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Development of a material characterization method for the Medieval codices of the collection from the Monastery of Alcobaça

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Aos meus quatro avós, a quem, quero
sempre, dar toda a alegria, e mantê-los
felizes junto de mim física e espiritualmente.

"It always seems impossible until it's done.", Nelson Mandela

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The collection of codices from the Monastery of Alcobaça is one of the most relevant in Europe because it contains one of the largest sets of codices that preserve Medieval materials. In this sense, it is an important primary source of information for a complete study on an entire community. In this dissertation we aimed at studying this collection's materiality. To do that, we designed a characterization method following leading tendencies recommend by main scholars in the field. The method was constructed as a structured record, done in a table-based digital format with a controlled vocabulary which was compiled in a multilingual glossary. It allows to perform a detailed codicological analysis of the codices' physical features and to record pioneering results achieved with advanced analysis on surviving materials. Thus, it provides researchers with codicological and analytical information on each codex and on the entire collection. Results attained revealed that the method allows researchers to perform interpretative analyses of recorded data and to compare it between itself and with related bookbinding literature. In the case of this dissertation, based on a comparative codicological analyses we were able to propose a chronology for different binding elements of three selected codices: Alc. 341, Alc. 413 and Alc. 414. This chronology and our observations also support the theory that these codices' current binding was done in this order. Their material analyses allowed a general identification of inks, paints and sewing threads' fibres, and a more concrete identification of wood and metallic materials. Paints and metallic materials' identification generally match literatures' findings, but wood analyses revealed completely new results with the potential detection of *Fagus* (a genus that was not considered in previous works regarding this collection). It also became evident that skin-based material analyses' methodologies, must be further developed for more positive results.

Keywords: Alcobaça collection's codices, Cistercians, material characterization method, codicological analyses, advanced analyses.

RESUMO

A coleção de códices do Mosteiro de Alcobaça é uma das mais relevantes na Europa, pois inclui um número de códices que conservam materiais Medievais muito considerável neste contexto. É, portanto, uma importante fonte primária de informação para o estudo completo de toda uma comunidade. Neste estudo pretende-se estudar a materialidade desta coleção. Para tal, foi desenvolvido um método de caracterização que segue as principais tendências recomendadas pelos investigadores da área. O método foi construído como um registo estruturado, feito em formato de tabela digital, e utiliza um vocabulário controlado através de um glossário compilado previamente. Desta forma, permite executar uma descrição detalhada das características físicas dos códices, bem como registar os resultados obtidos em análises avançadas pioneiras realizadas aos seus materiais. Desta forma, os investigadores conseguem obter informações codicológicas e analíticas sobre os códices individuais e sobre toda a coleção. Os principais resultados alcançados revelaram que o método permite realizar uma análise interpretativa dos dados registados e compará-los não só entre os códices documentados, mas também com literatura sobre encadernação. No caso desta dissertação, com base na análise comparativa dos dados desenvolvemos uma proposta de cronologia para diferentes elementos da encadernação de três códices selecionados: Alc. 341, Alc. 413 e Alc. 414. Estes dados também suportam a teoria de que estes códices terão sido encadernados nesta ordem. As análises de materiais dos três permitiram uma identificação geral das tintas de escrita e pintura e das fibras dos fios de costura. Permitiu também uma identificação mais concreta dos materiais em madeira e dos materiais metálicos, sendo que os resultados obtidos para os últimos correspondem com os dados reportados na literatura, mas as análises às madeiras revelaram resultados completamente novos, com a potencial deteção de *Fagus* (um género que não foi considerado nos estudos anteriores relativos a esta coleção). Também ficou evidente que a metodologia para análise de materiais em pele deve ser desenvolvida para ser possível obter resultados mais positivos neste campo.

Termos-chave: Códices da coleção de Alcobaça, Cistercienses, método de caracterização material, descrição, análises avançadas.

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®	Registered Trademark
ºC	Degree Celsius
δ	Bending vibrations
μ–	Micro
$\nu_{(\alpha/\tau)}$	Stretching vibration (asymmetric/symetric)
AIC	American Institute for Conservation
Alc.	Alcobacense (associated to the BNP's quota for the codices)
As	Arsenic
Au	Gold
av.	Average
BNP	Biblioteca Nacional de Portugal
c./cs.	Century/centuries
Ca	Calcium
ca.	Circa
Col	Colorimetric analyses
CEF	Centro de Estudos Florestais
CIDOC	Comité International pour la Documentation
CISTER.Hor	Cistercian Horizons. Study and characterize a Medieval scriptorium and its production: Alcobaça. Dialogues between local identities and liturgical uniformity (Refª PTDC/ART-HIS/29522/2017)
CRM	Conceptual Reference Model
Cu	Copper
DCR	Departamento de Conservação e Restauro
DM	Digital microscopy
DNA	Deoxyribonucleic acid
ECCO	European Confederation of Conservator-Restorers Organisations
EDXRF	Energy-dispersive micro X-ray fluorescence spectroscopy
f.	Folio
FCSH	Faculdade de Ciências Sociais e Humanas
FCT	Faculdade de Ciências e Tecnologias
Fe	Iron
FORS	Fibre-optic reflectance spectroscopy
FTIR	Fourier-transform infrared spectroscopy
HERCULES Lab	Laboratório Hércules
HgS	Mercury sulfide
HI	Hyperspectral Imaging
ICOM	International Council of Museums
IEM	Instituto de Estudos Medievais
ISA	Instituto Superior de Agronomia
kα, kβ, Lα…	Different energy x-ray levels associated to XRF spectral peaks
LAQV-REQUIMTE	Associated Laboratory for Green Chemistry (LAQV) of the Network of Chemistry and Technology (REQUIMTE)
LCDN	Linked Conservation Data Network
LoB	Language of Bindings
Met	The Metropolitan Museum of Art
MJC	Médiathèque Jacques-Chirac
NH, CH, OH	Nitrogen/Carbon/Oxygen – Hydrogen bonding
Ni	Nickel
NIR	Near infrared light
NY	New York

OM	Optical microscopy
Pb	Lead
r	Recto
S	Sulfur
SCP	Saint Catherine's Project
SEM	Scanning electron microscopy
Sn	Tin
Ti	Titanium
UAL	University of the Arts London
UE	Universidade de Évora
UL	Universidade de Lisboa
UNL	Universidade Nova de Lisboa
UV	Ultraviolet light
VC	Vocabulaire codicologique
Vis	Visible light
v	Verso

Conservation has long been seen by the professionals in this field as a set of measures and actions taken to ensure the long-term safeguarding of cultural heritage. One such conservation procedure recognized by international organisations, e.g. ECCO or AIC, is Documentation. [1-3] However, Documentation of cultural heritage is not solely produced by conservators. [4] On the contrary, as was made clear in the 2006 *Digital Formats, Institutional Priorities, and Public Access* meeting[1] [5], Documentation has long since become an interdisciplinary action. Standards and guidelines developed in past decades also confirm this. [6-8] Thus, Documentation can be defined as a holistic recording of information about the evolution and contextualization of a cultural object covering the time, spaces, uses and meanings associated to it, from its conception to its present condition. It must include information on management records, descriptions, research findings (historical, scientific, etc), conservation records, among other criteria. [4] In short, Documentation can be considered an important action which enables different professionals to preserve objects and disseminate their histories, and their reveals about the societies in which they were present.

A consistent Documentation of the collection of codices from the Monastery of Santa Maria of Alcobaça has been in progress since when the codices were still housed in the monastery. Pursuing this same goal, Cistercian Horizons is a recent interdisciplinary project, started in October 2018, devoted to the study and characterization of three book-related elements in the collection: liturgical and illumination contents and bookbinding. It also looks for associate them with local and European Cistercian historical contexts. To this end, fifty liturgical codices were chosen to be studied by three Portuguese research units in collaboration. These are the IEM (FCSH-UNL), the HERCULES Lab (UE) and the LAQV-REQUIMTE (FCT-UNL), dedicated to the three areas, respectively. Findings and resulting Documentation will be shared with BNP and Alcobaça Monastery and will be disseminated throughout international community.

This dissertation is inserted in the project's part for LAQV-REQUIMTE thus, it is dedicated to bookbinding study. It will focus on the Documentation process of recording the codices' materiality, mainly their bindings. The significance of the Alcobaça collection [9] along with the current state and challenges in studying Medieval bindings, will be addressed in the Introduction. Since the inception of CISTER.Hor, members responsible for bookbinding study took these challenges into consideration and strove to define ground rules for future work. Thereby, the primary goal of this dissertation is to develop an initial draft of a characterization method that includes: an exhaustive codicological analysis of all the constituents and structures present in each codex; and a pilot survey of codices' materials, identified through advanced analyses. This method will allow researchers to document every aspect related to the codices' materiality, as well as to interpret and compare collected data among itself and with bookbinding literature. In Practical Work procedures used to construct this characterization method are summarized. They include the compilation of a multilingual glossary (based on leading references), and selection and initial developments of a digital table-based characterization method. The glossary was used to control this method's vocabulary. At this stage, only three case-studies (from the Medieval period) were selected to be characterized: Alc. 341, Alc. 413 and Alc. 414. They were thoroughly described and their materials examined with various advanced techniques, including DM, OM, SEM, EDXRF, FORS and others. All this information was recorded in the tables. In Results & Discussion, methodological and empirical (codicological and analytical) results are presented as a primary evaluation of the characterization method's efficiency through a detailed and individual analysis of the data recorded for each constituent. Due to the limit on number of pages imposed by DCR, crucial information for the understanding of this chapter is presented in the Appendices. Finally, Conclusion summarizes main achievements and focus on future work proposals.

[1] In this meeting housed by MET, NY, professionals of several fields related to cultural heritage recognized the need to develop mechanisms for information exchange among them. [5]

1.1. FROM *CÎTEAUX* TO THE CODICES OF ALCOBAÇA MONASTERY

Cistercians are a monastic order that branched off from the Benedictines as a result from a reformist movement that began in 1098, when Robert of Molesm and his monks left the Molesm Abbey in Burgundy to found the *Novum Monasterium*, at *Cîteaux.* These monks sought to return to the original Benedictine ideals by performing their tasks (prayer, manual work and self-sustenance) with simplicity, seclusion and balance. [10] According to St. Benedict's Rule every abbey should be governed autonomously, but with the beginning of an unprecedented expansion, standards and regularity had to be safeguarded. Contrary to the Cluniac model, the Cistercian order gradually developed and applied actions of mutual supervision to ensure a strict and uniform compliance with the Rule. [11] The annual General Chapter, established norms like Visitation[2] and other obligations. These norms were crystalized in documents like the *Carta Caritatis* (wrote in 1119) and the *Statuta Capitulorum* (written documents produced by the General Chapter between the 12th-18th cs.). [12-13] With the order's expansion, several new communities were established including the Abbey of *Clairvaux*, in 1115, by Bernard of *Fontaine*, who became the order's most famous abbot under the name Bernard of *Clairvaux*. During his abbacy, Cistercians probably saw their greatest growth; in less than forty years, they had spread all over western Europe establishing over three hundred daughter and granddaughter houses (sixty-eight direct descendants from *Clairvaux*). [10-11]

Shortly before his death in 1153 (and a few years after the arrival of the Cistercians to Portugal[3]) Bernard was granted the "Couto Charter" by D. Afonso Henriques – the first King of Portugal, to erect the Monastery of Alcobaça. [15] The donation of this large tract of land was undoubtedly inspired by political questions [16], but it was also ideal for the Cistercians' vocation of prayer and self-sustenance, given its isolation and fertile soil. Thus, while Portugal was becoming established as an independent kingdom, Cistercians were securing their position in the Iberian Peninsula. [16] Several scholars have focused on the history of this monastery and its monks. Since Cocheril [17], more recent works like those by Nascimento, Gusmão and Gomes, have provided solid studies resulting in a coherent chronology of events. [15-21]

Reading (not writing) is explicitly mentioned in the *Rule* of St. Benedict and subsequently in the *Carta Caritatis*. [11-12] Mother house was, in fact, responsible for providing its daughters with a first set of books[4] essential to a uniform following of religious work. [22-24] The proper fulfilment of Cistercian principles implied monks (including those of Alcobaça) worked in the production (writing, illumination and binding) of their own codices. [22] Cistercian uniformity has been discussed in studies from several fields (from architecture to liturgy) with researchers arguing that common rules existed but were often disregarded due to local contexts. [13, 23, 25-26] Nascimento - who over 40 years studied Alcobaça's codices and obtained valuable results - also defends the uniformity of these codices. [18, 23] However, as Casanova declares, "it is important to revisit [Alcobaça] bindings with new available technologies […] that reflect the recent state of Medieval binding studies" [27, p.4] to make further progresses on this topic.

To date, the Alcobaça collection housed at the BNP is comprised by 459 codices[5] [28] recovered from Alcobaça Monastery in the process of dissolution of religious orders in Portugal (1834). (Appx.1) They range from the 12th-18th cs. and cover the entire period of Cistercian network flourishment. This endows this collection with relevant and inherent historical and spiritual meanings, respectively. Slightly more than a third of these codices (194) were attributed to Medieval period and the largest portion

[2] The affiliation system obliged mother abbey to visit once per year its daughters, in an action called Visitation. [11]

[3] According to recent research works the first Cistercian occupation in Portuguese territory occurred at the Monastery of Saint Cristóvão of Lafões, c. 1137. [14]

[4] The set included: a *psalterio*, an *hymnario*, a *collectane*, na *antifonario*, a *gradali*, a *regula*, a *missali*. [22]

[5] These numbers result from a personal count to the online catalogue of BNP. [28] They do not entirely match those of Nascimento (total: 456, 12th/13th c.: 5; 13th c.: 139; 13 / 14th c.: 14). [29] Also, they do not consider other collections' codices (including foreign ones) which have recently been attributed to Alcobaça production, nor codices from Alcobaça's collection that have recently been attributed to other productions. In total these would make 467 codices. See Barreira [22]. The count merely includes all the codices on BNP's online Catalogue (apart from 3 that do not have online entry). [28] For now, the author cannot explain the inconsistencies in the numbers. However, this count is relevant because it is the first one ever made for bindings typologies of the Alcobaça's collection.

(136) pertains to the 13th c.[5] (Fig.A1-1) In a preliminary comparison between equivalent Portuguese [30] and French [31-32] collections, only *Cîteaux* and *Clairvaux* surpass these large numbers, making the BNP collection the largest of its kind in Portugal and a relevant unit among its European counterparts.[6] (Fig.A1-3) In terms of materiality, loss of few codices over time [38-39] and sporadic material interventions[7] [23] do not weaken the collection's significance. In fact, this large subgroup of Medieval codices stands out from its Portuguese and French counterparts because a third of them (64)[5] still preserve all (or almost all) materials from Medieval period (unlike the Frenchs which lost many refurbishing materials). (Fig.A1-3) [41] These high numbers balance the collection's completeness and preservation value. Regarding its artistic and aesthetic relevance, Medieval codices seem to incorporate in the ascetic ideals of simplicity upheld by the Cistercians, and their longevity supports amazing technical feats possibly associated to dedicated labour. In addition, the small group of Medieval codices that still preserves materials from Medieval times can be divided into two main typologies, according to the colour and materials of their covers: white (alum tawed) and brown (tanned) leathers. (Fig.A1-1) This raises interesting questions that remain, as yet, unanswered, such as why are there two different typologies? Do they have associated specific meanings? Despite the doubts, all these factors contribute to enhance the collection's scientific and research value. In fact, these codices are a primary source of information for a holistic study (crossing e.g. history, art, liturgy, society, technology) that can reveal their uses and circulation within a community as well as the community's way of living, preferences and beliefs.

1.2. THE CISTERCIAN *SCRIPTORIUM*: THE PLACE AND ITS PRODUCTS

Several authors have validated the existence of a *scriptorium* in Alcobaça, working since the end of the 12th c. onwards [23, 42-43], which implies that production had started in the temporary quarters. [52] Little is known about the conditions in which codices were produced. Where, in the precinct, were they made? By whom? Which procedures were followed? Under what hierarchy? Scholars usually agree that Medieval monastic book production followed strict rules and was done by specialized monks in a specific space; but was that really the case? De Hamel, Suarez, and Tock argue that all tasks related to book production (writing, illumination and binding) could have been performed by a single person. [44-46] This contradicts the idea that books were produced by monks specialized in one task. According to the book *Livro da Fazenda* (1437-1440) the monastery was facing an unusual situation at that time. The book mentions the presence of a *procurador,* Estevão Anes Lourido, who knew how to prepare parchment, copy manuscripts and bind them. It also refers that monk copyist Nicolau Vieira also learned to bind codices. [47-48] However, the context of Alcobaça's production Medieval codices remains unclear.

Research regarding the production of codices has been more prolific than the study of the physical space [49] and the work context of Alcobaça's Medieval *scriptorium*. Since the first inventories[8] [29, 39, 50-51], scholars from different fields have assiduously studied Alcobaça's library and its codices. Works by Barreira and Bragança have focused on liturgical texts [13, 22, 52-57], while Ferreira dedicated his studies to musical notation. [58-60] In Medieval illumination, leading scholars include Peixeiro and Miranda. [42, 61-64] Since 2005, Miranda and a team of conservation scientists from FCT-UNL have addressed issues related to materiality. They focused mainly on identifying materials and techniques

[6] For a more representative framework, it is important to consider other Medieval Cistercian collections which have bindings from that period. Throughout Europe, there are numerous large Medieval Cistercian collections, like those from Heiligenkreuz [33-34] or Salem [35-36] abbeys. However, do these collections keep codices with Medieval bindings? To the author's knowledge, this information has not yet been compiled (like it was done for Alcobaça collection (Fig.A1-2)). If one wants to know whether (continues in the next page) a collection has codices with Medieval bindings, one must survey them, on the entire collection. Researchers know that these codices exist; countless works studied them since first bookbinding studies. [37] These studies indeed inform the community on some collections that maintain these kinds of codices. Nevertheless, they appear to have never been compiled and thus, to identify the collections, one must again survey them in every study. Moreover, investigators do not have any warranty that these collections represent the existing universe. The need for a complete and exhaustive survey of collections with this type of codices seems to be in order, so that scholars know what they can compare.

[7] Arrojado *et al*. identified parchment repairs which appear to have been done during the Medieval period at the monastery. They seem to suggest an early concern with the care and preservation of these objects, by the religious community. [40]

[8] These inventories and catalogues, written in past centuries, usually contain very little, and sometimes inaccurate information for each codex. This information includes very sporadic and brief notes on a few bindings "worth mention", which reveals a trivial (but present) interest for material questions, even at those early days. [29, 39, 50-51]

used in Portuguese Medieval illuminations from the 12th-13th cs. (including those produced in Alcobaça). [30, 65-67] Nascimento, who was crucial in defining the *scriptorium*'s existence through the examination of the codices' binding structures (namely board attachment systems), was also able to propose a material-based chronology. [23, 68-69] Other sporadic studies carried out by Casanova under FCT-UNL's auspices, addressed the collection's binding materiality in terms of constituents and description of studied codices' structures. [27, 70-72]

Other Portuguese studies regarding material characterization in the Medieval period outside the scope of Alcobaça, (whether codicological or material analyses) are rare. There are some studies concerning bindings from the Lorvão [67] and Sta. Cruz monasteries [30, 72-73] as well as the ones from the *Forais Manuelinos* [74-77]. Araujo's dissertation on Books of Hours in Portuguese collections (although from a later period) is also noteworthy. [78] Besides the above-mentioned studies, no further research was carried out on the identification of Medieval binding materials. Guerra's work includes parchment identification and an analysis of working systems (mainly writing) for private documents in Portuguese collections of the 9th-12th cs. He proposed a reasoned identification of i) support materials (mainly sheep's neck) based on follicle patterns, ii) writing tools (calamus) and iii) sequential work tasks. [43, 79] His work is a potential model of study and can be very important in terms of Alcobaça codices, to determine potential relationships between an apparent common source of materials.

Internationally, tendencies vary a little. Codicological studies on Medieval bindings (including monastic and Cistercians) are more frequent. To clarify information on book production and use, several scholars have focused on this issue, proving the importance of attending binding details. [37, 80-84] Regarding Cistercian bindings we have three important contributions: two by Regemorter [85-86] describing French Cistercian Medieval bindings; and one by Szirmai [37] who sought to compile available information in that time (which included Regemorter and Nascimento & Diogo works). Through detailed characterisations of codices from several periods (including what he calls the Romanesque type), Szirmai built one of the most coherent and systematized bodies of knowledge on bookbinding evolution. [37] A very interesting work performed by Clarkson, shows that there might exist some similarities between certain English Medieval monastic bindings and those from the Alcobaça collection.[9] [80] Unfortunately, he could not identify which religious orders produced the codices. Works like these enhance our common knowledge on structures and characteristics of monastic Medieval bindings. However, a comparative study of the Alcobaça collection with regional, Cistercian and European production contexts is yet to be done. Does the collection relate to its counterparts? Does it follow a Cistercian uniformity? Did local context affect production? How does it relate to other codices from the same period?

As for material analyses, it appears that there has been a greater interest for painting materials. In fact, most publications' titles which erroneously refer to "manuscript materials" merely identify illumination and writing materials. [88-90] Very few (if any) publications carry out a complete identification of any kind of bookbinding materials (including Cistercian or from other monastic orders). These, frequently led by conservators, focus mostly on specific materials such as parchment, leathers and adhesives. [91-92] Alternatively some works focus on individual constituents. One online article identified hairy covers in Clairvaux as sealskin, but the authors do not list analytical procedures in detail. [93] Two publications studied coloured materials of covers from 16th-17th cs. with singular features. [94-95] To the author's knowledge, constituents like boards, sewing supports, threads or furniture remain unstudied. These materials are also part of the whole bound book. So, they too require accurate and precise identifications to trace historical patterns and expand common knowledge.

Many questions remain unanswered in the study of Medieval monastic bookbinding. Places, contexts of production, materials used, and relationships among structures of different origins remain unclear. Historical records from those times are scarce and sometimes vague, thus one cannot solely rely on them. Many studies on codicological analyses of constituents and structures are proving to be valuable sources. Can advanced material analyses be useful too, in the study of Alcobaça collection?

[9] Some exemplars housed at the British Library, e.g. the Glossed Book of Genesis (MS 63077), appear to have bindings very similar to those of the Alcobaça collection. [87]

1.3. CHALLENGES IN BOOKBINDING STUDY

Academic interest in bookbinding dates back the 19th c. (later than other book-related fields such as text or illustration). [37,96] Luxury and richness of some codices' covers drew the attention of some historians. Based on decoration, aesthetics and "styles", these professionals followed an art history approach in their studies. [37, 97-98] Some later authors even mention an "history of bookbinding decoration". [97-99] In the second half of the 20th c., a new approach for studying the whole bound book emerged, and this more holistic, almost archaeological, approach resulted in great advances. [98] In recent decades, several studies proved the importance of analysing a book like an artefact and showed how every detail can help provide information about a book's production (date, region, producer, financial status, etc.) and its historic biography (uses, modifications, etc.). They also help establish different styles and categories worldwide (influences, tastes, trades, etc.). [80-82, 98, 100] Nevertheless, progress seems to be encumbered by a series of factors that are regularly debated by academics. Some authors list and individually discuss each specific factor. [101] Others address them all together as a cycle. [97, p.38] Perhaps, a more plausible scenario is the development of a network of factors that became both the causes and the consequences of an unfavourable context.

One long-standing factor seems to be the preference for the topic of decorated books. In 1999, Szirmai emphasized this tendency by stating that "no more than 10 per cent [of bookbinding literature] is concerned with binding techniques and binding structures". [37, p.ix] This disproportionate interest in decorated bindings seems inopportune because, according to various scholars, these bindings are a minority of the entire corpus ever produced (probably no more than 1%). [98, 102] Recently, Campagnolo, Velios and Clarke shared this concern again. [98, 101-102] Pristine bindings are also a small faction that received more attention than intervened bindings. [27, 103] In fact, despite the number of publications on bookbinding be vast, simpler everyday books (which may have suffered alterations) appear to be underrepresented. As Clarke says "[…] we remain largely ignorant about standard manufacture [of books without «exceptional decoration»]." [102, p.11] Therefore, "we cannot build a coherent history of Western bookbinding". [27, p.3] On the other hand, it is possible that researchers' access to publications is often hampered by admission restrictions (especially in online resources). [27] The greater interest in richer and more prestigious books is understandable, while the study of these complex, variable and at times hidden structures is very challenging (especially because only few examples endured without changes). Moreover, there is a dearth of surviving records, and those that are available tend to be ambiguous, imprecise and sometimes they too are in so poor condition (just like the bindings) that information extraction becomes very difficult. However, by using a segmented approach, rather than addressing every type of book as a whole, representativity and meaning can be lost and this will prevent scholars from understanding the bigger picture. [27, 98, 102]

It is debatable whether these unrepresentative publications on more rich books are a cause or a consequence of other problems. The variety of disciplines involved - each one with its own actors, approaches, methodologies and languages - is a more definite recipe for complication. Lack of undefined tools seems to hamper the field, too. An abundance of published glossaries demonstrates the need for a defined, multilingual terminology, as very few include translations to other languages (beyond the main), illustrative images of each term, or entries for all book constituents (i.e. most times minor elements and their configurations are not considered).[10] Bookbinding literature justifies the lack of this terminology with the enormous and complex variety of existing structures. [97] According to this literature, the lack of classification for details that have not yet been examined (mainly elements that form more complex constituents) is another reason for the absence of a common terminology. The situation is even more complicated by the diverse configurations that each constituent can assume. All these configurations must be distinguished and identified as well. [98, 101] Authors also mentioned that new specific and separate lexicons usually emerge from local practices and traditions. Consequently, there are many terms (for structural details) without equivalents in other languages; there are different terms that refer to the same structure; and there are equal terms that refer to unrelated structures. [98, 101] To address this issue, *Ligatus* Research Centre at UAL developed what is now considered the

[10] Consider these examples: Roberts & Etherington [104], La Fabrica de Libros [105] and POEFDS [118].

most comprehensive, representative and widely available Thesaurus of bookbinding terms, the LoB. [106] Nevertheless, problems persist. Besides the above-mentioned lack of representativity, dearth of easily accessible publications, and absence of a common terminology, there are other problems related to description methods and their variable formats in each study field.

According to Velios, researchers do not have a representative sample of bookbinding descriptions to reach accurate conclusions. [101] Furthermore, description methods frequently follow particular rules from each book-related discipline which hinders interpretation and information crossing. Important work developed since 1990s by ICOM-CIDOC got to the conclusion that a single description method applicable to all cultural objects could not be created due to the inherently diverse methodologies of each field. So, they began to develop the Conceptual Reference Model (CRM) as an alternative solution. [7, 107-108] Nowadays it is the most complete method for cultural heritage Documentation. It allows different cultural heritage professionals to work together and in collaboration with informatics professionals, because it resorts to informatics languages to record cultural heritage data by means of an ontology[11]. Thus, CRM is based on the definition of a generic, abstract structure - the ontology - which conveys a variety of database fields used in different study areas. [107] This allows the establishment of relationships between pre-selected concepts, regardless of the field. At the present, aggregator tools that can later centralize information do not exist [101], but the Linked Conservation Data Network (LCDN) is assessing CRM potential for linked data[12] dissemination. [110] This would create major online resources and would be a crucial step for creating an all-inclusive cultural heritage community. However, the complex informatics requirements that CRM implies are beyond the scope of this dissertation. Therefore, for now, the author chose to resort to more traditional methods used in bookbinding descriptions. These will be briefly discussed below.

Describing methods can be divided into two main categories: free text and structured records. [101] Both can be subdivided into multiple categories according to their specific features. For example, free text is usually written in natural language, either in a lengthy and detailed format or as short one-sentence notes. While very complete, and usually thematically organised, long free text descriptions are mostly hard and time-consuming to interpret (as they frequently lead to ambiguous interpretations and misunderstandings). Crossing information between different cases is also challenging, especially in large collections. [98, 101] In contrast, short-note texts are quick to register but rather incomplete and highly subjective. Thus, they prevent researchers from obtaining clear and correct understandings that are suitable for comparison. [111] Interpretation of textual descriptions with controlled vocabularies can be more accurate if they are well organised (following a coherent thematic sequence) and systematically applied. They can also be increasingly easier to read (though initial adaptation may be difficult) and they reinforce the need for a common terminology. [98] A relevant problem in all free text formats is the translation between languages which can lead to changes in meaning (even when a controlled vocabulary was used). [98] Although free texts with natural language are less advantageously, they have, been the most used methods, namely in catalogues, monographs and journal/conference papers. [101]

Alternatively, during systematic bindings' surveys most typically produced descriptions are customized structured records (printed or digital; forms or tables). [98, 101] They allow easier databases constructions at later stages. Good examples are the *Ligatus* SCP [112-115], the metadata scheme for database complement developed by a Slovenian team [111] and others mentioned by McCarthy *et al.* (e.g. ProBok). [116]. In structured records, comparable features are recorded under common rules. Automatic tools in digital formats facilitate search and faster comparisons. Tailored systematized structures with controlled vocabularies are proving to be an easier and more precise method for data assembly, interpretation and even analyses (particularly in digital formats). [98] Finally, data crossing of one database with another is becoming more accessible, thanks to CRM and Linked Data. [101] Given these advantages, structured records binding descriptions in databases are now considered the best format to reduce inaccuracies (with just one interpretation) and promote dissemination. [98]

[11] In Computer Sciences, ontologies are means to analyse and organize relevant entities into concepts and relations, creating the structures of a complex systems. [109]

[12] In Computer Sciences, linked data are structured, interlinked data that can be read by humans but more importantly by computers, automatically. [109]

Books are very complex objects and to enable a more comprehensive understanding of them, they must be studied and documented as a whole (text, illumination and binding). It is vital that different book related professionals work together to develop tools that conciliate the various methodologies they use. It is also important that every part of every type of book is studied equally. Professionals must promote interdisciplinarity and avoid focusing on specific fractions because that leads to unrepresentative and misleading conclusions. Finally, new findings must be spread and accessible to all to assure common knowledge development. Leading projects, like CISTER.Hor, support these needs, as will be seen with our proposal.

2. PRACTICAL WORK

Practical work was divided into two main parts: compilation of a glossary and construction of a material characterization method which includes codices' codicological and advanced analyses' results.

For practical reasons, the main body of the glossary was done in Portuguese. Existing terms were compiled, alphabetically ordered and assigned with their definitions, synonyms and translations (English, French and Spanish), according to consulted literature. Main references used were Nascimento & Diogo [23], Faria & Pericão [117], POEFDS [118], LoB [106] and *VC* [119]. Correia [67], Seixas [77] and Freitas [120] were also used when terms were more obscure or harder to define. Each term was also given an auxiliary illustration taken from the *VC* [119] or digitally drawn by the author. New terms were avoided since, as mentioned above, this is one of the causes preventing a common terminology. However, exceptions had to be made because some English terms had never been translated, and some specific features of the collection had never been designated. Even so, these non-referenced terms were carefully identified for future revision.

The glossary was built in the Microsoft 365 ProPlus Excel® program to benefit from some of its automatic tools, namely "filters" and "drop-down boxes". Excel also has the advantage of being an accessible and familiar program, which made it easier to use. Since it is a spreadsheet program, the glossary became displayed as a table. Thus, glossary's criteria are presented in the first row, while compiled terms are listed in the first column. Each term has one corresponding row. Terms were also assigned with specific colours so that, through "filters", they could be grouped by categories of book constituents. For a more detailed description of glossary construction, see Appx.A2.1

The construction of the characterization method started with its selection. Free text descriptions were immediately disregarded due to their aforementioned disadvantages. Moreover, construction of an entire database was beyond the scope of this dissertation. Therefore, the choice laid in structured record formats typically used in bindings surveys (printed or digital; forms or tables). Of them, digital table formats were selected because they provide automatic tools and do not require continuous formatting adjustments whenever new fields appear. The glossary was used to control the method's vocabulary. The decision was made to continue using the Microsoft 365 ProPlus Excel® programme because it had yet another advantage: its files are easily transferable to more advanced databases.

Once the method was established, construction began. First, tables were developed separately by this author. Later, significant reformulations were made in collaboration with material team researcher responsible for the remaining codices' codicological analyses. Due to the substantial degree of detail required, the method was simplified by constructing several tables, one for each book constituent category. These categories (which correspond to the codicological tables[13]) followed the ones of the glossary (plus one for gatherings collating data), having been assigned with the correspondent colours. Three additional categories were created. One, already complete, was for general information of identification (inventory number, title, author, previous studies, etc.). Another was for the metric measures of every element. The third was for advanced material analysis techniques and results. Due to issues inherent to the type of information (which prevent the normal application of "Count" formulas and force the search for alternative solutions), it has not yet been possible to conclude the structuring

[13] It is important to recall that the method is a "characterization method" that includes a "codicological" part, an "identification" part, a "material analyses" part and a "measurements" part. Thus, "codicology" is just a specific part (exclusive for records based on observation, codicological analyses and comparison with prototypes) of the whole that is "characterization".

of these tables. Two additional sheets for text and image description and evaluation of conservation condition are still under planning.

All tables follow the general template of Fig.A2-1. The first 3-6 rows present the characterization criteria, while codices are listed by BNP Quota's crescent order in the first column. Thereby each codex has one corresponding row, where it is characterized. Criteria were established according to literature previous examples [115, 121-122] and presential observations of the codices. Bellow criteria rows, there is a very important row coloured in blue. Each of its cells has a formula that counts how many codices in that column correspond to the criteria above. These data will provide researchers with a global view of the collection, aside from codices' individual codicological results in the rows below. In the yellow row are the rules to apply during the characterization and the main white cells are where experimental data is recorded.

Three codices were selected for tables' first filling: Alc. 341 [123], Alc. 413 [124] and Alc. 414 [125]. (Fig.A2-3) These codices belong to a wider group of codices attributed to the copyist *Ioannes Peccator* [23], and several of them conserve a considerable amount of Medieval materials. Alc. 341 is considered to be the closest to its original state, according to Nascimento & Diogo. [23] The pristine state (of at least one codex) was an important requirement in this selection because that codex could serve as a basis for comparison with others and for identification of posterior evolutions. Thus, this codex was also subjected to a broader material study. Alc. 413 and Alc.414 allowed to respond to other necessities, namely that selected codices included i) the diversity of Medieval typologies (Alc. 413 belongs to the white codices) and ii) already altered cases (Alc. 413 and Alc. 414 are considered to have undergone intervention in later Medieval periods [23]). In addition, as part of an established group, where the unifying link is the copyist, it was possible to keep an open door for more ambitious investigations such as the copyist as a bookbinder (which is an issue under discussion as seen before [44-46]).

Codicological tables were filled after presential observations (aided by microtools such as expandable dentist mirror, borescope, and portable lens for mobile phone) of the three case-studies. Collating analysis and comparisons with auxiliary prototypes or digital schemes[14] produced were also performed. (Appx.A2.2.2) Identification table uses the information available at BNP online catalogue. [28] Measurements and advanced material analyses tables were filled with the data acquired in these actions, respectively. For more details on the construction of this method see Appx.A2.2

Constituents examined with advanced techniques include several inks and paints (only for Alc. 341), skin-based materials (parchment, sewing supports, linings, covers, clasp straps), core sewing threads, boards, and metalwork (fastenings, furniture). Table 1 has a complete list of techniques used and materials analysed. A detailed description of procedures adopted for these analyses is given in Appx.A2.2.4 For a more complete characterization of white skin materials it is important to mention the work that is being developed by Faustino, in her masters' thesis also under CISTER.Hor scope. All collected data (either codicological or analytical) was compared among each other and with literature.

3. RESULTS & DISCUSSION

Results presentation and discussion follow practical work's themes. Thus, they include a first part focused on the glossary and a broader second part which consists in an overview of global results achieved through the characterization method. This second part includes a detailed and comparative analysis of individual results (both codicological and analytical) attained for each category of the three case-studies' constituents. These individual results were also compared with literature.

Starting with the glossary, latest version includes 145 terms, the equivalent to ca. 45 A4 pages. Given this extent, full document is presented in Appx.3. Each term was first assigned with a specific category to distinguish between constituents and configurations. Then, a single definition, common synonyms, translations for English, French and Spanish and a schematic figure were added, according

[14] To aid interpretation of more complex structures observed auxiliary prototypes were produced (both physical and digital). Digital schemes were also drawn. For more details on their production see Appx.2.

Table.1. Analyses performed to each codex's materials (codices do not contain the elements that were strikethrough)

Alc. 341	Writing ink	Green paint	Red light paint	Red dark paint	Yellow paint	White paint	Parchment	Core sewing thread	Endbands threads	Cover threads	Sewing supports (thongs)	Wood boards	Adhesives	Linings	Sewn pockets	Cover	Clasp straps	Pulls	~~Open Pin Clasp~~	Pins	Nails	Bosses
DM	•	•	•	•		•	•				•	•		•	•	•	•					
OM								•				•										
SEM												•										
FORS		•	•	•	•*		•*															
EDXRF	•	•	•	•	•*	•	•*															•
HI	•	•	•	•	•*	•	•*															
Col	•	•	•	•	•	•	•															

Alc. 413	Writing Ink	Green Paint	Red Light Paint	Red Dark Paint	Yellow Paint	~~White Paint~~	Parchment	Core Sewing Thread	Endbands Threads	Cover Threads	Sewing Supports (Thongs)	Wood Boards	Adhesives	Linings	Sewn Pockets	Cover	Clasp Straps	Pulls	Open Pin Clasp	Pins	Nails	Bosses
DM							•				•	•		•	•	•	•					
OM								•				•										
SEM												•										
EDXRF																			•			•

Alc. 414	Writing Ink	Green Paint	Red Light Paint	Red Dark Paint	Yellow Paint	~~White Paint~~	Parchment	Core Sewing Thread	Endbands Threads	Cover Threads	Sewing Supports (Thongs)	Wood Boards	Adhesives	Linings	Sewn Pockets	Cover	Clasp Straps	Pulls	~~Open Pin Clasp~~	Pins	Nails	Bosses
DM							•				•	•		•	•	•	•					
OM								•				•										
SEM												•										
EDXRF																						•

*Yellow paints were indeed analysed, but their results were very elusive. Parchment analyses with FORS and EDXRF were to distinguish the paints and inks from the support, not in-depth analyses of the material. Thus, neither the results of the yellow paint and nor the ones of FORS and EDXRF of parchment will be addressed in this dissertation.

to mentioned references. Regarding images two other topics must be stated. First, it was planned to add real photographs to illustrate each term, besides the schemes. However, this was not possible due to lack of time. Second, a significant problem manifested when the glossary was transferred to a format other than Excel (like this dissertation): it lost images' hyperlinks.[15] This was like losing all images since they were not connected in any other way. There are several ways to solve this issue (including by transferring it into a more suitable program). For now, the author simply proposes the addition of legends in the images themselves and their files' names, which must be the same used in hyperlinks. This way it would be possible to minimize the problem in a fast and efficient way, plus maintain the use of a program with which researchers are already familiar.

In digital format, the glossary has yet three other major advantages. First two are related to the way it can be used. As said before it was organized in alphabetic order. Nevertheless, with the colour assignment applied to each term, Excel's Filter tool (Fig.1) allows to group terms (and respective rows) by categories of constituents. (Fig.2) In addition, users can resort to Excel Find tool (Fig.1) to rapidly find any individual term, which reduces time spent in looking for it. Third advantage is related to program's ability to build graphics on data recorded and encoded in numbers. This allows researchers to identify tendencies, like which constituents require a larger number of terms. (Fig.3)

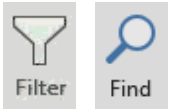

Fig.1. Excel's Filter and Find tools.

[15] To prevent file overloading, images were placed in an external folder and connected to file through hyperlinks.

Termo Term	Categoria Category	Definição [Ref] Definition [Ref]
Oo		
Orifício	Constituinte das pastas	Orifício que atravessa a pasta da capa à contracap secção quadrada ou circular.
Orifício de costura	Constituinte do fólio ou bifólio	Orifícios de formato circular ou fendido, efetuadc permitem a costura.

Termo Term	Categoria Category	Definição [Ref] Definition [Ref]
Esquadria	Tipologias de tratamento das margens das pastas	Talhe em ângulo reto da(s) aresta(s) de um dado caso, das tábuas. [1]
Orifício	Constituinte das pastas	Orifício que atravessa a pasta da capa à contracap secção quadrada ou circular.

Fig.2. Excel's Filter tool application: terms alphabetically order (above); and terms grouped by board related elements (below).

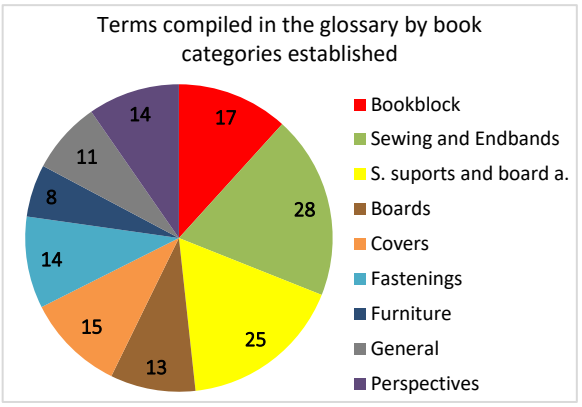

Fig.3. Graphic illustration the distribution of terms compiled in the glossary by book categories.

Nevertheless, glossary's last and most relevant attribute is none of these. It is the way it adapted, very positively, to the characterization method developed. Indeed, it reduces tables' subjectivity and makes them more direct, concrete and concise. It is very specific to early Medieval western bindings, specially to the Alcobaça collection (i.e. for now it does not have enough terms to describe codices with other features) and as seen in Introduction, it does force adaptation in first uses. In any case, by controlling the vocabulary it was possible to standardize the developed method and unify team's language, aside from creating an independent tool that can be consulted at any moment. Therefore, one can say that it fulfils its main goal.

The characterization method is fully presented in Fig.4 (identification and codicological tables) and Appx.4 (table for collating table and ongoing tables for measurements and material analyses).

Regarding the method, it is important to begin by remember that although the codicological tables achieved a final display this is, yet, a very preliminary stage and many aspects are still in progress (like tables for measurements and material analyses, already mentioned). Consequently, the author, does not yet possess a suitably representative number of data, neither to say that global conclusions achieved are entirely trustworthy or authentic (three codices is a very reduced number in a collection with 64 codices that retain Medieval materials, p.2) nor to evaluate the method's full potential. It appears that data record will be fast and easy, and tools incorporated to simplify data analyses will perform their tasks. Nonetheless, three codices are indeed a very reduced number to assure these outcomes.

In any case, even at such preliminary stages, it is possible to foresee some aspects where the method may achieve a good performance. The first is that it is a very dynamic and changeable method. This means that it is very easy and quick to alter it whenever new information appears (without compromise data already registered). Since new observations are made every day this feature provides researchers with a freedom that other methods cannot. It results from Excel's ability to edit data at several degrees (cells, rows/columns or even entire tables or files). So, one can add, change or eliminate row(s)/column(s) or even files at any moment. This is exemplified by the ongoing tables for measurements or material analyses (Appx.4) which production is not affecting any of already constructed tables.

Characterization method also revealed to be very efficient in the fulfilment of its main goal. It does document (at least a part of) codices materiality. Fig.4 illustrates how it successfully and exhaustively documents codices codicological features as was proposed in the Preamble. In quantitative terms this is reinforced by the high number of specific criteria for codicological (more than 300), which reveals an impressive degree of detail. It is certain that the strand for survey of materials used is still under development.[16] Nevertheless, as will be seen ahead, material analyses are already providing important new information on the studied codices, suggesting that with some refinement this strand will be very successful and valuable for the whole method.

[16] One must remember that material analyses tables could not be completed because the author is still looking for an alternative way to record that kind of information in a way that allows the proper use of count formulas.

IDENTIFICAÇÃO

Cota	Data	Tipologia	Título (Link Catálogo BNP)	Autor	Copista	Data de Publicação	Codicologia/ Impaginação	Dimensões	NOTAS	Ligação para Digitalização da	Ligação para Catálogo da BNP	Revisão: Autor	Revisão: Resultado	Obs.
ALC. [n.º]	dd/mm/yyyy	Info. Retirada do catálogo online da BNP									Link	Nome	+/-	[descrever]
ALC. 341	05/02/2019	–	[Expositio in Evangelium Matthei / Godefridus Babio ; copiado por João Pecador] [Manuscrito]	Godefridus Babio, ?-1158 O.S.B.	copiado por João Pecador	[1201-1300]	[129] f. (2 colunas, 36 linhas) : pergaminho, il. color.	399x274 mm	Texto em latim. Estrutura dos cadernos: i-xvi//8, xvii//1. Assinaturas no fim de cada caderno de 8 fólios. Iniciais a vermelho e verde, muitas folheadas a cores. Encadernação da época.	http://purl.pt/24736	http://catalogo.bnportugal.gov.pt/ipac20/ipac.jsp?session=M55499415I5M9.102435&profile=bn&uri=link=3100042~!3808943~!3100024~!3100022&aspect=advanced&menu=search&ri=4&source=~!bnp&term=ALC.+341&index=CALLDD	–	–	–
ALC. 413	06/02/2019	Leccionário	[HOMILIÁRIO / COPIADO POR JOÃO PECADOR] [MANUSCRITO]	–	copiado por João Pecador	[1201-1300]	[2] f, papel, [216], [1] f. (2 colunas, 33 linhas) : pergaminho, il. color.	468x313 mm	Cópia em letra carolina. Texto em latim. Estrutura dos cadernos: i-xxi//8, xxii//3+8, xxiii-xxvii//5. Assinaturas no fim de cada caderno de 8 fólios. Rubricas. Iniciais a vermelho, azul, verde e vermelho escuro, e iniciais folheadas a cores com figuras humanas e animais. Encadernação da época	http://purl.pt/24738	http://catalogo.bnportugal.gov.pt/ipac20/ipac.jsp?session=155793M9798L5.109626&profile=bn&uri=link=3100042~!3809069~!3100024~!3100022&aspect=advanced&menu=search&ri=4&source=~!bnp&term=ALC.+413&index=CALLDD	–	–	–
ALC. 414	07/02/2019	Leccionário	[HOMILIÁRIO / COPIADO POR JOÃO PECADOR] [MANUSCRITO]	Ordonius Cellae Novae, 10 , O.S.B., co-autor; Aldebertus Portuensis, co-autor	copiado por João Pecador	[1201-1300]	[1] f., [2] f. papel, [254], [1] f. (2 colunas, 27 linhas) : pergaminho, il. color.	412x290 mm	Cópia de diversas mãos, em letra carolina. Texto em latim. Estrutura dos cadernos: i//7+8,ii-xxx//8, xxxi//7. Assinaturas no fim de cada caderno de 8 fólios. Rubricas. Iniciais a vermelho, azul, verde e vermelho escuro, e iniciais folheadas a cores com figuras humanas e animais. Encadernação da época. Folha preliminar com texto em português, em letra cursiva do séc. XV . - Tábua do conteúdo, em letra do séc XVIII (3 f.) . - Vita Sancti Rudesindi / Ordonius Cellae Novae (f. 1, 1a coluna-7 v., 2a coluna) . - Epistola Aldeberti ad Samerium Archidiaconum Bracharensem / Aldebertus Portuensis (f. 8, 2a coluna) . - Colecção de Homilias De Sanctis e De commune sanctorum (f. 8 v. 1a coluna-252, 2a coluna) . - Narrativa histórica, em latim, em letra do séc. XV (f. 252 v. 1a coluna-253 v., 2a coluna)	http://purl.pt/24815	http://catalogo.bnportugal.gov.pt/ipac20/ipac.jsp?session=155793M9798L5.109626&profile=bn&uri=link=3100042~!3809070~!3100024~!3100022&aspect=advanced&menu=search&ri=6&source=~!bnp&term=ALC.+414&index=CALLDD	–	–	–

CORPOdoLIVRO

Cota	Data	Suporte de escrita: Fólio	Bifólio	Material: Pergaminho	Papel	OUTRO Qual?	Arranjo: Carne-Pêlo	Carne-Carne	Irregular	Nº de cadernos (não considerar as guardas nem folhas de rosto)	Nº de bifólio (não considerar as guardas nem folhas de rosto)	Nº de fólios TOTAL (não considerar as guardas nem folhas de rosto)	Composição/Estrutura dos cadernos (VER FOLHAdeCOLAÇÃO): binio (2 bifólios)	ternio (3 bifólios)	quaternio (4 bifólios)	quinio (5 bifólios)	sénio (6 bifólios)	Outros (ver folha de colação)	GUARDAS: Tipologia: Simples	Dupla	Plano ANTERIOR: Contra-guarda	Em branco	Escrita	Guarda Volante	Em branco	Escrita	Plano POSTERIOR: Contra-guarda	Em branco	Escrita	Guarda Volante	Em branco	Escrita	Tamanho (relativamente ao corpo do livro): Igual	Maior	Menor	Disposição das contraguarda: Plano Anterior: Sobre todos os virados	Sobre V_{ref} mas sob $V_{ref.}$	Sob todos virados	OUTRO Qual?	Plano Posterior: Sobre todos os virados	Sobre V_{ref} mas sob $V_{ref.}$	Sob todos virados	OUTRO Qual?	Formato: Circular	Fenda	Total	Associados a LIVRO DE COSTURA	Associados a TRANCHEFILA	Associados ao PONTO DE REMATE	OUTRO/Não associados a suporte de costura	Costura dos cadernos passa por todos os orifícios associados a suportes de costura?: Sim	Descrever (se não)	Correspondência entre a costura dos cadernos e o suporte de costura (ver tabela Medidas)	Obs.
3	3	3	3	3	0	-	0	3	0	-	-	-	0	0	3	0	0	-	3	0	2	1	1	1	0	1	3	3	0	2	3	0	3	0	0	1	1	0	-	1	2	0	-	3	0	-	-	-	2	0	3	-	2	-
ALC. [n.º]	dd/mm/aaaa	x/-/?				[descrever]	x/-/?			[n.º]			x/-/?																																														
ALC. 341	05/02/2019	x	x	x	-	-	-	x	-	16	64	129	-	-	x	-	-	x	x	-	x	x	-	-	N.A.	N.A.	x	x	-	x	-	-	x	-	-	-	x	-	-	-	x	-	-	-	-	x	-	7	3	4	x	-	x	-	x	-
ALC. 413	06/02/2019	x	x	x	-	-	-	x	-	28	108	219	-	-	x	-	-	x	x	-	-	N.A.	N.A.	-	N.A.	N.A.	x	x	-	x	-	x	-	-	N.A.	N.A.	-	-	-	x	-	-	-	x	-	8	4	4	x	-	x	-	?	Cólofon atribuído a João Pecador; Pode ter acrescentos textuais (?); Tipologias de iluminuras diferentes (n.º?)
ALC. 414	07/02/2019	x	x	x	-	-	-	x	-	32	125	254	-	-	x	-	-	x	x	-	x	-	x	x	-	x	x	-	x	-	x	-	-	x	-	-	-	x	-	-	-	x	-	-	-	7	5	0	0	-	x	-	x	Cólofon atribuído a João Pecador; Tem acrescentos textuais (guardas plano superior; f.1r-7v; 8r); Tipologias de iluminuras diferentes (n.º?); linhas de regramento com (material n.i.)

COSTURA&TRANCHEFILA

Cota	Data	Fio de costura: Estado	Lacunas	Época: Original	Posterior à encadernação	Material: Linho	Cânhamo	Algodão	OUTRO Qual?	Twist: z	s	Cor: Cru	Castanho	OUTRA Qual?	Tipologia da costura (actual): Suporte Simples [Medieval Manuscripts, 2013]: Costura simples	Costura compacta (voltas adicionais)	Suporte Duplo [Medieval Manuscripts, 2013]: Espinha: Costura simples	Costura compacta (voltas adicionais)	Direita: Costura simples	Costura compacta (voltas adicionais)	OUTRA Qual?	Ordem da costura: Início para fim	Fim para início	Movimento do fio em torno do suporte [Szirmai, 1999]: [a]	[b]	OUTRA Qual?	Tranchefila (actual): Formato: Meia-lua	Enrolado	Outro	Elementos: Suporte de Tranchefila	Requife: Trança	Costura	Lingueta	Reforço da Tranchefila	Reforço (da cobertura)	Esquema (fazer no power point - ESQUEMA TRANCHEFILA) ST - Suporte (de costura) da tranchefila (antigo NT - nervo de tranchefila); R - Requife; L - Lingueta; RT - reforço da tranchefila; RC - Reforço (da cobertura) (antigo RE- reforço da encadernação); (antigo ML - meia-lua - está no RT ou na Lingueta)	Descrição (se necessário)	Obs.
3	3	-	-	1	0	0	0	0	-	1	2	3	0	-	0	0	1	0	0	2	-	1	0	0	0	-	1	1	0	2	1	2	1	1	1	-	-	-
ALC. [n.º]	dd/mm/aaaa	x/-/?				[descrever]				x/-/?			[descrever]		x/-/?						[descrever]	x/-/?			[descrever]		x/-/?										Link para a pasta do códice	[descrever]	[descrever]
ALC. 341	05/02/2019	x	-	x	-	?	?	-	-	x	-	x	-	-	-	-	x	-	-	-	-	x	-	N.O.	N.O.	N.O.	x	-	-	x	x	x	x	x	x	Img.	-	-
ALC. 413	06/02/2019	x	N.O.	?	?	?	?	-	-	-	x	x	-	-	-	-	-	-	-	x	-	N.O.	N.O.	N.O.	N.O.	N.O.	-	x	-	x	-	x	-	-	-	Img.	completar	Tranchefila - sistema enrolado
ALC. 414	07/02/2019	x	-	?	?	?	?	-	-	-	x	x	-	-	-	-	-	-	-	x	-	N.A.	N.A.	N.O.	N.O.	N.O.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-	Tranchefila - inexistente

SUPORT.COSTURA&SIST.ARTICULAÇÃO

Cota	Data	Nº de Suportes de Costura e Tranchefila (TOTAL) Presentes	Função: Suporte de Costura	Suporte de Tranchefila	Material/Formato/Cor: Pele (branca)	OUTRO Qual?	Simples	Duplos	Fendidos	Tamanho da fenda: Igual ao Corpo do Livro nos 2 planos	Maior que o Corpo do Livro no PA	Maior que o Corpo do Livro no PP	OUTRO Qual?	Sistema de Articulação por excedente do SUPORTE de COSTURA e TRANCHEFILA (Empaste) [Nascimento & Diogo, 1984]: Laço de volta inteira	Laço com nó	Sigmático	Semi-sigmático	Variante de semi-sigmático	OUTRO Qual?	Sistema de fixação do Suporte de costura (quando o próprio sistema não garante fixação: sigmático, semi-sigmático e variante de sigmático): Localização na PASTA: Capa	Contra-capa	Localização na CALHA: Término	Meio	Material: Madeira	OUTRO (Qual?)	Forma: Cunha	Cavilha	Obs.
3	3	-	-	-	3	-	0	0	3	1	0	1	-	1	0	0	0	2	-	0	2	2	0	2	-	2	0	-
ALC.[n.º]	dd/mm/aaaa	[n.º]			x/-/?	[descrever]	x/-/?						[descrever]			x/-/?			[descrever]	[descrever]						x/-/?					
ALC. 341	05/02/2019	5	3	2	x	-	-	-	x	-	-	x	-	x	-	-	-	-	-	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-
ALC. 413	06/02/2019	6	4	2	x	-	-	-	x	N.O.	-	N.O.	-	-	-	-	-	x	-	-	x	x	-	x	-	x	-	-
ALC. 414	07/02/2019	5	5	N.A.	x	-	-	-	x	x	-	-	-	-	-	-	-	x	-	-	x	x	-	x	-	x	-	-

Fig.4. Characterization method's identification (first) and codicological (all the others) tables, already filled with the data of the three case-studies (continues in the next page).

PASTAS

Cota	Data	Nº de PASTAS	Estado	Lacunas	Época: Original	Época: Reaproveitado	Época: Posterior à encadernação	Material: Madeira	Material: Cartão	Material: OUTRO Qual?	Marcas de ferramentas nos Planos	Seixas	ARESTAS das Pastas – Formato(s): Esquad.	Formato(s): Bisel.	Formato(s): Bolea.	Formato(s): Remo. Arest.	Diferente nalguma(s)	Que formatos? Quais arestas?	Entrada do SUPORTE de COSTURA na PASTA – TÚNEL: Circular	TÚNEL: Retângular	CALHA de ENTRADA	ORÍFICIOS: N.º TOTAL de Orifícios	Orifício vazio	Orifício de percurso do Suporte de costura: Nº de orifícios por supor. de cost.	Formato: circular	Formato: rectangular	CALHAS – Execução: Mecânico (Cinzel)	Execução: Por queima	N.º calhas por supor. de cost. (contar com a Tranchefila, mas não com a Calha de Entrada) – P. Anterior: Contra-capa	P. Anterior: Capa	P. Posterior: Contra-capa	P. Posterior: Capa	Obs.
3	3	3	3	0	1	2	0	3	0	0	-	2	3	2	2	0	2	-	0	1	2	-	1	-	-	-	3	2	-	-	-	-	-
ALC.[n.º]	dd/mm/aaaa	[n.º]	x/-/?							[descrever]	[descrever]	x/-/?						[descrever]	x/-/?			[n.º]	x/-/?	[n.º]	x/-/?				[n.º]				[descrever]
ALC. 341	05/02/2019	2	x	N.O.	x	-	-	x	-	-	Marcas de ferramentas a quente e de sulcar junto aos entalhes para empaste (visiveis no PP)	-	x	-	-	-	-	-	-	x	N.A.	2	x	1	-	x	x	x	1	1	1?	1?	-
ALC. 413	06/02/2019	2	x	N.O.	-	x	-	x	-	-	Marcas de ferramentas a quente e de sulcar junto aos entalhes para empaste (visiveis no PP)	x	x	x	x	-	x	Biselado nas arestas exteriores (excepto nas arestas da lombada, onde é boleado)	-	-	x	N.O.	-	2	-	x	x	x	1	0	N.O.	N.O.	-
ALC. 414	07/02/2019	2	x	N.O.	-	x	-	x	-	-	Marcas de ferramentas a quente e de sulcar junto aos entalhes para empaste (visiveis no PP)	x	x	x	x	-	x	Biselado nas arestas exteriores (excepto nas arestas da lombada, onde é boleado)	-	-	x	2	-	2	-	x	x	-	1?	0?	1	0?	-

COBERTURA

Cota	Data	Resumo de características à data de produção – Tipologia: Simples	Tipologia: Simples c/ reforços	Tipologia: Dupla	Tipologia: Dupla c/ reforços	Tipologia: OUTRA Qual?	IMAGEM	Cor (coberturas duplas: cor da cobertura exterior): Branca	Cor: Castanha	Cor: OUTRA Qual?	Variantes: Quais?	Características Actualmente – Cobertura Externa (Cobertura simples e dupla): N.º tipos de pele	Lacunas	Cor/Material: Pb	Cor/Material: Pc	Cor/Material: Pe	Cor/Material: Ou	Localização: P	Localização: L	Localização: A	Localização: V_{PA}	Localização: V_{PP}	Corte: Regular	Corte: Irregular	Obs.	Cobertura Interna (Cobertura dupla): N.º tipos de pele	Lacunas	Cor/Material: Pb	Cor/Material: Pc	Cor/Material: Pe	Cor/Material: Ou	Localização: P	Localização: L	Localização: V_{PA}	Localização: V_{PP}	Corte: Regular	Corte: Irregular	Obs.	Reforços: N.º reforços	Lacunas	Cor/Material: Pb	Cor/Material: Pc	Cor/Material: Pe	Cor/Material: Ou	Orientação: HORIZONTAL (paralelo à cabeça/pé)	Orientação: VERTICAL (paralelo à lombada /goteira)	Localização: Preench. PA Parcial	Preench. PA Total	Preench. PP Parcial	Preench. PP Total	Preench. L Parcial	Preench. L Total	V_{PA}	V_{PP}	Corte: Regular	Corte: Irregular	Obs.	Tipo de virado – Cosido: a (cob. ext, Vcoz)	Cosido: b (cob. ext, Vcoz)	Dobrado (cantos): c	Dobrado (cantos): d	Dobrado (cantos): e	Sistemas de fixação dos virados das coberturas: Cosido/ Encaixe	Colado	Pregos/ Cavilhas (inclui Brochos)	OUTROS Quais?	Adesivos (elementos de cobertura colados às pastas, i.e. com residuos observáveis; adicionar nota se os residuos estiverem só numa face): 1	2	3	4	5	6	7	8	9	10	Linha do virado cosido: Igual à da costura	OUTRA Qual?	Decoração e outros – Remate decorativo: Acompanha o limite da cobertura exterior	Presença	Lacunas	Cor/Material: Pele Castanha	Cor/Material: OUTRO Qual?	Cor da costura: Crú	Cor da costura: OUTRO Qual?	Elementos de preensão, etiquetas, lacres: Descrever	IMAGEM	OUTROS Quais?	Obs.
3	3	0	3	0	0	0	-	1	2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	1	1	2	3	3	3	-	0	2	2	1	2	2	1	1	1	1	3	-	2		-	2	-	1	-	-	-	-	-
ALC.[n.º]	dd/mm/aaaa	x/-/?				[descrever]	Link p/ pasta	x/-/?		[descrever]	[descrever]	[n.º]	identificar por números cada elemento												[descrever]	[n.º]	identificar por números cada elemento											[descrever]	[n.º]	identificar por números cada elemento																	[descrever]	identificar por números cada elemento					x/-/?			[descrever]											x/-/?	[descrever]					[descrever]	x/-/?	[descrever]	[descrever]	Link p/ pasta	[descrever]	[descrever]
ALC. 341	05/02/2019	-	x	-	-	-	Img.	-	x	-	Vestigios de pele branca cosida nos cortes da castanha exterior, como prolongamento.	4	1, 2, 3, 4	2, 3, 4	1	-	-	1	1	1, 4	3	2	1, 2, 3, 4	-	-	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	2	-	5, 6	-	-	-	5, 6	-	5, 6	-	5, 6	-	5, 6	-	5, 6	5, 6	5, 6	-	-	2, 3	-	5, 6	5, 6	-	x	x	x	-	-	-	-	-	x	x	N.A.	N.A.	N.A.	N.A.	x	-	x	x	x	x	-	-	Azul	4 Etiquetas de papel coladas: -3 directamente na cobertura ext. (lombada); -1 colada sobre uma das etiquetas	Img.	-	-
ALC. 413	06/02/2019	-	x	-	-	-	Img.	x	-	-	-	2	1	1, 2	-	-	-	1	1	1	2	1	1	2	Aba da goteira com orificios que encaixam nos brochos, ajudando à fixação (dano/original?)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1	-	-	3	-	-	-	3	3	-	3	-	-	3	3	3	-	3	-	2	1	-	-	3	x	x	x	-	-	x	x	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	x	-	x	x	x	x	-	x	-	1 etiqueta colada na lombada, junto ao pé; vestigios de mais 2 etiquetas (embora inexistentes) ao longo da lombada	Img.	-	-
ALC. 414	07/02/2019	-	x	-	-	-	Img.	-	x	-	-	3	1	2	1	-	3	1, 3	3	1	2	1	1, 2, 3	-	2 tem um remendo 3 é uma intervenção posterior	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7	6	6	-	4,5, 7, 8, 9, 10	-	7, 8, 9, 10	4, 5, 6	4, 5, 6, 9	-	6, 9	-	6, 7, 8, 9, 10	-	4, 5, 6	-	7, 8, 9, 10	4, 5, 6	-	2	1	-	-	3, 4, 5, 6,	x	x	x	-	-	x	x	x	x	x	x	x	x	x	x	-	N.A.	N.A.	N.A.	N.A.	-	N.A.	N.A.	5 pregos metálicos , da face exterior, plano posterior; 1 etiqueta colada na lombada, junto ao pé	Img.	-	-

FECHOS

Cota	Data	Tipologia: TÍPICA de Alcobaça	Tipologia: OUTRA Qual?	Nº de fechos	Nº cons-tituintes de cada fecho (ATUAL)	Elementos individuais – ESPIGÃO: Presença	Lacunas	Loca-lização: P.Anterior	Loca-lização: P.Posterior	Cor: Castanho/ cinzento	Cor: OUTRO Qual?	Material: Metal	Material: OUTRO Qual?	ATACA: Presença	Lacunas	Loca-lização: P.Anterior	Loca-lização: P.Posterior	Cor: Branca	Cor: OUTRO Qual?	Material: Pele	Material: OUTRO Qual?	Fixação da ATACA à pasta: Calha na Pasta	Fixação: Elementos auxiliares (Pregos)	Fixação: OUTRO Qual?	Elemento de costura da ATACA à aba: Presença	Lacunas	Cumpre função	Material: Igual à ataca	Material: OUTRO Qual?	Tipo de fixação da PLACA à ATACA: ATACA dá a volta na PLACA e volta para trás	Tipo de fixação: OUTRO Qual?	PLACA de ORIFÍCIO: Presença	Lacunas	Loca-lização: P.Anterior	Loca-lização: P.Posterior	Cor: Castanho/ cinzento	Cor: OUTRO Qual?	Material: Metal	Material: OUTRO Qual?	Formato: Circular	Formato: Rendilhado	Tem argola para puxador?	PUXADOR: Presença	Lacunas	Loca-lização: P.Anterior	Loca-lização: P.Posterior	Cor: Igual à ataca	Cor: OUTRO Qual?	Material: Metal	Material: OUTRO Qual?	Obs.
3	3	3	-	3	0	3	0	0	3	3	-	3	-	3	3	3	0	3	-	3	-	2	2	-	2	2	1	2	-	2	-	1	0	1	0	1	-	1	-	1	1	1	0	0	0	0	0	-	-	-	-
ALC.[n.º]	dd/mm/aaaa	x/-/?	[descrever]	[n.º]		x/-/?					[descrever]	x/-/?	[descrever]	x/-/?					[descrever]	x/-/?	[descrever]	x/-/?		[descrever]	x/-/?				[descrever]	x/-/?	[descrever]	x/-/?					[descrever]	x/-/?	[descrever]	x/-/?								[descrever]	x/-/?	[descrever]	[descrever]
ALC.341	05/02/2019	x	-	2	2 2	x x	- -	- -	x x	x x	- -	x x	- -	x x	x x	x x	- -	x x	- -	x x	Com pergaminho no meio	x x	x x	- -	- -	N.A. N.A.	N.A. N.A.	N.A. N.A.		N.A. N.A.	-	- -	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	- -	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-
ALC.413	06/02/2019	x	-	2	3 3	x x	- -	- -	x x	x x	- -	x x	- -	x x	x -	x x	- -	x x	- -	x x	- -	x? x?	x? x?	- -	x x	x x	- x	x x		- x	Fecho superior composto por duas partes metálicas: uma para fixação à tira (através de pregos metálicos); outra é a placa de orifício	x x	- -	x x	- -	x x	- -	x x	- -	x -	- x	x x	- -	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-
ALC.414	07/02/2019	x	-	2	2 2	x x	- -	- -	x x	x x	- -	x x	- -	x x	x -	x x	- -	x x	- -	x x	- -	x x	x x	- -	- X	N.A. X	N.A. -	N.A. X		N.A. x	-	- -	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	N.A. N.A.	- -	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-

BROCHOS

Cota	Data	IMAGEM	TIPOLOGIA: Brochos	TIPOLOGIA: Tachas	TIPOLOGIA: Brochos&Tachas	Nº de Brochos ou Tachas EXISTENTES	Brochos ou Tachas EM FALTA	Brochos ou Tachas EXTRA	Localização – P. ANTERIOR: 1	2	3	4	5	P. POSTERIOR: 6	7	8	9	10	Estado: Existente sem lacunas	Existente com lacunas	Inexistente	Vestígios	?	N.O.	N.A.	N.º de tipologias	Formato: Circular	Formato: Quadrângular	Formato: Triângular	Formato: OUTRO Qual?	Decoração: Singela	Decoração: Ornamentada	Cor: Castanho/cinzento	Cor: OUTRA Qual?	Material: Metal	Material: OUTRO Qual?	Fixação à Pasta: Pregos que atravessam a pasta e cuja ponta vira na contracapa	Fixação à Pasta: OUTRO Qual?	Pregos: Cabeça redonda	Pregos: Cabeça plana	Pregos: Cabeça em cúpula	Pregos: OUTRO Qual?	Obs.
3	3	-	3	0	0	1	2	0	2	2	3	1	3	2	3	3	3	3	-	-	-	-	-	-	-	-	3	2	0	-	3	2	3	-	3	-	3	-	3	3	2	0	-
ALC.[n.º]	dd/mm/aaaa	Link para a pasta	x/-/?			[n.º]	[n.º]	[n.º]	x/-/?										identificar os brochos							[n.º]	x/-/?			[descrever]	x/-/?			[descrever]	x/-/?	[descrever]	x/-/?	[descrever]	x/-/?			[descrever]	-
ALC. 341	05/02/2019	Img.	x	-	-	10	0	0	x	x	x	x	x	x	x	x	x	x	1 a 10	-	-	-	-	-	-	1	x	-	-	-	x	-	x	-	x	-	x	-	x	x	-	-	Brocho nº5 - falta um prego Brocho Nº 9 - solto
ALC. 413	06/02/2019	Img.	x	-	-	8	2	0	x	-	x	-	x	x	x	x	x	x	3, 5 a 8	1, 9	2, 4	2, 4	-	-	-	3	x	x	-	-	x	x	x	-	x	-	x	-	x	x	x	-	Brocho n.º1 - com lacuna Brocho n.º 9 - solto e com lacuna
ALC. 414	07/02/2019	Img.	x	-	-	7	3	0	-	x	x	-	x	-	x	x	x	x	2, 3, 8 a 10	3, 7	6	6	-	1, 4	-	2	x	x	-	-	x	x	x	-	x	-	x	-	x	x	x	-	Brocho nº3 - falta um prego, solto e com lacuna Brocho Nº 7 - com lacuna

Fig.4. Characterization method's remaining and codicological tables already filled with the data of the three case-studies.

Conversely, method's success increases with its ability to facilitate interpretation and comparison of recorded data (both codicological and analytical) among each codex and with existing literature. This feature that was not mentioned in any of previous examples studied and was another goal expressed in Preamble. It is the author's hope that with a facilitated comparative analysis, researchers will be able to reach global conclusions on the entire collection more easily. So far, as can be seen with the following analysis of each constituent's recorded results (both codicological and analytical), it seems that this was achieved. This analysis was conducted by comparing achieved results with each other and with literature. Nonetheless, it is important to remember (again) that the set of studied codices is very small to reflect the results that may be achieved on a larger scale.

INKS AND PAINTS Following characterization method's order, analysis will start by Alc.341's ink and paints material analyses results[17]. EDXRF ink results revealed the ubiquitous presence of Ca and Fe and with possible traces of Ni, Ti and S in all analysed areas. (Appx.A6.1) Besides Ca and Fe, remaining elements were not identified in consulted literature. [30, 66] For now, the author does not have enough data to propose a reasonable and detailed explanation, other than the fact that examined codices were not the same. Ink's spectra are very similar to the one of parchment; only a variation in Ca and Fe peaks' heights is observable: parchment's spectrum has a higher peak for Ca and a lower one for Fe. Ink's spectra invert. (Fig.A6-1) In any case, the invariable presence of Fe's higher peaks undoubtfully points to the use of an iron gall ink. According to Miguel, the different ratios of counts for Ca/Fe can be elucidative of a carbon-mixed paint (mixture of carbon black pigment with iron gall ink). [66] Oliveira seems to have achieved better results conciliating XRF results with Raman spectroscopy, to identify the carbon-based part of the mixture, in St.ª Cruz collection. [30] This might be a technique to consider for future analyses. Cuevas *et al*. studied another promising method based on the identification of characteristic UV-Vis signals. [126] Tibúrcio *et al.* developed a strontium normalization for the different elements present in the ink, which allowed them to determine variations in vitriol composition, and consequently, the use of different ink batches. [127] This could provide a better understanding of inks used in Alcobaça collection and is yet another experiment to consider.

Alc.341 paint's material analyses point to the presence of a Cu-proteinate green pigment, an HgS light red pigment and a lac dye dark red lake pigment. (Appx.A6-1) Green paints' FORS spectra show an absorption band at ca. 700 nm which can be assigned to d-d transitions in the ligand field of a Cu based pigment. [128-129] There is a strong match between the acquired data and HERCULES Lab's Cu-proteinate standard[18]. (Appx.6-3) These results, plus paints' morphological appearance (glossy and fractured), agree with Miguel's findings regarding a probable Cu-proteinate, which resulted from the complexation of Verdigris pigment (source of Cu) in a proteinaceous binder. [66] FORS spectra for light red paints show sigmoid curves with steep rises near inflection points at ca. 605 nm. Both shape and position of these inflection points indicate an electron transition of semi-conductors (with a middle-gap band) typical in HgS crystalline lattice after light absorption. [128] As for dark red paints, FORS spectra show two reflection bands at ca. 523 nm and ca. 568 nm and a low-slope band with an inflection point at ca. 598 nm. [30, 40, 128-129] These features are suggestive of an organic-red based paint. According to Oliveira these signals may be related with the complexation between laccaic acids (from lac dye) and Al^{3+} (from an alum mordant) which suggest the use of a lac lake pigment. [30, 40] FORS spectra from all paints show characteristic absorption bands in NIR region at ca. 1180 nm, ca. 1518 nm, ca. 1694 nm, ca. 1732 nm and ca. 1944 nm that can be respectively attributed to NH 2ν, NH ν, CH_2 ν_a, CH_2 ns and OH ν + δ vibrations of an egg white binder. [131] Egg yolk/whole egg binders can be safely excluded because of the absence of pronounced vibrations related to the lipid components of these binders (combination bands of stretching and bending of the alkylic groups, overtones of the symmetric and asymmetric stretching of the alkylic groups). When these two binders are left out, egg white is further discriminated

[17] Remember that description of texts and illuminations will not be addressed because correspondent tables are still under planning in collaboration with CISTER.Hor's members responsible for those researches. Also, remember that ink and paint material analyses were only performed to Alc.341 due to time limitations.

[18] Previous comparison with other Medieval Cu-proteinates characterized by means of molecular analyses (like FITR), confirmed the identification of the standards used in our comparison. [66, 130] (Fig. A6-3)

from other protein binders used in illumination (e.g. animal skin glue) for all the identified vibration bands fall in shorter wavelength if compared to other protein binders. The identification of this binder as egg white is only tentative because these absorption bands are not very well expressed and are relatively weak if compared to the vibrations of the parchment ground. [131] Nonetheless, all these findings match the results of previous studies on Alcobaça collection. [30, 66]

EDXRF results also appear to support these observations with the detection of Cu in green paints' spectra and Hg in light red paints' spectra. However, due to equipment's large spot of analysis it appears that spectra were "contaminated" by elements of neighbouring paints. This would explain why Hg and Cu are also present in the green and the red paints' spectra, respectively. It also explains the presence of Pb as a result from a white area in the proximate vicinity of the spot and as part of a lead white pigment. This pigment is very evident in DM photographs. (Appx.A6.1) HI results show that spectra of each coloured pixel (in the mapping images) match the software's reference spectra and the results acquired with FORS equipment. This indicates a generalized and evenly distribution of paints through respective initials studied. Data discussed in this paragraph is presented in Appx.A6.1.

Paint material analyses revealed promising results that are in accordance with consulted literature. Thus, the author concludes that the selected techniques are good indicators of the materials used. However, it could be interesting to develop some of the additional methods discussed for inks further analyses for a deeper characterization also of paints' materials, as all of these pigments and binders were common for long period of time (with the exception of the red dye which according to Oliveira was mostly used in the 12^{th}-13^{th} cs. [30, p.7]). The hypothesis of resorting to other techniques (like handle FTIR) that can better support the results achieved and unravel those elusive materials (e.g. yellow paints), should not be put aside, either.

BOOKBLOCK Following to the bookblock, all the three codices are formed by parchment leaves, arranged hairside to hairside, fleshside to fleshside, etc. Hairside has a yellow colour, while fleshside has a whiter shade. According to Guerra this colour pattern can be a secondary feature for identification of sheep skins. [79] However, macroscopic observations are not enough for a scientific identification (maybe if consistent colorimetric analyses were to be performed, they could provide more solid information). On the other hand, DM analyses were not very conclusive because no follicle patterns were observed. (Appx.6.2) This was not totally unexpected, since parchment production procedures (namely scraping and stretching) damage skin surface so badly, it loses many features (ex: texture and follicle pattern). With these results, the author is not comfortable in identifying the animal origin nor in establishing relations with Guerra's results [43, 79] (even when historical claims point to the same direction[19]) let alone determine relations between possessions of the order (animal flocks, forests, etc.) and materials' sources. Nevertheless, it is important to extend these investigations (preferably with even more advanced techniques) to improve our common understanding of the collection. Some examples to consider are the proteomic methods developed by Fiddyment *et al*. [91] or Kirby [133] which achieved very promising results. Also, Aceto *et al.* [134] made a deeper characterization on parchment production with XRF, that could provide other interesting information on the collection.

Regarding bookblock codicological data, Fig.4 and Appx.4 tables show that leaves are mostly grouped in gatherings of four bifolia similarly to what was done throughout European Medieval collections [135] The regularity in bookblocks' gatherings was also recorded in the collating table of Appx.4. It is possible to see that exceptions to this regularity occur mostly at the beginning or ending of the bookblocks. There are three possible explanations for irregular gatherings: i) end of the text (usually the last gathering is smaller than the others to save materials); and ii) later additions or iii) elimination of folios or bifolios (anywhere in the bookblock). These can be clarified by comparing with data from different elements (ex: textual, illumination or even ink material analyses). Despite no textual analyses were performed, Barreira observations of the illuminated initials indicate the main text of the three codices dates back the beginning of the 13^{th} c. and Alc. 341 shows no evidence of sequence variations. [136] Subsequently, its single last folio (Appx.4) seems to merely correspond to the end of the text and

[19] According to Serrão, the order owned large flocks of sheep. [132]

does not imply binding alterations. Regarding Alc. 413 and Alc. 414, both display evidences of codicological irregularities (Appx.4) that according to Barreira also date from the 13th c. [136] These dates agree with the ones identified by Nascimento. [23, 29] Considering these observations, it would be important to define a methodology for ink and paint analyses (possibly based on suggestions presented before) that conciliates good results (i.e. the identification of variations in composition that could explain these irregularities) with CISTER.Hor time limitations.

As for endleaves, despite their diversity of structures (Appx.4) it seems possible to take some conclusions. It looks like they were composed by folded endleaves, of which one folio was a pastedown and the other a flyleaf. This format was fully observed in left endleaf of Alc. 414[20]. (Appx.4) Since there are no evidences that this endleaf was altered, the author is led to believe that Alc. 341 and Alc. 413[21] ones were more than the pasted down folios with stubs that are currently observable. It seems probable that they were once flyleaves. (Appx.4) To assure veracity and representativity for this statement, more codices must be observed. On the other hand, it is not possible to determine when did the codices suffered these alterations. Moreover, according to Szirmai, in Romanesque period, pastedowns were pasted after covering. [37] In this corpus, only Alc. 414 follows this format; Alc. 341 and Alc. 413 pastedowns are above lining turn-ins and below sewn pockets. (Fig.5) Since Alc. 341 was considered the less intervened [23], this raises some doubts regarding Alcobaça's formats and their chronology: which was the typical format, and which appeared after? Following observations may suggest that in an earlier period the format of Alc. 341 and Alc. 413 was the most common, but once again we do not have enough representativity. On the other hand, all endleaves seem to have been blank[22] and with the same size of the bookblock (Fig.4) (Appx. 4), following reported tendencies. [37, 135]

Fig.5. Beginning endleaves disposition in Alc. 414 (above) and Alc. 341 (below).

Sewing holes at the centre-folds were described as circular.[23] (Figs.4 & 6) This, plus their small size suggest they were done with the needle, during sewing. According to Szirmai, circular holes seem less common in the Continent than in British Isles. [37] Alc. 341 and Alc. 414 have 7 sewing holes each and Alc. 413 has 8[24], which seems to result in an additional sewing station due to codex bigger size (see the paragraph for supports in p.17). (Fig.4)

Fig.6. Circular sewing holes in Alc.414. Note the two holes in the same station at the right.

Holes and stations disposition are symmetrical from head- to-middle and middle-to-tail forming Fig.A5-1's pattern in all codices. These pattern's similarities suggest that, at some point in the past, the three codices followed a common rule for the correspondence between holes and stations. The hypothetical rule is better exemplified by Alc. 341 and Alc. 413, as their metric measurements show a clear correspondence between holes and specific stations. (Appx.4) Alc. 414 is harder to interpret because it has all the evidences of an altered sewing structure, and consequently the correspondence between holes and the specific stations determined is not so clear. However, if one considers that this codex had

[20] Alc. 414 right endleaf is different: two single folios united by guards, making it very hard to explain. (Appx.4)

[21] Alc. 413 only has one endleaf, at the end of the bookblock. It seems likely that it started with two but, at some time during later alterations, beginning endleaf was cut leaving only its stubs behind. Thus, when referring to Alc. 413 endleaf, the author is talking about the one that exists. (Appx.4)

[22] Alc. 414 left endleaf was written with calligraphy that appears to date from later periods. As said, there are no evidences the endleaf is not original; it merely looks like the blank space was seized to record information.

[23] In some cases, there are two holes for the same station (one for thread entering and other for thread exiting) but since they belong to the same station, they were counted as one in the tables. (Figs.4 & 6)

[24] Alc. 413's head and tail holes are very hard to observe because they are so close to the bookblock edge and in many cases, parchment has torn.

a similar structure to the other two, then its observations and measurements also match. (Appx.4) Measurements show that the segments between the head/tail and the outermost sewing stations are in average ca. 23% shorter than the equidistant segments between sewing stations (which are ca. 27% and ca. 21% of the codices' height for the three and four sewing stations codices, respectively). (Appxs.4 & A5.1) These findings differ slightly from those that Szirmai considered most common. [37, p.144] Could they indicate a local rule or a Cistercian tendency? These two shorter segments seem to have four endband stations, two at the head and two at the tail (see Sewing and Endbands); the two innermost seem to overlap with changeover stations (due to the observations of the thread pattern at the centre-folds). The remaining three stations (or four, in the case of Alc. 413) show a complete correspondence between the sewing holes and sewing stations. (Appxs.4 & A5.1) Thread patterns at the centre-folds point to the same direction as these observations. (Fig.A5-2) In fact, despite the difficulties in confirming this theory due to thread similarity and lack of representability, these results suggest the use of separate endbands sewing (except for Alc. 414 which seems to be integral, see Sewing and Endbands). On the contrary, another observation that limits the author's confidence to say this theory was a rule is the fact that changeover stations are covered by endbands' linings in the three codices. This disallowed their observation. Therefore, it was also impossible to determine the type of sewing present.

SEWING AND ENDBANDS As previously seen, sewing stations observations point to separate stations of endbands, thus before presenting and discussing core sewing, let's look at endbands. Material analyses of endbands' constituents (threads, endband cores and linings) were not performed due to their hard access. Contrarily, endbands structures were very hard to interpret but provided some information. Alc. 414 seems to be of what Szirmai calls an integral sewing type (see the next paragraph). (Appx.A5.2) He identified this type mostly on bindings from the Gothic period (see the next paragraph). [37, p.150] Alc. 413 has a typology that appears to correspond with Szirmai's proposal of "wound" endbands on single twisted endband cores (the author found this typology to be slightly less common than the ones with double supports, but still much used). [37, p.160] It also appears similar to Regemorter's description. [86] (Appx.A5.2) Alc. 341 head and tail endbands differ slightly between themselves and have no correspondence with the ones reported in consulted literature. [37, 80, 86] (Appx.5.2) Since Alc. 341 was considered to be the closest the pristine state, and since no similar structures were identified in the literature both its endbands were scrutinized to construct the proposal illustrated in the schemes of Fig.A5-6. Gathered data is insufficient to assure that those schemes are correct or are representative of the collection. Nevertheless, it is important to mention that they were based in the physical prototype (as mentioned in Appx.A2.2.2 will result on an online video) closer to the author's observations. This provides our proposal with a more solid support.

In the three codices, core sewing is supported by split-strap thongs of white leather.[25] (Fig.4) Pattern of thread movement around the support could not be observed in any codex due to their good conservation condition. (Fig.4) Alc. 341 has a structure of the herringbone type, oriented from the first to the last gathering (indicating the sewing direction). (Fig.4) (Appx.A5.3) According to Szirmai and Clarkson herringbone was the most used type of sewing in the "Romanesque" period. [37, 80] Alc. 413 has a straight packed structure (since changeover could not be observed it was impossible to determine sewing direction). (Fig.4) (Appx.A5.3) So far, neither Alc. 341 nor Alc. 413 show evidences of later interventions: text additions are from the same period and sewing structures do not display suggestive irregularities (e.g. empty holes). Thus, in theory, structures of Alc. 413 and Alc. 341 should be similar, if produced under the same conditions. Nevertheless, Szirmai argues that the straight packed sewing slowly replaced the herringbone type in later periods. [37, p.186] Without significant variations in textual dates nor evidences of later interventions, could this suggest that Alc. 413 was sewn after Alc. 341? Or merely under different conditions? Can this be an evidence of a different binder's work? Alc. 414, in its turn was definitely (re-)sewn after the other two. Its similarities with Szirmai's integral sewing[26] point

[25] Only Alc. 341 and Alc. 413 have single supports, but just at the endbands, as seen before.

[26] Alc. 414 has 5 stations and 2 empty sets of holes. (Fig.A5-2) Omitted change-over stations seem to occur at the two outermost stations (which are considered to be the endbands). There, it is possible to observe one single thread running through the centre-

to much later periods. [37, p.151] Additionally, this codex presents a straight packed sewing, in every station, (Appxs.A5.1 & A5.3) which could reinforce the theory that Alc. 413 sewing structure is more recent than the one from Alc. 341; but older than Alc. 414, because Alc. 413 seems to have a sewing separate from its endbands. Is it possible that Alc. 413 binding belongs to an intermediary period between the other two codices? It is hard to say when the picture of the whole collection was not yet achieved.

Sewing threads show some variations between the three codices (but not among different stations like sewing or endbands in the same codex). Alc. 341 has a Z-twist thread while Alc. 413 and Alc. 414 both have S-twisted threads. (Fig.7) This seems to reflect Szirmai findings, according to which Z-twist was slowly replaced by S-twist [37] and is a potentially stronger indicator of the different moments in which the three codices were sewn (first Alc. 341 and later Alc. 413 and Alc. 414). Alc. 341 and Alc. 413 threads look a bit darker and rougher when comparing to Alc. 414 one. Nonetheless, analytical results of Alc. 341 and Alc. 414 core sewing threads point to a similar material of bast fibre nature. OM observations were not enough to distinguish among those that scholars believe were in use in Medieval Europe (flax, hemp, nettle and hop). [137-138] (Appx.A6.3) Thus, doubts arise: were the differently twisted threads made from the same material? If so, are we looking at a continuous use? Or, on the contrary, if they are different can they be used to date different moments? Additional analyses that guarantee a more accurate identification and suit CISTER.Hor time limitations must be proposed and applied. A parallel study on the existing methods for vegetable fibres identification is being carried out by the author, and the findings suggest that FTIR or the drying-twist test may be two efficient options. Serrão mentioned the order owned vast linen crops. [132] Even so, to this author knowledge no historical records confirm this, and archaeobotanical studies for Medieval period have not yet been performed in Portuguese territory. So, the author does not consider this data completely certain.

Fig.7. Alc. 341, Alc. 413 and Alc. 414 sewing threads, respectively. Note how Alc. 341's Z-twist opposes to the other two codices' S-twists.

SEWING SUPPORTS AND BOARD ATTACHMENT The animal origin of the white split-strap leather thongs that support sewing (as usual in this period [37, 80, 86]) could not be identified by DM because hairside was inaccessible for observation. We hope that Faustino work will provide more information both on the identification of the animal origin as well as on the tawing materials used. Nevertheless, other results can be presented and discussed. Thongs showed a relatively regular size within each codex (Appx.4), fitting the range presented by Szirmai (8-20mm). [37, p147] Slight variations were detected when comparing the average values between the three codices. Relations with codex size are hard to establish due to the lack of representability. One could speculate that thongs size increased with codex size in an earlier period but diminished in a more recent one. (Appx.4) However, with the current data this is totally uncertain. More concrete observations regard the slits size, which extend beyond the bookblock width at the side of the right board in Alc. 341. (Fig.A5-8) According to Szirmai, this is suggestive of the sewing direction as here is where sewing should end. It also agrees with our observations (see Sewing and Endbands). It is uncertain that slits' shorter size in Alc. 414 (which are limited to the width of the bookblock) are a relevant feature to distinguish different moments because slits' limits in Alc. 413's right side could not be observed to compare. (Fig.A5-8) In any case, this must be something to take into consideration during future observations of other codices. Moreover, Szirmai did not found any relation between number of supports and codex size. In the case of Alcobaça collection, observations of the case-studies suggest that there might be a pattern resulting from codices size variations: the biggest codex, Alc. 413, is the only one with an additional support. (Fig.4) Once again, these findings lack representability within the scope of the collection.

folds, suggesting that it exits somewhere and enters elsewhere; in the main sewing stations exist two: one exiting and one entering). (Figs.A5-2 & A5-7) These observations agree with Szirmai descriptions of integral sewing. [37]

Board attachment is made through lacing. Identified paths were documented in the tables (Fig.4) and correspond to Nascimento & Diogo's findings. [23] (Appx.A5.4) Moreover, authors' carefully established chronology[27] seems to reinforce suggestions already presented in this work, namely that despite the three codices illumination seems to date back the 13th c. their bindings have different moments: Alc. 341 binding (which seems to be pristine with its herringbone separate sewing and a round lacing) appears to be the oldest, possibly even contemporary with text; Alc. 413 also looks pristine but its straight packed separate sewing and out entering short lacing point it to a following period (thus, its text would be a little latter too); finally Alc. 414, with a straight packed (apparent) integral sewing and out entering short lacing, seems to be the most recent. In addition, it is not possible to determine whether sewing structures are contemporary with the board lacing. Their appearances look like they are (namely for Alc. 341 and Alc. 414, which structures' features point in this direction). Alc. 413 is more intriguing because its sewing seems to be a transition between the other two, which leads to the speculation that this is either i) a later board or ii) the result of the different evolutions that each specific system (sewing, lacing, etc.) suffered. In other words, could it be that while sewing structures were still evolving, the more recent board lacing system had already been established? It is important to highlight again that these hypotheses are merely speculatively, since they lack comparative and representative remarks. On the other hand, it seems rather odd that so different systems co-existed in the same period (although it cannot be excluded the presence of different binders that followed different methods).

BOARDS Lacing is done through holes, tunnels and channels in wooden boards, following European tendencies. [37, 80, 86] Besides helping identify the board attachment systems (each system has a typical disposition), these carves also show very interesting evidences of the use of heated tools (dark burnt areas around the holes) as has happened in other European cases. [37, 80] (Fig.A5-8) Carves' measurements show that they form regular disposition patterns at boards' inner faces, with channels equidistant to the spine edge and homogeneous size for each codex. (Appx.4) This matches Szirmai's most common findings. [37] It might be interesting to determine if there is any relation between the boards sizes and i) the carves sizes and ii) their distances. This could help create schemes like those made for sewing (Appx.A5.1) and is something that is being planned for measurements table.

General wood boards' features follow the tendencies of previous observations. Alc. 341 boards are of the same size as the bookblock (no squares), all the edges have a square profile (Fig.4 & 8) and their thicknesses matches the most common values identified by Szirmai (10-13mm). [37] (Appx.4) These are all features typical of bindings of receded periods. [23, 37, 86] Alc. 413 is less obvious, since the boards were re-used after they served on a codex with what appears to have

Fig.8. Boards features: squares and edges profiles of the three case studies. First image shows that Alc. 341 does not have squares and board's edges are square. The images below show that Alc. 413 and Alc. 414 have squares and the two images on the right show that the same two codices have bevelled outer edges (except the one from the spine, which is round, black curve).

[27] According to Nascimento & Diogo and Szirmai round lacing path was typical from Alcobaça. [23, 37] It evolved from a peninsular format designated by "knot lacing" and progressed to the long lacing with two variants. [23] Nascimento and Diogo reported only two cases of short lacing indicating a brief occurrence of this type in the scriptorium or even territory. This is in accordance with Szirmai and Clarkson observations: throughout Europe the most common systems were the long and short lacing paths (the last virtually only used in England). [37, 80] Ultimately, the long lacing variants were replaced by a system that according to Nascimento & Diogo] and Szirmai appeared much later (already in the 14th c.): it is similar to the short lacing but enters throughout the outer faces of the boards (rather than through their thicknesses). [23, 37] Regemorter descriptions seem to fit these features. [84] If so, this could raise more questions like, could this system came from a French model?

been a long lacing path (typical of previous times, as seen before). [23] (Appx.A5.4) In fact, it appears that Alc. 413's boards conjugate features of two different periods[28]: they are very thick but also have squares, bevelled profiles at the edges on boards' outer faces (except for the spine ones which are round) and carves for a later lacing path (all features of later times). [37] (Fig.4 & 8) (Appx.A5.4) None of these features clarify the doubts presented before; they do not point to any direction on if the boards are contemporary with the lacing system or not, because the fact that they were re-used does not mean that they were (or not) the original ones applied in the current codex. Alc. 414 has these same features (squares, bevel and round profiles at the outer edges and at the spines' edges (respectively) and carves of a later lacing path) typical of later periods, which reinforces the previously suggested theory. (Fig.4 & 8) (Appx.A5.4)

Boards' material analyses revealed structures characteristic of two different genera: Alc. 341 and Alc. 414 showed many indicators of a *Castanea spp*. genus, while Alc. 413 looks more like *Fagus* genus. Results acquired are presented and further discussed in Appx.A6.4. According to Szirmai and Clarkson [37, 80], English bindings were almost invariably made of oak, but in the continent were more diverse and included both genera mentioned. [37] Oak, chestnut and alder have been mentioned in the Portuguese context [23, 154] thus, *Castanea* (chestnut) is in agreement, but *Fagus* (beech) is a rather unexpected result. What are the meanings of these findings? Do they indicate that material selection was arbitrary? Why Alc. 413's genus is different? Could wood dating (e.g. dendrochronology) be of help? Doubts remain, but the followed methodology revealed positive results in the identification of these materials; so positive it seems appropriate for analyses of other codices in the collection.

COVERS Regarding covering materials, the three codices have only a single cover and at least one board lining (all linings were carefully documented in the tables with the aid of digital prototypes). (Fig.4) (Appx.A5.5) Linings appear to be ordinary in this period [37, 80] but it is hard to establish patterns and functions, since their formats vary greatly (between the three codices under study and when comparing to Szirmai's records [37]). Alc. 341 is the only one that has two horizontal linings (running one at the head and other at the tail, from one board to the other). The other two codices have at least one vertical lining, that covers each codex spine area from head to tail.[29] (Appx.A5.5) Turn-ins and their corners were only observed in the linings, but they were not very elucidative as well; some turn-ins were very regularly cut while others were not, and only Alc. 341's has corners which appear to have been sewn together or pasted to the boards with a mitred shape. (Fig.A5-10) Their sizes also vary greatly. (Appx.4)

The covers, instead, have cover extensions (throughout the head and tail, and at the fore-edge of the left side board) and sewn pockets[30,31] (at both fore-edges of boards' inner faces) forming structures similar to those reported in studies of English bindings, in the three codices. [37, 80] (Fig.A5-11) Similar indeed because unlike those none of the three codices in study has a double cover. Regermoter had come across with "incomplete" primary covers, on a French Cistercian abbey, saying about them that they were "practical and solid, without any pretension of beauty and even denouncing an economy of resources". [86, p.99] It is hard to say if Alcobaça followed this tendency because in the three codices observed none of the linings resembles a primary cover (apart from Alc. 413) and none of the three has any complete primary cover (even though they have been mentioned before [23]). On the other hand, it seems possible that Alc. 341 white leather cover extensions sewn to the brown main cover, its right side added sewn pocket or the patch in Alc. 414 sewn pocket (Fig.4 & A5-11) are indicators of a resource saving policy that justifies the suggested "economy of resources". (Fig.A5-11) Cover extensions' measures are also hard to interpret since i) only Alc. 341 and Alc. 413's head extensions can be

[28] Board attachment systems suggest three different periods which helped establish Nascimento & Diogo's chronology. [23] However, metric measurements of the previous systems show no direct relation with the current sewing stations, indicating that the boards belonged to yet another larger codex.

[29] Alc. 413 has only one lining that almost looks like a primary cover (but is not since it does not cover the boards entirely); Alc. 414 has several linings (with different formats and placed throughout different areas of the book) which were thoroughly recorded in the tables. (Fig.4) (Appx.A5)

[30] Left side pockets are always made with an additional white leather; while right side ones are usually made of the prolonged cover leather (that is not used as a cover extension as happens in the left side).

[31] Used threads appear similar to the sewing ones, but due to time limitations they were not deeply addressed.

compared and ii) only Alc. 413 has enough cover extensions to perceive their total dimension in all sides; Alc. 341 and Alc. 414 have only one or none cover extension complete. Alc. 341 and Alc. 413 head extensions' height matches bookbinding literature, as they are not very long (ca. 10% of each codex's height). [80, 86] A more curious observation notes that Alc. 413 tail's cover extension is much higher than the one at the head (Appx.4). However, it was not possible to explain this for now. Sewn pockets' measures also differed considerably (Appx.4) and no rule could be established, yet.

Although not analysed with advanced techniques remains of adhesive materials were observed, mainly at boards' inner faces, usually associated with linings or endleaves. The absence of residues at the outer faces along with the successful attempt to introduce a thin spatula in-between the covers and the boards suggest that the firsts were not adhered to the seconds. (Fig.A5-10) Adhesives residues were not observed at the spines (between cover and gatherings folds), which suggests loose back coverings.

Three other relevant cover features are i) the interesting colour variety: white or brown (Fig.4 & A2-3), which was already mentioned in the literature regarding other European cases [37] but could not yet be fully explained; ii) the square spine profile which according to Clarkson is the result of the board attachment systems used [80], iii) and the finishing strap of leather (of inverse colour to the main leather) sewn all-over the edges of the cover extensions, with a blue or white thread, which seems to have finishing and decorative functions (and was also previously reported by Clarkson). [80] (Fig.A5-11)

Despite the diversity of structures observed at cover level, none of them helps dating different moments (like how it happened for example with sewing structures). One can speculate that the change of horizontal linings to vertical spine linings can correspond to an evolution (since Alc. 413 and Alc. 414, according to previous observations seem to be of later periods) or that cover extensions' longer lengths can be indicators of later periods [80]. However main cover features observed seem to point to the maintenance of the same production at least throughout the different moments of these three codices.

Identification of these materials' animal origin was more promising than the previous skin-based ones since variable follicle patterns were observed, indeed. However, their observations were not entirely effective because i) it was very hard to distinguish those patterns that look more alike, without the orientation of an experienced and specialized professional (as had happened in wood identification) and ii) the leathers were very damaged. Observed patterns suggest the uncertain use of sheep, cow or even pig skins, without any clear pattern throughout the different elements. (Appx.A6.5) These animals match the ones reported in the literature. [37, 80] Nevertheless, to guaranty more accurate and absolute identification, the author reinforces the proposal to develop the use of other methods like the proteomics' ones mentioned before.

FASTENINGS In the observed codices, although fastenings are mostly incomplete (Fig.4), their traces seem to point (just like covers) to an unvarying production system that lasted (at least) during these three codices' production. In fact, the surviving traces point to some common characteristics between themselves and among bookbinding literature. [37, 80, 86] Observed features indicate that Alcobaça codices had two fastenings[32] (distanced ca. 20% of the spine height to the head and to the tail, respectively), each one composed by 4 elements (a clasp strap, an open pin clasp plate, a pin and a pull). (Fig. 4) (Apxx.A5.6) Every element was fully described in the tables (Fig.4) with the help of the glossary (Appx.3) since these were some of the elements that did not had direct translations and definitions. Observations indicate that long straps were nailed in channels located at left boards' outer faces, close to the fore-edges and exited through a slit in the sewn pocket. (Apxx.A5.6) Alc. 413's observations indicate that the straps (ca. 3 cm height) were folded and neatly sewn around the metallic hinge of the open pin clasp, sometimes with a parchment remnant in-between the two layers (as is the case of Alc. 341). (Apxx.A5.6) They were also tacketed to the fore-edge cover extension. (Apxx.A5.6) Alc. 341 and Alc. 414 straps vestiges observed agree with these observations. This system of long folded straps attached to channels in the left board was only reported so thoroughly by Szirmai. [37] Clarkson mentions some common features [80] but Regemorter is very synthetic in her descriptions because

[32] Clarkson reports only one, Szirmai is not very clear and Regemorter reports two. [37, 80, 86]

those elements were lost in the codices she studied. Again, the animal origin of the (tawed) skin strap could not be identified due to difficulties in observing the follicle patterns.

Only Alc. 413 has open pin clasp plates and they are different from one another: one is plain round and the other shows a kind of intertwist vegetable decoration. (Fig.4) Their shapes look like some of the ones studied by Howsam, which she dates: the first (round) from ca. 12th-13th cs. and the last (decorated) from ca. 13th-15th cs. [83] No other consulted references showed similar designs. Important to say that it is doubtful that the upper clasp is the original one, since the strap was cut and (even with a different mechanism of attachment that should extend the strap, i.e. a hinged plate secured by two nails sandwiches the strap) the current clasp does not reach the pin. The lower clasp also does not reach the pin entirely, but since the straps is intact there is nothing suggesting it is not original. (Fig.A5.13) In fact, it seems possible that it points to another example of the resources saving policies. On the other side, could it be that this clasp (apparently from a later period) was the original one while the upper round one (apparently from an earlier period) was in fact a later addition that copied the original? If so, this could reinforce the theory that Alc. 413 was bound after Alc. 341. Clasps material analyses revealed that the compositions of upper clasp's two constituents are different from the other metallic constituents. Besides all the other elements identified (Cu, Sn, Pb, and traces of Fe and Ti) we also detected Zn and traces of As in the hinge and the clasp, respectively. (Appx.A6-6) This is highly suggestive of a different production (potentially even a later one). However, to say so, a deeper characterization of these elements (like the ones performed by Githinji) is required. [139] In any case all results acquired for the clasps composition agree with bookbinding literature as they are a Cu based alloy. [23, 37, 80, 86]

The pins ubiquitous in all the case-studies, have a very simple cylindrical shape (similar to those reported by Howsam [83]) and are always placed ca. 10 cm away from each codex's head/tail. The distance to the fore-edge varies a bit more. Their elementary composition could not be analysed because they were too small for equipment's area of analysis. As for the pulls none survived; they only were included in this method because previous studies have reported them. [23, 37, 80] Regarding the fastenings one must also mention Alc. 413's holes on the fore-edge cover extension, in the area correspondent to the bosses. It is uncertain if this was original or the result of abrasion/latter intervention.

FURNITURE (BOSSES AND OTHERS) No other metallic elements were observed besides protective bosses and nails. As Szirmai said, to discuss these elements one must be very careful because we never know when they were added. [37] Regarding the ones observed, despite having the common disposition (4 to each corner and a central one) they present some diversity as at least 3 different typologies were observed. All the 24 bosses have the typical domed shapes reported by Szirmai and Howsam. [37, 83] (Appx.A5.7) 16 of them match the most common typology identified by Howsam, which main characteristics are flange's circular shape, which is riveted with three nails through the covering materials to the boards and the plain decoration (some bosses have concentric circles either on the dome or on the flange). [83] (Fig.A5-14) All bosses of Alc. 341 belong to this format, which Howsam dated between the 12th-16th cs. [83] 8 bosses in Alc. 413 and Alc. 414 have another format marked by a squarer shape of the flange (riveted by four nails, not three) and intricate decoration which was not matched in any of the consulted references.[33] (Fig.A5-14) Most of these bosses are oriented as squares, except for two which are tilted; one is even oriented as a diamond. (Fig.A2-3) This information is not enough to achieve accurate conclusions about these constituents thought it looks like the circular format is the eldest and square format the youngest. This once again, is in accordance with our theory that Alc. 413 and Alc. 414 were bound after Alc. 341. However, they are very weak arguments when compared to other previous observations (like sewing structures or board attachment systems).

Material analyses revealed mostly a common elementary composition. Cu, Sn, Pb and traces of Fe and Ti were ubiquitous in the spectra of all measured bosses. Only one boss in Alc. 413 also revealed traces of As and another boss in Alc. 414 showed a very low peak for Sn. (Appx.A6.6) It is hard to explain these inconsistencies because they are not entirely associated with any specific format. Thus, the author reinforces the previous propose of performing additional analyses for a deeper characterization.

[33] Two of Alc. 413's bosses are even slightly different, i.e. simpler in their decoration and oriented as squares. (Fig.A2-3 & A5-14)

Other metallic book constituents were the nails used to rivet the bosses. They usually have a circular head, plain or domed, with 0,3-0,8 cm of diameter. (Fig.4 & A5-14, Appx.4) Like fastenings' pins, nails are too small for the XRF equipment's area of analysis. Thus, they too were not analysed. Alc. 414 has 5 nails similar to the ones of the bosses, riveted to the right board's outer face, near the tail. Alc. 413 has holes in the same location and disposition. (Fig. A5-15) Some of the consulted works, like the ones from Nascimento & Diogo, Szirmai, Clarkson or Regemorter reported a tag with the title was frequently applied in this area. Could it be the case of Alcobaça? It is hard to say so when no tag was observed in these case-studies and Alc. 341 has no evidence of it.

After concluding this detailed analysis, one has a better notion of the characterization method's potential. These results show that all the three codices have similarities as well as differences in smaller details, but more importantly, the author and CISTER.Hor's researchers can now identify which constituents appear to be more suggestive of different moments or even variations in the bindings production system. These constituents are presented on Table 2 and their observations show variations in each codex. When comparing their observations with literature, the variations appear to correspond to different moments, indicating that codices were not bound all at the same time. In fact, with the results of these "most suggestive" constituents the author was even able to propose a hypothetical chronology, illustrated in Fig.9.

Table.2. Elements which appear to be the "most suggestive" in dating studies of Alcobaça collection. * indicate those "suggestive" elements which have a stronger (**) or weaker (no *) potential to become a "most suggestive". Note that in-depth analyses of text and illuminations were not performed, but it is known that they can provide strong evidences that help dating these codices

Most suggestive	Suggestive
Text	Ink*
Illuminations	Paints*
Sewing holes & stations	Parchment
Endbands	Bookblock*
Sewing structures	Endleaves*
Sewing threads	Sewing supports*
Board a. systems	Covers**
Boards	Fastenings*
	Furniture*

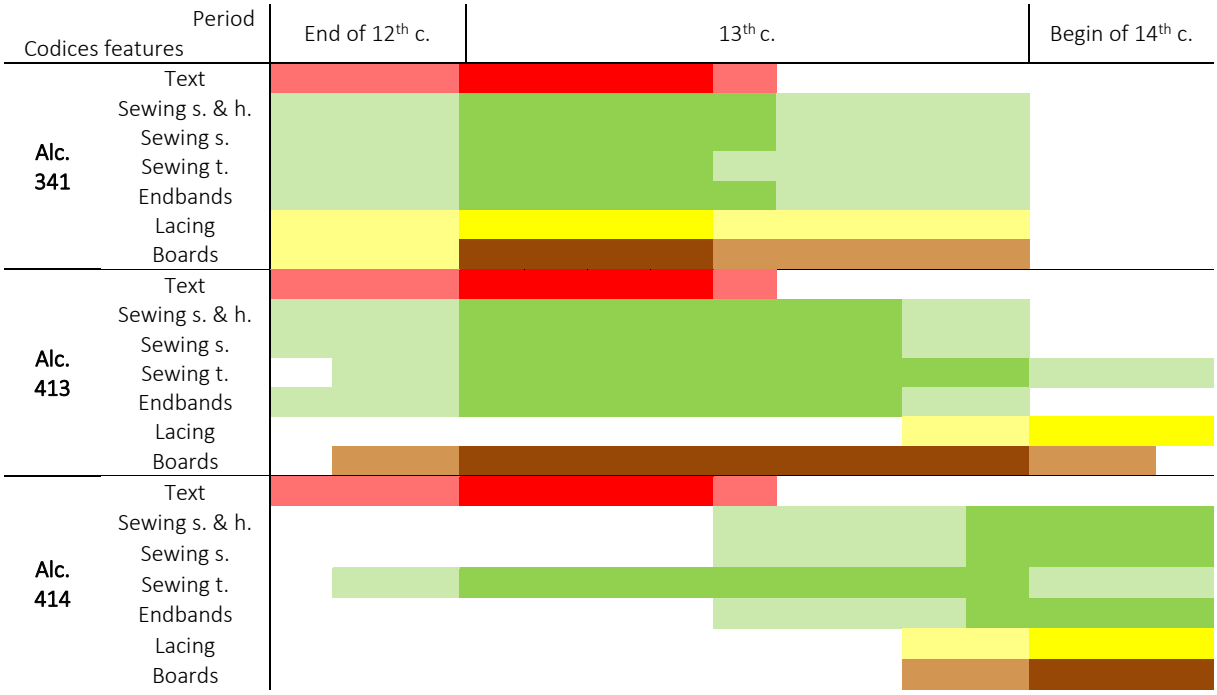

Fig.9. Proposed chronology, based on most suggestive features of studied codices, compared with consulted literature. [23,37, 80, 86] Colours match glossary and characterization method. Lighter shades represent an error margin. Proposed dates are very relative and subjective thus, they cover so broad periods. Note how Alc. 341 features match so well those reported for the 13th c., while some features of Alc. 413 and most in Alc. 414 point to more recent periods.

Summarizing, Barreira preliminary textual and illuminations observations indicated that the three codices main text dates from the beginning of the 13th c. [136] Thus, in relation to the current existing codices, none of the other elements should date before this period. Collating irregularities did not allow to take further conclusions. (see Bookblock) Based on the author's observations, it appears that Alc. 341 and Alc. 413 bindings are both original. Assuming this, then the features of sewing and endbands structures, sewing threads, board attachment systems, cover extensions and even bosses seem to indicate that Alc. 413 was bound after Alc. 341 in the 13th c. It is true that some constituents' observations were more solid than others (Table 2) but it is undeniable that these are too many features pointing into the same direction. Alc. 414, on its turn, shows strong signs of a much posterior re-binding (e.g. two rows of empty sewing holes, integral sewing, etc.); hence it is not possible to propose a more specific date to its text by relation with its binding. On the other hand, several of its structures (sewing, endbands, sewing threads, lacing and boards) suggest its binding is the most recent of the three codices, almost transitioning to the 14th c.[34] [23, 37, 80, 86] Bookblock, endleaves, cover materials, fastenings and furniture features revealed to be weak elements for indication of distinct moments because they did not suffered great variations or the consulted literature could not provide enough information to support further conclusions. Thus, this does not mean that they should not be recorded and analysed. On the contrary, it is important to determine in each of them if observed uniformity relates to the remaining collection and what is its meaning. Does it mean that while the other elements were evolving (as proposed) these did not suffer so great alterations? Can this be confirmed? If so, for how long did they persist? And more importantly, is it possible to construct a history of the collection based on the individual biographies of each codex?

Graphics constructed with "Count" formulas suggest this might be possible, as they can provide a global view of the collection. (Fig.10) These very positive accomplishments of the method suggest it can be used to study and achieve global conclusions on the entire collection and not only on individual codices (as was one of the author's hopes).

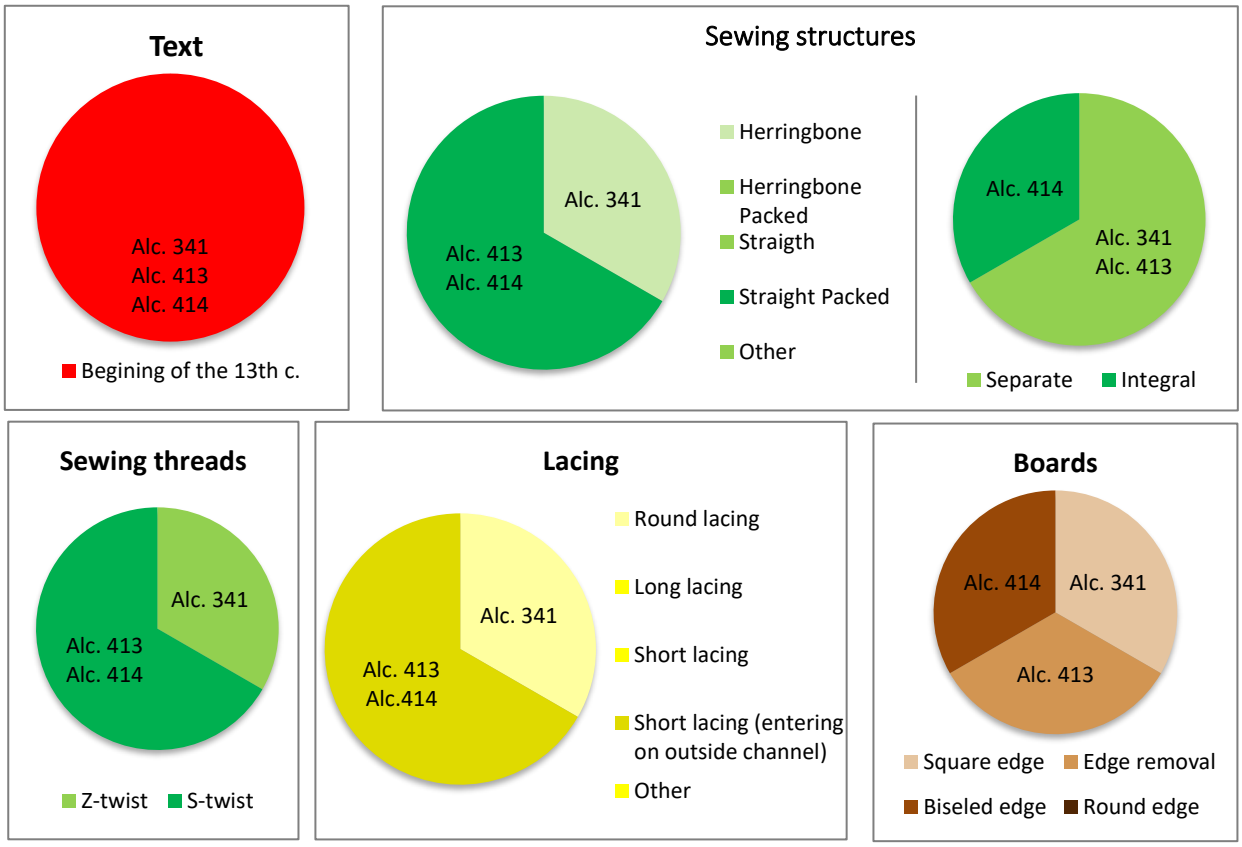

Fig.10. Examples of resulting graphics extracted from tables "count" formulas, for the three codices. Colours match glossary and tables.

[34] Its dating distance to Alc. 413 is less certain, because they have different sewing structures but similar lacing paths.

The detailed comparative analysis performed in this chapter also allowed to determine which advanced material analyses methodologies proved more efficient. To perform this evaluation, one must consider attained results, its contributions to collection knowledge improvement, easiness and accessibility of the applied methodology and time spent during analyses.

Taking these criteria into consideration, three methodologies adopted for identification stood out: paints, wood boards[35] and metallic elements. Acquired results allowed to identify pigments and binders, wood genera and metal alloy, in the respective materials. Some results matched consulted literature's findings, but others were completely new discoveries, reinforcing the relevance of performing material analyses. In any case these new important findings require further comparison with analyses of remaining codices to determine their impact on common knowledge regarding the collection. On the other hand, they evidence some limitations regarding accessibility since they require a strategic collaboration with partner Institutions. Again, it is hard to determine how this affect the number of exams that can be performed, since three codices are not representative enough to take such certain conclusions. The good results achieved with these methodologies do not mean that additional proposals cannot be made; on the contrary they encourage the consideration of further studies like dendrochronology for wood materials' dating, or pigments, binders and metals deeper characterizations, for a more precise understanding of their nature and variances in formulations.

On the opposite side, methodology adopted for skin-based materials proved to be the less effective of all. Observations of follicle patterns were very elusive for parchment and sewing supports and even when they were sporadically made in covering materials, they were not conclusive. Besides these reduced observations in part due to the poor physical condition of leathers' surfaces, it was also very hard to attribute the patterns to a single genus. As in wood analyses, it would have been essential to have the support of an expert on this subject or implementing more specific analyses. Literature on identification of these materials reports efficient methodologies based for example on proteomic analyses. Although planned within CISTER.Hor, it was not possible to perform those during this dissertation's period, but this is a most important future suggestion for this type of materials.

Inks and sewing threads analyses achieved median results. They did point to potential identifications (iron gall ink and linen threads). However, these analyses lack the strength of paints, wood or metals analyses, since complementary techniques were not used and those which were used do not provide results that can be considered absolute (specially microscopy). Moreover, additional analyses for a broader characterization that would allow the detection of variations in formulations appear to be even more relevant in these materials. It seems that this would be crucial information to establish clearer understandings of the monastic production systems.

Now that the techniques that attained better results were determined, investigators can focus on improving the ones that were weaker.

In short, the developed characterization method still requires some enhancements: some tables must be concluded, some advanced techniques must be further developed or even replaced for other more efficient and it requires a broader range of analysed codices to express representativity. Nevertheless, at such preliminary stages, it already achieved important results by allowing investigators to performed detailed analyses that lead to global conclusions on the entire collection (proposed chronology) and the method itself (determination of material analyses that provided better results).

4. CONCLUSIONS

This dissertation aimed at constructing the first draft of a characterization method that included i) an exhaustive codicological analysis of every book constituent and its structures; ii) a pilot survey of the materials used, identified through advanced analyses. The method would also allow researchers not only to document every aspect related with codices materiality, but also to interpret and compare collected data with literature. At its end, it seems safe to say that this goal was successfully achieved.

[35] Important to mention that given the nature of the analyses wood results can never be absolute. However, the combination of three complementary techniques helps support and strengthen each individual finding and reduces error probability.

Multiple questions raised in the Introduction – regarding Cistercian uniformity, Alcobaça *scriptorium* place and work conditions, and relationship between Alcobaça collection materials and other national and international counterparts – cannot, for now, be completely answered. To do that, a greater global knowledge of the collection (one that investigators do not possess yet and that can only be achieved with a higher representativity) is still required. From the very beginning of this dissertation it was clear that its aim was the conception of the method hereby presented, not answering to all these important research questions. Document the entire collection and achieve these answers are CISTER.Hor goals; not of this dissertation. Naturally, with only three codices selected, one can never consider them as a representative sample for a collection comprised by 64 codices that retain Medieval materials and 459 codices in its totality.

Nevertheless, several gaps in Portuguese and European frameworks for bindings study were directly addresses. These included the glossary compilation based on forefront references used in vocabulary control of a characterization method; the study of codices that at first sight may be considered simpler (when in reality and as seen before they represent a broad and most important community in western European History); the construction of a material characterization method according to most relevant recommendations at the present; and the material analyses of binding materials which were for the first time compared directly with the codicological data and both results were included in the characterization method. These were also the most relevant feats achieved.

To put it into perspective, performed tasks can be summarized into the next 8 topics:

1. A complete survey of Alcobaça codices made available at BNP online catalogue;
2. A general comparison with Portuguese and (surveyed) French equivalent collections;
3. An assessment of the significance of such relevant collection in Portuguese and European framework;
4. A complete review of the literature regarding Alcobaça collection and on the national and international backgrounds of bookbinding material codicological and advanced analyses, as well as its main challenges as a discipline;
5. The construction of a multilingual glossary supported by graphic representations that assure a clearer understanding of definitions;
6. The selection of a characterization method and construction of 11 material characterization tables conceived for bindings from Alcobaça but which can be adapted to other western Medieval monastic bindings, especially Cistercian ones;
7. The tables filling with three first codices (which were also used to test proposed advanced analyses methodologies);
8. A meticulous comparative analysis of codicological structures and attained analytical results, within the three selected codices and related literature, which culminated in a global preliminary evaluation of the developed method.

Given these feats, one can say that through a combined codicological and analytical analyses the author was able to build an archaeological biography of the case-studies, and thus provide researchers with new tools (that include new suggestions for constituents and materials interpretation) they can resort to when studying Alcobaça collection materiality. This was important for CISTER.Hor's members and eventually for the entire scientific community, as it is intended to be disseminated through it.

With these good achievements, most relevant considerations for future work are related to the continuous improvement of the developed method. Some measures include the conclusion of those aspects that could not be solved during the time of this dissertation (mainly the image related problems of the glossary and the under development tables of the method), the establishment of efficient and concrete analytical methodologies for those that got less positive results (especially for skin-based materials) and the achievement of more representative results with a higher number of analysed cases. These aspects will certainly be addressed along CISTER.Hor project. Thus, author further proposes a closer partnership with, e.g. the *Ligatus* team, to assure a better relation between the glossary's translations, as well as the hypothesis of transferring it into an online resource so it can become accessible to a wider range of researchers. Transfer to an online resource is something that the team also intends for the characterization method and that the author here reinforces, plus doing so

according to the CRM's guidelines and adding other areas (such as historical, textual and illumination) information.

The last remark goes to the topic with which the author began this dissertation: documentation. Throughout this dissertation I always felt it was a challenge to attain a balance between the most thorough Documentation and the limited time these projects usually have. Just like in any other task in Conservation, researchers must face the hard duty of choosing between relevant actions, in this case, which information would be more relevant for Alcobaça collection's documentation. At the moment of this dissertation's end, I cannot help but think that we achieved the goals to which we proposed in the beginning, making our decisions as broad as possible and assuring a most complete material characterization we could, within all the limitations we faced.

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APPENDIX.1. The codices of Alcobaça collection in numbers

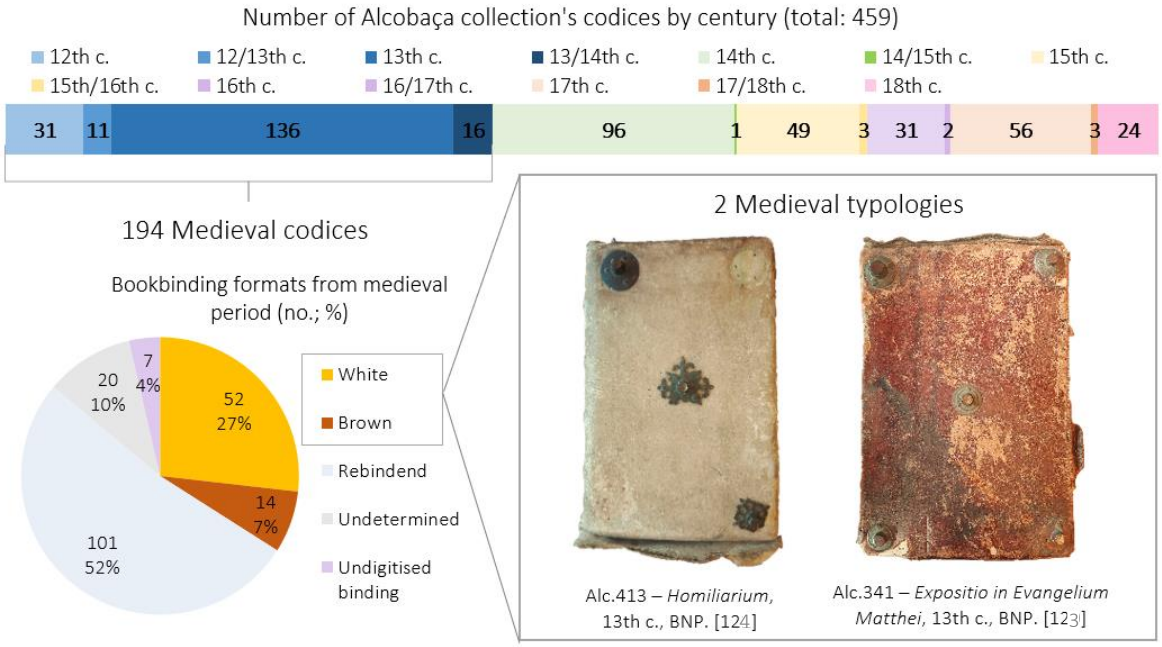


Fig.A1-1. Graphics illustrating Alcobaça collection, by century (above), and Medieval typologies (bellow, with exemplifying cases on the right), according to the personal count of BNP online catalogue.[5 (see p.2)] [28]

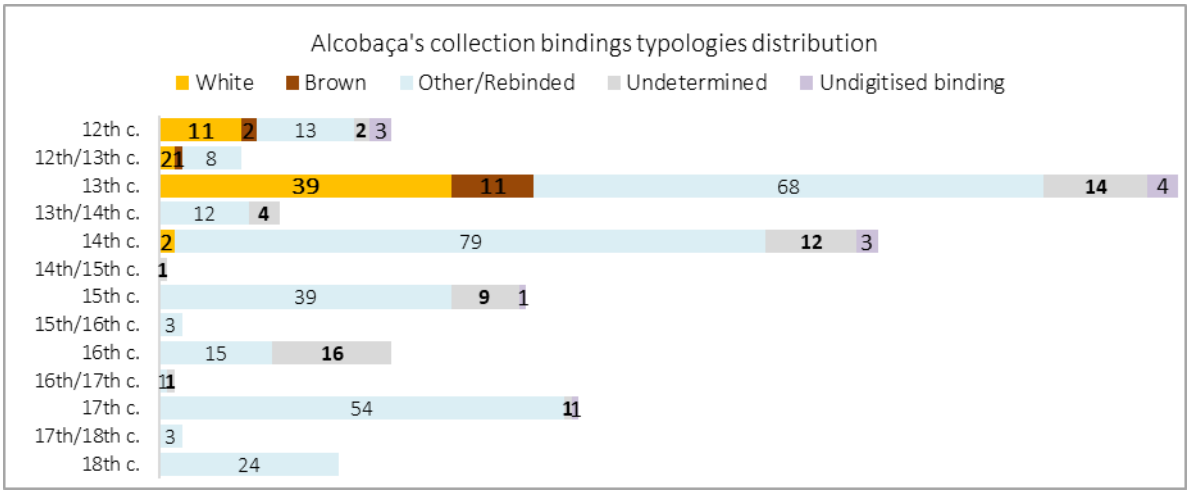
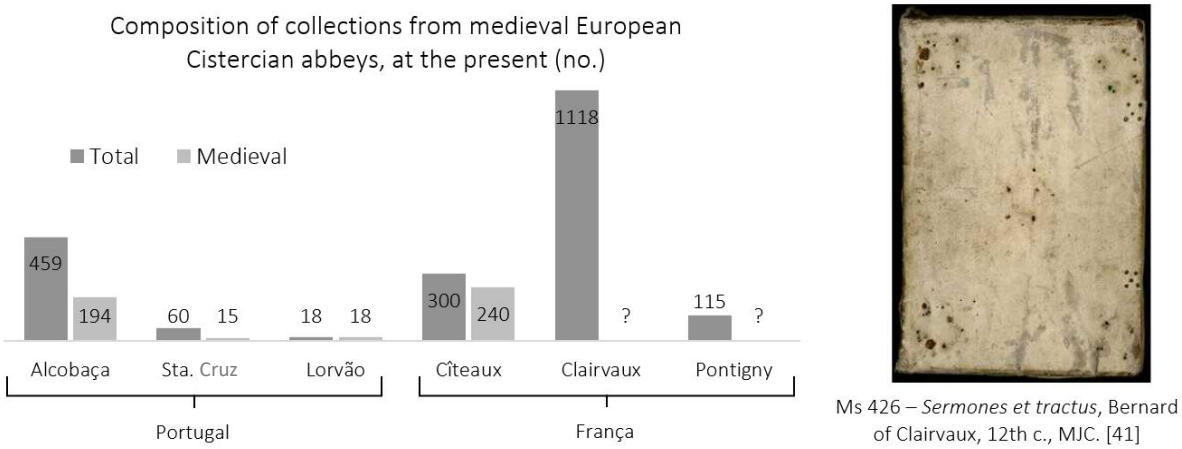


Fig.A1-2. Graphics illustrating distribution of binding typologies in Alcobaça collection. [5 (see p.2)] [28]



Ms 426 – *Sermones et tractus*, Bernard of Clairvaux, 12th c., MJC. [41]

Fig.A1-3. Graphic comparing Alcobaça collection[5 (see p.2)] [28] with equivalent Portuguese [30] and French [31] collections. At the right an image of a codex from the MJC illustrating lost components in French collections.

APPENDIX.2. Practical work (full version)

A2.1. COMPILING A GLOSSARY

As seen in chapter 1.3., lack of a defined multilingual universal terminology is hampering the development of bookbinding studies. Also, one of the most complete, comprehensive and representative work available is the LoB developed by *Ligatus*, in English language. [106] To the author's knowledge, there is no Portuguese reference as wide-ranging as the LoB. They are all very general and do not address many constituents' elements. On the other hand, CISTER.Hor team is mostly composed by Portuguese researchers, so working in their native language will be faster and more practical. However, without a national reference as the LoB, the need for a common language manifested. Developing an equivalent Portuguese reference for the LoB, is out of the scope of both CISTER.Hor and this dissertation. Likewise, the establishment of new terms was not one of the aims of this glossary. Since this is considered one of the causes for the absence of a common terminology, it was thoughtfully avoided. Consequently, this glossary is (for now) a carefully chosen list of terms (compiled from 5 main references) to be used in the material description of western monastic Medieval codices, particularly those from Alcobaça. Exceptions lay upon terms which were not found in any of the consulted references or were not translated from English to Portuguese.

Although not very numerous, main Portuguese references were carefully selected. Nascimento & Diogo [23] made the first study on Alcobaça's collection bindings. Faria & Pericão [117] and POEFDS [118] are two of the most complete Portuguese references for all book related subjects. LoB [106] is the leading international reference, in English language. By using it, glossary could be updated with most recent works in the field. *VC* [119] has translations not only for English but also French and Spanish, aside from schematic illustrations. The glossary was built primarily in Portuguese language for practical reasons, but terms' translation for English, French and Spanish (based on these last two references) were also included. Additional Portuguese references sporadically used to define terms more obscure or harder to describe were Correia [67], Seixas [77] and Freitas [120].

For the glossary construction, the author used Microsoft 365 ProPlus Excel® program to benefit from some of its automatic tools, like "filters" and "drop-down boxes". Excel also had the advantage of being an accessible and familiar program, which made it easy to use. Since it is a spreadsheet program, the glossary gained a table-based display which allowed a practical organisation of the information. Thus, the glossary criteria are presented in the first row, while compiled terms are listed in the first column. These terms, in Portuguese language were organised by alphabetic order under the first criterion "Terms". To each term was attributed a colour that corresponds to one of the nine book structure-based categories established (as usual in the field [98]): i) seven book categories - "bookblock", "sewing and endbands", "sewing supports and board attachment", "boards", "covers", "fastenings", "furniture"; ii) and two additional categories - "perspectives" and "general terms".

The column immediately after (which corresponds to the criterion "Type") distinguishes whether each term refers to i) a constituent or a typology (i.e. a constituent's configuration) in case of book categories or ii) a perspective or general terms, in case of additional categories. Data validation lists were applied in the cells of this second column, which means users must select the single option of the dropdown box that fits the respective term to fill it. In addition, each cell was coloured with lighter versions of the colours used in "Terms" to connect them with the respective book category. This way, users can easily identify the constituents and typologies in a book category. In the third and fourth column terms' definitions and synonyms are presented and duly referenced, respectively. Whenever references are not presented immediately after text, it means the written definition may have been adapted to better suit the collection characteristics. The next three columns present English, French and Spanish translations, again properly referenced. Finally, the eighth and ninth columns have hyperlinks to images in external folders (to reduce file's size). They were taken from the *VC* [119] or drawn by the author. The first gathers schematic representations; the second is for photographs of real objects. "Filters" tool was applied in the first cell (criteria row) of each column to benefit from alternative displays (other than alphabetic order) based on the colour system applied. There is a second worksheet in the document with the key for all the colours used in the glossary worksheet. This includes the system for identification of new terms (i.e. that do not exist in Portuguese references). According to this system, these terms' text colour is white, instead of the normal black (or golden yellow for a better reading in darker backgrounds). This second worksheet also contains the list of consulted references.

Concluded the glossary, it was reviewed by the author, the coordinator, and the project's member responsible for the material characterization. Then it was made available for all material team members. The glossary was tailored to the Alcobaça collection, but it can be adapted to other collections. Terms in the glossary where applied in the development of the characterization method.

A2.2. BUILDING A CHARACTERIZATION METHOD

A2.2.1. Selection of the characterization method

Unlike terminology, defining a universal description method is virtually impossible, since they must be tailored to each project's goals, case-studies and other specificities. However, according to chapter 1.3., there are several types of methods, and some are preferable than others, as is the case of structured records in databases. Databases are complex and require a previous knowledge of what will be necessary to be include in them. At the first stages of CISTER.Hor project, the team did not have such knowledge. Thus, it would be anachronical to study the fundamentals of database creation at the point of this dissertation development. Free text descriptions were also disregarded due to the disadvantages they present (as seen before). Therefore, the choice laid in structured records formats typically used in bindings surveys (printed or digital; forms or tables). Of them, the choice was driven by practical reasons. Printed methods, such as the SCP, were immediately disregarded because unlike them[36] our team had the conditions to use computers during observations of the codices and immediately introduce the data in the digital program. Thus, printed records would just add unnecessary steps of data conversion to the work. Regarding form or table formats, despite the two being good for data systematization, form methods have the disadvantage of requiring a continuous formatting adjustment whenever new fields came along. Contrarily, tables allow a simple addiction of row/column(s). Thus, the choice fell into digital table format.

After establishing the method, program selection became rather simple. Excel Microsoft 365 ProPlus® is a spreadsheet program suitable for diverse operating systems, including Windows®, Android®, macOS® and iOS® (which suited the diversity of systems in the members computers). Besides the very positive systematization with table format, spreadsheet programs also allow easy and fast continuous adding of new information (as mentioned above). As for Excel, it is one of the most broadly accessible programs of the kind, in economic terms. Also, team members were already familiar with its multiple advantageous tools. All these benefits made Excel one of the best candidates for first stage projects with large data. Based on empirical experience, other equivalent programs were not as powerful (e.g. Google's *Google Forms*®) or widely available (e.g. Apple's *Numbers*®). The large set of tools provided by Excel include: i) different functionalities for cell formatting that allow simpler systematizations; ii) grammar correction and dropdown boxes that help users avoid grammatical errors; iii) grouping by sheets and filters that conjugated with formulas like Count or search tools help organize data and consequently run fast and easier analyses; iv) hyperlinks to outside images which prevent overloaded files; v) drawing of graphics and schemes that summarize data during or after data assembly, which benefit users understanding of work evolution. These tools facilitate data assembly and potentially help in the analysis of numerous data. Nevertheless, the most important feature that immediately led to Excel choice was its ability of being transferable not only for other common spreadsheet programs such as *Google Forms*® or *Numbers*® (this is not so easy in reverse), but especially for more complex databases (which also allow online data sharing). [140-141]

A2.2.2. Method's development

Once the method was established, construction began. First tables were developed separately by this author. Later, significant reformulations were made in collaboration with the team member responsible for remaining codices' codicological analyses. The original idea was to group all information in a single table (if not in the same sheet, at least in the same file). However, given the amount of detail desired, this rapidly proved infeasible due to the fast size increase because of formatting. Consequently, the book, as an object, was divided into seven structure-based categories (the same used in the glossary) to be descry-bed. To each codicological category corresponds one Excel sheet/file with the same colour

[36] Due to technological limitations at the place were books were housed, the method used in the SCP resorted to physical sheets for the bindings survey. [112-115]

used in the glossary. Thus, they are usually called by Codicological tables. Three additional categories were created: the first, is for general information (such as inventory number, title, author, previous studies, etc); the second is for metric measurements of every element; and the third for advanced material analysis (techniques used, and respective results). These (specially the last two, as they are more directly related to material issues) are still under development since they require the search for alternative data input types (their type of information prevents the use of Count formulas, making it harder to retrieve global information), it has not yet been possible to conclude the structuring of these last two tables. Two additional sheets for text and image description and evaluation of conservation condition are still under planning.

All tables follow the template of Fig.A2-1. They can be divided into 2 horizontal areas: i) Conceptual data and ii) Empirical data.

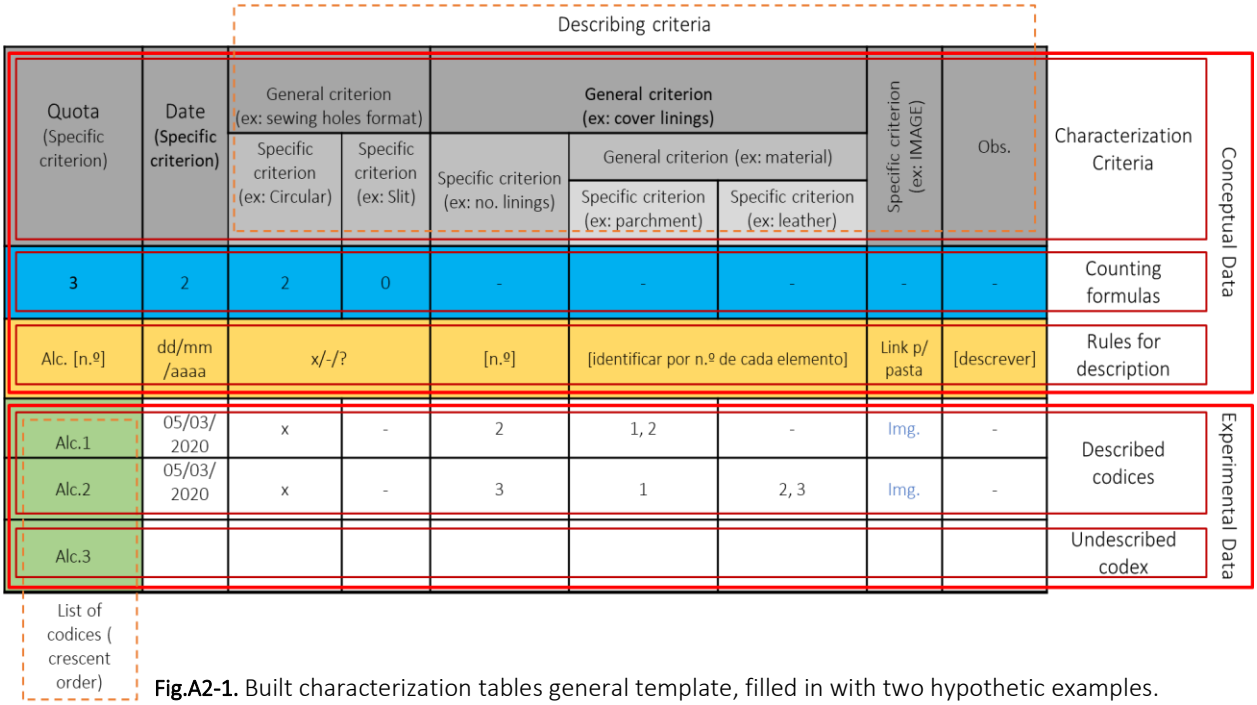


Fig.A2-1. Built characterization tables general template, filled in with two hypothetic examples.

Conceptual data subdivides into 3 horizontal subgroups, each represented in a different colour. The first horizontal subgroup (with different grey values) corresponds to the first 3-6 rows (depending on the table). Characterization criteria (selected according to presential observations of the three codices and other projects examples [115, 121-122]) are presented in them. (See A2.2.3) Horizontally, top rows (united cells) are more general while lower ones (ununited cells) are more specific. Each specific criterion (presented in the lower grey cell) is characterized in the column below. Vertically, criteria were divided in "Quota" (*Cota*) - first cell; "Date" (Data) - second cell; and remaining characterization criteria - cells on the right. (Fig.A2-1) Codicological criteria are formed by four main classes: i) constituents and sub-constituents' identification, ii) material visual identification, iii) form and visual features of constituents/sub-constituents and iv) structures formed by each constituent/sub-constituent. This sequence was usually followed along the row. However, it was not mandatory, since every constituent has very different features and alternative sequences allowed more coherent records. Thus, the order of criteria was always adapted to each category. Criteria were meant to be the most thorough and complete as possible, aiming for the maximum detail. This caused the need to separate material analysis and metric measurements, because files were getting very loaded and tables very large and quite confusing. Another reason for the division was for easier data analysis (more detailed ahead in this chapter).

The second horizontal subgroup - blue row, below grey cells - was filled with counting formulas. These were applied to the Experimental area's cells corresponding to the specific criteria of data input type 3 (see paragraph below). They count all codices in that column which have a positive record for the specific criterion identified in the grey row. (Fig.A2-1) This is an important function that allows general, ongoing and automatic data analysis and is very helpful in defining collection's most common characteristics. Without it, researchers would have to count the criteria individually for each codex.

The yellow row, below, is the third horizontal subgroup. Here is where rules according to which codices must be characterized are presented. To each specific criterion corresponds the yellow cell bellow (united or not). (Fig.A2-1) Criteria can only be recorded according to the data input type (see next paragraph) defined in the correspondent yellow cell. These data input types present a limited number of options. When examining a codex, researcher must choose the one that better applies to his/her observations. (Fig.A2-1)

Empirical data area is where codices' characterization information is added during examination. In the first column, headed by the first specific criterion in Conceptual data area "Quota", codices identification is added by crescent order, when a new one is observed with BNP quota number: "Alc. [*nº.*]". This is the type 1 of data input (it is the format that appears in the correspondent yellow cell above). (Fig.A2-1) To each of these cells (coloured in green) corresponds one codex. Each green cell has a hyperlink to an outside folder where photographs taken during examination and drawn schemes for the respective codex were saved. Cells on the right, which correspond to the second column (headed by "Date" criterion), have the date of examination to help track spent time. It goes under the format presented in the respective yellow cell: "*dd/mm/yyyy*" forming data input type 2. Finally, in the cells on the right, each codex is characterized, per row. For these cells there are only five types of data input, which are determined, for each criterion, in the yellow cells i) type 3: "x/-/?" - for a positive/negative/doubtful observation; ii) type 4: "nº."- to count the constituents; iii) type 5: "Link to folder" (*Link p/ pasta*) - for hyperlinks to the images' folder; iv) type 6: "identify […]" (*identificar […]*) - for listing all the elements that match the criterion; v) type 7: "describe" (*descrever*) - for additional observations. Two additional abbreviations can always be added whenever i) the constituent /structure is not observed – "N.O."; and i) the criterion does not apply to that codex – "N.A.". (Fig.A2-1) Codicological analyses were made through and presential observations (aided by microtools such as expandable dentist mirror, borescope, and portable lens for mobile phone) and codicological analyses of codices' extant appearance. Experimental prototypes (both physical[37] and digital) and several digital schemes[38] of more complex structures were also produced and compared to codices' observations, for clearer understandings. (Fig.A2-2)

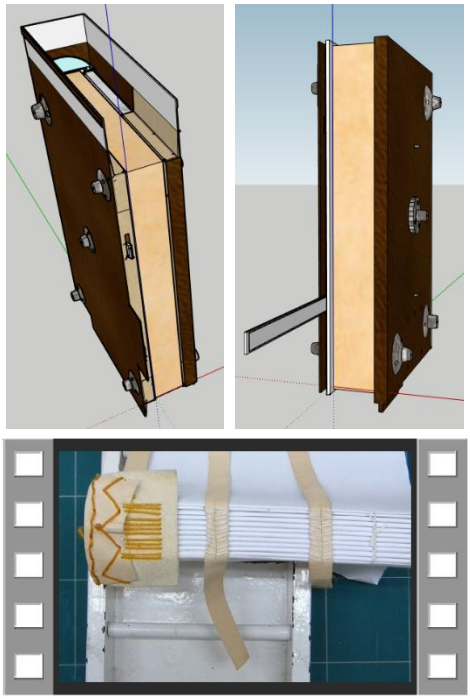


Fig.A2-2. Digital prototypes of Alc. 341 (left) and Alc. 414 (right) and photogram of the recorded video for endbands (bottom).

Summing up, if one analyses the tables horizontally, the researcher can have a global view of the characteristics of each codex individually. If, on the contrary, the researcher analyses tables vertically he/she will be looking at a specific characteristic throughout the collection.

There are yet two additional topics worth mention. The first is the sheet titled "Aux. Info. – Not change" (*Info. Aux. – Não mudar*) with Fig.A2-1 and all the legends for abbreviations used. This sheet summarizes the explanation given above and works as a quick user's manual for brief introductions to the method. The second are the "Identification" (*Identificação*), "Material analyses" (*Análises Materiais*) and "Measurments" (*Medidas*) sheets. These three follow the same template as the others, except for type of data input. For now, the first two are a more textual and descriptive, while the third only allows the introduction of numbers. This prevents the proper use of Count formulas, and thus data comparison has to be done individually for each codex. Consequently, the team is still looking for a better solution (specially for the last two[39] which are considered to be under development still, because of this issue). The data assembled in these three sheets results, not from observation, codicological analyses or

[37] A short video recording a proposal for the making of endbands will be made available at CISTER.Hor website: http://cistercianhorizons.fcsh.unl.pt/

[38] Digital prototypes were constructed on Google Trimble SketchUp Free®, while schemes were designed on PowerPoint Microsoft Office 365 ProPlus®.

[39] "Identification" is not affecting material characterization, but it will also be reviewed by CISTER.Hor's history part team members.

prototype comparisons (like in the Codicological tables), but from information retrieved directly from BNP online catalogue ("Identification"); advanced analytical techniques performed to the codices' materials ("Material analyses"); and metric measurements of the codex and its constituents ("*Medidas*"). Constituents analysed include several inks and paints[40], skin-based materials (parchment, sewing supports, linings, covers, clasp straps), core sewing threads, boards, and metalwork[41] (fastenings, furniture). Table 1 (p.9) has a complete list of techniques used and materials analysed. Adhesives were the only materials that were not analysed at all due to lack of time. For a more complete characterization of white skin materials it is important to mention the work that is being developed by Faustino, in her masters' thesis also under CISTER.Hor's umbrella. All collected data (either codicological or analytical) were compared among each other and with literature, resulting in a detailed analysis presented in chapter 3.

A2.2.3. Selection of case-studies

To establish criteria required for characterization and begin tables' filling three codices were selected. Descriptions in literature (even in structured records) are, naturally, relatively different since they are tailored to their projects. Consequently, direct observations of some selected codices were mandatory to start defining which criteria would better suit Alcobaça collection.[42] First requirement for codices' choosing was that at least one of them was as close to the pristine state as possible. Thus, it could serve as ground for further comparisons and establishment of evolution patterns. Surveying Nascimento & Diogo work [23], one codex stood out: Alc. 341. (Fig.A2-3) [123] This codex belongs to a group of several others attributed to the copyist *Ioannes Peccator*. [23] Various codices in this group conserve a considerable amount of Medieval materials. Alc. 341, in particular, was considered, to be the closest to the original state, by the authors. [23] Moreover, being part of group potentially written by the same copyist, it promoted the selection of two other codices: Alc. 413 and 414. (Fig.A2-3) [124-125] With these two codices it became possible to respond to other requirements, in particular, that selected codices included the diversity of Medieval typologies (Alc. 413 is a white codex) and already altered examples (both Alc.413 and Alc. 414 are considered to have been altered even in Medieval times). These two codices could provide a wider range of codicological criteria. Additionally, unlike Alc. 341, both these latter-chosen codices are integrated in CISTER.Hor's fifty selected codices. Therefore, to the binding material characterization performed in this dissertation, a liturgical and illumination analysis will certainly be added, hopefully contributing to a more exact dating. Finally, as part of an established group, where the unifying link is the copyist, we kept an open door for more ambitious researches such as the copyist as a bookbinder (which is an issue under discussion due to the recent findings as seen in chapter 1.2).

Alc.341 – *Expositio in Evangelium Matthei*, 13th c., BNP. [123]

Alc.413 - *Homiliarium*, 13th c., BNP. [124]

Alc.414 – *Homiliarium*, 13th c., BNP. [125]

Fig.A2-3. Selected codices for tables development and first filling: Alc. 341, Alc. 413 and Alc. 414.

[40] Yellow paints were not included in this dissertation because they are very elusive.
[41] Pins were not analysed because they are smaller than equipment analysing area.
[42] Note that establishment of characterization criteria is an ongoing work that will continue for as long as new observations are made. Since these are made almost in every examined codex tables may yet suffer some alterations.

A2.2.4. Material Analyses (Experimental)

INKS AND PIGMENTS Due to time limitations only Alc. 341's inks and paints were analysed. They were very preliminary, just to confirm tendencies with existing literature's records. BNP did not allow sampling of these materials which prevented the use of common techniques like FTIR or Raman spectroscopies. Preferably, chosen techniques had to be *in situ*. Thus, the team resorted to some which had been successfully reported in previous works (including by HERCULES Lab investigators) like FORS, EDXRF, HI and Col. [30, 40, 65-66, 88, 129, 134, 142-143] Techniques used are listed in Table 1 (p.9).

To determine whether Alc. 341 textblock ink has a metallic or carbonic nature [66, 142], we performed *in-situ* analyses by EDXRF. Since no textual differences were identified [136] a total of 3 folia (first, middle and last) were analysed, corresponding to 9 areas of analysis (3 in each folia). The EDXRF Spectra were acquired with handheld Tracer III-SD ED-XRF spectrometer (Bruker) equipped with a Rh target x-ray tube excitation source, a 10 mm^2 XFlash® SDD, a peltier-cooled detector with a resolution of 145 eV at 100,000 cps (2048 channels) and a Rh target. Analyses were made at 40 keV, 11 μA, without filter, acquisition time of 30 s, and a spot size of 12 mm2 (3 mm x 4 mm). The working distance was 2-3 mm from the analysed area. The spectra were acquired with S1PXRF Software and processed later with MATLAB® R2019b. MATLAB® processing was done with no baseline correction, only plotting.

For preliminary identification of Alc. 341 decorated initials' paint *palette,* besides EDXRF, two other techniques were used: Vis-NIR FORS and HI. Through EDXRF, 2 folia were analysed corresponding to 3 analysed areas: 1 for green paint, 1 for red light red paint and 1 for white paint. EDXRF instrumentation and conditions were the same as the ones used for inks (see previous paragraph).

A total of 9 folia where analysed through FORS, corresponding to 27 analysed areas: 9 areas for green paints; 9 for light red paints; and 9 for dark red paints. The FORS Spectra were acquired with i-Spec® 25 Vis-NIR handheld spectrometer, equipped with an air-cooling system and Si, InGaAs and extended InGaAs array sensors (spectral range 400-2500 nm). Resolution 4.0/4.5/15.0 (for each sensor). The handheld bundle was equipped with 19.6 mm^2 spot fitting (5 mm diameter size). White calibration was made with a reference supplied by the producing company (B&W-TEK, SRR-1.25-99, composition: compressed PTFE) with reflectance above 92% in all analytical regions (400-800 nm > 99%, 300-1800 nm > 98%, 250-2500 nm > 92%). The working distance was 2-3 mm from the analysed area. Detector settings were 70 ms integration time, 3 averages (sensor 1); 237 μs integration time, 4 averages (sensor 2); 315 μs integration time, 250 averages (sensor 3). Throughout the analysis measured temperature did not raise more by 2 °C than the original temperature (surface thermometer used for the purpose). The spectra were acquired with iSpec® 4 software and processed later with MATLAB® R2019b. *Processing with MATLAB®* was made by smoothing with Savitsky-Golay filter (polynomial order 2, wavelength frame 7 nm), no averaging, then plotting.

Regarding HI, 6 folia were analysed covering the three main colours: green light red and dark red. The hyperspectral image cubes were acquired with Specim IQ portable hyperspectral camera, that utilizes a visible (Vis) camera equipped with a CMOS sensor that has got a spatial resolution of 512 x 512 pix, with a spatial sampling of 17.58 x 17.58 μm per pixel. The camera is equipped with an objective with focal length 21 mm, f/number 2.2 (fixed) and field of view (FOV) 31 x 31°. The spectrometer included in the body of the camera operates at f/number 1.7 (at the slit) to return a Vis-NIR spectra ranging between 400 and 1000 nm. The spectral resolution is of 7 nm, slit length is of 11.70 mm and slit height 42 μm. The hyperspectral image cubes were recorded in DMR-Simultaneous mode (Default recording mode, that provides unprocessed data without further classification results and with the white reference panel supplied by the brand included in each cube). In other words, the white target is included in each cube throughout data recording and validation. This methodology has been chosen to correct illumination conditions and make the data comparable among each other. The obtained data were validated and balanced with the WR through the device after each recording. The codex was diffusely illuminated with one halogen lamp (1000 W, temperature colour 3200K), placed at ca. 3 m distance from the manuscript with a 20 °C angle lamp-manuscript-camera to ensure diffuse illumination to the object and avoid specular reflectance. These conditions were implemented for codex analyses in order to allow acquisition of cubes of good quality for very small areas (minimum area: 1 cm^2). Throughout the analyses the radiation illuminated to the object was 2000-2200 lux (natural daylight + halogen lamp) and no temperature raise > 2 °C occurred. For the purpose,

a luxmeter and a surface thermometer were used.

Inks and paints were further observed under DM. Images were recorded with Dino-lite Pro AM413T digital microscope, that ensures images of spatial sampling 1280 x 1024 pixels (1,3 MP) at 435x magnification, corresponding to a Field-of-View (FOV) of 0.69 x 0.51 mm (WxH) at a working distance (WD) of approximately 1 cm. Paints' chromaticity coordinates were acquired with a handheld colorimeter Datacolor Mercury 3000 equipped with 1 mm spot fitting. For each spot, 3 acquisitions were taken to ensure statistical representativity of each set of measures and to calculate ΔE (colour differences) related to the un-evenness of the parchment ground. The CIELAB (CIE 1976) colour space used was adapted to D56 illuminator and 10° observer. Data were plotted with MATLAB® R2019b as 3-D and 2-D plots. For all techniques ink/paint's support material (i.e. parchment) was also analysed. All results were compared with related literature. [30, 40, 66, 126-131] Table A2-1 summarizes all the analyses performed to inks and paints.[43, 44]

Table A2-1. Summary of ink and paint analyses performed to Alc. 341

Ink/Paint	Techn.	*f*.1v	*f*.21v	*f*.33r	*f*.34v	*f*.40r	*f*.49v	*f*.65v	*f*.68r	*f*.75v	*f*.103r	*f*.103v	*f*.129r
Ink	XRF	•						•					•
	DM	•	•								•	•	•
Light red	FORS			•		•						•	
	XRF	•											
	HI					•	•					•	
	DM		•					•				•	
	Col											•	
Dark red	FORS	•			•						•		
	XRF												
	HI	•			•						•		
	DM	•							•		•		
	Col	•									•		
Green	FORS	•					•			•			
	XRF	•					•						
	HI	•				•	•				•		
	DM	•	•					•			•		
	Col	•	•										
White	XRF						•						

SKIN-BASED MATERIALS (PARCHMENT AND LEATHERS) Skin-based materials were, for now, solely analysed *in situ*, by DM under the leadership of the team member responsible for leather materials. Related literature mentions more powerful techniques based on molecular biology (e.g. proteomics or DNA-based or analyses). [91, 133, 144] However, at this stage it was not possible to perform those. Subsequently, they will be discussed as future work elsewhere. Equipment used was Dino-Lite 5MP Edge AM7915MZTL with a magnification range of 10x-140x. Two interchangeable caps were used: N3C-L long cap and N3C-O open cap, to guarantee better focus with manual handling. Images were captured with DinoCapture 2.0 software and compared with literature. [144-147]

SEWING THREADS For sewing threads, an exhaustive review of the literature on vegetable fibres was conducted to select an effective, commonly used and accessible technique for identification. Thus, the sewing threads of the core sewing were observed under OM for a preliminary identification based on cells morphology observation. [148-150]

Two samples were taken from loose thread ends of the core sewing, one from Alc. 341 and other from Alc. 414 (Alc. 413 did not have any accessible loose thread). Both samples were later divided so that in total 4 samples were observed under microscope longitudinally and transversely and 2 samples were stored. (Table A2-2) Images were obtained with an Axioplan 2ie Zeiss microscope equipped with a

Table A2-2. Number of s. thread samples and their respective use

	Alc.341	Alc.414
$MO_{Longi.}$	1	1
$MO_{Trans.}$	1	1
Stored	1	1

[43] It is important to mention that the codex has yet a yellow paint which the analyses were proving to elusive, thus were not included in this dissertation.

[44] Analyses to ink, paint and metalwork were performed during two missions two the BNP performed with HERCULES Lab team's members. Thus, many information here presented and data results of chapter 3 were also their courtesy.

transmitted and incident halogen light illuminator (tungsten light source, HAL 100); UV light (mercury light source, HBO 100 illuminator); and a digital Nikon camera DXM1200F, with Nikon ACT-1 application program software, for microphotographs. Both longitudinal and transverse samples were analysed in brightfield with 10x ocular lenses and 5x/10x/20x/50x objective Epiplan lenses (giving total optical magnification of 50x, 100x, 200x, and 500x, respectively). Longitudinal samples, of 5 mm, were mounted in glass slides, with a drop of water, to separate and keep fibres disperse. Fibres' separation was aided with micro-tweezers and pointy-end probes, under the magnifying lens. A coverslip was added to each of the three slides, to protect the samples. They were then observed from lowest to higher magnifications, under transmitted polarized and cross polarized light. Following DCR's methodology, transverse samples were prepared by mounting them vertically in a translucent silicon tray. Samples of 2 mm were fixed to the base of individual silicon trays, with Technovit 2000 LC Fixierpaste from Kulzer®. Then Technovit 2000 LC Light Curing resin, from Kulzer®, was poured into the individual trays (just enough to cover the samples). The resin solidified for 20 mins in a UV light chamber. Then the side in which the fixierpaste was applied was sanded and polished until samples' surface was observable under the microscope. Samples were observed with incident polarized light. Images attained with both methods were later compared with appropriate references. [148-150]

BOARDS Wood-board analyses, for general identification, were performed following the methodology developed by CEF, ISA-UL. This methodology involves macro and microscopic observations of wood morphology and cell structures, and posterior comparison with related references.

Photographs of wood morphology were obtained *in-situ* with the portable DM used for skin-based materials, under the same conditions. Transverse cut of both boards of each codex were observed at different locations along the head and the tail of the boards.

Loosely connected micro-samples (av. 2x6x1 mm) were taken from insect damaged areas of the codices' boards. One half was stored while the other was taken for wood morphology observation under SEM. Samples were mounted on a specimen holder with UHU Patafix white adhesive paste, to secure them in place during atmosphere change. For better observations (without air dust) some samples were broken in half (c. $2mm^2$). Different images were obtained with a TM3030Plus Tabletop Microscope (Hitachi), in vacuum atmosphere, at 15 kV, using mixing image (Mix) observation mode, and a magnification range from 40x to 1000x.

Samples observed with SEM were later dissociated with Franklin solution for observation of wood cellular elements under OM. Franklin solution is composed of glacial acetic acid (CH_3COOH) and 26% hydrogen peroxide (H_2O_2) at 130 vol., in equal parts. [151] Samples were placed in 1 mL of the solution for 48 hours in a Universal oven UFB 400 (Memmert GmbH + Co.KG ©) at 60 ° C. The bleached samples were then individually collected with a fine weave net, washed with distilled water, subjected to mechanical disintegration by hand and stored in a solution of ethanol 70%. For microscopic observation, a few drops of the suspension were placed in a glass slide with a previously added glycerine drop. The elements were also stained with astral blue colorant to easy observations. Light microscopy observations were made using Leica DM LA and photomicrographs were taken with a Nikon Microphot-FXA. All photographs obtained were later compared with reference bibliography. [150-153] [45]

METALWORK (FASTENINGS AND FURNITURE) The technique chosen for metalwork preliminary analyses, EDXRF, is also a recognized technique in the field of metal study. [139] Analyses were performed *in-situ* by EDXRF. Each metal peace of the two fastenings of Alc. 413 and six bosses of each codex (four of Alc. 414) were measured with a Tracer III-SD handheld XRF spectrometer (Bruker). It is equipped with an Rh target x-ray tube excitation source, a 10 mm^2 XFlash® SDD, a Peltier cooled detector with a typical resolution of 145 eV at 100,000 cps, a Rh target and a maximum voltage of 40 kV. Analyses were made at 40 kV and 11 μA, with a filter and an acquisition time of 30 seconds. The instrument was set up on a tripod and positioned approximately 2–3 mm away from the surface under analysis. XRF spectra were collected using the S1PXRF software and analysed using the ARTAX software.[43]

[45] SEM and OM images of wood boards' samples were acquired at CEF-ISA, thus many information here presented and data results of chapter 3 were their courtesy.

APPENDIX.3. Compiled glossary (full version)

Termo Term	**Categoria** **Category**	**Definição [Ref]** Definition [Ref]	**Sinónimos** Synonyms	**Tradução Inglesa** English translation	**Tradução Francesa** French translation	**Tradução Espanhola** Spanish translation	**Esquema** Scheme	**Fotos** Photo	**Notas** Notes
Aa									
Aba	Constituinte de cobertura	Extremidade da sobrecapa/parte da cobertura que ultrapassa os planos e cai sobre/envolve o corte (ou mesmo o plano oposto). [2] [1][2]	Asa [1], Badana [1] [2], Desdobro [1], Envelope [2], Orelha [1] [2], Solapa [1]	Cover extension	Rabat (só para envelope?)	Solapa (só para envelope?)	A DD'D''		Envelope pode ser sinónimo da Aba da Goteira
Articulação por excedente	Tipologia de sistema de articulação	Sistemas de articulação entre o corpo do livro e a encadernação, que recorrem aos excedentes do suporte de costura para efetuar essa articulação.	-	Slip lacing	-	-	B, C, D		As diversas tipologias incluem excedentes empastados, colados, cosidos, etc.
Ataca	Constituinte de fecho	Tiras de pele, de pergaminho ou tecido, fixas nas bordas das pastas dos livros, especialmente nos livros encadernados em pergaminho (que tinham tendência a encarquilhar); eram atadas ou presas para evitar que o livro se abrisse e, por vezes, usadas como elemento decorativo; podiam estar colocadas não só do lado do corte lateral, mas igualmente na cabeça e no pé, o que geralmente sucedia apenas em obras de grande formato. [1] No caso de coberturas com aba, também podiam ser cosidas à da goteira, criando mais um elemento decorativo, mas essencialmente funcional, pois ao fixar os dois elementos num só, evitava-se que um deles (neste caso a ataca) fica-se pendurada e desta forma dificultasse o manuseamento do livro.	Atilhos [1], Laços [1] [2], Tiras [2], Cintas [4]	Clasp straps	Patte de fermoir	Manecilla Manezuela Manija	H C K		Como eram muito manuseadas e o material era frágil, restam poucas atacas ainda em bom estado e daí as encadernações das obras serem descritas muitas vezes como apresentando apenas vestígios ou restos de atacas.
Bb									
Bifólio	Constituinte do caderno	Conjunto de dois fólios derivados da dobragem de uma folha; é a unidade básica de um caderno. [1] [1][2]	-	Bifolia Bifolium (Muzerelle)	Bifeuillet Bifolio Bifolium Diplôme Feuillet double Double feuille	Bifolio Doble folio	AA', CC', DD'		
Bifólio exterior	Constituinte do caderno	Bifólio que forma a primeira e última folhas de um caderno. [1] [1]	-	Outside bifolium (Muzerelle)	Bifeuillet extérieur	Bifolio exterior	AA'		
Bifólio intermédio	Constituinte do caderno	Bifólio colocado entre os bifólios exterior e médio. [1] [1]	-	Intermediate bifolium (Muzerelle)	Bifeuillet intermédiaire	Bifolio intermedio	CC'		
Bifólio médio	Constituinte do caderno	Bifólio que ocupa o meio do caderno sobre o qual passa o fio de cosedura. [1] [1]	Bifólio central	Centre-folds Central bifolium (Muzerelle)	Bifeuillet médian Bifeuillet central	Bifolio central	DD'		
Biselado	Tipologias de tratamento das margens das pastas	Talhe obliquo efetuado na(s) aresta(s) de um dado objeto, neste caso, das tábuas. Quando o talhe se encontra a 45º é designado chanfrado. No caso das tábuas, pode ser em todas as arestas ou não (ex: só nas exteriores, só nas da goteira, etc.) [1]	-	Bevel	Ais biseauté	Canto biselado, Canto achaflanado	A		Chanfrado - Bisel a 45º Steep bevel e Shallow bevel Traduções Fr. e Esp. não são literais.
Boleado	Tipologias de tratamento das margens das pastas	Arredondamento de aresta(s) de um dado objeto, neste caso, das tábuas. [1]	-	Cushion	-	-	D		
Brochos	Constituinte da guarnição	Peças de metal fundido, que apesar de geralmente decorativos, são acima de tudo funcionais, servindo para reduzir o efeito de abrasão na cobertura. Encontram-se sobretudo, em manuscritos de maiores dimensões e relacionam-se com a sua posição horizontal de armazenamento e leitura. Fixam-se às pastas por meio de pregos, e são normalmente dispostos em número de 5. Podem tratar-se de um único elemento em formato de tacha, de cabeça grande, redonda, plana ou facetada; ou vários elementos, nomeadamente uma peça de proteção fixa por um ou mais pregos. Esta peça, geralmente apresenta uma base plana, que apoia na pasta, e uma saliência, designada por cabeça de brocho, que tal como a cabeça da tacha, apoia na mesa/prateleira. Podiam ser fabricados em ouro, prata, cobre ou bronze. [4] [1][3][4][5]	Bola [1], *Bullum* [1], Cabochões [1] [5], *Clavus* [1] Cravo [1] [2], Enxarrafos [5], Guarnições [5], Pregos [5], Tacha, [1]	Bosses	Boulon, Bouillon, Bossette, Cabochon	Bullón, Cabujón	F, G	Foto	
Brochos de canto	Tipologia de brochos	Brochos aplicados nos cantos dos planos. São normalmente 4, embora, nalguns casos sejam apenas dois, aplicados numa das margens laterais dos planos. [1][2][4]	-	Corner Bosses	-	-	F		
Brochos individuais	Tipologia de brochos	Brocho que não é parte integrante de nenhum outro elemento; vive independentemente.	-	Separate bosses	-	-	F, G		
Brochos integrais	Tipologia de brochos	Brochos criados a partir/em conjunto com outro(s) elemento(s) como peças de canto ou centro.	-	Integral bosses	-	-	B		
Cc									
Cabeça	Perspectiva global	A parte superior do livro, ou de qualquer página, quando posto ao alto, seguindo a orientação do texto. [1][3]	-	Head	Tête	Cabeza	Img.		Vista Superior
Caderno	Constituinte do corpo do livro	Grupo de bifólios obtidos por dobragem de uma folha (abrindo-se todos os lados, exceto o último a ser dobrado, com recurso a uma ferramenta de corte), ou pela reunião (por encasamento, encarte) de várias folhas dobradas. Segundo a sua composição/estrutura pode ser formado por: 8 páginas, 4 fólios, 2 bifólios - bínio, 12 páginas, 6 fólios, 3 bifólios - terno, 16, páginas, 8 fólios, 4 bifólios - quaterno, 20, páginas, 10 fólios, 5 bifólios - quínio, 24, páginas, 12 fólios, 6 bifólios – sénio, etc. [2] [1] [3] [2]	-	Gatherings Quires (Muzerelle)	Cahier	Cuaderno Cuadernillo	C		binion Ternion Quaternion Quinion ... (Muzerelle)
Calha	Constituinte das pastas	Recorte em profundidade na superfície da pasta, que permite o encaixe da continuidade do suporte de costura, sem a criação de deformações superfícies após a aplicação dos elementos de cobertura.	Mortagem [2]	Channels	Cuvette, Fosse	Ventana	B, B'		
Calha de entrada	Constituinte das pastas	Recorte em profundidade na superfície da pasta, à face, no lado da goteira, que permite a entrada do suporte de costura na pasta. Pode ser considerado um sistema alternativo ao túnel.	-	-	-	-	E		
Calha para fecho	Constituinte das pastas	Recorte em profundidade na superfície da pasta, que permite o encaixe da ataca do fecho, sem a criação de deformações superfícies após a aplicação dos elementos de cobertura.	-	Clasp recess	Cuvette, Fosse	Ventana	A		
Canto de virado	Constituinte do virado	Ângulo formado nas margens dos virados da cobertura que correspondem aos cantos da goteira com a cabeça/pé, das pastas. Pode apresentar diferentes tipologias.	-	Mitres (cover features)	-	-	I Img.		Dúvidas relativamente ao inglês
Capa	Perspectiva das pastas	Lado exterior da pasta. Lado exterior de um documento, seja de que matéria for, destinada a protegê-lo; pode conter o título da obra, o nome, do autor e do editor, a data, etc. [...] [1] [1]	-	Outer	Plat	Tapa, Plano	Img. A		Vista Frontal/Face externa do plano

Fig.A3-1. Compiled glossary (continues in the next page).

Carcela	Constituinte do caderno	Tira de pano ou papel (ou outro) que liga as folhas ou gravuras soltas do livro. [3] [1] [3]	-	Guard	Onglet	Cartivana	B		endleaf, extension, leaf guards
Carcela de reforço	Constituinte do caderno	Tira de pano colocada na encadernação por dentro (e/ou fora) do festo da folha exterior do primeiro e último cadernos. [1] [1] [3]	-	Text guards Reinforcing strip (Muzerelle)	Fond de cahier Onglet	Refuerzo de cuaderno	A		
Carnaz	Geral	Parte inferior da pele que esteve em contacto com a carne do animal (por oposição a flor); o lado carnaz do pergaminho apresenta-se bem mais claro e liso do que o lado oposto – a flor – pois, após retirar os músculos e a carne, a superfície era raspada com facas, esfregada com cinzas para a desengordurar e branquear e desbastada com o *lunellum* , espécie de faca em forma de crescente de lua, que a alisava; por oposição à flor, pode dizer-se que este é o lado mais nobre do pergaminho e não é por acaso que, quando observamos encadernações feitas com velhos pergaminhos (por vezes manuscritos reaproveitados), é o lado escolhido para ficar para o interior. [1] [1] [2]	*Album* [1], Carnaça [2], Carne [1]	Fleshside	Côté chair Dos	Cara de Carne Pars munda			Lado da carne (no animal) Lado em "camurça" (na pele) Só aplicável em peles e pergaminho
Cavilha	Constituinte de empaste	Peça de madeira, de secção circular, utilizada para fixar os suportes de costura, nos entalhes das pastas.	-	Wooden peg	Cheville	Clavija	A		Trenail?
Cobertura	Constituinte da encadernação	Revestimento que cobre, pelo menos, três perspetivas do códice (planos e lombada). [2] Pode também cobrir total ou parcialmente os cortes da cabeça, pé e goteira e as contracapas. [1][2][3][4]	-	Cover	Couverture	Cubierta Forro	A		
Cobertura dupla	Tipologia de cobertura	Conjunto de duas coberturas que se sobrepõem: uma interior (ver Cobertura interna) e outra exterior (ver Cobertura externa). Quando a Cobertura externa se encontra solta face aos restantes elementos do livro pode ser designada Sobrecapa.	-	-	-	-	B, C		double cover
Cobertura externa	Constituinte de cobertura dupla	Cobertura mais exterior, colocada sobre uma cobertura interna (a presença desta é obrigatória). É geralmente feita com um (ou mais) material(ais) mais robusto(s) e margens prolongadas (em aba) ou corte rente, embora não sejam características vinculativas. Quando a Cobertura externa se encontra solta face aos restantes elementos do livro pode ser designada Sobrecapa.	-	Secondary cover	-	-	C		Em inglês, faz-se a distinção entre Fixed secondary cover, Loose secondary cover e Chemise, Sendo a "chemise" um tipo específico de cobertura secundária, característico do período medieval, que não é considerada permanetemente fixa nem solta.
Cobertura interna	Constituinte de cobertura dupla	Cobertura mais interior, colocada junto à face externa dos planos, geralmente com algum sistema de fixação aos restantes elementos do códice (seja brochos, cola, costura, etc.). É geralmente constituída por um (ou mais) material(ais) menos espesso(s) e com margens viradas, embora não sejam características vinculativas.	-	Primary cover	-	-	B		Em [4] destaca-se que a cobertura interna só cobre os planos.
Cobertura simples	Tipologia de cobertura	Cobertura única, isto é, de uma só peça que cobre os planos e lombada. Geralmente apresenta virados.	-	-	-	-	B		single cover
Códice	Geral	Livro manuscrito organizado em cadernos solidários entre si por costura e encadernação. [2] [1][2][3]	Codex [4]	Codex (Muzerelle)	Codex	Códice	D		
Coifa	Constituinte de cobertura	Volta de pele que protege as extremidades do dorso do livro e cobre a tranchefila. [2] [1] [2] [3] [5]	Adorno, Graça [2]	Caps	Coiffe	Cofia, Adorno	B F		
Colacionar	Geral	[...] Em encadernação, ato de verificar se os cadernos do livro estão na ordem exata, ou através das assinaturas ou à escala. [1] Verificação da formação dos cadernos. [1]	-	-	-	-			Pode ser efectuada, com auxílio a folhas de colação; e insere-se na disciplina da Codicologia.
Contracapa	Perspectiva das pastas	Lado interior da pasta. [1][3]	-	Inner	Contre-plat Plat intérieur	Contratapa Contraplano	Img. B, D		Face interna do plano
Contraguarda	Tipologia de guarda	[...] Trata-se do revestimento da contracapa da encadernação, cujo material tanto pode ser o papel como o tecido (ou outro). [1] [1]	Forro [1] Guarda espelho	(Separate) Pastedown	Contre-garde	Guarda pegada	E		
Corda	Tipologia de suporte de costura	Entrelaçado de fios que suporta a costura. [3] Podem ser simples ou duplas. [1][3]	Nervo de corda	Cord	-	-	H, I		
Corpo do livro	Constituinte do livro	Conjunto de elementos formado pelos cadernos, uma vez cosidos. [2] (podendo ou não incluir os elementos de registo caso já tenham sido, ou não, aplicados) Juntamente com a encadernação, constituem os dois elementos que formam o códice. [1] [2][4]	Miolo	Bookblock	Corps du volume Bloc de cahiers	Cuerpo del libro Bloque del libro	X		
Corte	Perspectiva global	Superfície exterior, formada pela reunião das folhas quando o livro está fechado. Margem superior, inferior e lateral exterior (oposta à lombada), dos livros . Corte de cabeça, de pé, goteira ou dianteira. [2] Na prática corresponde a três perspetivas do objeto livro (a superior, a inferior e a lateral direita). [2] [1][2] e [3]	Aparo (do livro) [1]	Sides (?) Edge (Muzerelle)	Tranche	Corte	Img.		Vista superior, inferior e lateral direita
Costura	Constituinte da encadernação	[...] Estrutura(s) formada(s) por um, ou mais, fios que unem os diferentes cadernos entre si, na lombada do livro. Podem ser efectuadas sobre suportes ou não, antes ou depois da aplicação [1] [1] [4]	Cosedura [1] [2] Costuragem [1]	Sewn structures, Stitched structures	-	-	Img.		Sewing e stitching são coisas diferentes, em inglês!!
Costura compacta	Tipologia de costura	Costura sobre suportes, em que o fio dá mais do que uma volta, por caderno, numa (ou mais) estações de costura.	-	Pack sewing	-	-	E, G, H,		
Costura direita	Tipologia de costura	Aquela que se faz na lombada sobre suportes de costura duplos ou fendidos, na qual a agulha sai a meio entre os dois suportes, dá a volta a um deles e os abraça a ambos, reentrando de imediato no caderno através do orifício de costura. Nome deriva da aparência final (linhas retas), por oposição à costura em espinha de peixe (linhas inclinadas).	-	-	-	-	C, D, E, F, H		Straight sewing (booklet)
Costura em cadeia	Tipologia de costura	Tipo de costura sem suporte, na qual o fio de costura que emerge do orifício é conduzido por baixo e à volta do fio do caderno anterior (mesma estação), para formar cadeias de linhas ligadas.	-	Chainstitch, Linked sewing Chain-sewing (Muzerelle)	Chaînette	Cadeneta	B		
Costura em espinha de peixe	Tipologia de costura	Aquela que se faz na lombada sobre os suportes de costura duplos ou fendidos, na qual a agulha sai a meio entre os dois suportes, dá a volta a um deles e os abraça a ambos, no caderno anterior, imediatamente sobre a costura, para depois reentrar no caderno através do orifício de costura de origem. [1] [1]	-	Herringbone sewing, Linked sewing	-	-	G, I		Herringbone sewing (booklet)
Costura sem suportes	Tipologia de costura	Costura na qual os cadernos são cosidos apenas com fio de costura.	-	Unsupported sewing	-	-	B		
Costura simples	Tipologia de costura	Costura sobre suportes, em que o fio dá exclusivamente uma volta ao suporte, por caderno, em cada estação de costura. Oposta à compacta.	-	-	-	-	C, D, F, I		Single Sweing (booklet)
Costura sobre cordas	Tipologia de costura	Tipologia de costura sobre suportes, em que estes são cordas.	-	-	-	-	H, I		
Costura sobre fitas	Tipologia de costura	Tipologia de costura sobre suportes, em que estes são fitas.	-	-	-	-	C		
Costura sobre nervos	Tipologia de costura	Sistema de costura da encadernação na qual um único fio percorre o comprimento do dorso no interior de cada caderno, saindo de cada furo da costura para se enrolar à volta do suporte e reentrar de novo no mesmo furo para seguir para o furo seguinte. [1] [1]	-	Sewing on cords (Muzerelle)	Couture sur nerfs	Cosido sobre nervios	D, E, F, G		

Fig.A3-1. Compiled glossary (continues in the next page).

Costura sobre suportes	Tipologia de costura	Costura na qual os cadernos são cosidos através de suportes de costura (nervos, cordas, fitas).	-	Supported sewing	-	-	C, D, E, F, G, H, I		
Cunha	Constituinte de empaste	Peça de madeira, de secção retangular, utilizada para fixar os suportes de costura, nos entalhes das pastas.	-	Wedge	Coin	Cuña,	B E		
Dd									
Desbaste de aresta	Tipologias de tratamento das margens das pastas	Talhe ligeiro, efectuado nas arestas do objeto (neste caso das Tábuas), para as tornar mais suaves e menos agressivas no contacto com os materiais adjacentes (ex: menos cortantes).	-	-	-	-	C		
Ee									
Empaste	Tipologia de articulação por excedente	Passagem dos excedentes dos suportes de costura pelas pastas, trespassando-as, de forma a garantir a articulação entre a encadernação e o corpo do livro. [3] [1][3]	-	Board lacing	-	-	D		Simple lacing??
Empaste por laço com nó	Tipologia de empaste	O empaste é feito através de i) entrada do suporte de costura em tunel na margem da tábua (até atingir o primeiro orifício), ii) saída para calha numa das faces da pasta, e iii) passagem para a face oposta através do segundo orifício, e iv) terminando no primeiro orifício.	-	-	-	-	A		
Empaste por laço de volta inteira	Tipologia de empaste	O empaste é feito através de i) entrada do suporte de costura em tunel na margem da tábua (até atingir o primeiro orifício, que não tem implicações para a passagem do suporte de costura), ii) saída para calha numa das faces da pasta, iii) passagem para a face oposta através do segundo orifício, e iv) terminando com regresso ao tunel de entrada.	-	-	-	-	B		Round lacing?
Empaste por semi-sigmático A	Tipologia de empaste	O empaste é feito através de i) entrada do suporte de costura em tunel na margem da tábua (até atingir o primeiro orifício, sem implicações para a passagem do suporte de costura), ii) saída para calha numa das faces da pasta, iii) passagem para a face oposta através do segundo orifício, e iv) terminando neste segundo orifício, com cavilha.	-	Short lacing path	-	-	C		
Empaste por semi-sigmático B	Tipologia de empaste	Difere do empaste por semi-sigmático A, no recorte reto/oblíquo das calhas.	-	Short lacing path	-	-	D		
Empaste por semi-sigmátio C	Tipologia de empaste	O empaste é feito através de i) entrada do suporte de costura em calha na face da pasta, ii) passagem para a face oposta através do primeiro orifício iii) percurso em calha na face correspondente, iv) terminando na passagem para a face oposta através do segundo orifício, com cavilha.	-	Short lacing path	-	-	E		Variante de semi-sigmático
Empaste por sigmático A	Tipologia de empaste	O empaste é feito através de i) entrada do suporte de costura em tunel na margem da tábua, ii) saída para calha numa das faces da pasta, iii) passagem para a face oposta através do primeiro orifício, e iv) terminando na passagem para a face oposta através do segundo orifício, com cavilha.	-	Long lacing path	-	-	F		
Empaste por sigmático B	Tipologia de empaste	O empaste é feito através de i) entrada do suporte de costura em tunel na margem da tábua (até atingir o primeiro orifício, sem implicações para a passagem do suporte de costura), ii) saída para calha numa das faces da pasta, iii) passagem para calha na face oposta através do segundo orifício, e iv) terminando na passagem novamente para a primeira face, através de um terceiro orifício, com cavilha. Difere do sigmático A pela presença do orifício vazio, após o canal de entrada.	-	Long lacing path	-	-	G		
Encadernação	Constituinte do livro	Consiste em reunir, coser as folhas (manual ou mecânicamente) e cobri-las com uma capa consistente; operação destinada a conservar e proteger os livros. [3] Na prática são o conjunto de elementos/materiais aplicados nesta operação. Juntamente com o corpo do livro, constituem os dois elementos que formam o códice. [1][2][3][4]	-	Binding	Reliure	Encuadernación	Z		
Encadernação de empaste	Tipologia de encadernação	Encadernação marcada pela utilização de um sistema de articulação do corpo do livro com as pastas da encadernação através de excedentes de suportes de costura que trespassam (empastam) as pastas.	-	Laced-case bindings with boards	-	-			
Entrenervos	Constituinte do sistema de articulação	Espaço entre dois nervos consecutivos medidos na lombada de um livro. No caso da lombada ser lisa, sem nervos, atravessada apenas por decoração em filetes, designar-se-á entrefilete. [1] [1] [2] [3]	Casa (de nervos) [1] [2] [3], Casela [1] [2], Entrefilete, Entrenervura [1] Painéis	Spine panels	Entre-nerf, Compartiment	Entrenervio	E		
Espigão	Constituinte de fecho de placa de orifício e espigão	Elemento, geralmente metálico, semelhante a um prego, mas de cabeça cilíndrica de maior altura (diâmetro semelhante ao da haste), que se fixa no interior de uma das pastas e permite o encaixe de uma placa de orifício.	-	Pin	Tenon	Hebijon, Pincho	K		Dúvidas quanto às trad. Fr. e Esp. Peg (Szirmai)
Esquadria	Tipologias de tratamento das margens das pastas	Talhe em ângulo reto da(s) aresta(s) de um dado objeto, neste caso, das tábuas. [1]	-	Square edges	-	-	B		
Estação de costura	Constituinte da costura	Cada conjunto de locais, transversais à lombada, que surgem ao mesmo nível, resultantes da passagem do fio pelo festo, para efeitos de costura. No caso de costura sobre suportes, corresponde ao número de suportes.	-	Sewing stations	-	-	B, C, D, E, F, G, H, I		
Estação de passagem	Constituinte da costura	Estações de costura em que se passa do caderno anterior para o seguinte, geralmente a primeira e a última (contando da cabeça para o pé e exceptuando as tranchefilas). Geralmente correspondem às estações onde é feito o ponto de remate.	Estação de remate	Change-over stations	-	-	A, J		
Excedente do suporte de costura	Constituinte do suporte de costura	Extensões de cada lado do suporte, em que não é aplicada costura, mas que servem antes para a articulação do corpo do livro nas pastas.	Correia do nervo [2]	(Sewing support, Endband) Slip	-	-	B		
Ff									
Fecho anterior	Tipologia de fecho de encadernação	Fecho cujo elemento móvel se encontra fixo no plano anterior e vai prender no plano posterior.	-	Left-to-right fastenings	-	-	Img.		
Fecho central	Tipologia de fecho de encadernação	Fecho que surge junto à goteira (na margem ou na face da pasta) na zona central.	-	Central fastening	-	-	B		
Fecho de encadernação	Constituinte da encadernação	Peças que ligam os dois planos pelas capas ou margens da goteira e permitem manter o livro fechado; na encadernação medieval usam-se para o efeito, tiras de pergaminho atadas entre si ou terminadas em ferragem presa num espigão no plano contrário àquele de onde parte a tira de pergaminho. [2] [1][2][4]	Brochas [5], *Fibulae* [1]	Fastening	Fermoir Fermail	Broche Cierre	Img.		
Fecho de elementos móvel e imóvel	Tipologia de fecho de encadernação	Tipologia de fecho de encadernação composto por dois elementos fixos a cada uma das pastas. Porém, um é móvel, ou seja, pode ser deslocado para prender/desprender, do outro, que é imóvel. O elemento móvel geralmente apresenta nos seus constituintes uma ataca ou uma placa de dobradiça.	-	Clasp fastening	-	-	F, G		Fecho de placa, fecho de fixação, outros?? Isto inclui os fechos constituidos por espigão, gancho, placas...
Fecho de placa de orifício e espigão	Tipologia de fecho de elementos móvel e imóvel	Fecho de elementos móvel e imóvel, em que o elemento móvel é uma placa de orifício, que vais encaixar no elemento imóvel, constituido por um espigão.	-	Open pin clasp	-	-	F		
Fecho inferior	Tipologia de fecho de encadernação	Fecho que surge na zona inferior da margem do plano.	-	Lower fastening	-	-	C		
Fecho posterior	Tipologia de fecho de encadernação	Fecho cujo elemento móvel se encontra fixo no plano posterior e vai prender no plano anterior.	-	Right-to-left fastenings	-	-	Img.		
Fecho superior	Tipologia de fecho de encadernação	Fecho que surge na zona superior da margem do plano.	-	Upper fastening	-	-	A		
Festo	Constituinte do fólio ou bifólio	Parte do caderno onde as folhas do livro estão dobradas e por onde passa a costura. [1]	Margem interior. [1]	Spine-fold	-	-	D		
Fio de costura	Constituinte da costura	Filamentos de fibras que são torcidos de forma compacta para formar um fio continuo que que serve para costurar os cadernos e outros elementos do livro.	Linha de costura	Thread	Fil de couture	Hilo de cosido, Cordel	L		

Fig.A3-1. Compiled glossary (continues in the next page).

Fita	Tipologia de suporte de costura	[...] Em encadernação é o material usado na costura, em geral pergaminho ou tecido, aplicado transversalmente aos cadernos, como suporte de costura. [1] [1]	-	Tape, Flat sewing supports, straight cores	-	-	C		
Flor	Geral	Parte exterior do pergaminho ou peles, em oposição ao carnaz; o lado flor do pergaminho é mais escuro que o lado carnaz, sendo frequentemente visíveis os folículos ou raízes do pelo do animal que por observação minuciosa, nos podem fornecer elementos de identificação da sua espécie; talvez por ser o lado mais escuro e mais brilhante do pergaminho seja aquele que quase sem exceção é preferido para o exterior das encadernações, dado que o lado carnaz, é além de mais claro, o de grão mais fino e delicado. [...] [1] [1][2] e [3]	-	Hairside	Côté poil Côté fleur	Cara de pelo 'Pars pili' Flor			Lado do pêlo (no animal) Lado liso (na pele) Só aplicável em peles e pergaminho
Folha	Geral	Peça retangular de pergaminho ou papel, inteira, não dobrada, antes da formação dos cadernos. [...][1] [1][3]	-	Sheet (Muzerelle)	Feuille	Hoja			Single leave?? Corresponde àquilo que vai ser o suporte de escrita.
Folha de rosto	Geral	Folha de rosto complementar que precede ou segue a folha de rosto principal e que inclui com frequência informações sobre a série ou outras informações acessórias sobre a obra. [1] No caso de Alcobaça, refere-se aos fólios de papel que foram adicionados num período posterior e que geralmente se encontram entre as guardas e o primeiro fólio. [1][3]	Folha de rosto complementar	-	-	-			
Fólio	Constituinte do caderno	Os dois elementos que formam o bifólio, resultando da dobragem de uma folha de papel ou pergaminho. Geralmente encontra-se numerado apenas no reto. [...] [1] [1][3]	-	Leaf, Folio (Muzerelle)	Feuillet Folio	Folio Hoja	A, C, C'		(f., ff.)
Gg									
Goteira	Perspectiva global	Corte da abertura dos livros, que pode assumir uma forma rente ou côncava. [2] [1][2][3]	Abertura, Canelura, Corte lateral, Corte Dianteiro, Dianteira, Frente [1]	Fore-edge	Gouttière	Canal	Img.		Vista lateral direita
Guarda	Constituinte do corpo do livro, Constituinte do sistema de articulação	Fólios ou bifólios, de papel ou de pergaminho, colocados no início e/ou no fim do livro que servem para unir o corpo do livro à encadernação, e geralmente cobrem os acabamentos da encadernação. [2] [1] [2] [3]	-	Endleaves Guard-leaf, Protective leaf (Muzerelle)	Garde	Guarda			No Muzerelle endleaf tem uma def. diferente; **separate endleaves, integral endleaves**
Guarda dupla	Tipologia de guarda	Guardas anteriores e posteriores que têm duas contraguardas e duas guardas volantes. [1] [1]	-	Hook-type endleaves	-	-			Hook-types, segundo a definição do ligatus, parece mais uma guarda com pestana
Guarda simples	Tipologia de guarda	Guarda que é formada por um só bifólio, por oposição à guarda dupla.	-	Fold endleaves	-	-	E, F		
Guarda volante	Tipologia de guarda	Por oposição à contraguarda, fólio da guarda simples que não se cola à contracapa. [1] [1]	Guarda livre [1]	Flyleaf (Muzerelle)	Garde volante	Guarda volante Hoja volante	F		
Guarnição	Constituinte da encadernação	Ferragens aplicadas sobre as encadernações. [5] Conjunto de elementos, geralmente com funções de fixação e proteção, mas também decorativas. Incluem brochos, peças de canto, molduras de título, etc. [5]	-	Furniture, Ironwork (Muzerelle)	Ferrure	Guarnición Clavación	F, G, H, J, P		
Hh									
Ii									
Jj									
Ll									
Lingueta	Constituinte de tranchefila	Elemento da tranchefila, cosido juntamente com o caderno e o nervo respetivo. Geralmente em pele ou pergaminho,podendo apresentar um formato em meia-lua, resultante de uma dobra transversal cosida. [2] [2]	-	Spine tab	Renfort de coiffe, Contrefort	Capitel, Refuerzo del adorno	F B		Dúvidas relativamente ao processo de aplicação das tranchefilas e respetivos componentes (como e quando era cada um aplicado?)
Livro	Geral	Objeto qu epode assumir diferentes formatos (que evoluiram ao longo do tempo até ao formato códice no Ocidente), onde é reunida informação coerente, textual ou gráfica, em diferentes formatos. [1][2][3]	-	Book	Livre	Libro	Img.		
Lombada	Perspectiva global	Parte do livro oposta ao corte da goteira, onde são cosidos os cadernos; na lombada, depois de encadernado, podem surgir elementos como o rótulo, o título, o nome, do autor, a data ou outros. [1] [1][3] e [5]	Costado [1], Dorso [1] [3], Lombo [1] [2] [3]	Spine, Back (Muzerelle)	Dos	Lomo	Img.		Vista lateral esquerda
Mm									
Manuscrito	Geral	Como nome, este termo designa, em especial, o escrito antes da introdução da imprensa ou nessa época. Obra original escrita à mão. Cópia manuscrita da obra de um autor anterior à sua impressão (original ou cópia de um texto destinado a ser impresso). [1] [1][4]	Dactilograma [1]	-	-	-			
Nn									
Nervo	Tipologia de suporte de costura	Tiras de pele transversais à lombada, em volta das quais passa o fio de costura, e que irá assegurar a solidariedade do corpo do livro aos planos. [4] Geralmente de origem animal e mais grossos do que as fitas. Podem ser simples ou duplos. [1][2][3][4]	Suporte de costura, Nervo de pele, Nervo de corda	Thong, (Genuine) Band	Nerf	Nervio	D, E, F, G		Nervo de tranchefila [2] Quando se considera o termo "nervo" como sinónimo de suporte de costura, diferencia-se o nervo em pele, o nervo em corda e a fita.
Nervo enrolado	Tipologia de nervo	Nervo que é enrolado sobre si mesmo, longitudinalmente, formando um cilindro.	-	Rolled sewing support, Rolled core	-	-	B		
Nervo torcido	Tipologia de nervo	Nervo simples ou duplo torcido em espiral sobre si mesmo (ou sobre cada uma das tiras que o compõem), suportando o fio de costura, nessa estrutura torcida.	-	Twisted sewing support, Twisted core	-	-	E		
Oo									
Orifício	Constituinte das pastas	Orifício que atravessa a pasta da capa à contracapa. Pode ser de secção quadrada ou circular.	Furação	Hole	-	-	C, C'		
Orifício de costura	Constituinte do fólio ou bifólio	Orifícios de formato circular ou fendido, efetuados no festo, que permitem a costura.	-	Sewing hole	-	-	K		
Orifício vazio	Constituinte das pastas	Orifício que atravessa a pasta, da capa à contracapa e surge, geralmente no final do túnel/calha de entrada. Pode ser de secção quadrada ou circular, mas ao contrário dos orifícios comuns, este não é utilizado para a passagem do suporte de costura. Questiona-se a hipótese de servir para auxiliar o empaste.	-	Hole	-	-	B, C, D, G		
Pp									
Página	Constituinte do fólio ou bifólio	Cada face do fólio do livro. [3] [1][3]	-	Page	Page	Página Plana	A, A'		(p., pp.)
Pastas (de encadernação)	Constituinte da encadernação	Planos rígidos que protegem o livro de um lado e de outro. [...] [1] Podem ser formadas por diversos materiais incluindo madeira, cartão, folhas de papel coladas. [1][3]	-	Board	Ais	Tabla	AB, D		Na imagem, "C" é referente à margem do pé da pasta.
Pé	Perspectiva global	A parte inferior do livro, ou de qualquer página, quando posto ao alto, seguindo a orientação do texto. [1][2][3]	-	Wooden peg	Queue	Pie	Img.		Vista inferior

Fig.A3-1. Compiled glossary (continues in the next page).

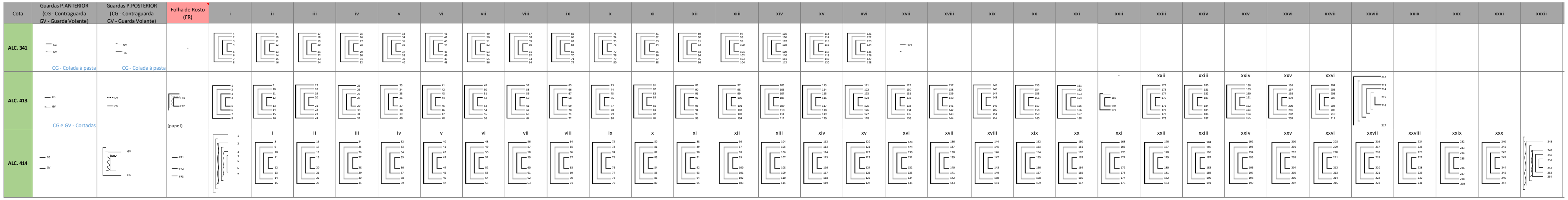
Pestana	Constituinte do fólio ou bifólio	Extremidade dobrada de um fólio, feita para permitir a costura. [1] [1] [2]	Badana, Bandeira, Marcador, Papagaio [1]	Extension guards? Stub? Rim (Muzerelle)	Talon Onglet	Pestaña	E		Em alguns livros a pestana é usada como marcador.
Placa de dobradiça	Constituinte de fecho de encadernação	Placa que apresenta uma dobradiça através da qual se liga a placa de fecho à ataca, garantindo uma maior mobilidade ao fecho.	Placa de charneira	Hinged plate	-	-	I		
Placa de orifício	Constituinte de fecho de placa de orifício e espigão	Tipologia de placas de fecho caracterizadas, pelo orifício central, que permite o encaixe no espigão. Para além deste, pode também apresentar a) uma charneira, que faz a ligação direta à ataca ou a uma placa de charneira, e b) um orifício transversal, no lado oposto, onde era colocado o puxador.	-	Open pin clasp	Tête de fermoir Agrafe Oeillet	Hebilla Ojal	J		Discriminar orifício de placa, orifício transversal e charneira? Dúvidas quanto às traduções Fr. e Espan.
Plano (de encadernação)	Perspectiva global	Faces do livro, por oposição aos cortes e à lombada; distinguem-se entre plano anterior e posterior. [4] [1][2][4]	-	Sides	Plat	Tapa, Plano	A		Vista frontal/traseira Trad. Fran. e Espan. Sinónimos de capa!
Plano anterior	Perspectiva global	Plano que corresponde à face frontal de uma encadernação, isto é, à face onde se encontra o início do texto. [1][2][3]	Capa anterior, Frente, Plano de abertura, Plano superior [1], Plano de dianteira [2], Primeiro plano [2] [3]	Right (side)	-	-	Img.		
Plano posterior	Perspectiva global	Plano que corresponde à face traseira de uma encadernação, isto é, à face onde se encontra o fim do texto. [1] [1][2][3]	Capa posterior, Costa, Plano de fecho, Plano inferior [1], Plano de trás, Segundo plano [2]	Left (side)	-	-	Img.		
Ponto de remate em cadeia	Tipologia de costura	Ponto de costura, tipicamente utilizado nas estações de passagem. É um ponto não suportado, em que o fio é conduzido por trás e por baixo do caderno anterior, antes de entrar pelo festo do caderno seguinte.	-	Kettlestitch, Catch-up stitch	-	-	A, J		Kettle stitch é um ponto de remate em cadeia ("changeover station of the link stitch type")
Prego	Constituinte da guarnição	Haste de metal com uma ponta afiada e outra de maiores dimensões, designada por cabeça do prego, a qual pode apresentar diferentes formatos, nomeadamente: circular plana, circular em cúpula, quadrangular plana, quadrangular em diâmante, etc; normalmente utilizados para discriminar o elemento presente. Serve para unir objetos.	-	Nail, Flat-headed nail, Domed nail	-	-	C		
Puxador	Constituinte de fecho de placa de orifício e espigão	Cordel aplicado no final do orifício transversal da placa de orifício, que servia para facilitar o despreendimento do fecho.	-	Pulls	-	-	B		
Qq									
Rr									
Reforço (de cobertura)	Constituinte de cobertura	Pedaço(s) de material(ais) de cobertura extra (pele, papel ou tecido), adicionado(s) no momento de produção para conferir maior resistência e proteção à estrutura. Pode(m) não cobrir por completo nenhuma das três perspetivas do códice (planos e lombada), podendo apresentar ou não virado(s) para a(s) contracapa(s). [1][3][4]	-	(Board) lining		-	A		
Reforço de tranchefila	Constituinte de tranchefila	Elemento da tranchefila que, através de uma costura independente, une os diversos elementos daquela zona, que geralmente incluem a lingueta e um reforço de cobertura.	-	-	-	-	D		Endband lining
Remate decorativo	Constituinte de cobertura	Elemento decorativo adicionado na margem, ao redor de toda a cobertura.	-	-	-	-	F		
Requife	Constituinte de tranchefila	Cordão aplicado nas extremidades da lombada, entre a cobertura e a espessura do conjunto das folhas. [3] Fio de costura utilizado na tranchefila. No caso da tranchefila *medieval monástica* (?), compreende duas partes: 1) a trança aplicada no suporte da tranchefila, previamente ao empastamento; 2) as duas costuras independentes que surgem uma na cabeça e outra no pé. Estas 2 costuras passam pelos 2 orifícios mais exteriores de todos os cadernos e apresentam um só ponto de remate (geralmente no orifício mais exterior). Para além disto, estas costuras atravessam também a lingueta nos dois orifícios. Geralmente no orifício mais exterior também atravessa o suporte de tranchefila; e no orifício mais interior utiliza o mesmo orifício que a estação de passagem da costura dos cadernos, em conjunto com o ponto de remate desta costura dos cadernos. [1][2][3]	Cabeçada, Sobrecabeceado, Tranchefila, Trincafio [1]	Tiedown	-	-	D C-Costura de ancoragem C' - trança		o tiedown normalmente só se refere à costura 2
Reto	Perspectiva dos fólios/bifólios	Face anterior de um fólio (por oposição ao verso); com o livro aberto corresponde à página da direita. [2] [2]	-	Recto	Recto Belle page	Recto	Img.		
Ss									
Seixas	Constituinte das pastas	Pequeno excedente no tamanho das pastas que ultrapassa o tamanho do corpo do livro, na cabeça goteira, e pé. [1][2][3]	-	Squares	Chasse	Ceja	C		
Sistema de articulação	Constituinte da encadernação	Meios através dos quais o corpo do livro é ligado às pastas, antes da adição dos materiais de cobertura.	-	Board attachment	-	-			As diversas tipologias incluem diversos sistemas de articulação por excedente (empastados, colados, cosidos), costura direta à cobertura, reforços de lombada, etc.
Suporte de costura	Constituinte do sistema de articulação	Componentes colocados transversalmente à lombada (nervos, cordas ou fitas), sobre os quais, é executada a costura, servindo como elemento de união.	Nervo, Nervo de pele, Nervo de corda	Sewing support	-	-	C, D, E, F, G, H, I		Nervo de ... (pele/corda) Garantem também uma maior flexibilidade e resistência à estrutura do que uma costura não suportada.
Suporte de tranchefila	Constituinte de tranchefila	Equivalente ao suporte de costura, mas aplicados nas tranchefilas da cabeça e do pé. Geralmente empastado a 45º, e com um formato e/ou dimensões ligeiramente diferentes dos restantes suportes.	Alma, Nervo da tranchefila [2]	Endband core	Âme, Nerf	Cabezada	B A		CORE diferente SEWING SUPPORT
Suporte duplo	Tipologia de suporte de costura	Tipologia de suporte de costura, composto por dois elementos que formam uma só estação de costura.	Nervo duplo	Double sewing supports	Nerf double	Niervo doble	F, G, I		Nerf não é bem o mesmo que suporte
Suporte empastado	Constituinte de empaste	Nervo que para além de servir de suporte à costura apresenta excedentes destinados ao seu empastamento, independentemente da tipologia.	-	Laced-in slip	Nerf passé	-	D		Nervo empastado é uma tipologia de suporte empastado.
Suporte fendido	Tipologia de nervo	Ocorre quando um nervo simples, apresenta um sulco ao meio, permitindo uma costura, como se tratasse de um nervo duplo. No entanto as extremidades permanecem unidas. Consequentemente quando se observa o nervo empastado, poderá aparentar um nervo simples.	Nervo fendido	Split-strap sewing support, Split-strap core	Nerf fendu	Niervo hendido	F		
Suporte saliente	Tipologia de nervo	Saliências formadas na lombada de um livro encadernado, devido à utilização de suportes de costura, sob os materiais de cobertura.	Nervo saliente	Raised band	-	-	F		
Suporte simples	Tipologia de suporte de costura	Tipologia de suporte de costura, composto por um só elemento que forma uma só estação de costura.	Nervo simples	Single sewing, Strap-type sewing support, Strap core	Flat band	Niervo simple	C, D, E, H		
Tt									
Tábua	Tipologia de pastas	Pranchas de madeira, por vezes adelgaçadas nas arestas, que eram usadas como pastas de encadernação. [1] [1][2]	Pasta de madeira	Wooden board	-	-	G		
Tacha	Tipologia de prego	Prego de dimensões geralmente maiores, utilizado não tanto para unir objetos (embora também possa servir essa função), mas essencialmente com funções de proteção e decoração. Os brochos constituídos por uma só peça podem também ser designados tachas.	Brocho	-	-	-	F, G		
Tranchefila	Constituinte da encadernação	Costura efectuada na cabeça e no pé da lombada, com funções de reforço, proteção e por vezes decorativas (podendo apresentar uma ou mais cores). Existem diversas tipologias que apresentam diferentes elementos, consoante a época/tipologia. [1][2][4]	Requife [1]	Endband	Tranchefile	Cabezada	A		

Fig.A3-1. Compiled glossary (continues in the next page).

Tranchefila da cabeça	Constituinte da encadernação	Tranchefila localizada na zona da cabeça (i.e.. superior) da lombada.	-	Headband	-	-	H		
Tranchefila do pé	Constituinte da encadernação	Tranchefila localizada na zona do pé (i.e.. inferior) da lombada.	-	Tailband	-	-	A		
Tranchefila medieval monástica (?)	*Tipologia de tranchefila*	Na encadernação medieval é uma costura de reforço executada por meio de um ou vários fios independentes da costura principal, sobre um nervo suplementar, em cada uma das extremidades do livro (cabeça e pé). [...][1] Na encadernação medieval convém distinguir três elementos: 1-suporte de tranchefila: para fixação na pasta, onde geralmente empasta em ângulo, com inclinação de 45º. 2- requife (colorido ou não). 3-lingueta cosida, juntamente com o nervo, na cabeça/pé dos cadernos, que pode formar, na extremidade exterior, uma meia lua que ultrapassa os planos. 4-reforço de tranchefila que é adicionado para unir a lingueta a eventuais reforços de cobertura que fossem aplicados na zona, e que pode formar, na extremidade exterior, uma meia lua que ultrapassa os planos; geralmente também apresenta uma costura em ziguezague.[2] [1][2][4]	-	*Tab endband*	-	-	Img. G		
Túnel	Constituinte das pastas	Orifício (de secção retangular, circular ou oval) que atravessa a pasta no seu comprimento, ou seja, é paralelo às faces que constituem os planos.	Canal [2]	Tunnel	-	-	D, D'		
Uu									
Umbílico	Tipologia de brochos	Na encadernação é o brocho ou cravo central, por oposição aos brochos de canto. As formas que assumia eram geralmente arredondadas, podendo apresentar motivos como flores, raios de sol, etc. [1] [1][2][4]	Brocho central, *Clavus* , *Orbicularia, Umbilicus ferratus* [1]	Central boss	Ombilic	Ombligo	G		
Vv									
Verso	Perspectiva dos fólios/bifólios	Face posterior dum fólio, (por oposição ao recto); com o livro aberto corresponde à página da esquerda. [2] [1][2]	-	Verso	Verso	Verso Vuelto	Img.		Geralmente corresponde à página par, da esquerda; lado do pergaminho que corresponde à carne
Virado	Constituinte de cobertura	Extremidades da cobertura, de um livro, que ultrapassam as pastas e são viradas para a contracapa. Existem várias tipologias quanto à forma, dimensão e fixação (colado, cosido/por encaixe, ou com pregos/cavilhas), sendo que as maiores variações ocorrem a nível dos cantos de virado. [1] [1] [2]	-	Turn-ins	Rempli	Doblez	D		Ver "mitres" no ligatus, para os cantos
Virado cosido	Constituinte de cobertura	Bolsa criada na goteira da contracapa (de uma ou ambas as pastas), por costura de um material (que pode ser o excesso da cobertura ou um outro adicionado) à cobertura, nas zonas da cabeça e do pé (e por vezes também da goteira, quando se trata de um elemento novo). Na encadernação medieval, visto que o plano anterior tem uma aba na goteira, geralmente o virado cosido neste plano, é constituído por um novo elemento de um material semelhante, enquanto no plano anterior, sem aba, é utilizado o excedente da cobertura.	-	Sewn pocket	-	-	E, E'		
Volta	Constituinte da costura	Cada uma das voltas completas, realizadas pelo fio de costura, em torno do suporte costura.	Laçada	Loop	Tour mort	Recorrido muerto	M		
Xx									
Zz									

Fig.A3-1. Compiled glossary.

FOLHAdeCOLAÇÃO



Medidas

Cota	Data	Dimensões totais (mm) Alt.	Comp.	Larg.	Dimensões CORPO DE TEXTO (mm) Alt.	Comp.	Larg.	Dimensões do FÓLIO (mm) Alt.	Comp.	Larg.	Distância entre os orifícios dos cadernos (mm) (medir no meio do 1º caderno) Cabeça → 1º O. (T)	1º O. (T) → 2º O. (R)	2º O. (R) → 3º O.(1ºSC)	3º O. (1ºSC) → 4º O. (2ºSC)	4º O. (2ºSC)→ 5º O. (3ºSC)	5º O. (3ºSC)→ 6º O. (4ºSC)	6º O. (xºSC) → 7º O. (R)	xº O. (R)→ yº O. (T)	yº O. (T) → Pé
-	3	560	360	170	469	310	65	460	305	0,2	3	39	45	113	114	95	45	38	4
-	-	430	280	100	400	275	43	396	269	0,2	1	35	41	101	101	95	40	36	2
Exemplo I																			
ALC. 341	2019	430	280	100	400	275	43	396	269	0,2	3	39	44	**113**	**114**	N.A.	45	38	2
ALC. 413	2019	560	360	170	469	310	65	460	305	?	1	37	41	**101**	**101**	**95**	40	37	2
ALC. 414	2019	430	300	145	410	290	65	397	281	0,2	3	35	45	**111**	**109**	N.A.	44	36	4

Cota	% distâncias entre orifícios dos cadernos/altura bloco livro: Cabeça → 1º O. (T)	1º O. (T) → 2º O. (R)	2º O. (R)→ 3º O.(1ºSC)	3º O. (1ºSC) → 4º O. (2ºSC)	4º O. (2ºSC)→ 5º O. (3ºSC)	5º O. (3ºSC)→ 6º O. (4ºSC)	6º O. (xºSC) → 7º O. (R)	xº O. (R)→ yº O. (T)	yº O. (T) → Pé	% distância entre a estação de costura equidistante, teórica seguinte e o limite do corpo do livro: Média	Cabeça		Pé		Espessura do FIO DE COSTURA (mm)
-	VBA- contar cels cor														1,7
-															1,5
Exemplo I															
ALC. 341	0,8	9,8	11,0	28,3	28,5	-	11,3	9,5	0,5	113,5	27,5	**24,229**	28,5	**25,1**	1,5
ALC. 413	0,2	7,9	8,7	21,5	21,5	20,3	8,5	7,9	0,4	101,0	22,0	**21,782**	22,0	**21,8**	?
ALC. 414	0,7	8,5	11,0	27,1	26,6	-	10,7	8,8	1,0	110,0	27,0	**24,545**	26,0	**23,6**	1,7

Cota	Distância entre SUPORTES DE COSTURA (mm) (medir na lombada, o mais próximo do corpo do livro parte inf. do nervo → parte sup. do nervo seguinte) Cabeça → T.	T. → 1º SC	1ºSC. → 2º SC	2ºSC. → 3º SC	3ºSC. → 4º SC	xºSC. → T.	T. → Pé	Correspondência entre ORIFICIOS e SUPORTES de COSTURA 1º SC	2ºSC	3ºSC	Dimensões dos SUPORTES DE COSTURA (mm) (medir no mesmo sitío que a "Distância entre SC") ST (Cabeça) Alt.	Esp.	SC 1 Alt.	Esp.	SC 2 Alt.	Esp.	SC 3 Alt.	Esp.	SC 4 Alt.	Esp.	ST (Pé) Alt.	Esp.	Média das dimensões dos SC Alt.	Esp.	Moda das dimensões dos SC Alt.	Esp.	Dimensões das linguetas: Alt. da Lingueta da Cabeça	Alt. da Lingueta do Pé
-	0	76	102	104	80	80	7	VBA- contar cels cor			10	3	13	3	13	3	13	3	15	0	10	2	13,5	3	#N/D	#N/D	78	79
-	0	60	90	90	80	62	0				6	2	8	2	10	3	9	2	15	0	7	2	9	2,333	-	-	78	79
Exemplo I																												
ALC. 341	0	60	**102**	**104**	N.A.	62	0	11	10	-	10	3	11	3	10	3	11	3	N.A.	N.A.	10	2	10,7	3	11	3	78	79
ALC. 413	0	76	**90**	**90**	**80**	75	0	11	11	15	6	N.O.	13	N.O.	13	N.O.	13	N.O.	15	N.O.	7	N.O.	13,5	-	13	-	N.O.	N.O.
ALC. 414	0	74	**100**	**97**	N.A.	80	7	11	12	-	8	2	8	2	10	3	9	2	N.A.	N.A.	8	2	9	2,333	-	2	N.A.	N.A.

Cota	Data	Dimensões das PASTAS (mm) Plano ANTERIOR Alt.	Comp.	Plano POSTERIOR Alt.	Comp.	Espessura Ver página "Formatos Irregulares" Formato	a	b	c
-						-			
-						-			
Exemplo I									
ALC. 341	2019	400	270	400	275	E	12	N.A.	N.A.
ALC. 413	2019	495	312	490	310	Bi	13	10	6
ALC. 414	2019	420	289	420	290	Bi	12	6	10

Cota	Dimensões do entalhe para entrada do SUPORTE DE COSTURA na PASTA (mm) — Plano ANTERIOR: SC 1 Alt.	Larg.	SC 2 Alt.	Larg.	SC 3 Alt.	Larg.	SC 4 Alt.	Larg.	SC 5 Alt.	Larg.	SC 6 Alt.	Larg.	Plano POSTERIOR: SC 1 Alt.	Larg.	SC 2 Alt.	Larg.	SC 3 Alt.	Larg.	SC 4 Alt.	Larg.	SC 5 Alt.	Larg.	SC 6 Alt.	Larg.
-																								
-																								
Exemplo I																								
ALC. 341	15	7	15	5	11	6	15	6	15	6	N.A.	N.A.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.
ALC. 413	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.
ALC. 414	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	9	N.A.	11	N.A.	13	N.A.	11	N.A.	9	N.A.	N.A.	N.A.

Cota	CALHAS do Plano ANTERIOR — DIMENSÕES (mm) (Nota: Contar com a tranchefila) CAPA: C 1 Alt.	Comp.	C 2 Alt.	Comp.	C 3 Alt.	Comp.	C 4 Alt.	Comp.	C 5 Alt.	Comp.	C 6 Alt.	Comp.	CONTRACAPA: C 1 Alt.	Comp.	C 2 Alt.	Comp.	C 3 Alt.	Comp.	C 4 Alt.	Comp.	C 5 Alt.	Comp.	C 6 Alt.	Comp.
-																								
-																								
Exemplo I																								
ALC. 341	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	10	26	12	45	12	35	12	40	12	29	N.A.	N.A.
ALC. 413	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	11	32	12	35	14	40	12	58	12	50	11	55
ALC. 414	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.

Cota	CALHAS do Plano ANTERIOR — DISTÂNCIAS (mm) (NOTA: medir na CONTRACAPA, na direção cabeça → pé) ARESTA da LOMBADA → 1º ORIFÍCIO (NOTA: medir no canto superior da calha; sem contar com a tranchefila. NOTA II: Cabeça (1) → pé (6)) 1	2	3	4	5	6	Entre CALHAS (parte inf. da calha → parte sup. da calha seguinte) (NOTA: Medir no canto mais próx. lombada, sem contar com a tranchefila. NOTA II: Cabeça (1) → pé (6)) 1	2	3	4	5
-											
-											
Exemplo I											
ALC. 341	19	20	15	N.A.	N.A.	N.A.	100	105	N.A.	N.A.	N.A.
ALC. 413	27	25	27	24	N.A.	N.A.	90	90	80	N.A.	N.A.
ALC. 414	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.

CALHAS do Plano ANTERIOR — DISTÂNCIAS (mm) (NOTA: medir na CONTRACAPA, na direção cabeça → pé)

Tranchefila da CABEÇA: aresta da lombada → c	d	aresta da cabeça → a	b	d → parte sup. da calha seguinte	Tranchefila do PÉ: aresta da lombada → a	d	aresta do pé → b	c	d → parte inf. da calha anterior
19	9	19	24	51	22	11	23	12	59
46	17	17	30	64	70	22	47	25	55
N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.

CALHAS do Plano POSTERIOR — DIMENSÕES (mm) (Nota: Contar com a tranchefila)

CAPA: C 1 Alt.	Comp.	C 2 Alt.	Comp.	C 3 Alt.	Comp.	C 4 Alt.	Comp.	C 5 Alt.	Comp.	C 6 Alt.	Comp.	CONTRACAPA: C 1 Alt.	Comp.	C 2 Alt.	Comp.	C 3 Alt.	Comp.	C 4 Alt.	Comp.	C 5 Alt.	Comp.	C 6 Alt.	Comp.
N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.
N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.
N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	9	35	12	40	11	41	13	37	10	29	N.A.	N.A.

CALHAS do Plano POSTERIOR — DISTÂNCIAS (mm) (NOTA: medir na CONTRACAPA, na direção cabeça → pé)

ARESTA da LOMBADA → 1º ORIFÍCIO (NOTA: medir no canto superior da calha; sem contar com a tranchefila) 1	2	3	4	5	6	Entre CALHAS (parte inf. da calha → parte sup. da calha seguinte) (NOTA: Medir no canto mais próx. lombada, sem contar com a tranchefila) 1	2	3	4	5	Tranchefila da CABEÇA: aresta da lombada → c	d	aresta da cabeça → a	b	d → parte sup. da calha seguinte	Tranchefila do PÉ: aresta da lombada → a	d	aresta do pé → b	c	d → parte inf. da calha anterior
N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.
N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.
22	17	16	20	25	N.A.	95	95	N.A.	N.A.	N.A.	18	19	18	26	71	47	22	22	14	75

Dimensões dos materiais de cobertura (mm)

Cobertura Exterior: Alt. da LOMBADA (medir do exterior do plano sup. ao ext. do plano post.)	Larg. da LOMBADA (medir do exterior do plano sup. ao ext. do plano post.)	Alt. ABA da CABEÇA (medir no canto, do final da madeira até ao final da aba)	Alt. ABA do PÉ (medir no canto, do final da madeira até ao final da aba)	Comp. ABA da GOTEIRA (medir no canto, do final da madeira até ao final do envelope)	Virado Cozido PA (medir no canto, do final da madeira até ao final do virado) Alt.	Comp.	Virado Cozido PP (medir no canto, do final da madeira até ao final do virado) Alt.	Comp.	Cobertura Interior: Alt. VIRADO da CABEÇA (medir no canto, do final da madeira até ao final do virado)	Alt. VIRADO do PÉ (medir no canto, do final da madeira até ao final do virado)	Comp. VIRADO da GOTEIRA (medir no canto, do final da madeira até ao final do virado)
610	100	50	115	275	495	120	495	125	0	0	0
430	75	40	115	275	430	80	430	80	0	0	0
470	75	50	N.A.	N.A.	460	120	430	125	N.A.	N.A.	N.A.
610	100	40	115	275	495	80	495	80	N.A.	N.A.	N.A.
430	100	N.A.	N.A.	N.A.	430	115	435	80	N.A.	N.A.	N.A.

Reforços

Número Reforço (ver ficheiro "Coberturas")	Alt. na capa	Comp. Total na Capa	Alt. VIRADO na CABEÇA (medir no canto, do final da madeira até ao final do virado)	Alt. VIRADO no PÉ (medir no canto, do final da madeira até ao final do virado)	Comp. VIRADO na GOTEIRA (medir no canto, do final da madeira até ao final do virado)	Número Reforço (ver ficheiro "Coberturas")	Alt. na capa	Comp. Total na Capa	Alt. VIRADO na CABEÇA	Alt. VIRADO no PÉ	Comp. VIRADO na GOTEIRA
-	560	635	45	40	0	-	50	635	0	425	0
-	50	53	20	40	0	-	30	115	0	35	0
5	50	635	35	N.A.	N.O.	6	50	635	N.A.	35	N.O.
3	560	580	45	40	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
4	165	53	20	N.A.	N.A.	5	30	115	N.A.	425	N.A.

Número Reforço (ver ficheiro "Coberturas")	Alt. na capa	Comp. Total na Capa	Alt. VIRADO na CABEÇA (medir no canto, do final da madeira até ao final do virado)	Alt. VIRADO no PÉ (medir no canto, do final da madeira até ao final do virado)	Comp. VIRADO na GOTEIRA (medir no canto, do final da madeira até ao final do virado)	Número Reforço (ver ficheiro "Coberturas")	Alt. na capa	Comp. Total na Capa	Alt. VIRADO na CABEÇA	Alt. VIRADO no PÉ	Comp. VIRADO na GOTEIRA
	425	255	0	38	0		77	90	0	0	0
	425	255	0	38	0		77	90	0	0	0
N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
6	425	255	N.A.	38	N.A.	7	77	90	N.A.	N.A.	N.A.

Fig.A4-1. Characterization method's collating, measurements and material analyses tables already filled with the data of the three case-studies (continues in the next page).

Cota	Data	Dimensões dos materiais de cobertura (mm)																		
		Reforços																		Alt. do REMATE decorativo (medir na cabeça, junto à goteira)
		Número Reforço (ver ficheiro "Coberturas")	Alt. na capa	Comp. Total na Capa	Alt. VIRADO na CABEÇA (medir no canto, do final da madeira até ao final do virado)	Alt. VIRADO no PÉ (medir no canto, do final da madeira até ao final do virado)	Comp. VIRADO na GOTEIRA (medir no canto, do final da madeira até ao final do virado)	Número Reforço (ver ficheiro "Coberturas")	Alt. na capa	Comp. Total na Capa	Alt. VIRADO na CABEÇA (medir no canto, do final da madeira até ao final do virado)	Alt. VIRADO no PÉ (medir no canto, do final da madeira até ao final do virado)	Comp. VIRADO na GOTEIRA (medir no canto, do final da madeira até ao final do virado)	Número Reforço (ver ficheiro "Coberturas")	Alt. na capa	Comp. Total na Capa	Alt. VIRADO na CABEÇA (medir no canto, do final da madeira até ao final do virado)	Alt. VIRADO no PÉ (medir no canto, do final da madeira até ao final do virado)	Comp. VIRADO na GOTEIRA (medir no canto, do final da madeira até ao final do virado)	
-	3		90	90	0	0	0		90	0	0	0	0		70	90	0	0	0	
-	-		90	90	0	0	0		90	0	0	0	0		70	90	0	0	0	
Exemplo I																				
ALC. 341	2019	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	10
ALC. 413	2019	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	13
ALC. 414	2019	8	90	90	N.A.	N.A.	N.A.	9	90	N.O.	N.A.	N.A.	N.A.	10	70	90	N.A.	N.A.	N.A.	N.A.

Cota	Distâncias entre os FECHOS (mm) (medir na goteira, no lado das tiras) cabeça → pé							
	Plano ANTERIOR (Ataca)			Plano POSTERIOR (Espigão)				
	Cabeça → Fecho Superior	Entre Fechos	Fecho Inferior→ Pé	Cabeça → Fecho Superior	Entre Fechos	Fecho Inferior→ Pé	Goteira → Fecho Superior	Goteira → Fecho Inferior
-	100	235	102					
-	87	155	97					
Exemplo I								
ALC. 341	99	155	102	110	175	110	63	63
ALC. 413	100	235	100	115	266	100	93	114
ALC. 414	87	191	97	115	197	100	157	160

Cota	Dimensões do FECHO SUPERIOR (mm)												Dimensões do FECHO INFERIOR (mm)											
	ESPIGÃO			ATACA			PLACA DE ORÍFICIO			PUXADOR			ESPIGÃO			ATACA			PLACA DE ORÍFICIO			PUXADOR		
	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.
-	4	4	9	30	182	4	28	73	10	0	0	0	4	4	9	30	260	4	48	60	8	0	0	0
-	3	3	8	20	145	4	28	73	10	0	0	0	3	3	8	20	182	3	48	60	8	0	0	0
Exemplo I																								
ALC. 341	3	3	9	20	N.A.	4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	3	3	9	20	N.A.	4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
ALC. 413	4	4	8	30	145	4	28	73	10	N.A.	N.A.	N.A.	4	4	9	30	182	4	48	60	8	N.A.	N.A.	N.A.
ALC. 414	3	3	8	30	182	4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	3	3	8	21	260	3	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Dimensões Totais dos BROCHOS (mm)																																
Plano ANTERIOR															Plano POSTERIOR															Média		
Brocho 1			Brocho 2			Brocho 3			Brocho 4			Brocho 5			Brocho 6			Brocho 7			Brocho 8			Brocho 9			Brocho 10					
Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.
70	65	20	50	50	25	81	98	26	35	35	15	55	65	27	85	95	23	98	102	25	91	93	23	82	75	23	97	94	25	82	86	24
45	45	16	40	40	13	40	40	11	35	35	15	38	38	15	39	39	11	42	42	13	38	38	12	40	40	15	39	39	15	40	40	14
45	45	16	40	40	13	40	40	11	35	35	15	38	38	15	39	39	11	42	42	13	38	38	12	40	40	15	39	39	15	40	40	14
70	65	20	N.A.	N.A.	N.A.	81	98	25	N.A.	N.A.	N.A.	55	65	20	85	95	23	98	102	25	91	93	23	82	75	23	97	94	25	82	86	23
N.A.	N.A.	N.A.	50	50	25	47	47	26	N.A.	N.A.	N.A.	47	47	27	N.A.	N.A.	N.A.	54	54	25	49	49	22	50	50	21	52	52	22	50	50	24

Dimensões da Cabeça dos BROCHOS (mm)																														Dimensões das cabeças dos pregos			
Plano ANTERIOR															Plano POSTERIOR																		
Brocho 1			Brocho 2			Brocho 3			Brocho 4			Brocho 5			Brocho 6			Brocho 7			Brocho 8			Brocho 9			Brocho 10						
Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Alt.	Comp.	Larg.	Menor		Maior	
																														Diâm.	Larg.	Diâm.	Larg.
19	19	18	16	16	20	17	17	22	15	15	10	17	17	20	15	17	21	19	19	23	18	18	20	17	17	20	20	20	20				
18	18	12	13	13	9	15	15	8	15	15	10	14	15	9	13	13	6	13	13	8	13	13	8	14	14	9	15	15	8				
18	18	12	13	13	9	15	15	8	15	15	10	15	15	9	13	13	6	13	13	8	13	13	8	14	14	9	15	15	8	8	1	3	1
19	19	18	N.A.	N.A.	N.A.	17	17	22	N.A.	N.A.	N.A.	14	15	18	15	17	21	18	18	23	18	18	20	14	15	20	18	17	20	5	1	7	1
N.A.	N.A.	N.A.	16	16	20	16	16	19	N.A.	N.A.	N.A.	17	17	20	N.A.	N.A.	N.A.	19	19	18	15	15	17	17	17	18	20	20	16	6	4	9	1

Análises materiais

Cota	Principais elementos															
	Texto				Iluminura				Suporte de escrita				Fio de costura			
	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EXEMPLO I																
ALC. 341	9-11/3 /2020	in situ	h-EDXRF - f.1v, 65v e 129r DM - f.1v, 21v, 103r, 103v e 129r	Ca, Fe, Ti (Ni, Cu, Si ?)	9-11/3 /2020 23-25/3 /2019	in-situ	Vis-NIR-FORS UV-Vis-FORS	Vermelho e. - Goma laca (UV e NIR) Vermelho c. - HgS (UV e NIR) Verde - Proteinato (?) de cobre (UV e NIR) Ligante - Clara de ovo (NIR)	9-11/3 /2020 02/03 /2020	in situ	h-EDXRF - f.1v Vis-Nir - f.1v MD	Ca, Fe (Ni, Ti, S?) Inconclusivo	04/06 /2019 25/06 /2019	x	MO ATR-FTIR	Bast fibre Inconclusivo
ALC. 413	-	-	-	-	-	-	-	-	02/03 /2020	in situ	MD	Inconclusivo	-	RI	N.A.	N.A.
ALC. 414	-	-	-	-	23-25/3 /2019	in-situ	UV-Vis-FO	Vermelho e. - Goma laca Vermelho c. - HgS Verde - Proteinato de cobre	02/03 /2020	in situ	MD	Inconclusivo	04/06 /2019 25/06 /2019	x	MO ATR-FTIR	Bast fibre Inconclusivo

Cota	Principais elementos															
	Suporte de costura				Pastas				Reforços				Cobertura interna			
	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EXEMPLO I																
ALC. 341	02/03 /2020 24/05 /2019	in situ x	MD µ-EDXRF	Inconclusivo s/Al (inconclusivo)	02/03 /2020 27/01 /2020	in situ x	MD MO SEM	Folhosa (Castanheiro?)	02/03 /2020 24/05 /2019	in situ x	MD µ-EDXRF	Inconclusivo s/ Al (inconclusivo)	N.A.	N.A.	N.A.	N.A.
ALC. 413	02/03 /2020	in situ	MD	Inconclusivo	02/03 /2020 22/05 /2020	in situ x	MD MO SEM	Folhosa (Faia, Plátano, Carpinus?)	02/03 /2020	in situ	MD	Inconclusivo	N.A.	N.A.	N.A.	N.A.
ALC. 414	02/03 /2020	in situ	MD	Inconclusivo	02/03 /2020 22/05 /2020	in situ x	MD MO SEM	Folhosa (Castanheiro?)	02/03 /2020	in situ	MD	Inconclusivo	N.A.	N.A.	N.A.	N.A.

Cota	Principais elementos																			
	Cobertura externa				Virado cosido				Fecho de encadernação (ataca)				Fecho de encadernação (placas)				Brochos			
	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EXEMPLO I																				
Alc. 341	02/03/2020	in situ	MD	Inconclusivo	02/03/2020 24/05/2019	in situ x	MD µ-EDXRF	Inconclusivo s/ Al (inconclusivo)	02/03/2020	in situ	MD	Inconclusivo	N.A.	N.A.	N.A.	N.A.	23-25/3 /2019	in-situ	h-EDXRF	Todos: Liga Cu-Sn-Pb-(Fe)-(Ti)
Alc. 413	02/03/2020 24/05/2019	in situ x	MD µ-EDXRF	Inconclusivo s/ Al (inconclusivo)	02/03/2020	in situ	MD	Inconclusivo	02/03/2020	in situ	MD	Inconclusivo	23-25/3 /2019	in-situ	h-EDXRF	FS(P2 e P4)-Liga Cu-Sn-Zn-Fe-Pb-(Ti)-(Ag) FS(P3)- Liga Cu-Sn-Fe-Pb-(Ti)-(Au) FI-Liga Cu-Sn-Fe-Pb-(Ti)	23-25/3 /2019	in-situ	h-EDXRF	Todos: Liga Cu-Sn-Pb-(Fe)-(Ti) PP P3: os anteriores mais (As)
Alc. 414	02/03/2020	in situ	MD	Inconclusivo	02/03/2020	in situ	MD	Inconclusivo	02/03/2020 24/05/2019	in situ x	MD µ-EDXRF	Inconclusivo s/ Al (inconclusivo)	N.A.	N.A.	N.A.	N.A.	23-25/3 /2019	in-situ	h-EDXRF	Todos: Liga Cu-Sn-Pb-(Fe)-(Ti) PP P1: menos Sn

Cota	Outros elementos - QUAIS?																							
	Pregos da etiqueta (?)				Pregos do fecho (ataca-pasta)				Remate Decorativo				Fio do remate				Fio da cobertura				Etiqueta da Cota (?)			
	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado	Data	Amostras	Análise	Resultado
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EXEMPLO I																								
Alc. 341	N.A.	N.A.	N.A.	N.A.	N.O.	N.O.	N.O.	N.O.	02/03 /2020	in situ	MD	Inconclusivo	-	-	-	-	-	-	-	-	-	-	-	-
Alc. 413	N.A.	N.A.	N.A.	N.A.	N.O.	N.O.	N.O.	N.O.	02/03 /2020	in situ	MD	Inconclusivo	-	-	-	-	-	-	-	-	-	-	-	-
Alc. 414	23-25/3 /2019	in-situ	h-EDXRF	Liga Cu-Pb-Fe-(Ca)-(Ti)-(Au)	23-25/3 /2019	in-situ	h-EDXRF	Liga Cu-Pb-Fe-(Ca)-(Ti)-(Au)	02/03 /2020	in situ	MD	Inconclusivo	-	-	-	-	-	-	-	-	-	-	-	-

Fig.A4-1. Characterization method's collating, measurements and material analyses tables already filled with the data of the three case-studies.

APPENDIX.5. In-depth codicological results

A5.1. PROPOSAL FOR INTERPRETATION OF MEASURED DATA REGARDING SEWING STRUCTURES (HOLES AND STATIONS)

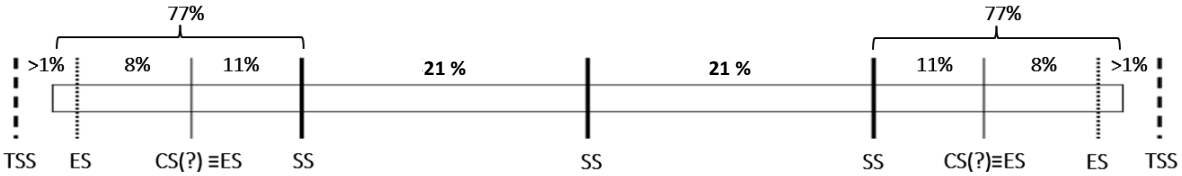


Fig.A5-1. Based on Szirmai's schemes [37, p.145], the author drew the scheme above according to the data recorded in measurements' table for sewing holes and stations distancing (Appx.4). Heavy vertical lines correspond to main sewing stations (SS) which are equidistant among them (ca. 24% and ca. 21% of the codices' height for the three and four sewing stations codices, respectively). Heavy broken lines (TSS) represent the next theoretical, equidistant station (ca. 23% beyond the bookblock's limit). Simple vertical lines correspond to what the author believes (they were not observed due to tabs and linings) to be changeover stations (CS). Two of the four endbands' stations (ES) seem to overlap with these changeover stations. The other two are represented by the simple broken lines. These last two stations also appear to follow strict patterns, as the distance between endbands stations is in average 8%, and the distance between change over stations and the closer sewing station is about 11% and 8% for three and four sewing stations codices, respectively. Outer endbands stations also occur mostly very close to the limit of the bookblock (less than 1%). The image follows the model of Alc.341's data, but as can be seen in the data recorded in Appx.4 it is proportional to the measures of the other two codices.

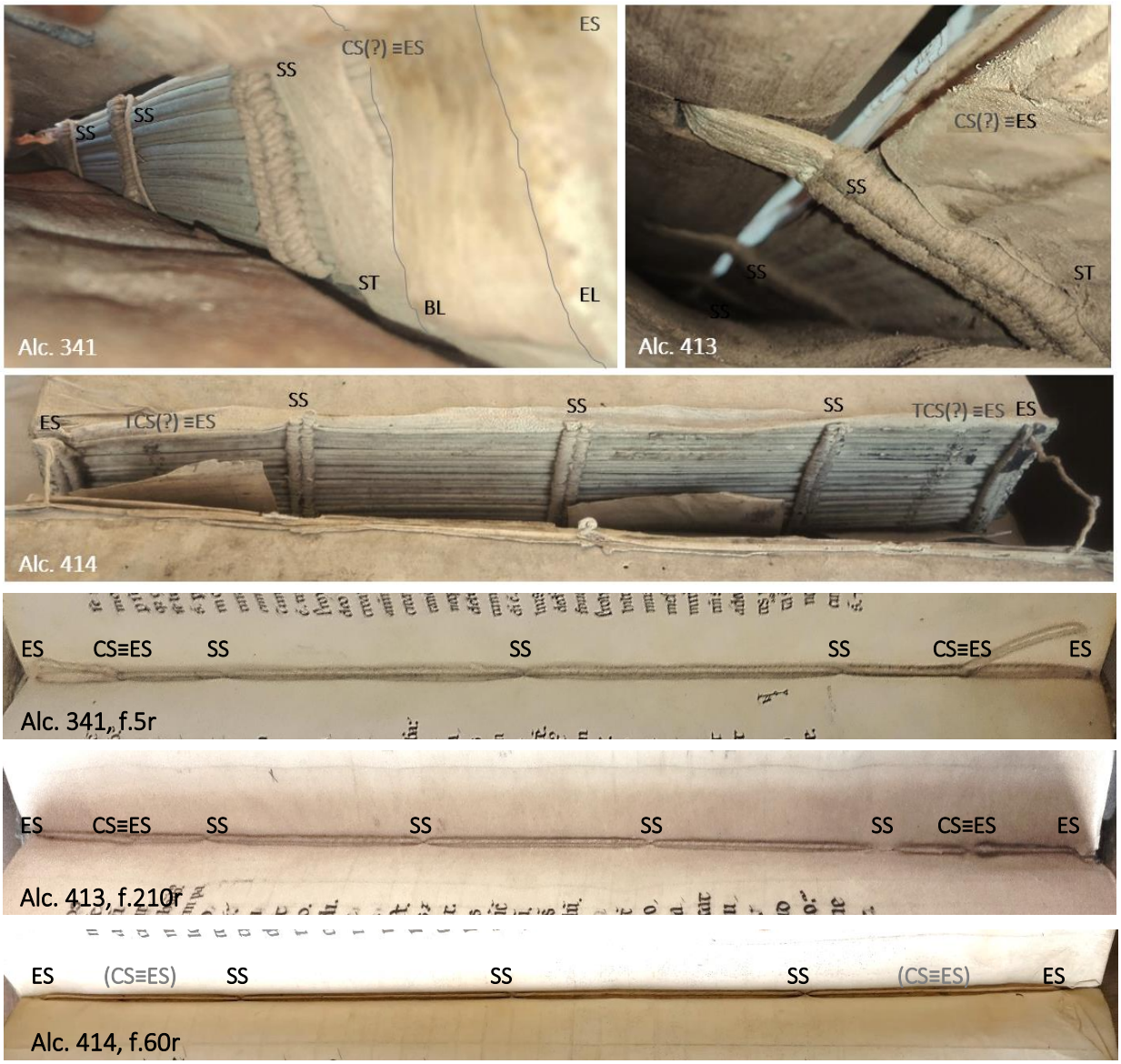


Fig.A5-2. Images of codices illustrating holes and stations distribution (as seen before holes measurements match those of sewing stations). See how changeover-stations cannot be observed (grey text) due to spine tabs (ST), board linings (CL) and endband linings (EL) or, in case of Alc. 414, they do not exist at all (TCS). The other two codices must have a change-over stations, because there is an extra passage at the same location, in the centre-folds. In Alc. 414 this passage is absent.

A5.2. ENDBANDS STRUCTURES' FEATURES OBSERVED IN THE CASE-STUDIES

Fig.A5-3. Alc.414's head (left and middle) and tail (right) endbands, which correspond with the first and last sewing supports, respectively.

Fig.A5-4. Alc.413's head (left) and tail (middle) endbands. A detail (right) at the head shows how the thread encircles the endband core. Spine tabs are shorter than the ones from Szirmai's proposal as they do not extend beyond the codex's limits. [37, p.160] Nonetheless, they were observed in Fig.A5-2 and the mirror in the detail image shows the typical pattern (tiedown) formed by the thread in these tabs – the thread runs in parallel lines (white arrow). The image in the middle also glimpses how the endband's core twists (black arrow).

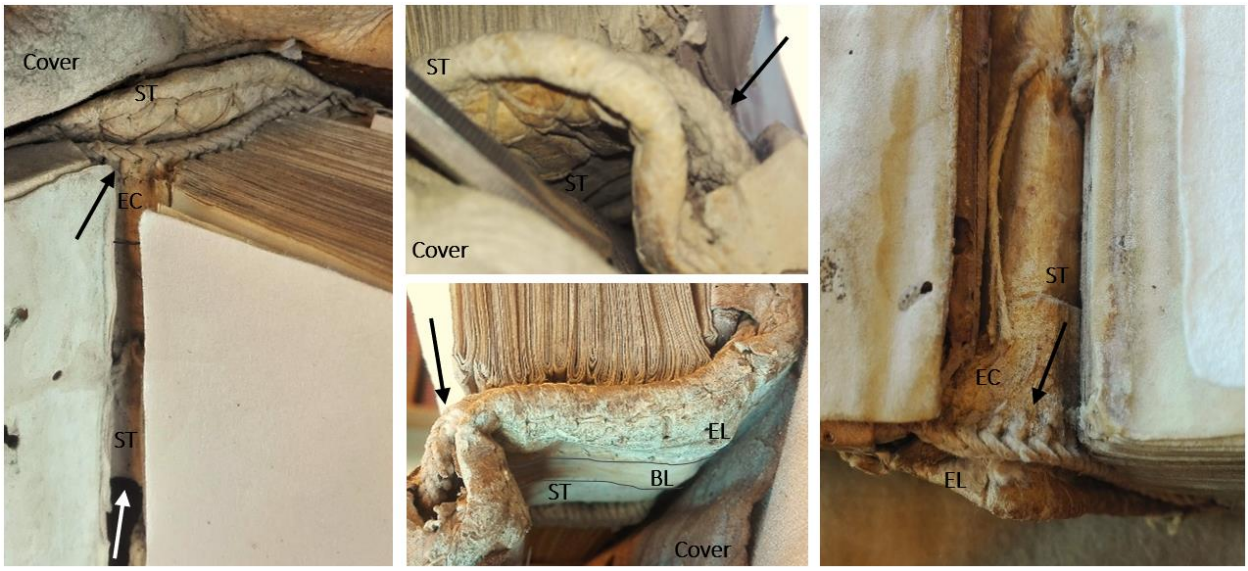


Fig.A5-5. Alc.341's head (left and middle top) and tail (right and middle bottom) endbands. Head's endband has a spine tab (ST) folded to form a semi-circle much more pronounced than tail's, because the later one has an additional endband lining (EL) that was sewn above all the other tabs and linings that make up the endband. (Fig. A5-6) See how a braid (black arrows) was sewn on the outside edge of the endband core (EC) and how the spine tab does not extend to the entire codex's spine (white arrow).

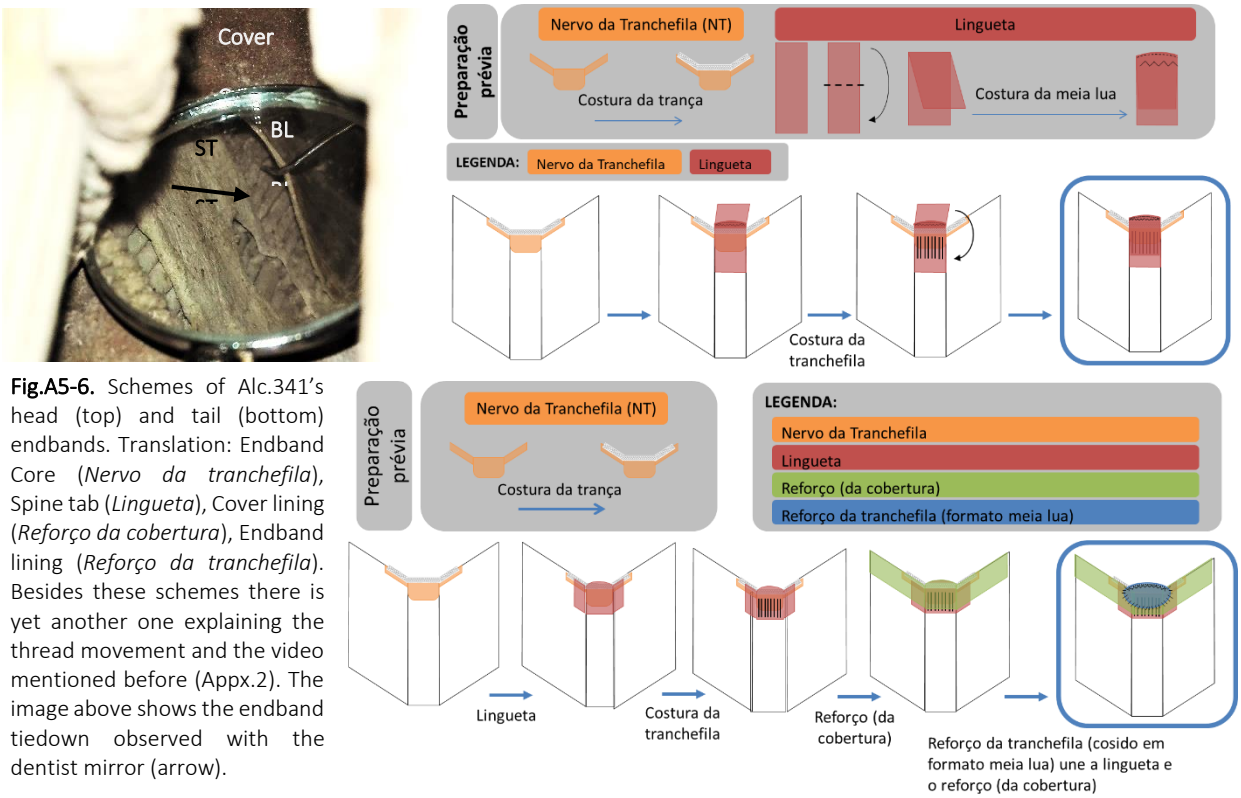


Fig.A5-6. Schemes of Alc.341's head (top) and tail (bottom) endbands. Translation: Endband Core (*Nervo da tranchefila*), Spine tab (*Lingueta*), Cover lining (*Reforço da cobertura*), Endband lining (*Reforço da tranchefila*). Besides these schemes there is yet another one explaining the thread movement and the video mentioned before (Appx.2). The image above shows the endband tiedown observed with the dentist mirror (arrow).

A5.3. SEWING STRUCTURES' FEATURES OBSERVED IN CASE-STUDIES

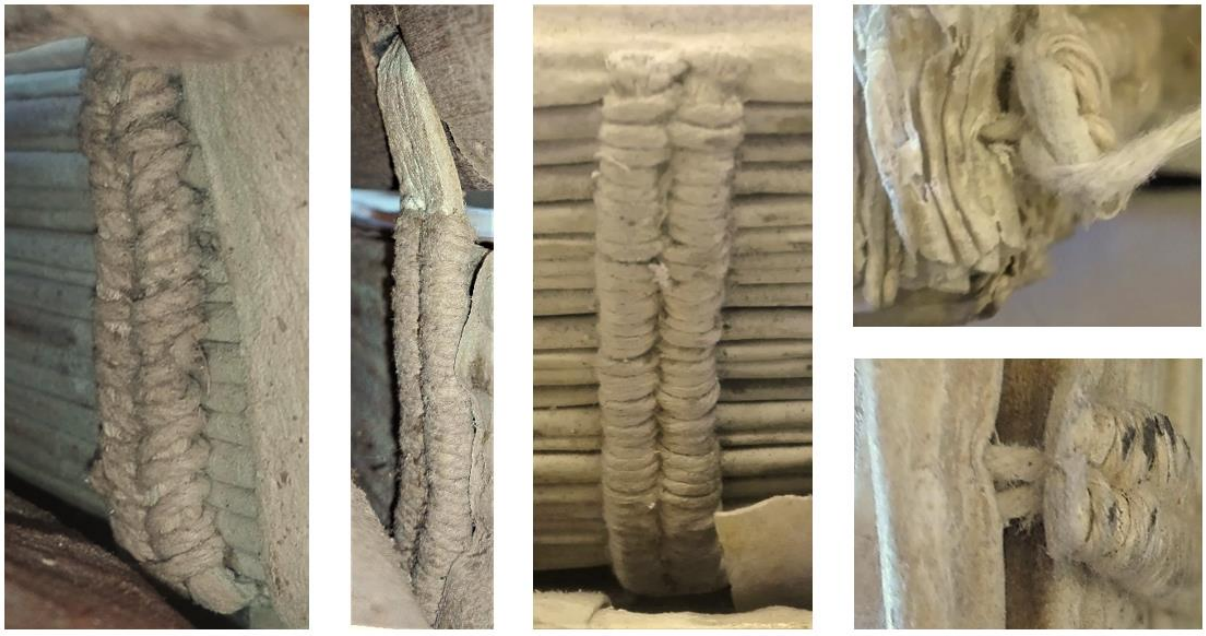


Fig.A5-7. Alc. 341's herringbone sewing (left) and Alc. 413 (middle left) and Alc. 414's (middle right) packed straight sewing. The details on the right show a single thread running through the centre-folds, at the tailband (top), and two threads running at the sewing stations (bottom) which agrees with Szirmai's descriptions of an integral sewing. [37]

A5.4. BOARD ATTACHMENT SYSTEMS' FEATURES OBSERVED IN THE CASE-STUDIES

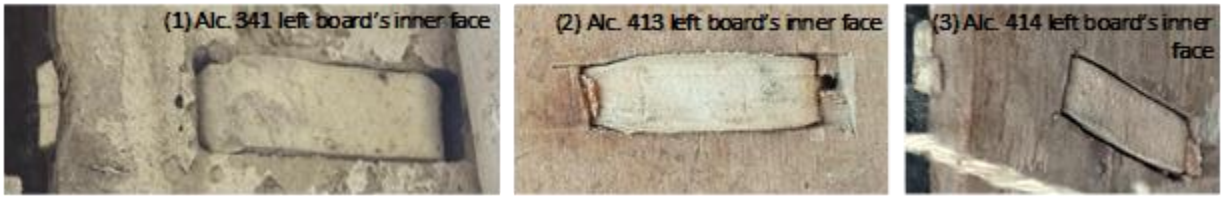


Fig.A5-8. Board attachment systems were inferred after observation of some features (continues in the next page).

Fig.A5-8. Board attachment systems were inferred after observation of some features. In case of Alc. 341, note how there is no wedge or peg at the channel (1), but the sewing supports enter through tunnels at the boards' thickness, closer to the inner face (white arrows in 4 & 5), and exit at the same place, closer to the board's outer face (black arrows in 4 & 5). These observations suggest that at some point the supports turn around and come back to the spot where they entered. An attentive look showed a channel in the left board outer face (7) as would happen if the scheme in the tables (Fig.4) designed by Nascimento & Diogo [23] was correct, confirming the use of a round lacing system. Regarding Alc. 341, also note how the slit is not observable in the image of the left board (4) but is very evident in the image of the right board (5), showing how it extends beyond the bookblock width. The other two codices have wedges in the channels indicating the end of the sewing supports (2 & 3), their sewing supports enter the boards by channels in the board's outer faces (6, 8 & 9) and we observed traces of holes were the supports end in the boards' outer faces (arrows in 6 & 10). These observations match carves' disposition of the schemes by Nascimento & Diogo. [23] (Fig.4) Note that contrary to Alc. 341, Alc. 414 thongs' slits do not extend beyond the bookblock width (arrows in 8 & 9). The images further show evidences of working tools used to carve the boards like darker surroundings, holes and scratches suggesting the use of heated and scraping tools.

A5.5. COVERING CONSTITUENTS' FEATURES OBSERVED IN THE CASE-STUDIES

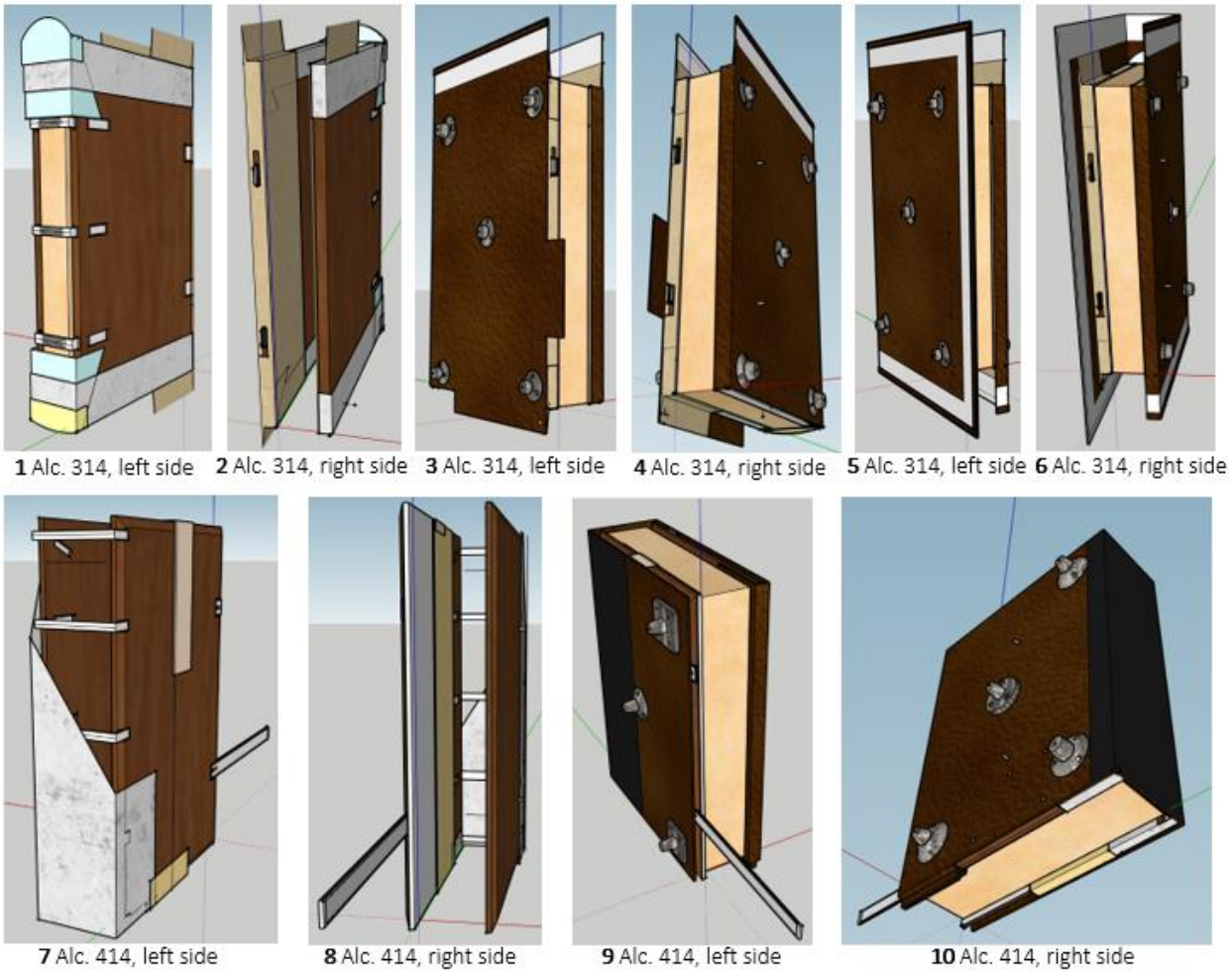


Fig.A5-9. Digital prototypes illustrate: i) linings disposition in Alc. 341 (1,2) and in Alc. 414 (7, 8), ii) current appearance of Alc. 341 (3, 4) and Alc. 414 (9, 10); and iii) what the author believes was Alc. 341 before damage (5, 6).

Fig.A5-10. Turn-ins' cuts in Alc. 341 (1), Alc. 413 (2) and Alc. 414 (3 & 4). Note how they are all very regular, apart from the one of Alc. 413. Alc. 341 turn-in's corner has a mitred cut (5). It is also possible to observe several residues of adhesives associated to the linings. However, image (6) shows that these residues are not visible in the boards' outer faces (below Alc. 414 cover). This, plus the fact that it is possible to introduce a thin spatula in-between the cover and the board in all the three codices, suggests that covers were not pasted/glued to the boards, unlike linings and endleaves. Adhesive residues were neither observed at the spines between the cover and the gatherings' folds (7 & 8).

Fig.A5-11. Case-studies' cover extensions (above). The ones from Alc. 414 are already lost. Below, images of sewn pockets (left and right respectively) of the three case-studies, and finishing straps of Alc. 341 of Alc. 413 (right limit).

A5.6. FASTENINGS' FEATURES OBSERVED IN THE CASE-STUDIES

Fig.A5-12. Alc. 413's fastenings (continues in the next page).

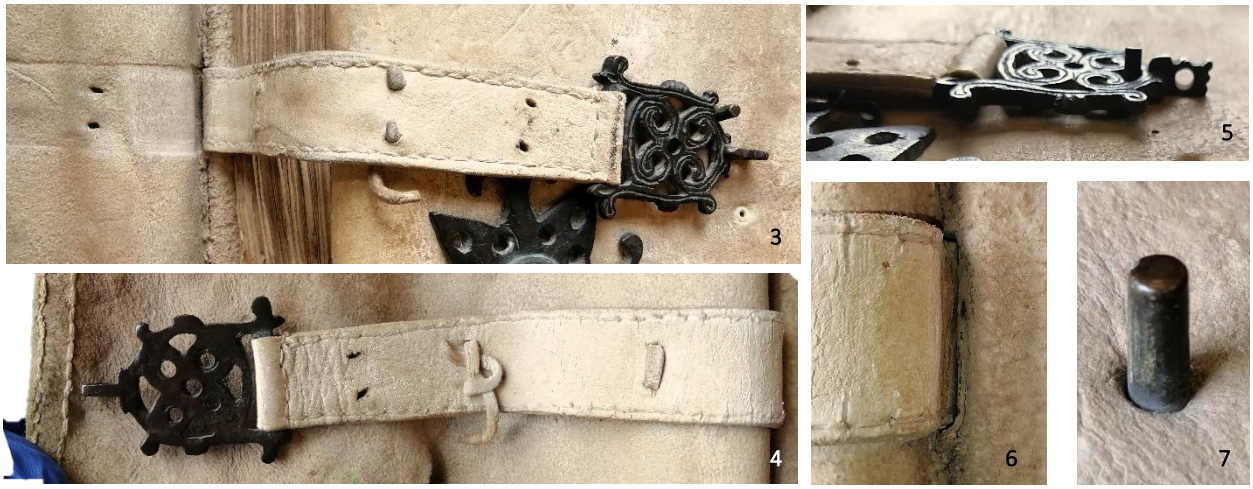


Fig.A5-12. Alc. 413's fastenings. The two images above show the upper fastening (1,2), where one can see the sewing to the fore-edge's cover extension, the hinge plate and the open pin clasp plate. Note how the fastening does not reach the correspondent pin. The remaining images illustrate full shots of the lower fastening (3-front and 4-back) and its details, namely the open pin clasp plate mounted on the pin (5-note how it is not centred with the central hole), the strap entering through the sewn pocket to be riveted to the left board's outer face (6) and the pin (7). In (4) note how the strap's fold encircles the hinge of the clasp plate.

Fig.A5-13. Alc. 414's fastenings. The two images on the left show the lower fastening (1,2), where one can see the traces of the sewing to the fore-edge's cover extension. The clasp was lost, but the strap appears to have the proper size to reach its pin and has very similar format to Alc. 413's lower strap. Two details in the middle show the upper fastening riveted to the upper board, in a channel (3) and the lower pin (5). The image on the right (6) is from Alc. 341's lower fastening and it shows how the strap (with a sheet of parchment in between what should be the two parts of a folded strap) exits through the sewn pocket.

A5.7. FASTENINGS' FEATURES OBSERVED IN THE CASE-STUDIES

Fig.A5-14. Some of the metal bosses observed in the codices. The circular ones were the most observed, while no literature match could be determined for the more intricate ones.

Fig.A5-15. Alc. 414 (right) has five nails in the outer face of the left board, near the tail. They are disposed has a rectangle and may be related with a tag for the title. Alc. 413 does not have the nails, but has 5 holes disposed in the same manner, which could indicate a common function.

APPENDIX.6. In-depth material analyses' results

A6.1. DATA ACQUIRED IN THE MATERIAL ANALYSIS OF ALC.341'S INK AND PAINTS (EDXRF, FORS, HI, DM)

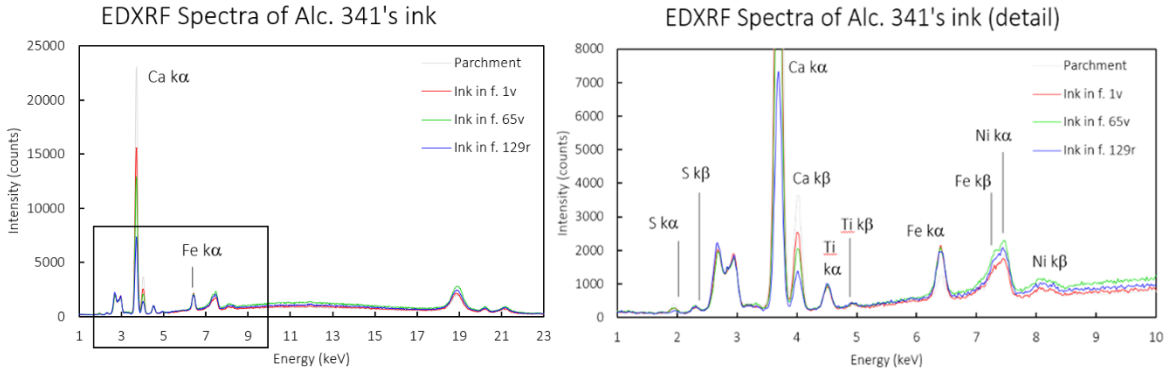


Fig.A6-1. EDXRF Spectra of Alc. 341's ink showing main elements present: Ca, Fe, (Ti), (Ni) and (S). Note the variance in the height of peaks of Ca and Fe, between ink and parchment's spectra.

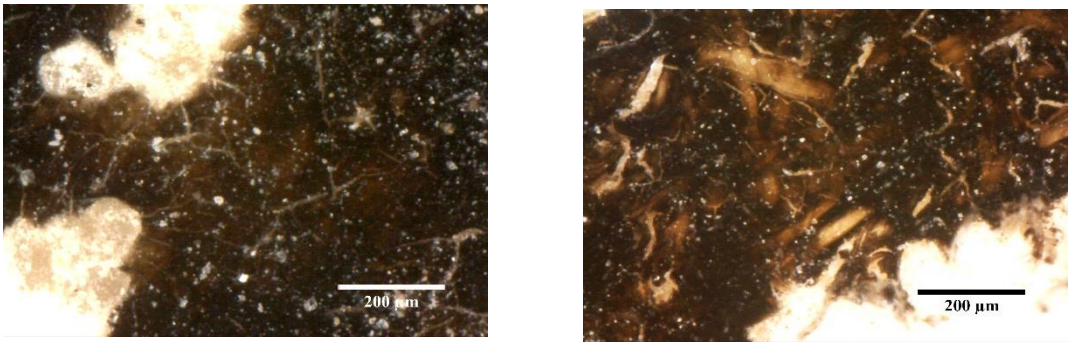


Fig.A6-2. DM photographs of Alc. 341's ink, f.21v (left) and f.129r (right). Note the ink's intensity of colour and uniform coverage.

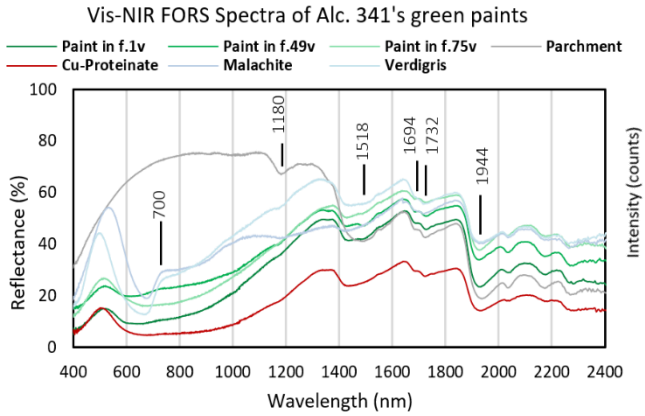


Fig.A6-3. Vis-NIR FORS Spectra of Alc. 341's paints (continues in the next page).

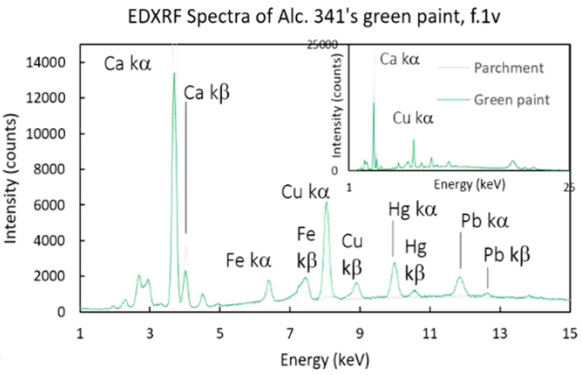
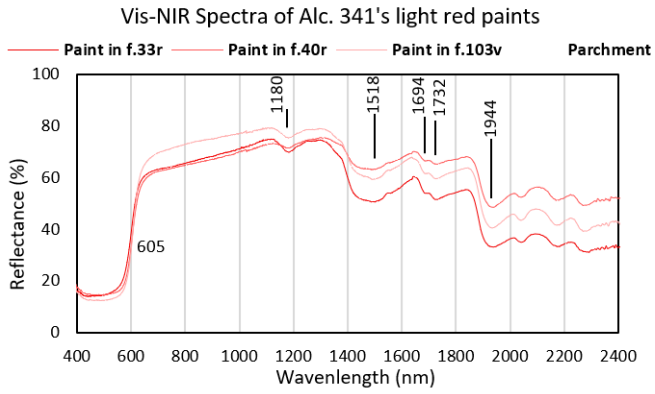
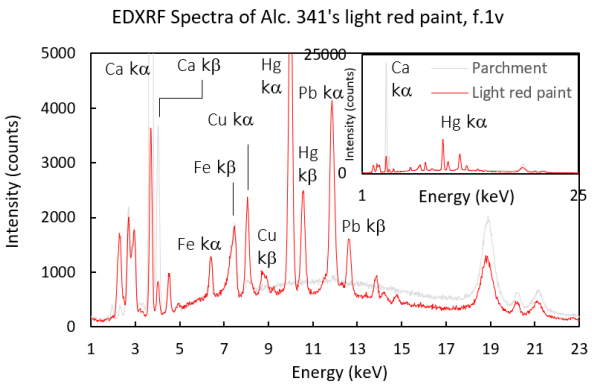
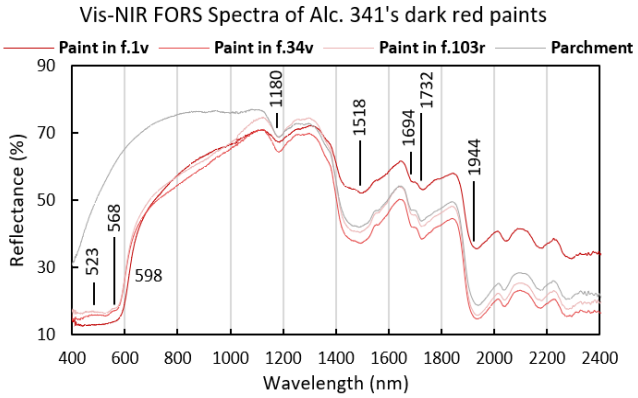


Fig.A6-4. EDXRF Spectra of Alc. 341's paints (continues in the next page).







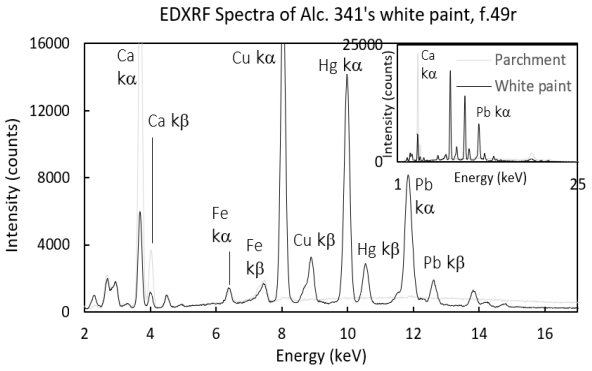


Fig.A6-3. Vis-Nir FORS Spectra of Alc. 341's paints. Besides the characteristic signals for pigment detection (in Vis region), NIR region shows weak signals that point to an egg white binder. In green spectra, one of the binder's peak is not evident perhaps because is being hidden by the pigment's band. [129]

Fig.A6-4. EDXRF Spectra of Alc. 341's paints. Note the variance in height of peaks of Cu, Hg and Pb, which can be indicative of neighbouring paints in measured areas. The area of analyses was too large for the initials' details.

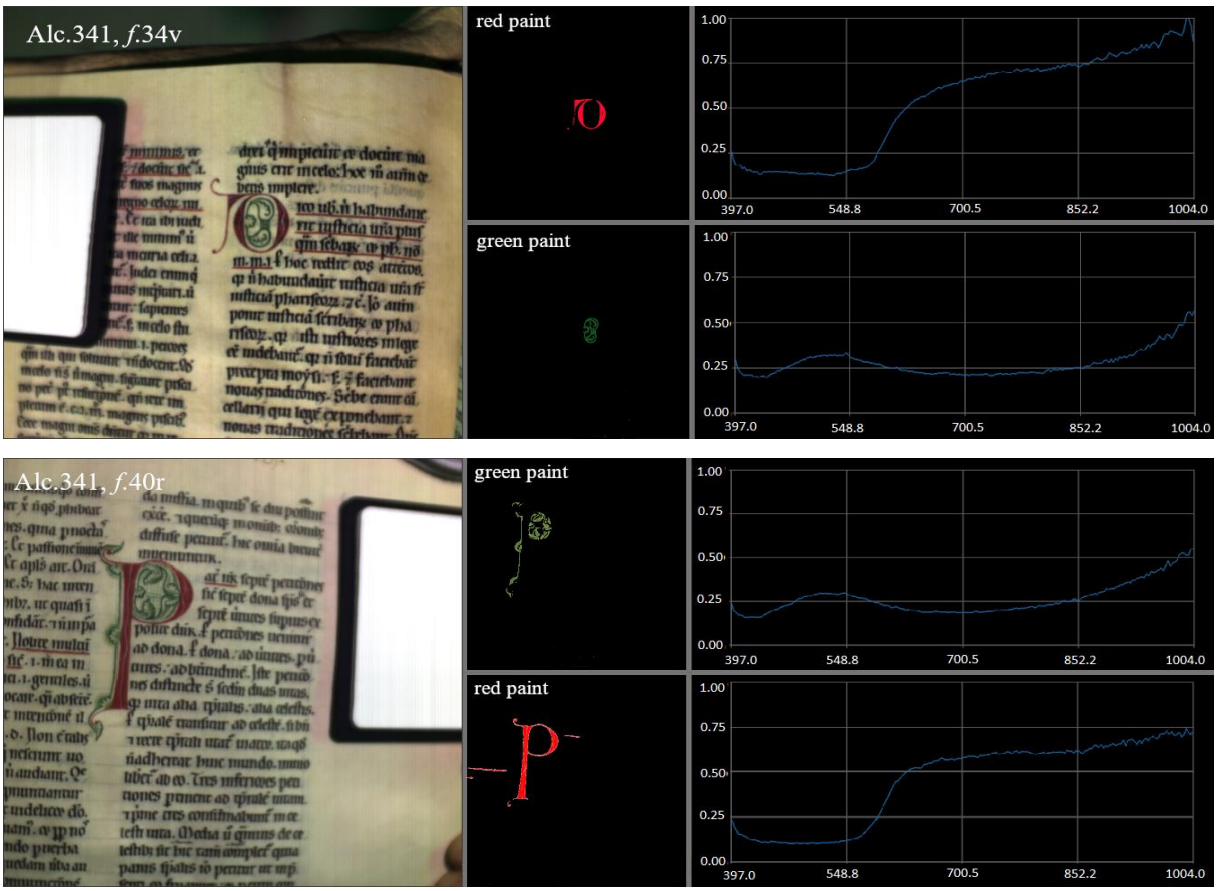


Fig.A6-5. HI Images, maps and spectra of Alc. 341's paints (continues in the next page).

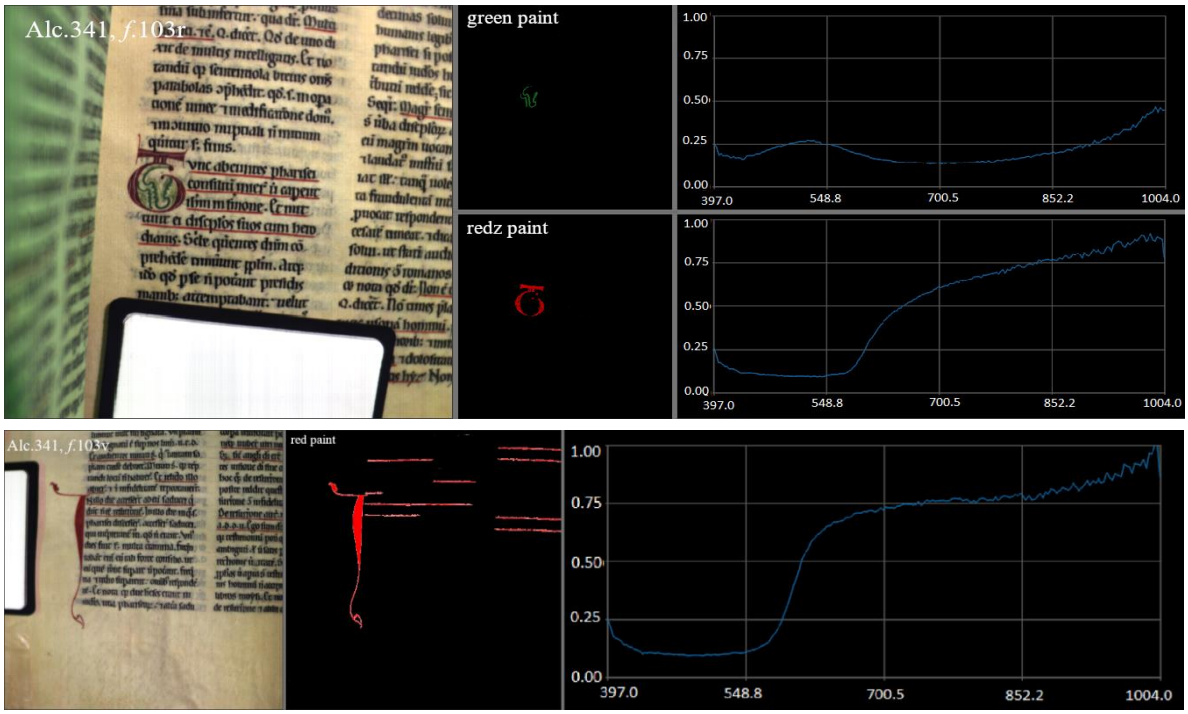


Fig.A6-5. HI Images, maps and spectra of Alc. 341's paints. Note the regularity of the green paint with a band always ca. 520nm and the differences between light and red paints' spectra (light red curve in f.40r and in f.103v is more steep and has an accentuated inflection point while dark red curve in f.34v and in f.103r is smother and does not have a so pronounced inflection point) are maintained throughout the codex.

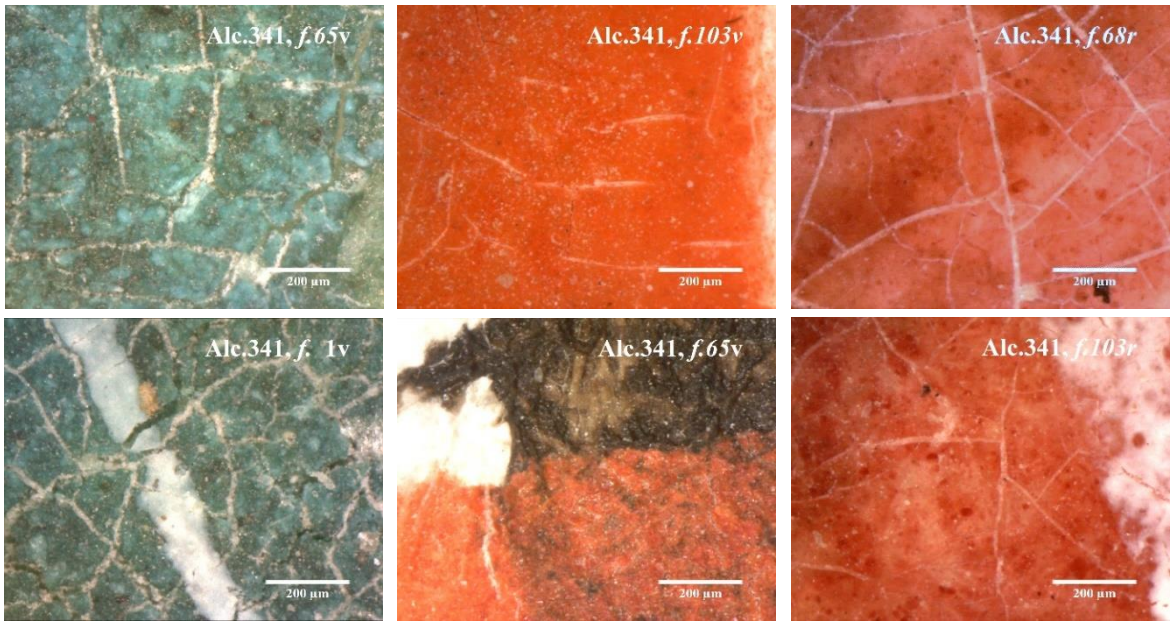


Fig.A6-6. DM images illustrate the differences between the three paints: green paints (left) are very granular and uneven, light red paints (middle) are very bright and even and dark red paints (right) have the typical clusters of concentrated colouring agent in these dyes. [66] Images below show how the paints overlap. Note how white paints are applied in very thin lines above the green and red paints. This could help explain EDXRF ambiguous results.

A6.2. DATA ACQUIRED IN THE MATERIAL ANALYSIS OF THE CASE-STUDIES' PARCHMENT (DM)

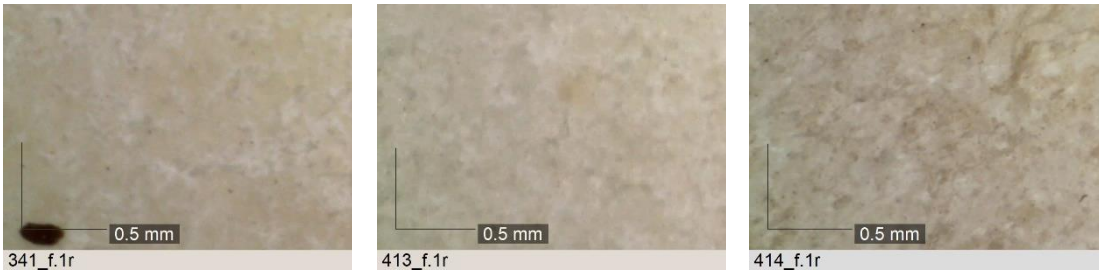


Fig.A6-7. DM Images on parchment did not allow to observe follicle patterns (continues in the next page).

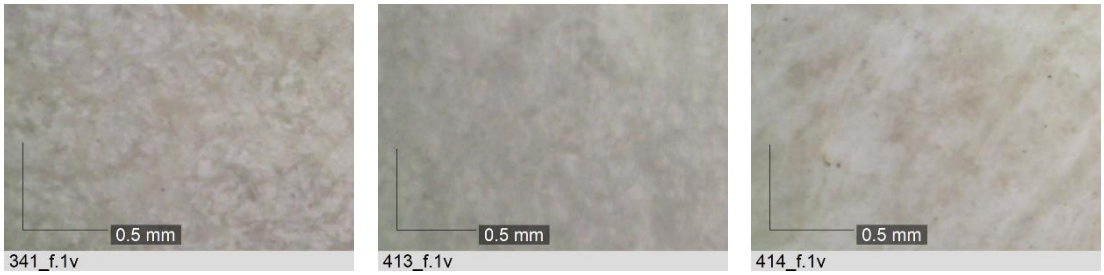


Fig.A6-7. DM Images on parchment did not allow to observe follicle patterns and assign it to specific animal species (magnification x60 for all images).

A6.3. DATA ACQUIRED IN THE MATERIAL ANALYSES OF THE CASE STUDIES' SEWING THREADS (OM)

Sewing threads of Alc. 341 and 414 were very similar in physical appearance and analytical results pointing to a common material. Observations of longitudinal thread samples revealed the presence of fibre cells with a stiff cylindrical shape of various sizes, for the two codices. These cells were highly divided by transverse dislocations and cross-marks of several shapes and sizes (but usually well pronounced and distinct); and presented sporadic swellings. Transverse sections revealed oval to polygonal (in bundles) fibres' shapes with very narrow lumens (usually a single line). (Fig.A6-8) These characteristics are very common of bast fibres[46]. [148-150] However, these observations are not sufficient to distinguish among them. It would be important to consider additional techniques like FTIR or micro-testing (which is commonly used to distinguish specific reactions to the reagent) besides crossing information with historical records.

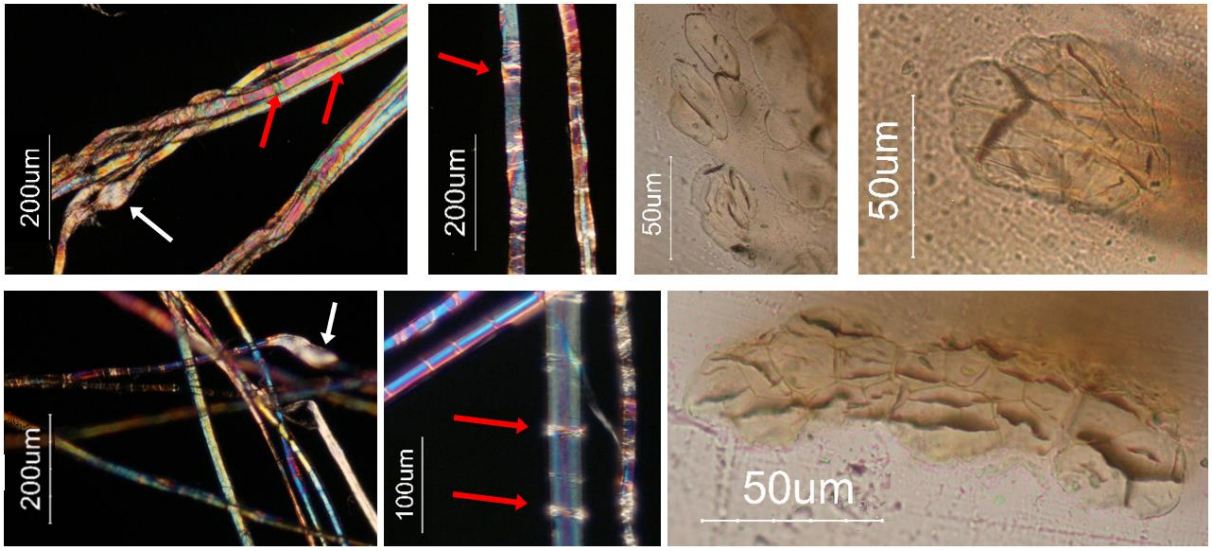


Fig.A6-8. Observed fibres of Alc. 341 (above) and Alc. 414's (below). Note the swellings (white arrows) and dislocation (grey arrows) in the longitudinal samples. In transverse samples see how fibres group in bundles, how each fibre has an oval to polygonal section and a very narrow lumen.

A6.4. DATA ACQUIRED IN THE MATERIAL ANALYSES OF THE CASE-STUDIES' BOARDS (DM, SEM, OM)

Microscopic observations of wood boards showed different structures for each codex, indicating that the sources came from different wood species. DM observations of Alc. 341 boards' transverse wood cut were hard to interpret since the wood was very damaged. An area of ca. 5 cm seems to point to a ring porous wood, with larger pores well demarcated in early wood, and no evident large rays (which could help discard *Quercus* (oak) genus). Smaller pores seem to be arranged in radial and/or diagonal chains. SEM observations allowed to distinguish at least two pores' sizes (reinforcing DM observations) and that sometimes they appear paired. Vessels are of two types: long and narrow or short and wide. They have simple perforation plates and at least two types of pits. Rays observed in tangential cut are uniseriate and in radial cut revealed to be homocellular. These features are common in *Castanea spp.* genus but given the size of the sample (the smallest of the three case-studies, with ca. 3mm^2) and condition (very damaged and contaminated with debris) this identification is very uncertain. [150-153]

[46] Bast fibres are the fibres which derive from the inner bark of some dicotyledons like flax, hemp, jute, ramie, etc. [150]

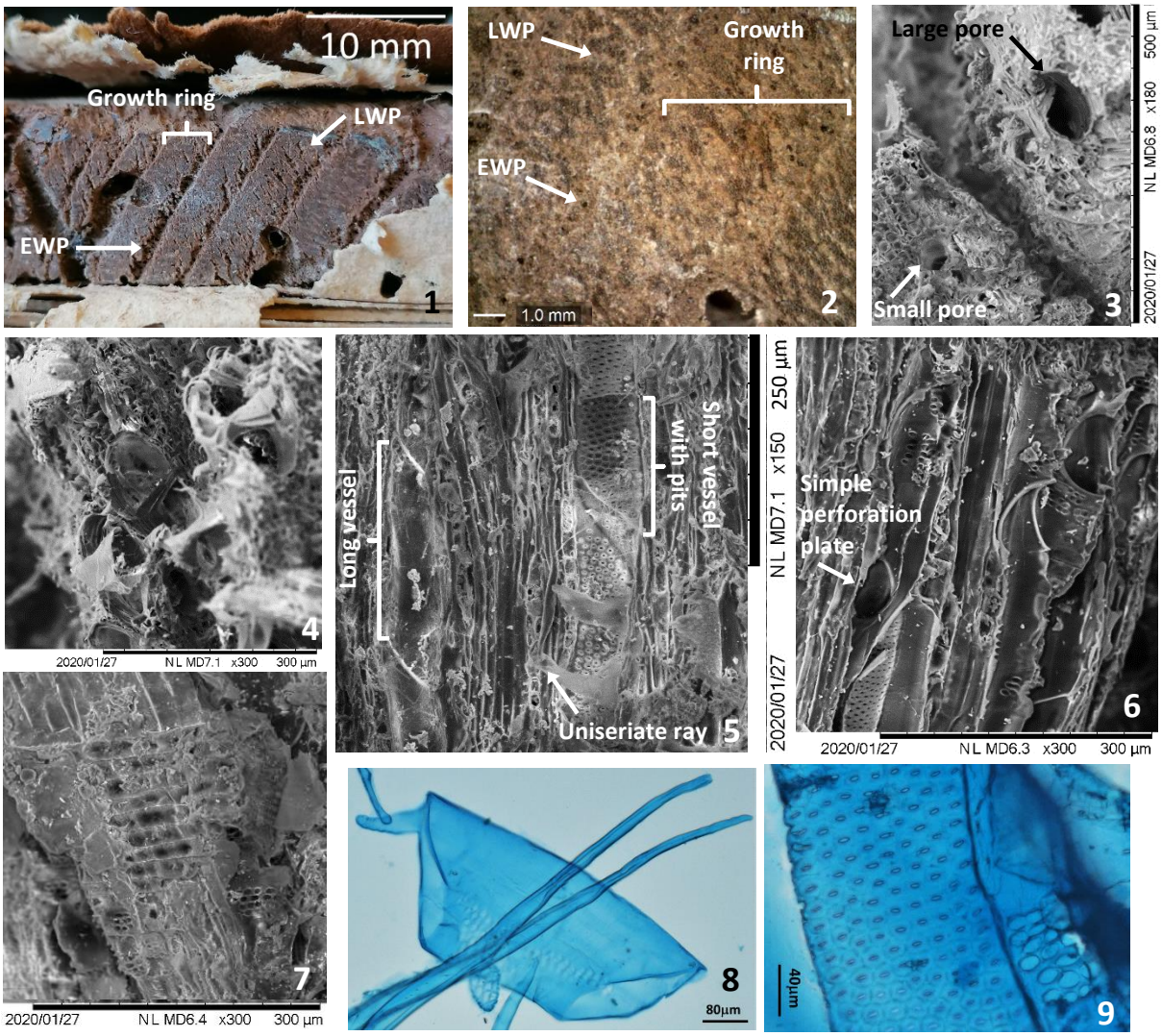


Fig.A6-9. Results of material analyses to Alc.341's boards. A detail of the area analysed with DM (1) and a photograph acquired with DM (2) (30x) show the appearance of a ring porous wood with larger early wood pores (EWP) and smaller latewood pores (LWP) arranged in radial/diagonal chains. Rays are not evident. In SEM images it is possible to see two pores' sizes (3) and how some form adjacent pairs (4). One can also see the longer and shorter vessels, both with simple perforation plates and pits in SEM and MO photographs (5-6, 8-9). Further note the uniseriate (5) homocellular (7) rays.

Alc. 413 presented different results. This sample was slightly bigger than the others (ca. 10mm^2), thus it was possible to observe a higher diversity of structures. Macroscopic observations showed a diffuse-porous wood, although somewhat larger pores appeared in early wood compared with those of latewood; latewood is also marked by a darker compact zone with less pores; large rays irregularly spaced were also observed (unlike what happens in *Platanus spp*.) intercalated with thinner ones. Latewood growth forms very pronounced arch structures between rays (that are not observed in *Carpinus* genus). SEM and OM observations revealed abundant mostly long vessel elements, with diameter's variation and tails. Perforation plates were predominantly simple, but rare scalariform ones (6-10 bars) were also observed (usually in narrower vessels with long tails). Presence of both types of perforations are signalled in *Fagus*, while *Alnus* (alder), a species mentioned by Nascimento & Diogo [23] exclusively has scalariform perforations [150-153] Pits were also observed. Rays were mostly uni to triseriate (another feature that allows to discard the species previously

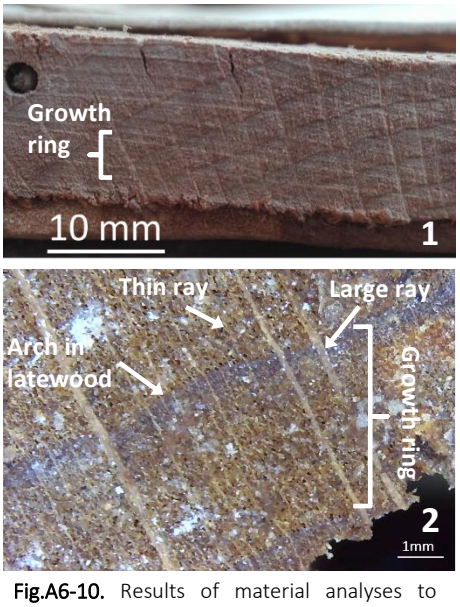


Fig.A6-10. Results of material analyses to Alc.341's boards (continues in the next page).

mentioned) and homocellular with procumbent cells. These features are in agreement with *Fagus* genus. [150-153] Interestingly *Fagus* was not mentioned in previous literature regarding Alcobaça's codices. [23] (Fig.A6-10)

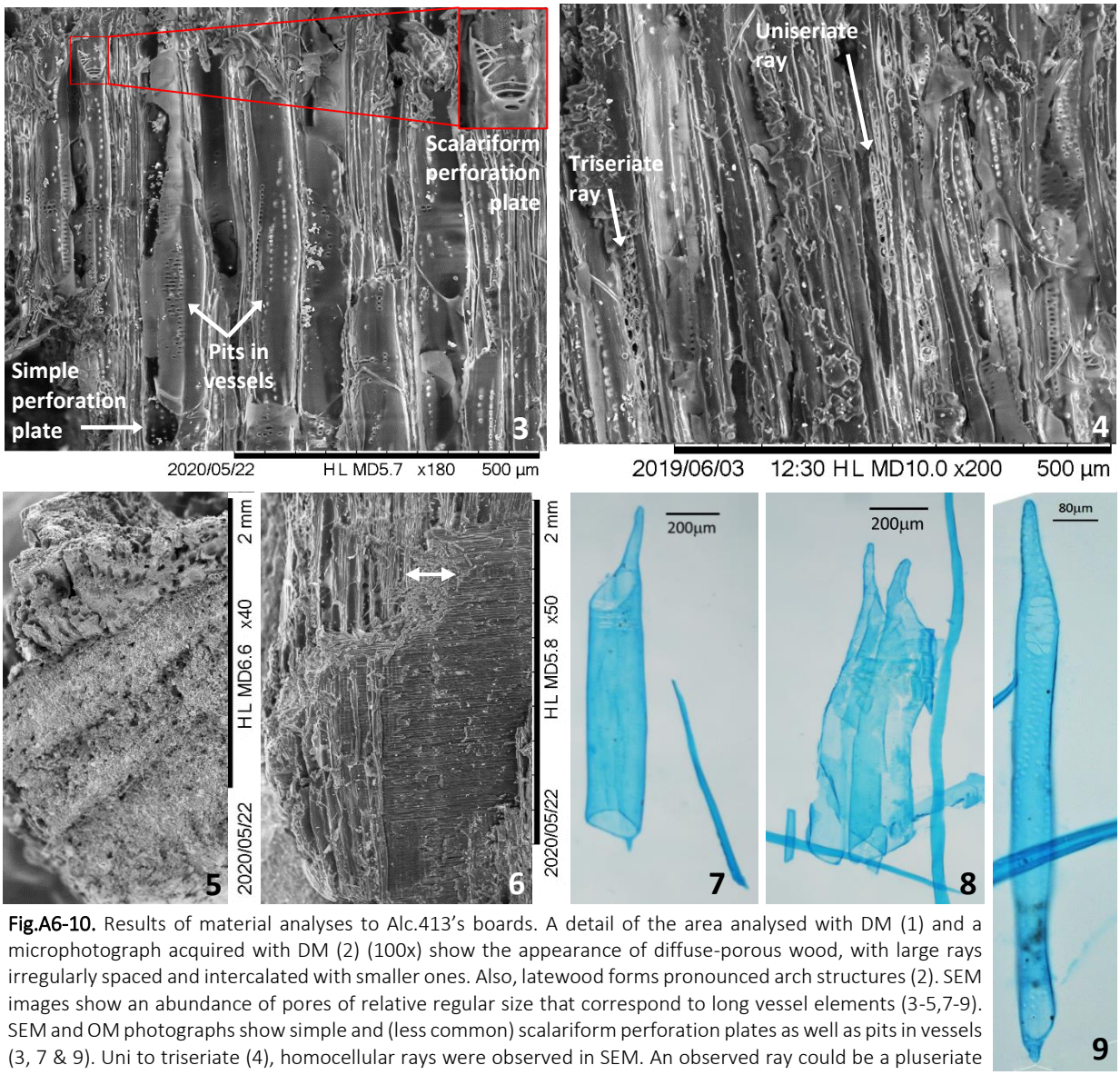


Fig.A6-10. Results of material analyses to Alc.413's boards. A detail of the area analysed with DM (1) and a microphotograph acquired with DM (2) (100x) show the appearance of diffuse-porous wood, with large rays irregularly spaced and intercalated with smaller ones. Also, latewood forms pronounced arch structures (2). SEM images show an abundance of pores of relative regular size that correspond to long vessel elements (3-5,7-9). SEM and OM photographs show simple and (less common) scalariform perforation plates as well as pits in vessels (3, 7 & 9). Uni to triseriate (4), homocellular rays were observed in SEM. An observed ray could be a pluseriate one (two side arrow line in 6), but it is hard to be certain, given the sample direction.

As for Alc. 414 observations resembled with the ones from Alc. 341 but since the wood was not so damaged and the micro sample was slightly bigger (ca. 7mm^2), more certain conclusions were achieved. Macroscopic observations showed a ring-porous wood, with larger pores well demarcated in early wood, and no evident large rays (which helps discard *Quercus* (oak) genus). Smaller pores also seem to be arranged in radial and/or diagonal chains. SEM and OM revealed less abundant vessel elements, shorter, more drum like, with some tylose inclusions. Observed perforation plates were simple and pits do not appear to be much abundant. Also, there are vasicentric tracheids near the vessels. Observed rays were exclusively uniseriate (surrounded by thin layers of parenchyma cells) and homocellular. These features are common of *Castanea spp*. (chestnut) genus (a wood that as seen before, was mentioned in related literature). [150-153] (Fig.A6-11)

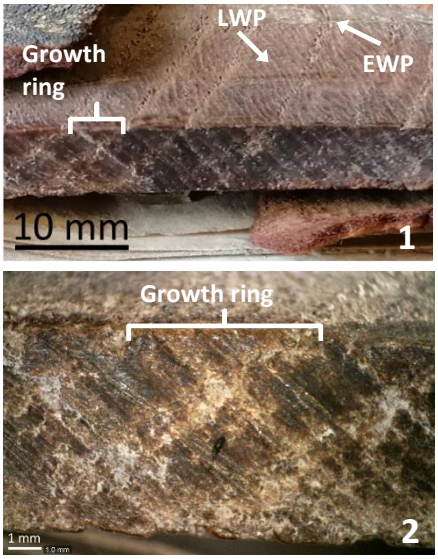


Fig.A6-11. Results of material analyses to Alc.414's boards (continues in the next page).

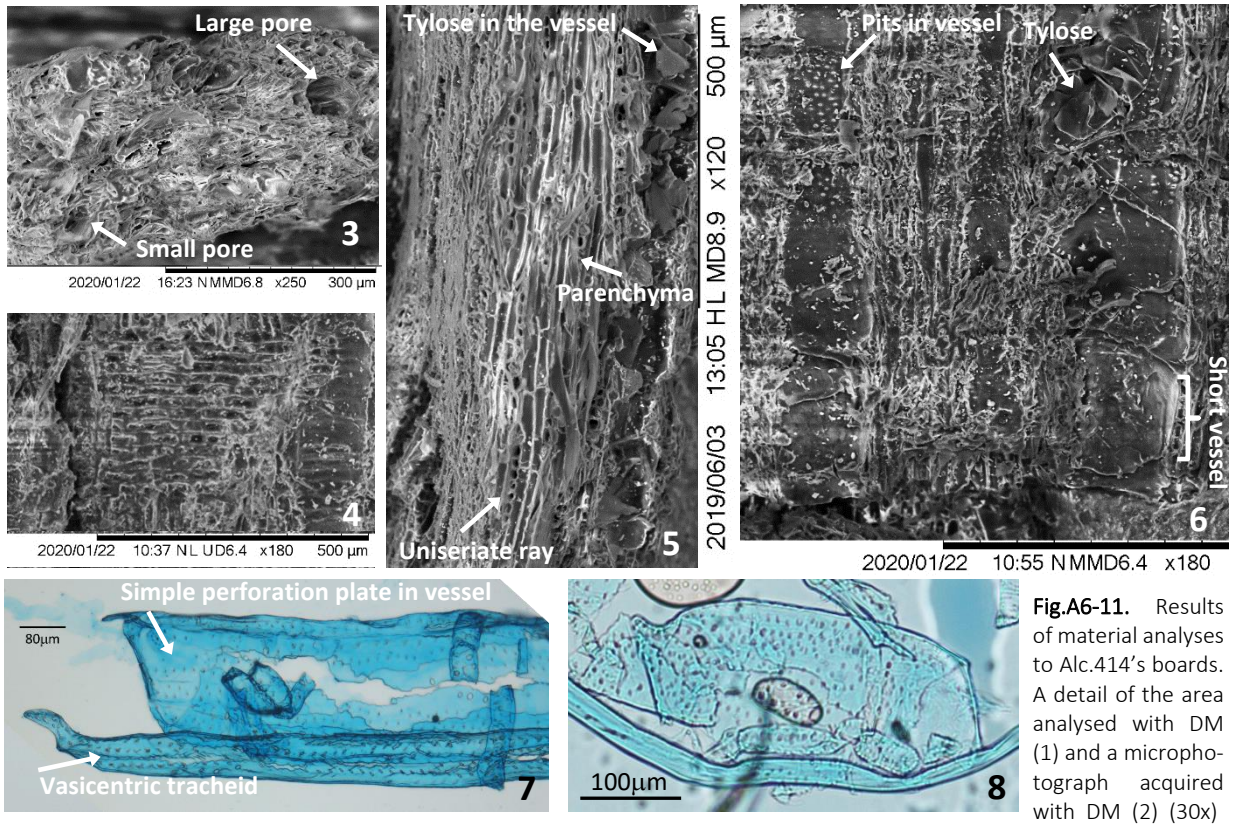


Fig.A6-11. Results of material analyses to Alc.414's boards. A detail of the area analysed with DM (1) and a microphotograph acquired with DM (2) (30x) show the appearance of a ring porous wood with larger early wood pores (EWP) and smaller latewood pores (LWP) arranged in radial/diagonal chains. Rays are not evident. In SEM images it is possible to see two pores' sizes (3). One can also see the short vessels, both with simple perforation plates and pits in SEM and MO photographs (6-8). Vasicentric tracheids were observed in OM (7). Further note the homocellular (4) and uniseriate (5) rays with parenchyma cells.

A6.5. Data acquired in the material analyses of the case-studies' covering materials (DM)

DM material analyses of linings and covers revealed that follicle patterns of Alc. 341 and Alc. 413's brown leathers (one is a cover the other is a lining, respectively) appeared to be very similar to the ones of goat or sheep forming clusters of 2-3 big pores surrounded by smaller ones. Pores appear in wide-set rows and the skins where a bit creased. The white linings of Alc. 341 and Alc. 414 and both the white and the brown covers of Alc. 413 and Alc. 414, respectively, resembled more to a cow or even calf skin pattern. The pores, close to each other, were distributed quite evenly through the surface not forming any more specific pattern. Sewn pockets of the three codices looked more like pig skin with large pores spread apart in the surface. These findings are too sparse to establish concrete conclusions, though all these animals were previously mentioned in bookbinding literature.

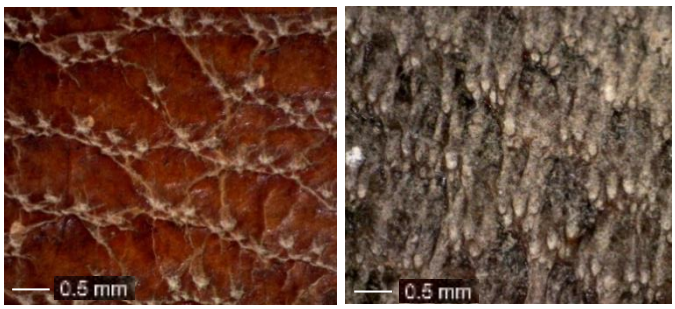


Fig.A6-12. DM observations of Alc. 341's brown cover and Alc. 413's brown lining. See how the pores form clusters and appear in wide-set rows.

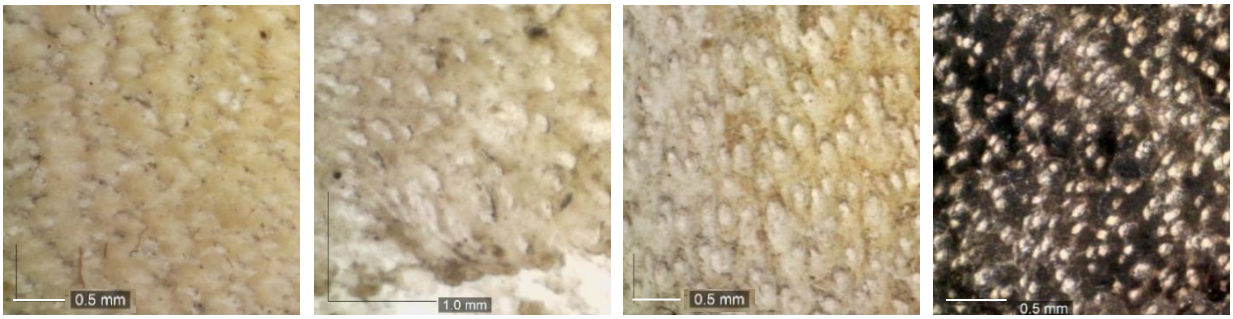


Fig.A6-13. White linings from Alc. 341 and from Alc. 414 and the covers from Alc. 413 (white) and from Alc. 414 (brown) have completely different patterns when compared to previous ones. These skins have pores very evenly distributed throughout the surface.

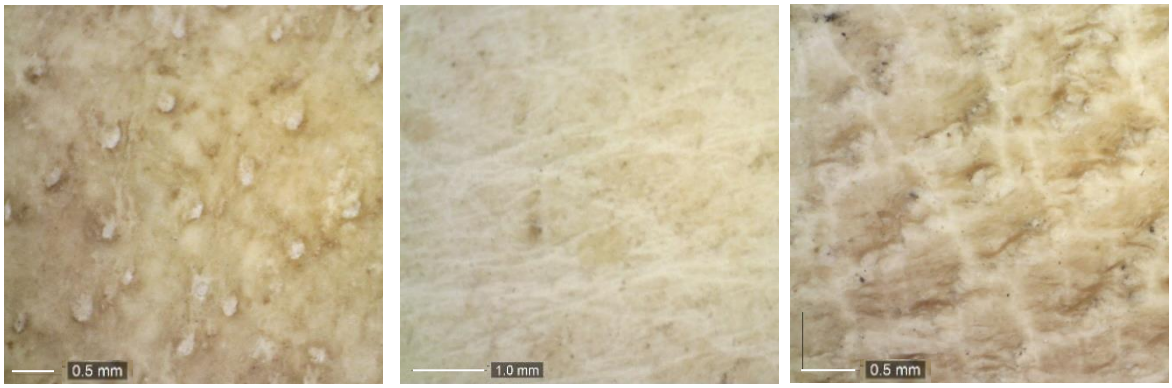


Fig.A6-14. Alc. 341, Alc. 413 and Alc. 414 sewn pockets' observations revealed large, scarce pores typical of pig skins.

A6.6. Data acquired in the material analyses of the case-studies' metallic materials (EDXRF)

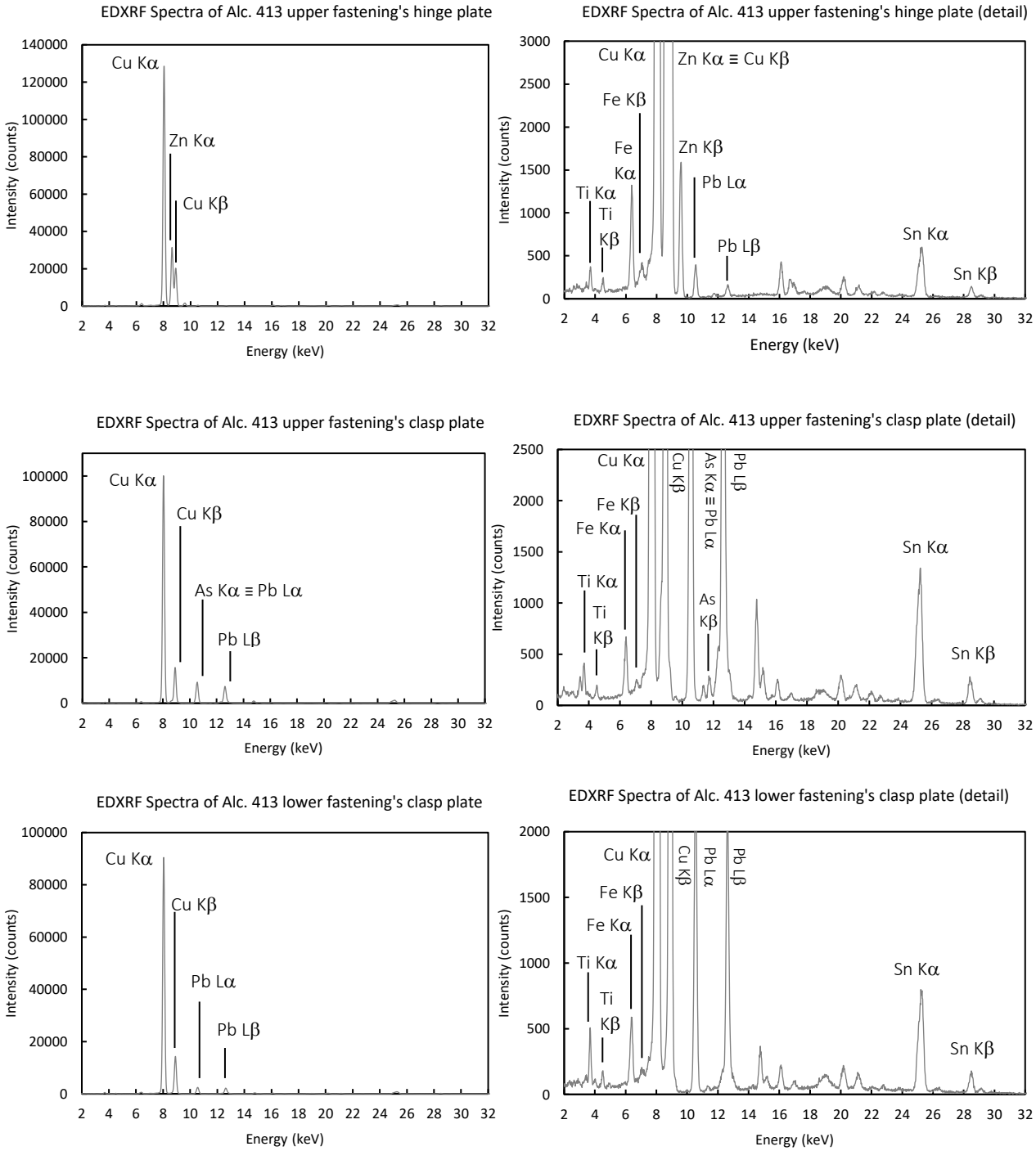


Fig.A6-15. EDXRF Spectra of Alc. 413 fastenings' metalwork.

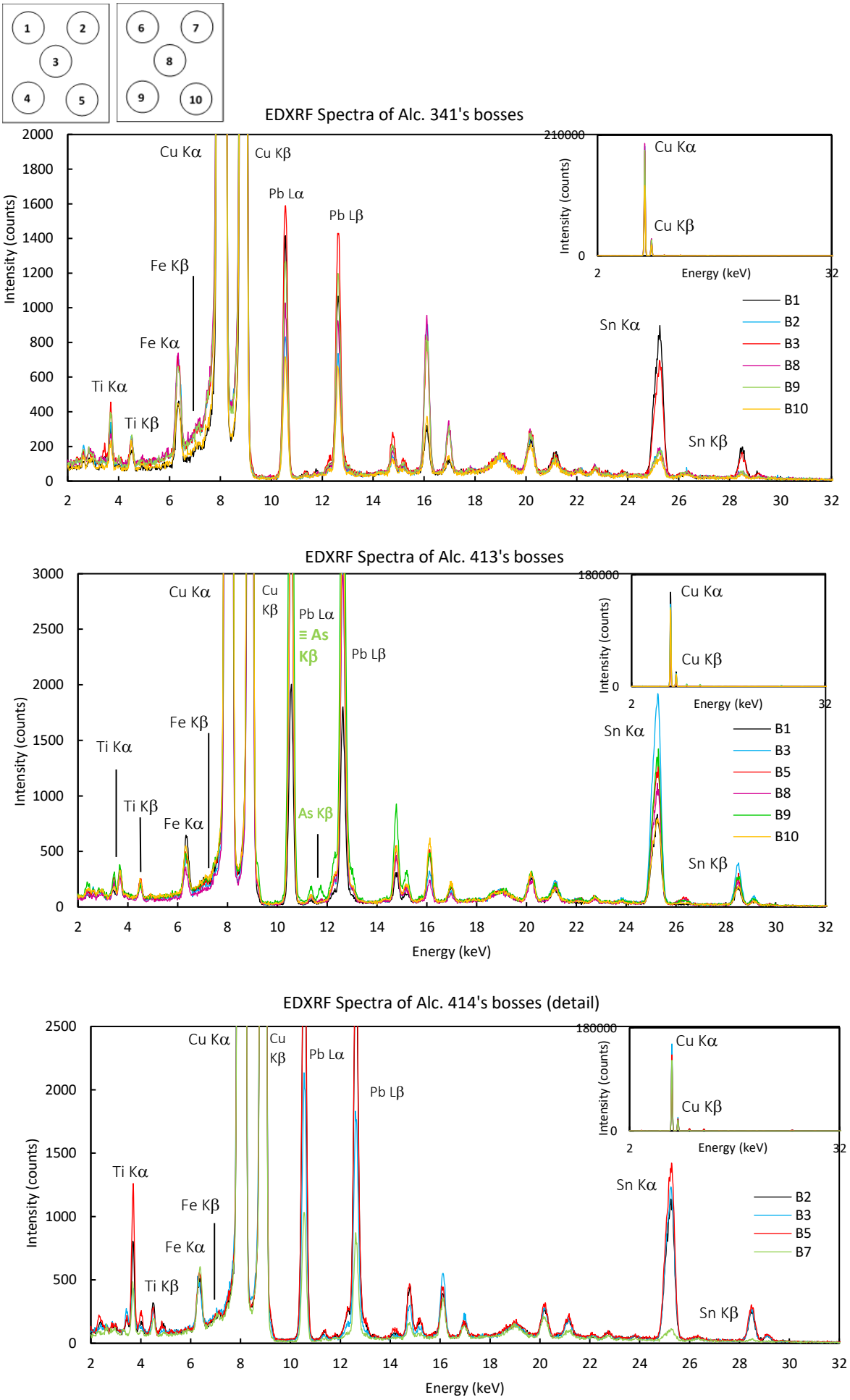


Fig.A6-16. EDXRF Spectra of the three case-studies' bosses. The images above (taken from the tables in Fig.4) identify each boss's number.