Period. Mineral. (2010), Special Issue, 11-20

doi: 10.2451/2010PM0018
http://go.to/permin

PERIODICO di MINERALOGIA
established in 1930

An International Journal of
MINERALOGY, CRYSTALLOGRAPHY, GEOCHEMISTRY, ORE DEPOSITS, PETROLOGY, VOLCANOLOGY
and applied topics on *Environment*, *Archeometry* and *Cultural Heritage*

Mapping of the stones in the main façade of St. Giuliana castle (Umbertide, Italy)

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Submitted, September 2010 - Accepted, November 2010

Abstract - This article reports the mapping of the materials employed in the main façade of the medieval castle of St. Giuliana (XIII-XIV century A.D). This is one of the best examples of a fortified settlement, located on Mt. Corona (708 m a.s.l.) in Umbertide (N-W Umbria).

The main façade, made with stones of local origin, is particularly interesting for the extensive and unusual presence of travertine ashlars, which are completely absent in the walls of the other structural units of this castle and in the construction walls of the other medieval castles belonging to the neighbouring territory.

Travertine stone, is now almost rare in the surrounding area; there are only small outcrops of it on Mt. Corona near Ascagnano.

The other stones that were used are either sandstones (belonging to the Umbrian Marnoso - Arenacea fm) and limestones (belonging to the lithostratigraphic Scaglia Variegata and Scaglia Rossa fms, and the Maiolica fm) all coming from the southern side of Mt. Corona at low distance from the castle (less than 3 km). There are also some bricks from later building restorations.

Riassunto - In questo articolo si riporta la mappatura dei materiali in opera nella facciata principale del castello medievale di S.Giuliana (XIII-XIV sec. d.c) ; uno dei migliori esempi di insediamento fortificato localizzato sul Monte Corona (708 m s.l.m.), nel comune di Umbertide (N-O Umbria).

La facciata principale, realizzata con rocce di provenienza locale, risulta particolarmente interessante per l'abbondante ed esclusiva presenza di conci di travertino, completamente assente sia nelle murature delle altre unità strutturali del castello sia nelle strutture murarie degli altri castelli medievali appartenenti al territorio di Umbertide.

Il travertino oggi è molto raro nel territorio limitrofo; ne rimangono soltanto piccole tracce sul Monte Corona nei pressi di Ascagnano.

Le altre rocce impiegate sia arenarie (appartenenti alla Formazione Marnoso-Arenacea Umbra) sia calcari (appartenenti alle formazioni della Scaglia; Membri della Scaglia Variegata e della Scaglia Rossa e alla formazione della Maiolica), provengono tutte dal Monte Corona ad una distanza dal castello non superiore ai 3 km.

In opera inoltre, sono presenti laterizi attribuibili ad una fase posteriore di restauro.

Key words: *lithological mapping; medieval buildings; N-W Umbria (Italy).*

Introduction

In many monuments different types of stones are used for architectural designs, construction and art. They also have been chosen for their availability and workability.

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During the restoration work it is foundamental to identify and to evaluate the degree of deterioration of the stones.

Currently, computer technology applied to cultural heritage is a valuable tool to support conservation and restoration of architectural and monumental heritage.

Thanks to modern CAD (Computer Aided Design) it is possible to map the monument using digitized plans and record the different lithotypes in place.

Plans and digital information files with planimetric data, allows multiple options for questions, pictures, and quantitative assessments processing information.

This article describes the lithological mapping of the main façade of the castle of St. Giuliana. It is particularly interesting because it represents the only example of a medieval wall in the municipal territory of Umbertide (Giammartini, 2009) in which were used travertine stone. This area has been mapped stone by stone to document the distribution of different lithotypes used.

The castle of St. Giuliana is considered a true pearl of superior beauty; of the 30 medieval castles belonging to the current territory of the municipality of Umbertide, it is particularly interesting and worthy of study for both the state of conservation and its structural typology. Last but not least it was chosen by director Michele Soavi, in 2002, when he shot some scenes for the film "Francesco" on the life of San Francesco d'Assisi.

METHODS AND SAMPLING

Lithological mapping

The mapping of the main façade of the Castle of St. Giuliana was carried out identifying the lithological nature of every single ashlar and every stone fragment, basing on macroscopic features visible to the naked eye and with the help of eye lenses.

CAD software (AutoCAD 2010, AutoDesk) was used to store, process and visualize, using a vector based graphics, the types of stones on the wall surface of the façade.

The obtained relief is composed of multiple sets of lines arranged on multiple levels; these have been converted into a set of closed objects, corresponding to the individual ashlars in the façade.

Lithological mapping includes the registration of all the types of stones and a quantitative assessment referred to the number and the surface of the stone.

In the final graphic elaboration an error in representing the ashlars in a range from 0 to max. 2 cm is expected.

Sampling

Up to 15 samples considered fully representative of the employed natural materials have been collected from the main façade of the previously cited castle in order to be characterized by micropaleontological - petrographic methods (a thin section).

IDENTIFICATION OF NATURAL STONES

Listed below are the various lithotypes identified in the main façade of the castle of St. Giuliana. They belong to the Umbria - Marche stratigraphic succession, outcropping in the Umbertide area and particularly just to the south (1-2 Km) of the top of Mt. Corona (708 m a.s.l.), site of the castle. The lithotypes cropping out in the area belong to two different overlying tectonic units. The Lower Unit (autochthonous) is made by a Triassic-Palaeogene sedimentary sequence, of Umbrian type, mainly carbonatic, followed by Miocene turbidites. The Upper Unit (allochthonous) of Tuscan type, is composed in the lower part by the "*Argille Varicolori*" (Late Eocene - Early Oligocene) and in the upper part by the "*Arenarie del Falterona*" (Late Oligocene - Aquitanian p.p.; Boscherini *et al*.,1981).

The ashlars used to build the main façade are sandstones and limestones and it is documented that these lithotypes were extracted in this area since ancient times.

For each type of natural stone present in the façade of the castle the main lithological characteristics and the more frequent associated damages are listed below.

Carbonatic rocks

Maiolica fm -This is a fine white or light gray limestone, with conchoidal fracture in regular, thin to medium (20-50 cm) strata, containing bands and nodules of brown or black chert.

Thickness about 130 m.

Microfacies: it consists of Calpionellae bearing wackestone - packestone, with radiolaria mostly concentrated in the lower part (Fig. 1-A, B; Fig. 2-E). The age of the formation is referred to the Tithonian p.p. - Aptian p.p. interval.

The ashlars show mostly the presence of black patina and some cracks due to the presence of vegetation.

Quite large Maiolica outcrops occur near the castle of St. Giuliana, more precisely to the south at a distance of nearly 1 Km.

Scaglia Rossa fm - It is pink limestone containing abundant planktonic foraminifera, locally varying in intensity and turning to white, alternating with thin-bedded pelitic layers and bands and nodules of amaranth chert.

The presence of calcite veins, and numerous minute granules of metal oxides together with an abundant foraminiferal microfauna gives it a characteristic pitting. Calcite veins are often enriched in iron oxides.

The Cretaceous part of the formation consists almost exclusively of limestones and is characterised by thicker strata (10-40 cm). The Palaeogenic part shows thinner beds with relatively thicker marly-clayey layers, of a brick-red colour more intense than that of the limestone.

Thickness about 100 m.

Microfacies: wackestone with benthonic and planctonic foraminifers (Fig. 1-C, D; Fig. 2-A).

The age of this formation is referable in the literature to the Turonian p.p. - Early Eocene p.p. interval.

The main forms of deterioration observed in this lithotypes are the formation of black crusts; they occur in a fairly compact way forming a dense and highly cohesive film on the wall.

There are also biological patinas caused by mosses and lichens activity and fractures on some ashlars due to the mechanical action of some plants climbing on the façade.

Also the Scaglia Rossa fm outcrops extensively on Mt. Corona to the south-east of the castle of St. Giuliana at a distance of less than 1 km. Its presence is also documented in the neighbouring localities of Col Di Lito, Galera and Colle San Gianni (A.S.C.U., 1862). It is the most diffused carbonate rock used for the construction walls of medieval castles and for most of the other monumental works in the area.

Scaglia Variegata fm - It is a marly limestone rich in planktonic foraminifera, whose colour ranges from pinkish gray to light-green. It is generally thin- bedded with strata on average of at least 10 cm, with irregular fracture, alternating with horizons of red clayey marls. The passage to the underlying Scaglia Rossa is fairly gradual, marked by a progressive reduction in the pelitic component an increase in the average thickness of the beds and the prevalence convergence of colours on red tones.

Thickness about 50 m.

Microfacies: wackestone with planctonic foraminifers (Fig. 1-E, F; Fig. 2-D). The age is referred to Middle and Late Eocene for this formation.

Forms of deterioration are, also in this case, black crusts and biological patinas from mosses and lichens.

There is an abundance of this rocks on the

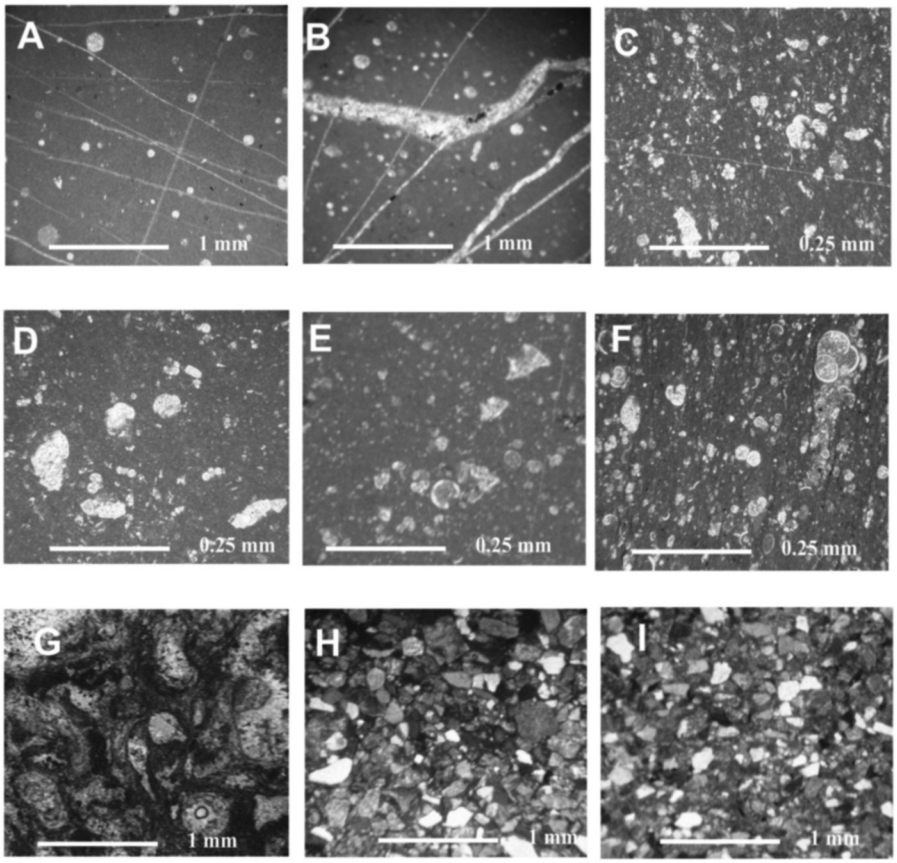

Fig. 1 - Thin section microphotos of the natural materials employed in the main façade of St. Giuliana castle. A,B: Maiolica microfacies, wackestone with radiolaria, rare Calpionellae (*Calpionella alpina*) and sparitic veins; C,D: Scaglia Rossa microfacies, wackestone with Cretaceous foraminifers (*Dicarinella concavata, Globotruncana linneiana*); E,F: Scaglia Variegata microfacies, wackestone with foraminifers (*Morozovella sp., Globigerinatheka sp., Globogerinatheka subconglobata, Subbotina eocaena, Subbotina hagni*); G: Travertine microfacies, phitoclastic - phitohermal travertine with Caharaceae oogonia, Ostracoda and bivalves; H,I: Marnoso - Arenacea microfacies, arkose - lithic sandstone with feldspar and mica.

surface towards Mt. Corona to the south-west of the castle of St. Giuliana at a distance of less than 1 Km.

Travertine - It is lithoid extremely compact, very porous and hard travertine. It is gray-zoned (zoning is measured in centimetres) and shows darker levels for the presence of organic or oxides-rich intervals.

Microfacies: from phitoclastic to phitohermal travertine with Caharaceae oogonia, Ostracoda, and bivalves. The siliciclastic component is rare and mostly consisting of fine grained quartz (Fig. 1-G; Fig. 2-C).

At present, the travertine is very rare in the territory adjacent to the St. Giuliana castle. Some small exposures can be sporadically found south-east of the castle and along the Nese stream near

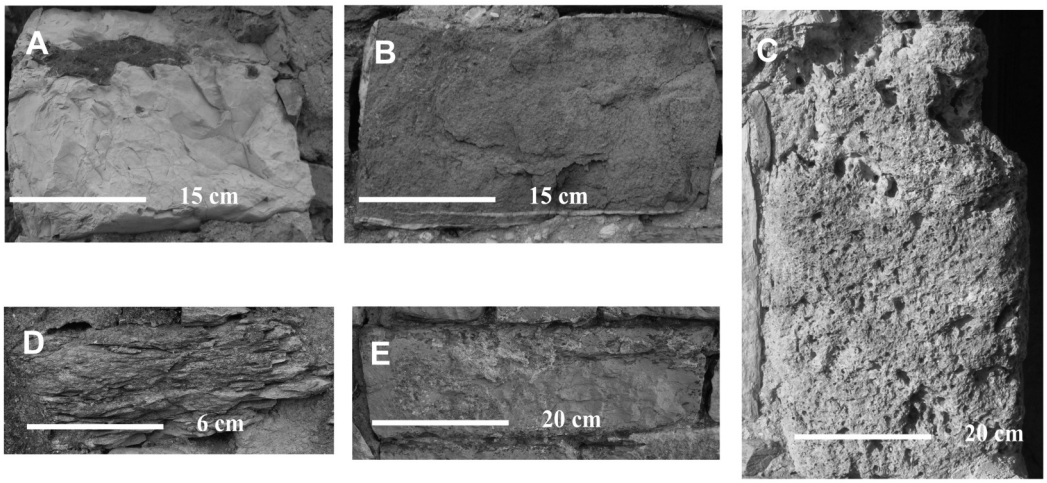

Fig. 2- Natural materials employed in the main façade of St.Giuliana castle. A: micritic limestone of Scaglia Rossa; B: sandstone from the Marnoso - Arenacea; C: phitoclastic - phitohermal Travertine ; D: marly limestone of Scaglia Variegata ; E: Maiolica made of fine micritic limestone with conchoidal fracture.

Ascagnano.

As this stone has a very little presence in this territory, has rarely been used in local architecture and is completely absent in other walls of medieval castles around Umbertide.

Arenaceous Lithotypes

Marnoso-Arenacea fm - This kind of stones comes mainly from the arenaceous component of the Marnoso Arenacea fm, broadly outcropping in the Mt. Corona area. They in general occur as fine-grained, micaceous grey sandstones, cross strips in thin-medium strata (10-40 cm) showing a variable grain-size and carbonatic content.

The age is referable from literature to the Burdigalian - Langhian interval.

Microfacies: arkose and arkose-lithic sandstone with many feldspar and mica (Fig. 1-H,I; Fig. 2-B).

The arenaceous ashlars mostly show erosion and exfoliation, causing removal of material from the surface and generating small setbacks to the building structure. They also suffer discoloration from gray to hazel.

The sandstones outcrops are abundant on both Mt. Corona and Umbertide areas.

For this reason, this is the building stone mostly used in all the walls of the historic buildings of the town of Umbertide (Sperandio, 2004) and in most of the walls of the other medieval castles in the territory.

Discussion and conclusions

An analysis of the collected data shows that the castle of St. Giuliana (approximately 75 m^2, not considering the portal opening, the grooves for the passage of the drawbridge rods and the putlog holes) was built with 2003 ashlars of various lithology, of which a quantitative assessment was made both in relation to the number and the area of dimension stones (Table 1).

The lithotypes used in order of their abundance (expressed as a % of the area) are: Scaglia Rossa (36%), Maiolica (10.2%), Marnoso Arenacea (6.2%), Bricks (5.7%), Travertine (4.1%), Scaglia Variegata (1.5%). Also listed are the areas relating to unidentifiable materials (28.6% mortar, 5.6% plant cover, 2% heavy black crusts).

TABLE 1

Mapping of the stones in the main façade of St. Giuliana castle. The portal opening, the grooves for the passage of the drawbridge rods and the putlog holes are not considered in the area calculation.

Material	**stones**		**area**	
	n.	**%**	**m²**	**%**
Scaglia Rossa	836	41.7	27.09	36
Mortar	n.d	n.d	21.48	28.6
Maiolica	392	19.6	7.72	10.3
Marnoso Arenacea	191	9.5	4.67	6.2
Bricks	383	19.1	4.29	5.7
Vegetation	n.d	n.d	4.19	5.6
Travertine	21	1	3.09	4.1
Black crusts	41	2	1.49	2
Scaglia Variegata	139	6.9	1.11	1.5
Total	**2003**		**75.13**	

TABLE 2

Area of dimension stones present in the main façade of St. Giuliana castle.

Material	**n.**	**Area (m²)**		
		min.	**max.**	**average**
Scaglia Rossa	836	0.0021	0.1435	0.0324
Maiolica	392	0.0018	0.1383	0.0196
Marnoso Arenacea	191	0.0021	0.2691	0.0244
Bricks	383	0.0007	0.0284	0.0112
Travertine	21	0.0385	0.3022	0.1471
Ashlars covered with black crusts	41	0.0027	0.1902	0.0363
Scaglia Variegata	139	0.0016	0.0448	0.007

Taking into account the obtained data (TABLE 1 and 2) and observing the maps of distribution of the materials (Fig. 3 and 4) made, it is possible to specify that:

- the Scaglia Rossa fm, in addition to being the lithotype most represented, both in respect of the area (36%) and the Nr. of ashlars (836), is also evenly distributed over the entire façade, the ashlars are whitish in colour and have an average size of 0.0324 m².

Perfectly square and larger ashlars (0.1435 m²) are arranged to form the left cantonal of the façade and the two slits placed in the lower right and in the middle;

- the Maiolica fm is the second lithotype found for both areas (10.3%) and Nr. of ashlars (392)

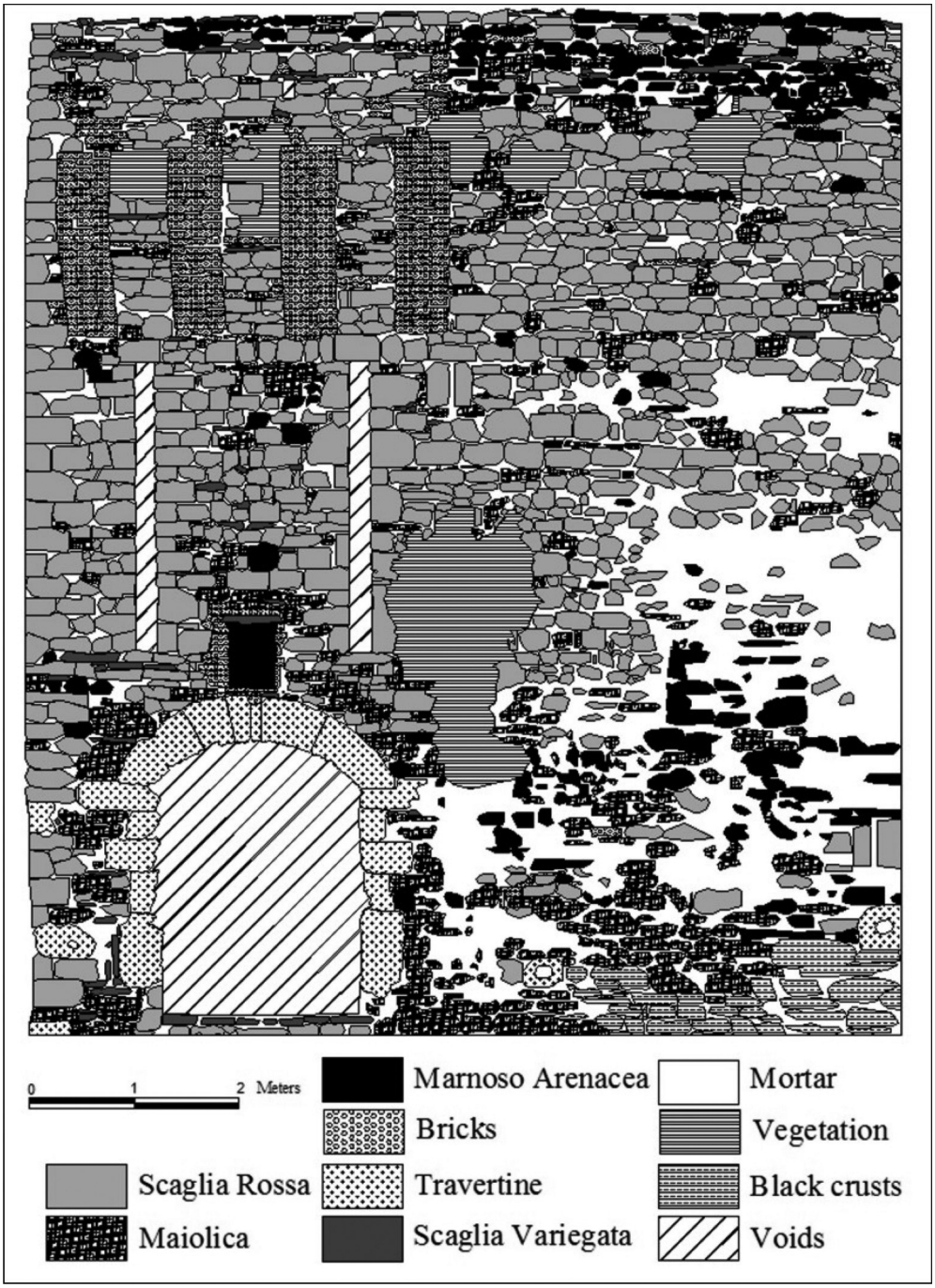

Fig. 3 - Lithological mapping St. Giuliana castle. Main façade.

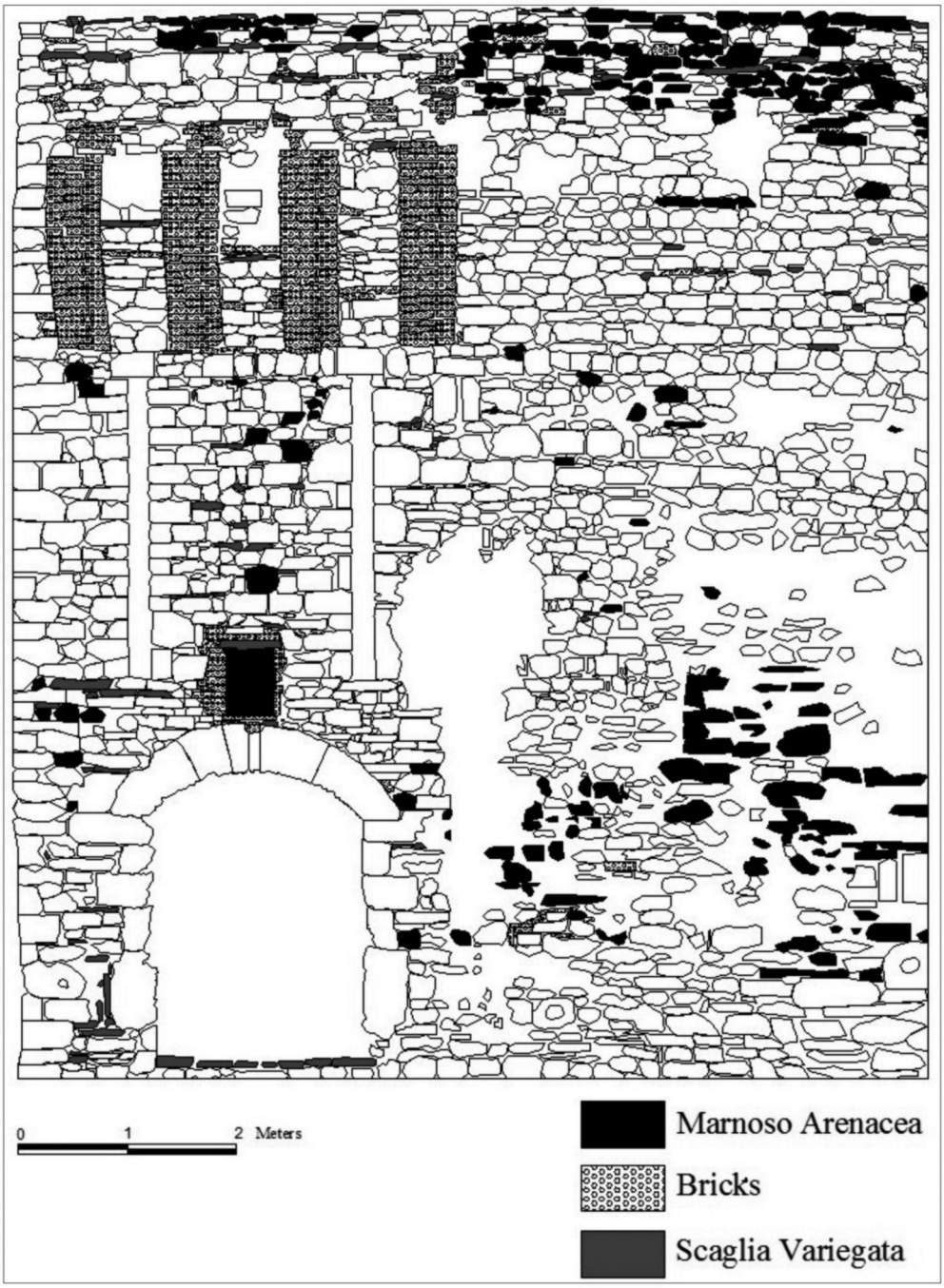

Fig. 4 - Mapping of the main materials used in the various restoration phases.

which are distributed preferentially at the bottom of the front and around the façade; the dimensions of ashlars are on average smaller than those made of Scaglia Rossa (0.0196 m^2);

- the Marnoso Arenacea is scarcely occurring (6.2%) and is mainly located in the extreme top of the façade and in the middle to lower right, from which it emerges, often showing only small parts of the ashlars, from the mortar used to plug up the holes. Among the various ashlars (Nr. 191) with average size of 0.0244 m^2, comparable to those of Maiolica, it stands out particularly large to form a sheet of 0.2691 m^2, placed over the portal, probably a replacement;

- bricks, numbering 383, have an area of 5.7% and are concentrated mostly in the upper part of the façade to make up the ornamental parts (brackets) and in the middle, around the large sandstone; only a small part is distributed among the various ashlars to fill some gaps left by the original stones. Their average size is 0.0112 m^2 and the minimum value of 0.0007 m^2 is indicative of its use in fragments;

- Travertine, despite being represented here by fewer blocks (21), occupies an area (4.1%) higher than the Scaglia Variegata (139 ashlars), coming very close to the values of the area occupied by both the bricks and those of the sandstone (respectively 383 and 191 blocks).

This is due to the large dimension of the stones (0.3022 m^2 max.), compared with those of other lithologies, which occupy an area average of 0.1471 m^2 each draw. Travertine is placed exclusively making an arch crowning the portal and in a small part on the left corner and bottom right of the façade where three blocks with a central hole emerge;

- 139 ashlars of Scaglia Variegata, occupy a very limited area (1.5%), this is due to increased use of ashlars of small and micro dimensions like fragments of stone (0.0016 m^2), used as wedge joints and the mortar setting beds. The larger sized ashlars (0.0448 m^2) were used in the pavement at the entrance façade and as replacement stones in front and are sparsely distributed;

- a significant portion of the façade area is occupied by the mortar (28.6%) which is present between the ashlars in thick layers and in the numerous plug ups on the right side; small portions of the underlying original rocks almost entirely incorporated in the cement emerge. The original building structure is further hidden by vegetation in the upper part by weed vegetation and in the central part due to the presence of climbing plants (5.6%). There are also aboundant black crusts on the bottom right of the façade (2%) and this doesn't allow recognition of the lithotypes below.

From the examination of materials used in the main façade of the castle of St. Giuliana, and according to their distribution (Fig.3 and 4) it is possible to draw the following conclusions:

- the main façade of the castle of St. Giuliana was mainly built with carbonatic lithotypes supplied by local sources. The Scaglia Rossa and Maiolica fms are the mostly used with blocks of variable dimension, from medium to large, arranged in horizontal rows linked by relatively thick layers of mortar;

- the Scaglia Variegata and the Marnoso Arenacea fms are less common natural stones and together with the bricks seem to have been mainly used in the various stages of restoration, often characterized by an improper use of the mortar so as to alter an important part of original façade structure;

- the large travertine blocks, located mostly in the main portal, are a decorative element typical of the Romanesque style. It is therefore assumed that they come from the dismantling of existing Romanesque structures; it is a known fact that in the territories adjacent to the castle there were Roman settlements near Scopeto, St. Maria and St. Orfeto (Cenciaioli, 1998).

Doubts remain about the local origin of the travertine, that now crops out only in sporadic exposures in the vicinity of the castle, near

Ascagnano;

- the use of different lithotypes and recuperated ashlars in the wall's structure perfectly reflects the typically chaotic medieval construction techniques characterized by the use of the more readily available materials (Fiorani, 1996). Infact, few and poor means of transport closely tie the medieval construction site to the territory in which it operates.

ACKNOWLEDGMENTS

I'm grateful to the following revisers: Giorgio Gasparotto, Giuseppe Bargossi and Francesco Brozzetti, for helpful suggestions and criticisms in reviewing the manuscript.

REFERENCES

A.S.C.U. (1862) - Archivio Storico Comunale di Umbertide, Perugia - Post-Unitario, carteggio amministrativo B.9.

BENNI G. (2006) - *Incastellamento e signorie rurali nell'Alta valle del Tevere tra Alto e Basso Medioevo - Il territorio di Umbertide (Perugia, Italia).* John W. Hedges, Oxford, 198 pp.

BOSCHERINI A., NOCCHI-LUCARELLI M., PIALLI G. (1981) - *Geologia della riva Etrusca del Tevere tra le confluenze del T. Niccone e del T. Nese.* Soc. Naz. di Sci. e Lett. di Napoli, **48**, 409-438.

CENCIAIOLI L. (1998) - *Umbri ed Etruschi - Genti di confine a Monte Acuto e nel territorio di Umbertide.* La Fratta, Umbertide, 127 pp.

FIORANI D. (1996) - *Tecniche costruttive murarie medievali - Il Lazio meridionale - Storia della tecnica edilizia e restauro dei monumenti.* "L'Erma" di Bretschneider, Roma, 292 pp.

FITZNER B., HEINRICHS K. and KOWNATZKI R. (1997) - *Weathering forms at natural stone monuments - classification, mapping and evaluation.* Int. J. for Rest. of Build. Mon., **3**, 105-124.

GIAMMARTINI B. (2009) - *The employment of Monte Acuto (Northern Umbria) lithoid materials troughout the time*. In: "*VII Forum Italiano di Scienze della Terra - Pietre, malte e ossidiane nel patrimonio storico e archeologico: caratterizzazione e provenienza"*. Epitome, Geoitalia, **3**, 258.

SPERANDIO B. (2004) - *Delle pietre dell'Umbria - Da costruzione e ornamentali.* Quattroemme, Perugia, 509 pp.