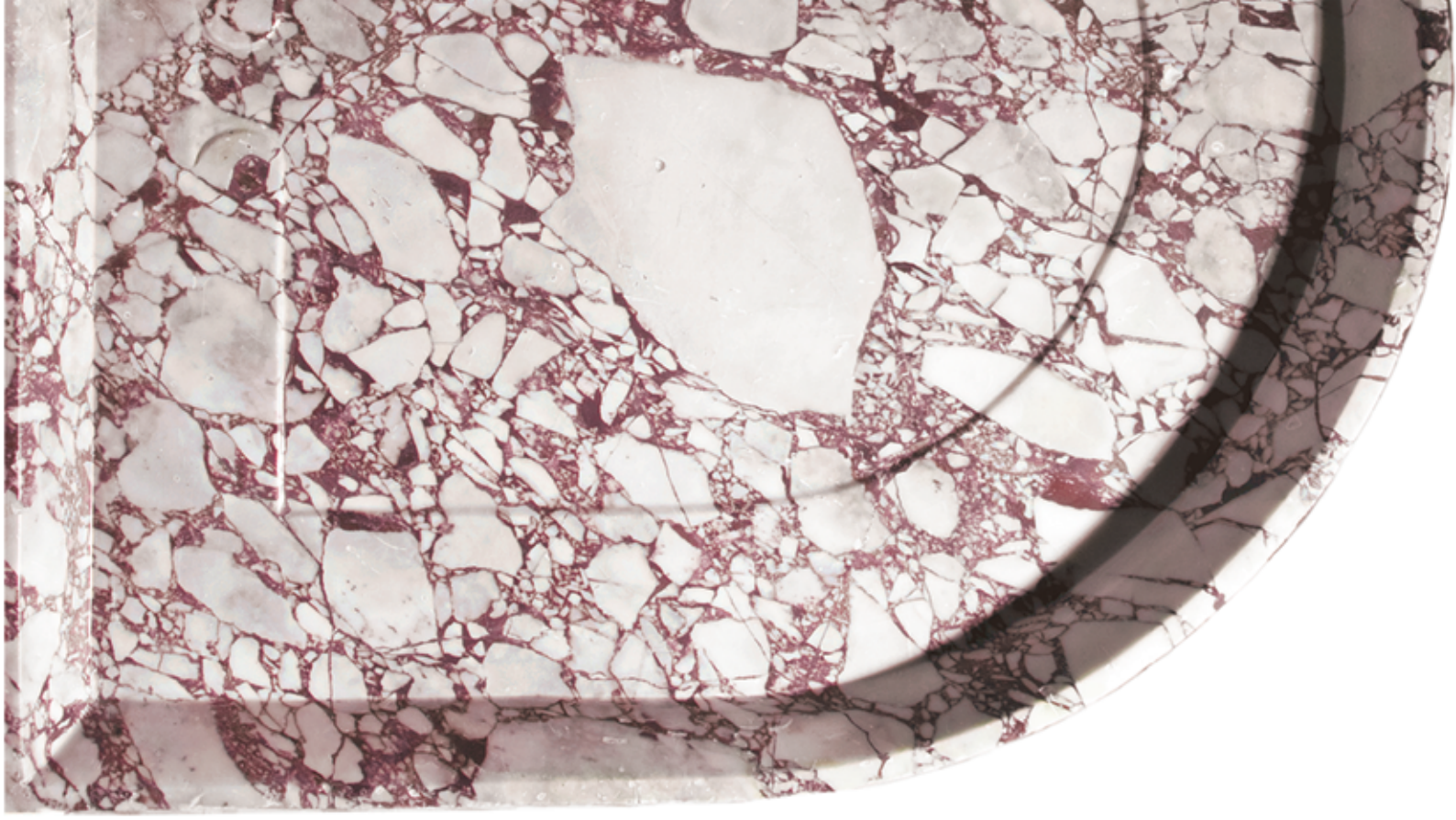
The Use of Limestone in the Roman Province of Dalmatia

Lozić, Edisa; Rižnar, Igor



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CONTENT

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THE USE OF LIMESTONE IN THE ROMAN PROVINCE OF DALMATIA

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Abstract

The primary objective of this study is to present the methodological approach used in an attempt to determine possible provenience areas (quarries) of the stone material used for the stonemasonry production of the funerary monuments (dated between 1st and 3rd century AD) in the interior of the Roman province of Dalmatia. To illustrate this methodological approach, we have decided to present the results of three regional case studies. The results of the study reveal the possible existence of Roman quarries in the interior of the province of Dalmatia.

Keywords
Roman province Dalmatia, provenance study, limestone

1. Introduction

This paper examines the stone supply used for the stonemasonry production of the funerary monuments in the interior of the Roman province of Dalmatia (today's BiH and parts of Croatia, western Serbia, Montenegro). Even though the number of funerary monuments is small compared to the coastal area of the province of Dalmatia they still provide ample evidence of rich stone masonry production and reveal an existing demand for stone.

In the past, many studies were devoted to different archaeological aspects of the funerary monuments from the interior of the province of Dalmatia, focusing on stylistic groupings, typological development and art history.[1] However, provenance analysis and mechanisms for the distribution of stone material are still in their infancy.

The present research aims to fill this gap by using a specific methodological approach in attempt to locate appropriate (possible) provenience areas (quarries) of the stone material.

There are three basic questions that need to be answered:

1. What type of stone material (in geological terms) was used for production of the stone monuments and are there any (micro) regional differences in the use of stone?
2. Is it possible to locate stone material source area(s)?
3. Is it possible to identify stone material transport routes?

Therefore, the work was organized in three different phases: (i) the first phase aimed at identifying what type of stone material (in geological terms) was used for the production of the stone funerary monuments, (ii) the second phase was devoted to determining the potential locations from which the stone material might have originated i.e. the possibility of locating appropriate quarries, (iii) the third phase was aimed at identifying possible routes of transport.

2. Methods of work

Here the methodological approach used in the study is outlined.

The aim of the first phase was to identify the types of stone material (in geological terms) used for production of the stone funerary monuments from the interior of the province of Dalmatia. To this end, macroscopic petrographic analysis was conducted on 177 funerary monuments curated at the National Museum of Bosnia and Herzegovina as this is the most representative corpus of the funerary monuments from this geographic area. The stone artefacts were macroscopically analysed using a hand lens and lithotypes (described below) were defined on the basis of the petrographic analysis. In addition, the archaeological analysis of the monuments was conducted, in which their cultural – historical background was defined.

The next step was to determine provenance, i.e. the potential locations from which the stone material could have been quarried. Using the finding-site location as the starting point, the lithotype of each monument has enabled comparison with the geology within a 30 km radius.[2] Data from the 1:100,000 scale basic geologic map

1 PAŠKVALIN 2012; ZOTOVIĆ 2003; ČREMOŠNIK 1963, 105-125.

2 Research has shown that transportation distance for building stone between larger urban centres and quarries was not larger than 30 km (*cf.* RUSSELL 2014).

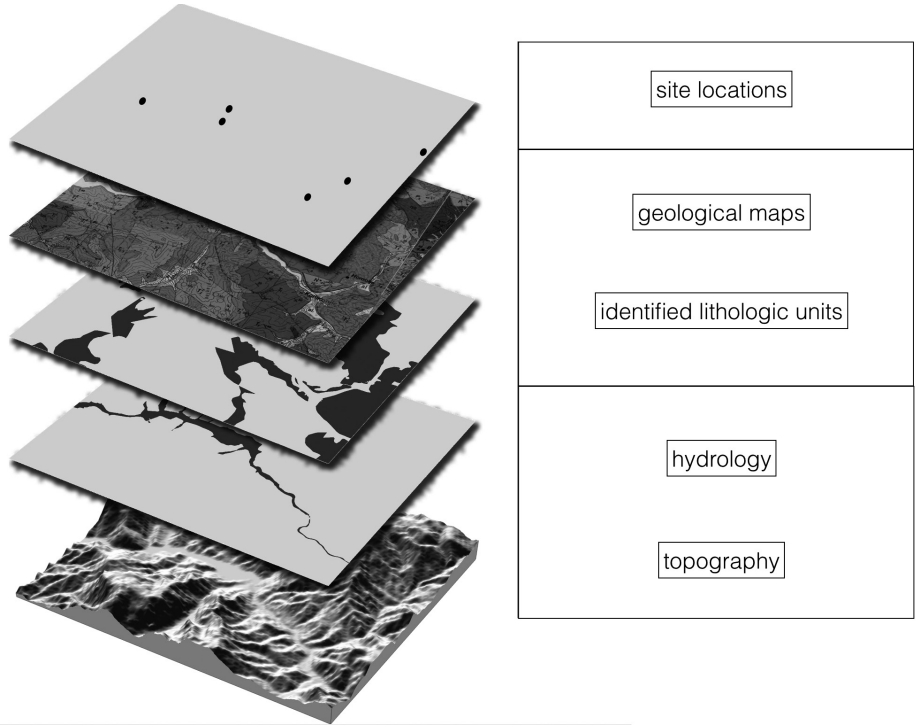

Fig.1.
Graphic representation
of GIS analysis workflow

of SFR Yugoslavia (maps and explanatory text) were used for this comparison. Using GIS-analysis enabled us to analyse spatial associations between archaeological (site location) and geological datasets (relevant lithostratigraphic units). The output was a series of maps of the (micro) regions with identified lithostratigraphic units from which particular stone material could have been acquired.

Since the logistics of stone supply within each (micro) region, highly depends on terrain characteristics and the possibility of water transport; we have also taken in account the topographical and the hydrological situation.[3] For this purpose the digital elevation model (DEM) with a 25 m spatial resolution[4] was used and hydrological data digitized from 1: 50, 000 maps. GIS- tools has allowed us to overlay data layers obtained and to identify the existence of potential locations for the quarry and possible routes of transport.

It should be pointed out that this is an initial phase of the study where a basic insight into the material from the artefacts is acquired with a non-destructive method, and in which basic information regarding potential provenance of the lithotypes is defined. In the second phase, the artefacts will be sampled, petrographically and paleontologically analysed, and compared to the exposures of relevant rock formations in the field.

To summarize: the collected datasets consist of the three main data layers: archaeological (site locations), geological (identified relevant lithostratigraphic unit) and spatial data (topographic and hydrological situation) (Fig. 1). By overlaying data layers we were able to obtain the result in form of topographic maps of the micro-regions (a series of maps). The map presents the stone material available in the immediate vicinity of the sites. Based on these maps the possible provenance area and the potential transport corridors were recognised.

3. Case studies

For illustration purposes of this methodological approach, the results of three regional case studies are presented. The areas have been chosen based on the high concentrations of the site locations in which the numerous stone funerary monuments were encountered (Fig. 2).

3.1. Bihać

The first study area is located in the Bihać area in the northwest of Bosnia and Herzegovina, where several archaeological sites with high concentration of stone funerary monuments are located (Fig. 4). Archaeological analysis has shown that the entire corpus (dated between the 1st and the 3rd century) of the funerary monuments from this area exhibits great typological diversity (cinerary urns, lids in the form of simple sloped roofs, stelai, aediculae etc.).[5] In a typological sense two types of funerary monuments prevail: most cinerary urns and lids in the forms of simple

3 *cf.* RUSSELL 2014, 78.

4 EU-DEM25.

5 LOZIĆ 2013.

Region	Number	Archeological site	Inventory number	Item	height (cm)	width (cm)	depth (cm)	Identification number	Type of stone	Lithotype
Bihać	1	Brekovica	96	stela	152	63	20	103	Limestone	A
	2	Čavkići	1501	cinerary urn	13	8	5	2	Limestone	A
	3	Čavkići	1333	cinerary urn lid	15	29	8	3	Limestone	A
	4	Čavkići	1337	cinerary urn lid	20	22	9	18	Limestone	A
	5	Čavkići	1338	cinerary urn lid	15	30	10	19	Limestone	A
	6	Doljani	1331	cinerary urn	38	16	12	7	Limestone	A
	7	Doljani	249	cinerary urn	55	71	72	130	Limestone	A
	8	Golubić	1322	cinerary urn	32	20	14	6	Limestone	A
	9	Golubić	50	edicula	170	50	15	22	Limestone	A
	10	Golubić	421	stela	77	83	15	23	Limestone	A
	11	Golubić	246	stela	200	67	17	35	Limestone	H
	12	Humačka Glavica	1318	cinerary urn	10	7	7	1	Limestone	A
	13	Humačka Glavica	1346	cinerary urn	38	30	29	17	Limestone	A
	14	Pritoka	1345	cinerary urn lid	20	56	57	12	Limestone	A
	15	Pritoka	1445	cinerary urn lid	15	55	47	15	Limestone	A
	16	Pritoka	1343	cinerary urn lid	15	48	46	20	Limestone	A
	17	Pritoka	408	cinerary urn lid	12	55	20	21	Limestone	A
	18	Pritoka	1446	cinerary urn lid	14	60	54	53	Limestone	A
	19	Pritoka	unknown	cinerary urn lid	49	40	10	112	Limestone	A
	20	Pritoka	unknown	edicula	38	77	27	31	Limestone	A
	21	Ribić	589	cinerary urn	52	101	97	131	Limestone	A
	22	Ribić	1827	cinerary urn	42	78	25	132	Limestone	A
Konjic	23	Brčani	49	stela	174	78	30	174	Limestone	BD
	24	Homolje	55	stela	178	68	26	94	Limestone	BD
	25	Homolje	57	stela	149	70	28	169	Limestone	BD
	26	Homolje	52	stela	170	85	29	172	Limestone	BD
	27	Lisičići	1824	stela	123	70	26	96	Limestone	BD
	28	Lisičići	161	stela	169	67	29	170	Limestone	BD
	29	Lisičići	264	stela	138	63	25	171	Limestone	BD
	30	Ostrožac	56	stela	159	70	23	155	Limestone	BD
	31	Radešine	58	stela	144	62	26	93	Limestone	BD
Srebrenica	32	Mihaljevići	267	stela	117	69	26	77	Limestone	C
	33	Sase	161	stela	140	65	23	83	Limestone	C
	34	Sikirići	1826	funerary altar	77	66	51	104	Limestone	C
	35	Skelani	1839	stela	114	45	18	82	Limestone	C
	36	Skelani	unknown	stela	26	29	21	121	Limestone	C
	37	Skelani	unknown	stela	32	33	17	122	Limestone	C
	38	Tegare	266	stela	124	60	24	62	Limestone	C
	39	Tegare	265	stela	170	61	24	85	Limestone	C
	40	Tegare	262	stela	91	66	23	105	Limestone	C
	41	Tegare	1831	stela	74	67	22	173	Limestone	C

Fig. 2. List of the funerary monuments from the case study areas on which the macroscopic petrographic analysis was conducted

sloped roofs that were, according to the epigraphic sources, produced for the local population.

Macroscopic petrographic analysis of the material was conducted on the 22 funerary monuments from the Bihać area (Fig. 2). Results of the macroscopic petrographic analysis have shown that funerary monuments from the Bihać area are made of two distinct limestone lithotypes (defined as A and H). The limestone of lithotype A was identified on 21 funerary monuments. The only exception is the funerary stela from Golubić (Fig 2: No. 11) made of the lithotype H limestone.

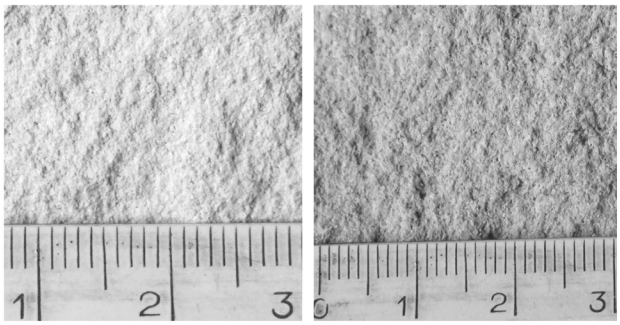

Fig. 3. The figure provides a comparison of macro-photos of lithotype A (Fig. 2: No. 13, on left) and the "bihacit" from the modern quarry (photo: I. Rižnar)

Description of the lithotypes and their possible provenance area

Lithotype A is white to rarely yellowish porous limestone. Allochems are well-sorted medium to well-rounded spherical grains 0.1 – 0.2 mm in size. Internal structure of the grains could not be established by macroscopic observation. In parts where the sorting is better, the lithotype resembles oolithic limestone but it seems that the spherical grains are bacterial in origin as the internal structure resembles travertine. According to a sarcophagus (exhibited in front of the Museum), which is the largest artefact made of this lithotype, it is clear that the limestone is massive- to thick-bedded with poorly expressed sedimentary structure. Poorly expressed bedding is manifested as subtle

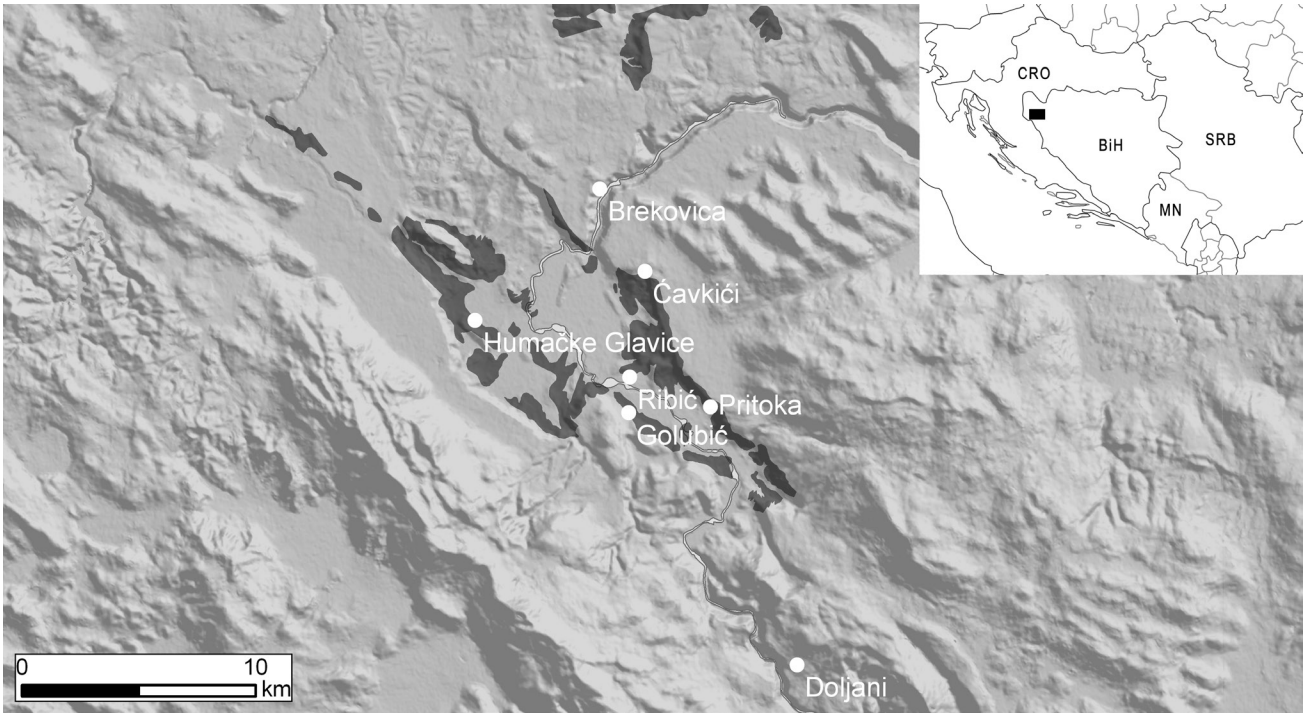

Fig. 4. Locations of the corresponding lithostratigraphic unit identified on the geological map Bihać (2M2) and archaeological sites referred to in this case study

changes in roundness, sorting and size of the grains. Regarding the porosity and general resemblance with other Neogene rocks of the Central Paratethys, it is clear that the limestone is of Neogene age. Due to its high porosity, lithotype A is much lighter than marble and the Mesozoic limestones from the Dinarides that underwent deep burial. High porosity, homogeneity and isotropy are important characteristics that make the limestone easy to work with, while the very fine grains enable an excellent workability even for the most delicate ornaments.

This kind of limestone is described in explanatory booklets of the geological maps of the area as "travertine –like" fresh water limestone. These rocks are present in the area in several stratigraphic units mapped as "Oligomiocene", and the Upper and Middle Miocene.[6]

The limestone of lithotype A corresponds to the limestone from the modern day quarry in the vicinity of Bihać town where it is known under commercial name "bihacit." From an archaeological point of view the most important characteristic of "bihacit" stone is its high porosity which enables excellent workability and easy extraction (fresh blocks of it can be cut or sawn); in addition, its deposits are very shallow, ca 1—1.5 m under the surface.

All the Neogene limestones that do not belong to the well distinguished Lithotype A are classified into lithotype H. In general lithotype H can be described as brownish to yellowish fine-grained porous limestone without macrofossils. In some artefacts limonitized terigenous grains are present. No sedimentary structures are present in the artefacts. The degree of cementation varies among the artefacts. The fine-grained structure and porosity of lithotype H allows elaboration of very fine details. According to geological maps of the area, lithotype H can be expected among the Oligomiocene succession in the base of the coal series.[7]

The lithotypes are very similar to each other. That is why we are confronted with a frequent problem in identification of the potential source of limestone: geological mapping is not precise enough to identify the differences between the two. This could only be achieved with field testing. This is why we were only able to determine areas, which correspond to potential sources of both.

Based on the geological map of the Bihać area and the descriptions of interpreters geological maps we were able to identify the lithostratigraphic unit ($^2M_2$) as the corresponding geological formation in which both lithotypes of the limestone occur.[8] The potential source area of the stone material is therefore present in the major part of the Bihać area (Fig. 4).

6 POLŠAK *et al.* 1977; POLŠAK *et al.* 1978.

7 POLŠAK *et al.* 1977; POLŠAK *et al.* 1978.

8 In order to be able to identify the geological formation for each lithotype (in lithostratigraphic unit $^2M_2$) more detailed outcrop mapping will be required.

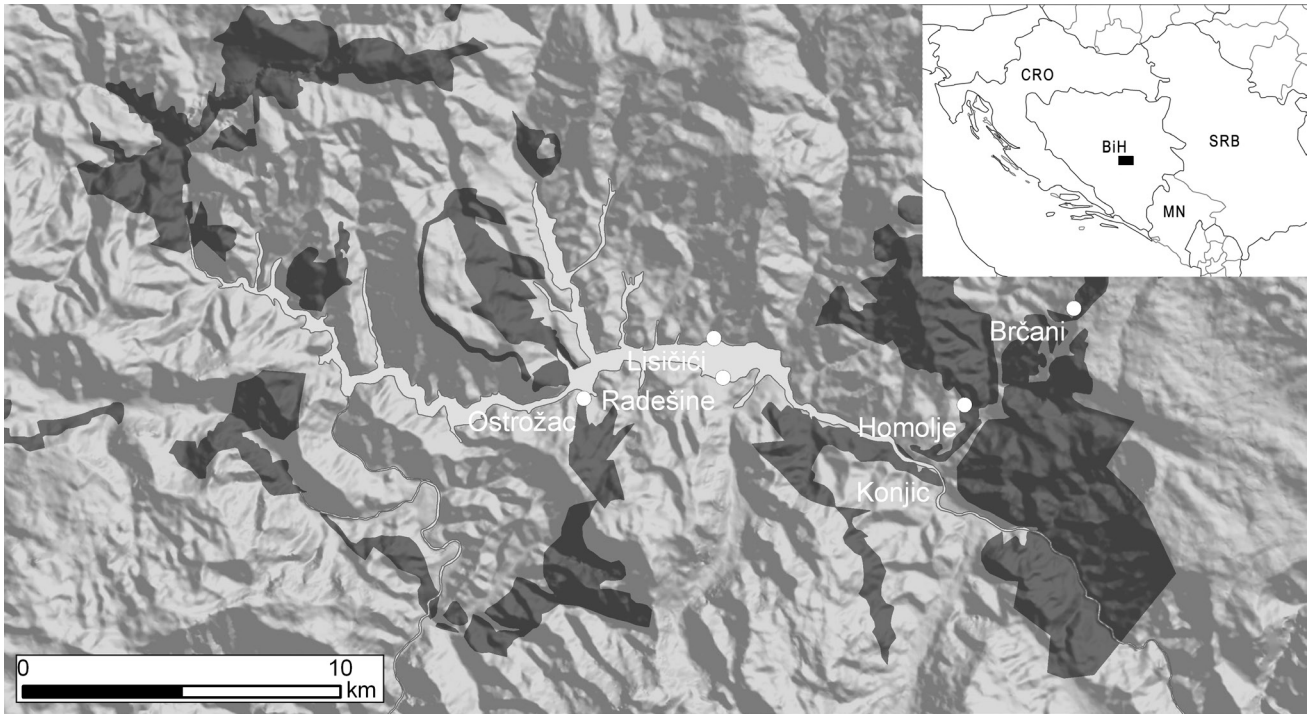

Fig. 5. Locations of the corresponding lithostratigraphic unit identified on the geological maps Prozor (T_2 ; $T_{2,3}$, T_3;) Mostar (T_3, T_2^1, 1 T_2^1); Kalinovik ($aT_3^{2,3}$, $cT_3^{2,3}$), Sarajevo ($T_{2,3}$, T_3) and archaeological sites referred to in this case study

Results and discussion

The results have shown that all finding sites of stone monuments are located within a 1 km radius of a potential source area of the stone material. The only exception is the cinerary urn (Fig. 2: No. 7) from the site of Doljani, which is located the furthest from the possible potential source of the limestone, ca 5 km. Numerous easily accessible surface limestone exposures near the site location lead us to conclude that in the Bihać area we could perhaps expect the existence of numerous small locations from which limestone was obtained. The existence of a large quarry or quarries (at least for the needs of production of the funerary monuments) does not seem likely. However, in order to be able to detect the exact locations of these small-scale, local Roman quarries, systematic terrain surveys are needed.

3.2. Konjic

The second study area is located 59 km southwest of Sarajevo in northern Herzegovina. Numerous archaeological sites with high concentrations of stone funerary monuments are located within 10 km of Konjic town (Fig. 5). The preferred type of funerary monuments on the territory of the Konjic area, during the 2nd and beginning the 3rd century AD, was the stela. The typological and stylistic analysis of the stele from the Konjic area has revealed that they were probably produced in local stonemasonry workshops.[9] The epigraphic data and women's clothing depicted on the stele suggest that the clients were local people.[10]

Macroscopic petrographic analysis of the stone material was conducted on 9 funerary monuments (Fig. 2). Results of the analysis have shown that all funerary monuments from the Konjic area are made of the same type of limestone, defined as lithotype B.

Description of the lithotype and its possible provenance area

The lithotype B is white detrital, bioclastic, partially dolomitized limestone with a "grainstone to packstone" texture. Fragments of shells, echinoderms, and other mollusc fragments are recognizable. The rock is composed of large rhomboidal dolomite crystals. Crystals range in size from 0.2 to 1 mm (0.5 mm on average). The matrix between dolomite crystal reacted to 10% hydrochloric acid demonstrating that partially dolomitized limestone samples prevail and that completely dolomitized samples are very rare. According to the geological maps in the Konjic area the dolomitized white limestone occurs among Middle and Upper Triassic rocks. These have been identified on the basic geological

9 LOZIĆ 2013.

10 LOZIĆ 2013.

Fig. 6. The figure provides a macro-photo of the limestone lithotype C (photo: I. Rižnar)

map on a scale of 1:100,000, Sheet Prozor (T2, T2,3, T3)[11], Sheet Mostar (T3, T2, 1; 1T2, 1)[12], Sheet Kalinovil (aT2, 3; cT3, 2,3)[13], Sheet Sarajevo (T2, 2; T3)[14]. The corresponding lithostratigraphic units (i.e. potential source area of the stone material) are also presented in the Upper Neretva valley (Fig. 5).

Results and discussion

The results have shown that all finding sites are located within a 3 km radius of the potential source area of the stone material. According to the geological analysis alone we cannot determine whether the material used for the stonemasonry production of the funerary monuments was sourced in a single large quarry or several smaller ones. However, the very small-scale production of the funerary monuments, produced in a relatively short time period would suggest the existence of a single quarry. The geological map and the transportation conditions narrowed the choices of potential locations for such a quarry to two possibilities (Fig. 5). The first is the outcrop of the limestone near the site Ostrožac under the assumption that the Neretva River was used for transport to the Lisičići, Radešine and Konjic. The second possibility is in the Konjic area at the junction of the Neretva valley and the known Roman road before it crosses over the Ivan pass to the Sarajevo area. Other source areas do not seem suitable since they are located on mountainous and inaccessible locations. However, in order to be able to confirm one or the other quarry systematic terrain surveys are needed.

3.3. Srebrenica

The third study area is located 75 km northeast of Sarajevo in eastern Bosnia and Herzegovina. The archaeological sites at which stone funerary monuments were found are located within 20 km of Srebrenica town (Fig. 7). In the Roman period this region was an important mining territory, with *Domavia* (Gradina near Srebrenica) as the most significant municipal and administrative centre in the eastern part of the Roman province of Dalmatia. Epigraphic analysis has revealed that in the area of *Domavia* lived not only local people but also those from different parts of the Roman Empire such as Romans, Greeks, and people from Orient.[15] This is also reflected in the typological and stylistic heterogeneity of the funerary monuments in this region. However, the preferred type of funerary monuments on the territory of the Srebrenica area, during the end 2nd and the 3rd century AD, was the stela with a portrait medallion. The macroscopic petrographic analysis of the material conducted on the 10 funerary monuments revealed that they were all made from the same type of limestone, defined as lithotype C.

Description of the lithotype and its possible provenance area

Lithotype C is a light grey to white limestone breccia of presumably Middle to Upper Triassic age. The breccia clasts are poorly sorted and are measuring from a few mm to 15 cm. The breccia has no matrix; the clasts are separated by stylolithe (pressure solution) seams in which the breccia clasts were partially dissolved. The breccia clasts are cut by a few millimetre thick calcite veins (arranged in conjugate pairs), ending at stylolitic seams. The breccia clasts are composed of light grey to almost white limestone, mudstone to rudstone type with rare, completely recrystallized shells, brachiopods (up to 2 cm) and algae. Lithotype C is a monomictic breccia, composed of angular clasts belonging to only one formation. However, some clasts appear to be brecciated as well. (Fig. 6).

The corresponding lithostratigraphic units have been identified on the basic geological map : 100,000, Sheet Ljubovija (T_2)[16] and Višegrad (T_2)[17] (Fig. 7).

11 SOFILJ, ŽIVANOVIĆ 1979; SOFILJ *et al*., 1980.

12 MOJIĆEVIĆ, LAUŠEVIĆ 1971; MOJIĆEVIĆ, LAUŠEVIĆ 1973.

13 MOJIĆEVIĆ, TOMIĆ 1981; MOJIĆEVIĆ, TOMIĆ 1982.

14 JOVANOVIĆ *et al.* 1977; JOVANOVIĆ *et al.* 1978.

15 ZOTOVIĆ 2003, 19.

16 KUBAT *et al.* 1976; KUBAT *et al.* 1977.

17 OLUJIĆ, KAROVIĆ 1986.

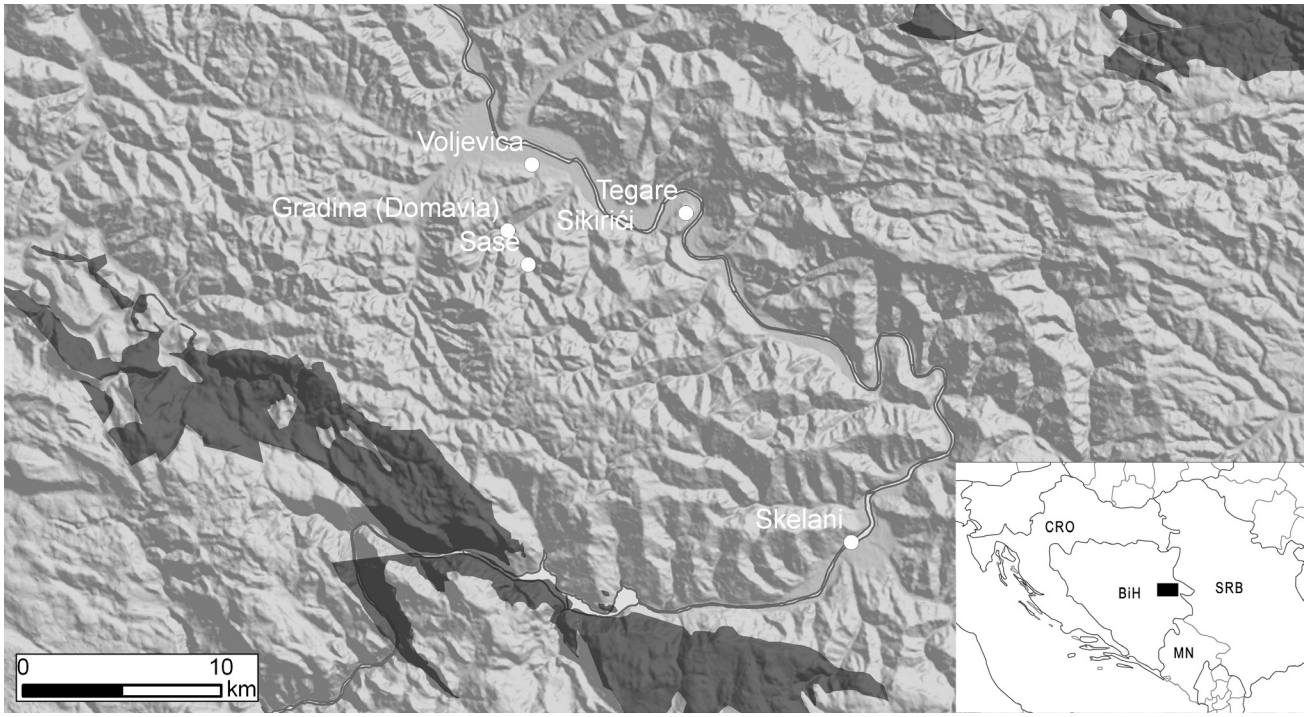

Fig. 7. Locations of the corresponding lithostratigraphic unit identified on the geological maps Ljubovija (sheet T_2) and Višegrad (T_2) and archaeological sites referred to in this case study

Results and discussion

Geological analysis showed that the entire corpus was made from a single lithotype C, suggesting a single source of the material. However, such stone material is absent in the region. In a geological sense the area around Srebrenica is characterised by Palaeozoic clastites and Neogene igneous rocks. The quality of this stone outcropping near Srebrenica is insufficient for exploitation. This implies that Roman settlements in the Upper Drina valley were faced with a problem regarding stone supply. Especially in *Domavia* (Gradina near Srebrenica), one of the biggest settlements in the area, this must have presented a major infrastructure problem. The nearest potential source of this type of limestone is located about 25 km to the east (Fig. 7). This location does not seem a likely source of the limestone, since it is located in a mountainous region and it is almost inaccessible. Taking into account the limitations of regional topography, underlying geological situation and the transportation conditions the situation permitted only one possible location of suitable material: the area near today's Klotijevac, 55 km upstream from Srebrenica. It seems that the Drina River as a transport route presented the only possible solution. The use the Drina River for transportation of stone material (from Zvornik — Sirmium) was already confirmed by recent research of the Dardagani quarry.[18]

4. Conclusion

The macroscopic-petrographic analysis has revealed that limestone was the first choice for the production of the funerary monuments (dated between 1st and 3rd century AD) in the interior of the Roman province of Dalmatia. By defining the type of stone material used, we were able to locate the potential source area(s). As it seems, apart from the availability of the stone material it was the terrain characteristics that dictated the quarry location. In the Bihać area, the numerous outcrops of limestone near the site location suggest the existence of small location on which limestone was procured. In the Konjic area only two possible locations for the quarry site. In the Srebrenica region the geological and topographical situation narrowed the choice to only one possible location for the quarry. Although determining exact locations is not possible without time-consuming additional fieldwork, our results suffice to point out the possible existence of the quarry locations not known previously.

In the case of Srebrenica we were also able to identify the transport route. Results of the material characterisation reveal that stone was obtained locally and each region had its own limestone source areas.

18 DJURIĆ *et al.* 2006,103-138; DJURIĆ *et al.* 2007, 83-100.

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