Roman Marble Stone Quarries in Jbel Saïkha and Jbel Essouïnia (Toujane – Tunisia): From Extraction to Uses

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Abstract

During the field-walking survey in the region of Toujane, five ancient quarries were discovered in the mountainous sector. Four coloured calcareous alabaster quarries were registered in Jbel Saïkha, and one grey limestone quarry was identified in Jbel Essouïnia. The quarries, belonging to the Upper Permian unity constituted of small mountain chains, are accessible by a road connecting the town of Medenine to the Berber town of Matmata. In the quarries, which were exploited in the open air, two different techniques of extraction were identified: the channelling technique and the splitting technique. These two techniques were similar to those identified at other Roman quarries in the Roman Empire. Some of the large-sized extracted blocks were split inside the quarry area. The results of the macroscopic and microscopic analyses revealed that the coloured calcareous alabaster blocks extracted from the quarries were not only used in the walls of the rural ancient constructions, but also employed in the *aedifici publici* of the Roman towns of *Gigthi* and *Meninx*. These data allowed us to date the exploitation of the quarries from the Roman period, in particular from the 2nd century AD.

Introduction

Despite the few studies that have been published on Tunisian marbles and marble stones up to the recent decades, these natural materials remain relatively little-known.[1] Among these marble stones, two types of calcareous alabasters (also known as "faux onyx" or hydrothermal travertine stone)[2] have been identified in Tunisia: the white calcareous alabaster and the coloured calcareous alabaster. The first one is unknown by the searchers, but the second one could be identified by geologists and archaeologists as the material used to decorate the public constructions in the towns of Carthage and *Uthina* during the Roman period.[3] According to these authors, the ancient quarries of Jbel Oust supplied the coloured calcareous alabaster.[4] Nevertheless, this thesis needed to be confirmed by further analytical analyses (microscopic, chemical, and isotopic), because ancient quarries of coloured calcareous alabaster also have been identified in Jbel Rouas, a few kilometres from the quarries in Jbel Oust. Besides these ancient quarries located in the northern part of Tunisia, others have been discovered in the south of the country during our field-walking survey, namely in the region of Toujane in the governorate of Medenine. The identified quarries belong to the Permian period and consist

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of coloured calcareous alabaster rock as well as grey limestone rock in the mountains called Jbel Saïkha and Jbel Essouïnia. During our field-walking survey we registered five ancient quarries. The preserved traces left on the quarry faces allowed us to identify both the exploitation and extraction techniques. To know where the blocks extracted from these quarries were employed, we prospected the ancient rural sites situated nearby the quarries, and we visited the archaeological sites of the two Roman towns of *Gigthi* and *Meninx.* A comparative study based on macroscopic and microscopic analyses[5] was carried out on samples taken from the calcareous alabaster quarries. Additionally, samples were taken from fragments of architectonic elements belonging to the constructions of the two Roman towns. This study will not only highlight unknown Roman quarries of calcareous alabaster and grey limestone situated in southern Tunisia, but also will identify the places where the extracted blocks were employed.

Geographical and Geological Setting

During the field-walking survey conducted on March 2015 in several sectors of Jbel Tebaga at Toujane, five Roman quarries were identified in an area covering nearly 10 km^2 of Jbel Saïkha and Jbel Essouïnia. This area is characterised by low altitudes (the peak of Jbel Saïkha does not exceed 302 m), by watercourses that are functional only after heavy rains (such as oued en Nagueb), and by a low vegetation cover. The quarries are accessible by an E-S-E/W-N-W rural road connecting the Berber town of Matmata with the town of Medenine, passing by the village of Toujane (fig. 1).

Geologically, the quarries belong to the Permian Unity comprise small mountain chains outcropping on the Northern edge of the Saharan Platform.[6] From east to west, the unity comprises Jbel Saïkha, Jbel Essouïnia and Jbel Tebaga (fig. 2). This 13 km-long monoclonal structure is oriented N80° and dips 20° to 30° southward with angular unconformity by Jurassic and Cretaceous strata.[7] The quarries are located in limestone and dolomite outcrops belonging to the Upper biohermal complex of the Permian period situated in Jbel Saïkha and Jbel Essouïnia.

Extraction Technique

The five quarries were exploited in the open air because the bedrock of calcareous alabaster or grey limestone was very compact (fig. 2). Hence, the quarry workers did not need to exploit them in galleries. This is contrary to the ancient oolitic sandstone underground quarries from the Tyrrhenian formation located in eastern *Byzacium* (Sahel-Tunisia), where the upper layer of the rock was very thick and unsuitable for building.[8] The five open air quarries are small-sized due to the presence of horizontal or vertical beds of calcareous alabaster in the dolomite rock of the Upper Permian period (table 1).

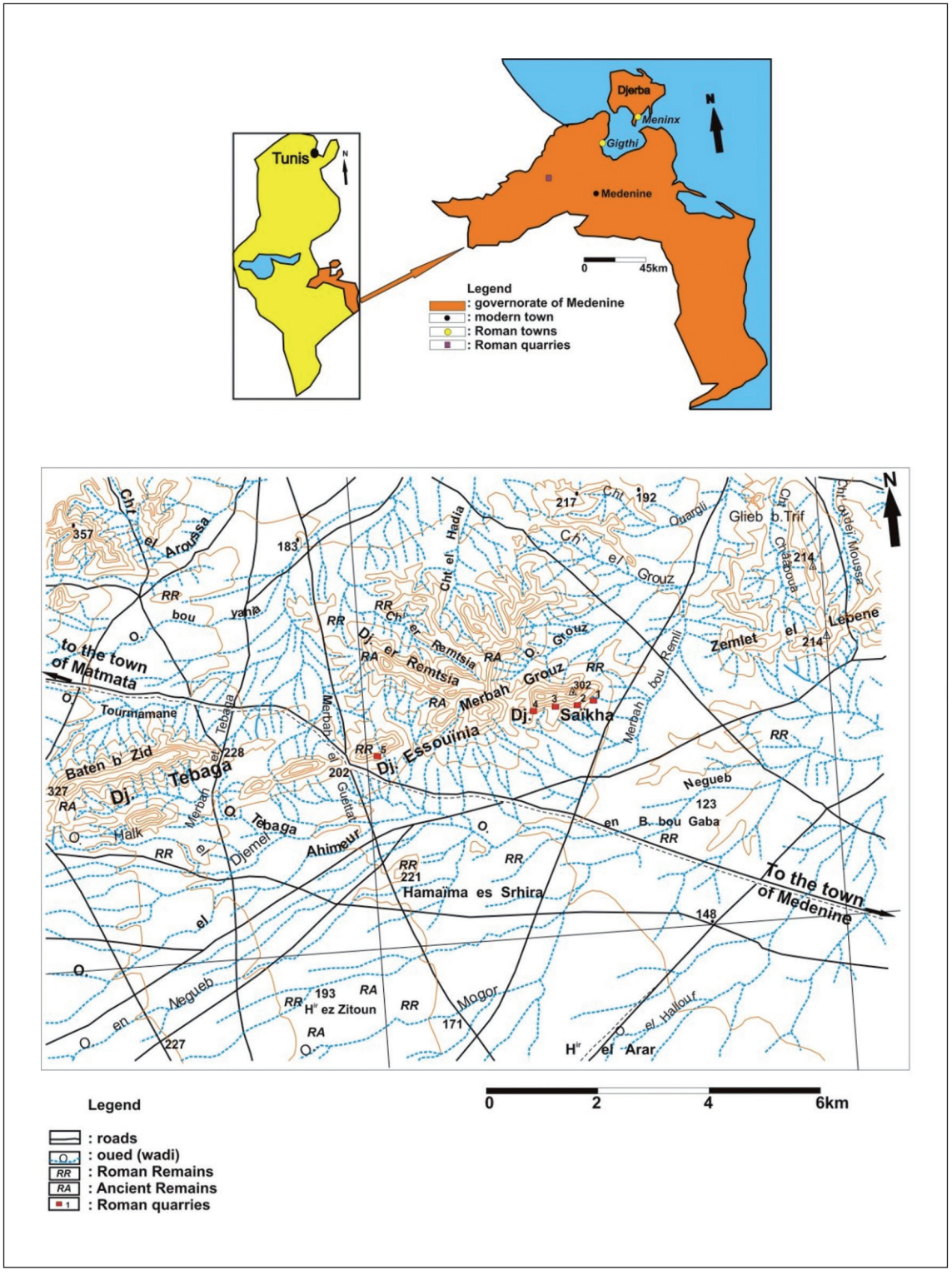

Fig. 1: Geographical map of the Roman quarry areas.

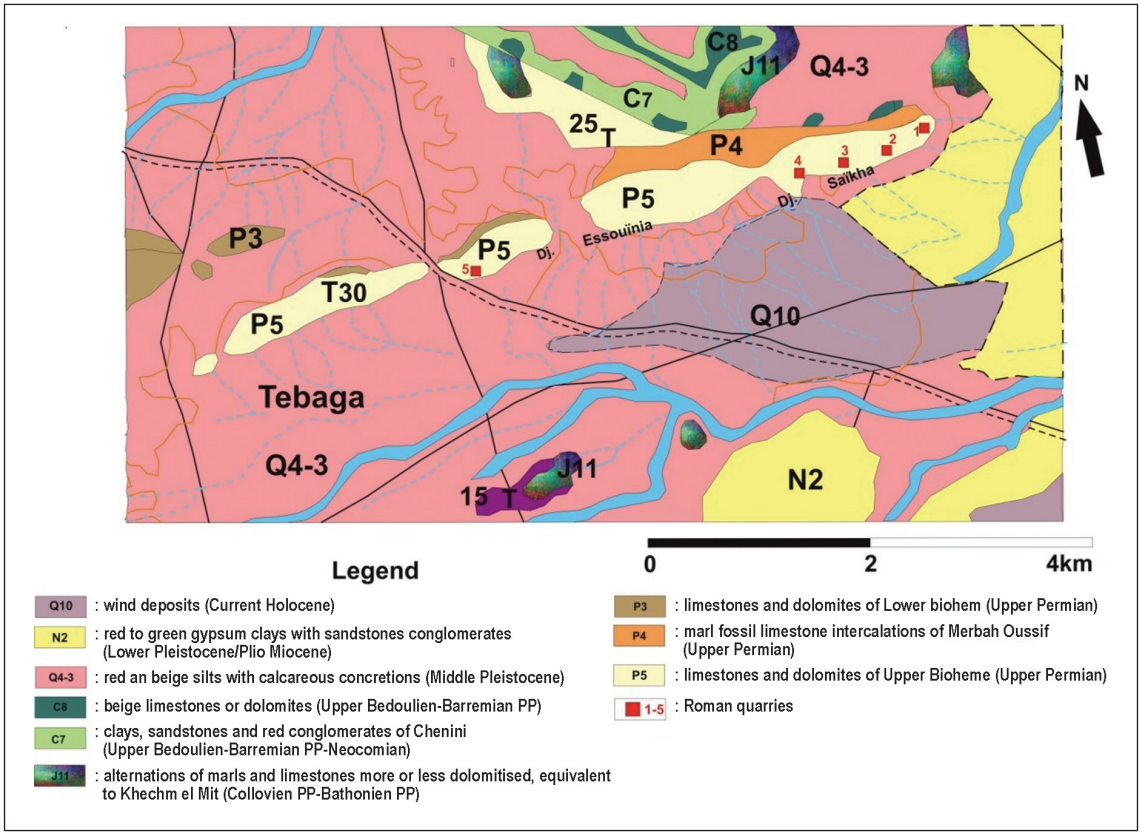

Fig. 2: Geological map of the Roman quarry areas.

Quarry N°	Approximate sizes of the quarries				Approximate amount of extracted blocks (m^3)
	Length (m)	Width (m)	Height (m)	Area (m^2)	
1	25	10.5	4	262.5	1050
2	16	13	4.50	208	936
3	18	13.5	3	243	729
4	16	15	3.20	240	768
5	25	15.5	1.50	387.5	581.25
					Total: 4064.25

Table 1: Approximate sizes of the 5 quarries and approximate amount of the extracted blocks.

The traces of extracted blocks left on the five quarry faces allowed us to identify two different extraction techniques used by the quarry workers. In the first one, called the splitting technique, the quarry workers started widening the natural lines of weakness (*diaklasis*), as well as the stratigraphic levels within the calcareous alabaster and grey limestone rocks. Then, they made holes in the upper part in order to insert iron wedges which were hammered in so as to break the block apart (fig. 3; table 2). Most of the extracted blocks were large-sized and allowed the stone carvers to shape them into architectural elements (e.g. columns, capitals, friezes) or to cut them into small and medium-sized blocks. The splitting technique has been identified in the Roman marble limestone quarries at *Thugga* (Dougga).[9] The second one, the channelling technique, has been identified in a few calcareous alabaster quarries for the extraction of blocks and column shafts (fig. 3; table 2). This technique consisted in more phases of quarrying operations than the first one. Indeed, when *diaklasis* and stratigraphic levels were missing in the bedrock, the quarry workers took off the upper layer of sand and vegetation covering the surface. Then, they outlined the block to be cut with a pick by making slits, which were widened and deepened with the use of an awl and a sledgehammer. This created extraction trenches whose width corresponded to the thickness of the block to be cut. Finally, the quarry workers made a line of rupture at the lower forward side of the block where holes were made to insert iron wedges to extract the block from the bedrock. Sometimes, when this last step was not successfully done, a part of the block remained attached to the bedrock. The sizes of the extraction trenches and of the holes vary (table 2). The width of the measured extraction trenches allows the quarry workers to move the awl easily when widening and deepening the trenches. The cutting marks left on the quarry faces give them a stepped profile. The channelling technique has been attested in several Roman quarries in Tunisia (Dougga, Chemtou, *Thapsus,* Sallakta),[10] in Spain (Tarragona),[11] and in France (Marseille).[12]

Thanks to the numerous pieces of debris of calcareous alabaster and grey limestone lying in the areas of quarries 2, 4 and 5, we can deduce that the quarry workers cut and

Fig. 3: Marks of extraction techniques.

Quarry N°	Sizes of the extraction trenches length × width × depth(cm)	Sizes of the wedge holes length × width × depth (cm)
1	10 × 30 × 110 12 × 25 × 150 14 × 52 × 100	----------
2	12 × 65 × 90 9 × 40 × 70	8 × 3 × 7 (7 wedge holes) 12 × 3 × 7
3	7 × 15 × 70 10 × 20 × 60	----------
4	10 × 27 × 40 12 × 15 × 30 12 × 50 × 90	10 × 3 × 7 12 × 3 × 7.5 10 × 3 × 7.2
5	----------	15 × 6 × 20 (3 wedge holes) 15 × 6 × 17 15 × 6 × 13 15 × 6 × 10

Table 2: Sizes of the extraction trenches and wedge holes.

carved the large-sized extracted blocks inside the quarry areas to facilitate their transport to the building sites. At present, no quarry-road has been identified in the five quarry areas.

A Preliminary Characterisation of the Quarry-Stones

Macroscopic analyses were carried out on calcareous alabaster and grey limestone fragments taken from the quarries. These were based on the colour and the grain size, together with mineralogical and chemical analyses. The results show that macroscopically, the calcareous alabaster fragment is characterised by a coarse-grained texture (superior to 5 mm) and by different colours (beige, grey, yellow, honey, pinkish, brick-red, brown) (fig. 4). The mineralogical (XRD) and chemical results reveal that calcite is the main component of the calcareous alabaster sample, but there are also traces of oxides (iron, magnesium and aluminium).[13] The grey limestone fragment is medium-grained (between 2 and 4 mm) and is characterised by a dark grey colour with the presence of small white spots (fig. 4). The mineralogical (XRD) and chemical results reveal a high content of calcite, with traces of silica and oxides.[14]

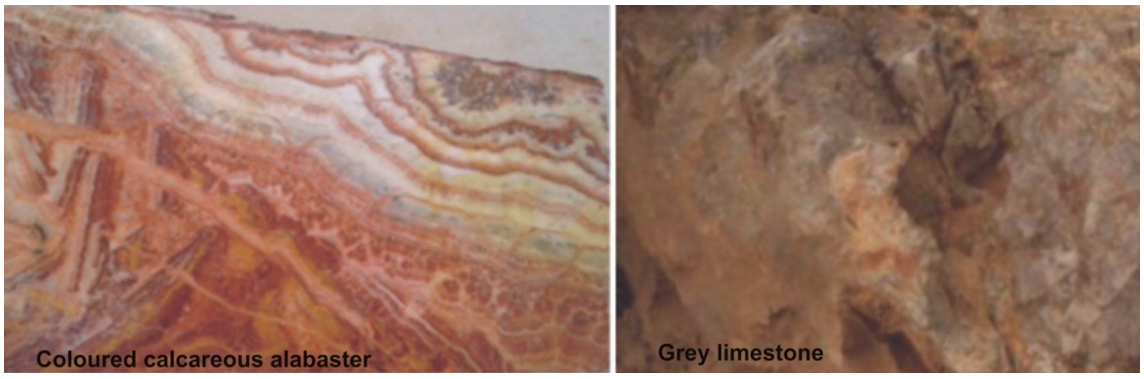

Fig. 4: Photos of coloured calcareous alabaster and grey limestone samples.

Uses and Provenance of the Blocks

Among the 18 rural archaeological sites denoted by the letters "*RR*" and "*RA*" ("Roman Remains" and "Ancient Remains") in the topographic map of Matmata (scale: 1:100,000), 6 are situated near the quarries. These sites contain the remains of rural constructions built with small blocks and rubble stones of calcareous alabaster and grey limestone.[15] The remaining walls of the rural constructions located at four sites were made of calcareous alabaster rubble stones and small blocks (fig. 5). At the other two sites, the few foundations of the still-visible walls were built with grey limestone rubble stones and

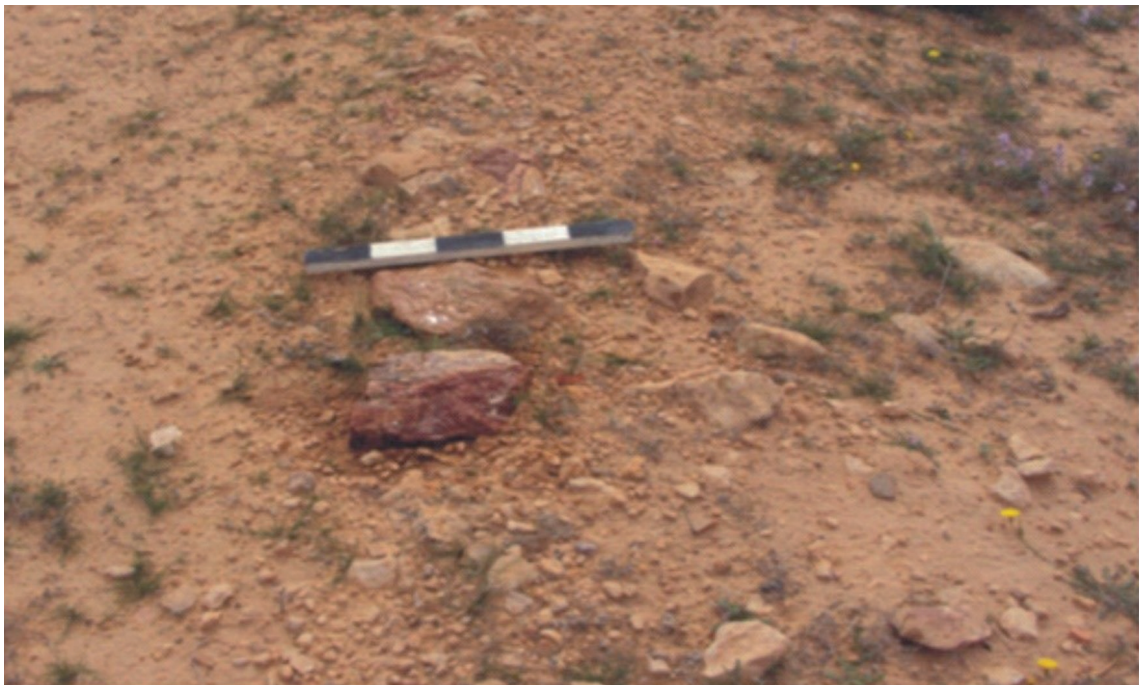

Fig. 5: View of the Roman rural archaeological sites.

blocks of small and medium sizes. According to the few Roman ceramic sherds found in the sites, it is very likely that these rural constructions date to the Roman period.

These two types of marble stones were used not only for building these rural constructions, but they were also used for the construction and the decoration of the monuments located in the Roman towns of Meninx and Gigthi, situated not very far from the quarries.

In the archaeological site of Meninx, situated roughly 75 km to the north-east of the quarries (fig. 1), large-sized blocks were discovered together with several fragments of architectural elements (fig. 6).[16] The large blocks are much altered.[17] Despite the few carvings still visible on the blocks, it is difficult to assert whether the stone carver left their work unfinished or whether the extended exposure to sand and sea water has eradicated most of the carvings. The fragments of the architectural elements come from column shafts,[18] from an architrave,[19] and from a capital, all of which belonging to edifices situated in the public place of the Roman town.[20]

The archaeological site of the town of Gigthi,[21] lying about 45 km north-north-east of the quarries, is better preserved than the archaeological site of *Meninx* (fig. 1). At Gigthi there are public constructions decorated with coloured calcareous alabaster stone. Panels of coloured calcareous alabaster covered the walls of the *ephebeum* in the *palestra* of the Roman baths, and column shafts[22] of the same coloured stone were very likely used to decorate the *Capitolium* and the *forum* (fig. 6).[23] These three monuments might have been built in the 2nd century AD.[24]

To identify the provenance of the coloured calcareous alabaster used for the architectural elements at both sites, some fragments were sampled and analysed in terms of their composition and provenance. The results of the macroscopic analyses (colour and grain size), together with the mineralogical (XRD) and chemical analyses revealed that the coloured calcareous alabaster stone came from the quarries of Jbel Saïkha.[25]

Fig. 6: Fragments of architectural elements at the sites of Meninx and Gigthi.

Attempts to Date the Quarries

It is difficult to date precisely the exploitation of the quarries because of a lack of epigraphic data. Nevertheless, archaeologists have proposed a relative dating thanks to the inherent features of the quarries, together with data concerning the uses of the extracted stone blocks. Hence, the techniques of extraction used in Jbel Saïkha's quarries for the exploitation of coloured calcareous alabaster were similar to those used in other Roman quarries in Africa Proconsularis,[26] in Catalonia,[27] and in southern Gaul.[28] At Meninx, the monuments decorated with architectonic elements made of coloured calcareous alabaster stone extracted from Jbel Saïkha's quarries date back to the earlier Roman Empire, while the same quarry was exploited in the 2nd century AD for the monuments at Gigthi.

In the quarry providing grey limestone, the extraction technique (splitting technique) used by the quarry workers also was well developed in the Roman quarries of calcareous marbles in Dougga[29] and in Tortosa.[30] Moreover, the grey limestone was employed in the construction of the two rural sites dating very likely from the Roman period. Consequently, on the basis of all these data it is very probable that this quarry was exploited during the Roman period, in particular during the 2nd century AD.

Conclusions

This study on coloured calcareous alabaster, together with the grey limestone extracted from Jbel Saïkha and Jbel Essouïnia in the region of Toujane in Medenine (southern Tunisia) led us to identify five ancient quarries. We registered four coloured calcareous alabaster quarries in Jbel Saïkha, and one quarry of grey limestone was identified in Jbel Essouïnia. The quarries, exploited in the open air, are located in limestone and dolomite outcrops belonging to the upper biohermal complex of the Permian period.

Two types of extraction techniques have been identified: the channelling technique and the splitting technique. These two different extraction techniques were also identified in other Roman quarries in the north and in the centre of Tunisia, in the southeast of France, and in the northeast of Spain. The extracted blocks were medium to large-sized. Some of the large blocks were split and carved inside the quarry-area.

The results of the macroscopic and microscopic analyses revealed that the extracted blocks, after being cut and carved, were used to build the walls of the constructions in the rural sites dating very likely from the Roman period. These blocks also decorated the public monuments located in the two Roman towns of *Meninx* and *Gigthi.*

The techniques of extraction, together with the constructions in which the coloured calcareous alabaster was employed, allowed us to date the exploitation of the quarries from the Roman period, particularly in the 2nd century AD.

Notes

[1] Ferchiou 1973, 633–642; Lazzarini 2006, 59–70; Rakob 1993; Rakob 1995, 65–69; Younès 2014, 231–248; Younès 2014a, 161–192.
[2] Bruno 1998, 19–24; Herrmann et al. 2012; Dillmann et al. 2014; Lazzarini et al. 2012.
[3] Agus et al. 2007, 375–394; Lazzarini et al. 2012.
[4] Idem.
[5] The student A. Amri was given the responsibility to carry out the petrographic, mineralogical, chemical and physico-mechanical analyses while preparing her mémoire of Master entitled "Les pierres décoratives de Jbel Tebaga de Médenine" which was submitted in 2016 under our direction.
[6] Bouaziz 1955; Ouaja et al. 2002.
[7] Bouaziz 1986; Chaouchi 1988; Amri 2015.
[8] Younès et al. 2008, 55–82; Younès et al. 2009, 229–237 pl. 14. 15.
[9] Younès 2018, 97–110.
[10] Younès et al. 2008, 55–82; Gaied et al. 2010, 531–549; Younès 2014, 161–192; Younès 2018, 97–110.
[11] Gutierrez Garcia Moreno 2009.
[12] Guery et al. 1981, 18–27; Treziny 2009, 203–212.
[13] Amri 2015.
[14] Idem.
[15] The visible archaeological remains at the sites are not numerous and most of them are in a bad state of preservation due to natural weathering and/or anthropic actions (fig. 5).
[16] Drine 2000, 87–94; Drine 2007, 239–251; Fentress et al. 2009.
[17] Three large-sized blocks of different dimensions have been discovered (Length × Width × Thickness in cm): 105 × 48 × 42; 125 × 47 × 45; 70 × 50 × 42.
[18] Four fragments from three different-sized column shafts have been measured (Length × Diameter in cm): 184 × ?; 120 × 70; 101 × 40; 98 × 70.
[19] Dimensions (Length × Height × Thickness in cm): 136 × 89 × 30.
[20] Nowadays, the remaining walls of the basilica and the presumed forum have nearly all been covered with beach sands.
[21] Constans 1914, 267–286; Constans 1916; Drine 1996, 683–692; Trousset 1998, 3128–3134; Drine 2008.
[22] Fourteen fragments of column shafts have been registered: seven are fluted, four are rudented-fluted, and three are rudented.
[23] Tlatli 1971, 62–71; Drine 2008, fig. 2 (plan of the site of Gigthi).
[24] Tlatli 1971, 67.
[25] Amri 2015, 35 f. 38.
[26] Younès 2008; Younès 2014a; Younès 2018.
[27] Gutierrez Garcia Moreno 2009.
[28] Guery et al. 1981.
[29] Younès 2018.
[30] Gutierrez Garcia Moreno 2009.

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