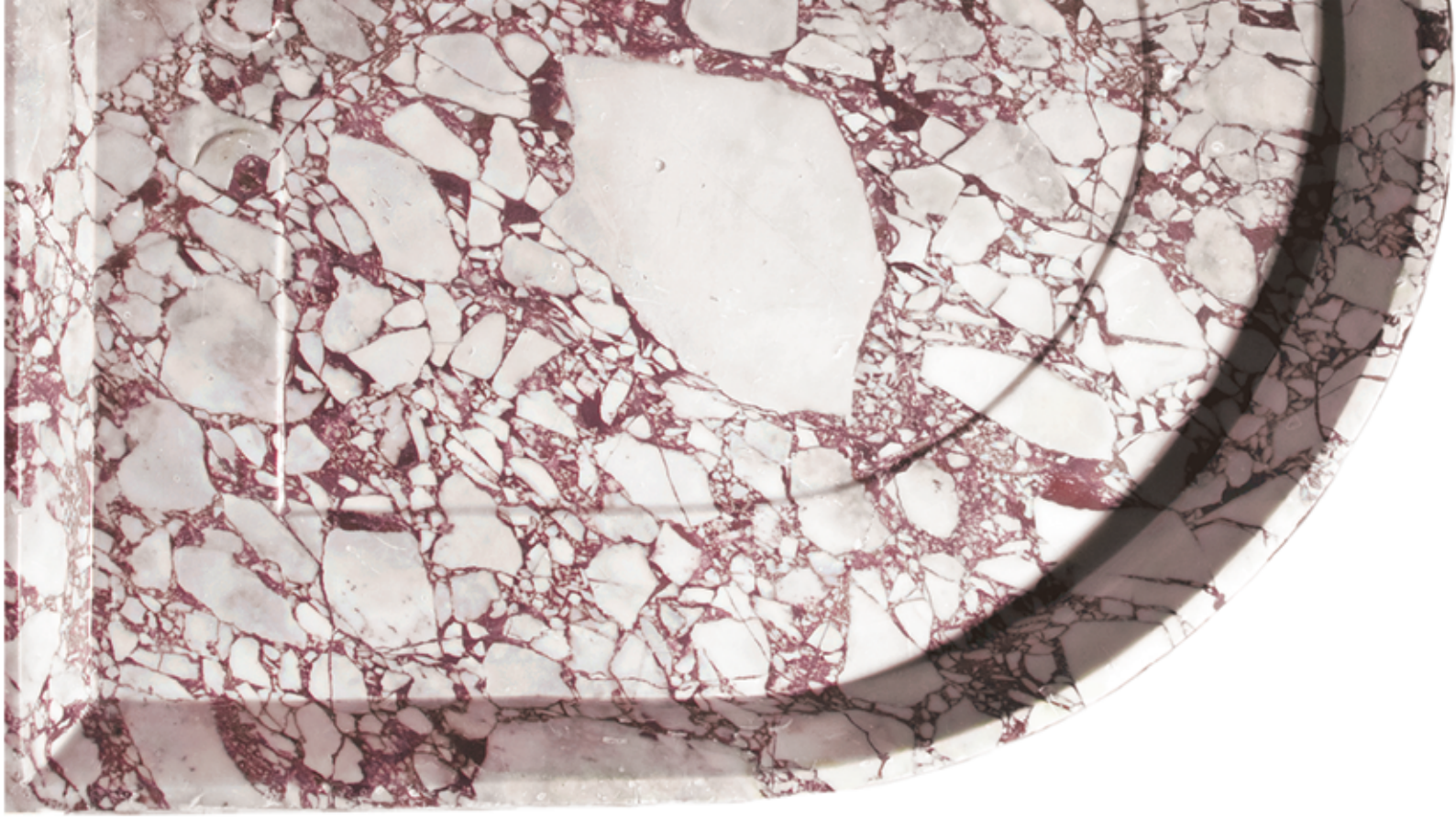
Marmore Lavdata Brattia

Miliša, Miona; Marinković, Vinka



ASMOSIA XI

Interdisciplinary Studies on Ancient Stone

PROCEEDINGS

of the XI ASMOSIA Conference, Split 2015

Edited by Daniela Matetić Poljak and Katja Marasović

ARTS ACADEMY IN SPLIT

UNIVERSITY OF SPLIT,
FACULTY OF CIVIL ENGINEERING,
ARCHITECTURE AND GEODESY

Interdisciplinary Studies on Ancient Stone

Proceedings of the XI ASMOSIA Conference (Split 2015)

Publishers:

ARTS ACADEMY IN SPLIT
UNIVERSITY OF SPLIT

and

UNIVERSITY OF SPLIT
FACULTY OF CIVIL ENGINEERING,
ARCHITECTURE AND GEODESY

Technical editor:
Kate Bošković

English language editor:
Graham McMaster

Computer pre-press:
Nikola Križanac

Cover design:
Mladen Čulić

Cover page:
Sigma shaped *mensa* of *pavonazzetto* marble from Diocletian's palace in Split

ISBN 978-953-6617-49-4 (Arts Academy in Split)
ISBN 978-953-6116-75-1 (Faculty of Civil Engineering, Architecture and Geodesy)

e-ISBN 978-953-6617-51-7 (Arts Academy in Split)
e-ISBN 978-953-6116-79-9 (Faculty of Civil Engineering, Architecture and Geodesy)

CIP available at the digital catalogue of the University Library in Split, no 170529005

Association for the Study of Marble & Other Stones in Antiquity

ASMOSIA XI

Interdisciplinary Studies of Ancient Stone

Proceedings of the Eleventh International Conference of ASMOSIA,
Split, 18–22 May 2015

Edited by
Daniela Matetić Poljak
Katja Marasović

Split, 2018

Nota bene
All papers are subjected to an international review.
The quality of the images relies on the quality of the originals provided by the authors.

CONTENT

DOI: https://doi.org/10.31534/XI.asmosia.2015/08.16

MARMORE LAVDATA BRATTIA[1]

Miona Miliša[1] and Vinka Marinković[2]
[1] Conservation-restauration department, Arts Academy in Split, University of Split, Split Croatia (miona.milisa@umas.hr)
[2] Croatian Conservation Institute, Split, Croatia (vmarinkovic@h-r-z.hr)

Abstract

Brač Island is situated on the eastern coast of the Adriatic Sea. On the island there is a very long tradition of stone carving. There are nearly a hundred known quarries today, be they in operation or abandoned. The text gives a brief review of stone exploitation in the eastern Adriatic coast during Ancient times, with special references to Brač limestone and its properties.

Keywords
lime stone, quarry, island Brač

Introduction

Stonecutting and stone dressing in the eastern Adriatic are a deeply rooted tradition going back to prehistoric times (Fig. 1.) Carving in stone has played a special role in the art and architecture of Brač and Dalmatia. As each historic period is necessarily shaped by momentary needs, be they geographical, social or religious, so the thousand-year-old tradition in stonemasonry has caused stone treatment to broaden and diversify. This tradition includes structural building elements, and religious, sepulchral and decorative artefacts in stone, but it also has recently come to involve contemporary artwork, unique items, as well as souvenirs designed for mass consumption, all of them in stone. When pebbles and scarps, in their many shapes and forms, are added into the picture of Brač, both above and below its surface, there seem to be no limits to the imaginative possibilities of the use of its stone. (Fig. 2.)

On Brač, there are nearly a hundred known quarries today, whether oprational or abandoned. Each of them has a story of its own, involving people who have since time immemorial lived *with*, *for* and *from* the magnificent stone. In fact, stone is etched into every aspect of the island's life: it can be found in old noble residences, shepherds' huts and farmers' roofs alike; in wells and bollards, in moulded doorposts, windowsills, dormers, and so forth. Stone is everywhere, whether the grey, hundred-year-old kind covered in ivy, moss or caper, hand-processed, or freshly extracted stone of dazzling whiteness. In this insular setting where stone is still quarried, people possess a valuable knowledge about stone, passing it from generation to generation, keeping the tradition alive.

Brač has been losing its stone, very much like its inhabitants, steadily through centuries, to various parts of the eastern Adriatic coast and beyond. In Antique times it was used for a great number of reliefs, statues and sarcophagi, now scattered across many sites, places and museums. However redundant it might seem here to list all the edifices, historical and contemporary alike, built using Brač limestone, there are a few deserving of special mention: the Parliament and Hofburg Palace in Vienna, the Parliament in Budapest, the White House in Washington, and the Regent's Palace in Trieste, Italy. The renowned Diocletian's Palace in Split is made of Brač stone. Apart from some imported varieties that were primarily used for decorative purposes, the Late Antique imperial palace was constructed using almost only stone from Brač quarries.

The aim of this paper is to give a methodical and multimedia insight into how stone was quarried in Antiquity and to show how the notion of stone has changed over time. Even if stone exploitation and the method of work in Antique quarries have been discussed thoroughly, there are still many uncertainties surrounding the matter. It is our firm belief that the solution to these quandaries lie in these little-researched Antique quarries. (Fig. 3. a-c) Systematic research, or at least a field survey, would surely lead to new discoveries about the artefacts or fragments of carved stone from Late Antiquity, or signatures of quarry workers – which would complement what is already known about the life of stonemasons in the past.

1 The following text was originally produced for the catalogue of the Exhibition *"MARMORE LAVDATA BRATTIA"* held from May till June 2015 in the City Museum of Split. The exhibition was opened during the International Conference Asmosia XI (Association for the Study of Marble & Other Stones in Antiquity).

Fig. 1. Map with quarries on Brač and eastern Adriatic coast (DONELLI, MATIJACA, PADUAN, RADOVANOVIĆ, 2009)

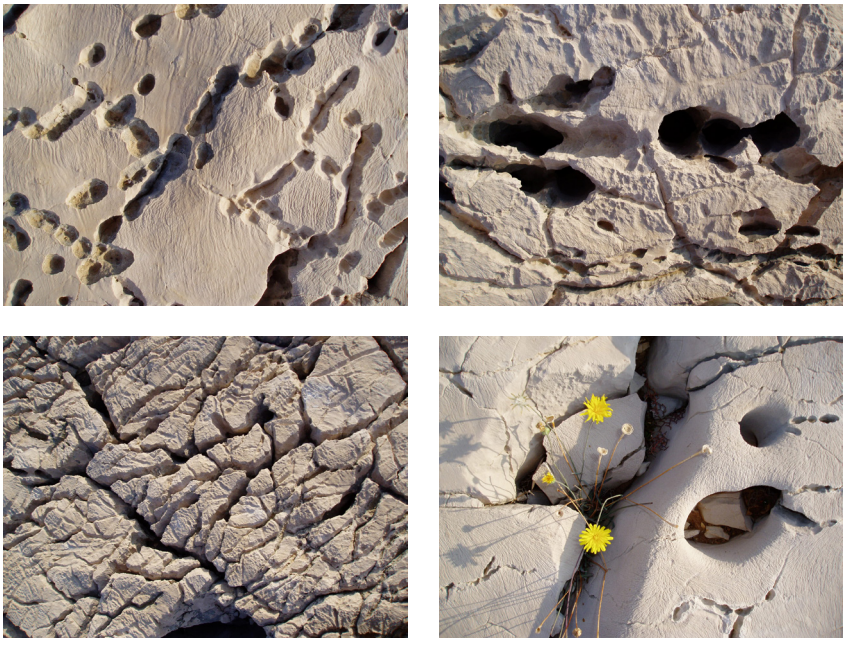


Fig. 2.
Island's rocky shore
(photo: M. Miliša)

Fig. 3 a–b. Rasohe, Roman quarrie, nearby Splitska bay (photo: M. Miliša)

1. Island of Brač – Salona, sea route and trade in Antiquity

The seafaring routes running along the eastern Adriatic coast in the period from the Neolithic to the early Middle Ages have remained busy to this very day. Unchanged over the millennia, these waterways have been determined from archaeological finds, written records and environmental conditions. The Mediterranean coasts have always been well-connected; that these would mostly be sea connections is only natural. The conflicts known to have taken place in this region in Late Antiquity were predominantly caused by the desire to control the eastern Adriatic sea route, which was the quickest and safest route between Greece, southern Italy, and Central Europe. By analysing the local climate, Antique settlement sites, sites of shipwrecks, and undersea archaeological sites, the aforesaid Adriatic route can be detected with great precision. From the economic viewpoint, as the shortest and safest way connecting the Orient, Greece, southern Italy and other Mediterranean regions with Central Europe, the eastern Adriatic route has contributed considerably to the economic development of the entire eastern Adriatic coast.

Salona, the centre of the Roman province of Dalmatia, was in a particularly favourable position in the innermost part of a sheltered bay, where important sea lanes met, and across from the Bay of Salona, today known as Kaštela Bay, lies Brač (Latin *Brattia*), with an equally advantageous position: only 16-17 km off the mainland, in a scenic archipelago, between Hvar and Split, and facing today's Poljice and Makarska coastline. It is enclosed by Split Gates and Šolta Island in the west, and Hvar Island and Hvar Channel in the south. Moreover, Brač is included in the 2nd-century Ptolemy world map as well as the 4th-century Peutinger Map.[2]

Owing to its position at the heart of Dalmatia, situated between the mainland and other Central Dalmatian islands, the island of Brač has always been settled, without however, having any fairly large town centre of the strategic and commercial importance that could match other island centres in the eastern Adriatic (e.g. *Pharos* or *Issa*). Still, while there is no evidence of an ancient town ever existing on the island, the stone of Brač was used, paradoxically enough, in the construction of many ancient buildings in the larger centres of the Empire. Such is the case with Diocletian's Palace of Late Antiquity, built almost entirely with stone from the Brač quarries, as supported by the latest archaeological findings.

During recent protective underwater surveys conducted in the port of Splitska, several fragments of processed limestone have been found, together with two varieties of marble, two varieties of granite, as well as several North African potsherds.[3] Furthermore, six stone blocks discovered in the vicinity, lying on the seafloor in an organized way, match in size the blocks in the Palace walls.[4] These findings clearly show not only that Brač stone was being transported to the Palace, but also that the imported material would be processed on Brač, before being sent to the Palace construction site.[5]

All in all, the advantages of the location and the abundance of stone material were sufficient reason for the obviously considerable transport and commerce going on across the Brač channel. What is more, there are firm archaeological indications that the waterways might have been busy even earlier. Finds of Greek provenance documented on the island hint at commerce taking place possibly even in the Archaic Period. In addition, an Antique shipwreck has recently been found near Sutivan, a place located in the western part of Brač.[6] The discovery was made by an islander who was looking for the best fishing area there (locally referred to as 'kampaneli'). The

2 BRUSIĆ 1999, 146.

3 PARICA 2012, 350.

4 PARICA 2012, 351.

5 BULIĆ 1908, 89.

6 MIHAJLOVIĆ 2012, 649-655; MIHAJLOVIĆ 2013, 67-72.

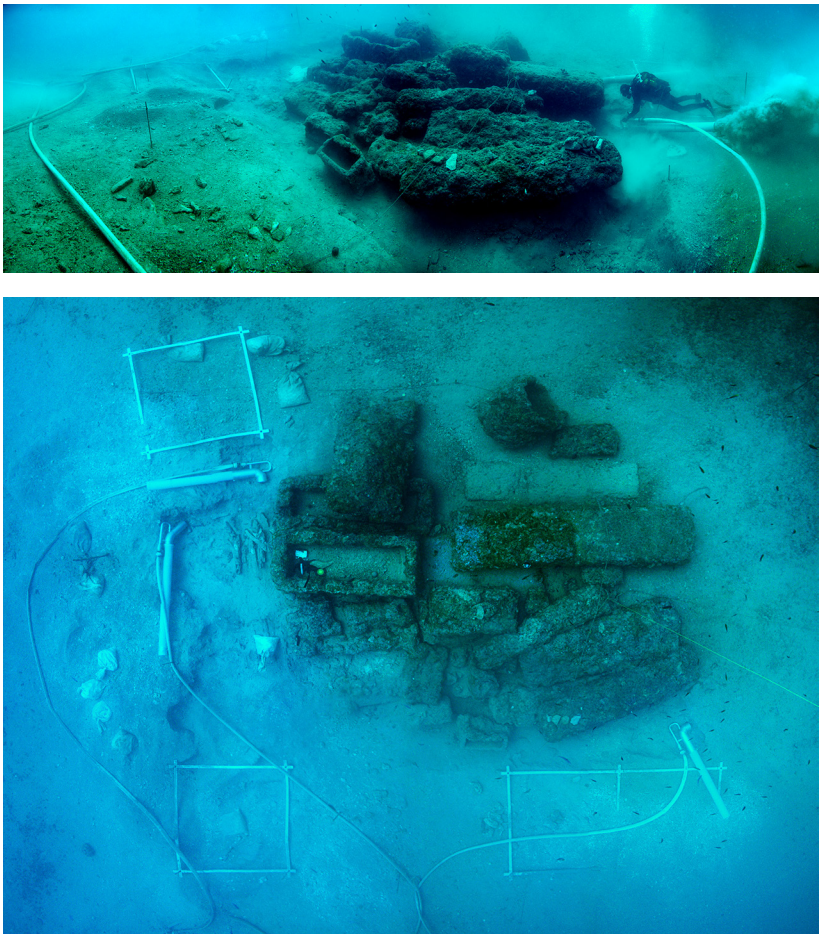


Fig. 4.
Sarcophagi found in the sea near Sutivan (photo: J. Macura, Archive of Croatian restoration department)

Fig. 5. Trace of an ancient notch in the rock – *pašarin* (photo: M. Miliša)

shipwreck was found along with roughly-finished sarcophagi, lying 32 metres under the sea, about 30 metres off the coast. (Fig. 4.) Despite the latest research findings and analyses that have proved that the stone which the cargo was made of originates from another island, there is no doubt that half-products were being shipped from Brač quarries to stonework production centres.

The strong bond between Brač and Salona,that is between the quarries and the stonemason's shops, was reflected first in the materials used and in the shapes of sarcophagi, later on extending to building components as well. From the mid-6th century on, basilicas were built in great numbers on Brač (in the coves of today's Supetar, Sutivan, Postira, Lovrečina, Pučišća, Povlja and Bol), and in in Mirje, near Postira, there was a monastery. In Late Antique times the former Imperial quarries were still active on Brač, which was now an important port of call on Justinian's sea route. Thus, it is highly probable that many more undiscovered products from Brač stone-carving workshops remain scattered along the said sea route.

Fig. 6 a–b. The relief of Hercules in Rasohe quarry (photo: V. Marinković)

2. Quarries of Brač

During Antiquity, the quarries of Brač were run and, according to epigraphic evidence, owned by the Empire. The majority were situated between Splitska and Škrip, and those of the greatest significance were Plate, Stražišće and Rasohe. Stone was transported from these quarries to the port of Splitska, where they were shipped to the final destinations. The existence of these quarries is supported by numerous inscriptions and recovered archaeological items on which quarrying marks are still visible (wedge holes known as "pašarini"). (Fig. 5.) In general, Brač quarries are of various sizes. Slabs for sarcophagi were probably extracted from larger quarries, but the names of the smaller ones, by the sea, are better known. The quarry of Kamenprag near Selca (Bunje site) makes an exception, since its name is well-known although it lies in the inland.

In the quarry of Rasohe, a relief depicting Hercules carved in live rock has been discovered. (Fig. 6. a-b) A couple of reliefs with exactly the same motif have been found in the vicinity of Škrip, alongside altars with inscriptions dedicated to the Greek hero. The cult of Hercules was widespread among the laborious quarrymen who considered him their patron on account of his

Fig. 7. Fossil footprints in the stone (photo: M. Miliša)

physical strength and mental toughness. Excavating and processing stone is arduous work, and that the stoneworkers of Brač worshiped Hercules and identified with his hardships should not come as a surprise.

At the beginning of the 20th century, the Brač quarries were subject to scrupulous research conducted by the famous Croatian priest-archaeologist Frane Bulić, mostly concerning the use of Brač stone in the construction of Diocletian's Palace.[7] It was then that the first comparative analyses between samples from the quarries and samples removed from the stone used in the construction of the Palace were carried out. The well-reasoned conclusions of these analyses have been further substantiated by modern science. Namely, during the systematic conservation and restoration works on the Peristyle of 2003-2013, the (comparative) mineralogical and petrographic analyses of reference samples from the Peristyle and the quarries confirmed both to be a variety of biomicrite, *wackestone*, which is the stone found in the Škrip, Plate and Rasohe quarries.[8]

Origin and geological formation – Brač is composed of hard dolomite and limestone. It was formed about 100 million years ago, during the Cretaceous, the last period of the Mesozoic Era. Back then, Brač was only an area of shallow water where a great number of bivalves (i.e. rudists) were shedding their shells. By sedimentation, these would eventually form the so-called rudist limestone. (Fig. 7.) It was in the Cretaceous and early Tertiary period that the area began rising above the sea level. Following another tectonic uplift in the Eocene, the Brač land did not yet form an island, but was part of the mainland. About a million years ago, in the Pleistocene, the climate was extremely cold. Because of increased precipitation, a river formed, with several tributaries, running across today's Brač and carrying rocks, sand and sludge, now

7 BULIĆ 1908, 101-104; BULIĆ, KARAMAN 1927, 19-23.

8 MUDRONJA 2013, 27.

Fig. 8 a–b. "Punta" quarry at Pučišća (photo: M. Miliša)

accumulated in lower valleys. This led to the formation of a diluvial breccia layer (especially in Bol, where cemented gravel is found even today). Since it was still part of the mainland, the island of Brač was populated by wild horses and cattle, deer and bears, whose bones lie in the breccia soil. During the Holocene, 20 to 30 thousand years ago, the crust sank once again, thereby separating Brač from the mainland. Other types of soil formed on the island, as well, by gradual erosion, transportation by water and sedimentation. Consequently, the soil of today's Brač is composed of different types of limestone, sandy limestone, sandstone, marlstone, breccia, gravel, sand, clay and red soil.

Thanks to the abundance of limestone, Brač has long been widely renowned for its exquisite white and gray stone varieties that have been used for construction all over the world since Antiquity. Brač limestone has typical karst features. It might be limestone by origin, but it is often confused with marble for its supreme quality.

Brač varieties of limestone

The landscape of Brač is mainly composed of limestone, dolomitic limestone and dolomite, as well as of sandy limestone, sandy soil, flysch, breccias and Quaternary deposits. These are all petrographic denominations. What is widely known as "white stone of Brač" is in fact Senonian limestone dating from the upper Cretaceous (i.e. Senonian). It is commonly found in northern, eastern as well as south-eastern parts of the island. (Fig. 8. a-b). Today there are about twenty different varieties of limestone on Brač, varying from nearly entirely white to dark brown shades. The so-called bituminous limestone can also be found (near Škrip). A map of all identified Antique quarries was presented at the 9th Asmosia Conference, held in Tarragona, Spain (Fig. 1.).[9]

TABLE – Stone varieties from quarries of Brač active today. (Fig. 9, 10.).

All stone varieties found on Brač are, geologically speaking, limestone of sedimentary origin dating from the Upper Cretaceous. They accumulated into firm deposits and thick layers from which sound slabs, suitable for processing, are extracted. Origin-wise, limestone represents a sedimentary rock that was formed by precipitation, as a consequence of physical, chemical and biological processes. Composition-wise, limestone is calcium carbonate. The samples include bioclastic limestone (biomicrite and biosparite), to packstone to grainstone (the so-called Brač "marble" from the Upper Cretaceous).

3. Other quarries in the Eastern Adriatic

Quarries have continually been formed along the Adriatic coast and in the inland alike. Apart from Brač, quarrying sites have been documented in Istria, in the vicinity of Trogir, on the islands of the Zadar archipelago, as well as on the islands of Hvar, Vis, Korčula, and so on.[10] As witnessed by a large number of historic records – contracts, orders, bills, the extraction, sale and export of raw or processed stone were a significant source of income for the islanders. Stone of exceptional quality and extreme cuttability was extracted on the islets (18 in total) east off the town of Korčula.

Korčula has a long tradition of stonemasonry and large workshops that goes back to Antiquity, when there were active quarries on the small islands of Lučnjak, Sutvara, Badija. In the Middle Ages, when the town of Korčula formed, mason's shops cropped up in great numbers. The largest ancient quarries were located on the islands of Vrnik, Sutvara and Kamenjak.[11] Stone export was regulated in the 1214 Statute of Korčula, Section 95, which also included a specification of the fees and taxes paid to the town.[12] Stone extraction was mostly in the hands of the families of builders and stone dressers,

9 DONELLI, MATIJACA, PADUAN 2009, 636-640.

10 ZANINOVIĆ 1997.

11 ĐIVOJE 1970, 68-75.

12 PEKOVIĆ 2010, 204.

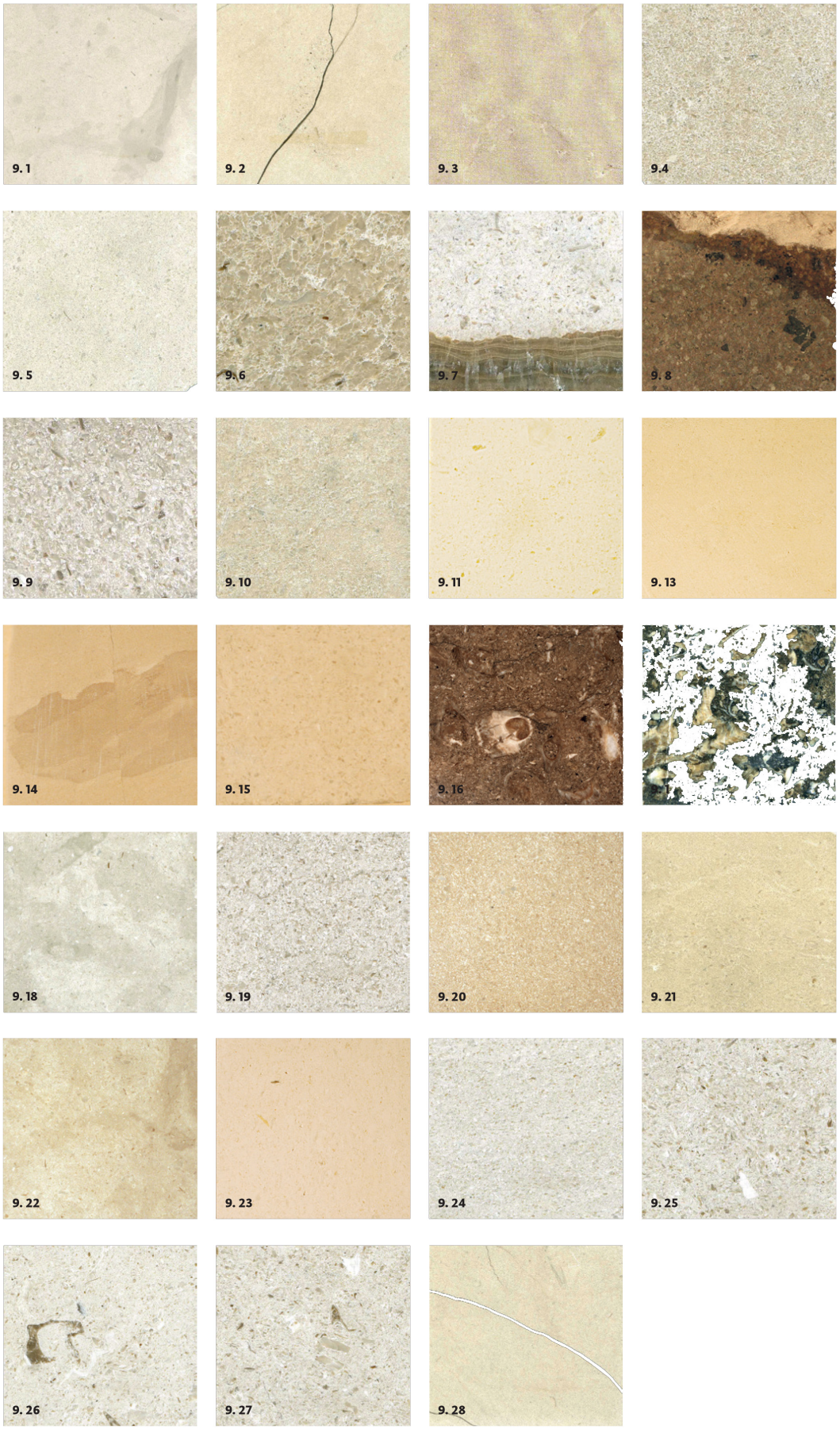


Fig. 9. Photos of Brač stone (photo: V. Marinković, M. Miliša)

Vrsta kamena -trgovački naziv / Rock type – commercial name	Lokalitet kamenoloma / Quarry site	Karakteristike – fizička i mehanička svojstva kamena / Characteristics – physical and mechanical properties of stone						Foto br./ Photo nr.
		Prostorna masa / Volumetric weight	Poroznost / Porosity	Upijanje vode / Water absorption	Čvrstoća na pritisak / Compressive strength	Čvrstoća na savijanje / Flexural strength	Otpornost na habanje / Resistance to wear	
Adria Grigio Machiato	Sivac, Pučišća	2.542 t/m³	7.7 %	2.02 %	138.0 MN/m²	15.3 MN/m²	21.0 cm³/50 cm²	**9.1**
Adria Grigio Venato	Sivac, Pučišća	2.520 t/m³	3.86 %	2.42 %	140.0 MN/m²	16.8 MN/m²	26.0 cm³/50 cm²	**9.2**
Adria Grigio Unito	Pučišća	2.551 t/m³	7.9 %	2.4 %	100.5 MN/m²	16.0 MN/m²	33.2 cm³/50 cm²	**9.3**
Avorio	Kavadur, Donji Humac	-	-	-	-	-	-	**9.4**
Cremavorio	Gianesini, Donji Humac	-	-	-	-	-	-	**9.5**
Dračevica	Dračevica, Donji Humac	2.553 t/m³	6.5 %	1.42 %	116.0 MN/m²	13.2 MN/m²	22.9 cm³/50 cm²	**9.6**
Dračevica-drsrva	Donji Humac	-	-	-	-	-	-	**9.7**
Dubčac	Lovrečina	-	-	-	-	-	-	**9.8**
Grižavica	Lovrečina	-	-	-	-	-	-	**9.9**
Ivory gold (Avorio oro)	Donji Humac	-	-	-	-	-	-	**9.10**
Maslinica	Pučišća	-	-	-	-	-	-	**9.11**
Oklad	Selca	2.490 t/m³	12.7 %	4.09 %	192.0 MN/m²	7.2 MN/m²	22.85 cm³/50 cm²	-
Prvija	Splitska, Postira	-	-	-	-	-	-	**9.13**
Postira	Splitska	-	-	-	-	-	-	**9.14**
Pašarin	Pašarin, Donji Humac	-	-	-	-	-	-	**9.15**
Rasotica B	Žaganj Dolac, Sumartin	2.640 t/m³	0.849 %	0.2 %	212.0 MN/m²	13.9 MN/m²	15.45 cm³/50 cm²	**9.16**
Rasotica C	Žaganj Dolac, Sumartin	2.640 t/m³	0.849 %	0.2 %	212.0 MN/m²	13.9 MN/m²	15.45 cm³/50 cm²	**9.17**
Roma	Donji Humac	-	-	-	-	-	-	**9.18**
San Giorgio E	Selca	2.572 t/m³	6.7 %	2.2 %	154.0 MN/m²	20.6 MN/m²	16.7 cm³/50 cm²	**9.19**
San Giorgio W	Selca	2.529 t/m³	5.68 %	1.72 %	176.5 MN/m²	23.7 MN/m²	15.8 cm³/50 cm²	**9.20**
Sivac Avorio	Pašarin, Donji Humac	-	-	-	-	-	-	**9.21**
Sivac Machiato	Pučišća	-	-	-	-	-	-	**9.22**
Sv.Petar	Donji Humac	-	-	-	-	-	-	**9.23**
Veselje Unito A	Punta, Pučišća	2.469 t/m³	8.18 %	2.22 %	121.6 MN/m²	12.6 MN/m²	27.1 cm³/50 cm²	**9.24**
Veselje Unito B	Punta, Pučišća	2.495 t/m³	7.7 %	2.02 %	116.0 MN/m²	9.4 MN/m²	32.16 cm³/50 cm²	**9.25**
Veselje Fiorito	Punta, Pučišća	2.506 t/m³	3.91 %	2.06 %	125.3 MN/m²	10.5 MN/m²	22.8 cm³/50 cm²	**9.26**
Veselje Fiorito Kupinovo	Pučišća	-	-	-	-	-	-	**9.27**
Zečevo	Zečevo, Selca	2.534 t/m³	5.867 %	1.74 %	180.2 MN/m²	22.5 MN/m²	15.6 cm³/50 cm²	**9.28**

Fig. 9a.
Physical and mehanical properties of stone from Brač

many of them natives, as attested by written records from Dubrovnik and Korčula. Although several foreign names are mentioned there as well, Dubrovnik owes its present look primarily to the Korčula stonemasons and the centuries of their hard work. They used primarily the high-quality variety of limestone from the island of Vrnik (with 29 documented quarries). The transport of the raw material was facilitated by numerous well-sheltered ports and coves with anchorage.

The stone of Dubrovnik and its surroundings is classified as Senonian rudist limestone (very thick and white in appearance). Its surface layer contains a great number of hippurites (bivalves), whereas the deeper layers are purer and more homogenous, with a smaller amount of bivalve shells. It is most suitable for sculptural and ornamental purposes.

The **Seget** quarry derives its name from the Latin word 'seco', meaning *to cut, to break*. The value of Seget stone is attested by various historic records. Among others, in his seminal work *Naturalis Historia*, Pliny the Elder wrote: "...Tragurium civium Romanorum, marmore notum..." Geologically speaking, the stone extracted from the Seget quarries dates from the Upper Cretaceous, just like the Brač stone. However, unlike the Antique quarries of Brač, which are no longer in operation, Seget stone is still being extracted, having started in the 3rd century. It is a biosparite, whitish in colour, slightly toned, with a layered appearance. Close-by, there is also the Sutlija quarry, which was active in Antiquity, and which is the findspot of yet another statue of Hercules.

On the island of **Hvar**, there are only two known areas where building stone has been quarried (in modern times) – one close to Bogomolje and the other in the

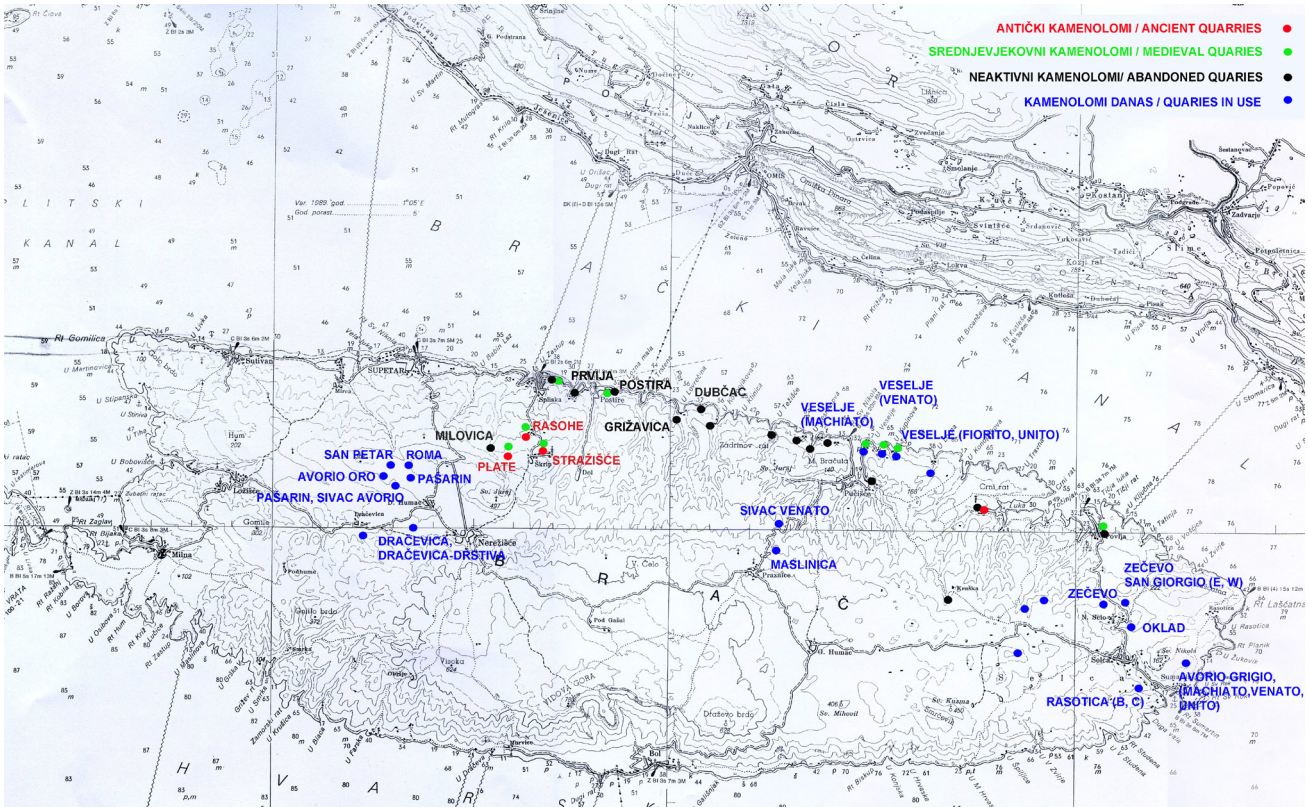


Fig. 10. Map of Brač quarries (by V. Marinković)

south, near the town of Hvar, including the quarries of Pokonji Dol, Križna luka and Mikićevici.[13] A field survey has also revealed quarrying marks at six sites along the northern coast of Starigrad Bay, two of which are located on the Dugi rat peninsula (or, as the locals call it, the Grandma Peninsula), while the others are scattered along the western coast of Brizenica cove and the eastern parts of the coves of Zavala, Zapaš bok and Veli Zelenikovac.[14]

On the island of **Vis**, an Antique quarry (among the oldest in the Adriatic) has been documented in the southeast, in Srebrena Cove.[15] A great number of quarries have been documented in **the Zadar archipelago** as well, on the islands of Sestrunje and Dugi otok. In the central region of Dugi otok, a total of 11 quarries can be found, clustered in two areas.[16] The southern one comprises Antique quarries with minor modern modifications.

The whole of **Istria** abounds in stone; the regions in the west and south-west are predominantly composed of Jurassic-Cretaceous deposits of limestone and dolomite, while the northern region is mostly made up of early Eocenic limestone, breccia and dolomite. During Antiquity, the main occupations in the well-connected Istria included quarrying and stone dressing. The oldest stone material originates from the Cretaceous quarries located in Vinkuran and Vintijan. Today better known as *Cave Romane*, these quarries supplied stone for the construction of the Amphitheatre, the Arch of the Sergii, and other ancient structures in Pula. In fact, Vinkuran, the oldest quarry on the Istrian peninsula (southeast of Pula), was one of the main suppliers for the construction of the Pula Amphitheatre, as well as many other stone structures along the Adriatic.[17] Vinkuran stone is more porous and, hence, physically and mechanically weaker. The local limestone variety 'kirmenjak' is the best-known building stone from Istria today (its other names are *Orsera, Pietra d'Istria, Pietra d'Rovigo, Lake Flower, Flower of Istria, Giallo venato d'Orsera,* and *Avorio*). It is bright to light brown in colour and dates from the Jurassic. During the Roman period *kirmenjak* was quarried at several sites, out of which four or five are still active, located to the south and north of the town of Kirmenjak, and can be found in many structures across Italy. As for other renowned Istrian quarries, Brijuni and Vrsar are worth mentioning, with a quarrying tradition harking back to the Antiquity.

13 POPOVIĆ 2012, 111.

14 POPOVIĆ 2012, 117-121.

15 BILIČIĆ, RADIĆ 1990, 38-39.

16 PARICA 2012, 345-353.

17 CRNKOVIĆ, ŠARIĆ 2003, 52.

a Klin

b Maca od taja

j Špuntarjola zubatka

l Tajenta

d Martelina

e Martelina

f Mlat od taja

i Šćapadur

h Punćot i laštre

k Štrangulin

c Maca

g Piket

Fig. 11a. Carving tools (photo: M. Miliša)

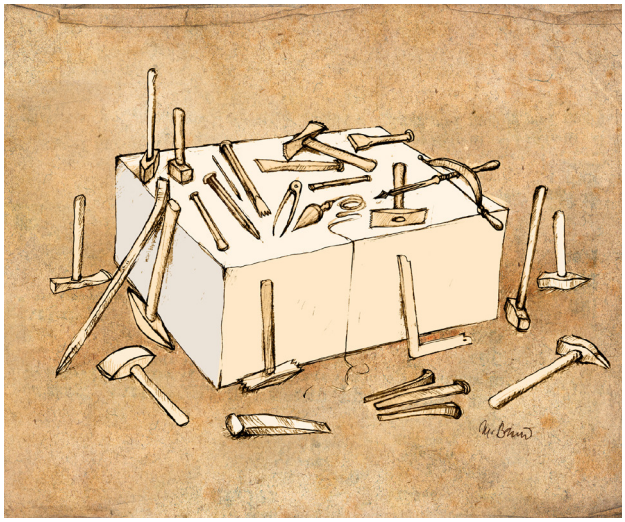
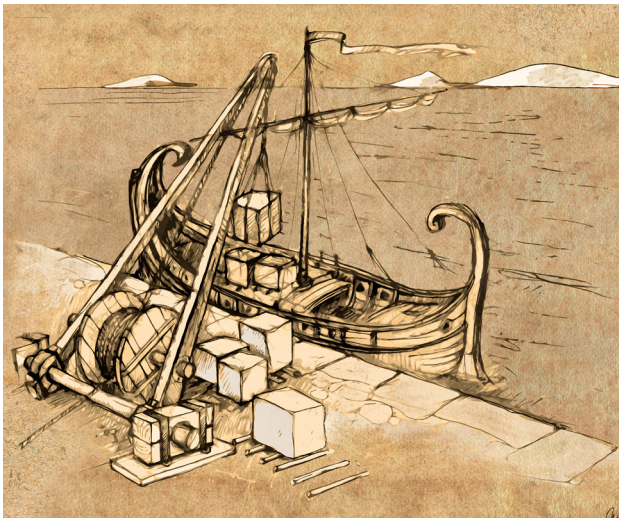


Fig. 12 a–c. Structure of an Antique quarry
(drawings: M. Barišić)



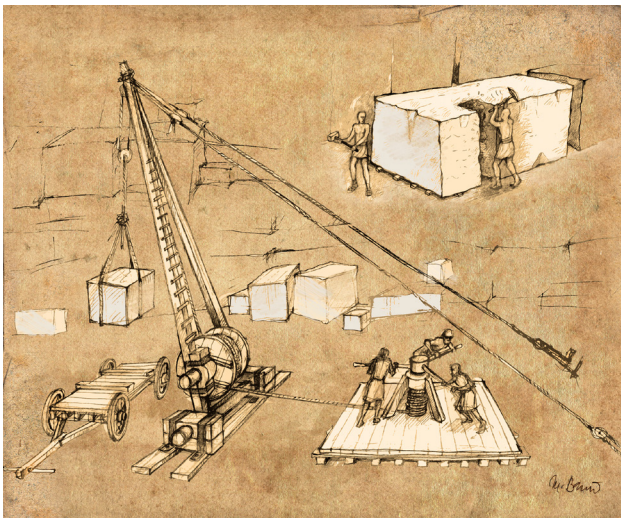


Fig. 13 a–b. Workflow at the quarry
(drawings: M. Barišić, 2015.)

4. Stonemason's trade and stone processing technology

The role of stone in building and in the production of sculptures and various utilitarian products has always been in harmony with the progress of material and spiritual culture. For over two centuries, the processing of raw stone of exceptional composition represented an important industrial branch in Central Dalmatia. While the craft of stone dressing in terms of sculptural treatment has not changed significantly in two millennia, the quarrying process has been modernized and simplified, with the development of modern (power) tools. The rules regarding the optimal use of extracted stone were defined as early as the Antiquity. Vitruvius was the one who laid them down in his seminal work *De architectura libri diecem* (Book II, Chapter VII – "On stone and stone quarries"): "*He who wishes to be a good builder shall follow these instructions. Two years before the commencement of the building, the stones should be extracted from*

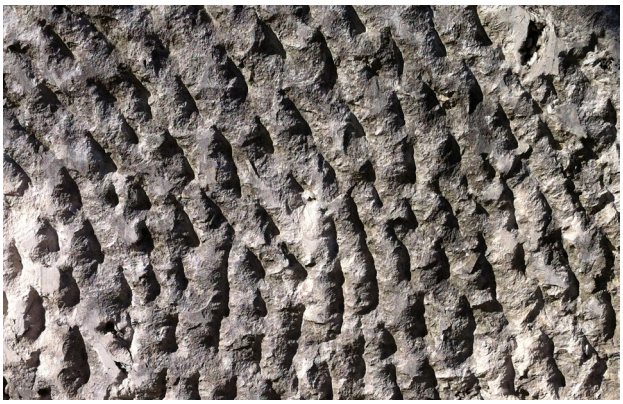


Fig. 14 a–d. Tool marks, carving details (photo: M. Miliša)

the quarries in the summer season; by no means in the winter; and they should then be exposed to the vicissitudes and action of the weather. Those which, after two years' exposure, are injured by the weather, may be used in the foundations; but those which continue sound after this ordeal, will endure in the parts above ground. These rules apply equally to squared and to rubble or unsquared stone work."[18]

Before any excavation work starts, it is necessary to perform preparatory operations which include the detection of good quality stone deposits, the clearing of surface vegetation, and the removal of soil and stone material above the healthy layer of stone (indigenous people of the island of Brač call it *skinut škorac*). The next step is to open and prepare the rock mass for extraction of large blocks of stone. The workflow at the quarry consists of a sequence of operations, starting with hand making of narrow "wedge holes" in the rock up to 5 meters deep (*pašarin*), followed by the separation of block using wedges (*kunji, punćoti* and *laštre*) (Fig. 11. h). The stone blocks would subsequently be transported to the port on wooden rollers and loaded on the ships. (Fig. 12. b, 13. a) The technology of stone excavation and stone processing has changed little since Antiquity (Fig. 12. - 13.), and the tools used today are practically the same: *maca od taja* (Fig. 11. b), *mlat od ruke* (Fig. 11. f), *macola* (Fig. 11. c), *šćapadur* (Fig. 11. i), *piket* (Fig. 11. g), *tajenta* (Fig. 11. l), *martelina* (Fig. 11. d-e).

Carving decorative details in stone is a challenging process. It is performed with tools of different sizes; various points, claws, chisels and rasps; with a toothed, flat, round or half-round cross-section. (Fig. 12. a).[19] There is a wide assortment of specific tools, ranging from rougher to finer, known under their authentic Brač names of 'zubača' and 'martelina' (rock hammers), 'špica' (point), 'gradina' (claw), 'ravno lito' (flat chisel) and 'šćapadur' (chipper chisel), 'brusevi' (sanders), and so forth. The pattern is traced on the work surface. Depending on the complexity and symmetry of a given motif, templates may be used as a guide. Regardless of the carving phase, the larger sizes are used first, working through to the finer tools. As each tool leaves specific marks on stone surface, these marks alone are sufficient to identify the tool used. (Fig. 14. a-d)

5. Antique stone-carving workshops in the Adriatic and their products

Stone processing is impossible to consider without reference to stone dressing workshops. Based on the inscriptions found, it is known for sure that there was a workshop in Salona (or even a stonemason's guild,

18 VITRUVIJE 1999, 41.

19 CRNKOVIĆ, ŠARIĆ 2003, 61-64; DŽAJA 1999, 52-63.

Fig. 15.
Roman sarcophagus
in Škrip (photo: M. Miliša)

collegium lapidariorum) and, according to an inscription discovered in Trogir,[20] in smaller settlements along the Adriatic coast as well, at least where stone resources were easily accessible (close to quarries).

In the Roman Empire stonemasons, builders, blacksmiths and other craftsmen moved about freely. There were no physically impenetrable borders between towns and settlements, which led to the intermingling of influences to the degree that they became indistinguishable one from another and, thus, could not be attributed to a specific stonemason school or workshop. Furthermore, as most of communication between Venice and Constantinople went on by sea, the Adriatic routes were of great importance for commerce, communications and connections at large in the Roman and, subsequently, Byzantine Empire. Rome as well as Byzantium, recognized this, and selected some Dalmatian towns as their administrative centres. All the while, books of patterns circulated throughout the Mediterranean, and it is a reasonable deduction that most of these motifs originated from the larger centres which were not far-off, such as Rome, Ravenna etc, with occasional introduction of an Eastern motif, blending in with the existing ones, and thereby giving rise to a new variation of an old compositions.

In any research into the circumstances in which Antique craftsmen with a specific stone-carving expression worked, several questions arise: Were they gathered around a particular seat and, if so, where was it? Who did they get the templates for reliefs from? Who or what was the source of their patterns and compositions? Where did they get the high-quality limestone? Who would paint their stone artefacts (stonemasons themselves or fresco painters)?

Due to a scarcity of archaeological evidence and written records, the question of possible stone-carving workshops and their production remains open. They

20 CAMBI 2010, 14.

can be directly studied, however, through their many products: sculptures, sarcophagi, architectural elements, liturgical furnishings, and even mosaics.

The Antique and Early Christian decorative stone sculpture from the region exhibits a few local twists. While it is true that local craftsmen kept emulating the style of the imported examples of stone handicraft, inspired by the prevailing style of the day dictated by the larger centres such as Rome, Aquileia, or Salona, their renditions of imported designs are still recognizably local. Thanks to the abundance of high-quality stone here, there has always been a possibility of artefacts being produced locally. Sarcophagi were among the most common workshop products in the period from the 2nd to the 4th century. Those that were produced in local workshops would be carved either in local stone or, often, in imported marble, which would make them more expensive and, as a rule, of a higher quality.

Apparently, there was a workshop on Brač and it was in close contact with, if not under the patronage of, the Salona workshop, as sarcophagi identical in shape and style of decoration have been found in both Salona and on Brač. (Fig. 15.) After being quarried, the slabs meant for sarcophagi were either finished on the island or sent to the purchaser as raw material or as roughly-finished items. While the majority of them were roughed out and shipped to Salona, some were retained on the island, where they would be shaped on the Salona model. These sarcophagi were sold throughout the eastern Adriatic and in the western part of the Italian Adriatic coast (so far, 17 of them have been documented in Italy and one in Albania).[21] No definitive conclusion has yet been made whether the sarcophagi were exported directly from Brač or after they had been shaped and finished in Salona. The fact that similar ornaments occur on sarcophagi and on the plutei in certain churches implies a workmanship connection between the two. In addition, certain similarities in motifs can be found between liturgical furnishings on Brač and in Salona, as well as across the entire Adriatic basin, even though there are distinctive differences with regard to the product quality and style.

The regulations from the metropolitan centre were applied throughout the province, as witnessed by architecture, sculpture and paintings in numerous Antique and medieval towns. As they were defined by liturgical needs, the architectural forms on the island mostly involved simple basilica-like structures. The Salona cultural sphere was highly influential at that time, as is noticeable in many Early Christian churches furnished with intricate sculptures, and decorated with fresco paintings and mosaics. This is best reflected in the church furniture from Salona workshops made in the predominant style of the time, i.e. emulating imported items in local materials. By way of example, the whole Early Christian liturgical furniture from the Province of Dalmatia fits the context of 6th-century Late Antique sculpture.

6. Conclusion

To date, several hundred representative fragments of the Antique and early medieval sculpture, architectural decoration, funerary architecture and other stones with inscriptions have been discovered in this part of the Adriatic. If we take it into account that many fragments were found earlier but fell into decay, or were removed and used as basic construction material in later periods, and that many still remain undiscovered, it becomes clear that the people who lived in Antiquity left behind a plethora of monuments reflecting their way of life and their civilization - their skills in construction, trades and art. With the recovered fragments, it is possible to develop a wider picture of the incredible wealth of the Antique architectural and sculptural heritage.

As an inorganic material, stone is much more resistant to the ravages of time than other materials, which is why it has managed to survive over the centuries, bearing witness to times long gone. Centuries and centuries after the stone structures and trimmings of Diocletian's Palace were shaped, it is easy to forget all the knowledge and effort it took to make it.

The typological and stylistic features of what has remained of the stone material culture, as identified in the archaeological layers from the earliest migration period on, reveal a clear profile of a long-term development and conservation of traditional forms and contents shaped by the logic of life during the islanders' age-long struggle with stone. The island's identity, its famous traditions, artistic expression and human relations, have been shaped by stone. This mixture of circumstances, influences and abundance of stone material has been the determining factor of their life with stone...

It is noteworthy that there is a clear continuity in the way stone is cut and carved that has been going on since the Antiquity. The work process – starting with the extraction of large blocks in quarries, all the way to the end product – has remained the same, save for few improvements accounted for by tool optimization and technological advancements. The tools are still being used in the same order, starting with the rougher ones and working through to the finer tools. It is therefore perplexing that stone is nowadays shipped from Brač only as raw material, in the form of unprocessed stone blocks, and not in the form of carved artefacts, as it could be. After all, this is a problem of our time which is unlikely to be solved any time soon, exacerbated by industrialization and the

21 CAMBI 2007, 105.

necessities of modern life. Nevertheless, the tradition of stonemasonry still runs strong here. In Pučišće there is a stonemason school. It was established in 1905, and remains the only one of its kind in Croatia, every year turning out a new generation of skilled masonry technicians.

Having investigated all of the quarrying sites described above, which are in varying degrees of preservation, one cannot but notice some of the causes of the decay of our cultural heritage. Considering the age and exposure to weather and physical hazards of the archaeological remains (in spite of the durability of stone), gradual decay is inevitable. Stone is subject to various patterns of deterioration, involving chemical and physical processes of great complexity, and its decay is accelerated by rain, sun, wind and vegetation.

With quarries and material secured, there have always been good local craftsmen dealing with stone. In order to get a better picture of the products made in the workshops of Salona, Brač, Hvar, Korčula, Istria, Zadar and its surroundings, with still more workshops adjoined to smaller quarries, it is indispensable to systemize the local stone types and varieties by sites. A unique, complete database of local limestone varieties from various quarries would contribute considerably to the systemization of the stone sculpture findings from the Antiquity and later periods. Furthermore, an appropriate stone sample database would surely provide answers regarding the provenance of many finds yet undocumented. In order to make some progress in the study of these matters, whether they pertain to archaeology, geology, conservation, or art history, systematic mineralogical and petrographic research should be conducted, and a database developed, containing all the stone varieties found at quarrying sites and used to make artefacts.

BILIOGRAPHY

BILIČIĆ V, RADIĆ, D. 1990: "Antički kamenolomi u Srebreni na otoku Visu", Obavijesti - Hrvatsko arheološko društvo 22/2, Zagreb, 38-39.

BRUSIĆ Z. 1999: "Uspostava hrvatske kontrole nad plovnim putem uz istočnu obalu Jadrana", Starohrvatska spomenička baština, rađanje prvog hrvatskog kulturnog pejzaža, Zagreb, 145-150.

BULIĆ F. 1908: "Materiale e provenienza della pietra, delle colonne nonchè delle sfingi del Palazzo di Diocleziano a Spalato e delle colonne ecc. delle basiliche christiane a Salona", Bullettino di Archeologia e Storia Dalmata 31, Split, 101-104.

BULIĆ F., KARAMAN LJ. 1927: "Palača cara Dioklecijana u Splitu", Zagreb.

CAMBI N. 2007: "Bilješke o kasnoj antici na Braču", Brački zbornik 22, Supetar, 87-127.

CAMBI N. 2010: "Sarkofazi lokalne produkcije u rimskoj Dalmaciji", Split.

CRNKOVIĆ B., ŠARIĆ LJ. 2003: "Građenje prirodnim kamenom", Zagreb.

DONELLI I., MATIJACA M., PADUAN I. 2009: "Ancient quarries on the Eastern Adriatic Coast with specific reference to the island of Brač", in ASMOSIA IX, 636-640.

ĐIVOJE M. 1970: "Antikni kamenolomi na Korčulanskim otocima", Zbornik otoka Korčule 1, Zagreb, 68-75.

DŽAJA N. 1999: "Tradicionalna obrada kamena klasičnim alatima", Split.

MIHAJLOVIĆ I. 2012: "Antički brodolom sa sarkofazima kod Sutivana na otoku Braču", Histria Antiqua 21, 649-655.

MIHAJLOVIĆ I. 2013: "The Sutivan shipwreck. A cargo of sarcophagi and stone of the Roman period", Skyllis, 67-72.

MUDRONJA D. 2013: "Prirodoslovna istraživanja na Peristilu / Natural Science Research at the Peristyle", in Peristyle 2003-2013, Katalog izložbe o konzervatorsko-restauratorskim radovima na Peristilu Dioklecijanove palače u Splitu, Split, 27-30.

PARICA M. 2012: "Nekoliko primjera lučkih instalacija antičkih kamenoloma na dalmatinskim otocima", Histria Antiqua 21, Pula, 345-353.

POPOVIĆ S. 2012: "Kamenolomi starogradskog zaljeva: problematika podrijetla kamena korištenog za izgradnju bedema antičkog Fara", Archaeologia Adriatica, Zadar, 107-128.

VITRUVIJE 1999: "Deset knjiga o arhitekturi", Zagreb.

ZANINOVIĆ M. 1997: "Obrada kamena i kamenolomi u antici srednje Dalmacije", Histria Antiqua 3, Pula, 37-45.