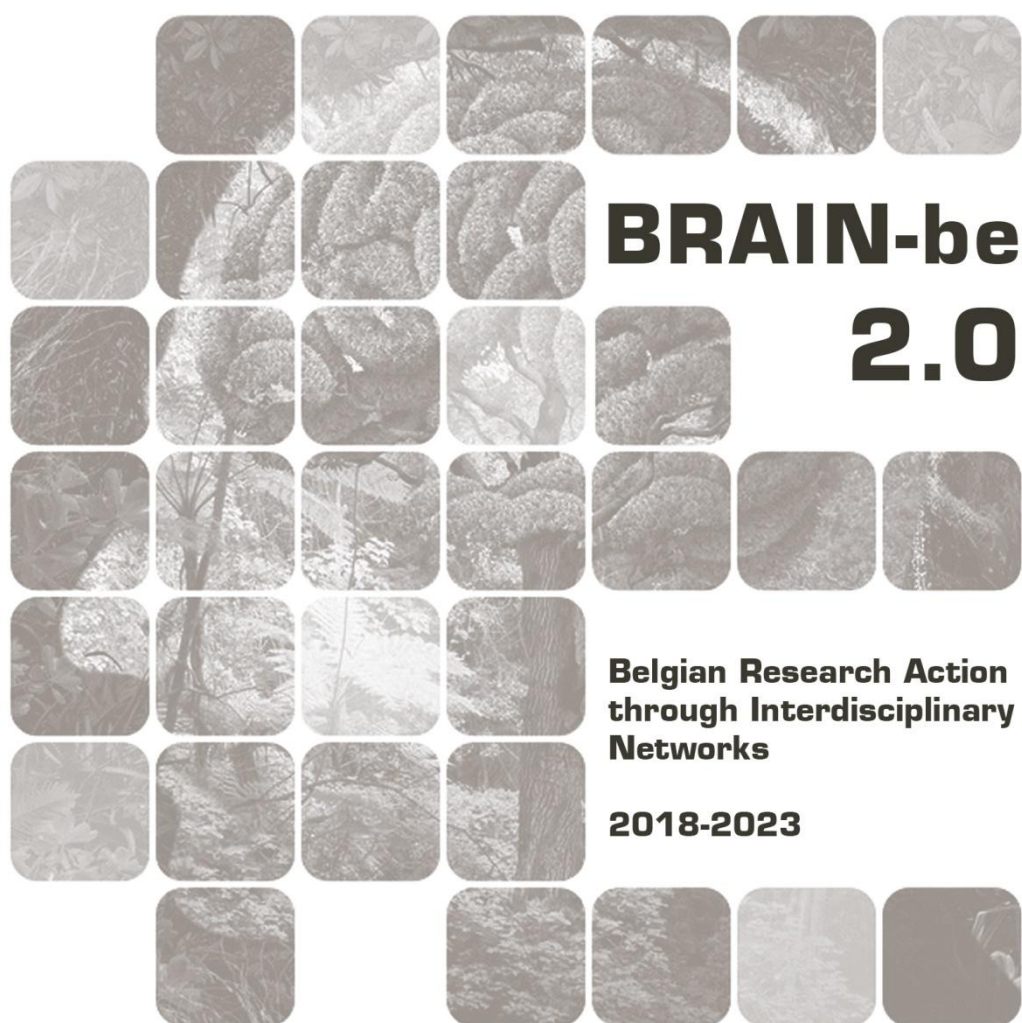


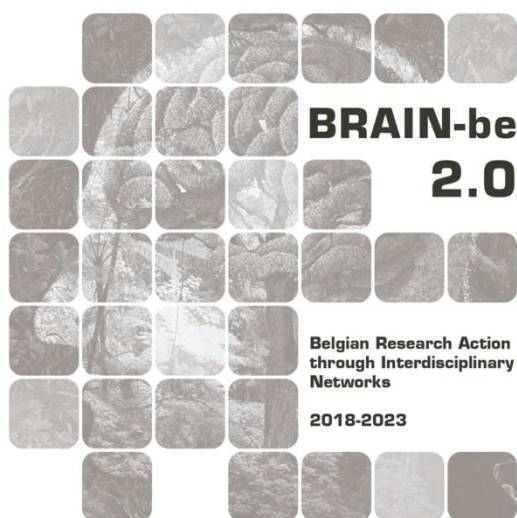


FRIABLE

Valorisation and Preservation of friable medium on paper. Case Study on the collection of the Royal Museums of Fine Arts of Belgium (RMFAB)

Inga Rossi-Schrimpf (MRBAB) - Marie-Noëlle Grison (KUL) - Estelle Van Geyts (La Cambre) - Ana Oñate Muñoz (La Cambre) - Juliette François (KIK-IRPA)

Pillar 2: Heritage science



NETWORK PROJECT

FRIABLE

Valorisation and Preservation of friable medium on paper. Caste Study on the collection of the Royal Museums of Fine Arts of Belgium (RMFAB)

Contract - B2/202/P2/FRIABLE

FINAL REPORT

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ABSTRACT

Context

Friable media artworks on paper, such as pastel, charcoal and chalk drawings, represent a fragile and understudied part of cultural heritage. Their vulnerability to handling, transport, exhibition and environmental change complicates conservation and collection management. The FRIABLE project (2022-2026) addressed these challenges through an interdisciplinary collaboration between heritage, conservation and research institutions, using the Royal Museums of Fine Arts of Belgium collection as a case study.

Objectives

To establish a representative corpus of Belgian friable media artworks; reconstruct their collection and conservation histories; characterize materials, techniques and degradation mechanisms through non-invasive analysis; assess risk factors affecting stability; and develop practical tools and recommendations for preservation, transport, exhibition and collection management.

Conclusions

FRIABLE significantly advanced knowledge of friable media by demonstrating the importance of material composition and layer build-up in determining fragility. The project delivered standardized documentation methods, technical datasets, handling and assessment protocols, a terminology thesaurus, and contributions to the AGATO decision-support platform. It strengthened Belgian and international expertise while providing practical guidance for the sustainable preservation of friable media collections.

Keywords

Friable media; works on paper; preventive conservation; technical art history; heritage science; risk assessment; non-invasive analysis; collection management.

1. INTRODUCTION

The FRIABLE project (2022-2026) was conceived to address critical knowledge gaps concerning the understanding, characterization, preservation, and risk assessment of modern works of art executed with friable media on paper and related supports. Such artworks, including pastels, charcoal drawings, chalk works, and mixed-media compositions, constitute a significant but particularly vulnerable component of European cultural heritage. Their intrinsic fragility, combined with limited scientific knowledge regarding their material composition, degradation mechanisms, and preventive conservation requirements, has long complicated collection management decisions.

Bringing together expertise from the Royal Museums of Fine Arts of Belgium (RMFAB), KU Leuven, KIK-IRPA, ENSAV La Cambre, and the Rijksmuseum Amsterdam, FRIABLE developed an interdisciplinary approach that combines collection history research, condition assessment, risk analysis, technical imaging, material characterization, and conservation experimentation.

The project utilized the RMFAB collection as a large-scale case study, allowing the research team to investigate the relationship between material composition, artistic technique, historical use, conservation histories, and current preservation challenges. Through the integration of heritage science, conservation practice, art historical research, and preventive conservation methodologies, FRIABLE has generated new knowledge and practical tools to support the long-term preservation of friable media collections.

2. STATE OF THE ART AND OBJECTIVES

2.1 State of the Art

Friable media, such as pastel, charcoal, and chalk, are inherently fragile due to the weak adhesion of the medium to the support (paper, canvas), leading to high risks of medium loss, abrasion, and damage from handling, transport, and environmental factors. While international research exists (e.g., Rijksmuseum, Getty Institute), there is currently no international consensus on the best practices for preventive conservation, transport, and exhibition of these objects, especially concerning modern media (late 19th and early 20th century).

In Belgium, although this period saw a predilection for friable media in Symbolist art (Khnopff, Ensor, Spilliaert), there was a lack of systematic art historical, technical, and conservation research on these materials within the national collections. This absence of scientific data prevented collection managers from substantiating loan and exhibition policies for this fragile heritage.

Friable media artworks occupy a unique position within collections of modern works on paper. Their visual richness derives, as mentioned before, from loosely bound particulate materials that are highly susceptible to loss, abrasion, cracking, flaking, and alteration through handling, transport, exhibition, and environmental fluctuations. Despite their prevalence in museum collections, systematic research into the complex interactions between materials, artistic techniques, support structures, and degradation mechanisms remains limited.

Previous conservation research has focused largely on individual media types such as pastel or charcoal, while broader comparative studies integrating material characterization, historical context, risk assessment, and conservation decision-making remain scarce. Similarly, the absence of standardized terminology, condition assessment approaches, and damage classification systems has hindered knowledge exchange across institutions.

Recent advances in non-invasive imaging and analytical technologies have opened new opportunities for studying fragile artworks without sampling. However, the practical application of these technologies to friable media collections required validation through carefully selected case studies and interdisciplinary interpretation.

FRIABLE emerged within this context, seeking to connect material science, collection management, preventive conservation, art history, and conservation practice into a unified research framework. The project also responded directly to priorities identified by international experts and initiatives focused on pastel and friable media heritage.

2.2 Project Objectives

The FRIABLE project's main goal was to establish a unified strategy for the preservation, loan, handling and transport of modern friable media drawings. This overall goal was pursued through five major objectives:

1. To establish a representative museum corpus of modern friable media artworks within the RMFAB collection.
2. To reconstruct the historical trajectories ("past lives") of selected artworks through provenance, exhibition, conservation, transport, and collection history research.
3. To characterize materials, techniques, and degradation patterns through advanced non-invasive imaging and analytical methods. In this context, KUL's primary scientific contribution was to achieve the specific objective of characterizing the vulnerability of modern (19th - 21st century) friable media drawings by carrying out an in-depth technical study on a representative corpus. This study aimed to answer the following research questions (as developed within the PhD project):
 - a. What are the main contributing factors to mechanical stability-related degradations?
 - b. Can we easily and accurately identify risk factors and fragility levels in artworks?
4. To identify and assess risk factors influencing the stability of friable media works and develop conservation-oriented decision-making tools. It is within this context that a study (to be published) was carried out by KIK-IRPA and La Cambre. It examines the impact on the powdery media layer of contact materials commonly used in conservation and restoration.
5. To translate scientific findings into practical methodologies, reference resources, and recommendations for museum professionals responsible for the preservation and management of friable media collections. It shall be accessible/usable by conservators, curators and collection managers.

3. METHODOLOGY

3.1 Corpus Selection Strategy (WP3.6 / WP5.0)

The research was initiated with the establishment of a large museum corpus derived from the RMFAB collections. Selection criteria were collectively defined by project partners and included artistic period, media type, support characteristics, dimensions, exhibition history, conservation history, provenance availability, and representativeness of Belgian artistic practice between approximately 1870 and 1940.

A systematic examination of candidate artworks was conducted through workshops, collection surveys, and expert consultations. This process resulted in the selection of a museum corpus of almost one hundred artworks, from which a reduced research corpus of nine representative objects was subsequently identified for intensive scientific investigation. The partners collaborated in the definition of the final research corpus for in-depth analysis (Task 3.6), ensuring it represented a variety of media, layer build-ups, and supports relevant to the main risks (Task 4.3).

The selected corpus encompasses diverse combinations of pastel, charcoal, chalk, and mixed media, providing a broad basis for studying material variability and degradation behaviour. Parallel cataloguing activities involved the reconstruction of provenance, exhibition, transport, storage, and treatment histories for the selected works. These historical datasets provided essential contextual information for interpreting condition and analytical results.

Due to logistical and access difficulties at the RMFAB (linked to staff absence and collection movements), additional measures were taken within the PhD research to ensure the continuity and robustness of the study. Rather than relying solely on the initially planned corpus, the research was further developed through complementary case studies and the consultation of additional institutional collections.

3.2 Non-Invasive Technical Study Protocol (WP5.1 / WP5.3)

A comprehensive multimodal technical examination protocol was developed by KU Leuven in collaboration with project partners.

The protocol combined:

- High-resolution visible photography;
- Raking light photography;
- Narrow-band multispectral imaging;
- Microdome photometric stereo imaging;

- Hirox digital microscopy;
- Macro X-ray fluorescence (MA-XRF);
- Portable XRF analysis;
- Fiber Optics Reflectance Spectroscopy (FORS);
- Raman spectroscopy;
- UV-induced visible fluorescence imaging.

Prior to examination, selected artworks were carefully unframed following conservation protocols that incorporated extensive photographic documentation and the collection of detached material fragments for future study. This operation was carried out collaboratively by La Cambre, Leila Sauvage, and the Royal Institute for Cultural Heritage (KIK-IRPA).

The imaging campaign generated standardized datasets that enabled the visualization of layer structures, surface topography, pigment distributions, hidden compositional features, and condition anomalies. Analytical results were examined alongside historical research and condition records to develop a comprehensive understanding of each artwork's materiality and fragility.

The protocols established during FRIABLE also served as a testing ground for safe handling, transport, and examination procedures for highly vulnerable artworks. KUL developed and executed a standardized, non-invasive, multi-modal imaging and analytical protocol, carried out in-situ at the museums using the mobile equipment of the KU Leuven VIEW Core Facility. This methodology was designed to characterize the artworks at macro, micro, and spectral levels:

Technique: High-Resolution & Raking Light Photography

Goal (Material Characterization): Document current condition, surface texture, and topography to reveal micro-damage (e.g., abrasion, flaking).

KUL role: KUL (VIEW) Implemented in-situ campaigns.

Technique: Narrow Band Multi-Spectral Imaging (NB-MSI)

Goal (Material Characterization): Non-invasive spectral characterisation to identify organic/inorganic pigments, binders, and fixatives based on spectral data

KUL role: KUL (VIEW) Led execution and data processing.

Technique: Microdome (Photometric Stereo)

Goal (Material Characterization): Macro-level characterisation of surface texture and geometry to classify fragility and damage (e.g., crack patterns, flaking)

KUL role: KUL (VIEW) Led execution and data processing.

Technique: Hirox Digital Microscopy

Goal (Material Characterization): Micro-level documentation of specific regions of interest (ROI) identified during the condition checks (Task 3.5.5)

KUL role: KUL (VIEW) Led execution

Technique: MA-XRF (Macro X-Ray Fluorescence)

Goal (Material Characterization): Elemental mapping of the medium to determine pigment distribution and composition

KUL role: KUL collaboration with KIK-IRPA (KIK-IRPA lead the analysis)

Technique: Micro-Raman Spectroscopy

Goal (Material Characterization): Point analysis to refine identification of pigments and binders in complex areas

KUL role: KUL collaboration with KIK-IRPA (KIK-IRPA lead the analysis)

3.3 Mock-Up Creation and Testing (WP5.5 / WP6.2 Input)

Mock-ups were developed by ENSAV La Cambre and KIK-IRPA to investigate the behaviour of friable media systems and the factors influencing their vulnerability.

Drawing upon observations from the research corpus, technical examination results, conservation literature, and previous academic research, the consortium identified key variables requiring investigation. Particular attention was given to media stratigraphies, combinations of friable and binding media, and interactions with materials commonly used in conservation and collection management.

Successive mock-up campaigns were conducted at ENSAV La Cambre, involving both researchers and conservation students. Preliminary trials refined the manufacturing protocols, while subsequent campaigns focused on reproducibility and standardisation. The samples were produced in collaboration with OSP Kitchen using pen-plotter technology and a standardised scientific approach designed to investigate the variables identified above. They were subsequently brought into contact with various materials to simulate museum storage systems and assess the effects of conservation conditions and restoration treatments. These samples have improved our understanding of how different materials interact with fragile powdery surfaces and have highlighted the types of damage that can result from the displacement of pastel particles.

The interpretation of the images was carried out with the support of Nicolas Nadisic (UGent), whose expertise contributed to the analysis and reading of the imaging data.

The resulting experimental framework provides a basis for establishing relative fragility levels and assessing the impact of contact materials and conservation interventions on friable media surfaces.

This research will be published in a forthcoming article, which is currently in preparation.

4. SCIENTIFIC RESULTS AND RECOMMENDATIONS

4.1 Scientific Results

FRIABLE generated significant advances in the understanding of modern friable media artworks.

The project established one of the most comprehensive documented corpora of Belgian friable media drawings currently available, combining condition assessment, historical research, and technical analysis.

Research demonstrated the importance of artistic layer build-up and media sequencing in determining mechanical stability. Findings originating from associated studies on Léon Spilliaert's works confirmed that fragility is influenced not only by binder content but also by the organization and interaction of successive material layers.

The multimodal imaging campaigns produced standardized datasets that revealed previously undocumented aspects of artistic technique, material composition, and degradation phenomena. The integration of imaging and analytical methods allowed improved identification of pigments, drawing materials, and material distributions.

Condition reporting and corpus evaluation enabled the identification of recurring deterioration patterns specific to friable media collections, contributing to the establishment of a preliminary typology of damages and vulnerabilities.

Historical reconstruction of the corpus further demonstrated the importance of detailed recording of exhibition, transport, framing, and handling histories in understanding present-day condition and risk profiles.

Collectively, these results provide new insight into the relationship between material composition, artistic technique, past lives, and long-term preservation outcomes.

These broader findings were underpinned by a comprehensive body of technical and imaging data, which forms a key foundation of Marie-Noëlle Grison's PhD research and enables more detailed investigation into the material composition, layer build-up, and behaviour of friable media artworks.

In the context of the Imaging Data Collection, two major standardized multimodal imaging datasets were created including nine artworks from the RMFAB corpus (Summer 2023), seven drawings from KBR, five drawings and the pastel box from Mu.ZEE Ostend (2024).

The obtained images were stitched and registered across imaging modalities by Pr. Dr. Robert G. Erdmann in the browser-based "Draper" tool he developed, enabling researchers to gain deep insights into the material make-up and layer build-up of artworks through data fusion and dynamic visualisation. Each configuration of viewing mode, image selection, and zoom-in has a unique URL, allowing for the precise specification of an exact view and facilitating information sharing among researchers. All artworks from the FRIABLE Research Corpus, as well the artworks from the KBR and Mu.ZEE collections imaged for this research can be accessed in full resolution and in multiple modalities at: <https://images.erdmann.io/Draper/?collection=/Friable.0>

Technical analyses (imaging, MA-XRF input) provided evidence on:

- The complex, multi-layered nature of fin-de-siècle drawings, often combining dry friable media (pastel, charcoal) with wet media (gouache, ink) and fixatives.
- Specific techniques used by Léon Spilliaert, including the nature of his black drawing media and the stratigraphy of his paper-based works.
- The correlation between specific media, layer build-up, and observed micro-damage patterns (flaking, cracking).

4.2 Contribution to Project Deliverables and Recommendations (WP6)

The project's findings contributed directly to the development of practical conservation resources.

Key outputs include:

- A structured thesaurus for friable media terminology;
- Standardized condition assessment methodologies;
- Digitized condition reporting datasets;
- Preliminary technical and damage atlas structures;
- Documentation supporting future decision-support tools;
- Handling, transport, and examination protocols.
- Mock-up-based research investigating the impact of contact materials on friable media layers, with results being developed into a publication currently in preparation.

A major achievement was the integration of risk assessment information into AGATO, KIK-IRPA's online preventive conservation decision-support platform.

Recommendations emerging from the project include:

- Adoption of standardized documentation practices for friable media collections;
- Systematic condition monitoring throughout loan, transport, and exhibition cycles;
- Increased use of non-invasive analytical methods to guide conservation decisions;
- Recognition of technical layer build-up as a critical risk factor;
- Development of collection-specific preventive conservation strategies based on identified vulnerabilities;
- Continued refinement of fragility ranking systems through mock-up testing and longitudinal observations.

The consortium also recommends further development of the planned publication and decision tree to facilitate practical implementation by heritage institutions.

5. DISSEMINATION AND VALORISATION

5.1 Scientific and Professional Dissemination

Throughout the project, results were actively disseminated through conferences, workshops, professional networks, and international collaborations.

Project outcomes were presented at:

- IADA XV Congress (Leipzig/Halle);
- ICOM-CC Triennial Conference (Valencia);
- Bridging the Gap: Synergies between Art History and Conservation (Oslo);
- Technical Art History Days (Utrecht);
- CIHA International Conference (Lyon);
- Various museum and professional meetings in Belgium and abroad.

The project also engaged with international specialists in friable media conservation, including members of the follow-up committee and researchers from institutions such as the Rijksmuseum, RCE, KBR, Mu.ZEE, Fondation Custodia, and others.

These activities strengthened international visibility and positioned FRIABLE within ongoing global discussions regarding the preservation of modern works on paper.

Conference Presentations (Oral & Poster)

Marie-Noëlle Grison

Marie-Noëlle Grison *et al.*, "FRIABLE: Characterising powdery materials in Belgian drawings from the Royal Museums of Fine Arts of Belgium (1850-1914)", IADA XVth Conference (Leipzig/Halle, Oct 2023) Grison, Marie-Noëlle, François, Juliette, Van Geyts, Estelle, Sauvage, Leila, Vandewal, Lise, Watteeuw, Lieve. *FRIABLE: Characterising powdery materials in Belgian drawings from the Royal Museums of Fine Arts of Belgium (1850-1914)*, IADA Congress, 16–20 October 2023, Halle.

[add all authors] ICOM-CC Triennial (Valencia, Sept 2023): Poster presentation: "The FRIABLE project and the investigation into the layer build-up and fragility levels of friable media drawings: The case-study of Léon Spilliaert's Spring." Grotz, Alison, Sauvage, Leila, Vandewal, Lise, Grison, Marie-Noëlle, Van Geyts, Estelle, François, Juliette, Debulpaep, Marjolijn, Van Ooteghem, Sarah, Watteeuw, Lieve. *The FRIABLE project and the investigation into the layer build-up and fragility levels of friable media drawings. The case-study of Léon Spilliaert's Spring* (poster presentation), ICOM-CC triennial meeting, 18–22 September 2023, Valencia.

Bridging the Gap Conference (Oslo, Nov 2023): "Drawing with 'scales from a butterfly's wings': Belgian fin-de-siècle artists' use of friable drawing techniques." Grison, Marie-Noëlle. *Drawing with "scales from a butterfly's wings": Belgian fin-de-siècle artists' use of friable drawing techniques* (poster presentation), Bridging the gap: synergies between art history and conservation, 23–24 November 2023, Oslo, Nasjonalmuseet.

OSK Technical Art History Days (Utrecht, April 2024): Presentation of PhD methodology.

CIHA Conference (Lyon, June 2024): "Not just powder. The metamorphoses of pastel in early works by Léon Spilliaert." Grison, Marie-Noëlle. *Not just powder. The metamorphoses of pastel in early works by Léon Spilliaert (Belgian, 1881-1946)*, oral presentation at the CIHA Conference, 24-28 June 2024, Lyon.

Grison, Marie-Noëlle, "Inside the Box: A Journey into Léon Spilliaert's Pastel Materials (ca. 1902). A three-part analytical approach", poster presentation, ICOM-CC Art Technological Source Research meeting, NOVA School of Science and Technology, Lisbon (23 May 2025).

Vandewal, Lise, *Prentenkabinettenbijeenkoms*, Royal Library, 10.06.2022: Presentation of the FRIABLE project as part of Paper Projects at the Royal Museum of Fine Arts of Belgium.

Vandewal, Lise, Studyday on Permeke at the Permeke Museum Jabbeke: Presentation on Permeke's friable media drawings in the collection of the RMFAB [Presenter | 25.08.2023]

Vandewal, Lise, BePaper talks : *Van aanwerving tot tentoonstelling. Collectiebeheer van moderne werken op papier in de KMSKB* [Co-presenter 13.02.2025]

Publications

Grison, M.-N., Erdmann, R.G., Hameeuw, H., Lainé, D., Watteeuw, L. "Materiality of a Vision: Unveiling the complex material make-up of an early Symbolist work with friable media by Alfred-Napoléon Delaunois," *Materia: Journal of Technical Art History*, no. 4 (2024): 107–29.

Available at: https://issue-4.materiajournal.com/essay_grison/

Grison, Marie-Noëlle, "Pastel or Not Pastel? Taking a Closer Look at Early Twentieth-century Drawing Materials and Their Use", in François, W., Hameeuw, H., Bassens, M. (eds.), *Preserving Fragile Wisdom. Essays in Honour of Lieve Watteeuw*, Leuven, Peeters, 2025, pp. 119-24

Marie-Noëlle Grison, Steven Saverwyns, Maaïke Vandorpe, Alexia Coudray, Lise Vandewal, Juliette François, Estelle Van Geyts, Ana Oñate-Muñoz, Leila Sauvage, Lieve Watteeuw, "Fin-de-siècle friable media: A multimodal analytical survey of pastel, charcoal and chalk drawings from the Royal Museums of Fine Arts of Belgium, *Journal of Paper Conservation* (in press).

Marie-Noëlle Grison, Anne Adriaens-Pannier, "Fade to black. A technical investigation of Léon Spilliaert's early-career drawings from the Royal Library of Belgium", *Master Drawings* (in press).

Marie-Noëlle Grison, Steven Saverwyns, Maaïke Vandorpe, Alexia Coudray, "Matter of Colour. Léon Spilliaert's experiments with pastel and crayon (1902–1904)", *ArtMatter* (under peer-review).

Forthcoming: PhD dissertation by Marie-Noëlle Grison (title: "Powder Power: Pastel and Friable Media in Belgian Art on Paper (ca. 1890–1912)" featuring peer-reviewed papers derived from the project; public defence on 9 September 2026.

Vandewal, Lise. 'Permeke as draughtsman'. In *Constant Permeke*. Hannibal Books, 2024.

Public Engagement & Digital Output

Webpage: <https://fine-arts-museum.be/en/research/research-projects/friable>

Website: Filmed interview and research feature on the website leonspilliaert.be (Launched in October 2024).

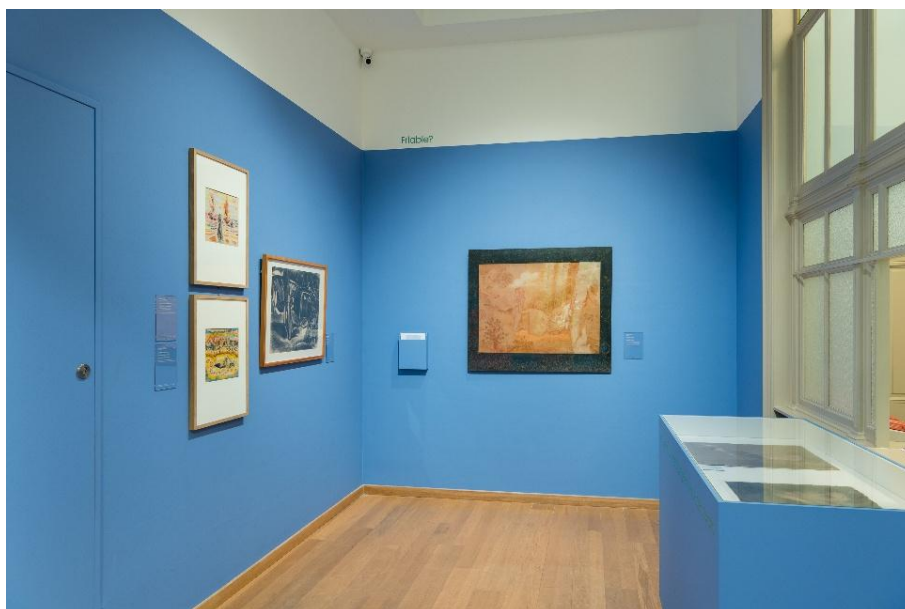
Museum Talks: Presentation by Marie-Noëlle Grison of her research results to the staff of Mu.ZEE (Dec 2024).

Presentation by Marie-Noëlle Grison of a talk titled “Materials in practice in Léon Spilliaert's drawings (1900-1912)” about the technical research she conducted on Spilliaert's works at the annual gathering of the Prentenkabinetwork, the network of prints and drawings curators in Flanders, held in Ostend on 3 April 2026.

Exhibition: “Fragile: Friable media in Belgian art on paper” at the Salle Spilliaert in the RMFAB (19.11.2025 - 19.04.2026). <https://fine-arts-museum.be/en/exhibitions/fragile>

This exhibition brings the FRIABLE research project to a broader audience. By displaying a large part of the research corpus, it contextualises the use of powdery materials in Belgian art at the end of the 19th century. It explores the new insights into the history of exhibiting, collecting, transporting and showcasing these fragile objects.

Finally, the objects are examined from a technical perspective through two themes (‘On the Surface’ and Under the Surface’), offering visitors the opportunity to view the objects under magnification, with raking light, under UV and IR light, via Raman spectroscopy and through macro-XRF scanning.







Musées royaux
des Beaux-Arts
de Belgique
Koninklijke Musea
voor Schone Kunsten
van België

**SALLE SPILLIAERT
ZAAL ROOM**

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19.11 2025 —
19.04 2026

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A brochure and a website were created to accompany the exhibition.

https://mngrison.github.io/fragile_minisite/index.html?lang=en

https://fine-arts-museum.be/uploads/exhibitions/files/guide_gids_fragile.pdf



FRAGILE

Friable Media in Belgian Art on Paper (1870-1940)

Colophon EN ▾



Tools and techniques



Glossary of Imaging Techniques



Black dry media?



Lucien Wollès
Portrait of Mr Verstraeten
RMFAB, inv. 10272



Henri Van Haelen
Portrait of Mr Brand Whitlock
RMFAB, inv. 4146



Georges Lemmen
A Working-Class Family
RMFAB, inv. 7777

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EN ▾



Tools and Techniques

Powdery materials, such as pastel, charcoal, and chalk, offer artists a wide range of expressive possibilities. The choice, handling, and combination of these materials are decisive for the final result of the artwork.

The three main powdery drawing materials each have their own characteristics. **Pastel** has been used since the 16th century and saw a revival in the eighteenth and late-19th centuries. It is made by mixing pigments with a white filler and a small amount of binder. This produces a soft, yet firm drawing material available as sticks of different shapes and hardnesses, applied directly or in a powdered form.

Charcoal, a material with a history dating back to Antiquity, is made from twigs of willow or vine, heated at a high temperature in an enclosed vessel without oxygen. This results in a sturdy drawing stick that can create black lines of varying thicknesses, depending on how it is held. It can also be applied directly to the paper as a powder.

Chalk is a natural material that is simple to use. It can be sawn into specific shapes, making it suitable for drawing fine, detailed lines. In its natural form, it is available in white, black, and various shades of red. When the three colours of chalk are used together in one composition, it is referred to as a drawing 'aux trois crayons'. By the 19th century, most of the commercialised chalks were fabricated and no longer mined from the earth.

The powdery, granular texture of these materials is central to the artistic process. Artists can manipulate the drawn lines or areas by blending them with their finger or with **tools** such as a stump. In addition, the drawing can be further worked on by scratching the surface, scraping away the medium, highlighting parts with light colours, mixing media, or erasing passages.

To preserve the drawing and prevent the powder from detaching from its support, a **fixative** may be applied. It can serve as a final protective layer or be used between layers of medium to facilitate the drawing process. While today fixatives are most commonly encountered as aerosol sprays, they have existed in many different forms throughout history.

Photo: Margaret Zayer

Website design and implementation Marie-Noëlle Grison & Robert G. Erdmann

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EN 



Macro-XRF device scanning an artwork by Léon Spilliaert
(photo: Marie-Noëlle Grison)

Glossary of Imaging Techniques

Macro x-ray fluorescence (Macro-XRF)

Macro x-ray fluorescence (Macro-XRF): An imaging technique that uses x-rays to detect and map the presence of various chemical elements in an artwork. It is a non-invasive technique, meaning that no contact between the imaging device and the surface of the object is required to collect the data. Producing a high resolution scan such as the ones presented here can take up to 24 hours. The result of this imaging procedure is a series of black and white images, one per element: the higher the concentration of an element, the whiter it will appear in the image. Applied to friable media, Macro-XRF enabled to identify many of the inorganic pigments and extenders that make up the materials used by the artists.

Multispectral imaging, or reflectance imaging spectroscopy (RIS)

Multispectral imaging, or reflectance imaging spectroscopy (RIS): While regular photography only captures the light reflected off an object within the visible light spectrum (that is, the portion of the light spectrum that a human eye can see), multispectral imaging covers a broader range, spanning from the ultraviolet (UV) to the infrared (IR). By recording the interaction of light with the object across a wider range of wavelengths, some features invisible to the naked eye can be evidenced, and in some cases pigments can be identified, all this without ever touching the artwork. The collected images are black and white, but can be further processed using statistical computations (such as principal component analysis) and false colours visualisations, to help with the interpretation of the data.

Micro-Raman spectroscopy (MRS)

Micro-Raman spectroscopy (MRS): MRS is a non-invasive point measurement technique which collects data on very precise spots on the artwork, unlike Macro-XRF and RIS which capture all or part of the surface of the artwork. It uses a tiny laser beam, focused through a microscope, to study pigments and other materials. When the laser light interacts with the pigment's molecules, it scatters in a unique way, producing a "fingerprint" spectrum. This spectrum is then compared with known spectra from materials libraries to secure an identification. MRS is routinely used in complement to Macro-XRF or other spectroscopic techniques, to confirm results with high precision data. In some cases, it can even identify organic pigments, something Macro-XRF cannot detect.

Website design and implementation Marie-Noëlle Grison & Robert G. Erdmann

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Léon Spilliaert
Vision. Elijah in the Chariot of Fire
RMFAB, inv. 10226

A self-taught artist, Léon Spilliaert is known for his **experimental and layered approach**, often combining various materials in a single artwork. His choice of ink, watercolour, pastel, and coloured pencils was not merely an aesthetic decision; the interaction between these materials also has a significant impact on the texture of his works. This not only has a visual effect but also presents challenges in terms of conservation and exhibition.

To unravel the complex material structure of these works, we illuminate them with **raking light**. This technique, in which a light source is cast across the surface at a closed angle, accentuates the slightest irregularities and reveals a wealth of information that usually remains invisible in normal lighting conditions. Depending on the direction of the light, different details become more visible, allowing us to map the topography of the artwork. In this work, for example, raking light reveals distinct craquelures and **'flakes'** visible in the red and yellow zones. The shadows thereby created show that many of these flakes have lifted edges, indicating the extreme instability of the pictorial layer in these specific parts. Due to its fragility, the artwork cannot be displayed at this time.



Léon Spilliaert
Vision. Elijah in the Chariot of Fire, pastel, paint and pencil on cardboard (detail: flakes with raised edges)
RMFAB, inv. 10226

Raking light photography also reveals the artist's interventions. We can see how Spilliaert, in his search for the right composition, carved lines into a wet reddish paint layer to expose a contrasting yellow colour underneath and build up the figure, a technique that testifies to his deliberate and sometimes unconventional working method. Finally, raking light helps us to identify the different materials. We can distinguish where thinner layers, such as pencil or lightly applied pastel, contrast with thicker, pasty materials like oil- or wax-based crayon and paint. In this way, the complex layering of Spilliaert's work becomes visible.

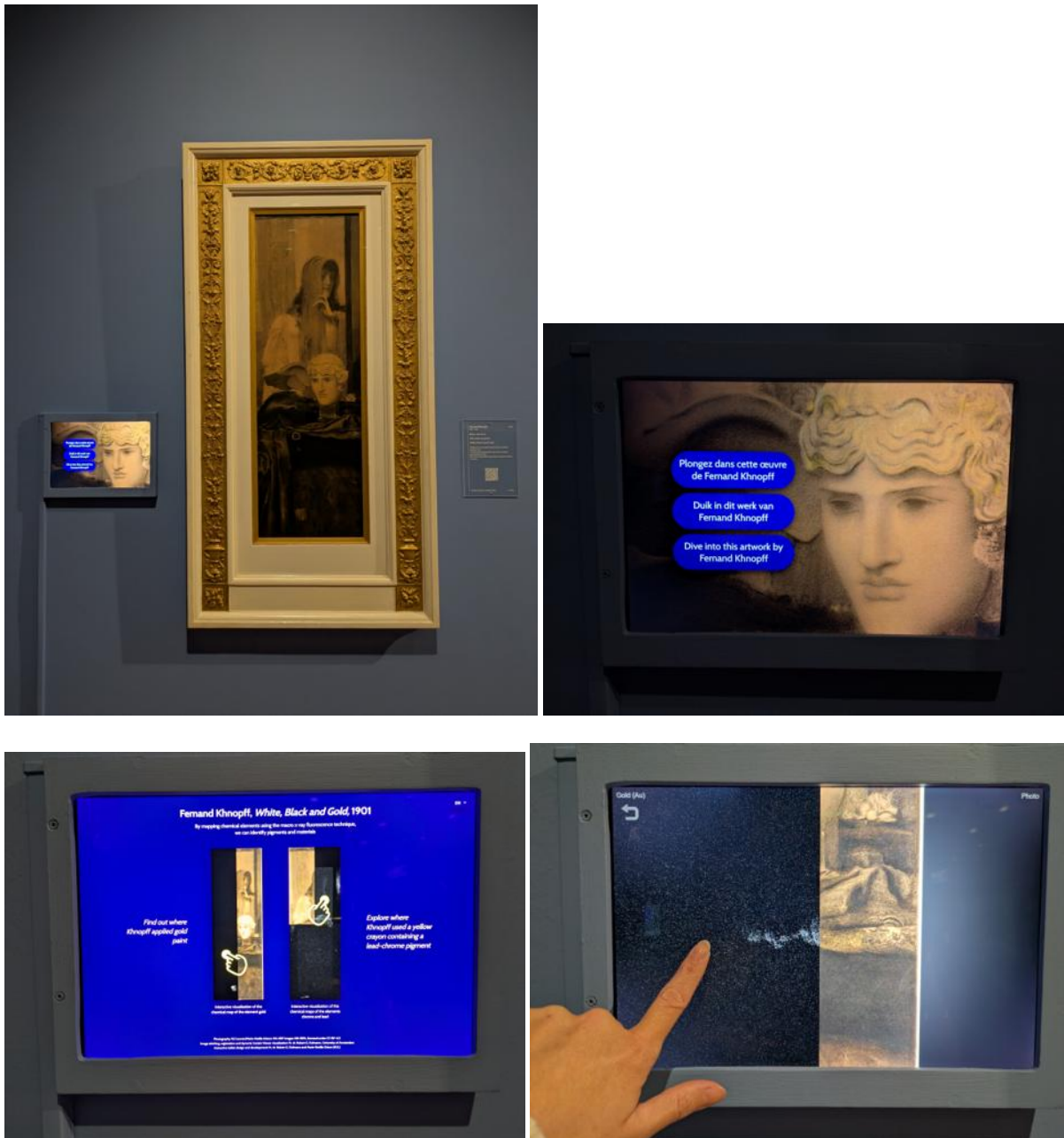


Léon Spilliaert
Vision. Elijah in the Chariot of Fire, pastel, paint and pencil on cardboard (detail: scratched medium)
RMFAB, inv. 10226

Photo credits: © RMFAB, Brussels / photo: J. Geleyns - Art Photography | © KU Leuven/Marie-Noëlle Grison; stitching and dynamic visualisation: Robert G. Erdmann (University of Amsterdam)

Website design and implementation: Marie-Noëlle Grison & Robert G. Erdmann

- Interactive content on three tablets designed and implemented by Pr. Dr. Robert G. Erdmann (University of Amsterdam), with help from Marie-Noëlle Grison, allowing visitors to explore the technical imaging dataset for three artworks in the exhibition (see photos below).



View of the *Fragile* exhibition, with Fernand Khnopff's *White, Black and Gold* and its interactive tablet showcasing insights from MA-XRF imaging with the Curtain Viewer (interface design and content: Marie-Noëlle Grison; implementation and development: Robert G. Erdmann. Photo: Marie-Noëlle Grison).

5.2 Training and Capacity Building

Training constituted a central component of FRIABLE.

A major condition reporting workshop enabled conservators, students, curators, and heritage professionals to develop practical expertise in assessing friable media artworks.

Conservation students from ENSAV La Cambre participated directly in corpus evaluation, condition reporting, mock-up production, and research activities. Knowledge was transferred through lectures and practical training (handling of friable media drawings training at the RMFAB), fostering a new generation of professionals aware of the fragility issues.

Additional academic outputs included master's theses and doctoral research directly connected to project objectives. The PhD thesis constitutes a major output of the project, focusing on a historically and materially significant Belgian art corpus, significantly advancing Belgian expertise in the technical art history and conservation science of friable media.

The project therefore contributed significantly to capacity-building within the conservation field by fostering interdisciplinary training that combined heritage science, conservation practice, and collection management.

Workshops/Meetings

Participation in the Condition Reporting Workshop (Sept 2022) at RMFAB, offering art historical content; involvement in expert discussions (e.g., with Agnes Brokerhof) and research visits (Rijksmuseum, Mu.ZEE, KBR).

Lise Vandewal, Juliette François, Marie-Noëlle Grison, Leila Sauvage, Estelle Van Geyts & Ana Oñate Muñoz, Conference of Isabelle Roché, from La Maison du pastel, Rijksmuseum, Amsterdam, April 2023/ Talk by Isabelle Roché and Margaret Zayer about La Maison du Pastel, Rijksmuseum [Participant | 21.04.2023]

Lise Vandewal, Juliette François, Marie-Noëlle Grison, Estelle Van Geyts & Ana Oñate Muñoz, Participation to the IADA conference 2023, Halle and Leipzig, October 2023/ IADA XVth Conference Halle/Leipzig [Participant | 16.10 - 20.10.2023]

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Lise Vandewal

- Training "De strijd tegen schimmels in collecties", KBR and Archives Générales du Royaume [Participant | 05.06.2023]
- ICOM-CC: 20th Triennial Conference. Working Towards a Sustainable Past [Participant | 18.09 – 22.09.2023]
- Brussels Drawing Week: Workshop on Modern Works on Paper from the collection of the Royal Museums of Fine Arts of Belgium, together with BePAPER project [Co-organizer | 03.10.2023]

- Art on Paper: Presentation *Traces of Travelling Art* [Co-presenter | 05.10.2023]
- Studyday at M Leuven: Registration and digitization of bound works on paper [Participant | 26.10.2023]
- *Dutch Bargains and Belgian Sales* [Participant Online Symposium | 20 and 21.04.2024]
- FARO Masterclass: *invloed van mechanica op erfgoedcollecties* [Participant | 10 & 11.12.2023]
- Getty Paper Project - *Exploring the Materiality of Powdered Colors* [Participant | 25.03.2025 - 03.04.2025]

6. PUBLICATIONS

The following scientific and professional outputs were produced or initiated within the framework of FRIABLE:

Conference Presentations

- *FRIABLE: Characterising Powdery Materials in Belgian Drawings from the Royal Museums of Fine Arts of Belgium (1850-1914)*, IADA XV Congress.
- *The FRIABLE Project and the Investigation into the Layer Build-Up and Fragility Levels of Friable Media Drawings: The Case Study of Léon Spilliaert's Spring*, ICOM-CC Triennial Conference poster.
- *Layer Build-Ups, Flaking and Fragility Levels in Drawings. A Case Study of Léon Spilliaert's Friable Media Drawings*, IADA Congress.
- *Not Just Powder. The Metamorphoses of Pastel in Early Works by Léon Spilliaert (1881-1946)*, CIHA Conference.

Academic Research Outputs

- PhD research by Marie-Noelle Grison (KU Leuven).
- Master's thesis by Alison Grotz (University of Amsterdam): *Layer Build-Ups, Flaking and Fragility Levels in Drawings. A Case Study of Leon Spilliaert's Friable Media Drawings*.
- Master's thesis by Mathilde Bezon concerning fungal treatment strategies for pastel artworks.

Unpublished Outputs

- Technical and Damage Atlas for Friable Media.
- Assessing the Impact of Conservation and Restoration Contact Materials on Friable Media Layers

7. ACKNOWLEDGEMENTS

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Special appreciation is extended to the conservators, collection managers, curators, researchers, students, photographers, imaging specialists, and museum staff whose expertise and collaboration made the successful implementation of the project possible.

The project additionally benefited from the support of external institutions and collections including KBR, Mu.ZEE, Fondation Custodia, the Royal Collection Trust, the Cultural Heritage Agency of the Netherlands (RCE), the University of Amsterdam, and numerous archive and collection partners who facilitated consultation, imaging, and research activities throughout the project.

ANNEXES

Annexe 1

Obstacles Encountered and Mitigation Measures

Throughout the project, FRIABLE faced several organisational, logistical, personnel, and technical challenges that affected the timing of certain activities. Nevertheless, the consortium adopted flexible management strategies and collaborative solutions to ensure the continuity and quality of the research.

The project start was initially delayed by approximately one year due to the COVID-19 pandemic, which postponed recruitment procedures and the launch of planned activities. This situation was compounded by the prolonged absence of the RMFAB project coordinator, Inga Rossi-Schrimpf, director collection and research as well as curator modern works on paper, whose responsibilities included collection access and institutional coordination. To mitigate these impacts, partners increased the frequency of coordination meetings, redistributed responsibilities, and implemented task-specific solutions whenever necessary. The recruitment of Sarah Van Ooteghem as curator for modern works on paper in late 2022 significantly improved access to the collections and supported project coordination within the museum.

Several personnel changes also affected the project. At KIK-IRPA, the departure of Laura Debry before project initiation required the appointment of a new promotor and the recruitment of Juliette François, whose onboarding and training temporarily slowed progress. Later, the departure of Marjolijn Debulpaep at the end of 2024 required a further reorganisation, with Juliette François assuming scientific responsibility to ensure continuity. Similar changes among senior researchers at partner institutions required adjustments to supervision and management structures.

Access to the RMFAB collections proved challenging throughout the project due to staff shortages, internal organisational constraints, and the absence of key personnel. These factors affected the implementation of condition reporting, technical analyses, and imaging campaigns. To maintain progress, partners adapted schedules and, where necessary, developed alternative case studies and workflows using comparable artworks outside the RMFAB collection.

The project also encountered significant difficulties regarding digital data management. As the museum's Digital Department lacked the capacity to provide dedicated tools, several planned deliverables related to data digitisation and management were delayed. The consortium responded by developing customised solutions, including online forms, shared databases, Excel datasets, and SharePoint-based storage systems, which ultimately enabled the digitisation and secure sharing of project data.

As research progressed, several methodological adaptations became necessary. The planned Value Assessment exercise was postponed because the institutional knowledge required to perform it was not readily available. Risk analysis activities were prioritised instead, while alternative sources of expertise were identified. Furthermore, some planned analytical activities, including micro-fading testing and artificial light ageing of mock-ups, were discontinued after evaluation of their scientific relevance and technical feasibility. The scope of the mock-up programme was also narrowed to focus on the most

significant factors influencing the fragility of friable media, thereby ensuring realistic and meaningful outcomes within the project timeframe.

Financial pressures caused by salary indexation reduced budget flexibility and shortened the available contract period for certain staff members. In parallel, the unframing of artworks revealed the need for more extensive reframing interventions than originally anticipated, for which no dedicated budget had been foreseen. The consortium addressed these issues through budget reallocations, prioritisation of activities, and close collaboration between the museum and conservation partners.

Finally, some dissemination objectives required adaptation. The creation of a dedicated project website proved infeasible due to limited institutional resources and technical expertise. Instead, dissemination efforts were redirected towards scientific publications, conference presentations, professional networks, and the integration of project outputs into existing digital tools such as AGATO.

Despite these challenges, the consortium successfully adapted its methodologies, timelines, and priorities, ensuring that the project objectives remained achievable and that the scientific quality of the final outputs was maintained.