials have consequences on the finished products. Woloyta productions seem to resist better to use, due to the type of raw materials used, but also because of the different operations for preparing the materials: intensive clay crushing, more intensive granulometric sorting, mixing matured clays with freshly kneaded clays, longer maturing phase, pre-drying, 12-hour firing, etc. The practices linked to the introduction of a grog temper agent in Oromo productions raise the following question: since grog is only used by Oromo groups for one particular type of vessel, the *ingera* dish, is it used to increase the solidity of these dishes, which are used on a daily basis and are subject to breakage, in order to obtain the same quality as the Woloyta productions? F. Convertini has already demonstrated that grog could be used for very variable types of clays, which indicates that the nature of clay materials is not a systematic criterion, or at least not the only criterion, to explain the use of a temper (Convertini, 1998).

But, we still wish to go beyond the cultural choices related to the Neolithic products and to explore in depth the contribution of grog to the hardness, toughness, durability and resistance of finished products, because there is a dearth of studies regarding these aspects. If we take the case of Chauve-Souris Cave, for example, grog was only used for vases with high technical investment, i.e., those corresponding to Bell-Beaker and Italian norms. These very sought after vessels were also more subject to breakage than the others, as they were transported over long distances.

Thus ethnographic fieldwork can help us to:

- understand the choice of materials in relation to the natural environment and the constraints imposed on the potter;

- reconstruct the modifications induced by adding grog to the raw materials and the effects on the physical and mechanical properties of the finished products;

- better identify the grog in archaeological pottery, as it can be used in varied ways: fired pots, reused, broken and ground or in spontaneous fabrication, as is the case for some Oromo potters who make patties with recycled clay during the scraping stage of *ingera* dish fabrication. It is thus a way of contributing to analysis issues and simply of identifying this special type of inclusion (Whitbread, 1986; Cuomo Di Caprio and Vaughan, 2013). The characteristic features of the particular inclusions must be identified by observing thin sections. The ethnographic contribution will thus be essential to propose features to distinguish between various forms of grogs.

Fig. 18 – Woloyta social group at Goljoota. 1 and 2: shaping of a conical rough-out; 3: pinching of the rough-out; 4: shaping of an Ingera dish rough-out.
***Fig. 18** – Les Woloyta de Goljoota. 1 et 2 : ébauchage à partir d'une motte conique ; 3 : modelage et étirement à partir de la masse ; 4 : préformage du plat à Ingera.*

Back to issue 2: incidence of clay preparation on the 'quality' of the finished products

These ethnographic references also enable us to broach other issues, such as the transformation of clay materials. In archaeology, the correlation between the

Fig. 19 – Oromo social group at Qarsa. 1: processing a big coil manually; 2: pressing of the coil on the ground in order to make a flat coil; 3: winding the coil in a ring to shape a cylindrical rough-out; 4: shaping a Jabana (coffee pot) by stretching the coiled rough-out walls.
***Fig. 19** – Les Oromo de Goljoota. 1 : mise en forme d'un colombin ; 2 ; aplatissement du colombin par pression ; 3 : les deux extrémités du colombin sont jointes pour en faire un anneau qui servira à l'ébauchage ; 4 : préformage de la cafetière par étirement du colombin.*

investment involved in clay preparation and the quality of ceramics often stems from empirical observation.

As stated above, the long and numerous operations in the Woloyta *chaîne opératoire* may have repercussions on the quality of the finished products. Over the past ten years, research carried out by V. Roux and M.-A. Courty involving SEM thin section analyses has shown that it is possible to identify not only shaping techniques, but also the treatments applied to clay as part of rotating kinetic energy production (RKE: Roux and Courty, 1998 and in press). The aim of these works is to build up an identical reference collection for the markers left by these successive operations of transformation and homogenization of clay materials (crushing, maturing, purging, etc.) on products made without the use of a potter's wheel. For the moment, this reference collection is still non-existent. If we succeed in this mission, this will imply that we will be able to provide in-depth descriptions of the first stages of the *chaîne opératoire*, based on the thin section analysis of finished products. Otherwise these early stages are rarely accessible. Yet, ethnographic work conducted over the past 30 years has shown that these

first stages are among the most stable phases throughout time (in the same way as primary and secondary shaping stages), and can act as a fixing agent for the prevailing cultural model of a society. Archaeologists thus need to develop the necessary tools and protocols to gain access to these data.

The implementation of the reference collection relies on:

– the analysis of raw materials;

– identifying the different clay preparation operations observed in the field and their repercussions on the rest of the *chaîne opératoire*;

– the analysis of the transformed materials, in particular in order to identify characteristic markers of structural states and textural composition treatments of finished products (following the terms used by M.-A. Courty: Roux and Courty, in press).

But this domain also has other benefits for prehistoric archaeology. As mentioned earlier, both the Oromo and the Woloyta use clay mixes. The proportions of these clay mixes can vary depending on whether the season is dry or wet. For us, it is thus important to establish whether the same social group uses identical clays, or whether households can be identified on the basis of their clay preparation techniques (for example by using different proportions in their mixes, or depending on the amount of time spent on kneading, maturation, etc.). This is an important issue at the scale of an archaeological site. This could signify that it is possible to differentiate households on a Neolithic site, not only by studying rough out and preforming techniques, or the type of earth used, as shown by L. Gomart (Gomart, 2014), but also by documenting the procedures used for the preparation of materials.

TO CONCLUDE: OUR ARCHAEOMETRIC APPROACH

There are many ways of analysing paste and ceramic technology (for an overview see: Rice, 1987 or Albero Santacreu, 2014) and in order to provide answers to all these questions we have established a partnership with several researchers from the IRAMAT laboratory in Bordeaux (N. Cantin and A. Ben Amara), CRAHAM laboratory in Caen (A. Bocquet) and the Calvados Archaeological Services (X. Savary). These researchers will deal with the development of the archaeometric aspects of the study from 2016 onwards.

Generally, the archaeometric approach is applied to finished products and enables us to evaluate the nature and characteristics of the raw materials used. Two types of information are available, at both the environmental (location and nature of supply sources) and economical levels (choices for settlement territories, circulation and distribution of finished products). The identification of raw materials and the observation of fabrics at different scales also enable us to detect anthropological signatures. The goal is to infer the technical processes involved in the *chaîne opératoire*, i.e. the methods used by potters to obtain their clays (decantation, crushing, sieving, mixing, tempering, etc.), firing processes and surface treatments of vessels.

For example, firing techniques can be studied by assessing the porosity, loss of crystalline phases and the presence of newly formed minerals. Various analytical techniques can be used and the choice of a specific technique is dependent on the questions raised and available samples (Regert et al., 2006; Tite, 2008). Prior to mineralogical (petrography, X-ray diffraction, Raman spectrometry, etc.), or chemical analysis (X-ray fluorescence, ICP-AES, PIXE-PIGE, etc.), observations are performed at different scales (macroscopy, optical microscopy, radiography, etc.).

Geological databases are often used to link archaeometric data to environmental information and to identify technical processes. The characteristics of raw materials, their geological origin and knowledge of environment allow us to recognize the nature of non-plastic inclusions and the possible combining of them in the clays used to make pottery and to have evidence of the clay mixtures. The geological data is an advantage for understanding the first stage of the *chaîne opératoire* and for identifying the source of the raw material (local, regional or exogenous; Jorge et al., 2013). Experimentally, it is also possible to reconstruct samples using modern techniques to infer ceramic properties (porosity, hardness, colour) and document different stages of the *chaîne opératoire*. Since modern techniques (firing in electric kilns, use of raw materials, etc.) are obviously different from traditional techniques, conclusions based on archaeometric analyses remain hypothetical (Tite et al., 2001; Allegretta et al., 2015; Müller et al., 2015). Fortunately, ethnography provides reference data including the diversity of the *chaîne opératoire* with respect to environmental, social and economic contexts. The rarely used ethnography-archaeometry combination leads to a better characterisation of certain aspects of the *chaîne opératoire*, in particular the strategies used for selecting and mixing raw materials, controlling proportions of added inclusions or even anticipating the impact of paste preparation on firing or on the hardness and resistance of vessels (Arnold et al., 1991; Buxeda i Garrigos et al., 2003; Van Doosselaere, 2010; Cantin and Huysecom, 2012).

Actualist reference data is well-suited to inferring ceramic sophistication and proposing a new interpretation of the analytical data obtained from archaeological materials. Ethnographic observations, combined with analyses of materials at different stages of the *chaîne opératoire*, should invert the traditional archaeometric approach and reinforce the hypotheses advanced by specialists with regard to the following points:

- Preparation and mixing of raw materials and inclusion processes: Clay mixing and preparation before modelling and the mixing of clay and non-plastic inclusions are often difficult to identify even with petrographic analysis or theoretical models. This stage of the *chaîne opératoire*, which is not always identified, can lead to misinterpretations concerning technical production processes and economic networks. In such cases, actualist references will make it possible to characterise the different *savoir-faire* of potters by analysing the raw materials used in the paste. The final goal is to emphasise the petrographic, chemical, textural and porosimetrical criteria relevant to the archaeological materials (Neff et al., 1988; Schwedt and Mommsen, 2004).
- Technical properties of ceramics: The consequences of mechanical resistance on the use and function of finished products depend on the characteristics and treatment of the clay, but also on shaping and firing techniques. These parameters must also be studied from an ethnological viewpoint (Tite et al., 2001).
- Firing techniques: Parameters such as the nature and preparation of raw materials and the thickness of vessel walls influence firing techniques (duration, temperature, atmosphere, etc.). These effects could be better assessed with enhanced knowledge of the thermal protocols used, in particular the evolution of temperature during firing, or several firing phases, and the ability to control the temperature.
- Finishing stages: The use of vegetal brew at the end of firing is unknown or not considered in the archaeometric approach. Methods to identify this type of finish on recently manufactured, used or buried ceramics must be investigated as part of this research program.
- The different usages: The impact of the use of ceramics on chemical and structural analyses is a topical issue for archaeologists. Comparative analyses before and after use, and even after the burial of vessels, would be relevant.

The protocol followed as part of this combined ethnographic–archaeometric project consists, first of all, of sampling products at different stages of the *chaîne opératoire* for both the Woloyta and Oromo groups, and secondly, in an archaeometric approach based on observation methods (petrography, etc.) and basic chemical analyses. During the first stage, a preliminary study will

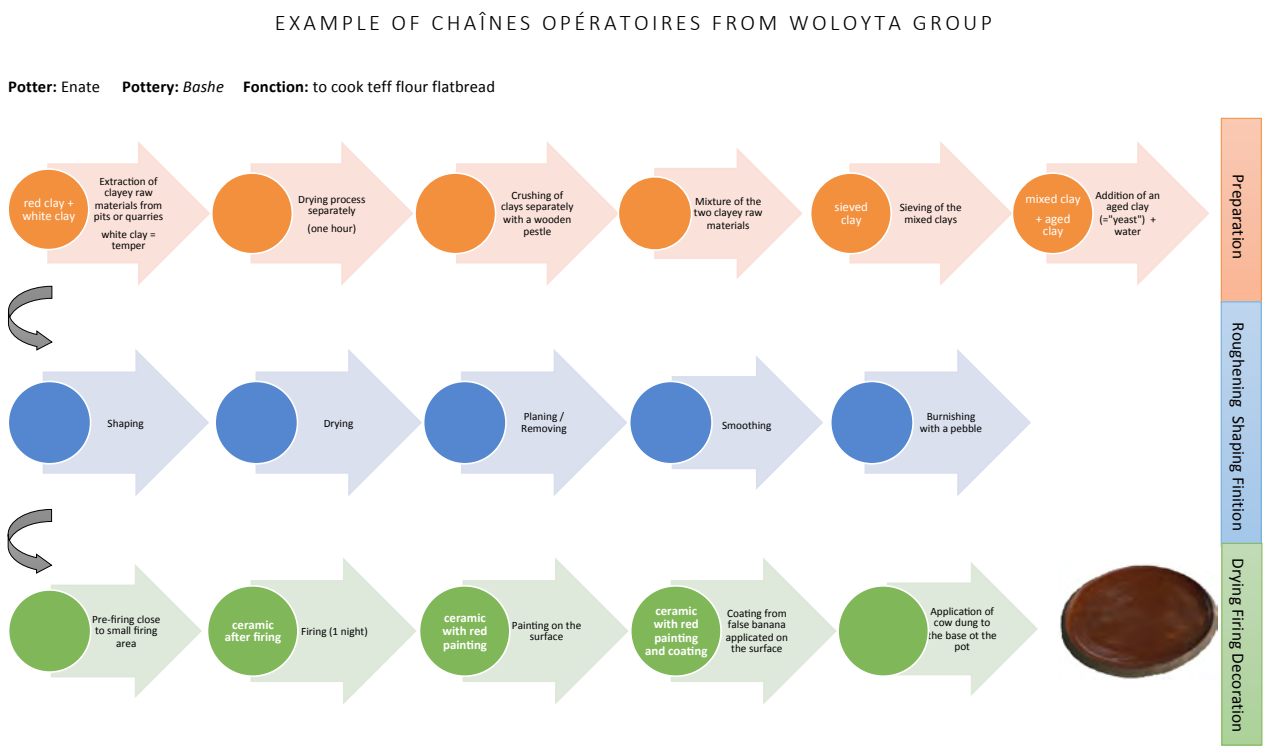

Fig. 20 – Example of the sampling process used for the archaeometric approach. The first samples analysed are presented within the circles. The same proccess of sampling was applied to 9 *chaînes opératoires* (including 2 potters from the Woloyta group and 4 potters from the Oromo group).

***Fig. 20** – Exemple de l'échantillonnage appliqué dans le cadre de l'approche archéométrique. Les premiers échantillons analysés sont mentionnés dans les cercles. Le même procédé a été appliqué à 9 chaînes opératoires de fabrication (comprenant 2 potières du groupe Woloyta et 4 potières du groupe Oromo).*

be carried out on a restricted sample (one or two potters per group) focusing on clay mixes (raw materials, transformed pastes, tempers, non-fired and fired mixes; fig. 20). During the second stage, the variability of practices and their consequences on the *chaînes opératoires* (firing, finishing, use and burial) will be considered through the study of additional potters using refined analysis. Through access to raw materials and finished products and by comparing our questions regarding the archaeological series and initiating research in material science, we hope to formalize the criteria leading to the objective characterization of certain aspects of our ceramic assemblages using well-defined parameters.

In conclusion, we wish to add that these actualist reference collections are kept in the archaeological TRACES laboratory in Toulouse, which is part of the ArchéoSciences platform. These collections are used to train students and can be consulted by all the TRACES teams in order to help them with the description, analysis and interpretation of remains.

NOTES

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