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First sampling of ceramic mixtures for Valle d'Aosta: research and perspectives related to the alpine settlement of Orgères (La Thuile-AO, Italy).

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***Abstract* – Characteristic of Alpine settlements is the low percentage of pottery probably for the use of wooden bowls. The study of the Orgères ceramic findings represents the first sampling on the clays which will be the starting point for the archeology of the Valle d'Aosta.**

I. INTRODUCTION

The alpine site of Orgères (La Thuile - AO) is located at 1665 m in the vallon des Chavannes which is an alternative route to the one leading to the Piccolo San Bernardo pass. Its strategic position is the reason for the continuity of the settlement, which is dated between 1st century and the 17th century AD [1].

The low percentage of manufactured items is the main characteristic of an alpine settlements both for the continuous reuse of materials and - as for tableware in particular - for the probable use of wooden bowls which are not always found in due to the fact they were made with perishable material.

However, the study of the pottery from the site of Orgères provided the first sampling on clays and, therefore, it has become a reference point for the archeology of the Valle d'Aosta and the neighboring mountain areas. In the last few decades, numerous analysis techniques have been refined which range across multiple scientific fields that interact with archeology in order to study and understand a territory [2-3].

Moreover, archaeometric analyses allow to gain new information on the chronology, the technology, the socio-economic features and, more generally, on the environmental parameters of an archaeological site [4].

The study of ceramic artifacts is a fundamental field of research, but before starting to think about the subject of typologies, it is essential to set up the study of ceramic mixtures, which has be the result of the cooperation between two disciplines: geology and archaeology.

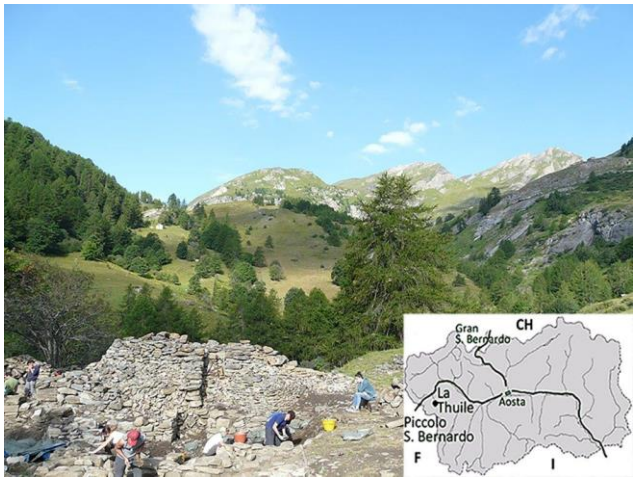


Fig.1. Orgères and vallon des Chavannes

II. METHODS

The Orgères site was preliminarily investigated through the use of CARG Project's geological maps for the new geological map of Italy, computerized and made available on the website of ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale). Considering that Valle d'Aosta does not have vasts clay deposits, it is reasonable to suppose that the pottery of a certain value was imported, while some manufacts of common use were made using the raw clay naturally which is naturally found in all soils, or at most in small clay fields around the site.

The study of the rocks of the area is fundamental both to establish which lithotypes are present and what their characteristics are, and to establish a connection between the composition of the artefacts and the origin of the materials, especially in the case ceramics.

This connection could, in fact, highlight a circulation of raw materials on different scales, from local to regional [5].

The ceramic material recovered in the excavation is quite scarce (310 total shards), fragmentary and almost totally represented by walls: therefore it was not possible to place the materials in a chronotypological grid, nor to use the usual counting methods, such as the minimum number of specimens (NME) or of weighing [6]: 194 fragments were taken into consideration, excluding those that did not exceed cm^2 and "earthenware", because it would be difficult to analyze them with a pair of lenses at 30 and 60 magnifications and without the use of a stereoscope.

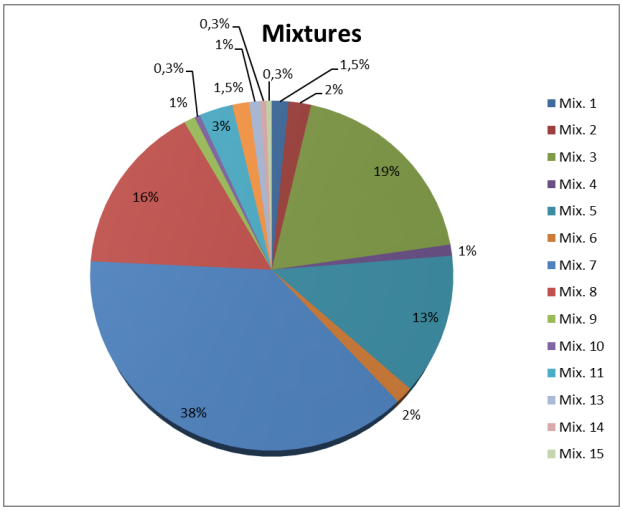
After identifying five different ceramic classes (terra sigillata, acroma, glazed, engobed and earthenware) a macroscopic classification of the mixtures was made [7], without consideration for the treatment and the color of the surfaces susceptible to variations based on manufacturing and cooking, but by identifying the characteristics of the matrix and the visible inclusions, respecting a terminology shared in the scientific and archaeological sector (5).

he ceramic shards are markers for archaeology, and petrography constitutes a fundamental source of support in recognizing the two main components of these artifacts: clay, whose content is generally higher than 50%, and inclusions, which can be of various nature such as minerals, sands and gravels.

Since the clay inside the ceramic fragments is composed of very fine grains (<0.002 mm in diameter), its analysis using the microscope is extremely difficult, since it appears as an amorphous ground mass (matrix) whose identification would result generic [8].

However, apart from the macroscopic observation, some considerations can be made on the consistency, structure and porosity of the matrix [5], as well as on the definition of the included (or clasts) which can be of two types: those naturally present and those added by anthropic action (tempers). The study of the latter must be carried out rigorously and with the help of an expert petrographer, especially while operating at a macroscopic level, since their identification or some of their properties (color, luster, shape, size) could be misfigured. The ability to discern the differences among the various types of included and among the various characteristics of the matrix constitutes the first fundamental step for the definition of classes of mixture [7].

The 15 ceramic mixtures (acroma and coated) from the Orgères site were classified according to the following parameters: structure and hardness of the matrix, porosity, qualitative and quantitative analysis and identification of the crystal habit of inclusions. Below are the most important:



Graph 1 (M. Russo, Progetto Orgères)

Mixture number 3 = hard consistency, granular structure with medium porosity. The inclusions are of two types, both of white color: one is quartz, which is opaque, sub-rounded and isodiametral, its dimensions vary, but do not exceeds 0.5 mm and the frequency is between 5 and 10%; the other is mica and it is shiny, rounded and isodiametral, but it is present for less than 5% in quantities and the dimensions are less than 0.03 mm. There is also a low content of *chamotte*, around 1%, with variable dimensions, but which, in some cases, reaches 2 millimeters in size. The mixture can be called coarse.

Mixture number 5 = quite purified with a hard consistency, while the internal structure is homogeneous with low porosity. Both included are white, rounded and isodiametral, but one is opaque (quartz) with various

dimensions that do not exceed 0.5 mm and very low frequency (about 1%); the other, instead, is shiny (mica) with a slightly higher frequency, which reaches 5%, and has dimensions smaller than 0.03 mm [7].

Mixture number 7 = very purified, with a practically non-existent porosity, and its structure does not present most of the inclusions that are present in other mixtures, but has a very low presence, around 1%, of white an shiny mica of smaller size than 0.03 mm. Moreover, the matrix is very soft and homogeneous.

Mixture number 8 = very similar to mixture 7 in terms of purity, but it differs from it for the structure, in this case lamellar, and for its harder consistency. It has a white and shiny mica content, slightly higher than mixture 7, calculated at 5%, but has the same characteristics both in terms of shape and size.

The matrix types in this classification seem to be very heterogeneous, but there is a prevalence of hard consistency and homogeneous structure, with generally low porosity.

Some mixtures have a high content of clasts, which vary considerably in frequency, size and habit, but in general most of the mixtures have two large categories of inclusions: white and opaque, presumably quartz, and white with metallic luster, identifiable as muscovite; few inclusions are opaque and black, and their identification should be performed by thin section analysis. It is important to underline the presence of *chamotte* [7], in mixture 3, due to its specifically degreasing function, which indicates an intentional addition for the manufacturing of the ceramic body.

However, the same consideration cannot be made for quartz and muscovite, naturally present in clays, since they require a microscopic observation of the shape with the SEM, in particular as regards quartz, because a very angular contour may suggest a grinding of the mineral [9] and therefore an intentional; moreover, the identification of the degree of vitrification of the matrix can be connected, for example, to the temperature reached during the firing phase and, indirectly, it can provide information on the type of furnace (10).

In a second phase, the work focused on the selection of samples suitable for quantitative and qualitative analysis [11]: the determination of mixture classes opens the way to numerous analysis that could give chemical, physical and mineralogical information for the study of ceramics: XRF [12], also in the portable version [13], and ICP-MS [14], are some of the techniques that can be used in the case of Orgères to determine the chemical composition of the mixtures.

The non-destructiveness of X-ray fluorescence spectroscopy combined with the simplicity of using the portable version and the relative speed in obtaining data, justify its wide use in the field of cultural heritage; however it should be emphasized that the XRF analysis, when not performed under ideal conditions or without appropriate sample preparation, can provide unreliable results, such as ignoring low atomic weight atoms or analyzing superficial and unwanted layers or patinas. This eventuality must be underlined, due to the low penetration power of X-ray fluorescence which limits the analysis to those atoms in a range from a few micrometers to a few millimeters, based on the experimental conditions [4].

Recently, in the field of cultural heritage, the use of laser ablation in mass spectrometry (LA-ICP-MS) has become widespread, employing a high-power laser that extracts the ions directly from the surface of the material. Unlike the ICP-MS, the sample is not brought into solution, but the laser produces a micro-hole visible only through the use of a microscope [4-15].

Both techniques allow an even more specific classification and, in the case of ICP-MS mass spectroscopy, also the identification of trace elements, useful for the investigation of provenance [16]; these techniques can be combined with XRD to investigate the mineralogical phases present in the mixtures and the transformation of some minerals subjected to specific temperatures [5-17]; this can help to understand what were the operating temperatures in the furnace and, consequently, it can help to deduce the classes of mixture fired *in situ*.

Invasive sampling often represents an obstacle, even when the results obtained could justify the loss of some portions of the find: in this sense the characteristics of the Orgères pottery, not only extremely fragmentary but also devoid of notable decorative aspects, are particularly suited to this "sacrifice" to highlight a connection between clay and ceramic class.

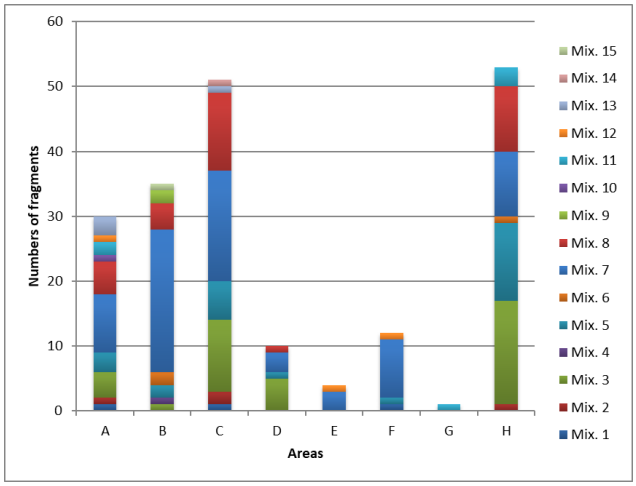
This will provide new and important data for the Valle d'Aosta region and the western Alpine area and it will help understanding the historical phases by overlapping stratigraphic data with laboratory data.

III. RESULTS

The classification and analysis of the 15 mixtures allows to elaborate some considerations on the Orgères site. The variety found indicates a widely diversified use of ceramics, especially of common use.

The majoritarian presence of some mixtures, such as 3 (19%), 5 (13%), 7 (38%) and 8 (16%) (graph 1), could indicate a precise choice on the use of certain clays and/or a purely local processing of clays typical of the place; the mixtures represented by minimal percentages could be connected to occasional permanence factors linked to the "passage" along the road that, from the inhabited area of Orgères, led both to Tarantasia (France) and to the neighboring Val Veny; the minimum percentage of coarse mixes indicates a good technological level reached. Furthermore, the quantitative diffusion

within the various excavations and the percentage ratio with other classes of artifacts were evaluated in trying to understand the intended use of the individual environments (graph 2).
What is the historical significance of these early research data? Even an alpine settlement, located at high altitude like Orgères, can have a differentiated ceramic apparatus, probably connected to its location.
It is desirable that this first reference table for clays will serve as a comparison for the study of valdostan ceramic artifacts in order to understand whether the variety of mixtures found in Orgères is also present in other sites in the region.



Graph 2 (M. Russo, Progetto Orgères, UniTO

HEADINGS

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