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aline.durand@univ-lemans.fr

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Editors
Stefano Biagetti
Barcelona, Spain

Francesca Lugli
Rome, Italy

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Chapter 20
Residue Analysis of the Floors of a Charcoal Burner's Hut at Naour (Morocco)

Alessandra Pecci, Sylvain Burri, Aline Durand, Fernanda Inserra, and Miguel Ángel Cau Ontiveros

Introduction

When human activities take place, the substances used and produced by these activities are spilled on the floors and absorbed by them. The chemical residues are absorbed by the pores of the earthen or plaster floors, in the position in which the activities were carried out and then can be identified by means of specific chemical analyses (Barba 1986, 2007; Barba and Lazos 2000; Ortiz and Barba 1993; Pecci 2009, 2013). Both the presence and the absence of residues are important archaeological indicators that provide an understanding of what kinds of human activities took place.

Chemical residues are not "visible" and are not "tangible"; however, they are the by-products of human activities, such as preparing and eating food, breeding animals, and performing rituals. These activities, and the way they are carried out, are strictly related to the specific cultures of the people carrying them out, which

A. Pecci (✉) • F. Inserra
Equip de Recerca Arqueològica i Arqueomètrica de la Universitat de Barcelona (ERAAUB), Barcelona, Spain
e-mail: alepecci@gmail.com; inserrafernanda@gmail.com

S. Burri
CNRS, Aix Marseille Université, LA3M UMR 7298, 13094 Aix-en-Provence cedex 1, France
e-mail: burri@mmsh.univ-aix.fr

A. Durand
Université du Maine, CréAAH UMR 6566, 72085 Le Mans cedex 9, France
e-mail: aline.durand@univ-lemans.fr

M.Á. Cau Ontiveros
Equip de Recerca Arqueològica i Arqueomètrica de la Universitat de Barcelona (ERAAUB), Barcelona, Spain

Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain
e-mail: macau@ub.es

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is why they can also be considered in some ways to be "intangible elements of culture." The study of these residues can provide important indications of the culture(s) that are investigated: the food consumed and the way it was consumed, the areas used to prepare and consume it, and, more generally, the use of space and the activities performed (which is why they can be considered markers of human activities—Rondelli et al. 2014). Barba (1986) observed that there are activities that can be considered "universal," that every culture in every period carries out (e.g., eating), and some activities that are specific to certain human groups; however, even in the first group, some differences can be observed, such as the way food is prepared and the foods themselves, and this is reflected in the residues absorbed in the floors. In Central America, *tortillas*, for instance (the local "bread"), are made of corn that has to be "nixtamalized" before being grinded (the corn has to be soaked in water with lime for several hours). Therefore, in Central American kitchens, in addition to the residues produced by the cooking of meat, corn, etc., there will also be the residues of the lime used in this food preparation process.

The patterns of enrichment of residues depend on the type of activity carried out (i.e,. food preparation and consumption leave abundant residues, while sleeping does not leave any), and on the repetition and intensity of the activity: the repetition of a daily activity, such as cooking, usually leaves abundant residues, but also an important occasional ritual that involves many offerings can leave residues. However, the kind of surface being analyzed (that has to be porous and homogeneous), the process of abandonment, or the eventual re-use of space for different functions, can have an impact on the residues that are absorbed by the surface, and in some cases can derive a more difficult interpretation of the functionality of space (Ortiz and Barba 1993; Barba and Lazos 2000; Pecci 2009). In most cases, different activities leave different traces; however, the interpretation of the use of space at an archaeological level has to take into account—besides the patterns of chemical residues—all the various indicators of human activities, such as the characteristics of the building that is being analyzed, the archaeozoological and archaeobotanical data, and the presence or absence of ceramics and other archaeological materials (Ortiz and Barba 1993; Pecci 2009).

Many investigations have been carried out in various parts of the world to identify the traces of human activities and to understand the use of space. These investigations have involved the study of various contexts, from single rooms and buildings to entire regions. In order to better understand the patterns of residues corresponding to the human activities carried out at one site, it is fundamental to work at different levels, carrying out archaeological projects and experiments, and using ethnoarchaeological and ethnoarchaeometrical approaches (Barba et al. 2014; Pecci 2003; Pecci et al. 2011, 2013a, b, c).

In particular, since the beginning of the application of the analysis of chemical residues of floors at the end of the 1970s (Barba 1986), ethnoarchaeology has had an important role to play: the possibility of relating the chemical residues that are identified in the studied floors with known activities provides a key to the interpretation of archaeological contexts where the activities that are carried out

are unknown. Ethnoarchaeological studies that aimed to identify the chemical traces of human activities have been carried out mainly in the area corresponding to ancient Mesoamerica (see, for example, Barba and Ortiz 1992; Fernández et al. 2002; Middleton et al. 2010; Pecci et al. 2011), in India (Rondelli et al. 2014), and in the Mediterranean area, mainly in order to study the chemical traces left by food production (oil and wine) (Pecci et al. 2013a, b, c). When possible, and each time an archaeological context is studied, it is important to carry out analyses of ethnoarchaeological contexts. As for Morocco, and for charcoal burner's lives, because no studies have been carried out until now, we decided to apply this kind of investigation as part of the ethnoarchaeological study carried out by S. Burri and A. Durand on the way of life of charcoal burners (Burri 2012; Burri et al. 2013).

Chemical analyses of samples from the floor of a temporary dwelling were carried out to identify the presence of chemical residues (Fig. 20.1). These analyses were done in order to understand the chemical traces left by the various activities during the occupation of the hut, and to provide data that could serve as a framework or the interpretation of the archaeological record in the future. In particular, the objective was to determine whether a temporary settlement (6 or 7 months' duration) could leave chemical traces in the soil.

The sampled structure is Mouha Baghbou's temporary dwelling located in Naour, at an altitude of 1400 m (Middle Atlas Mountains—Morocco). Mouha is an

Fig 20.1 Photo of the dwelling

itinerant charcoal burner who lives at his place of work during the work season. Unlike other charcoal burners of the region, he lives alone, although sometimes a boy comes to help him during peak charcoal burning season (Burri 2012; Burri et al. 2013). The studied structure, rectangular and made of wood with a surface area of approximately 9 m^2, was built by Mouha on an artificial platform dug into the slope.

The domestic space is divided into two main areas, one for food preparation and consumption and heating, and the other for resting and sometimes sociability and food consumption (Figs. 20.2 and 20.3). The latter is covered by cardboard and some carpets, while the rest of the floor is made of earth or soil. The food is cooked near the fireplace on a mobile burner. Outside the hut there is an oven for baking bread and heating water for tea. In 2009 the hut, which had been abandoned 1 year before, was sampled (Fig. 20.4). For the project, the area inside and outside the hut was sampled and analyzed.

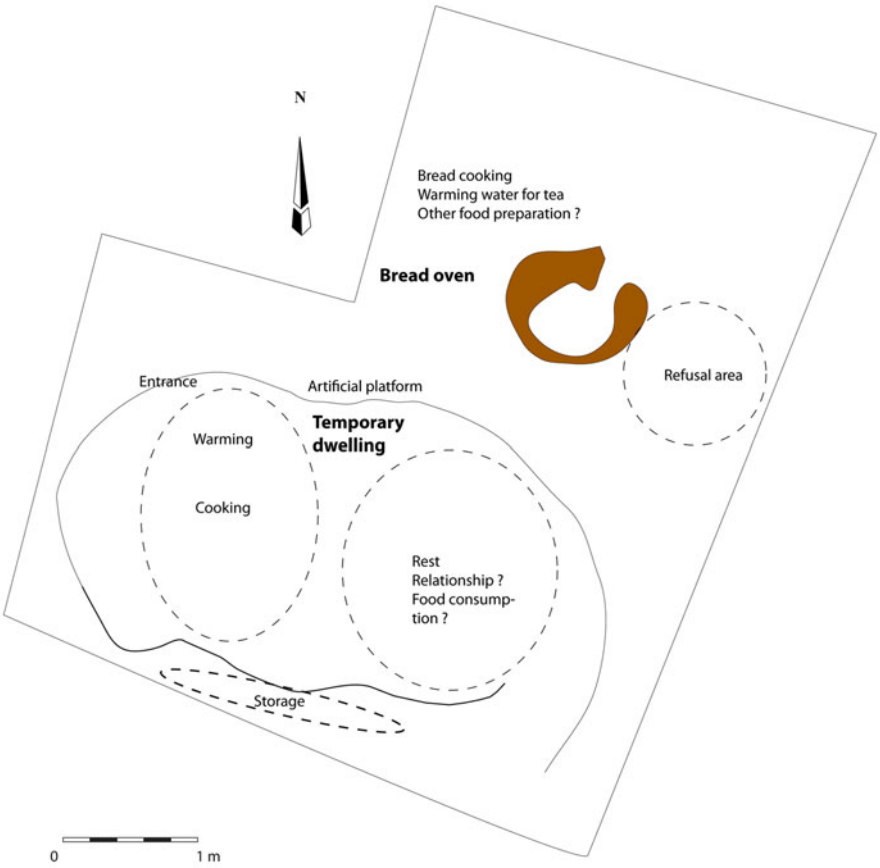

Fig 20.2 Map of the dwelling

Fig. 20.3 Interior of the dwelling

Fig. 20.4 Photo of the dwelling 1 year after it was abandoned

Materials and Methods

A total of 55 samples were taken from the inner floor of the hut and from outside around the structure (Fig. 20.5). Inside the hut, a grid of 0.50 × 0.50 m was followed, while outside samples were taken following a grid of 1 m × 1 m. Samples were analyzed by spot tests designed to identify the presence of phosphates, fatty acids, and protein residues following the method developed by Barba et al. (1991) and Barba (2007). These tests were developed for the study of Mesoamerican buildings, but have also proven useful for the study of sites of various periods and geographical areas (Middleton et al. 2010; Pecci 2009; Pecci et al. 2013a; Rondelli et al. 2014). The results of the analyses were interpolated in order to obtain distribution maps of the compounds analyzed (Fig. 20.5), using an Inverse Distance Weight (IDW) method. Maps were modified to follow the walls of the hut.

Results of the Analyses

Phosphates, which are indicators of the decomposition of organic matter, are distributed on almost all the investigated area (central map of Fig. 20.5). However, it is possible to see that their distribution is, in part, related to that of cinders and of food preparation and consumption. In fact, the major concentrations are located where the bread oven outside the hut and the inner fireplace are placed. In the northern part of the hut, phosphates are higher than in the southern part, suggesting a differential use of space. Fatty acids that are present in animal or vegetable oils and fats (e.g., from blood or meat) have been recorded in the entire area that was analyzed, and concentrations can be observed both inside and outside the hut. Inside, they are related mostly to the fireplace and reflect food preparation and consumption activities. Although the fireplace is used mostly for heating, a mobile burner is used to cook. Here, Mouha cooks various kinds of *tajine* (a North African dish named after the type of ceramic pot in which it is cooked) and other foods, mainly vegetables. Mainly during the autumn and winter, Mouha eats to the west of the fireplace (Burri et al. 2013). Another fats' concentration has been recorded outside the hut in front of the entrance, where the cinders of the fireplace have spread. Outside, the concentration of fats around the bread oven cannot be related to the cooking of the bread, which is not rich in fats (although some oil is usually added to the dough), nor to the boiling of tea that takes place here. However, the fats could be released when Mouha eats the bread with olive oil (which is rich in fatty acids), or the *tajine*, whose sauce is rich in fats. In fact, he often eats outside when it is not cold and the weather is good. Moreover, the area of the bread oven is also used for discarding domestic waste, so some residues can be related to this activity.

Protein residues, which could be the result of food preparation activities, cooking, consumption of foods, or slaughtering of animals, are also present on most of the surfaces under study (Fig. 20.5). Although the food that Mouha consumes is usually poor in meat because meat is expensive and cannot be preserved for long,

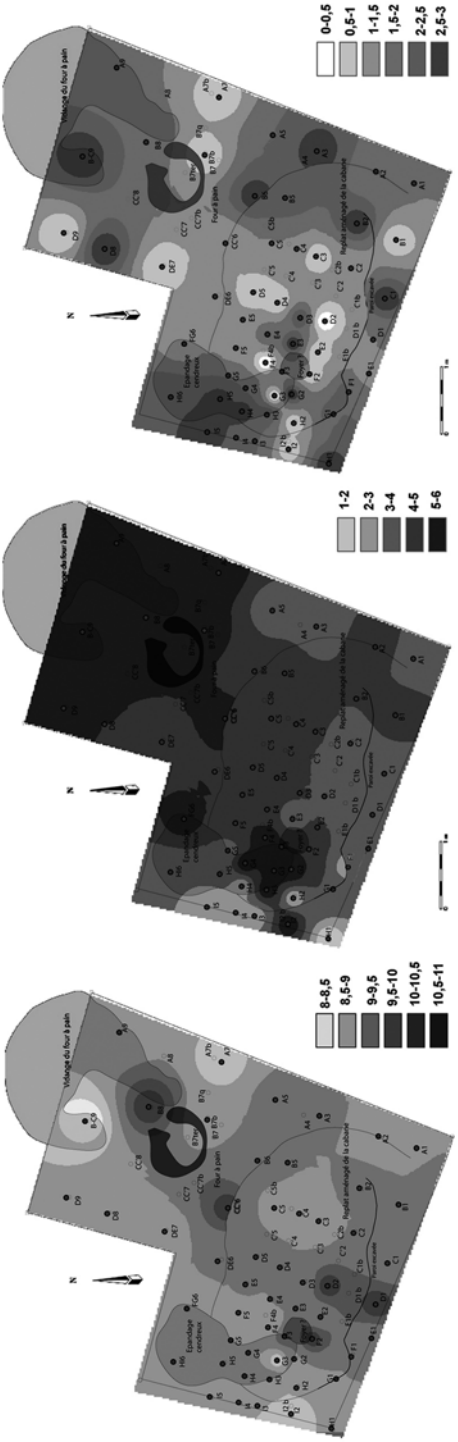

Fig. 20.5 Distribution maps of the phosphates, fatty acids and protein residues. The *black spots* are the sampling points. The scales used for the analyses are semi-quantitative and show the presence and absence of the compounds in the samples (6–12 for protein residues in the left map, 0–6 for phosphates in the central map, 0–3 for fatty acids in the right map) (Barba 2007)

it is possible that at least some of the residues come from the preparation and consumption of the meat that he buys occasionally at the weekly *souk* or from other foodstuffs that are rich in protein. The concentrations of protein residuesare present both inside the hut and around the bread oven outside, where, as mentioned, Mouha eats when the weather is good. In general, the analyses have pointed out the patterns of both food preparation and consumption inside the hut. In particular, the consistency of residues around the fireplace suggests that the location of the mobile burner used for cooking must have always been the same: close to the fireplace.

The ethnoarchaeological research demonstrates that Mouha sleeps in the eastern half of the hut, where the cardboard and carpets are placed (Burri et al. 2013). "Sleeping" activities are usually characterized by the absence of residues; however, although there are less residues than in the rest of the hut, some are present in this area. This could be explained by the fact that the floor absorbs the sum of the activities that are carried out, and in the same area food is also consumed, producing an enrichment of the floor, which possibly penetrates between the cardboard and carpets.

In general, although it is not always possible to correlate certain chemical concentrations to specific activities, the analyses at Naour recognize a differential use of space inside and outside the hut. Moreover, the chemical concentrations outside the hut suggest an intensive use of this area for various activities, as has been observed in other projects (Barba and Ortiz 1992; López Varela et al. 2004; Pecci 2009, 2013; Pecci et al. 2011; Rondelli et al. 2014).

This experiment is the first step of a research process aimed at highlighting the chemical traces in the soil left by a temporary settlement. It must be reinforced by new experiments accompanied by extensive ethnoarchaeological research.

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