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Characterisation of ancient mortars from the S. Niccolò archaeological complex in Montieri (Tuscany – Italy)

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HIGHLIGHTS

- The study of the mortars allowed us to identify 5 principal building phases.
- Metallurgic slags, *cocciopesto* and glasses are visible in the mortar aggregate.
- The metallurgic slags give to the binder a greater hydraulicity.
- Argentiferous minerals are present in the aggregate of some mortars.

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ABSTRACT

The object of the present work is the archaeometric study of the mortars from the S. Niccolò archaeological site in Montieri (Tuscany – Italy). The petrographic, mineralogical and chemical characterisation of the samples was obtained by the use of multi-analytical techniques (OM, XRD, SEM–EDS, XRF). The knowledge of the constitutive materials allowed us to understand the different production technologies and highlighted the use of materials with hydraulic behaviour, such as metallurgical slags and *cocciopesto*. The compositional analogies and differences among the samples contributed to the reconstruction of the building phases, favouring the reading of the history and the evolution of the site over time.

1. Introduction

Mortars have been employed for the edification of historical monuments since the ancient times. They can be defined as artificial stone materials, consisting of a mixture of inorganic or organic binders, aggregate, water and inorganic or organic additives. The proportions of the previous single components should give suitable workability and appropriate physical, mechanical and aesthetic characteristics to the finished product [1]. Today, a great number of researches focus the attention on the study of historical mortars, as source material of important information in archaeological, conservative and scientific fields [2–12]. The investigation about the nature and the provenance of the raw materials, the productive technologies, the change of the production practices (lime burning, mortar mixing), the building phases and the dating of the builds are interesting data in historical and archaeological contexts, in order to reconstruct the economic and political scene of the countries. The compatible materials for restoration can be planned through the study of the original compositions and the deep knowledge of the deterioration processes. Furthermore the chemical, physical and mechanical processes in the mortars, such as the burning of the binder, hydration, carbonation and production of the hydraulic phases, are analysed for a better understanding of the behaviour and potentiality of these materials.

The present work is focussed on the study of ancient mortars coming from the Canonica of S. Niccolò, a medieval archaeological site, located in the Colline Metallifere area (Tuscany)

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Fig. 1. Location of the archaeological site, (a) map, (b) aerial photo and (c) wall rests of the church.

Fig. 2. Sampling, (a) location of the samples on the map, (b) macrophotography of the mortar MM1 and (c, d) sampling of the mortar MM19 and MM1.

(Fig. 1a and b). The development of the site is closely related to the near centre of Montieri (Grosseto), founded for the control and exploitation of the mines in the district.

The aim of the study is the compositional characterization of the mortar samples, extensively taken from the wall remains of the archaeological site. For this purpose a multi-analytical approach is necessary, by using different analytical techniques: the petrographic study in thin section of the samples by optical microscopy (OM); the mineralogical analysis by X-ray diffraction (XRD); micro-chemical investigations by scanning electron microscope (SEM–EDS) and bulk chemical analysis by X-ray fluorescence (XRF). The combination of this methodology with archaeological studies provides useful data to understand different aspects linked to the production technology of the mortars, the provenance of the