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XV to XVIII Centuries

Giorgio VERDIANI (Ed.)

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How archeometry can help history and geology: the case of the Geonoese towers in Capraia island

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Abstract

The island of Capraia belonged to the Republic of Genoa from the XIVth century to the end of the XVIIIth century. During that period three towers and a fortress were built for defensive purposes. Concerning the building materials, it should be noticed that Capraia is a volcanic island, therefore lacking of carbonate rocks, which are essential for the production of lime. The literature reports that the lime arrived from Genoa and/or from Corsica while the sand seems to come from the beach of the port. This research reports the results of the study of the mortar utilized to build the towers with a particular focus on the provenance of the raw materials (lime and sand) and on the technology utilized to realize the mortar itself. As a matter of fact, in the mortar aggregate traces of metamorphic rock fragments peculiar of Northern Corsica, Gorgona and Western Liguria have been found, eventually interpreted as sand impurities of the beaches from where the transport boats (*leudi*) were leaving carrying goods from Corsica and Genoa. This is an example as how archaeometry can give information on the maritime trade routes of the north Tyrrenian sea and on the geology of the island.

Keywords: mortar, Genoese towers, stone ballasts, Capraia island.

1. Introduction

The island of Capraia belonged to the Republic of Genoa from the XIVth century to the end of the XVIIIth century. During the Genoese rule, after the destruction perpetrated by the Ottoman corsair Dragut in 1540, the Banco di San Giorgio supported the renovation and expansion of the fortress built by the Pisans (St. George fortress) and the construction of two towers, of Porto (1541) to defend the bay and prevent the landing of enemy ships, and of Zenòbito (1545) in the southern tip of the island. Later on the tower of Barbìci was built in the Northern tip (1699) with the function to watch over the sea toward the Tuscan coast (Fig. 1). The island was in fact a strategic point on the route Corsica-Genoa. The Zenòbito tower owes its name to an ancient monastery (*cenobio*) which was located nearby in the Middle Ages and gave its name to the plain of Zenòbito. At present this tower shows all the signs of more than four centuries of history but its striking shape still dominate the landscape (Fig. 2). With regards to the tower of Zenòbito, the achievement was particularly difficult because of the position of the site: with the exception of stones blocks that were extracted nearby, all other construction materials (lime and sand for the mortar, beams for floors and for carpentry, etc.) had to be transported by sea from the port of Capraia, 5 miles away, and then carried by mules along a steep slope.

Fig.1- Position of the towers in Capraia.

Fig. 2- Tower of Zenòbito.

The tower consists of a truncated cone base which continues with a cylindrical body topped by corbels that sustained a wooden balcony. The interior has three floors and the entrance is halfway up the tower for a better defense. At present the tower shows important residues of the original rendering, still characterized by good adhesion to the masonry which is realized according to a core structure, with the outer wall made of irregular roughly shaped volcanic rock blocks placed with quite a lot of mortar. This masonry shows a good cohesion, even if the mortar joints are deeply eroded. Therefore, the tower has a surface deeply marked by the time, which shows a multitude of signs and information [Mannoni 1994; Pittaluga 2009] (Fig. 3).

Fig.3- Tower of Zenòbito: the surface naturalized with the surrounding environment.

Nevertheless, two conservation problems are present: the portion exposed southeast, where the outer wall fell down uncovering the inner core of the masonry and the deeply eroded corbels that supported the balcony.

The tower of Porto (Fig. 4), sited on the promontory east of the harbour, shows an aspect similar to that of Zenòbito, but with a smaller diameter. It has been recently restored and although it might seem a good intervention to the normal not aware persons, unfortunately the restoration has not been able to keep on the surface the track of time, completely removing the remains of the original plaster and sealing with a new mortar the joints of the original bedding mortar (Fig. 5).

Fig. 4- Tower of Porto.

Fig. 5- Tower of Porto: the restored surface.

Fig. 6- Tower of Barbìci.

The tower of Barbìci, called also “della Regina” (Fig. 6) has a square base and was realized, like the other towers, according to a core structure, made of roughly shaped volcanic rock blocks placed with a lot of mortar.

Fig.7 - Tower of Barbìci: the deeply eroded masonry.

The eastern side shows little residues of the original rendering but in the complex the masonry is deeply eroded (Fig. 7) and in the southern side the outer wall has completely collapsed.

2. Research studies

The research started from the study of the mortars present in the Zenòbito tower (bedding mortars and rendering) in order to verify the origin of the raw materials (lime and aggregate) and the preparation technology. This interest arose because Capraia is a completely volcanic island (andesitic-riodacitic products rich in potassium [7.5-6.9My] in the northern area and trachybasalt-shoshonitic rocks [4.6My] in the Zenòbito area [Chelazzi, 2006; Poli, 2003], therefore it could not provide the raw material for the production of lime (carbonate rocks).

Actually in Liguria, from the XIIth century a highly specialized lime production system developed [Vecchiattini, 2009] due to the presence of dolomite rocks outcrops near the coast (Sestri Ponente, Cogoleto, Vado Ligure) and to the consequent possibility of carrying the lime by sea cost-effectively, even in distant sites. The clods of quicklime obtained by burning were stored in wooden barrels and transported by mule to the beach, where they were loaded into *leudi* but also *filuche* and boats conducted by sailors at service of the lime producers.

It was therefore reasonable to assume that the lime for the construction of the fortifications of Capraia and of many coastal towers of Corsica (an island relatively poor of carbonate outcrops), Genovese possession at the time, arrived from Liguria [Moresco, 2007 a, b; Moresco, 2008].

As a matter of fact, the petrographic and mineralogical analyses on the mortars of the Zenòbito tower confirmed that the lime is an air hardening magnesium lime with the typical spherical hydromagnesite structures characteristic of the Genoese production [Fratini, 2012; Pecchioni, 2014] (Fig. 8).

However, the study of the composition of the aggregate had shown, beside the prevailing presence of fragments of andesitic volcanic rocks, pyroxenes, feldspars, biotite, also the sporadic presence of fragments of calc-schists, quartzites and phyllites characteristic of high pressure/low temperature metamorphism, in any case of low grade conditions (mica schists, calc schists, quartzites) (Fig. 9). The prevailing presence of fragments of volcanic rocks is in accord with the composition of the sandy sediments of the bay where the port of Capraia is sited or nearby creeks while the presence of fragments of metamorphic rocks is problematic because of the absence of outcrops of this type of rocks in the island [Poli, 2003].

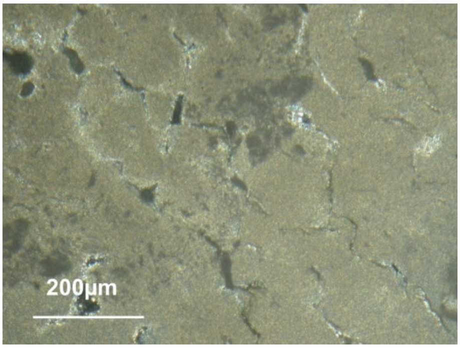

Fig. 8- Spherical hydromagnesite structures in the mortar binder (thin section, XPL).

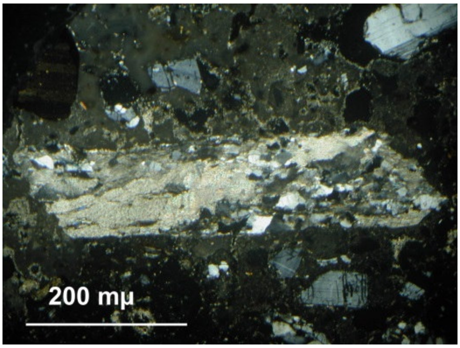

Fig.9- Calc schist grain (thin section, XPL).

Therefore, the study of the mortars of the two other towers (of the Porto and of Barbìci), was undertaken. Even in this case the use of a magnesian lime and the presence in the aggregate of "allochthon materials" was recognized. In particular, in the Tower of Barbìci numerous centimetric under-burnt dolomite fragments were recognized (presence in XRD spectra of brucite and calcite) (Fig 10). This high amount of lumps, the excellent mechanical characteristics and good adhesion to the masonry elements may indicate that for the realization of the mortar, the technique of the hot lime was adopted [Pecchioni, 2008]. Regarding the aggregate, already with the naked eye it was possible to observe the presence of small pebbles of serpentinite (0.5cm in size) (Fig. 11).

Regarding the provenance of this aggregate, apparently referring to a high pressure /low temperature metamorphism, similar to that affecting the Ligurian Piedmontese metamorphic units (Schistes Lustrés), which closest outcrops are in northeastern Corsica and in Gorgona island but which widely crop out further away west of Genoa [Durand-Delga 1978, 1984; Orti, 2002].

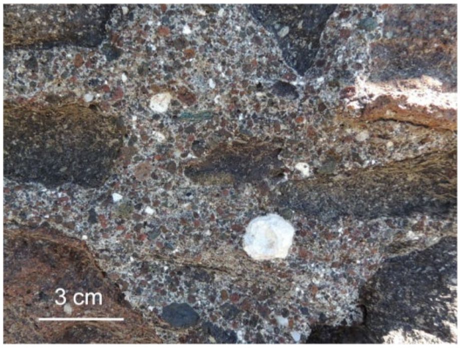

Fig. 10- Under-burnt dolomite fragment.

Fig. 11- Little pebble of serpentinite.

But how these rocks can be found in the island considering that they cannot be sandy sediments transported by sea currents since the island is separated from the closest Corsica, Gorgona and Liguria by fairly deep sea crossings (i.e. Corsica channel and Ligurian

Sea) ? The first hypothesis was the presence of xenoliths ripped along the volcanic chimney from the metamorphic wall rocks. In literature, however, the presence of this type of inclusions in the volcanic rocks of the island is not reported [Prosperino, 1993; Peccerillo, 2005; Poli, 2016] and also a survey of the cliffs that surround the bay where the port of Capraia is sited, excluded their presence.

The other possible hypothesis was the origin from the Ligurian metamorphic units cropping out west of Genoa, in particular from stone ballast taken from the beaches of Cogoleto and Sestri Ponente (characterized by the presence of pebbles coming from the *Schistes Lustrés*) where the Genoese shipping vessels load the quiklime, stone ballast later abandoned on the Capraia harbour. During loading, sandy/gravelly debris could have been also unintentionally transported aboard (Fig. 12).

Fig. 12- The beach of Cogoleto (Genoa) with *leudi* before loading (late XIXth century).

Actually a careful survey at the base of the cliffs surrounding the bay, made it possible to find some large pebbles of metamorphic rocks of a nature similar to that found in the aggregate of the towers mortars. On the other hand the study of the sand of the bay will not give reliable information any more because now it is completely "contaminated" by the materials transported from the Italian peninsula for the renovation of the port and for building works in general. Stone ballast were typically used in a suitable position to correct the trim of a boat and ensure greater stability during navigation and this is testified by the load of numerous shipwrecks, especially Romans, found in the Mediterranean. However there are few archaeometric studies on the stones themselves in order to determine the routes and ports. In this regard we report the finding in a bay near Ginostra (shoals of Lazarus-island of Stromboli) of blocks some decimetres in diameter consisting of metamorphic rocks and migmatites characteristic of the Calabrian Peloritan arc interpreted as the ballast of a ship wrecked (Alberto Renzulli-University of Urbino, personal communication) and the study of the stone ballast of the ships and stowage materials from the archeological site of Pisa San Rossore [Pecchioni, 2007].

Conclusions

The archaeometric study of the bedding mortars and renders of the Genoese towers on the island of Capraia made it possible to recognize the use of a magnesium lime that was most probably produced nearby Genoa from local outcrops of dolomite rocks because the island cannot supply carbonate rocks suitable for producing lime.

The aggregate is of local origin (sandy sediments of the bay where the port of Capraia is sited or neighbouring creeks), but the presence of traces of low-grade metamorphic rocks and serpentinite (rocks absent in the island) has led to the hypothesis that they come from stone ballasts transported by ships and abandoned on the beach or sandy/gravelly debris unconsciously transported on board, as was later confirmed by the discovery of large pebbles of this nature at the base of the cliff of the bay of the port of Capraia

This research therefore enables to understand how the study of the material culture (in this case the materials of architecture) provides interesting historical information on ancient trade routes, operational practices (loading of the goods from a beach), but also it can give information from the geological point of view about lithological particularities not recognized during the geological surveys.

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