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Characterization of mortars from the medieval Abbey of Cerrate (southern Italy)

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ABSTRACT

Mortars from the walls of S. Maria di Cerrate Abbey (South Italy) ranging in age from the 12th to the 20th century, were studied using a multidisciplinary approach designed to produce a guideline of investigation that can be applied to the knowledge and preservation of archaeological sites. The analyses highlighted the differences between medieval and post-medieval mortars; the former showed a dominantly carbonate aggregate, the latter a mostly siliciclastic aggregate. Among these, mortars dated from the XVI–XVII centuries display a mixed siliciclastic-carbonate binder whereas mortars from the XIX–XX centuries exhibit a predominantly carbonate binder with the Al-silicates mostly gathered as lumps.

1. Introduction

Building materials, including their mineralogical, petrographical, and chemical characteristics, the processing tracks they present, as well as the different ways of employing the same materials, must be studied with a view to implement interventions for their conservation and restoration. This approach insures that the proposed interventions will be compatible from the chemical-physical point of view and consistent with criteria such as reversibility and discernibility. Specifically, the case study of the complex of Santa Maria di Cerrate is an example of scientific complementarity.

Although archaeological remains in the Salento area are abundant, surprisingly few published analytical data are available on the ancient mortars from its historical sites. In this paper, we approach the study of mortars coming from S. Maria di Cerrate Abbey, located a few kilometers north of Lecce (Salento) (Fig. 1).

Studying ancient mortars, because of their complexity and heterogeneity, involves many different individual methods and combinations of methods. Selecting the right analytical method depends on what type of result is expected and on the difficulty of distinguishing and identifying binders and aggregates, particularly when the finest components of aggregate are intimately intermingled with binder.

The multi-analytical approach employed in this study includes petrographic analyses coupled with scanning electron microscopy, X-ray powder diffraction, and X-ray fluorescence. These methods were selected to maximize the understanding of the S. Maria di Cerrate mortars, ranging in age from the 12th to the 20th century.

The main aim of this paper is to determine the texture of mortars of different ages and to characterize the nature of the types of aggregates and binders used. Our results have implications not only for the characterization of mortars, given the absence of prior works on the mortars of this important site, but also for helping to answer questions related to the restoration techniques.

2. Historical and archaeological background

The Salento region is renowned for its rich and extensive archaeological record from the Messapic period onwards. The abbey of Santa Maria di Cerrate lies just a few kilometers east of a Roman road called *Traiano-calabra*, which led from Brindisi to Lecce and then to Otranto, passing through the Lecce "forest". The complex of Cerrate is an important witness to the Byzantine

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Fig. 1. S. Maria di Cerrate complex.

colonization process of southern Salento, which started between the ninth and the eleventh centuries. The importance of the abbey suffered a gradual decline as the importance of the Latin Church increased. Only the church continued to be officiated on behalf of the rural population of the area. From 1452, Giovanni Antonio del Balzo Orsini instituted a holiday and a market in front of the church courtyard. In 1531, the estate was acquired by the Hospital of Incurables in Naples. The abbey became a manor farm and the church was gradually abandoned. The manor farm carried out its agricultural activity until the Postwar period, when it was purchased by the Biancos. In 1965, they ceded the complex to the Province of Lecce.

Owing to its importance particularly during the medieval history of the Salento region, this fascinating monastic complex has been chosen for a restoration and conservation project supported by FAI (Fondo Ambiente Italiano).

The history of the Cerrate complex, beginning with the construction of the abbey, within the first three decades of the twelfth century, up to those of the sixteenth-century manor farm, is divided into various construction phases. These are partly documented by archival sources and partly recognizable in the structures themselves, i.e. in their architectural, stylistic and typological features (De Giorgi, 1888; Barletta, 2003; Arthur and Limoncelli, 2004; Bruno and Gravili, 2005).

Over time, the complex underwent several modifications, and in the second half of the last century it was completely abandoned, until its transfer ownership (with Prefectorial Decree of July 27, 1967) to the Provincial Administration of Lecce. In the seventies, restoration interventions of the complex were started, designed by Franco Minissi. Some adaptations followed in 1986, and other interventions in 2006, on the initiative of the provincial administration.

3. Geological setting

The Apennines are a fold-and-thrust belt developed since the Tertiary on top of an eastward-retreating westward-dipping Adriatic plate (Boccaletti et al., 1971; Doglioni, 1991). The Salento region represents a wide part of this Adriatic foreland outcropping from the Istria peninsula along the Gargano promontory and the Murge-Salento peninsula up to the Ibleo-Malta platform. It comprises a Mesozoic carbonate succession overlain by deposits of Neogene and Quaternary age (Ciaranfi et al., 1992; Ricchetti et al., 1992; Vezzani et al., 2010). The Mesozoic succession mostly consists of >6000 m of fine-grained limestones and dolomites representative of a shallow-water carbonate system with episodic red clayey and bauxite lenses testifying exposure periods during the Late Cretaceous; i.e. one such horizon is visible in the “bauxite quarry” outcropping near Otranto. The Mesozoic carbonates are locally overlain by a thin Paleogenic succession represented by the “Calcari di Castro” Formation. The Miocene succession, which covers unconformably the Cretaceous and Paleogene units, consists of different lithostratigraphic units mostly represented by bioclastic calcirudites, calcarenites and calcilutites known as “Pietra leccese” and “Calcareniti di Andrano” Formations.

From a tectonic point of view, during the Paleogen-Neogene, accretionary processes accompanied by the eastward shifting of the foredeep-foreland system, involved the Apennine chain, starting from the westernmost internal units mostly deriving from the erosion of the exhuming belt (Bigi et al., 2002; Civitelli and Corda, 1982; Doglioni, 1991; Elter et al., 2003; Ricci Lucchi, 1986). From the Miocene on, the accretionary prism was affected by extensional tectonics and by the back-arc extension in the Tyrrhenian side (Doglioni, 1991. Contemporaneously, during the Miocene–Early Pleistocene, because of the converging migration of the Apenninic and Dynaric chains (Ricchetti et al., 1992), the Apulian foreland became an asymmetric horst affected by tensional and transtensional tectonics resulted in the formation of grabens and half-grabens successively filled with cyclical Pliocene and Pleistocene deposits (D'Alessandro et al., 2004).

4. Sampling

In order to appropriately plan restoration techniques, the sampling of materials had to be carefully decided and conducted to interpret the resulting characteristics of samples within the framework of the historical knowledge of the abbey complex.

The sampling procedure aimed to conservation efforts depends on fundamental factors such as: i) a knowledge of both the documentation and conservative history that provides a basis on which one decides the focus of the study; ii) the number of samples, which must be the least invasive yet as completely representative as possible; iii) the fundamental importance of the preliminary analysis of the sampled material (i.e. the macroscopic characteristics of samples). To ensure the legitimacy of a study on constituent materials from historical and artistic samples, it is necessary that the first reading of the samples is done by the same person who performs the sampling. For the complex of S. Maria di Cerrate the detail of the study and, consequently, the samplings were carried out based on the information contained in the stratigraphic units of the masonry (Fig. 2; Table 1).

The aim was to give answers on changes of wall textures, aligning them, whenever possible, with other available sources.

5. Materials and methods

The survey on masonry construction techniques was performed through specific forms of the stratigraphic units. The forms developed for this purpose contain information about type of material employed, type of masonry, construction characteristics, and reference chronology. Next, within wall forms, sampling extraction points were identified to characterize their constituent materials such as mortars and lithoids. After extracting samples, polished slices were produced for macroscopic interpretation, and to provide more selected test samples to be analyzed. Macroscopic reading of ancient mortars reveals a critical statistic: the ratio between percentage of matter selected to be observed and the whole masonry unit. Therefore, interpretation of results coming from samples analyzed must be supported by other surveys of a historical-critical, petrographic, and chemical-physical nature (Torraca, 2004-2007). The