ANALYSES ON BUILDING MORTAR SAMPLES USED IN THE WORKS OF MASONRY OF THE JASOS ARCHAEOLOGICAL SITE, TURKEY.

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Keywords: Archaeological Heritage Conservation, Survey and Mapping, Data collection Information Technology

Abstract

Mineralogical and petrographical analyses of mortar samples coming from different stratigraphic units of the walls,have been attempted. The importance of a deep knowledge of the materials used as mortars in the works of masonry is due to the need of characterising their composition and quantifying the percentage of the different components, suche as aggregate and/or binder.
The comparison of the samples and the evaluation of data from both excavation samples and stratigraphical analyses of the walls could allow to define relative or absolute chronologies. These temporal data could be useful for the study of manufacts of the Iasos archaeological site. The large use of these methodologies in the survey could add useful information on both the technological processes and on the sites the studied materials come from. The research will also represent an important documentation for a reliable chronological reconstruction of the different phases of development of the ancient urban site.

1. Analytical methodologies

The analytical methodologies used for the purpose follow the UNI-NORMAL 12/83 rules (artificial aggregates of clasts with a not clayey binder matrix: scheme of description).
Materials have been described and classified through the observation of thin sections – thin sections are 30 micron thick - . The observation are made through an optical microscope at trasmission light. The observations allow to recognize both mineralogical, and textural and structural differences among the samples.
The mineralogical and petrographical description of the samples follows. Photos of thin sections are enclosed.

2. Results

Sample UF10 USM3: mortar made of an aggregate with a little omogeneous granulometry, not oriented, omogeneously distributed and with dimensions between 50 micron and few millimeters. The mineralogical anlysis suggests the presence of vulcanic and sedimentary rocks – sandstones -. The vulcanic rocks have a porfiric structure, with fenocrystals included in a microcrystalline to vitreous ground mass. Brick fragments are also present. The granes of the aggregate have different forms and are quite rounded. The aggregate/binder ratio is high – about 50% - , and the adhesion of clasts and binder along the grain boundary is good. The hazel binder is quite omogeneous; its composition is calcitic, with micro-cristalline dimensions; some lumps are also present. Many pores of different forms and dimensions occurr; porosity is high and shrink fissures are rare (See Fig.1-2).

Sample UF1 USM6: mortar made of an aggregate with a little omogeneous granulometry, not oriented, omogeneously distributed and with dimensions between 50 and 100 micron and few millimeters -this fraction is less abundant -. The mineralogical analysis suggests the presence of quartzose-micaceous to carbonatic rocks –calcschists -, brick fragments and parts of microorganism shells. Polycristalline quartzose crystals and rare felspars also occurr. The granes of the aggregate have different forms and are generally well rounded. The aggregate/binder ratio is made by 30-40% aggregate and 60-70% binder, and the adhesion along the grain boundary of clasts and binder is good. The binder is not omogeneous, with dark hazel colourportions; some lumps and cooking remains are also present. The binder has a calcitic composition, and the texture is from cripto- to micro- crystalline.Many pores of different forms and dimensions occurr; porosity is quite high and shrink fissures are also present (See Fig.3-4).

Sample UF10 USM1: mortar made of an aggregate with a little omogeneous granulometry, not oriented, omogeneously distributed and with dimensions between 50 micron and few centimeters. The mineralogical anlysis suggests the presence of calcschists, arenaceous fragments, rare carbonatic fragments, some brick fragments and parts of microorganism shells. Quartz and feldspar crystals are also present: quartz crystals are often policrystals with wavy extinction. The granes of the aggregate shows many different forms and are generally well rounded. The aggregate/binder ratio is made by 30-40% aggregate and 60-70% binder, and the adhesion along the grain boundary of clasts and binder is scarce. The binder is characterized by a quite omogeneous hazel colour alternating with pale grey bands; lumps also occurr. The binder is calcitic, and the texture is micro crystalline. Many pores are present; porosity is quite high and many shrink fissures also occurr (See Fig.5-6).

Sample UF1 USM5: mortar made of an aggregate with a little omogeneous granulometry, not oriented, omogeneously distributed and with dimensions between 100 micron and few millimeters. The granulometric class of about 100 micron is scarcely represented; the most represented one is that between about 200 and 600 micron.The mineralogical anlysis suggests the presence of calcschists, arenaceous rock fragments and rare carbonatic fragments. Rare brick fragments and parts of microorganism shells also occurr. Quartz and feldspar crystals are also present: their dimensions are between 200 and 400 micron. Quartz crystals are often policrystals with wavy extinction. Crystals have different forms and are generally subrounded and/or subangular. The aggregate/binder ratio is about 40-50% and the adhesion along the grain boundary between clasts and binder is quite good.. The binder is characterized by a not omogeneous colour and apparance, with the presence of lumps. The dominating colour is dark hazel; the binder composition is calcitic, and the texture is micro crystalline. Many pores with different forms and dimensions are present. Many shrink fissures also occurr in correspondance with lumps (See Fig.7-8).

Sample UF1 USM2: mortar made of an aggregate with a little omogeneous granulometry, not oriented, omogeneously distributed and with dimensions between few micron and few millimeters. The mineralogical anlysis suggests the presence of arenaceous rock fragments, calcschists, quartz crystals, both monomineral and policrystalline, felspars, biotite and rare bioclastic fragments.
The aggregate grains have different forms and are subangular and/or subrounded, depending on the hardness of the clasts. The aggregate/binder ratio is about 30% and the adhesion along the grain boundary is quite good.. The binder is characterized by a not omogeneous colour, from dark hazel to pale grey; its composition is calcitic, and the texture is micro crystalline, locally criptocrystalline. Many pores with different forms and dimensions are present. Many shrink fissures also occurr (See Fig.9-10).

Sample UF1 USM3: mortar made of an aggregate with a little omogeneous granulometry, not oriented, omogeneously distributed and with dimensions between 100 micron and few millimeters. The granulometric class of about 100 micron is scarcely represented; the most represented one is that between about 200 and 600 micron. The mineralogical anlysys suggests the presence of arenaceous rock fragments and, calcschists, with rare carbonatic rocks. There are also brick and bioclastic fragments. A less abundant portion is represented by crystals with dimensions between 200 and 400 micron, mainly felspars and quartz, sometimes policrystalline with wavy extinction. Crystals have different forms, and are subangular and/ or subrounded. The aggregate/binder ratio is about 50% and the adhesion along the grain boundary is good.. The binder is characterized by a quite omogeneous dark hazel colour, with the presence of some cooking remains of the originating rock (marble). The composition is calcitic, and the texture is micro crystalline. Many pores with different forms and dimensions are present. Many shrink fissures also occurr (See Fig.11-12-13)

3. Conclusion

Six building mortar samples used in the works of masonry of the archaeological site of Jasos (Turkey) have been analyzed. The samples come from different wall stratigraphy units of the walls. They have been distinguished into three groups, on the basis of mineralogical and petrographical observations.
The first group includes most of the samples, characterized by a little omogeneous and quite tenacious binder with a micro- and cripto-crystalline texture containing many lumps. The aggregate has a little omogeneous granulometry, and is made of fragments of arenaceous rocks, calcschists, bioclasts, brick fragments, quartz and feldspars.
The second group includes sample UF1 USM3, quite similar to the samples of the preceding group, except for the presence of relic marble structures in the binder. They suggest the use of this material in the preparation of the binder of this mixture.
The third group includes sample UF10 USM3, that is characterized by a quite omogeneous binder with a microcrystalline texture, rare lumps, good tenacity, and an aggregate with a quite omogeneous granulometry. The aggregate is made of fragments of vulcanic rocks – pozzolana – and sandstone. This different composition suggests that the three types of mixtures here recognized date back to temporally different periods or are referred to remakes and corrections in different ages.

References

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Autori Vari, scienza e beni culturali nulla ars sine scientia “rivista quadrimestrale del Convegno di Studi di Bressanone”.

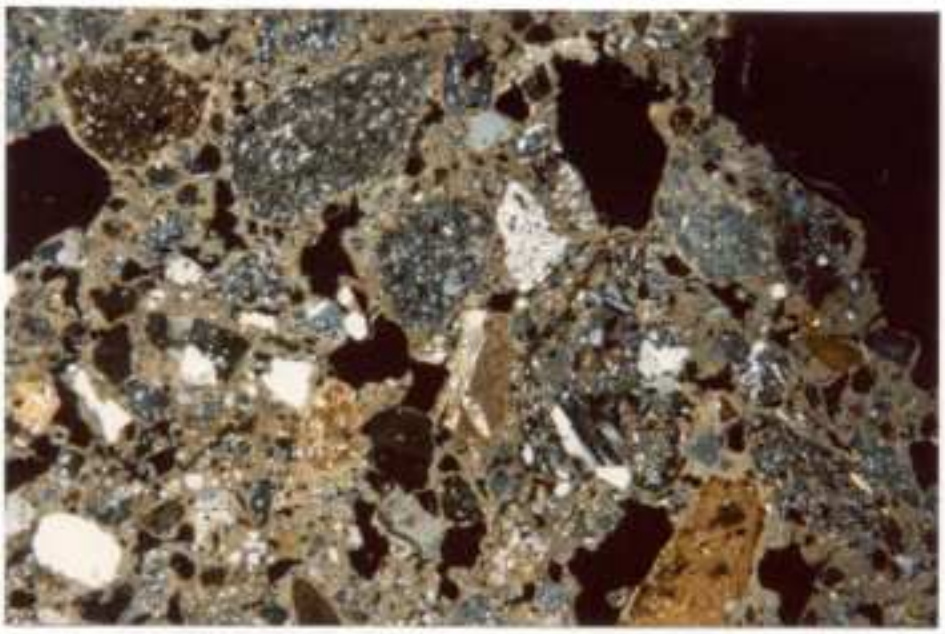

Fig.1 - camp.UF10 USM3, 6,5x, nicol+, aspetto generale

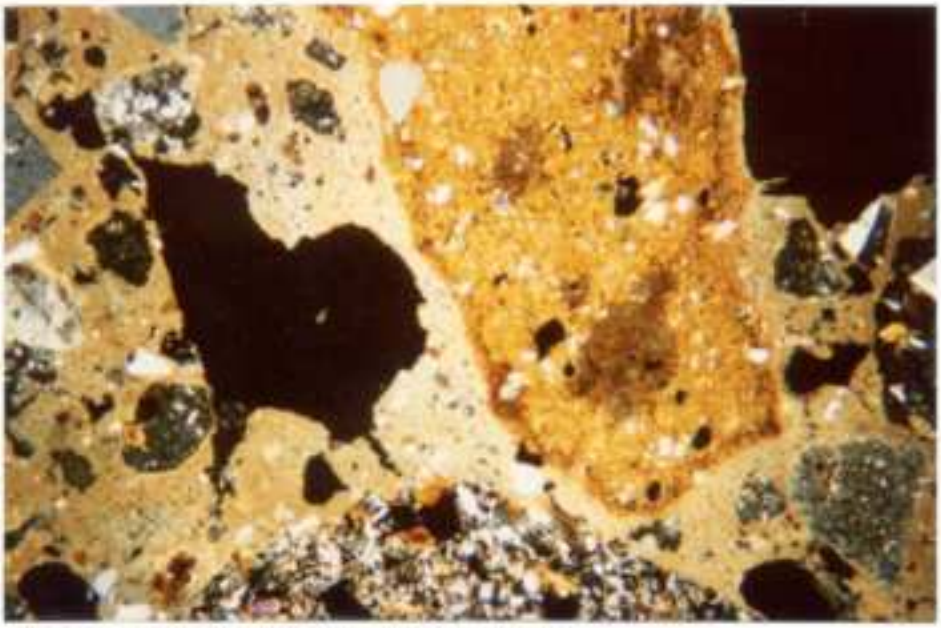

Fig.2 - camp.UF10 USM3, 25x, nicol+, particolare ingrandito

Fig.3 - camp.UF1 USM6, 6,5x, nicol//, aspetto generale

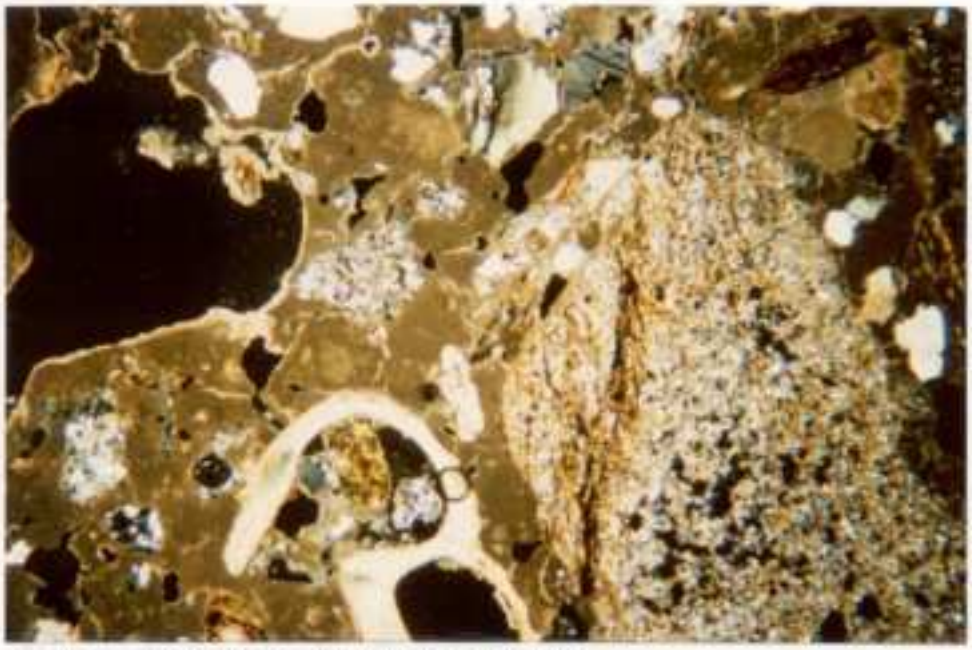

Fig.4 - camp.UF1 USM6, 25x, nicol+, particolare ingrandito

Fig.5 - camp.UF10 USM1, 6.5x, nicol+, aspetto generale

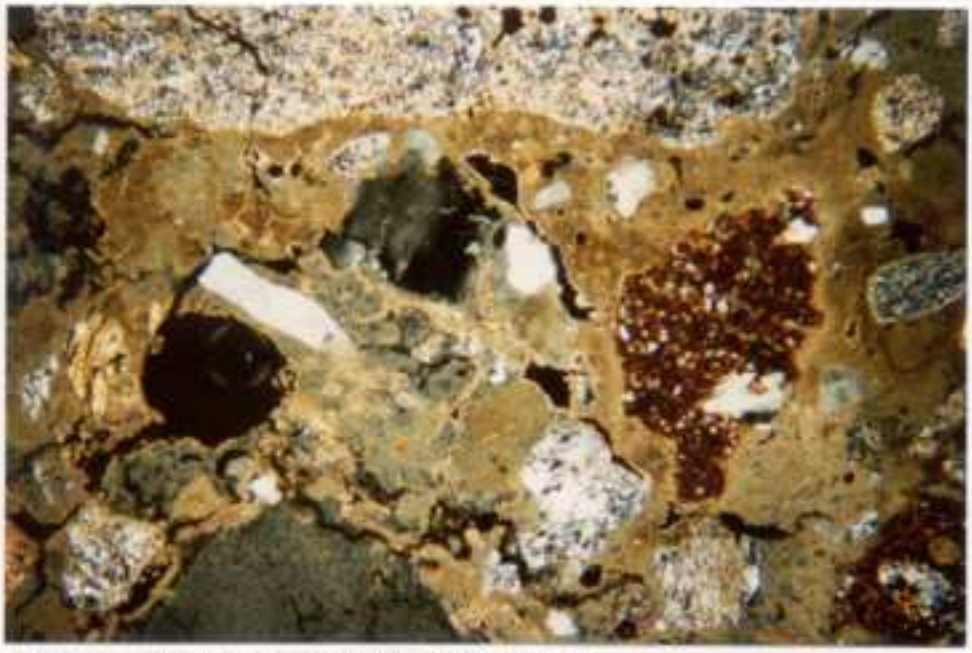

Fig.6 - camp.UF10 USM1, 25x, nicol+, particolare ingrandito

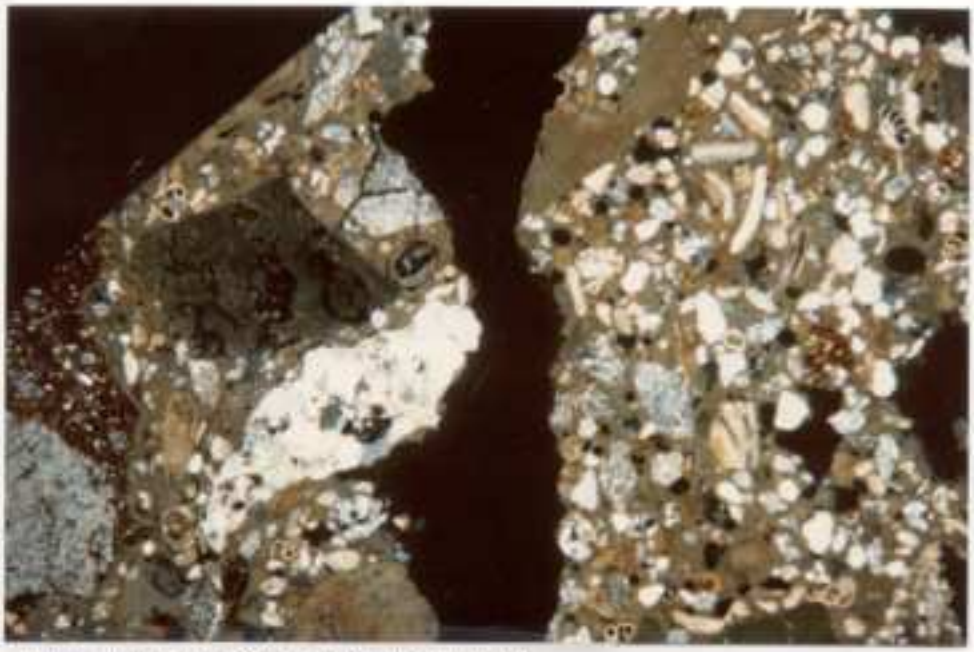

Fig.7 - camp UF1 USM5, 6.5x, nicol+, aspetto generale

Fig.8 - camp UF1 USM5, 25x, nicol+, particolare ingrandito