The marmor of Tarraco or Santa Tecla stone (Tarragona, Spain)[1]

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Abstract: One of the most characteristic local materials used for decorative purposes by the Romans in the NE part of the Iberian Peninsula is the *marmor* of *Tarraco* or Santa Tecla stone. It is a Cretaceous limestone of a yellowish colour, white spots (recrystallized calcite) and small dark red veins (mineralized stylolites). Samples were observed and characterized by optical microscopy and cathodoluminescence technique (CL). The use of Santa Tecla stone is documented since Augustan times and although it was mainly used on a local basis, it was also object of a relatively wide, regional distribution.

Key words: *marmor*, *Tarraco*, Roman Spain, archaeology, epigraphy, quarries, cretaceous limestone, petrographic microscope, cathodoluminescence.

Introduction

Santa Tecla stone or *marmor* of *Tarraco* is one of the most distinctive local stones used for decorative purposes during Roman times in the northeast corner of the Iberian Peninsula (fig. 1). It is a usually yellow limestone that was exploited at Tarragona until very recently. Even though other stones were locally exploited at Tarragona environs in ancient times, Santa Tecla stone was by far the most valued, widespread and prestigious one. Its current name, Santa Tecla stone, comes from the fact that chapel dedicated to Santa Tecla at the cathedral of Tarragona is completely panelled with a combination of several varieties of this limestone. Little is known about the name given to this stone by the Romans since it was not enough prized and distributed to be mentioned by the classical sources. Nevertheless, the epigraphic record provides evidence to suggest it was considered a *marmor*; i.e. the mention on two Santa Tecla stone pedestals dedicated to Lucius Pedanius Euphro[2] that "*basis lapidea aere clusa vetustate erat corrupta*" were replaced by *marmoreae* ones. Another

Fig. 1 Schematic map showing the location of *Tarraco* and other Roman towns of the northeast corner of the Iberian Peninsula (after Carreté et al. 1995: 8, fig.1.1).

[1] Preliminary version. Article in press due to be published in the proceedings of the 8th International Conference of ASMOSIA (Association for the Study of Marbles and Other Stones in Antiquity). Please quote this publication.
[2] IRC IV 107 and 108; they are currently deposited at *Museu d'Història de la Ciutat de Barcelona* (MHCB) and *Museu d'Arqueologia de Catalunya – Barcelona*, respectively.

epigraph that supports this assumption is the inscription that reads "*titulum sulcato marmore ferro*" in which the term *marmor* definitely refers to Santa Tecla stone (RIT 441).

Geological setting

The local geology of Tarragona consists of Mesozoic materials of Triassic, Jurassic and Cretaceous age. All these geological levels are covered by formations of the Neogene. This area is located in the easternmost limit of the Iberic Coastal Range and it has only suffered a slight tectonic deformation, therefore the sedimentary layers have a sub-horizontal position, small folds and some fractures can be observed. The earlier sediments that crop out are from the upper Albian. Santa Tecla limestone belongs to the upper Cenomanian, and forms a 6-km-long and 1-km-width, narrow stretch of land. It is a compact limestone, biomicrite and sparite, more o less dolomitized and affected by karstic activity. There are many colour varieties with predominance of the yellow-pink-red tonalities.

Petrographic study

Santa Tecla limestone can be classified as a packstone (Dunham 1962) or according to Folk (1959) as a biomicrite. However, diagenetic processes have transformed the original texture turning it into a crystalline limestone. Alternatively, the rock name could range from a microesparstone (with crystals < 10 μm) to an esparstone (with crystals < 10 μm) as it shows micritical zones with irregular areas of sparite (Wright 1992). Although no fossils with the original shells are preserved, calcite fillings (sparite) of shell moulds can be encountered. These are bivalves (lamelibranquia) with its usual curved shape (fig. 2).

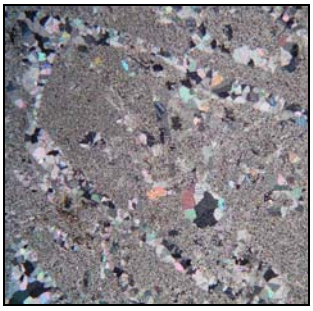

Fig. 2 Microphotograh of Santa Tecla stone (X30, crossed polarized light) with remains of bivalves shells.

Also, there are plates from crinoids that develop sintaxial growths of sparite. In some areas the calcite cement can be identified among round-shaped micrite peloids. Sinusoidal cracks with drusy fillings of calcite (sparite) can be observed. These correspond to epidiagenetic processes of crack filling linked to the karstic system. The development of stylolites with iron oxide accumulations is recognizable as a late diagenetic process as it affects the rest of structures.

Cathodoluminescence characterization

The areas with higher rate of recrystallization (sparite) are the ones that exhibit luminescence. The bright areas with yellow-orange tones are distributed along the limits of the calcite crystals. These correspond to areas that contain elements that activate the luminescence (Mn2+) (fig. 3 and 4).

For some crystals a gradual change of the luminescence is observed from the surface of the calcite crystals to its centre, this reveals the compositional variation of these crystals during its growing. The areas where we observe the original texture (micrite) do not show luminescence. The observed cathodoluminescence colours are:

- Purple back with orange calcite micro veins
- Dark in the bioclastic cavities (drusy calcite)
- Dull luminescence in micritic shells
- Sparry cement: zonation dark/bright/dull luminescence.

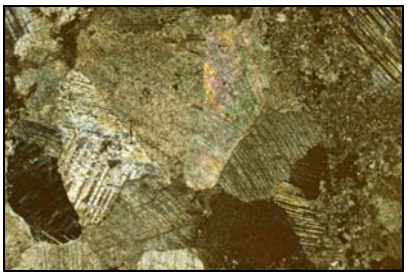

Fig. 3 Microphotograh of Santa Tecla stone (X60, crossed polarized light).

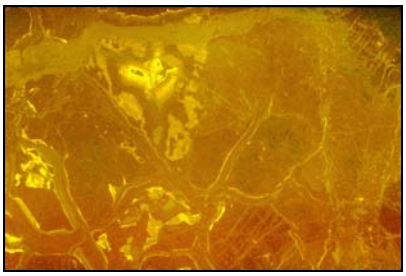

Fig. 4 Same thin section as figure 6 observed under cathodoluminischence.

The quarries

The outcrops that have been traditionally exploited are located at the area comprised between Nostra Senyora de Loreto chapel, commonly known as *Llorito*, and Nostra Senyora de la Salut chapel, on a lot northeast from Tarragona known as La Bulladera. Up to ten quarry sites were initially identified, but only eight of them remain still untouched by the quarrying currently in progress at the area (fig. 5)[3]. Yet only Llorito quarry sites 4 and 10 preserves traces of traditional method quarrying (e.g. vertical smooth walls, trenches to delimit blocks and wedge sockets) and solely Llorito 4, a small quarry site on the east slope of the low hill facing Tarragona, could date back from ancient times[4]. The rest of the sites basically present traces of very recent use and the continuous use of these geological layers, which were intensively exploited since modern times until the present-day, lead to the irremediable lost of the few evidences of possible Roman date.

Fig. 5 Location map of Santa Tecla quarries (El Llorito and La Salut) at La Bulladera area, north from modern Tarragona (Orthophotoimage at 1:5.000, sheets 267-138, ICC).

In any case, the wide range of stone varieties that can be found in a relatively small area is perfectly illustrated at any of these sites. Even though they are not too large, the most valued golden yellow coloured varieties appear together with the pinkish *portasanta*-like ones as well as less valued Cretaceous limestones that, in spite of being also used in Roman times, were not so valued as Santa Tecla stone .

Similarities

From its macroscopic and external appearance the Santa Tecla stone (fig. 6 to 8) could be mistaken by other varieties used during the roman period, namely the *portasanta* from Chios, Greece (fig. 9) and the Buixcarró from Xàtiva-*Saetabis*, Spain (fig. 10).

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[3] Quarry sites 6, 7 and 9 were lost due to very recent quarrying at La Bulladera.

[4] Llorito 10 seems to be related to a 19th century fort remains that stand on top of the hill. As for Llorito 4, the lack of archaeological excavation prevents us to assign a specific date to this site due to the small changes that extraction methods underwent through the centuries and the well-attested post-Roman use of Santa Tecla stone (in particular during the Baroque period).

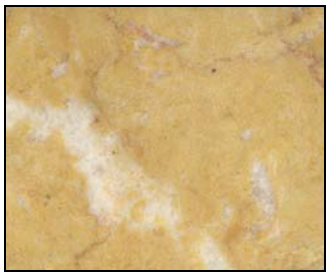

Fig. 6 Aspect of Santa Tecla stone commonest variety (yellow variety).

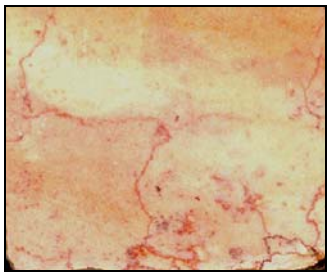

Fig. 7 Aspect of Santa Tecla stone pinkish variety.

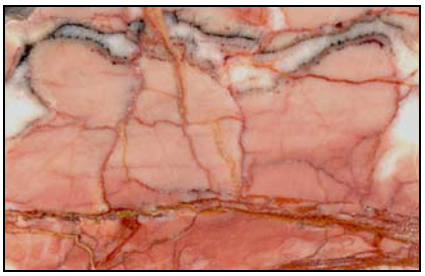

Fig. 8 Aspect of Santa Tecla stone dark pink variety.

Fig. 9 Aspect of Portasanta stone.

Fig. 10 Aspect of Buxicarró stone

Portasanta presents rosy shades whereas Buixcarró is yellowish. They can be easily distinguished through microscope observation.

Portasanta limestone is a *breccia* with a calcareous matrix (of micritical size, from 1/16 to 1/256 ∅ mm). The material has been fractured, and latter the cracks have been filled by secondary calcite (sparite) crystals more or less idiomorphic that grow perpendicular to the cracks edges. Sometimes, the cracks have been filled with micas and quartz grains that have been introduced by diagenetic dynamism. In this way, in the matrix several mica layers (muscovite and biotite) can be observed as well as quartz grains with re-dissolution (round-shaped surfaces and ameboidal shapes). Occasionally the cracks are filled uniquely materials of detrital origin, this often present stylolites mineralised by iron oxide.

Buixcarró stone is also a very fractured limestone, can be even considered a *breccia* with heterometric fragments of fossils which are difficult to identify due to the intense diagenetic processes. This stone can be classified as a bioclastic packstone (Dunham 1962) or a biosparite not well selected (Folk 1959). Despite the diagenetic modifications, in the varieties not classified as a breccia the fossil structures are much more common than in the Santa Tecla stone. Being recognisable not only the moulds but also the shells.

There is a great variety of skeletal grains: bivalves, gastropods, calcareous algae, echinoderms, and microforaminifera (especially orbitoids, among others). Also, the presence is common of a thin diagenetic micritization surrounded most shells, caused by multiple microboring and subsequent infilling with microcrystalline calcite cement. Micritic peloids are abundant. Sometimes the Buixcarró is a brecciated stone, and also iron oxides (in stylolites) are common as they are in the Santa Tecla stone. In general terms, Buixcarró stone shows lower luminescence than Santa Tecla one.

In the most brecciated varieties, the diagenetic processes have affected the general texture in such a way that its appearance is really similar to the Santa Tecla stone. However, the transformation degree is much more important and sparry components predominate on the micritic ones. The iron oxides have impregnated the first-generation crystal faces formed within the rock

cracks. In a second stage, the cracks have been filled right up with calcite developed as idiomorphic polygonal grains.

Santa Tecla stone use in Roman times

Nonetheless, the evidence of Roman use of Santa Tecla stone is abundant at the archaeological record. As any other material, no matter how fine and valued it is, it is also locally used for minor purposes when abundant in its own source area, Santa Tecla stone was employed as raw material for a wide range of purposes at *Tarraco*.

One of the first uses of stone has always been as building material and Santa Tecla stone is not an exception. However, except for irregular small chunks included in *opus caementicium* masses[5], it was mainly intended for architectural elements at sight such as basis, thresholds, sockles, column shafts, architraves and revetments. There are also examples of cylindrical cornices[6] and bench fragments[7]. On the other hand, Santa Tecla stone was also used to produce an extensive assortment of epigraphic monuments such as funerary stelae[8], pedestals, altars[9], commemorative stones or plaques[10] and even sarcophagi (Claveria 2001:9 and 29, num. cat. 13 and 47). Among them, honorific parallelepipedic pedestals stand out as the most abundant type since numerous examples have been found not only at Tarragona but also at many other cities of the *conventus Tarraconensis*. The study of these monuments lead to the identification of a workshop at *Tarraco* that produced a great number of semi-manufactured and completely finished pedestals that were subsequently distributed (Rodà 2001:70-71). The case of *Barcino* is demonstrative: 11 out of 12 moulded, parallelepipedic pedestals dedicated to *Lucius Licinius Secundo*, a powerful freedman of the consul *Licinius Sura*, friend and counsellor of Emperor Trajan, are made of Santa Tecla stone[11].

Santa Tecla stone was largely used at *opus sectile* pavements or simply as decorative *crustae* used either as wall veneers or flooring slabs. They tend to be quite thick and usually have a quite rough internal surface. These revetment slabs were part of several *villae* of *conventus Tarraconensis* ornamentation next to the most prized imported *marmora* and, especially at *Tarraco hinterland*, it was the predominant decorative stone (e.g. Can Modolell[12] and Can Xammar, in the area of *Iluro*, north of *Barcino*, but in particular at Els Antigons and Els Munts, near *Tarraco*) (Àlvarez and Mayer 1990:36-9, Àlvarez and Mayer 1998:48-49, Àlvarez et al. 1992:122-123, Otiña 2002:120-121, Otiña 2005:273-274)[13].

Due to the fact it is not very suitable for carving, decoration motifs on Santa Tecla stone are usually quite unelaborated. Mouldings are found sometimes on architectural elements while other motifs and lesbian mouldings are more common on sarcophagi. By way of illustrative examples, we can mention two sarcophagi (Claveria 2001:9 and 29, num. cat. 13 and 47) with two little *eros* that hold a garland or with striations. The case of some more elaborated sarcophagi found at *Tarraco* that at first were considered products of this town's workshop is worth mentioning; subsequent petrological analysis demonstrate that they are in fact made of «kadel» stone (from near *Carthago*, in Tunis) and that, hence, they had been imported from the north African workshops that during late imperial times had a strong presence on the necropolis of *Tarraco (*Rodà 1990:727-733).

Up to the present day, we have no notice of sculptures made with Santa Tecla stone.

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[5] Santa Tecla stone has been identified at the remains of the Roman circus, Amphitheatre and Provincial Forum at *Tarraco* (Àlvarez et al. 1994: 25).
[6] IRC I 86 (IRC V ad IRC I 86) from Can Modolell (Cabrera de Mar).
[7] IRC I 56 from Rubí and IRC I 144 from Badalona (ancient *Baetulo*).
[8] RIT 210, 216, 635, 645 and 909 which have bas-relief or carved decoration and are date around 100 AD.
[9] IRC I, 39 and RIT 19 and 41.
[10] RIT 23, 66, 435 from Tarragona; IRC I 157 from Badalona; IRC IV 119-120, 184, 203, 281?, 288-289, 296 from Barcelona; and IRC II 76 from Guissona (ancient *Iesso*).
[11] IRC IV 83, 84, 85, 87, 88, 95, 96, 97, 98, 100 and 103.
[12] A volumetric study of the lithic material was undertaken at this site which provided very interesting information as Santa Tecla stone is 55,86% of the total amount of *marmora* used at this site; it illustrates the abundance of its use as decorative stone at the *villae* build on the northeast coast of Spain (Àlvarez and Mayer 1998:49).
[13] For the use of Santa Tecla stone in *opus sectile* in various sites, see Pérez Olmedo 1996:26, 82-83, 88, 95, 180.

Santa Tecla stone diffusion

Through the identification of architectonic elements, slabs, epigraphs or other objects made of Santa Tecla stone, it is clear that this material went over the limits of merely local distribution. Indeed, the geographic diffusion of this material covers most of the northeast sector of *conventus Tarraconensis* but hypothetic cases of possible Santa Tecla stone slab fragments have been identified further away places, such as *Caesaraugusta* or *Caesar Augusta* (modern Zaragoza)[14], upstream the Ebro (ancient *Hiberus*) river, and the coastal town of *Carthago Nova* (modern Cartagena)(Soler 2003:167, 178, 2005:49, 58)[15]. The presence of Santa Tecla stone at these relatively distant places is quite surprising but we cannot venture any conclusion about these assemblages provenance as far as they are still under study.

Nevertheless, distribution within this area of influence is uneven. The main part of the objects made of this material were found in *Tarragona* and its *hinterland*[16] but there is a quite important presence of Santa Tecla stone objects at *Barcino*[17] and its surrounding territory, e.g. at Rubí[18], Castellbisbal[19], Terrassa (ancient *Egara*), Badalona (ancient *Baetulo*)[20], Mataró (ancient *Iluro*)[21], Cabrera de Mar[22] and as far as Prats de Rei towards the interior as well as Caldes de Montbui (ancient *Aquae Calidae*) and Granollers towards north. The number of epigraphic monuments found further inland, namely Guissona (ancient *Iesso*) and Lleida (ancient *Ilerda*)[23], is much restricted. However, what really stands out of the general distribution overview is the total absence of Santa Tecla stone at Girona (ancient *Gerunda*) and Empúries (ancient *Emporiae*), on the northeast corner of present day Catalonia, and Isona (ancient *Aeso*). The concurrence of other local Cretaceous limestones of similar aspect and quality is the reason why Santa Tecla stone object import did not enjoy much successful as they could be locally produced and consumed by using nearby material. Likewise, the existence of *broccatello*[24] at Tortosa (ancient *Dertosa*) is the reason of the lack of epigraphy and other elements in Santa Tecla stone. Towards south, however, its area of influence reaches as far as Sagunt (ancient *Saguntum*) where Buixcarró stone, a local bluish grey limestone, predominates. The presence of possible Santa Tecla stone south from this town, at Cartagena (ancient *Carthago Nova*) is indeed interesting and the research still in progress in this sense will be very useful to elucidate whether Santa Tecla and Buixcarró limestones coexisted at some point or not.

One of the factors that explain this relatively wide diffusion is the probable export of semi-manufactured of finished monuments such as the tripartite pedestals, which show a strong uniformity not only in the raw material (Santa Tecla stone) but also in typology.

Chronological framework

Because of the lack of clear evidence at the quarries, epigraphy emerges as a crucial and only reliable source of chronological data about its exploitation. Thus, the first attested testimony of this stone use is a slab from *Tarraco* that was dedicated to Tiberius before his appointed emperor and dates from 16 BC to 14 AD[25] (fig. 11). However, this material became widely extracted and used under the Flavian dynasty and without doubt after Vespasian's death. By looking at epigraphic

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[14] Slabs fragments were identified in the *orchestra* of the Roman Theatre (Lapuente 1999: 1-67, Lapuente et al. 2006:83-94).

[15] Our warmest thanks go to archaeologist Begoña Soler for kindly providing us with a large collection of samples from *Carthago Nova*.

[16] The best examples are the Roman *villae* of Centcelles (Constantí), Els Munts (Altafulla) and Els Antigons (Reus).

[17] See above, the already mentioned parallelepipedic pedestals.

[18] Can Fatjó, Can Carabassa, Sant Llorenç, Can Tintorer, Sant Llorenç de Fontcalçada.

[19] Can Pedrerols de Baix

[20] IRC I 135, 137-138, 140.

[21] *Crustae* and slabs from Can Xammar and Torre Llauder; epigraphic elements (IRC I 97-100, 103, 105) from Mataró.

[22] Can Modolell.

[23] Pedestals IRC II 1, 3, 6 from Lleida and four fragments of a same plaque from Guissona (IRC II 76).

[24] Locally called Jaspi de la Cinta (Borghini 1989:198, Gnoli 1971:210-211, Lazzarini 2004: 100, 118, Mayer 1998:100-101, Mayer and Rodà 1999:43-52).

[25] RIT 66.

monuments, the beginning of the massive extraction can be dated *circa* 70 AD and increases during the Antonine and Severian periods. Large scale extraction seems to coincide with an ideological change on the conception of urban architecture which, thanks to the large supply of Santa Tecla stone at disposal, is reflected on the improvement and large-scale ornamentation of the town layout. Epigraphically, the beginning of the decadence is signalled by the reuse of early imperial inscriptions such as *C.Clodius Chariton*'s pedestal, which became the support of a dedication to *Ulpia Severina*[26], emperor Aurelian's wife, or *P.Licinus Laevinus*' pedestal, which bears three subsequent inscriptions dedicated to emperor Carus, emperor Licinius and emperor Constantinus respectively[27]. Nevertheless, epigraphic monuments begin to be reused not only at *Tarraco* but at other towns too; an illustrative case is the pedestal dedicated to *N. Aemilianus Dexter*, which dates from Theodosian times (*c*. 387)[28], found at *Barcino*. The simultaneity of this phenomenon strongly suggests that the supply and transport where in fact interrupted. Even if we cannot extrapolate this interruption at the quarry activity, it is indeed manifest that Santa Tecla stone extraction slowed down from late 3rd century AD and especially during the 4th century AD; probably a change on the organization of this industry and on the production of Santa Tecla stone objects took place then seeing that the production of sarcophagi in Santa Tecla stone flourished during this period and afterwards (see Claveria 1998:138-149, 2001b:19-50, Rodà 2002:38.).

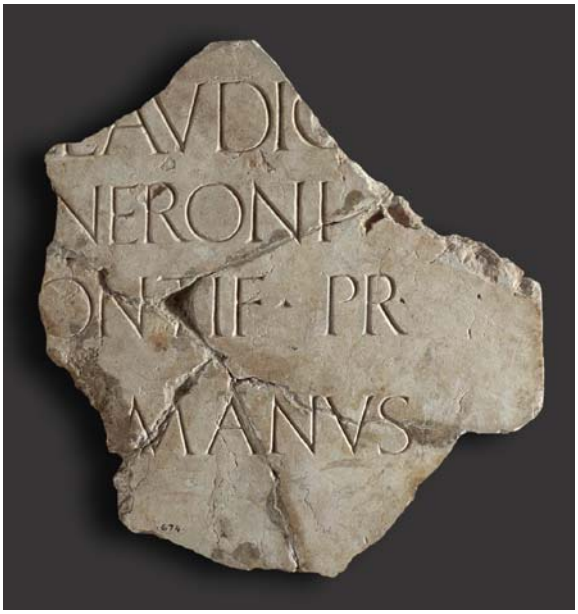

Fig. 11 Roman inscribed plaque dedicated to Tiberius before him being appointed emperor (RIT 66)(photo: MNAT).

Consequently, it seems plausible that the quarries were still open only with less intensive extraction activity than before. It is difficult to determine a specific date for the end of Santa Tecla stone extraction as the use of already detached blocks, of previously discarded blocks, or the reuse of earlier elements may diffuse our perception. Besides, one must bear in mind that, as many other quarries, the end of extraction activity is not sudden but part of a process during which the conditions were especially favourable for a major boost of reuse trade.

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IRC = Fabre G., Mayer M., Rodà I., *Inscriptions Romaines de Catalogne*, Paris.

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[26] RIT 457 and RIT 87, respectively.
[27] RIT 171, RIT 87, RIT 94 and RIT 95.
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