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Case study

The vernacular sculpture of Saint Anthony the Abbot of Museo Colle del Duomo in Viterbo (Italy). Diagnostic and Wood dating

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ABSTRACT

The sculpture of Sant'Antonio Abate represents an interesting example of vernacular art, it is a devotional object celebrated and carried in procession in many villages of Tuscia. The poor documentation and the observations of technical and stylistic characteristics do not allow the placement of the artifact at a well-defined period. It is also necessary to know the materials used for its realization before the start of restoration operations. Preliminary diagnostic investigations have allowed to date by radiocarbon, the sculpture, which was carved on lime wood, in the second half of the fifteenth century. XRF analysis has identified White Lead, Titanium and Zinc, this last in the habit of the sculpture. XRF data's interpretation is not so obvious because all the investigated repainted areas did not show strong compositional differences from the original ones. Re-depicting were assessed after stratigraphic sections. The obtained data support exploitation of the cultural heritage in the museum and are the basic information for restoration

1. Introduction

Italy has numerous historic-artistic artefacts that deserve further recognition. Wooden sculpture, for example, remains largely unexplored because it has been considered for long time an art-form of secondary importance. Such is the case of the sculpture of *Saint Anthony the Abbot*, which was recently transferred from the Museo Colle del Duomo (Viterbo, Italy) to the laboratories of Tuscia University for restoration. The historical region of Tuscia has strong ties to agriculture and animal husbandry and Saint Anthony, an Egyptian and eremite monk, is the protector of rural affairs and pets. For this reason, he is celebrated in the villages of Tuscia, and in many other countries, with wooden sculptures of his likeness carried in processions. On the night of January 16, the Saint is celebrated in Tuscia's villages with large, symbolic fires called ̈focaronëin the main square. On January 17, the day dedicated to the Saint, animals are blessed at the foot of a sculpture depicting the holy hermit. These are ancient celebrations, and it is difficult to specify when they could have started. Local sources also mention the key role this sculpture played during devotional rituals dedicated to the Saint [1]. Due to its provincial character, the sculpture of *Saint Anthony the Abbot* was not given much scrutiny and its age is unclear. Nonetheless, this artefact deserves examination because it is historical evidence of the presence of the French order of the Canons Regular of Saint Anthony of Vienne [Dauphiné] in Viterbo, the first order of devotees to Saint Anthony, as well as the first step in the course of restoration.

2. Research aims

The aim is to contribute to the knowledge of a frequently neglected cultural heritage, vernacular wooden sculptures, by investigating pigments and wood in a case study: Saint Anthony the Abbot in Viterbo. To get information of the original artefact by means of wood dating.

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3. Historical background

The sculpture of *Saint Anthony the Abbot* is from the Sant'Antonio Church in Valle Faul [2], built in the 13th century (Fig. 1). In the 15th century, the church was taken over by the French order of Canons Regular of Saint Anthony of Vienne, the first European order of Saint Anthony, who managed the complex for two centuries until 1587. In 1608, the church ceased its religious services [3] and the sculpture was transferred to Saint Lorenzo Cathedral in Viterbo until the 2000s, when it was transferred to the adjacent Colle del Duomo Museum. Based on the above information it can be estimated that the sculpture was carved sometime between the 13th century and 1608. There are no references to polychromatic sculptures in the Tuscia region, and what was known of this artefact was not considered valuable [4].

4. Stylistic description and execution technique

The polychrome, full relief sculpture of *Saint Anthony the Abbot* is characterized by simple forms, producing a static appearance and a structural rigidity. The Saint was carved in an upright position, and its dimensions ($186 \times 60 \times 40$ cm) are quite remarkable (Fig. 2). From a stylistic point of view, there are some interesting features to be considered when compared with traditional Antonian iconography adopted between the 15th and 16th centuries.

The Saint has thick hair and his robe is missing the hood (Fig. 3a); for this reason, it is not possible to compare the sculpture to the most available depictions of the Saint in the 15th and 16th centuries, opening some questions as to the date of the artefact. The feet appear deformed, and the unrefined hands hold two objects: the right flaunts an open book with a bright red cover and the left originally supported a wooden stick, which has been lost.

Full relief wood working was typical between the 14th and 15th centuries, and the sculpture was carved from a solid trunk of wood (Fig. 3c). In places where the volume and the shape of the original trunk were not sufficient, separately carved wooden elements were attached to achieve the desired model shape, as is visible in the added left shoulder (Fig. 3e). This technique also explains the particular woodworking of the Saint's face, (Fig. 3a) which can be compared to a mask. Indeed, the face was added separately to the main body of the sculpture due to the lack of wood in that location and to avoid splitting due to shrinkage. Two grooves on the back of the statue, into which two metal elements have been placed, are thought to be the original anchoring system.

The sculptor was very knowledgeable about the wood, as he used the trunk's original splits and natural shrinkage to get the effect of the movement in the folds of the Saint's habit (Fig. 3b and 3d).

On the back of the statue, the sculpting is different and less precise (Fig. 3d), indicating it was not visible to the votaries. The final finish and shape of the sculpture was done by modelling the wooden splits with stucco. Wood substrate was prepared by treating with oil or animal glue to make it more compatible with the overlapping pigments.

5. Pigmented surface

Surface observations of *Saint Anthony the Abbot* do not provide a clear picture of the variety of pigments in this polychromed artefact, which are believed to have been repainted. The Saint has a black mantle and a brown habit, and the hair and beard are a greywhitish tone. The Saint's skin is a bright pink and displays evidence of a rough repainting. The assumption of one or more repaintings was confirmed by a light scalpel cleaning on some parts, revealing the presence of more paint layers difficult to distinguish from each other. Additionally, some degraded parts of the sculpture further revealed the remains of paint over the original work. For this reason, a deep laboratory analysis was undertaken.

6. Laboratory analysis methods

6.1. *Wood identification*

Microsamples using a hand blade were taken from different parts of the sculpture (Fig. 2) to determine if the assembled parts, such as the face and the left shoulder, were from different wood types compared to the main body (Fig. 3). On some parts of the sculpture, such as the red book held by the right hand, microsampling for wood identification was not possible due to the integral pigmented surface. On the sampled specimen, anatomical characters were observed by transmission light optical microscope and analysed by means of identification key [5,6] on transversal, radial and tangential sections.

6.2. *XRF analysis*

The points investigated by XRF analysis are reported in Fig. 2. They were selected by looking at different parts of the sculpture and after cleaning patches of the original polychromy. XRF was used to pinpoint different elements in the painting layers. The XRF system used has a resolution of 5.9 keV; a sample-detector distance of 1.4 cm; and a collimator diameter on the incident X beam of 0.1 cm. The results are expressed as counts per second [cps] of the main fluorescence line intensities of the determined elements.

6.3. *Stratigraphic microscopy*

In order to enhance the results of XRF, stratigraphic analysis was carried out on two points (Fig. 2 in yellow) where it was possible to take samples (less than 1 mm in size) without damaging the polychromy of the sculpture and where, presumably, the original painted layers were still present and not degraded. For this reason, the samples were taken from the heel of the right foot (representative of the original form) and from the bottom of the habit. The samples were embedded in epoxide resin, then cut and polished. The analysis was performed with the Nikon Eclipse 50i pol microscope, the Nikon digital camera (reflected light), the Nikon eclipse E40, 50 W mercury vapor lamps and the Nikon digital camera (UV light).

6.4. *Radiocarbon wiggle matching*

Since the samples were taken from just a single wood artefact and the observed tree ring series was quite short, dendrochronological analysis alone could not guarantee success in determining age compared to other important single artefacts, such as a painted panel containing a long tree ring series [7]. The additional use of wiggle matching proved to be suitable for obtaining adequate dating results for the artefact [8]. Wood microsamples sampled from the foot of the sculpture (Fig. 4a) belong to rings n. 1 and ring n. 10 respectively. 14C dating was performed at CIRCE Laboratory (Campania University). Briefly, samples underwent to cellulose extraction [9], combustion plus graphitization [10] and measurements [11] by Accelerator Mass Spectrometry. Measured Radiocarbon ages were calibrated to calendar ages by means of INTCAL 20 utilising [12] Oxcal software [13].

Fig. 1. (a) Location of Sant'Antonio church in an ancient map of the town of Viterbo. (b) Colle del Duomo Museum located at the left side of Saint Lorenzo Cathedral in the town.

Fig. 2. Different views of the sculpture. In red the points examined by means of XRF analysis, in yellow the points selected for stratigraphic analysis, in light blue the points sampled for wood microscopic analysis. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

7. Results and discussion

All examined parts of the sculpture were carved from lime wood (*Tilia* sp.). Lime is one of the most used wood species in Italy for sculpture due to its fine texture, making it easier to apply a good finish to the final artefact. Taking into account an estimated volume of about 0.2 m^3 and a specific wood density of about 650 kg/m^3 [14], it can be estimated that the sculpture's total weight is about 130 kg. Since all the examined microsamples identified the same type of wood, this identification alone does not support the theory of multiple restorations to the sculpture over the centuries.

XRF analysis results are shown in Table 1. The palette of the original and later applied polychrome is very poor, due to the narrow chromatic range present on the statue. The repainted parts, macroscopically identified, show the presence of titanium. It is well known that titanium white was used as a substitute for white lead in more recent times. However, the XRF data is not conclusive because all the repainted areas that were examined did not exhibit strong compositional differences from the original painting, and no modern pigments – characterized by the presence of chromium or cadmium – were detected. White lead was present in all of the analysed points, which does not help to identify the chronological order of the evident repaintings. White lead was generally used up to the middle of the 19th century but because it lasts a long time, it comingles with zinc white and titanium white in subsequent repaintings. It is also possible that white lead was used even later than the 19th century, due to the persistence of deep-rooted traditions and possible delays in adopting modern pigments in more remote geographical areas.

Zinc was found in the habit's mantle (points 8, 9, 15, 20, 21) but does not seem attributable to white zinc due to the black colour of these areas and a weak correlation with copper based pigments, present in higher contents. Since XRF cannot identify carbon-based black pigments, it can be only inferred that a blue or green mineral copper-based pigment with zinc impurities was used to correct the hues of dark areas on the artefact. It is presumed that the zinc in point 14 is under the minimum detectable quantity (MDQ). The same areas, mostly the brown ones, also contain iron-based pigments with titanium and manganese impurities; this is likely an earth pigment, but the ratios between manganese and iron counts are too low for umber earth. Vermilion has been used for the red of the book and in low quantities, mixed with white lead in the original and repainted in flesh tones. Arsenic has been detected only in zones located on the book (point 12), carved from a wood block structurally separated from the main body of the statue. The presence of arsenic also occurs in large quantities in areas where paint layers are either lacking or are barely present, probably due to the previous treatment of the wood with biocides to prevent pathogen attacks. Based on these details, we can assume that the

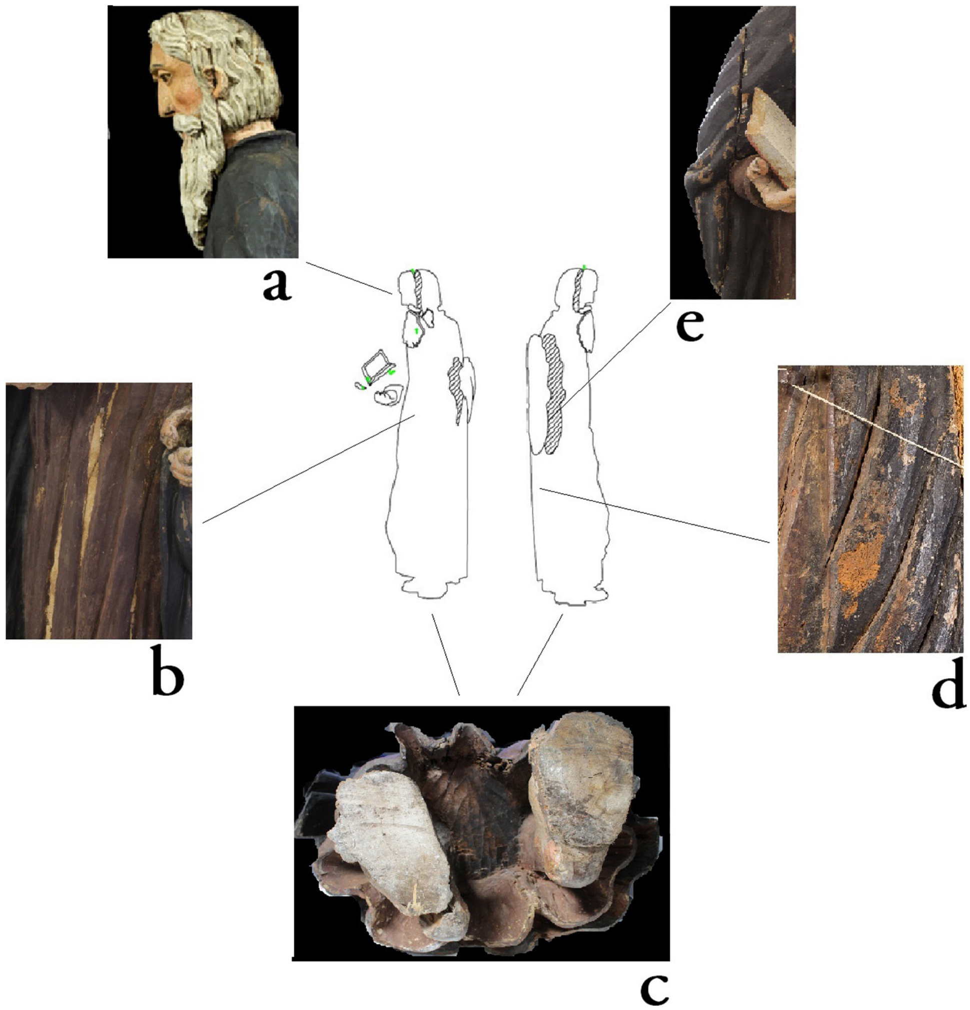

Fig. 3. Wood sculpture scheme with dashed points in the assembled parts. 3a - the face where it is visible the glued line with the main body of the sculpture; 3b - part of the habit where the natural wood grain supports the effect of the folds in the habit; 3c - bottom of the sculpture's body were it is visible wood working on solid trunk; 3d - back side of the sculpture where gaps in depicting can be observed; 3e - the right shoulder with assembled part.

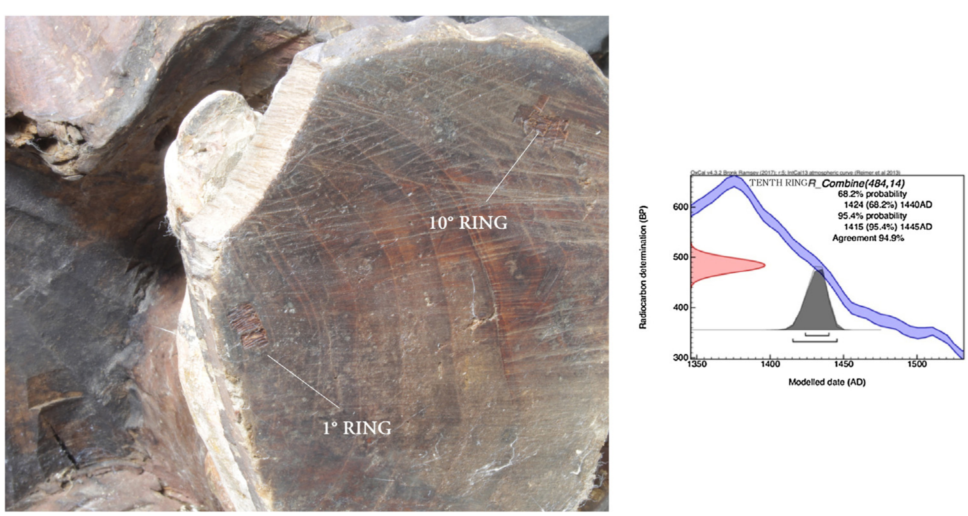

Fig. 4. Micro samples taken from the foot of the sculpture with visible tree rings in the wood (4a). The graph shows the dating of the tenth ring (4b).

book was added during one of the restorations, replacing the missing or broken original, and that the wood used for this purpose was preliminarily treated with arsenic compounds; otherwise we would find arsenic all over the statue.

Except for the result on the book, XRF does not help determine the periods during which the sculpture was carved or repainted. More information was obtained from stratigraphic analyses. The stratigraphy of the brown habit in the back of the

Table 1
Intensities of the main fluorescence lines of the determined elements as counts per second [cps].

pt	Colour	location	Description	Ca	Ti	Mn	Fe	Cu	Zn	Hg	As	Pb	Sr
17	–	wood		178	tr		18.5				96.0	30.3	8.10
2	–	wood		229	11.3		20.2				14.2	105	16.5
13	–	wood		47.4	tr		16.2						7.71
16	–	wood		115	tr		19.5						6.87
18	–	wood		116	tr		20.8						10.0
19	–	forehead	cleaning swab	3.25	tr		15.9					186	
1	White	book	repainting	159	6.76		96.2				453	309	tr
10	White	beard	repainting	49.6	tr		15.9					1354	6.46
3	Flesh	hand	repainting	15.4			17.2			11.0		1530	tr
4	Flesh	hand	original	47.8			13.1			21.2		1471	tr
5	Flesh	hand	original	19.6			10.9			25.4		1263	tr
11	Red	lips	repainting	33.4			34.8			784		935	tr
12	Red	book	repainting	19.1			21.1			951	84.4	851	tr
6	Brown	habit	repainting	171	15.6	17.6	993	3.17				441	10.6
7	Brown	habit	original	173	16.3	15.8	1229	5.37				530	8.62
20	Grey	mantle	original	169	tr	tr	16.2	13.8	tr			15.5	13.4
14	Black	mantle	repainting	329	6.20	3.71	75.6	4.47				28.2	20.3
15	Black	mantle	original	331	14.3	6.14	122	8.76	7.49			45.6	30.1
8	Black	mantle	original with repainting remains	69.6	tr	4.54	56.2	148	12.3			122	14.9
9	Black	mantle	repainting	112	7.21	5.49	69.0	117	13.9			91.3	13.4
21	Black	mantle	repainting	123	8.10	4.89	147	162	18.4			79.7	2.04

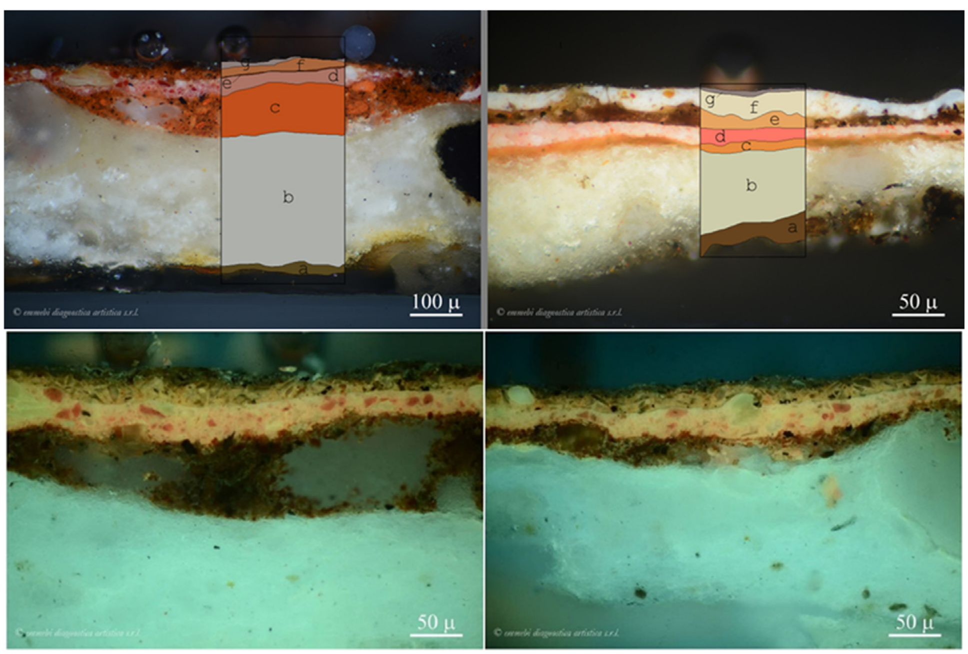

Fig. 5. Description of the stratigraphy, from the inner to the outer layer. The pictures a and b are related to different points in the sculpture, pictures c and d are under UV light.

sculpture (n.1, Fig. 5a) shows seven layers. The first and innermost layer (a) is brown in colour and organic in appearance, probably related to the wood primer. The second (b) is a white preparation layer, containing rare black particles. The third layer (c), 20–150 microns thick, has a red-orange colour with very fine brown and orange inclusions; this is probably the original colour of the habit. Stratigraphy of the habit provides proof that the sculpture was restored over the centuries because repainting can be identified in the fourth layer (d), as seen in the cross section with white and red particles. The organic appearance and high fluorescence under UV light (data not shown) (Fig. 5c) suggests the use of red lake pigment. The fifth layer, fluorescent under UV light, is very thin and organic. The last two layers are clearly separate from the others and are related to the first repainting. The penultimate layer has a medium fluorescent red-orange background (Fig. 5c), while the outer layer has a brown-greyish colour and an uneven application, testifying to a second repainting.

Seven layers were again identified in the right foot. The inner two layers (a and b) are similar to the ones in sample n. 1, and they likely represent the original preparation of the substrate. The third is an organic layer (c), highly fluorescent under UV light and probably related to a priming. The fourth layer is pinkish in colour, with very fine red and white particles (d); it is the original colour of the flesh. The fifth layer (e), similar to the fifth one in cross section n. 1 but thicker, is composed of an organic substance with very fine black and brown particles, possibly the result of a more recent priming intervention. The next layer is identifiable as a repainting (f): it is white-yellow in colour, with very fine yellow, red, brown and black particles. The outer layer is very thin and uneven, containing very fine black and brown particles (g). This level of detail was only available from stratigraphic analysis, as it was not possible to reach the original hatching by XRF or through superficial scalpel cleaning due to subsequent repainting.

More conclusive analysis for dating the sculpture was the radiocarbon wiggle matching method. Wiggle matching was not totally successful because the first sampled ring (n. 1) was likely contaminated with organic solvents and not accurately dated. The ring n. 10, on the other hand, provided a date range spanning from 1415 to 1445 at 2 sigma (i.e. 95% Fig. 4b) by combining 2 replicate measurements onto the same sample. It was possible to estimate about 30 additional growth rings from other parts of the sculpture, reasonably leading to a terminus post quem of 1445−1475. Due to the high dimension of the sculpture and evidence of insect infestation, it can be assumed that terminus post quem is close to time the tree was felled. As the sculptures were carved of fresh wood, the time of wood seasoning does not considerably affect the estimated time when the sculpture was made. The wood dating is consistent with the period identified with the pigments found by XRF analysis.

8. Conclusions

This case study on the sculpture of *Saint Anthony Abbot* from the Colle del Duomo Museum in Viterbo confirms a deficit, or at least a superficial, level of knowledge on wooden sculptures, especially of a devotional and vernacular nature. These types of artefacts are rarely the subject of in-depth studies and are hardly mentioned in documents with regard to their history of possible repairs or restoration. An analytic examination before attempting artefact restoration is known to be relevant, in order to plan the best practices of intervention. In the present case, the results have established the original background and repaintings that have guided the subsequent restoration work.

The analysis also allows for more recognition and appreciation of the sculpture in the Colle del Duomo Museum. Beyond describing the sculpture to museum visitors, it will be possible to show the executive technique and materials used in the original polychromy, illustrating the different periods of restoration, as revealed by the scientific evidence. Through radiocarbon analysis it was possible to estimate the *terminus post quem* of the artefact, therefore delineating the period of when the object was created, which was impossible to decipher from a purely stylistic point of view. Scientific evidence increases knowledge of vernacular sculptures, helping define the relationship between historical data and the materials of art in this kind of amazing artefact.

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References

[1] E. Corsi, A. Giannotti, M. Salemme, Zibaldone Viterbese, Folklore e vecchie cronache curiosità storiche e arte, Quatrini Archimede & figli, Viterbo, 1974, pp. 34.
[2] M. Signorelli, Il Palazzo Papale di Viterbo, Agnesotti, Viterbo, 1986.
[3] S. Valtieri, Il complesso antoniano di S. Antonio in Valle a Viterbo, in Studi in ricordo di Attilio Carosi, 2016, pp. 553.
[4] A. Scriattoli, Viterbo nei suoi monumenti, Buffetti, Viterbo, 1920.
[5] F. Schweingruber, Anatomy of European Wood: an Atlas for the Identification of European Trees, Shrubs and Dwarf Shrubs, Paul Haupt Berne, 1990.
[6] M. Romagnolj, M. Sarlatto, F. Terranova, E. Bizzarrj, S. Cesettj, Wood Identification in the Cappella Palatina Ceiling (12th Century) in Palermo (Sicily, Italy), Iawa Journal, 2010, pp. 109–124.
[7] M. Romagnoli, L. D'Alessandro, C. Seccaroni, P. Moioli, D. Poggi, M. Grabner, The Pietà di Ragusa panel: a science-based contribution to its dating by dendrochronology, wood anatomy and pigment analysis, J. Cult. Herit. (2016) 767–774.
[8] I. Folettia, M. Romagnoli, L. Liccioli, M. Fedi, R. Saccuman, Wiggle matching analysis of the doors of Santa Sabina in Rome, RIHA J. (2019).
[9] I. Passariello, F. Marzaioli, C. Lubritto, M. Rubino, A. D'Onofrio, N. De Cesare, G. Borriello, G. Casa, A. Palmieri, D. Rogalla, C. Sabbarese, F. Terrasi, Radiocarbon sample preparation at CIRCE AMS laboratory in Caserta, Italy, Radiocarbon 49 (2) (2007) 225–232.
[10] F. Marzaioli, G. Borriello, I. Passariello, C. Lubritto, N. De Cesare, N.A. D'Onofrio, F. Terrasi, Zinc reductionas an alternative method for AMS radiocarbon dating: process optimization at CIRCE, Radiocarbon 50 (1) (2008) 139–149.
[11] F. Terrasi, N. De Cesare, A. D'Onofrio, C. Lubritto, F. Marzaioli, I. Passariello, D. Rogalla, C. Sabbarese, G. Borriello, G. Casa, A. Palmieri, High precision 14C AMS at CIRCE, Nucl. Instrum. Methods Phys. Res. B (2008) 2221–2224.
[12] P. Reimer, W. Austin, E. Bard, A. Bayliss, P. Blackwell, C. Bronk Ramsey, S. Talamo, The IntCal20 northern hemisphere radiocarbon age calibration curve (0–55 cal kBP), Radiocarbon 62 (4) (2020) 725–757.
[13] C. Ramsey, S. Lee, Recent and planned developments of the program OxCal, Radiocarbon 55 (2) (2013) 720–730.
[14] G. Giordano, Tecnologia del Legno, UTET Torino, 1984.