# Asyèt yo, Ollas, and Vasijas: situating pottery production in the circum-Caribbean through a technological perspective

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# CHAPTER 1

## Dissertation Goals and Overview

This research explores the role of ceramic production, use and consumption in the daily life of people from the precolonial, colonial, and post-colonial circum-Caribbean regions. Ceramic productions are analyzed in detail and situated in their social and historical context. The results contribute to two important aspects in archaeology related to ceramic manufacture and social studies. The first aspect focuses on developing a solid scientific approach to reconstruct key technological phases in the ceramic production, with an emphasis on the origin of the raw materials, use and preparation of the vessels. A detailed analysis develops around the technological knowledge applied to achieve certain qualitative and aesthetical characteristics that distinguish and make unique each ceramic tradition. Petrographic and chemical methods are applied in this regard.



The second aspect of this research is the translation of scientific results into an archaeological narrative. This goal is achieved by focusing attention on situating ceramic production in the social context of daily practice and shared cultural knowledge. In this way, I bind two fundamental methodologies that have got a leading role in archaeology and anthropology in the past decades, the "community of practice" (Lave & Wenger, 1991) model and the *chaîne opératoire* or technological approach (*sensu* Leroi-Gourhan 1973; Creswell 1976; Lemonnier, 1986; Dobres and Hoffman 1994; Dobres 2000; Roux, 2016, 2019a). These two theoretical models complement each other and allow us to shed light on large-scale cultural process by tackling micro-scale events at the community level.

With these ideas in mind, this dissertation is structured around this main research question:

How can the combination of archaeometric analysis of ceramic materials be combined with *chaîne opératoire* and communities of practice model to more holistically investigate archaeological assemblages in the circum-Caribbean region?

A sub-question is - how does the combination of these approaches differ according to time period, ceramic materials and region?

To answer this leading question the dissertation develops along four case studies. Each individual chapter has been published in peer-reviewed journal and can stand alone, as an independent research. They have different research questions, tailored with a precise methodology and provide autonomous answers. The results offer a fine-grained view of the circum-Caribbean regions, investigating micro-scale events through a ceramic manufacture perspective. Although, if at first reading the outcomes of each chapter seem to be confined to the single case study, the entire dissertation can be seen as a wide analytical umbrella that encompasses new technological and methodological insights. The results bring new important socio-cultural knowledge of past populations and are applied in varying historical moments of the Caribbean archipelago during the Ceramic Age (BCE 600-1500 CE), at the edge of the Haitian Revolution (*ca.* 1804 CE), and in precolonial Central Nicaragua (400-1250 CE). I argue in the following chapters that the use of a technological approach to material culture, together with a focus on daily practice, is a constructive means of analysis for questioning and re-thinking some basic assumptions towards a communities' production, use and trade of earthenware throughout different historical periods.

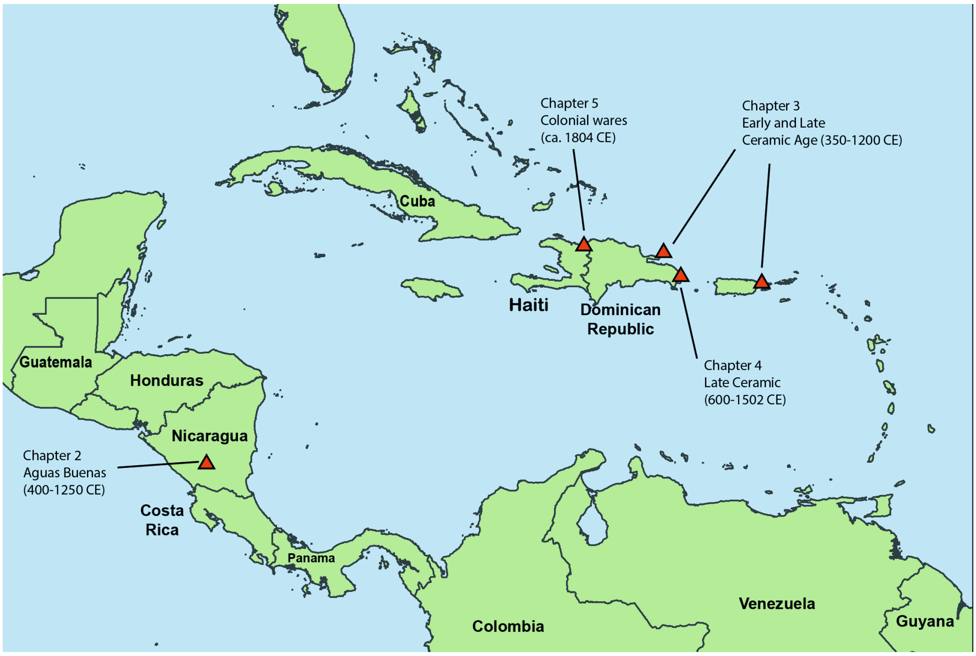


**Figure 1.** The location of each case study presented in the dissertation is indicated on the map with the historical context.

## 1.1. Objectives and aims

In the circum-Caribbean, a region characterized by a tropical climate, organic remains tend to deteriorate quickly leaving archaeologists with a restricted amount of material culture to study ancient populations. Due to their resistance to weathering, ceramic materials are one of the most ubiquitous remains found in the region, and since the beginning of archaeological research have had a prominent role in the understanding of past socio-cultural organization (*e.g.*, Boomert, 1985; Hofman, 1993; Lothrop, 1926; Norweb, 1962; Rouse, 1939, 1948). This dissertation aims to bring insights on potential sources of socio-cultural information that are embedded in the ceramic manufacturing process. The key aspect is to center the research through a lens of technology and daily practice, by examining the manufacturing process as a community, and day to day actions from the collection of the natural resources to the shaping, decorating and firing of the pottery.

With the different social and technological aspects touched upon in the dissertation, I reflect on the human-landscape relationship and how we can recognize and integrate the role of the environment into the archaeological narrative. Can we discuss the action of raw material procurement as being part of a community's knowledge and shared practice? To answer these questions, I examine the case-study of the monumental site of *Aguas Buenas* (400-1250 CE) in central Nicaragua and the surrounding environment. To contextualize this monumental site within the area and with the immediate archaeological sites, I question where the specific raw materials (*e.g.,* clay outcrops) used for producing the ceramics deposited at the site were located. Were vessels manufactured with clays of specific qualities? Where were the clay outcrops located, and how do we relate their position to the communities that populated the area nearby *Aguas Buenas* for centuries? Were the locations, dimensions and qualities of the clay sources shared knowledge within different communities?

A second series of questions focused on the preparation of the raw clay materials and practices of fashioning the vessels in the Greater Antilles during the Ceramic Age (600 BCE-1500 CE). I center the research around the ceramic manufacturing process. How can we identify manufacturing traditions, and how do we relate manufacturing traditions to cultural boundaries? Can we recognize intra-site and inter-site differences within ceramic manufacturing traditions? How do we understand the presence of locally produced versus non-locally produced pottery within an archaeological assemblage? Were there changes in the manufacturing process that can be synchronically and diachronically inferred? To respond to these questions, I analyzed in detail the ceramic assemblage of two sites (*El Cabo* and *El Frances*) in the Dominican Republic and link my data with other contemporaneous sites in other parts of the Dominican Republic, and also in Puerto Rico and Vieques islands.

The third study explores an 18$^{th}$ century glazed ware production, known as *taches noires*, manufactured in Albissola (Italy). *Taches noires* ceramics were widely copied in Spain and France and exported *en masse* throughout Europe and in the Americas. Their wide export means this type of glazed ware has the potential to be used as a chronological marker, as there are detailed records of the production recipes, and of imitations products. Questions developed around the idea of applying a technological approach also to highly standardized ceramics. Were recipes changed when new workshops were opened, and replicas were made? Can we identify technological changes in the recipes of the glaze, decoration and body through the years?

All these questions are answered in-depth in the following chapters and presented with a methodology that can be used as a source of inspiration for further studies, and to reconsider previously published data. The follow section describes the range of methodological approaches that is available to archaeologists. A comprehensive and informed body of literature is presented to introduce each section of the dissertation and how to build a scientific approach tailored to each research question posed above and to propose more avenues for studying ceramic manufactures.

## 1.2. Theoretical kick off: a technological approach to ceramic material and its social context

Interpretations of material culture have been the basis for writing narratives about the past with the aim of understanding cultural variability and social identity. In archaeology the identification of variation in material culture, such as craft production, morphology, styles and consumption, across space and time was, and still is, an important variable to investigate population dispersals and social organization such as migrations activities, political changes, and social and trade connections (Binford, 1965; Dobres & Hoffman, 1994; Schiffer & Skibo, 1997; Stark, 1999). The outcomes of these interpretations aim to draw socio-cultural boundaries on maps, where areas are created to help us to organize populations into cultural groups synchronically and diachronically.

In the circum-Caribbean region archaeologists have long been focused on answering socio-cultural questions through the analysis of material culture styles and morphologies. Patterning of ceramic typologies were the major drivers to comprehend macro-scale social relationship, such as human expansions, migrations and group affiliations. Variation in aesthetical and morphological aspects were decisive to build chronocultural typologies and situate culture and societies (Boomert, 1985, 2000, 2007; Chanlatte Baik, 1981, 2005; Hofman, 1993; Hofman and Bright, 2010; Hofman and Ulloa Hung, 2008; Keegan, 2000; Keegan and Hofman, 2017; Persons, 2019; Rouse, 1939, 1948, 1960, 1986). Artefacts were labelled following stylistic traits and organized in geographically localized categories that aim to establish relationships between ceramic assemblages and archaeological sites, with aim of tracing cultural boundaries between communities or describe shared social aspects between cultural groups (Curet, 2014; Pestle et al., 2013; Rouse, 1960, 1986). Although, this methodology provides a clear picture on a broad scale of the social organization in the studied region, the drawbacks are that it produces biased descriptions at the micro-scale level of community boundedness and social connection, where visual and functional aspects of material culture are indications of cultural groups, and used to create chronological series.

In this research, I challenge this typological classification by moving the concept of technology and culture to the center of the study of ceramics, and I consider ceramic typologies (morphological aspects) as one of the variables that resides in the ceramic manufacturing process. The way clay materials are modified and fashioned involved particular preparation of the clay paste, movements of the hands, and in some cases the use of certain tools to shape the object in the desire formed. Whether some of those actions can be understood by the observation of the final appearance of the object, some are not obvious if you are not acquainted with the forming procedure that potters have followed. On the one hand, this aspect leads to the idea that reproducing the ceramic manufacturing process only based on the observation of the final appearance of the object requires a direct assistance from the potters that created the item. On the other hand, the imitation of the stylistic and morphological features of ceramic vessels can be performed without direct assistance but only through visual observation.

I highlight the complexities of the relationship between people and material culture. Both crafts and people "have mutual biographies which unfold in culturally specific ways" (Gosden & Marshall, 1999). Culture can be defined as a shared-way-of-doing, a web of social practices in a daily routinization of actions that binds people and objects together, and that is the means by which individuals identify within each other as a community or as part of a shared network (*sensu* Dobres & Hoffman, 1994; Hendon, 2008, 2015; Joyce, Hendon and Lopiparo, 2015; Lave & Wenger, 1991; Roddick & Stahl, eds. 2016). When studying material culture, we must keep in mind that what we are looking at is the result of previous human actions embedded in meaningful and socially negotiated sets of material and non-material-based practices (Dobres & Hoffman, 1994; Joyce and Lopiparo 2005; Pauketat and Alt 2005). An expression of a cultural behavior of someone, who like us nowadays, walked on the same land, saw similar landscapes, interacted with their communities, built social and cultural agency with the environment and other people, searched for natural resources, cooked, ate, and feasted.



### 1.2.1 The community of practice's model

Based on the work of Lave and Wenger's (1991) *Situated Learning: Legitimate Peripheral Participation*, archaeologists have directed attention to examining the learning process as a key phase in the development and transmission of culture (Dobres & Hoffman, 1994; Dobres, 2000; Gosselain & Livingstone Smith, 2005; Gosselain, 2000, 2008; Pauketat & Alt, 2005; Roddick, 2009, 2013; Roddick & Stahl, 2016; Roux, 2015, 2019a; Sassaman, 2016). This work underlines the fundamental role of learning during daily life activities as a proxy in forming and preserving cultural identity. At the individual level, there is a direct movement of knowledge from person to person, from a tutor and a learner, which partakes in producing and reproducing a way-of-doing a practice, a shared action (Dietler & Herbich, 1998). The sense of community and belonging to a cultural group is expressed by the awareness of sharing an information or an action, a cultural practice that identifies you within your social world and distinguishes you from others. This sense of cultural belonging can be explored at different social levels, from a small community scale to a more broader population level (*sensu* Bourdieu, 1977, 1984; Joyce and Lopiparo 2005). Imagine something you have learned from your parents or from your close relatives, for instance a particular food recipe that you loved when you were a child. Let's imagine an *Italian lasagna* (obviously, I pick this example). Your parents or your relatives are your tutors in this situation and have instructed you during the preparation of the food and they taught you each step of the procedure to achieve the intended dish. Once you completely mastered the process, it means you have understood all the phases needed to complete a certain final product, a dish that meets your and their expectations. This specific set of information is the result of a direct knowledge transmission of a way-of-doing from one generation to another, where the tutoring process played a key part. Probably, if you will ever ask someone if they know how to cook *lasagna*, you will find out that, perhaps they do know a similar recipe and working procedure, probably similar but different when it comes to the detailed steps. The differences between the two ways of doing the same action, in this case the two recipes, is what makes you identify yourself with your food's recipe and your family's tradition, distinguished from other family's knowledge. The base idea is that at the end of the apprentice process the learners have acquired a specific way of proceeding and visualizing the way-of-doing that they identify with it, and they will hardly change or adapt to a different technique (*sensu* Lave & Wenger, 1991).

This was just a simple example; however, it helps to understand the connection between knowledge, learning and identity. Technical practices are a process of inheritances which can occur either at the single, individual scale or at broader community level. Sharing practices can be seen within a multitude of social actions, such as producing pottery or stone tools, manufacturing clothes, and all other actions embedded in the material and non-material worlds (Clark, 2008; Costin, 1991, 2008; Dobres, 1995; Dobres & Hoffman, 1994; Hendon, 2006, 2008, 2015; Herbich, 1987; Joyce, Hendon and Lopiparo, 2015; Pauketat & Alt, 2005; Roddick, 2009, 2015; Sassaman, 2016).

A group of individuals sharing an action is seen as a community of practitioners, as a group of people that carry out the same action driven by shared learning. At the collective level, the transmission of knowledge can occur between individuals of separate communities that are tied by a social action. This creates networks of communities of practices, where some individuals of different groups are linked by a common practice (Roddick & Stahl, eds. 2016; Joyce 2020; Joyce, Hendon and Lopiparo, 2015). The identification of these shared networks of social practices allows us to determine the extension of the social and cultural ties and tracing cultural networks. Therefore, examining technological behaviors (the ways of working materials) can provide a method to investigate how the diffusion of ideas, styles and technologies were embodied on a sociological level and into manufacturing traditions (*sensu* Costin, 2008; Creswell, 1983; Dietler & Herbich, 1998; Dobres, 1995; Dobres, 2000; Roux, 2003, 2013, 2015, 2019a, 2019b).

### 1.2.2 The chaîne opératoire approach

Following the community of practices and the transmission of knowledge models, a technological approach to material culture is revealed to be a solid and valuable way to glean insights on the social space behind the production of artefacts (Dobres & Hoffman, 1994; Lemonnier, 1986; Leroi-Gourhan, 1971). The past decades have seen articulate discussions in archaeology and anthropology on how to reach a comprehensive understanding of the concepts of identity, cultural expression and cultural transmission that are visible through material culture patterns (Dobres, 1995; Dobres & Hoffman, 1994;Dobres, 2000; Gosselain, 2000, 2016; Joyce, 2020; Roux, 2013, 2015; Roux & Manzo, 2018). This discussion brought up important aspects to the interpretation of the material cultural, and begun to consider the concept of *technology*, seen as the sequence of technical operations that lie behind the manufacture of artefacts as a crucial source of cultural information to shed light on human behavior, identities and knowledge transmission between individuals (Gosselain, 2018; Roux, 2019b).



Ethno-anthropological studies have demonstrated how crafts, crafting practices and crafters are embedded within a complex and dynamic system of social relationships (Crown, 2007; Gandon, Roux and Coyle, 2014; Gosselain, 1998, 2000, 2018; Gosselain & Livingstone Smith, 2005; Haour et al., 2010; Livingstone Smith, 2000, 2010a, 2010b; Tehrani & Collard, 2009; Tehrani & Riede, 2008). Ceramics that yield similar shape, function or style can be shaped using several different technical methodologies, which vary from one community to another (Gelbert, 2003). Technological behaviors, intended as crafting practices, are not randomly adopted, they are the result of a learning process, which is situated in a particular social and dynamic dimension. These ethno-anthropological studies highlight the parallel between technological behaviors and social groups.

Going back to the community of practice model, people act on the basis of what they have experienced and learnt. Manufacturing ceramics requires knowledge, a way of working the clay that must be learned from someone. The *chaîne opératoire* approach, intended as the study of the entire production process including all the series of technical operations that transform a raw material into a finished product (Creswell, 1976), was designed to tackle the cultural dimension of material cultural and to schematically organize the technical phases involved in the manufacturing process, giving us a tool to move beyond the final aesthetical aspects of material culture and to explore in detail the social and cultural context it was produced in. As potters are integrated into a social system, their technological behavior is the outcome of the cultural world to which they are exposed (Roux, 2016; Thér, 2020).

The ceramic manufacturing process includes a series of steps that are common to every production and begins with the collection of the raw materials and preparation, continues with the shaping of the clay mass when the final form of the vessel is decided, followed by finishing operations and surface treatments that aim to adjust the external surface prior to decoration and final firing. This series of steps is quite commonly standardized for each ceramic production, and each individual phase is the result of a transmission of knowledge that occurs between individuals and through generations of the same social groups or through social and exchange networks (Roux 2019a, 2019b).

The complexity and the potential of the *chaîne opératoire* lies in the extensive variability of actions and materials that potters can use to achieve a certain final product. The advancement of ethnographic and experimental research on ceramic production provides a clearer understanding of the manufacturing process and its social dimensions (Gosselain & Livingstone Smith, 2005; Gosselain, 2000, 2008; Hofman et al., 2008; Hofman & Jacobs, 2004; Roux, 2019b). The creation of reference collections developed together with skilled potters coupled with archaeometric analyses allow us to get a better grasp on the different technical behaviors that could be involved in the production of pottery. Macro and micro trace analyses with the use of a stereomicroscope provides an overview of the gestures and objects used during the shaping and decoration process (Roux, 2016, 2019b), while archaeometric analysis can elucidate on the provenance of the raw materials, preparation of the paste, and addition of temper materials, firing procedures and other details of the decoration process (e.g. glazes recipes) (Degryse & Braekmans, 2013; Quinn, 2013). Therefore, we can review past operational sequences, understanding how different manufacture phases were interconnected and the extent of their variability and frequency, as well as if specific gesture and materials were linked to particular end products or social contexts (Santacreu 2014, 2017).

The introduction of this combined methodological approach is relevant in the circum-Caribbean region, where rarely entire manufacturing process were studied (see Donner, 2020; Graves, 2020; Hofman et al., 2008; Hofman & Jacobs, 2001; Hofman & Jacobs, 2004; Ulloa Hung, 2014) and more commonly archaeometric research is presented (*e.g.*, Curet 1997; Crock et al. 2008; Ting et al. 2016; Lawrence, Fitzpatrick and Giovas 2021; Stienaers et al. 2020; Descantes, Speakman and Glascock,, 2008; Scott et al., 2018). Through the analysis of these technical choices and the materials used we can address aspects of pottery manufacturing that move beyond the objects and their morphologies. This methodology allows us to explore the distribution of technical traditions on a diachronic perspective by understanding the transmission through generations across time, and on a synchronous scale by observing the distribution of technical traditions on a geographic level. Results produce a detailed understanding of micro-scale processes that occur at the community-based level and can be used to portray large-scale events. The extension of shared technological traits can tell us much about the level of social interactions of individuals from different settlements (Joyce, Hendon and Lopiparo 2015; Roux 2019b), how social boundaries extend, and how they evolved and changed through time. Social spaces are observed not as a fixed container with a delimited area but as a dynamic set of networks of practitioners free from geographical constrictions.

### 1.2.3. Understanding the operational sequence

In this section I briefly introduce and describe each manufacturing phase to provide an overview of the production process and later I present the analytical methodology to tackle each aspect of the *chaîne opératoire*. Generally, the most important and common phases in ceramic production are:

1. Clay procurement and preparation
2. Fashioning
    a. roughing-out
    b. pre-forming
3. Finishing
4. Surface treatments
5. Decoration
6. Drying
7. Firing



### 1. Clay procurement and preparation

The procurement of raw materials and their preparation into a workable paste that can be modelled and fired are two fundamental steps to begin the manufacturing process. Clay outcrops are commonly found in the landscape either as surface or subsurface deposits. The parent materials vary from rock outcrops, sedimentations of bioclastic organism and organic compounds that, through natural transformation such as waterborne and/or aeolian events, are transported and deposits across the environment. Usually clay deposits accumulate along rivers, depressions, alluvial flats and other natural sedimentary traps (Roux 2019b:20). Clay outcrops are not always easy to spot and may be hide under several meters of layers of soil. A good understanding of the environment and of the materials needed for a specific product is central to the clay extraction process (Stark, 2003 and reference therein).

Several studies on clay procurement practices have highlighted how different natural and social constrictions can drive people through the selection of clay outcrops: (1) shortest distance to the site, (2) environmental changes through the year, for instance, the rainy or dry seasons that open or close natural passage or (3) habitual and spiritual reasons that go beyond the more practical, economic reason for exploitation to a more transcendental way of understanding the environment (Arnold, 1985, 1989; Livingstone Smith 2000; Gosselain and Livingstone Smith 2005).

Raw materials can be ready to use as they naturally appear when they present a good malleability, ductility and capacity to harden. However, often that is not the case and raw materials do not match the needed characteristics. Thus, potters need to add some constituents to improve these qualities and different pastes can be prepared by the same raw materials (Santancreu 2014:67-75). Clay preparation practices involve modifying the argillaceous components and changing the texture and the chemical and mineralogical composition of the raw materials. Potters increase the workability being able to shape the clay pastes in the intended form and to improve their drying and firing resistance. Different paste can be prepared for instance, if the containers are manufactured for cooking and need a high thermal shock resistance because of heating or for serving beverages and foods.

Preparation practices separate in two main groups: modification and homogenization of clay pastes. Modification aims to reduce or improve the granularity of the sediments. The sorting process can be done manually by removing the coarser inclusions by hand, with a sieve or with a levigation process. During the levigation process clays are deposited in water for the removal of coarse fractions and to improve the plasticity of the paste. In other cases, inclusions can be added, or clays can be mixed to improve plasticity or other chemical and physical characteristics of the paste. Temper materials are inclusions, either organic or inorganic that are intentionally added to the paste.

The homogenization of the pastes consists in mixing, wedging, kneading and maturing the clays. These steps are important for a good mixing of pastes and the incorporation of the added tempers and the reduction of pores (Roux 2019a: 16-40).

## 2. Fashioning

The fashioning phase includes all the steps necessary to create from clay pastes different parts of the vessel such as the base, the body, the neck and rim. By the end of this process the paste is shaped into the desired form. This phase entails two different stages: *roughing out*, when a hollow form without the final geometrical shape is created and the *pre-forming*, when the final volume and shape of the object is completely formed, though without the finishing details (Roux 2019a). These two stages involve several technological steps, which can be integrated in different operational sequences or *chaînes opératoires*. Figure 2 summarizes both *roughing out* and *pre-forming* and their variability. The interpretation of each step is important to understand technological behaviors as both steps are considered the core of the manufacturing process in which potters build their work-identity. Given the importance, is also the most stable technological expression transmitted by potters (Gosselain and Livingstone smith 2005, Roux 2019a; Thér 2020). The main variables to consider in these stages are five physical options: the source of energy, the elementary volume, the forces, the type of pressure, and the degree of hygrometry (Roux 2016, 2019a)[1].

Generally, the *roughing out* is divided in two main fashioning way of working: (1) without rotative kinetic energy (RKE) and (2) with rotative kinetic energy. The first group of techniques is further subdivided into two families, one that involves the use of assembled elements such as coiling and slabs methods, and the other that includes the use of the entire clay mass that is shaped on mould, by a hammer or with hands. The second group that uses RKE is what is considered wheel-throwing. This group is subdivided into several families according to the use of entire clay mass or assembled elements (e.g. coiling) that are later shaped with rotative energy.

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1. For a detailed description of the entire process, please referred to Valentine Roux, Ceramics and Society (2019a).

The *pre-forming* stage contains different technical approaches that can be divided according to the hygrometry of the clay paste into two general families: one that uses wet clay and one that uses a drier consistent state of paste and is denominated as leather hard clay. These two families are subdivided into different technical approaches following the use of different active tools that are handled by potters (e.g. hammer, wooden scraper, stone pusher, paddles), passive tools (e.g. working plan and forming support) and use different types of pressure, such as percussion with hand, hammer and paddle or in a leather hard state, shaving with a sharp tool and pushing with a hard object (e.g. pebble or wood) to progressively thin and uniform the surface.



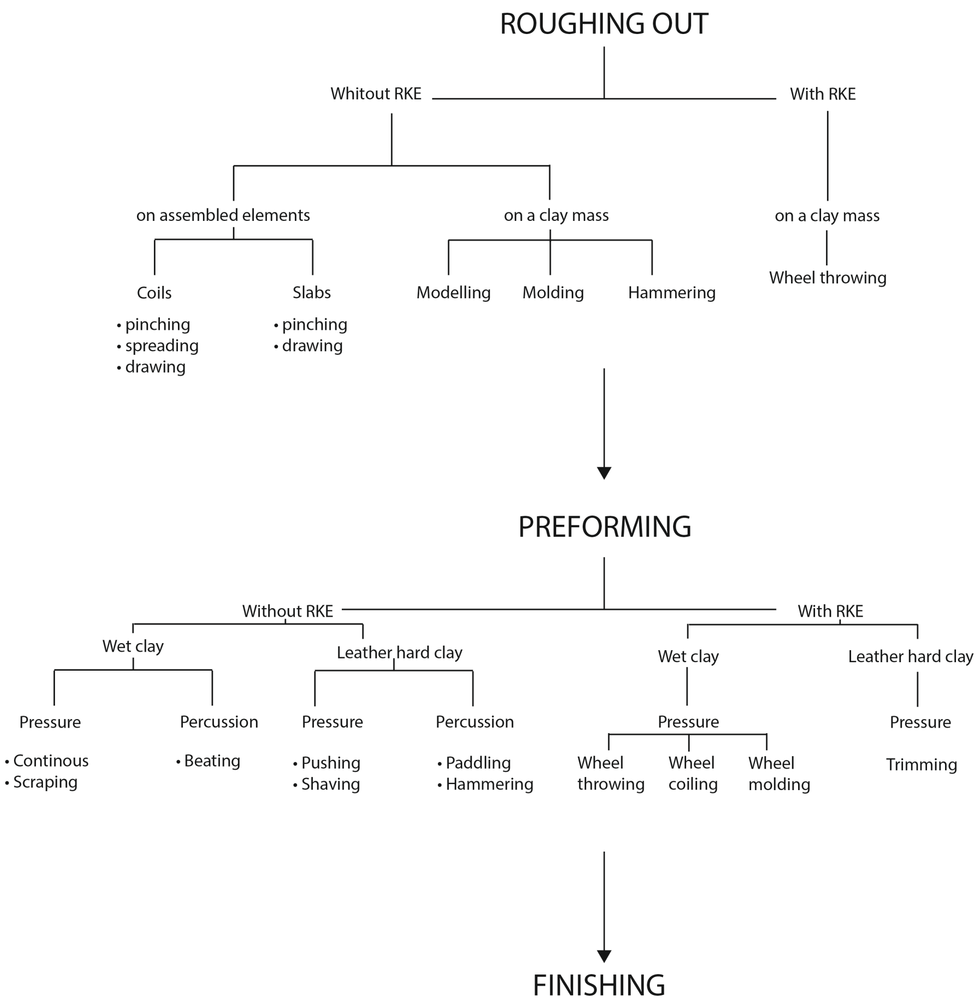


**Figure 2** Summary of the different operational sequence that can be applied in the roughing-out and preforming stage. Adapted by Roux (2019a).

### 3. Finishing

Finishing operations are performed after *pre-forming* with the aim of homogenization of the superficial layers of the paste. Finishing can be grouped in different techniques following the hygrometry of the paste. Three main methods are identified: smoothing on wet clay, smoothing on leather hard paste, based on continuous (wheel-throwing) or discontinuous force and brushing on leather hard paste with a tool that can be re-hydrated or dry.

### 4. Surface Treatments

Surface Treatments are operations that modify the internal and external surface of vessels and can be carried out on dry pastes and on fired pastes. They divided in two main groups, one by friction actions and one by coating operations. Friction methods consist in (1) softening, which is rubbing a leather hard paste with a moist hard tool to remove the imperfection and fill in the holes and lines of the surface layer, (2) burnishing, which consists of rubbing a leather hard paste with a hard dry tool to produce a shiny and compact surface. Coating operations include all the actions that aim to coat the internal and external layers of the vessels. It can be done with clay materials, silica, organic materials and graphite. The coating with clay materials consists in adding to the surface a very fine clayish materials obtained through a levigation process, producing a clay slurry and/or a slip that covers the vessel's surface. The glaze is a coating method achieved by firing silica materials mixed with a flux (*e.g.* lead oxide, alkaline flux or boron oxide) to lower down the melting temperature. The result is a vitreous layer that can have both the aim of achieving an impermeable state of the paste and to add decoration layers. Both glaze and slip can be produced in different colors according to the need of the potters.

### 5. Decoration

Decorative operations have both ornamental and sometimes functional purposes. They involve painting the surface, impressed and relief techniques. Painting is the most common technique and can be performed with a mixture of different mineral and organic materials before or after firing. Impressed and relief techniques consist of adding or removing part of the surface, they are classified according to the type of forces, gestures and degree of hygrometry of the paste. Different tools can be used to make impressions (rolled, stamped and paddled), incisions (such as punctuations, lines, pivoting and scraping), excisions and the application of separate elements or modelled decorations.

### 6. Drying and Firing

Drying is an important step to progressively prepare the object for the firing event. It reduces the possibility of cracks and fissure and deformation during firing. The duration can take some days and varies depending on the shape and size of the object. Firing is the operation that changes the physicochemical properties of the clay paste transforming it from a plastic substance into a solid and hard material. Clays are subjected to several changes that are linked to the temperature achieved during firing. In general, the average firing temperature to produce an irreversible change in clay is higher than 400 °C and a complete firing of clay objects is achieved around 650-700 °C. However, higher temperatures can be reached, for instance, to produce porcelain the kiln must be heated between 1200 and 1400 °C.

Firing practices require important knowledge because the maintaining of certain parameters during the event has a strong repercussion on the structure and color of the finished earthenware. Generally, two main firing techniques are known, and classified as open firing when the objects are in direct contact with the fuel, and enclosed firing (e.g. kiln or furnace), where there is not a direct contact with the fuel and a built structure contains the clay objects and the surrounding atmosphere raises in temperature. Firing atmospheres play a key role in the process. On the one hand, an oxidizing atmosphere occurs when free oxygen is constantly available during this phase and it favors the oxidation of the organic and iron components present in the clay pastes, usually generating reddish or beige colors depending on the proportions of iron or calcareous components in the paste. On the other hand, a reducing atmosphere is a combustion event that occurs with a lack of free oxygen and is usually prepared in an enclosed place where the air is blocked from flowing. Pottery fired in reduced atmosphere presents a darker color, from a greyish to black paste.

### 1.2.4. Archaeometric analysis

Archaeometric analysis has been an important factor in archaeological studies. Archaeological ceramics production relies on the use of clay-rich materials, which are modified, shaped and fired. In the previous section, we have seen how it is important to understand different step of the manufacturing process to shed light on technological behaviors. In this sense, archaeologists carry out macro and microscopic analysis to comprehend traces left by potters on the ceramic body during the manufacturing phases (fashioning, finishing and surface treatments). The aim is to identify bodily gestures, source of force, shaping techniques and use of different tools. Archaeometric analysis are a complementary approach to ceramic technological studies and offers focus on the clay procurement and preparation practices, glaze recipes and firing strategies. Normally they provide detailed insights in the clay-rich materials and the chemical and physical transformation that occurred during the production process. The range of observations vary from the annotations of the general paste structure, a detailed microscopic analysis of the mineralogical components to the scientific characterization of the chemical signatures of the pastes (Degryse & Braekmans, 2013).

Archaeometric analysis can be divided in geochemical and mineralogical analysis. Geochemical methods encompass several techniques that aim to understand the elemental compositions of the materials contained in the ceramic paste, paint and glazes. The scientific assumption behind chemical analysis is the ''provenance postulate'', which relies on the fact that there is a measurable difference in the chemical composition between materials from different geographical and geological origins employed in the production of ceramics (Weigand et al., 1977). Therefore, based on the provenance postulate, within a given ceramic assemblage, ceramics manufactured with the same clay yield a similar chemical composition that allows us to spot (imported) materials prepared with other clay sources.

In the past decades, chemical analysis has become a well-established method to understand the provenance of clay constituents, especially when chemical data are compared to reference materials which can be either locally manufactured ceramic assemblages or a collection of local sediments (Casale et al., 2020; Finlay et al., 2012; Hunt & Speakman, 2015; Neyt et al., 2012; Sharratt et al., 2009). The geochemical techniques that are widely applied in archaeometric studies include instrumental neutron activation analysis (INAA), X-ray fluorescence (XRF), inductively coupled plasma mass spectrometry (ICP-MS) and optical emission spectroscopy (ICP-OES) (*e.g.* Degryse & Braekmans, 2013; Gehres & Querré, 2018; Goren et al., 2011; Mommsen et al., 1992; Montana et al., 2003; Stienaers et al., 2020; Stoner, 2016; Wagner et al., 2012; Walton & Tite, 2010). These techniques have proved to be a reliable source of information for the characterization of the elemental compositions of the pastes and have a long history in archaeological studies. In the circum-Caribbean area the application of geochemical data has been increasingly used to answer provenance questions both in the pre-colonial and colonial time (Crock et al., 2008; Dennet, 2016; Descantes, Speakman and Glascock, 2008; Fitzpatrick et al., 2008; Scott et al., 2018; Siegel et al., 2008; Stienaers et al., 2020)

Ceramic pastes, however, can have a wide variability in structure and size of their inclusions. The minerals and other types of components (*e.g.*, organic tempers) that are present in the pastes can vary from being fine to coarse grained. The variation of the size of the grains, as well as the presence of temper inclusions that were intentionally added, tend to have an influence on the final chemical composition of the paste. Therefore, while in the case of homogeneous and fine pastes these previously mentioned geochemical techniques (INAA, XRF, ICP-MS and ICP-OES) are suitable for chemical characterization of the clay paste, when dealing with irregular and coarse grains paste, electron microprobe analysis (EPMA) and scanning electronic microscope with energy dispersive spectroscopy (SEM-EDS) can provide a more suitable resolution (Degryse & Braekmans, 2013). EPMA and SEM-EDS have the potential of zooming directly on the ceramic body and selecting specific areas of interest or individual spot that we want to analyse. For instance, SEM-EDS allows us on a radial cross-section of a ceramic body to select or avoid specific tempering materials (*e.g.*, a particular type of mineral or rock inclusions) at the advantage of the more fine component of the paste, and to identify the composition and the thickness of the glaze or slip layers that were applied on the ceramic body (see Chapter 5) (di Febo et al., 2018).

Mineralogical analysis offers a detailed view of the mineralogical phases that are critical to interpret the geochemical data. X-ray diffraction (XRD) and petrographic analysis by means of thin section observations with polarizing light microscope are two robust techniques for mineralogical characterization. XRD may be useful to identify firing temperatures of fine ceramic paste. Minerals tend to modify when they are exposed to high firing temperature, and that is what happen when clays sinter above 400-500 °C and transform their material state irreversibly. Minerals are sensitive to temperature changes and due to its capacity of detecting mineralogical phases, XRD in the context of technological analysis can provide information on the firing temperatures that were reached by potters (Buxeda I Garrigós et al., 2002; Maggetti, 1994; Maggetti et al., 2001).



Ceramic petrography borrows the methodology of analysis from geological studies in order to classify mineral and rock inclusions that are present within the ceramic body (Quinn, 2013; Whitbread, 1986). A slice of the ceramic body is cut and fixed on a glass slide to be polished to 30 μm thickness. The analysis of ceramic thin sections is performed on a polarizing microscope, which uses one mode of light transmission and 2 modes of interpretation: (1) plane polarized light (PPL), and (2) crossed polars that polarized the light in two directions. Minerals when intersected by polarized light produce specific optical effects such as transparency, color, pleochroism, morphology, birefringence and isotropism or anisotropism that are used for their characterization. The interpretation of these optical observations about mineral components of the paste allows us to distinguish ceramic bodies that were manufactured with materials of different origin or with different techniques (see Chapter 3). For instance, we can identify the presence of particular temper materials and make distinctions between local and imported wares when mineralogical difference is notable. The disposition of the inclusions can help to identify traces of the manufacturing process such as coiling (circular disposition) and percussion (parallel disposition) practices (see Chapter 3 and 4), finishing layers and the addition of decorative layer (slip and glaze). Next to that, the observation of the paste can be useful to broadly establish the firing temperature ranges (Quinn, 2013).

Overall, the application of archaeometric analysis to archaeological ceramic studies has the potential to provide meaningful information on the provenance of the materials and to identify compositional patterns that are characteristic of one production or of a geographical area. Traded objects can be spotted through a ceramic assemblage and the change of use of raw materials through time can be understood when the analyses are supported by chronological research of the ceramic assemblage. Combined with other technological analyses, e.g. macro and microscopic observation of the ceramic bodies, archaeometric analysis provides a holistic description of ceramic production. Results from these analyses allow us to classify archaeological assemblages through the description of the *chaîne opératoire* concept and to produce an important functional and socio-cultural characterization of past communities.

## 1.3. Dissertation outline

This dissertation has a twofold framework, on the one hand, is formed along a methodological thread that connects all the chapters. This binding methodological approach provides a full overview of the entire ceramic production process, and how to step by step untangle it to produce meaningful narratives of the past. On the other hand, the different case studies demonstrate how the use of a combined methodology with a focus on technology and shared practice can help to explain complex socio-political events and can be tailored to different historical periods, geographical areas and technological traditions.

In the next chapters, I explore the role of material culture in understanding human action and how, pottery can tell us about the socio-historical context in which they were embedded. Each chapter of this dissertation is composed of independent articles published in peer-reviewed journals. The order of the chapters should not be seen as strict and chronologically predetermined. The sequence, however, is structured to tackle the major steps of the ceramic manufacturing process and to drive the reader from the beginning of the story with the procurement of raw materials and their preparation, through the fashioning and finishing stages to the end of the journey with an understanding of the decoration steps.

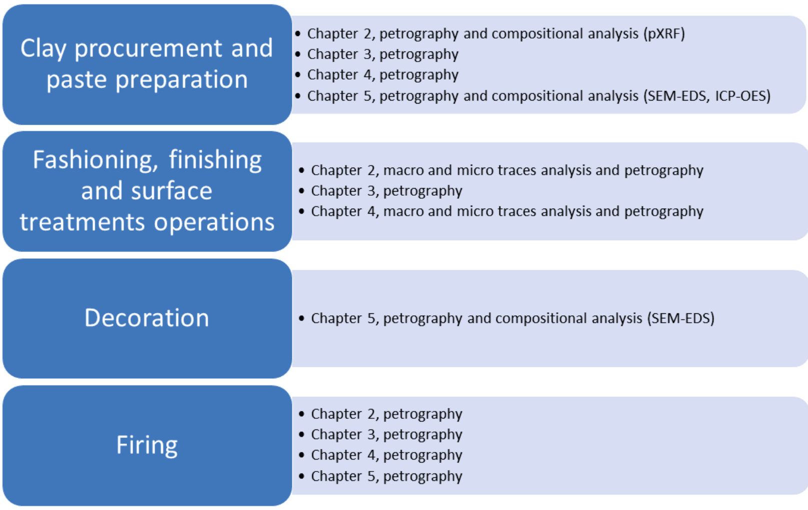


**Figure 3.** Graphic scheme of the dissertation. Each phase of ceramic production is linked with chapter that discussed it and with the methodology used.

**Part 1:** Designing a methodological approach to understand clay procurement practices and paste preparations.

Chapter 2 and 3 deal with different aspects related to the collection of clay raw materials and their preparation to be shaped and fired into a ceramic body. Both chapters provide applications of archaeometric methods such as chemical and petrographic analysis to glean important information regarding the provenance of the ceramics and the identification of different technological characteristics of the pastes.



Chapter 2: A pilot study to identify challenges and solutions for linking raw materials to fired ceramics

This chapter presents a case study from Central Nicaragua and is used as a pilot methodological approach to explore raw material procurement practices. The work is a follow up to previous research of Casale et al. (2020) that carried out the first systematic clay-rich soils survey in the area around the pre-Hispanic monumental site of Aguas Buenas (cal 400-1250 CE). A microanalytical approach based on geochemical analysis supported by petrographic observations is presented to glean provenance information and to identify imported wares within a ceramic assemblage.

This paper presents specific challenges faced during the gathering of the analytical data and offers directions for their interpretation. Chemical analysis by means of portable X-ray fluorescence (p-XRF) was applied to clay-rich samples to characterize geologically based compositional groups, collected through the area around Aguas Buenas and to compare them to the ceramic retrieved at the site. Thin-section petrographic observations were carried out to get detailed insights on the aplastic inclusions contained in the ceramic bodies and pastes preparation. Results shows how the integration of geochemical and petrographic analyses together with the use of statistical analysis produce a reliable set of data. The interpretation of the elemental and petrographic data allows us to get a better grasp of the geochemical patterns presented in the environment and how those patterns are reflected and visible in the ceramic bodies. Several hypotheses on the clay procurement strategies are presented and contextualized with the archaeological findings in the region showing ancient human behaviors and adaptation. The case study presented in this chapter was published as:

Casale, S., Donner, D., Braekmans, D., Geurds, A. (2020). Geochemical and petrographic assessment of clay outcrops and archaeological ceramics from the pre-Hispanic site of Aguas Buenas (cal 400-1250 CE), Central Nicaragua. *Microchemical journal* 156, 104829. https://doi.org/10.1016/j.microc.2020.104829

### Chapter 3: Understanding ceramics variability and provenance through the study of ceramic bodies

Following the previous chapter, Chapter 3 expands the study of ceramic pastes to archaeological sites in the Dominican Republic and Puerto Rico. Six different ceramic assemblages from precolonial sites are analyzed to understand the origin of the raw materials and their preparation for the manufacturing stage. The research deals particularly with the use of petrography as a proxy to explore different *chaîne opératoires* employed by the potters to modify the raw materials sources such as the preparation of fine and homogeneous paste or more heterogenous and coarse bodies, the identification of temper materials, voids, disposition of inclusions and firing temperature and atmospheres. Results are chronologically interpreted and provide an overview of the changes that occurred and the level of similarity/dissimilarity in the technical behaviors that was shared within the communities that lived on the islands. The mineralogical composition of the inclusions is analyzed in detail and contextualized with the geological region where the sites are located to provide an understanding of the origin of the raw materials, and to distinguish between wares manufactured from locally available sources or wares imported from other areas. The contents of this chapter were submitted to a peer-reviewed journal as followed:

Casale, S., López Belando, A.; Shelley, D.; Narganes, Y.; Hernández, I., Degryse, P. (submitted). Communities in contact. A technological and petrographic study on ceramic production and trade between Hispaniola and Puerto Rico (350-1200 CE). *Journal of Island and Coastal Archaeology*.

## **Part 2** Reconstructing ceramic manufacturing traditions.

This part includes Chapter 4 and 5 and provides an overview of two different methodological approach to tackle a similar research question: understanding ceramic manufacturing traditions but for two completely different types of wares. The idea that stems from this section is that there are different research avenues and not a fixed approach to ceramic studies. The methodology has to be arranged following different variables to be tailored to different earthenware materials. This is the case in chapter 4, where we move from a precolonial community at the site of El Cabo (600-1500 CE) in the Dominican Republic and their related ceramic production, to standardized and mass-produced glazed wares from the late 18$^{th}$ century in chapter 5.

### Chapter 4: A focus on the fashioning and finishing step

In this chapter, I present the first case study in the Caribbean Archipelago concerning the entire ceramic manufacturing process from the selection of the raw materials to the shaping and firing during the Late Ceramic Age. The focus of the study is the ceramic assemblage retrieved from the site of El Cabo (600-1502), on the east coast of the

Dominican Republic. El Cabo has an important and strategic location overlooking the Mona Passage, the water channel that divides Puerto Rico and the Dominican Republic. The site was regarded as a node in the trading networks within the islands and evidences a long-term human occupation until the contact period (Hofman et al., 2020; Samson, 2010). The study of the ceramic assemblage offers the opportunity to investigate the evolution of technological behaviors on a community-based scale, providing fine-grained results from a wide timeframe.

This chapter presents the result of petrographic and macro-trace analyses by means of stereomicroscope. The combined use of these methods provides a robust description of each of the major phase of the manufacturing process. Each phase is critically reviewed, and the research forms the first reference of macro-trace analysis for fashioning (roughing out and pre-forming) and finishing traditions in the Caribbean Archipelago, setting the ground for future comparative studies. Petrographic observations show the presence of different compositions for the ceramic pastes, offering insights on production strategies, exchange of wares and clay procurement practices through the centuries. Results of the *chaîne opératoire* are contextualized in the methodological frameworks of the community of practice model, highlighting the importance of tracing technological networks to reconstruct large-scale socio-cultural process. This research is published as:

Casale, S., van Dessel, K., Hoogland, M.L.P., Degryse, P., Hofman, C. (2022). Technological persistence in ceramic production in the southeastern Hispaniola. The case study of El Cabo (600-1502 CE). *Journal of Anthropological Archaeology* 65, 101387. https://doi.org/10.1016/j.jaa.2021.101387



### Chapter 5: Understanding 18th century glazed wares production through archaeometric analysis

This final chapter presents a case study concerning the analysis of the *chaîne opératoire* for highly standardized ceramic production. The *taches noires* wares were produced in Albissola (Italy) during the late 18th and the beginning of the 19th century. The production of *taches noires* was massive, one of the first industrial scale productions of ceramics with an estimation of twenty million pieces per year (Cameirana, 1980). The vessels, due to their high international appreciation, were exported worldwide from Europe to the Americas and several attempts of copying were done in Spain and in France. A consistent number of *taches noires* is found in Haiti. The import occurred mostly during the French colonial period and less information is available for the period of the Haitian Independence Wars and the establishment of the Haitian Republic. This research explores *taches noires* wares retrieved in different locations (urban settlement, French military fortress, and plantation areas) in the northeast of Haiti, in the area of Fort Liberté, to clarify on the use of those wares through an important social period of transition from a colonial regime to the advent in history of the first black republic.

The production steps of the *taches noires* are detailed and described in the literature, and changes in the recipes and materials are documented through the years. This research suggests a methodology that aims to tackle specific aspects of the manufacturing process that offers room to distinguish original products from French and Spanish replicas, and to understand Albissola productions chronologically to clarify the period of importation to Haiti and their social context.

The geochemical techniques provide an excellent tool for the investigation of the materials employed in the production process and to understand different paste and glaze recipes. ICP-OES was used to investigate the elemental composition of the paste, while SEM-EDS and petrographic analysis were used to understand the major components of the ceramic bodies and mineralogical inclusions. Results were compared with previously published data on French and Spanish replicas. The SEM-EDS also provides insights on the glaze compositions and decorative methods. The research provides new data on the *taches noires* and add information on the contested period between the French colonization and the social changes that prepare the ground for the establishment of the Republic of Haiti. Geochemical results have also a broader interest for colonial archaeology, being a case study to follow for future research in modern wares and those geochemical data on the *taches noires* wares can be used to trace the origin and time of import of those wares in other areas of the Americas and Europe. The study is published as:

Casale, S., Joseph, S.J., Capelli, C., Braekmans, D., Degryse, P., Hofman, C. (2021). Transatlantic Connections in Colonial and Post-Colonial Haiti: Archaeometric Evidence for *Taches noires* Glazed tableware imported from Albissola, Italy to Fort Liberté, Haiti. *International Journal of Historical Archaeology* 25, 423-447. https://doi.org/10.1007/s10761-020-00559-3

The concluding chapter summarizes and critically discusses the main results of each study and contextualizes them in the general literature. In particular, the research questions are revisited for the circum-Caribbean area and the role of the community of practice model and *chaîne opératoire* is presented, with a critical evaluation of the contribution that a fine-grained approach to material culture with a lens on daily practice brings to the general picture of indigenous, colonial and post-colonial lifeways and cultural change.

## BIBLIOGRAPHY


Arnold, D. E. (1985). *Ceramic theory and cultural process*. Cambridge University Press.

Arnold, D. E. (1989). Patterns of learning, residence and descent among the potters in Ticul, Yucatan, Mexico 1. In S. J. Shennan (Ed.), *Archaeological Approaches to Cultural Identity* (pp. 174–184). Unwin Hyman.

Binford, L. (1965). Archaeological Systematics and the Study of Culture Process. *America Antiquity* 30 (1), 203–210.

Boomert, A. (1985). The Guayabitoid and Mayoid series: Amerindian Culture History in Trinidad During Late Prehistoric and Protohistoric Times. *Proceedings of the Tenth International Congress for the Study of the Pre-Columbian Cultures of the Lesser Antilles*, 93–148.

Boomert A. (2000), *Trinidad, Tobago and the lower Gisnoca Interaction Sphere, an archaeological/ethnohistorical study.* (PhD thesis).

Boomert, A. (2007). Plymouth: a late-prehistoric ceramic complex of Tobago. *Leiden Journal of Pottery Studies*, *23*, 121–158.

Bourdieu, P. (1977). *Outline of a Theory of Practice, Cambridge Studies in Social Anthropology 16*. Cambridge [Uk] : Cambridge University Press.

Bourdieu, P. (1984). *Distinction. A social critique of the judgment of taste* (M. H. U. P. Cambridge, Ed.).

Buxeda I Garrigós, J., Mommsen, H., & Tsolakidou, A. (2002). Alterations of Na, K and Rb concentrations in Mycenaean pottery and a proposed explanation using X-ray diffraction. *Archaeometry*, *43*, 349–371.

Cameirana, A. (1980). La ceramica albisolese a “taches noires.” *Atti X Convegno Internazionale Della Ceramica, 1977*, 277–293.

Casale, S., Donner, N. R., Braekmans, D., Alexander Geurds, K., & Geurds, A. (2020). Pre-Hispanic and contemporary raw materials use in earthenware production in the Río Mayales subbasin, Chontales, central Nicaragua. In M.V. Klinkenberg, R.M.R. van Oosten and C. van Driel-Murray (eds) 2020. *A Human Environment. Studies in honour of 20 years Analecta editorship by prof. dr. Corrie Bakels*, Leiden: Sidestone Press, pp. 107-120.

Chanlatte Baik, L. A. (1981). *La Hueca y Sorcé (Vieques, Puerto Rico) Primeras Migraciones Agroalfareras Antillanas Antillanas*.

Chanlatte-Baik, L. (2005). Evidencia huecoide en la Republica Dominicana. *XXI Congreso Internacional de Arqueología Del Caribe*, 459–465.

Clark, J. E. (2008). In Craft Specialization’s Penumbra: Things, Persons, Action, Value, and Surplus. *Archeological Papers of the American Anthropological Association*, *17*(1), 20–35. https://doi.org/10.1525/ap3a.2007.17.1.20

Costin, C. L. (1991). Craft Specialization: Issues in Defining, Documenting, and Explaining the Organization of Production. In M. B. Schiffer (Ed.), *Archaeological Method and Theory, vol. 3* (pp. 1–56). University of Arizona Press.

Costin, C. L. (2008). Introduction: Craft and Social Identity. *Archeological Papers of the American Anthropological Association*, *8*(1), 3–16. https://doi.org/10.1525/ap3a.1998.8.1.3

Creswell, R. 1976. Techniques et culture, les bases d’un programme de travail. Techniques et Culture 1, 7-59.

Creswell, R. (1983). Transferts de techniques et chaînes opératoires. *Techniques & Culture*, *2*, 143–164. https://doi.org/10.4000/tc.1030

Crock, J. G., Morse, B. F., Descantes, C., Petersen, J. B., & Glascock, M. D. (2008). Preliminary Interpretations of Ceramic Compositional Analysis in Anguilla and the Salt River Site in St. Croix. *Journal of Caribbean Archaeology, Special Publication 2*, 57–68.

Crown, P. L. (2007). Life Histories of Pots and Potters: Situating the Individual in Archaeology. American Antiquity, Vol. 72 (4), 677-690.

Curet, L. A. (1997). Technological Changes in Prehistoric Ceramics from Eastern Puerto Rico: an Exploratory Study. *Journal of Archaeological Science* 24, 497-504.

Curet, L. A. (2014). The Taíno: Phenomena, concepts, and terms. *Ethnohistory*, *61*(3), 467–495. https://doi.org/10.1215/00141801-2681759

Degryse, P., & Braekmans, D. (2013). Elemental and Isotopic Analysis of Ancient Ceramics and Glass. In *Treatise on Geochemistry: Second Edition* (2nd ed., Vol. 14). Elsevier Ltd. https://doi.org/10.1016/B978-0-08-095975-7.01215-8

Dennet C. L. (2016). *The Ceramic Economy of Pre-Columbian Pacific Nicaragua (AD 1–1250)*. University of Calgary.

Descantes, C., Speakman, R., & Glascock, M. (2008). Compositional Studies of Caribbean Ceramics: An Introduction to Instrumental Neutron Activation Analysis. *Journal of Caribbean Archaeology*, *2*(2), 1–14.

di Febo, R., Casas, L., Capelli, C., Cabella, R., & Vallcorba, O. (2018). Catalan Imitations of the Ligurian Taches Noires Ware in Barcelona (18th–19th Century): An Example of Technical Knowledge Transfer. *Minerals*, *8* (5), 183. https://doi.org/10.3390/min8050183

Dietler, M., & Herbich, I. (1998). Habitus, techniques, style: an integrated approach to the social understanding of material culture and boundaries. In M. T. Stark (Ed.), *The Archaeology of social boundaries* (pp. 232–263). Smithsonian Institution press.

Dobres, M. A. (1995). Gender and prehistoric technology: On the social agency of technical strategies. *World Archaeology*, *27*(1), 25–49. https://doi.org/10.1080/00438243.1995.9980291

Dobres, M.A. (2000). *Technology and social agency : outlining a practice framework for archaeology*. Blackwell.

Dobres, M., & Hoffman, C. R. (1994). Social agency and the dynamics of prehistoric technology. *Journal of Archaeological Method and Theory*, *1*(3), 211–258. https://doi.org/10.1007/BF02231876

Donner, N. R. (2020). *The potters' perspectives A vibrant chronological narrative of ceramic manufacturing practices in the valley of Juigalpa, Chontales, Nicaragua (cal 400 CE-present)*. PhD dissertation, Leiden University.

Finlay, A. J., McComish, J. M., Ottley, C. J., Bates, C. R., & Selby, D. (2012). Trace element fingerprinting of ceramic building material from Carpow and York Roman fortresses manufactured by the VI Legion. *Journal of Archaeological Science*, *39*(7), 2385–2391. https://doi.org/10.1016/J.JAS.2012.03.002

Fitzpatrick, S., Carstensen, J., Marsaglia, K., Descantes, C., Glascock, M., Kaye, Q., Kappers, M., & Technics, I.-T. (2008). Preliminary petrographic and chemical analyses of prehistoric ceramics from Carriacou, West Indies. *Journal of Caribbean Archaeology*, *2*, 59–82.

Gandon, E., Roux, V., & Coyle, T. (2014). Copying errors of potters from three cultures: Predictable directions for a so-called random phenomenon. *Journal of Anthropological Archaeology*, *33*(1), 99–107. https://doi.org/10.1016/j.jaa.2013.12.003

Gehres, B., & Querré, G. (2018). Analysis of mica inclusions using LA-ICP-MS: A new approach for sourcing raw material of ceramics. *Journal of Archaeological Science: Reports*, *21*, 912–920. https://doi.org/10.1016/J.JASREP.2017.05.018

Gelbert, A. (2003). *Traditions céramiques et emprunts techniques dans la vallée du fleuve Sénégal*. (Editions d). Editions Epistèmes.

Goren, Y., Mommsen, H., & Klinger, J. (2011). Non-destructive provenance study of cuneiform tablets using portable X-ray fluorescence (pXRF). *Journal of Archaeological Science*, *38*(3), 684–696. https://doi.org/10.1016/j.jas.2010.10.020

Gosden, C., & Marshall, Y. (1999). The cultural biography of objects. *World Archaeology*, *31*(2), 169–178. https://doi.org/10.1080/00438243.1999.9980439

Gosselain, O. (1998). Social and technical identity in a clay crystal ball. In M. Stark (Ed.), *The Archaeology of Social Boundaries* (pp. 78–106). Smithsonian Institution Press.

Gosselain, O. P. (2000). Materializing identities: An African perspective. *Journal of Archaeological Method and Theory*, *7*(3), 187–217. https://doi.org/10.1023/A:1026558503986

Gosselain, O. P. (2008). Thoughts and Adjustments in the Potter's Backyard. *Breaking the Mould: Challenging the Past through Pottery*, 67–79.

Gosselain, O. P. (2016). The World is like a Beanstalk. In Roddick, A. P., & Stahl Ann, B (eds.) *Knowledge in Motion: Constellations of Learning Across Time and Place*, (pp. 36–65). Tucson: The University of Arizona Press.

Gosselain, O. P. (2018). Pottery chaînes opératoires as Historical Documents. In *Oxford Research Encyclopedia of African History* (Issue December). https://doi.org/10.1093/acrefore/9780190277734.013.208

Gosselain, O., & Livingstone Smith, A. (2005). The source. Clay selection and processing practices in sub-Saharan Africa. *Pottery Manufacturing Processes: Reconstruction and Interpretation*, *1349*(August), 33–47.

Graves, D. (2020). Decoding Pottery Making Practices. Technical and stylistic analyses of Late Ceramic Age traditions from the northern Caribbean (1000-1400 C.E.). Master thesis, Leiden University.

Haour, A., Manning, K., Arazi, N., & Gosselain, O. (2010). *African Pottery Roulettes Past and Present*. Havertown: Oxbow Books.

Hendon, J. A. (2006). Textile production as craft in Mesoamerica: Time, labor and knowledge. *Journal of Social Archaeology*, *6*(3), 354–378. https://doi.org/10.1177/1469605306067841

Hendon, J. A. (2008). Production as Social Process. *Archeological Papers of the American Anthropological Association*, *17*(1), 163–168. https://doi.org/10.1525/ap3a.2007.17.1.163

Hendon, J. A. (2015). Producing Goods, Shaping People: The Materiality of Crafting. *Archeological Papers of the American Anthropological Association*, *26*(1), 149–165. https://doi.org/10.1111/apaa.12068

Herbich, I. (1987). Learning patterns, pottery interaction and ceramic style among the Luo of Kenya. *African Archaeologial Review*, *5*, 193–204.

Hofman, C., Isendoorn, A. J. D., & Booden, M. (2008). A tuneful threefold. Combining conventional archaeological methods, archaeometric techniques in the study of pre-colonial pottery of the Caribbean and ethnoarchaeological research. In C. Hofman, M. L. P. Hoogland, & A. van Gijn (Eds.), *Crossing the borders. New methods and techniques in the study of archaeological materials from the Caribbean* (pp. 1–21). University of Alabama Press.

Hofman, C. L. (1993). *In search of the native population of pre-Columbian Saba. Part One. Pottery styles and their interpretations*. PhD dissertation, Leiden University.

Hofman, C. L., Bright, A.J., Rodrigues Ramos, R. (2010). Crossing the Caribbean Sea. Towards a holistic view of pre-colonial mobility and exchange. *Journal of Caribbean Archaeology*.

Hofman, C. L., Hoogland, M. L. P., & Pagán-Jiménez, J. R. (2020). En la víspera de la colonización europea: Los sitios indígenas El Flaco, El Carril y El Cabo, República Dominicana. *Boletín Del Museo Del Hombre Dominicano*, *48*, 133–152.

Hofman, C., & Jacobs, L. (2001). The dynamics of technology, function and style: a study of early Ceramic Age pottery from the Caribbean. *Newsletter of the Department of Pottery Technology*, *18/19*, 7–44.

Hofman, C. L., & Jacobs, L. (2004). Different or Alike? A technological comparison between Late-Prehistoric ceramics and modern-day folk pottery of St. Lucia (W.I). *Leiden Journal of Pottery Studies*, *20*, 23–52.

Hofman, C. L.; Ulloa Hung, J. (2008). Piecing the puzzle together: a ceramic chronology of eastern Dominican Republic. *El Caribe Arqueologico*.

Hunt, A. M. W., & Speakman, R. J. (2015). Portable XRF analysis of archaeological sediments and ceramics. *Journal of Archaeological Science*, *53*, 626–638. https://doi.org/10.1016/J.JAS.2014.11.031

Joyce, R. (2020). Central America: Time for a Paradigm Shift. In C. McEwan, & Hoopes, J., & B. Cockrell (Eds.), *Towards an Archaeology of "Greater" Central America: The Dumbarton Oaks Catalogue on Central America and Colombia*. Dumbarton Oaks Research and Library Collection.

Joyce, R. A., Hendon, J. A., & Lopiparo, J. (2015). Working with clay. *Ancient Mesoamerica*, *25*(2), 411–420. https://doi.org/10.1017/S0956536114000303

Joyce, R. A., and Lopiparo, L. 2005. Postscript: Doing Agency in Archaeology. Journal of Archaeological Method and Theory 12(4):365-374.

Keegan, W. F. (2000). West Indian Archaeology. 3. Ceramic Age. In *Journal of Archaeological Research* (Vol. 8, Issue 2). https://about.jstor.org/terms

Keegan, W. F.; Hofman, C. L. (2017). *The Caribbean before Columbus*. New York: Oxford University Press.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation.* Cambridge University Press.

Lawrence, J., Fitzpatrick, S., & Giovas, C. (2021). Petrographic analysis of Pre-Columbian pottery from Nevis, Eastern Caribbean. *Journal of Archaeological Science, Reports, 35*, 102741.

Lemonnier, P. (1986). the study of material culture today: towards an anthropology of technical systems. *Journal of Anthropological Archaeology*, *5*, 147–186.

Leroi-Gourhan, A. (1971). *Evolution et techniques. L'Homme et la matière*. Albin Michel.

Leroi-Gourhan, A. (1973). *Evolution et techniques. Milieu et techniques. Vol. 2.* Paris : Albin Michel.

Livingstone Smith, A. (2000). Processing clay for pottery in northern Cameroon: Social and technical requirements. *Archaeometry*, *42*(1), 21–42. https://doi.org/10.1111/j.1475-4754.2000.tb00864.x

Livingstone Smith, A. (2010a). Pottery traditions in Katanga (DRC). A comparative examination of roughing-out technologies. *Anthropos*, *105*(1), 179–190. https://doi.org/10.5771/0257-9774-2010-1-179

Livingstone Smith, A. (2010b). Reconstitution de la chaîne opératoire de la poterie. *Les Nouvelles de l'archéologie*, *119*, 9–12. https://doi.org/10.4000/nda.955

Lothrop, S. 1926. *The Pottery of Costa Rica and Nicaragua, Contributions from the Museum of the American Indian, Heye Foundation. Memoir, no. 8*. New York, N.Y.: Museum of the American Indian, Heye Foundation.

Maggetti, M. (1994). *Mineralogical and petrographical methods for the study of ancient pottery*. In: Burragato F, Grubessi O, and Lazzarini L (eds.) 1st European Workshop on Archaeological Ceramics, pp. 23–35. Rome: Università degli studi La Sapienza, Dipartimento di Scienza della Terra.

Maggetti, M., Rodriguez-Navarrou, C., Sebastian, E., Cazalla, O., & de La Torre, M. J. (2001). Carbonate and silicate phase reactions during ceramic firing. *European Journal of Mineralogy*, *13*, 621–634.

Mommsen, H., Beier, T., Diehl, U., & Podzuweit, C. (1992). Provenance determination of Mycenaean sherds found in Tell el Amarna by Neutron Activation Analysis. *Journal of Archaeological Science*, *19*(3), 295–302. https://doi.org/10.1016/0305-4403(92)90018-X

Montana, G., Mommsen, H., Iliopoulos, I., Schwedt, A., & Denaro, M. (2003). The petrography and chemistry of thin-walled ware from an hellenistic - Roman site at Segesta (Sicily). *Archaeometry*, *45*(3), 375–389. https://doi.org/10.1111/1475-4754.00115

Neyt, B., Braekmans, D., Poblome, J., Elsen, J., Waelkens, M., & Degryse, P. (2012). Long-term clay raw material selection and use in the region of Classical/Hellenistic to Early Byzantine Sagalassos (SW Turkey). *Journal of Archaeological Science*, *39*(5), 1296–1305. https://doi.org/10.1016/j.jas.2012.01.005

Norweb, A. (1962). Ceramic Stratigraphy in Southwestern Nicaragua. *35th International Congress of Americanists*, 551–561.

Pauketat, T. R., & Alt, S. M. (2005). Agency in a postmold? Physicality and the archaeology of culture-making. *Journal of Archaeological Method and Theory*, *12*(3), 213–237. https://doi.org/10.1007/s10816-005-6929-9

Persons, B. A. (2019). Pottery, People, And Place: Examining The Emergence Of Political Authority In Late Ceramic Age Cuba. In *PhD Dissertation*.

Pestle, W. J., Curet, L. A., Rodriguez Ramos, R., & López, M. R. (2013). New Questions and Old Paradigms: Reexamining Caribbean Culture History [Article]. *Latin American Antiquity*, *24*(3), 243–261. https://doi.org/10.7183/1045-6635.24.3.243

Quinn, P. (2013). *Ceramic Petrography, the Interpretation of Archaeological Pottery & Related Artifacts in Thin-section*. (Archaeopress, Ed.).

Roddick, A. P. (2009). *Communities of Pottery Production and Consumption on the Taraco Peninsula, Bolivia, 200 BC-300 AD*. PhD dissertation University of California, Berkeley.

Roddick, A. P. (2013). Temporalities of the Formative Period Taraco Peninsula, Bolivia. *Journal of Social Archaeology*, *13*(3), 287–309. https://doi.org/10.1177/1469605313485396

Roddick, A. P., & Stahl, A. B. (2016). Knowledge in motion: Constellations of learning across time and place. Tucson: The University of Arizona Press

Rouse, I. (1939). *Prehistory in Haiti: A Study in Method*. PhD dissertation. Yale University.

Rouse, I. (1948). The Arawak. In J. Steward (Ed.), *The Circum-Caribbean Tribes, Handbook of South American Indians, Vol. 4* (Bulletin o, pp. 46–50). Smithsonian Institution.

Rouse, I. (1960). The Classification of Artifacts in Archaeology. *American Antiquity*, *25*(3), 313–323. https://doi.org/10.2307/277514

Rouse, I. (1986). *Migrations in Prehistory: Inferring Population Movement from Cultural Remains*. Yale University Press.

Roux, V. (2003). A Dynamic Systems Framework for Studying Technological Change: Application to the Emergence of the Potter's Wheel in the Southern Levant. In *Journal of Archaeological Method and Theory* (Vol. 10, Issue 1).

Roux, V. (2013). Spreading of Innovative Technical Traits and Cumulative Technical Evolution: Continuity or Discontinuity? *Journal of Archaeological Method and Theory*, *20*(2), 312–330. https://doi.org/10.1007/s10816-012-9153-4

Roux, V. (2015). Standardization of ceramic assemblages: Transmission mechanisms and diffusion of morpho-functional traits across social boundaries. *Journal of Anthropological Archaeology*, *40*, 1–9. https://doi.org/10.1016/j.jaa.2015.04.004

Roux, V. (2016). Ceramic Manufacture. In A. Hunt (Ed.), *The Oxford Handbook of Archaeological Ceramic Analysis* (pp. 100–113). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199681532.013.8

Roux, V. (2019a). Ceramics and Society. In *Ceramics and Society*. Springer International Publishing. https://doi.org/10.1007/978-3-030-03973-8

Roux, V. (2019b). Modeling the Relational Structure of Ancient Societies through the Chaîne opératoire: The Late Chalcolithic Societies of the Southern Levant as a Case Study. In: Saqalli, M., Vander Linden, M. (eds) Integrating Qualitative and Social Science Factors in Archaeological Modelling. Computational Social Sciences(). Springer, Cham. https://doi.org/10.1007/978-3-030-12723-7_7

Roux, V., & Manzo, G. (2018). Social Boundaries and Networks in the Diffusion of Innovations: a Short Introduction. Journal of Archaeological Method and Theory, 25(4), 967–973. https://doi.org/10.1007/s10816-018-9395-x

Samson, A. V. M. (2010). *Renewing the house. Trajectories of social life in the yucayeque (community) of El Cabo, Higuey, Dominican Republic, AD 800 to 1504*. Leiden: Sidestone Press.

Santacreu, D. A. (2014). *Materiality, techniques and society in pottery production : the technological study of archaeological ceramics through paste analysis*. Warsaw/Berlin: De Gruyter Open Ltd.

Santacreu, D. A. (2017). Interpreting long-term use of raw materials in pottery production: A holistic perspective. *Journal of Archaeological Science: Reports*, *16*, 505–512. https://doi.org/10.1016/j.jasrep.2016.04.008

Sassaman, K. E. (2016). A constellation of practice in the experience of sea-level rise. In Roddick, A. P., & Stahl Ann, B (eds.), *Knowledge in Motion: Constellations of Learning Across Time and Place*, 271–298. Tucson: The University of Arizona Press.

Schiffer, M. B., & Skibo, J. M. (1997). The Explanation of Artifact Variability. *American Antiquity* 62(1), 27–50.

Scott, R. B., Neyt, B., Hofman, C., & Degryse, P. (2018). Determining the Provenance of Cayo Pottery from Grenada, Lesser Antilles, Using Portable X-Ray Fluorescence Spectrometry. *Archaeometry*, *60*(5), 966–985. https://doi.org/10.1111/arcm.12359

Sharratt, N., Golitko, M., Ryan Williams, P., & Dussubieux, L. (2009). Ceramic production during the middle horizon: Wari and Tiwanaku clay procurement in the Moquegua Valley, Peru. *Geoarchaeology*, *24*(6), 792–820. https://doi.org/10.1002/gea.20288

Siegel, P. E., Descantes, C., Glascock, M. D., & Fergurson, J. R. (2008). Pre-Columbian Pottery in the West Indies: Compositional Change in Context. *Journal of Caribbean Archaeology*, 25–44.

Stark, M. T. (1999). Technical Choices and Social Boundaries in Material Culture Patterning: An Introduction. In Stark, M.T. (ed.), *The Archaeology of Social Boundaries* (pp. 1–12). Smithsonian Institute Press.

Stark, M. T. (2003). Current issues in ceramic ethnoarchaeology. *Journal of Archaeological Research*, *11*(3), 193–242. https://doi.org/10.1023/A:1025079730891

Stienaers, A., Neyt, B., Hofman, C., & Degryse, P. (2020). A petrographic and chemical analysis of Trinidad pre-colonial ceramics. *Science and Technology of Archaeological Research*. https://doi.org/10.1080/20548923.2020.1771898

Stoner, W. D. (2016). The analytical nexus of ceramic paste composition studies: A comparison of NAA, LA-ICP-MS, and petrography in the prehispanic Basin of Mexico. *Journal of Archaeological Science*, *76*, 31–47. https://doi.org/10.1016/J.JAS.2016.10.006

Tehrani, J. J., & Collard, M. (2009). On the relationship between interindividual cultural transmission and population-level cultural diversity: a case study of weaving in Iranian tribal populations. *Evolution and Human Behavior*, *30*(4). https://doi.org/10.1016/j.evolhumbehav.2009.03.002

Tehrani, J. J., & Riede, F. (2008). Towards an archaeology of pedagogy: Learning, teaching and the generation of material culture traditions. *World Archaeology*, *40*(3), 316–331. https://doi.org/10.1080/00438240802261267

Thér, R. (2020). Ceramic technology. How to reconstruct and describe pottery-forming practices. *Archaeological and Anthropological Sciences*, *12*(8). https://doi.org/10.1007/s12520-020-01131-0

Ulloa Hung, J. (2014). *Arqueología en la Línea noroeste de La Española*. PhD dissertation, Leiden University.

Wagner, B., Nowak, A., Bulska, E., Hametner, K., & Günther, D. (2012). Critical assessment of the elemental composition of Corning archeological reference glasses by LA-ICP-MS. *Analytical and Bioanalytical Chemistry*, *402*(4), 1667–1677. https://doi.org/10.1007/s00216-011-5597-8

Walton, M. S., & Tite, M. S. (2010). Production technology of roman lead-glazed pottery and its continuance into late antiquity. *Archaeometry*, *52*(5), 733–759. https://doi.org/10.1111/j.1475-4754.2009.00506.x

Weigand P.C., Harbottle G., and Sayre E.V. (1977). Turquoise sources and source analysis: Mesoamerica and the Southwestern USA. In: Earle T.K. and Ericson J.E. (eds.) *Exchange Systems in Prehistory*, pp. 15–34. New York: Academic Press.

Whitbread, I. K. (1986). The characterisation of argillaceous inclusions in ceramic thin sections. *Archaeometry*, *28*(1), 79–88. https://doi.org/10.1111/j.1475-4754.1986.tb00376.x