

# ROMAN QUARRIES IN THE NORTHEAST OF HISPANIA (MODERN CATALONIA, SPAIN)

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## Abstract

This paper presents the results of a PhD research<sup>1</sup>, which was part of a broader research project on artistic, epigraphic and other Roman remains made of stone, that focused on the material itself and, above all, its origin. The foremost purpose was a global approach to the stone industries, both from the extraction point (quarries) and from the final use (stone objects, buildings, etc.), to get an overall picture of the whole process and its organization. In this sense, local stone proved an appropriate study case since both their quarries and the resulting objects/buildings are usually located nearby. A comprehensive bibliographic survey was undertaken as previous step to delimiting the study areas (the territories around Tarraco, Dertosa, Barcino, Aeso, Emporiae, Gerunda and other scattered areas) and to the field survey, which enabled to record as much data as possible from the sites. As a result a comprehensive collection of data has been compiled (tool marks, volume of stone extracted, contextualization on the ancient landscape, petrographic characterization of each stone, and examples of monuments/objects/buildings where it was used). The analysis of all this data led to reconsider the chronology of most of the quarries and to propose new dates on the basis of more reliable data as well as to understand how quarrying was undertaken and developed after the arrival of the Romans in this territory.

## Keywords

Roman quarries, local stone, Santa Tecla stone, broccatello, extraction techniques, extraction strategies, north-eastern Spain.

## Introduction

Stone and their use in ancient Spain has received a growing attention in the last decades has helped to evi-

dence the importance of stone extraction and its related activities in this territory<sup>2</sup>. However, the areas of procurement (i.e. the quarries) have been less addressed<sup>3</sup>. The study presented here has focused on the territories surrounding some of the main Roman urban centres in northeastern Spain, as they were more likely to have been object of intense stone exploitation: Tarraco (modern Tarragona), the former capital of the province of Hispania Citerior, which later became Hispania Tarraconensis; Emporion/Emporiae (modern Empúries), a major urban centre from the time of the arrival of the Phocaeans in the early 6<sup>th</sup> century BC; and the smaller towns of Gerunda (modern Girona), Barcino (modern Barcelona), Dertosa (modern Tortosa) and Aeso (modern Isona). Additionally, some specific already known quarries that, due to its importance, could not be left out were also included in the study (Fig. 1).

The research on previous works together with the field survey and analysis of quarry fronts led to compile a large amount of data that, combined with the information from stone artefacts and buildings, provide a greater understanding of the exploitation of this region's stone resources in Roman times.

## The quarries

The first and main factor addressed was the dating of the quarries as no in-depth study was available of most of them and it was the basis for the whole of the following discussions. Despite some major drawbacks<sup>4</sup>, a close analysis of the data available (i.e. extraction traces preserved at the sites, presence/absence of Roman buildings or monuments nearby, location of the quarry in relation to the road network of coastal transport, etc) enabled to venture a chronological framework for most of the quarries.

Only 6 out of 40 quarries<sup>5</sup> are Roman, of which only 3 could be dated thanks to archaeological evidence (Fig.

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2. Despite some pioneering work, the number of studies addressing the identification of marbles and other stones increased significantly in the late 90s (see, for example, Álvarez *et al.* 2009a, 2009b, 2009c, 2009d, 2011; Gutiérrez Garcia-M. 2009, 2011; Lapuente *et al.* 2002, 2009; Lapuente and Blanc 2002; Nogales *et al.* 1999; Rodà 1997, 1998, 2004 and 2005; Royo *et al.* 2008; Soler 2004, 2005; as well as the several contributions to this volume).

3. With the exception of very recent works presented in national conferences (Garcia-Entero 2011; Nogales and Beltrán 2009) and the works included in this volume.

4. The resumption of quarrying during later periods led either to the destruction of the ancient remains or their concealment under debris.

5. A number for each quarry, related to those used in Fig. 1, is provided next to them each time they are mentioned in the text in order to facilitate their location on the map.

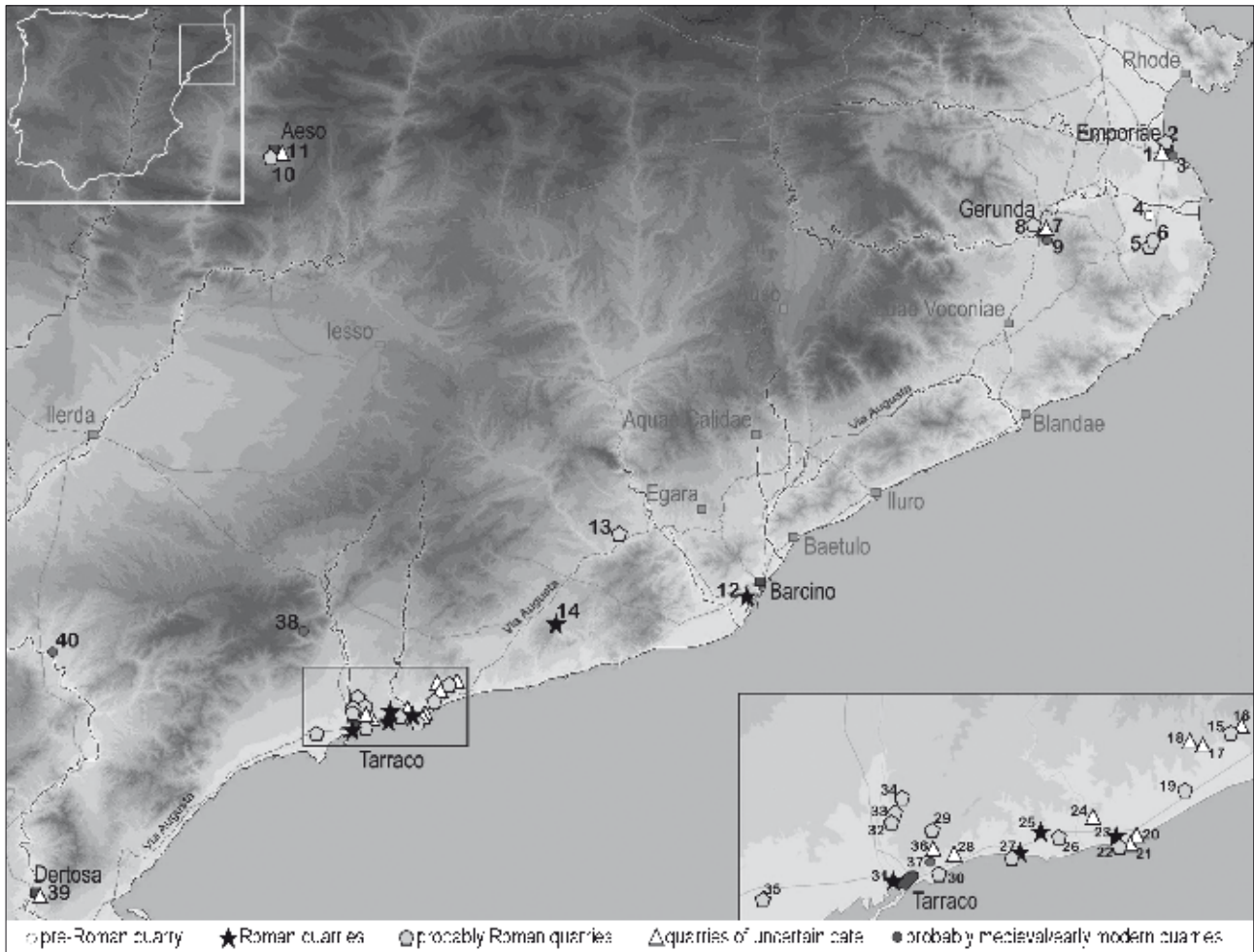


FIG. 1. Topographic map of north-eastern Spain showing the location of the quarries and Roman towns mentioned in the text, the road network and river courses. Quarries: Santa Margarida and Santa Magdalena (1), Sant Martí d'Empúries (2), Mar d'en Manassa (3), Puig de Serra (4), Clots de Sant Julià (5), Puig d'en Torrò (6) Pedrera d'en Bohiga or Les Pedreres (7), Domeny (8), Pedrera del Cementiri (9), Antic Camí de Sant Salvador (10), Gafans (11), Pedrera romana at Montjuïc (12), La Rierussa (13), Olèrdola (14), Roda de Berà (15), Corral d'en Xim (16) Mas de Nin (17), L'Aguilera (18), Marítima Residencial (19), Roca Foradada (20), Punta de la Llança (21), Platja dels Capellans (o de Canyadell) (22), Els Munts (23), Altafulla (24), El Mèdol (25), Mas del Marquès (26), Punta de la Creueta (27), La Savinosa (28), Coves del Llorito (29), Platja de l'Arrabassada (30), Lots 18 and 21-PERI 2 (31), Coves de la Pedrera (32), Pedreres de l'Aqüeducte (33), Mas dels Arcs (34), Torre d'en Dolça (35), El Llorito (36), La Salut (37), La Lloera (38), Barranc de la Llet (39) and Flix (40).

1). They are the quarry at Olèrdola (14)<sup>6</sup>, the Pedrera Romana at Montjuïc (12) and PERI 2-Lots 18 and 21 (31)<sup>7</sup> (Fig. 2). The other three quarries, of Els Munts (23), El Mèdol (25) and Punta de la Creueta (27) (Fig. 3), near Tarraco, were also exploited in ancient times, as their direct link to Roman monuments or buildings attests.

On the other hand, a large group of quarries and specific fronts of quarries were probably of Roman date

(Fig. 1). This is the case of the outstanding quarries of Clots de Sant Julià<sup>8</sup> and Puig d'en Torrò (5 and 6) (Fig. 4), part of El Mèdol (25)<sup>9</sup>, Coves del Llorito (29) and most of the Coves de la Pedrera sites (32), as well as smaller quarries scattered throughout the territory such as Sant Martí d'Empúries (2), Puig de Serra (4), one of the sites at Domeny (8), Antic Camí de Sant Salvador (10), La Rierussa (13), part of the largest site of Roda de Berà (15), Marítima Residencial (19), Plat-

6. A Roman military site that was built and inhabited for a short period of time (first quarter of the 1<sup>st</sup> century BC) and reoccupied in early Medieval times (10<sup>th</sup> -12<sup>th</sup> century). It includes two quarrying areas –called “interior” and “exterior” quarries (Batista-Noguera *et al.* 1991; Molist and Otiña 2012).

7. They were discovered due to urban development at Barcelona and Tarragona during the early 90s and were object of archaeological excavations (see Álvarez *et al.* 1993; Blanch *et al.* 1993; Granados *et al.* 1990; Miró and Revilla 2012, in this volume, for Pedrera Romana at Montjuïc; and Otiña 2001; Sánchez Gil de Montes 2004; Vilaseca and Carilla 1997 for the PERI 2 quarry at Tarragona).

8. A thorough study of these quarries and Clots stone is provided by Rocas *et al.* (2002).

9. It is worth mentioning that a large new front was discovered at this quarry as a result of a fire in 2010. The first preliminary results of its study will be presented at the X ASMOSIA Conference, in Rome 2012.

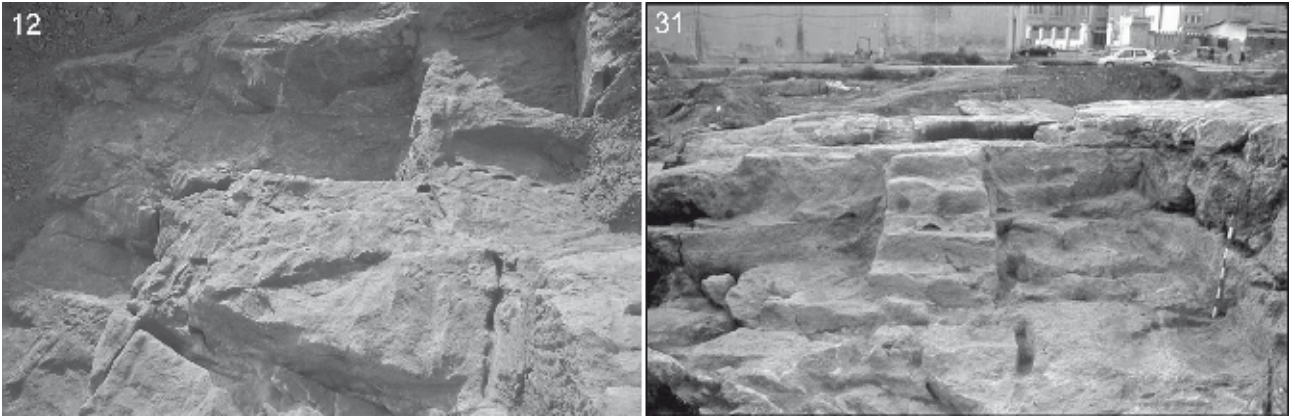


FIG. 2. Partial view of Pedrera Romana al Montjuic (12) and PERI 2-Lot 21 (31)(Photos: Archive MUHBA and Archive Codex S.L/C.Benet, respectively).



FIG. 3. View of Els Munts (23), Punta de la Creueta (27) and the Roman part of El Mèdol (25) quarries.

ja dels Capellans (22), three of the sites located at Mas del Marquès (26), Platja de l'Arrabassada (30), most of Pedreres de l'Aqüeducte sites (33), the smallest site of Mas dels Arcs (34) and Mas d'en Dolça (35) (Fig. 5).

The first and most important aspect in determining the probable ancient origin of a quarry site was to verify the use of its stone in ancient times. Although this was not always possible<sup>10</sup>, it was one of the main factors for not ruling out a possible Roman date. However, alternative factors based on the extraction patterns or strategies observed at other well-dated Roman quarries were used

to discern whether they were the result of Roman works or of later quarrying.

Thus, strict regularity of extraction regardless of the stratigraphic bedding, when found together with generally large-scale blocks and intensive use of the site, the presence of rounded/subrounded wedge holes, that were most likely employed with wooden wedges, or rounded elements were considered a strong indicator of early modern extraction. Likewise, as there are some examples of underground quarries being the result of the reuse of Roman opencast quarries in later times<sup>11</sup>, the few exam-

10. For instance, in the territory of Tarragona many of the quarries supplied a very similar type of stone (see Table 1).

11. See in particular, the quarries of Glanum (Saint-Rémy-de-Provence, southern France) (Bessac 1999, 36, fig. 26; 2003, 36-37; 2006, 21-22) or Puerto de Santa Maria (Cádiz, southern Spain) (López Amador *et al.* 1991).



FIG. 4. Two views of Clots de St. Julià quarries (5): example of the concave walls (left) and the squared ventilation/lighting hole (right).



FIG. 5. Details of Roda de Berà (15), Marítima Residencial (19), Platja dels Capellans (o de Canyadell) (22) and Mas d'en Dolça (35) quarries.

ples of subterranean extraction in northeastern Spain were closely examined. Most of the studied sites were considered very likely of post-Roman date, and in particular the result of early modern quarrying, which was a quite important industry in the study area in 16<sup>th</sup>, 17<sup>th</sup> and especially early to mid 18<sup>th</sup> century, when a period of economic prosperity led to a building boom, both in the private and public spheres.

For several cases neither the extraction traces nor the extraction pattern were enough to tip the balance in favour of an ancient date or a later one. Nevertheless, there are some quarries for which an ancient date is very plausible, even though the evidence preserved at their fronts is more in keeping with post-Roman rather than with ancient working (see Fig. 1, quarries of uncertain date).

### The use of local stone

Evidence from the quarry fronts cannot provide a more precise date. However, it is possible to narrow a bit the lifespan of these quarries by looking at the dating of archaeological objects and Roman buildings that were built with stone from these quarries.

The main types of local stone used in Roman times in northeastern Spain (Fig. 6) are summarized in Table 1.

The petrological characterization of these stones (Àlvarez 1985; Álvarez *et al.* 2009b, 2009c, 2009d, 2011; Gutierrez Garcia-M. 2009) enabled to link a large number of objects or buildings, whose stone was also object of analysis, thus making it possible to ascribe not only the use to which each stone was put to but also a chronological framework to the quarrying activity.

Apart from Empúries and Clots stone, which were used since pre-Roman times, the introduction of local stone exploitation was gradual over a period of about two centuries and, despite a general decrease from the latter stages of the early Imperial period, the abandonment of most local stones was also progressive (Table 2). The reasons for the differences on the chronology of each type of stone lie not only in the specific circumstances of each town and its surrounding area, where it was mostly used –especially the non-ornamental one–, but also in the many other factors involved in the stone industry, such as their quality, its uses and the area of diffusion. Thus, as the examples of Santa Tecla stone and especially broccatello<sup>12</sup> show, the more ornamental and unique a stone was, the longer it was in use.

The case of broccatello is exemplary<sup>13</sup>. The fact that its source area is quite restricted allows us to date the initial large-scale exploitation of the Barranc de la Llet

Common name	Type of stone	Geological date	Quarries	Use	Places of use
Empúries limestone	Light grey to yellow/beige limestone	Cretaceous (Upper Albian – Cenomanian)	Sta. Margarida & Sta. Magdalena (1), St. Martí d'Empúries (2)	Building, epigraphy, sculpture	Emporiae
Clots stone	Medium to coarse grain, ocre sandstone	Eocene (Bartonian)	Clots de Sant Julià (5), Puig d'en Torró (6), Domeny (8)	Building, architectural elements, epigraphy	Emporiae, Gerunda and their territory
Girona stone	Nummulitic limestone	Eocene (Lutecian)	Les Pedreres (7)	Building, epigraphy	Gerunda, Emporiae
Isona limestone	Light grey limestone	Cretaceous (Santonian?)	Unknown (probably erratic blocs)	Epigraphy (pedestals)	Aeso and its territory
? (Aeso stone)	Grey limestone	Cretaceous (Maastrichtian)	Antic Camí de St. Salvador (10), Gafans (11)	Buliding	Aeso
Montjuïc sandstone	Medium to coarse grain, grey sandstone	Upper Miocene	Pedrerà romana (12) and probably other currently lost quarries, at Montjuïc hill	Building, architectural elements, epigraphy, sculpture, portraits	Barcino
Coves stone	Yellow to orange calcisiltite	Miocene	Coves de la Pedrerà (32)	Building	Tarraco
Llorito stone	Light yellow calcisiltite	Miocene	Coves del Llorito (29)	Buliding and sarcophagi	Tarraco
Mèdol stone	Yellow to golden sometimes pinkish bioclastic calcarenite (shelly limestone)	Miocene	El Mèdol (25), Mas del Marquès (26), Punta de la Creueta (27), Platja de l'Arrabassada (30), PERI2-lots18-21 (31)	Building, sarcophagi, sculpture, epigraphy and architectural elements (columns and capitals)	Tarraco and its hinterland

12. Among all the types of local stone presented in Table 2, they are the only two that can be considered *marmor*, i.e. a stone with ornamental quality that takes a polished, regardless of it being or not a marble in the geological sense of the term.

13. For an updated assessment of exploitation and use of broccatello, see Álvarez *et al.* 2011; Gutiérrez Garcia-M. 2011, 323-327.

Soldó	Yellow to golden, sometimes pinkish calcarenite (sandy limestone)	Miocene	Mas dels Arcs (34), Aqüeducte (33), Torre d'en Dolça/Vila-seca (35); upper layers of El Mèdol (25), Mas del Marquès (26), Coves de la Pedrera (32) and Coves del Llorito (29)	Building, sarcophagi, sculpture, epigraphy and <i>cupae</i>	Tarraco and its hinterland
Altafulla stone	Yellow, bioclastic calcarenite (shelly limestone)	Miocene	Altafulla (24), Els Munts (23), Platja dels Capellans/de Canyadell (22), Punta de la Llança (21), Roca Foradada (20), Marítima Residencial (19)	Building	Northern coastline of the territory of Tarraco
? (Roda de Berà stone)	Yellow bioclastic calcarenite (shelly limestone)	Miocene	Roda de Berà (15), Corral del Xim (16), Mas de Nin (17), L'Aguilera (18)	Building	Northern <i>territorium</i> of Tarraco
Savinosa or Aigüeres stone	Grey to orange limestone	Miocene	La Savinosa (28)	Building, epigraphy, quicklime?	Tarraco
Santa Tecla stone	Yellow to golden limestone with red striae and white calcite veins	Cretaceous	El Llorito (36), La Salut (37)	Epigraphy and ornamental purposes (wall veneers, pavements, opus sectile, architectural elements).	Mainly Tarraco but also throughout northeastern Hispania, Labitolosa, Caesar Augusta and Carthago Nova
Llisós	Grey to brownish limestone	Lower Cretaceous-Upper Jurassic	El Llorito (36), La Salut (37)	Epigraphy and ornamental purposes (wall veneers, pavements) and sarcophagi	Tarraco
Alcover stone	Grey to brownish mudstone	Upper Muschelkalk	La Lloera (38)	Epigraphy, wall and floor panelling, tombstones	Tarraco and its hinterland
Broccatello (or jaspi de la Cinta)	Dark red to purple and yellow, spotted shelly limestone (coquina)	Lower Cretaceous	Barranc de la Llet (39)	Epigraphy and ornamental purposes (wall veneers, pavements, opus sectile, architectural elements)	Dertosa, most of Hispania, central Italy (Rome and Lazio) and north African coast <sup>14</sup>

TABLE I. Summary of the main stones exploited in northeastern Hispania, their provenance and use.

quarries to the Augustan period.<sup>15</sup> Nevertheless, the finds of broccatello in 5<sup>th</sup>-century Latium *villae* (Falcone and Lazzarini 1998, 88) suggest that, either a distribution network of broccatello was still active during late Roman times or that this stone was valued enough to be reused in buildings as important as the *villae* of the Gordians

and Montecelio. Thus, it is not easy to assess until when the quarries were in use. The evidence from the fronts (Fig. 7) can be deceptive since large quarrying activity at Barranc de la Llet (39) took place from the Baroque period to mid 20<sup>th</sup> century.<sup>16</sup> In addition, broccatello was in fashion during Baroque and early modern times not

14. For the updated distribution map of this stone, see Gutiérrez Garcia-M. 2009, 237, fig. 268.

15. As attested by the find of broccatello slabs at Segobriga's forum (Cebrián *et al.* 2004, 245-6).

16. The case of La Cinta and Els Valencians, the two main quarry sites at Barranc de la Llet, is illustrative: although some evidences considered "Roman" have been recorded at La Cinta (cf. Álvarez *et al.* 2009b, 74-79) and scattered fragments of Roman pottery were found at Els Valencians, these quarries were exploited later on during some centuries (Muñoz and Rovira 1997) by using very similar methods to the ancient ones. Thus, it is not possible to confirm whether the traces preserved are Roman or early-modern.

TYPE OF STONE	BC			AD				
	Mid 3 <sup>rd</sup> c.	2 <sup>nd</sup> century	1 <sup>st</sup> century	1 <sup>st</sup> century	2 <sup>nd</sup> century	3 <sup>rd</sup> century	4 <sup>th</sup> century	5 <sup>th</sup> century
Empúries stone								
Clots stone								
Girona stone								
? (Aeso stone)								
Isona limestone								
Montjuïc stone								
Santa Tecla stone								
Llisós								
Savinosa								
Mèdol st./soldó								
Coves/Llorito stone								
Altafulla stone								
? (Roda de B. stone)								
Alcover stone								
Broccatello								

TABLE 2. Summary of the chronological span of the use of the main types of local stones in northeastern Hispania.

only in Spain but also in France and Italy<sup>17</sup>, which lead to a wide reuse of broccatello slabs from ancient contexts.

Nonetheless, broccatello was not the only local stone being put in new uses after its employ for the original purpose. Santa Tecla stone began to be reused from the late 3<sup>rd</sup> century, which clearly indicates a slow-down of the extraction activity. Yet these quarries were not completely closed because sarcophagi in this same stone as well as in Llisós, which crops out at the same area, were still produced subsequently (Álvarez *et al.* 2009c, 51, 87-88).

### Some aspects of stone extraction in northeastern Hispania

#### Tools and extraction methods

The erosion of the tool traces preserved makes impossible a proper metrological study, yet they deserve being carefully considered. Rectangular blocks show sizes that do not follow a pattern based on strict metrological the Roman unit of measurement (Roman foot), confirming that non-ornamental stone<sup>18</sup> block sizes were basically determined by two main factors: the lithology of the outcrop, i.e. the presence of natural fractures and planes of deposition, if any; and, when no lithological restraints, the purpose for which they were intended. Aeso quarries (10, 11), near the Pyrenees, and Lloera (38), in the hinterland of Tarraco, are clear examples of the former, while

the quarries of Montjuïc (12) and Olèrdola (14) are illustrative of the second case. Indeed, despite the lithological uniformity of these two last outcrops, the block sizes are not uniform and do not strictly correspond to multiple values of the Roman foot (Batista-Noguera *et al.* 1991; Molist and Otiña 2012; Granados *et al.* 1990).

Another worth noting aspect is the various typologies of trenches. A large majority show square longitudinal section while only a few examples of V-shaped section trenches were recorded. Nevertheless, no chronological inferences can be made from these differences: examples of both types of trenches were identified at quarries where only Roman works took place, such as at La Punta de la Creueta (27). As pointed to by Bessac (1996, 212; 1999, 21-22), they simply reflect the employ of different types of picks; yet the use of different types of pick in the same quarry in what seems to be coeval extractions still wants an explanation. Moreover, the width of the trench does not seem to respond to chronological factors either. The comparison between the trenches at Olèrdola (14) (Batista-Noguera *et al.* 1991, 393-394; Molist and Otiña 2012), where accurate measurements were taken, and the ones at the quarry of Mathieu, southern France (Bessac 1996, 208) reveals that the chronological implications observed at southern Gaul quarries do not apply to the northeastern Spain ones.

Most of the pick evidence is preserved as grooves on the vertical walls of the fronts which follow three different patterns: spike pattern, diagonal and random (Fig. 8). These different patterns seem to result from the changes

17. It was abundantly used in Baroque churches as well as palaces (Lazzarini 2004, 118; Muñoz and Rovira 1997, 39-52).

18. As for the broccatello (*vid. supra*) the few traces of Santa Tecla stone extraction cannot be confirmed as Roman since it was largely exploited also in early-modern times (Álvarez *et al.* 2011; Gutiérrez Garcia-M. 2009, 208-223).

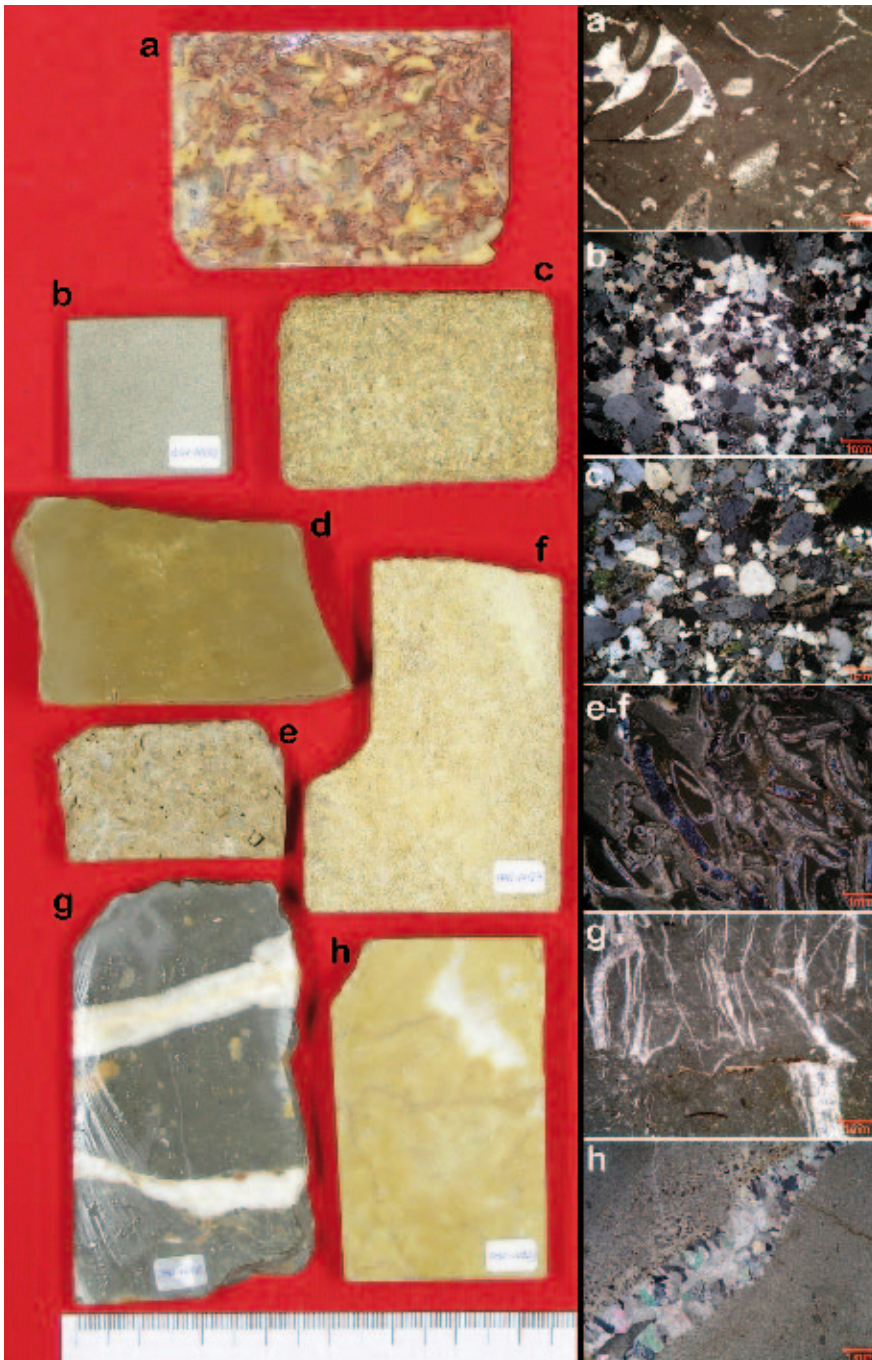


FIG. 6. Some of the most important stones of northeastern Spain (macroscopic and microscopic aspect): broccatello/ jaspi de la Cinta (a), Montjuïc sandstone (b), Clots stone (c), Alcover stone (d), two varieties of Mèdol stone (e-f), Illisós (g) and Santa Tecla stone (h).

introduced on the picks, which modified the angle and position of the quarrymen (Fant 2008, 129). Yet again, in our case, all three patterns are clearly visible in quarries for which archaeological excavations have confirmed a Roman date, e.g. Pedrera Romana at Montjuïc (12).

Ancient wedges are very rare in the archaeological record,<sup>19</sup> the evidence of its use through the holes where they were inserted provides valuable information. Two

different types were recorded at the quarries: a rectangular and elongated one, and an oval-shaped one. However, only the first type ones match in size and outline with other well-attested Roman wedge holes documented from the western Mediterranean area (Bessac 1996, 214-225; 1999, 22; Dworakowska 1987, 1988). These parallels prove that, indeed, iron wedges were employed at the quarries of northeastern Hispania.

19. The only examples in northeastern Spain were found at Empúries, La Maçana (Guardiola de Font-Rubó), an Iberian settlement near La Rierussa (13), and Olèrdola (14). They are all iron wedges; the first two are incidental findings but keep a strong resemblance to other Roman iron wedges (see Bessac 1996, 214-216, fig. 136, Dworakowska 1983, 74-87; González Tascón 2002, 137, even though this last one has been considered a mining tool); the third one is pre-Roman and has a very particular triangular cutting-edge (Sanahuja 1971, 66, 82, 100-101, fig. 26); the last one is still under study, and its shape has not been yet published (Molist and Otiña 2012).



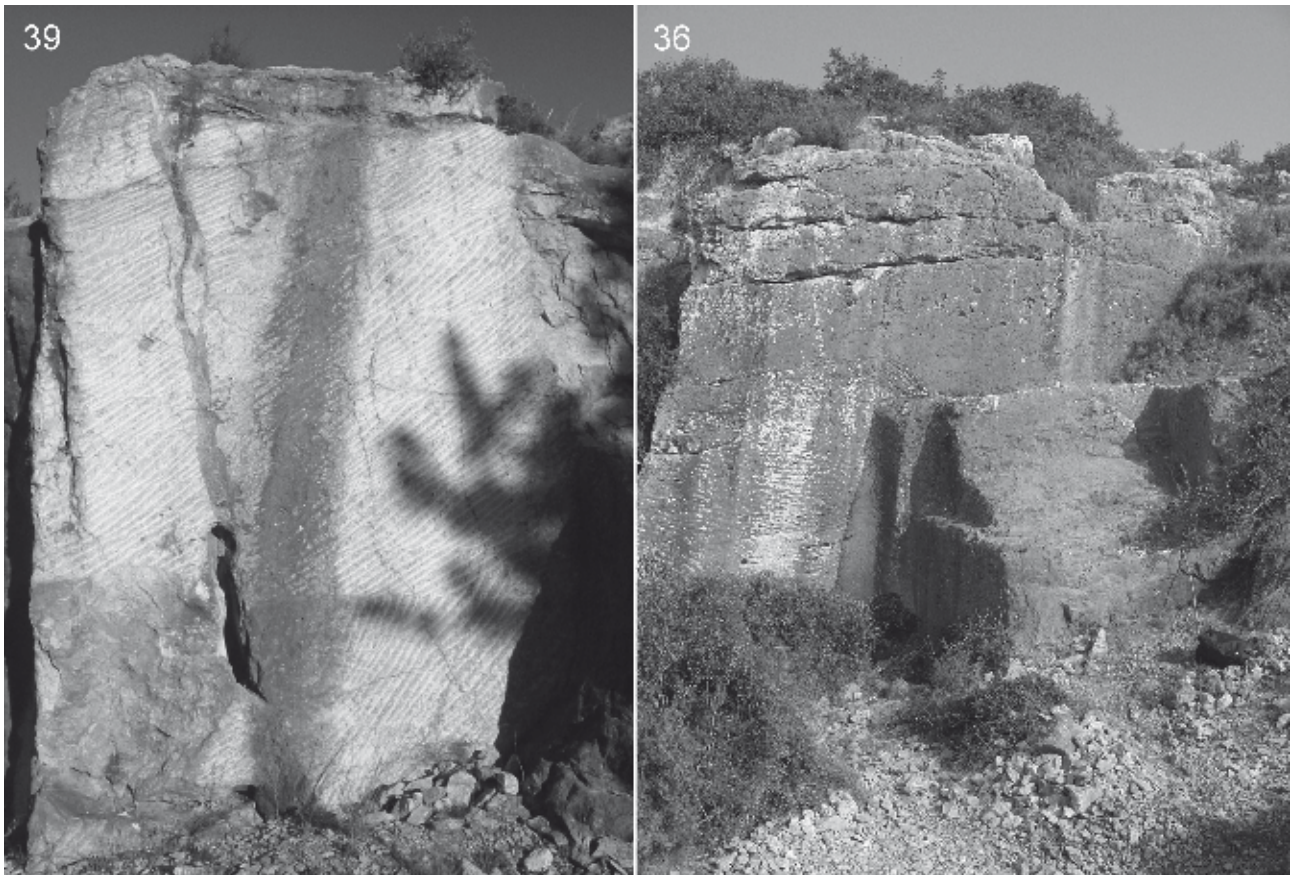


FIG. 7. Partial views of Barranc de la Llet (quarry front called La Cinta) (39) and one of the fronts at El Llorito (36).

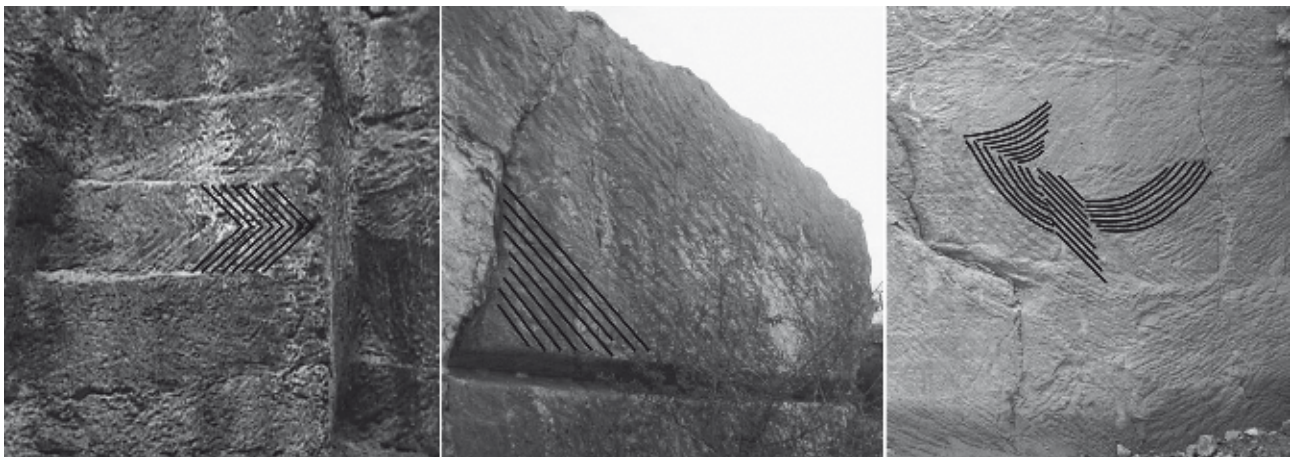


FIG. 8. Examples of the different groove patterns recorded at the quarries of northeastern Spain; from left to right: spike-pattern at Clot del Mèdol (25), diagonal-pattern at Barranc de la Llet (39) and random pattern at Pedrera romana at Montjuïc (12).

### Quarrying Strategies (Fig. 9)

Opencast quarries in the area of study largely predominate over underground sites. Among the first group, there is a wide variety of strategies: intensive extraction is represented by pit-type quarries – El Mèdol (25), PERI2-Lots 18-21 (31), and some fronts at Puig

d'en Torró (6) and Clots de St. Julia (5), although the oval and concave walls of the latter ones give them a significantly different appearance (Fig. 4); trench-type quarries and extraction “in terraces”, both considered as intermediate strategies between extensive and intensive extraction, are also recorded<sup>20</sup> while there are also examples of extensive quarrying such as the “extraction en

20. The first type is well represented by Maritima Residencial (19) while Pedrera Romana at Montjuïc (12) is a perfect example of a quarry that progressed “in terraces”.

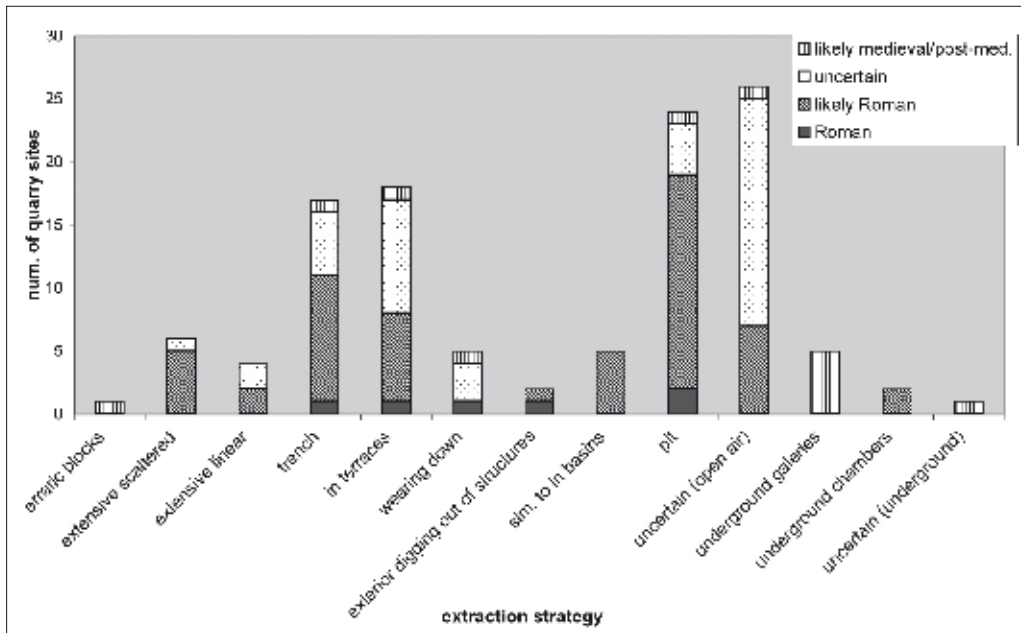


FIG. 9. Graph showing the extraction strategies employed at the quarries studied.

conque” quarries<sup>21</sup> (some fronts at Puig d’en Torró (6)), extraction by wearing down or at the exterior of defensive structures (e.g. the “exterior” quarry at Olèrdola (14)); or a possible use of erratic blocks at the area of Aeso where high vertical cliffs of Isona stone provide large chunks of stone naturally fallen from the bedrock.<sup>22</sup>

On the other hand, the only two examples of underground quarries, Coves del Llorito (29) (Fig. 10) and Coves de La Pedrera (32), are very plausibly the result of post-Roman works. Underground extraction was an uncommon strategy in Roman times for non-ornamental stones, as is the case<sup>23</sup>, and the existence of documents proving their use in the 18<sup>th</sup> century suggests that the current appearance of these quarries is most likely due to early modern works even though there is no doubt that they were first exploited in Roman times as their characteristic calcisilitite stone (see Table 1) was already employed at the Roman wall (Bermúdez *et al.* 1993).

Nonetheless, the exceptional case of two fronts at Clots de Sant Julià (5) is worth mentioning. They show a concave section that ends at the top with a kind of thin roof where a quadrangular hole, probably a ventilation or lighting aperture, is partially preserved (Fig. 4). If we also take into account the presence of long, narrow, descending corridors that allow access to their interior, it seems clear that at some point in their history, these fronts were subterraneously or semi-subterraneously exploited. Although it has not been possible to identify

which strategy extraction was carried out there, Clots de Sant Julià remains a very interesting case to which more attention needs to be paid in future research because of its uniqueness and the fact that its stone has been well documented in several nearby ancient sites.

By looking at other features, another pattern of exploitation at the quarries of northeastern Hispania comes to light. According to it, the quarries can be grouped in:

- small, short-lived quarries, probably opened for a very specific purpose and thus linked to a particular monument or building, such as Punta de la Creueta (27), which was opened to build the funerary monument of Torre dels Escipions, or the quarries around the Roman aqueduct of Tarraco (33); and
- large quarries that resulted from long-term extraction and usually consisting of more than one site. They are less in number but, in terms of volume of extraction, their contribution was significantly greater (Fig. 11).

### Quarry management

The archaeological record provides little evidence about quarry management in northeastern Hispania. They are “Q IV”, “Q V”, and “Q VII” carved on roughly-hewn blocks from found near the Pedrera Romana at Montjuïc (12) and “Q III” carved letters on the bedrock of some cuts recently found during rescue excavations at Tarragona.<sup>24</sup> Despite the disparity of their provenance, they are very uniform and maybe indicate the area of ex-

21. As described by Bessac (2003, 28-29).

22. Although it has not been included in the map, it has been object of a recent paper (Gutiérrez Garcia-M. in press).

23. Underground extraction was usually restricted to very special cases of highly-prized stone, such as the lichnites marble of Paros (Dodge 1991) or to specific conditions, such as the volcanic tufa quarries of the Rhineland (Germany) or the *lapis specularis* ones, near Segóbriga (Spain), (Röder 1957; Bernardez and Guisado 2002).

24. This inscription remains unpublished, but it has been interpreted as “Q(uadratum) III” by Drs. I.Rodà and D.Gorostidi (pers. comm.) which matches the interpretation of the inscriptions on the blocks found at Montjuïc: “Q(uadratum) IV”, “Q(uadratum) V” and “Q(uadratum) VII” (IRC IV 304).



FIG. 10. View of two sites of Coves del Llorito (29) and Coves de la Pedrera (32) quarries.

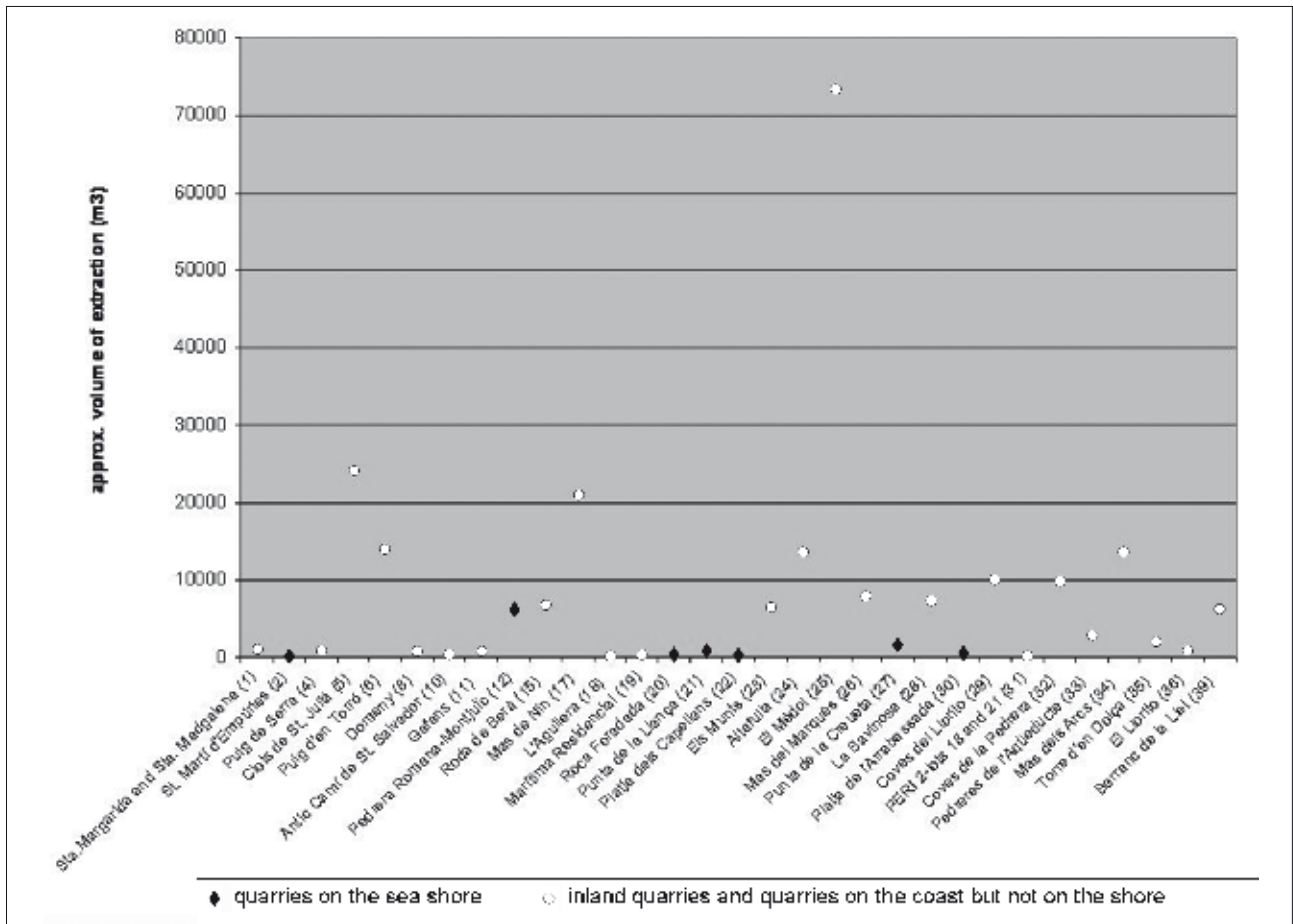


FIG. 11. Graph showing of the volume of extraction and the location of each quarry.

traction within the quarry where the blocks came from, in the first case, and the area of extraction within a quarry (perhaps a third sector of a larger quarrying area), in the second one (Gutiérrez García-M. 2009, 275; 2011, 333). If so, it attests the organisation of quarrying at Montjuïc

and Tarraco in several sectors; at least seven at Montjuïc and three in Tarraco.

Nevertheless, other aspects such as debris management<sup>25</sup>, the handling of the extracted material and how they were operated remain mostly unknown due to the

25. Small masses of debris have been recently identified at El Mèdol as a result of the 2010 fire. They are still under study and although some of them seem to be related to the large Roman part of this quarry (El Clot), some others seem to be related to modern fronts. Therefore, no inferences can be made from them until further data is available.

lack of solid evidence. Obviously, labour at these quarries could vary significantly depending on several intrinsic factors. However, overall northeastern Spain quarries bear a strong resemblance to the relatively small, limited quarries in southern France rather than the large, imperial quarries (Hirt 2010); hence, it seems plausible that the same model of small teams of freemen workers (Besac 1996, 297-298) apply to our quarries.

As for who owned these quarries, the broccatello ones (39) were probably municipal property as well as the Empúries limestone ones (at Emporiae), the Montjuïc sandstone ones (near Barcino) and most of those in the hinterland of Tarraco.<sup>26</sup> The parallels in nearby well-studied stone industries, such as the sarcophagi production of Lourdes (French Pyrenees), are significant; the local diffusion of these objects has been interpreted as possibly corresponding to a public or semi-public quarrying complex within the administrative confines of the town of Bigerriones (Boudartchouk 2002, 60). Also Dworakowska (1983, 29, 31) reached the conclusion that, generally, many common stone quarries situated around various towns and supplying them would have been under municipal ownership. Therefore, there is some basis for considering a similar arrangement for the most important types of stone in northeastern Hispania. As for the ownership of the smaller building-stone quarries, the grounds on which any conjecture can be based are even fainter. Although we cannot rule out that some of them were in private hands, this cannot be confirmed with the evidence we have to date.

### Final considerations

The amount of evidence on quarrying in ancient times in northeastern Spain is indeed significant. Although only a small number of the quarries can be dated with certainty to Roman times, there are many that have a high possibility of having originated in ancient times. Nevertheless, the current evidence is enough to show that local stone exploitation was strongly determined by the development of the urban phenomenon that was part of the whole Romanisation process of this territory. Although stone was indeed used prior to the arrival of the Romans, its extraction was only occasional or, when employed as a building stone, without a specific quarrying pattern. The only exception, Empúries limestone and Clots de Sant Julià sandstone, is focused in the northeastern corner of the territory, where the influence of the Greek colony of Emporion had a greater effect

on the early development of traditions tending towards the Classical by the natives. It is not surprising that the extraction areas probably thus dated are next to a large Iberian settlement<sup>27</sup>.

On another level, there are smaller, short-term quarries that are not directly related to a population centre, but to the use of the natural resources and a new configuration of the territory, such as those specifically opened to build the Roman aqueduct of Tarraco or *villae*, or the specific constituents of a Romanised monumental landscape. Both the towns and the new elements of the territory (roads, aqueducts, arches, etc) reflect the incorporation of the territory to the Roman world, and thus were embedded of strong implications.

The quarries opened between late 3<sup>rd</sup> and late 1<sup>st</sup> centuries BC were mainly opened for military purposes, such as at Olèrdola or the Tarraco ramparts<sup>28</sup>, or to build new towns, such as Tarraco or the Roman town of Emporiae (on the site of the earlier *praetorium*)<sup>29</sup> at first, and Gerunda and Aeso later on. The techniques applied varied significantly depending on the lithology of each particular site, although the introduction of the systematised, organised extraction characteristic of the Romans is an important feature. As early as this time the same local stone used for building purposes, in particular Mèdol stone, was used to carve sculptures, portraits, epigraphy and for luxury uses.

However, it was during the Late Republican period that quarrying intensified. The initial dates for each quarry depended very much on the particularities and purposes of their stone, but it is clear that from Augustan to Flavian times there was a progressive proliferation of stone extraction. Extraction boosted at the already existing quarries and new ones were opened to supply the urban development of already founded towns or the foundation of the last Roman town<sup>30</sup> with stone.

Additionally, during this period more attractive stones began to substitute plainer ones for sumptuous and ornamental purposes. This applies not only to imported *mar-mora*, which began to arrive in larger quantities, but also local ones; indeed, it is now when the extraction and use of Santa Tecla stone and broccatello began. The Flavian period saw the culmination of this process. Epigraphy and monumentalization of many towns show that stone extraction was intense during this period, and northeastern Hispania was not an exception. The large monumental programmes already initiated in Julio-Claudian times needed large amounts of both building and decorative stone. Tarraco, capital of a large province, is particularly illustrative, as a major reorganisation and monumental-

26. Probably Santa Tecla quarries and the larger sites, such as El Mèdol, that supplied construction materials for the large monumental buildings in the town itself.

27. Clots de Sant Julià (5) is next to the large pre-Roman sites of Ullastret (Martin *et al.* 1999; Martin 2001).

28. Calcisiltite from Coves del Llorito, Coves del Pedrera as well as Mèdol stone type from undetermined quarries (El Mèdol quarry being the most likely, although other closer quarries cannot be dismissed).

29. In addition to the use of the same limestone that crops out at the low hill where the town was founded (Empúries limestone), the widespread use of Clots stone at Empúries dates from this period.

30. Barcino (modern Barcelona), which was founded ca. 15-10 BC.

sation in which the local *marmor* played a key role in it by being extensively used next to Carrara, giallo antico and many other imperial marbles put into use at the new temple and provincial forum (Àlvarez *et al.* 2012; Arola *et al.* 2012; Gutiérrez García-M. and López Vilar 2012). The need to supply stone for large-scale urban transformations and the improvement of the distribution network probably were linked to a gradual process leading to highly standardised block production.

Similarly, the changes that occurred in the Roman world at the end of the early Imperial period were reflected in the quarries. They entered a major period of recession, as can be deduced from the assessable slow-down in local stone use. This recession was not simultaneous at every site<sup>31</sup>, but clearly happened in the 3<sup>rd</sup> century AD. Again, this same pattern has been recognized in other parts of the Mediterranean, such as southern France, and the progressive deterioration of the general organisation of the work and technique, together with an appreciable reduction in production, probably occurred in our area of study as well.

To understand the exceptional continuation of broccatello extraction and use, we have to look at the Mediterranean context as a whole. Indeed, the progressive weakening of Imperial cohesion also affected stone industry. The arrival of oriental marble to Rome became less smooth and thus, western ornamental stones, which until then had only been used on a regional or provincial basis, gradually took on the Imperial market as well. This was the case of broccatello, which became to be exported outside Hispania from the late 3<sup>rd</sup> - early 4<sup>th</sup> century AD<sup>32</sup>. Nevertheless, the reasons of its upgrade to marble worth of being employed at *basilicae* and *villae* closely linked to the imperial power at Rome were not merely political. As Falcone and Lazzarini point out (1998, 87), a slight change in the marble taste and fashion that led to the introduction of new stones, most of which were spotted marbles, in Severians' times. Moreover, the symbolism implicit in broccatello colours<sup>33</sup> must have been a key factor as well, especially if we consider the high esteem that *marmora* that were reminiscent of gold but especially the imperial colour (purple) had during the late Empire.

The adoption of the Roman stone exploitation strategy not only meant a change in the scale on which stone was used and, hence, quarried, but also in the techniques employed. Moreover, it implied a great deal of planning prior to extraction, which had to be undertaken both quantitatively (the amount of stone) and qualitatively (the intended uses) by the Roman quarrymen. All these changes were only possible thanks to a firmly consolidated regional economic and political power structure which was provided by the Roman Empire.

31. However, the differences may lie in the degree of precision about the dating of monuments or buildings that mark the final use of each type of stone, which directly depends on whether they have been subjected to recent comprehensive research or not. The case of the wall at Barcino is representative: it was originally dated to the 3<sup>rd</sup> century AD, then to the 5<sup>th</sup> century AD and is currently considered to be from the first half of the 4<sup>th</sup> century AD (cf. Puig and Rodà 2007).

32. As it has been well-attested in several works (see, for example, Àlvarez *et al.* 2011; Falcone and Lazzarini 1998, 87-88; 211; Lazzarini 2004, 118; among others).

33. Yellow to golden on a dark red or purple background, resembling a gold brocade on a purple cloth.

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