MIE - Multispectral Imaging Explorer
V 1.0 - USER GUIDE



PROCESS / ALIGN / EDIT / EXPORT

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2026

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Presentation

MIE is a **browser-based, modular environment** for preparing, processing, aligning and interactively exploring multispectral and documentary imaging datasets in archaeology and heritage science. Its **four connected modules** — Process, Align, Edit and Export — support a workflow from image enhancement and registration to the creation and dissemination of interactive multilayer Viewers. Projects can be **saved locally and reopened** for further work.

The **Process module** provides tools to prepare and optimise images for multispectral exploration, including adjustments to light, colour, tonal levels and individual channels, as well as reference-based colour correction for visible-light photographs. Exploratory enhancements — including **chromatic separation, colour decorrelation, principal component analysis and false-colour compositions** — can increase the legibility of faded or low-contrast decoration, bring out subtle traces and accentuate differences in the response of colours and materials. These operations support visual examination and the formulation of hypotheses; they do not, on their own, establish material identifications.

Across **wall paintings, easel paintings, manuscripts, polychrome objects and other works of cultural heritage**, the combination of different imaging layers can reveal features difficult to distinguish in visible light and help map variations associated with materials, execution techniques and later interventions. **Visible-induced luminescence (VIL)** can highlight Egyptian blue; **UV-induced fluorescence (UVF)** can reveal differences in surface coatings, certain binders and other materials, as well as retouching and past restorations. **UV reflectance (UVR)** can enhance the contrast of faded paints and inks and help distinguish some pigments, retouches and surface alterations. **Infrared reflectance (IRR)** can reveal preparatory drawings, compositional changes (pentimenti), retouching and, under suitable conditions, details obscured by overlying paint, darkened or carbonised surface deposits. The visibility of these features depends on the materials, their stratigraphy and the imaging conditions. MIE also brings these images together with **historical photographs, drawings and digital reconstructions** in a common spatial framework, supporting the study of making techniques and the development and visual assessment of virtual reconstructions.

Alongside its research applications, MIE is also intended as a tool for **teaching and dissemination**. Interactive comparison tools such as the **slider** and **spotlight** make differences between imaging layers immediately visible, allowing students and non-specialist audiences to explore information that may otherwise be difficult to perceive or interpret. Its accessible interactive Viewers can also be used in **museums and exhibitions** to present scientific images and interpretations directly to visitors.

Getting started

MIE is a web-based application designed to work locally on your computer, whether you use the online version or the downloadable local version. The suggested browser is Firefox, although it works on other browsers as well. MIE also supports mobile use, but a laptop, desktop computer or a tablet with a large screen is preferable for precise image processing and alignment.

Online version

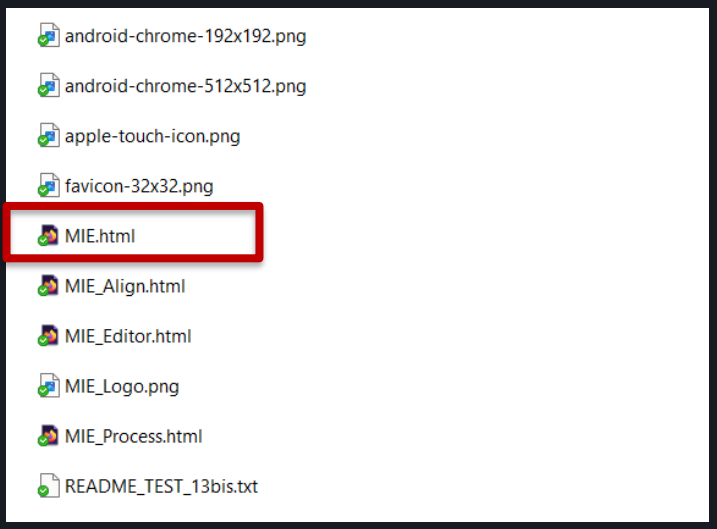
Open the MIE website and select **Online Editor**. Image processing and project operations run locally in your browser; your photographs are not uploaded to MIE servers. Save your work explicitly using Save Project, and keep the downloaded file.

Local version — download and extract

Download the MIE ZIP package. Extract its complete contents to a dedicated folder before opening anything. Do not run the application directly from the compressed ZIP, and do not move or rename its accompanying files.

Launch MIE

Inside the extracted folder, locate **MIE.html**. Open this file in a browser (preferably Mozilla Firefox). MIE.html is the entry point: PROCESS, ALIGN, EDIT and EXPORT are accessed from its navigation bar. Keep the entire extracted folder together and do not move or rename the files inside the folder.



Create a desktop shortcut

Windows: right-drag MIE.html to the desktop and choose Create shortcut here (or use Send to → Desktop). macOS: select **MIE.html** in Finder and choose File → Make Alias, then move the alias to the desktop. Linux: create a desktop launcher or symbolic link pointing to MIE.html. Do not move the original file out of the MIE folder. The icon can be changed with the file MIE_Logo in order to be more recognisable on your desktop.



The four MIE modules

MIE is organised into four complementary modules. They form a possible workflow, but they can also be used independently according to the material already available.

01 PROCESS

Prepare, calibrate and enhance individual images. Use presets, manual controls and chromatic transformations to explore visual information.

02 ALIGN

Register different photographs to a common reference using corresponding points, geometric transformations and optional local corrections.

03 EDIT

Assemble and organise image layers, then configure interactive tools for comparison, research, teaching or interpretation.

04 EXPORT

Generate either a Full Viewer for detailed exploration or a Simplified Viewer for a focused public-facing experience.

Save and reopen your work

Use the project controls to preserve an editable working session.

1 Save the project

Select **Save Project** to download a local project file. Saving is not automatic: save again after making changes, creating each time a new file.

2 Resume editing later

Select **Open Project** in MIE to reopen the saved JSON file with the .mie extension. Do not open the project file by double-clicking it; it must be reopened from within MIE.

3 Keep your source photographs

Keep the original photographs separately from processed images, project files and exported Viewers.

4 Refresh = Erase

Using the refresh button on your browser will reset the software, use it only to start a new project.



Image processing

MODULE OVERVIEW

PROCESS provides a flexible workspace for preparing and exploring digital photographs, from basic tonal correction to advanced chromatic transformations. Imaging-mode presets offer a rapid starting point for VIS, VIL, UVF, UVR and IRR images; the resulting settings can be adjusted manually and saved as reusable JSON configurations. The module includes reference-based VIS calibration, controls for light, colour, HSL and individual channels, and enhancement methods such as chromatic separation, RGB decorrelation, principal-component analysis and custom false-colour composition. These transformations can reveal variations that are difficult to distinguish in the original photograph, but their interpretation must remain grounded in the acquisition conditions and source data.

KEY POINT

Always preserve the original photograph. Image enhancements should be treated as derived working documents, not as replacements for the source data.

Open and inspect an image

Adjust one photograph while retaining its original as a reference.

1 Import the photograph

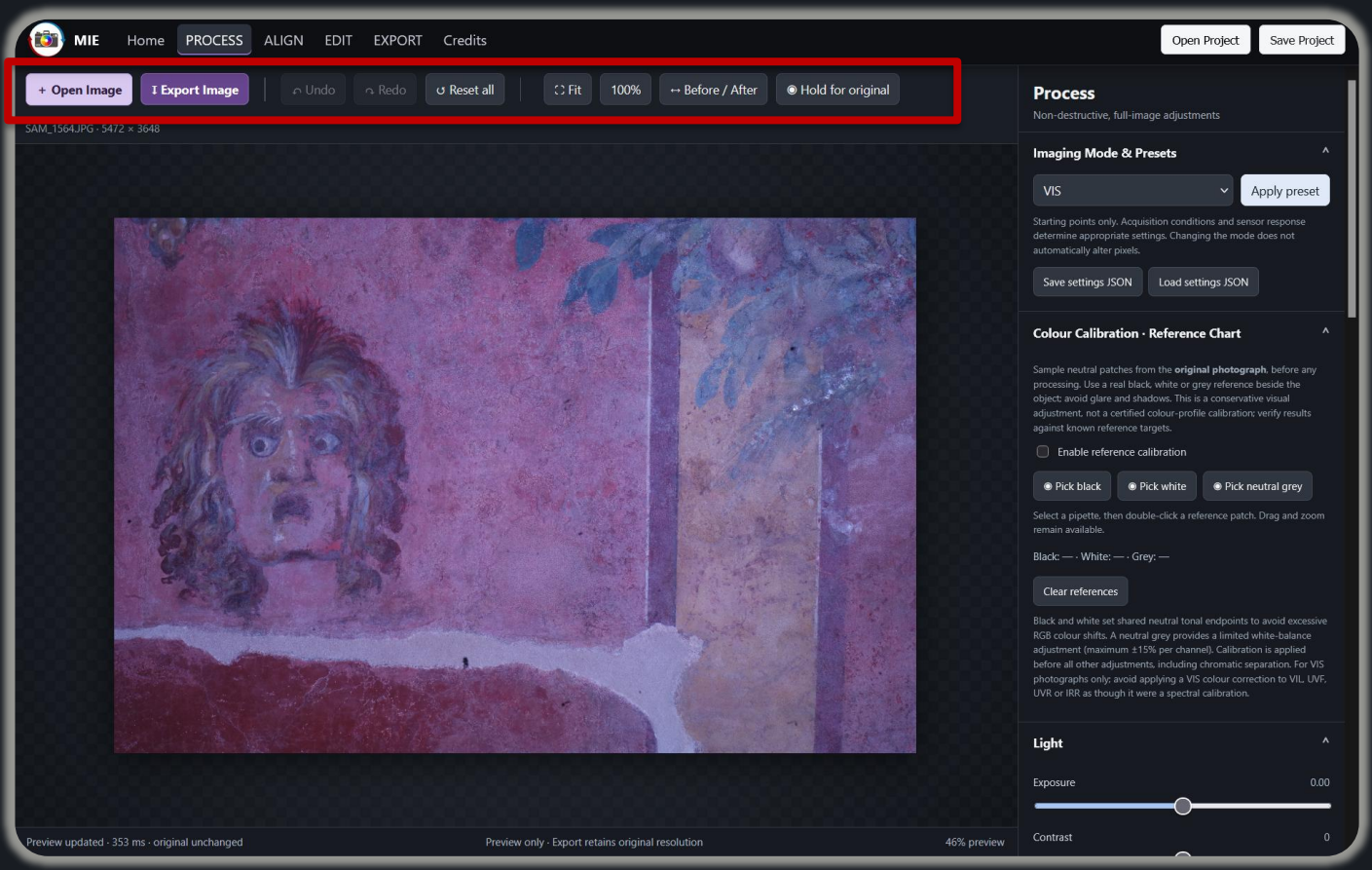
Select Open Image and choose a JPEG or PNG file from your computer.

2 Inspect the original

Use Fit or 100% to change the display; use Hold for original to temporarily reveal the unprocessed image.

3 Compare the changes

Activate Before / After to compare the original and processed versions without exporting a file.



Boscoreale, villa of P. Fannius Synistor. Detail from the exedra L, 1st century BC.
Today exposed at the royal Museum of Mariemont, Belgium (© Musée royal de Mariemont, inv. B99).

Set imaging mode and calibration

Choose an appropriate starting point and, where relevant, sample reference patches.

1 Choose the imaging mode

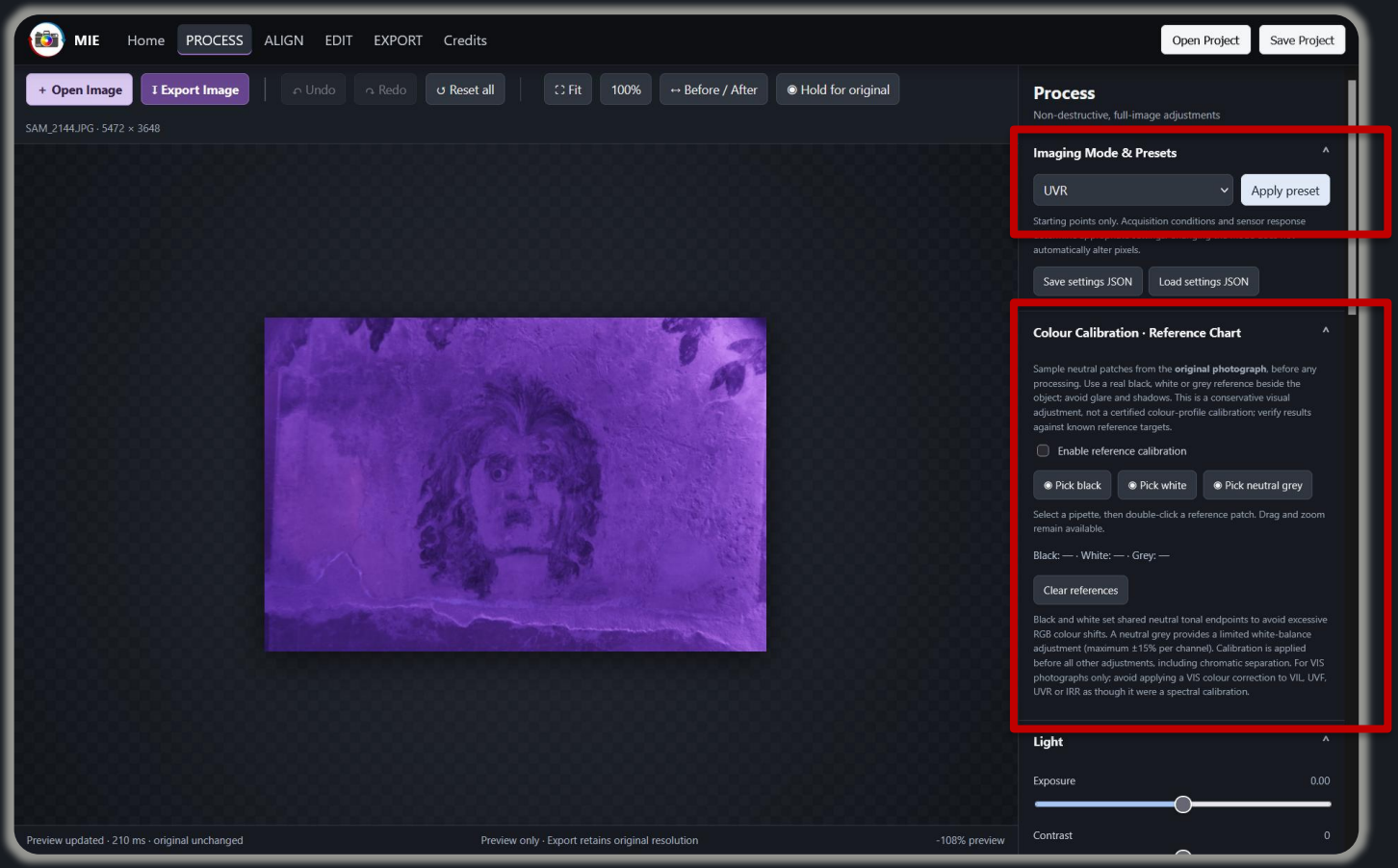
In Imaging Mode & Presets, select VIS, VIL, UVF, UVR, IRR or Custom.

2 Apply a preset deliberately

Click **Apply preset** only if you want its suggested adjustments; changing the mode alone does not change the pixels.

3 Calibrate a VIS photograph

Under Colour Calibration, **enable** reference calibration and use Pick black, Pick white or Pick neutral grey on suitable targets.



WORKING TIP

Use reliable reference patches. Select black, white and neutral-grey targets only when they are known references within the photograph. Avoid sampling painted surfaces, shadows or highlights as calibration references.

Adjust light and colour

Use the adjustment panels to improve legibility without altering the source file.

1 Open Light or Colour

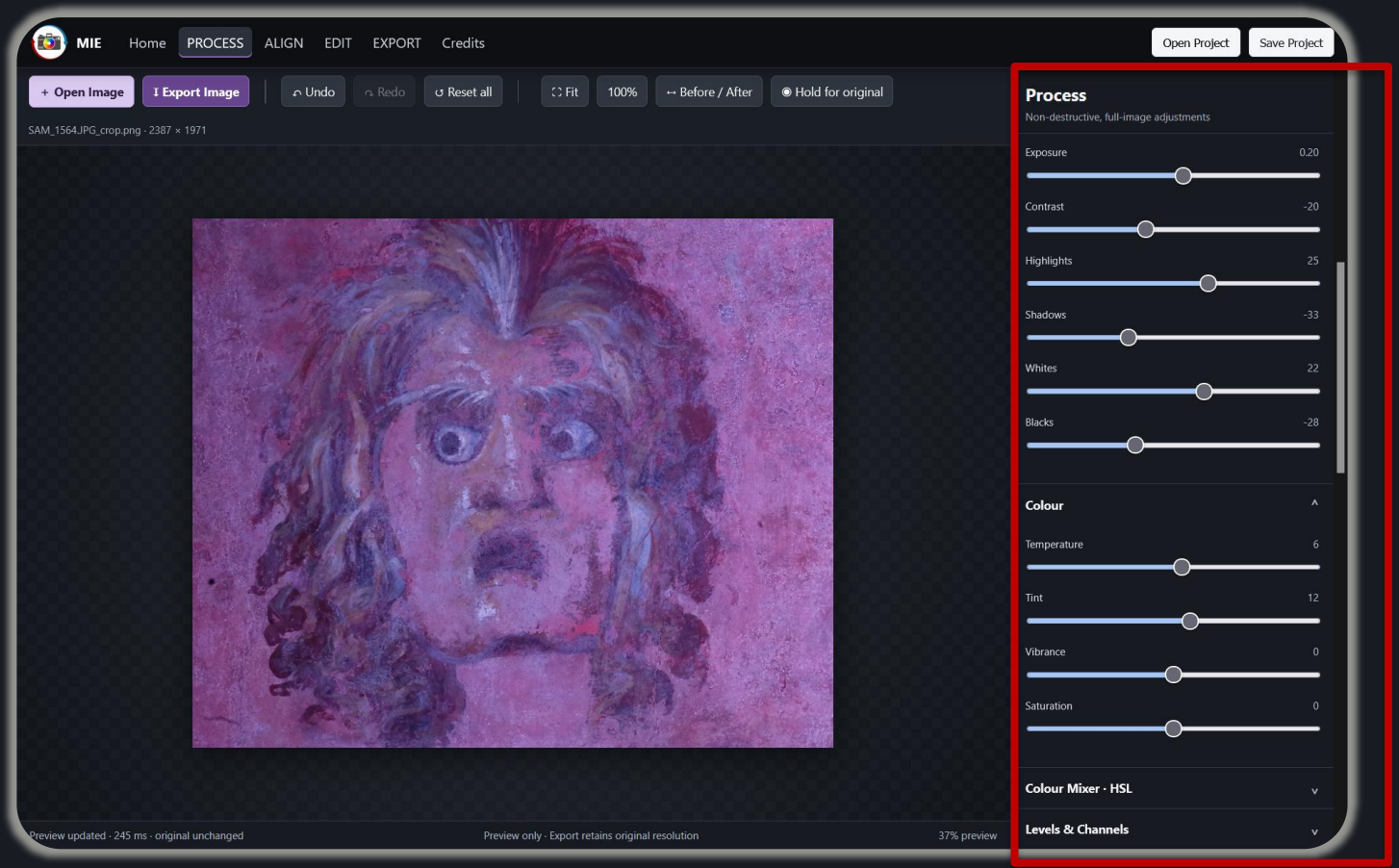
Expand the corresponding panel and modify the relevant sliders while observing the image.

2 Adjust individual colours

Use **Colour Mixer · HSL** to modify one of the eight hue families independently.

3 Review tonal distribution

Inspect **Levels & Channels** and **Histogram**; use **Undo** or **Reset** all if the processing is unsuitable.



WORKING TIP

Work progressively. Adjust tonal levels before making strong colour changes, and use Before / After regularly. Excessive contrast or saturation may conceal faint details or amplify image noise.

Chromatic separation

Chromatic Separation · Lab is an exploratory enhancement intended to make subtle chromatic variations easier to see. Its parameters should be adjusted while comparing the processed image with the original photograph. The resulting colours are transformations of image data: they must not be treated as direct evidence for the identity of pigments.

Choose the enhancement

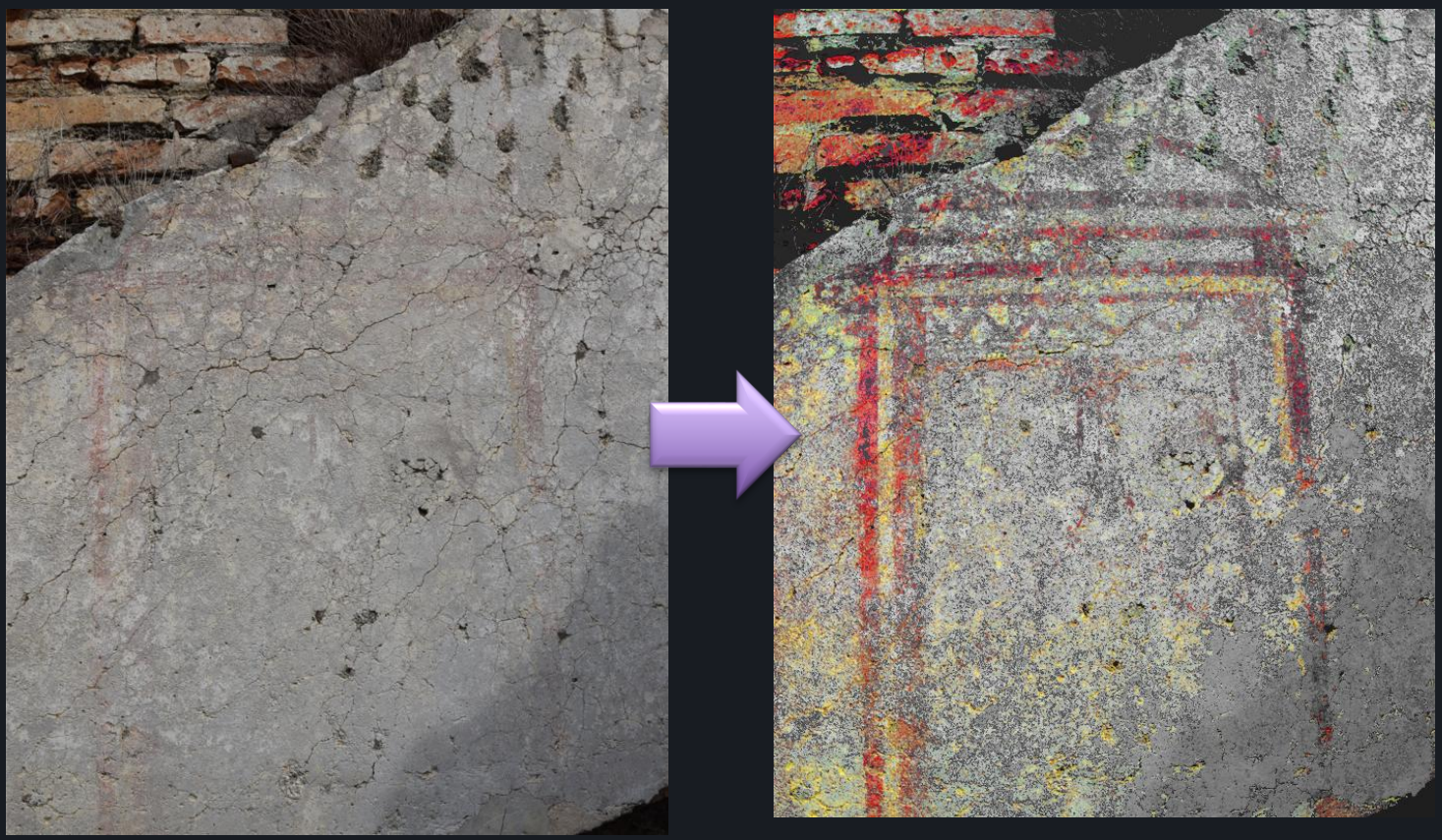
In Enhancement & False Colours, select **Chromatic Separation · Lab**.

Adjust the effect

Modify the available controls gradually, checking which details become more legible and whether important visual information is lost.

Document the result

Compare the transformation with the source image and save the processed output with a descriptive filename.



Ostia antica, Terme del bagnino Buticosus, room 10. End of 2nd century AD. (© Parco archeologico di Ostia antica). To the right, picture processed with the Chromatic separation tool of MIE Process.

False-colour transformations

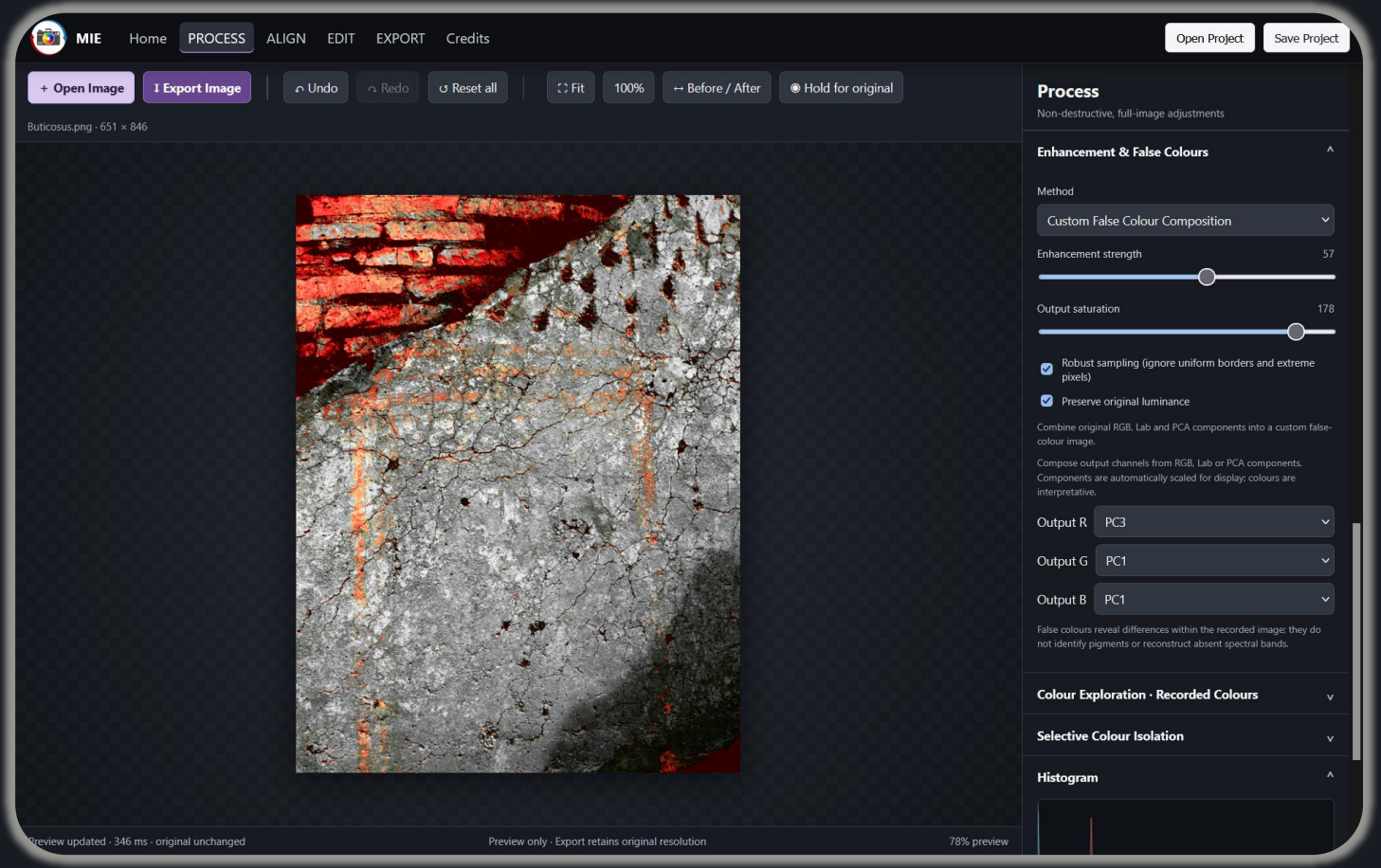
Enhancement & False Colours offers complementary ways to redistribute colour information. Colour Decorrelation · RGB enhances subtle differences between correlated channels; Principal Components · RGB separates dominant patterns of variation; Custom False Colour Composition lets you assign recorded channels to alternative output colours. These are exploratory transformations of the source photograph, not pigment identifications.

Choose a transformation

Under **Enhancement & False C**olours, select Colour Decorrelation · RGB, Principal Components · RGB or Custom False Colour Composition.

Adjust and compare

Test the methods separately. For custom compositions, adjust channel assignments; use **Before / After** to assess which features become clearer.



Colour exploration and selective isolation

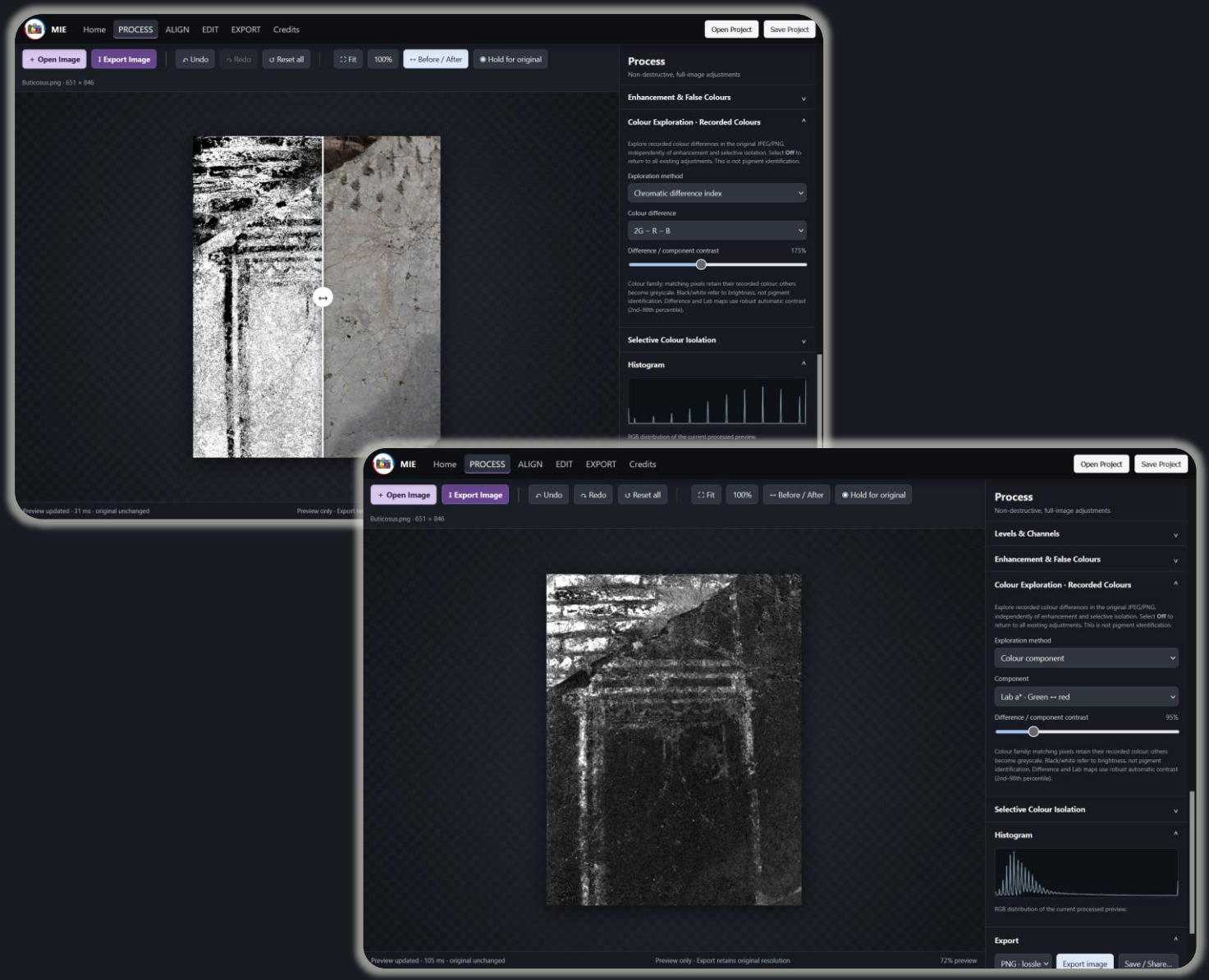
Colour Exploration · Recorded Colours examines chromatic information in the original image, independently of other enhancements. Chromatic Difference Index highlights differences between RGB channels; Colour Component displays selected RGB or Lab components. Selective Colour Isolation instead retains chosen colour families in the processed result while reducing the visibility of others. These visualisations help locate faint traces, but do not establish pigment identity.

Explore recorded colours

Open **Colour Exploration · Recorded Colours**. Choose Chromatic difference index or Colour component, select a difference or component and adjust contrast.

Isolate and compare colours

Use **Selective Colour Isolation** to retain selected colour families in the processed image. Compare the results with the original using **Before / After**.



Selective colour isolation

Selective Colour Isolation retains selected colour families in the processed image while displaying the others in greyscale. Used after chromatic enhancement or false-colour transformations, it helps focus attention on relevant traces and reduce distracting colours. The selection affects only the visualisation: it does not identify pigments or modify the original photograph.

Enable colour isolation

Expand **Selective Colour Isolation** and tick **Enable colour isolation**. Choose the colour families you wish to keep visible.

Refine the selection

Select or deselect the eight colour families to highlight relevant details or hide unnecessary parts. Combine with other transformation tools for a better result and compare the result with the original using **Before / After**.

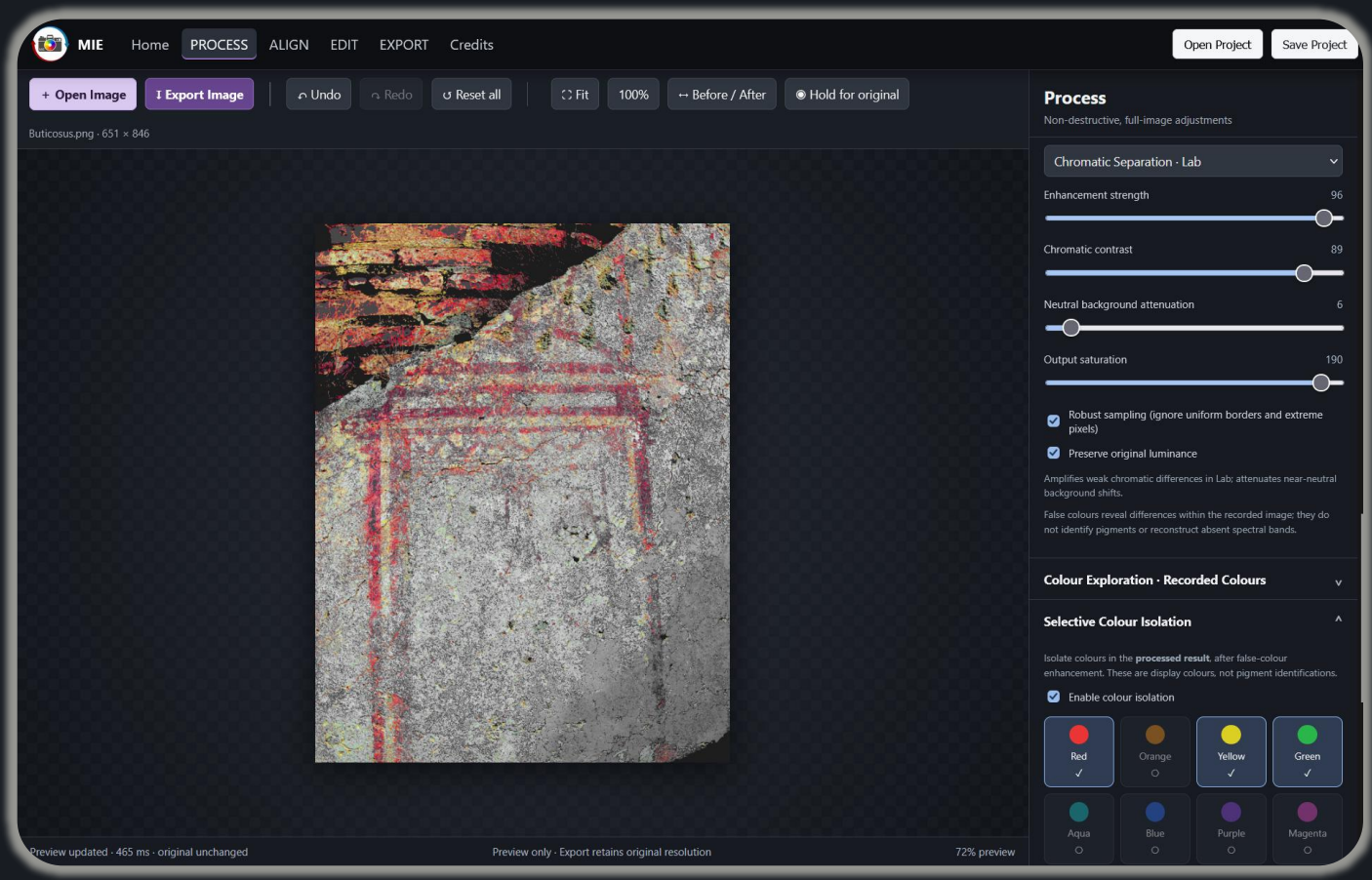


Image registration

MODULE OVERVIEW

ALIGN geometrically registers photographs of the same surface so that corresponding features occupy matching positions. This step is especially important before combining visible-light, ultraviolet, infrared or other image layers in EDIT: even small offsets can compromise comparisons. Place accurate reference points across the whole image, including its margins, and use additional points wherever reliable features can be identified. Test Auto, Affine and Perspective transformations as appropriate, then inspect the overlay with Opacity and Blink. Mesh Warp can correct residual local distortions after the main registration, without losing the reference image dimensions.

KEY POINT

Quality depends on the accuracy and distribution of points, not their number alone. Accurate registration is essential for meaningful comparisons. Distribute control points across the image and verify the alignment on features not used to calculate the transformation.

ALIGN

Load two corresponding images

Define the spatial reference and the image to be transformed.

1 Load the reference image

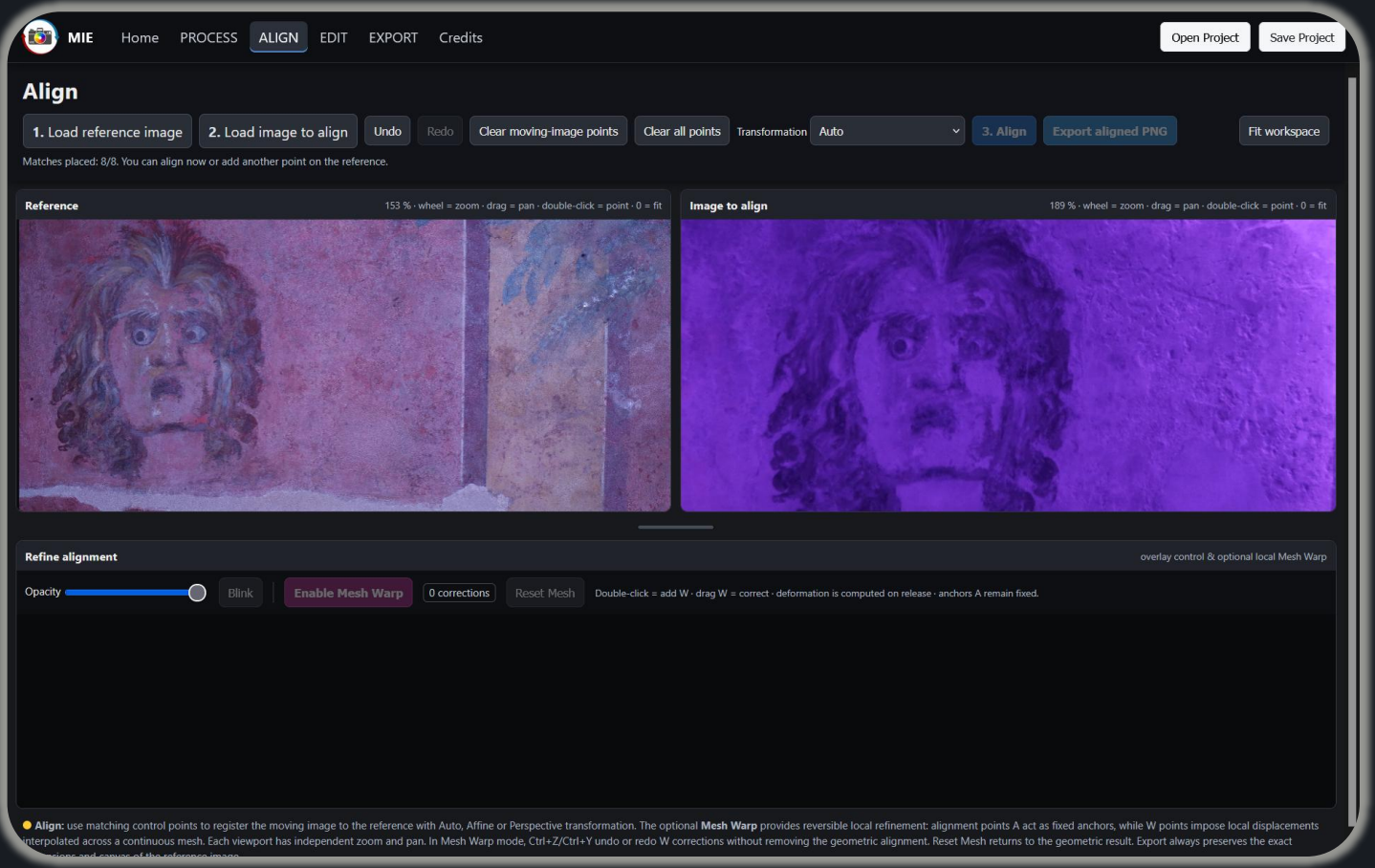
Click **Load reference image** and select the photograph that defines the output canvas.

2 Load the moving image

Click **Load image to align** and choose the photograph that needs registration.

3 Navigate each image independently

Drag to pan, use the mouse wheel to zoom and Fit workspace to restore the workspace layout.



WORKING TIP

Use a common reference image. When preparing multiple imaging layers, align each photograph to the same reference rather than aligning them successively to one another. This prevents cumulative registration errors.

Register with control points

Identify the same features in both photographs before calculating a transformation.

1 Mark corresponding features

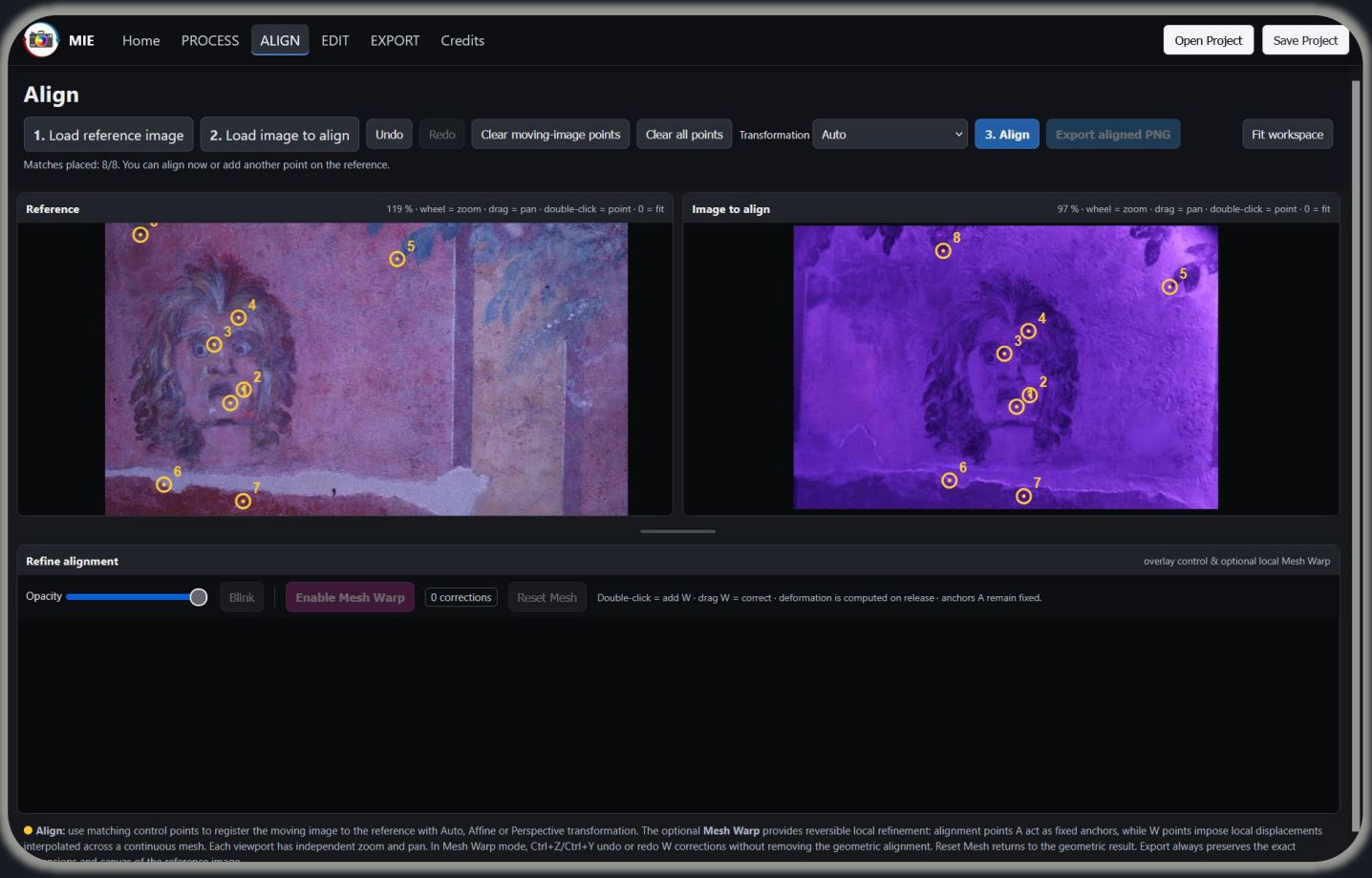
Double-click a recognisable feature in the reference and the same feature in the moving image.

2 Distribute the points

Repeat on several features across the photographed surface, avoiding points clustered in one small area. To undo the last action at any stage, click **Undo** or press **Ctrl+Z** (Windows/Linux) or **Cmd+Z** (macOS).

3 Calculate the alignment

Choose **Auto** to let MIE select the transformation, **Affine** for images with differences in position, rotation, scale or shear, or **Perspective** when the photographs also differ in viewpoint. Click **Align** to calculate the registration, then inspect the result.



WORKING TIP

Choose stable, recognisable features. Corners, cracks and small painted details generally make better control points than broad colour areas, reflections or blurred boundaries.

Verify and refine alignment

Inspect the overlay and correct residual local differences if necessary.

1 Inspect the overlay

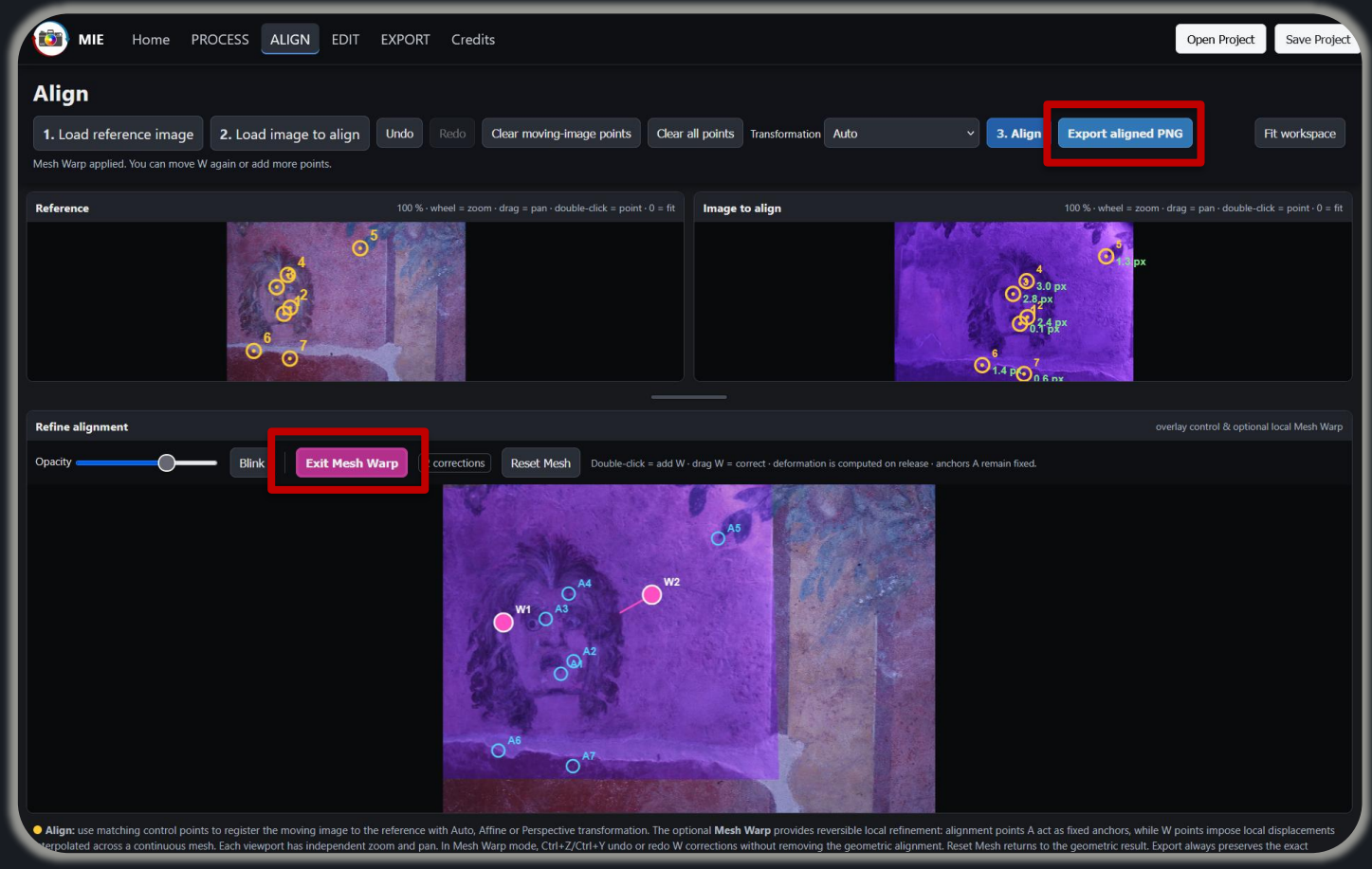
Use the Opacity control or Blink in Refine alignment to compare the two registered images.

2 Apply local corrections if needed

Choose **Enable Mesh Warp**, double-click to add W points and drag them to correct local offsets. Mesh Warp allows users to refine an existing alignment by correcting local geometric distortions that cannot be adequately resolved by a single global transformation. Additional pairs of corresponding points can be placed in areas where the images remain misaligned. MIE uses these points to calculate a local deformation, improving correspondence across the image while preserving the overall registration.

3 Export the registered image

Click **Export aligned PNG**. The output preserves the reference image's canvas dimensions.



WORKING TIP

Add control points progressively, concentrating on areas where residual misalignment is visible. Check the result regularly using Blink or opacity comparison. Additional warp points are useful only when they improve the local correspondence between images. To undo the last action at any stage, click **Undo** or press **Ctrl+Z** (Windows/Linux) or **Cmd+Z** (macOS).

EDIT

Interactive explorer: visualisation and comparison

MODULE OVERVIEW

EDIT brings together images, drawings and reconstructions as organised layers in a single interactive workspace. Researchers can switch rapidly between imaging modalities, examine correspondence between details and explore possible interpretations without opening separate files. The same environment can also support teaching and heritage interpretation: layers, labels, icons and reveal tools can be arranged to guide attention to particular features. The Editor allows the author to prepare and preview these interactions before generating a Viewer, while preserving an editable project for later revisions.

KEY POINT

Unlike PROCESS and ALIGN, EDIT does not modify or transform the images themselves: it organises them into an interactive environment for comparison and interpretation. The same dataset can support both detailed scholarly analysis and accessible public interpretation.

EDIT

Import and prepare image layers

Build the image collection that will be used in the interactive Viewer.

1

Open the Editor

Select **EDIT** from the main navigation to open the Editor panel.

2

Import the images

Load the photographs on the layers you want to show. Additional images, drawings or reconstructions can be added by clicking **Add custom layer**.

3

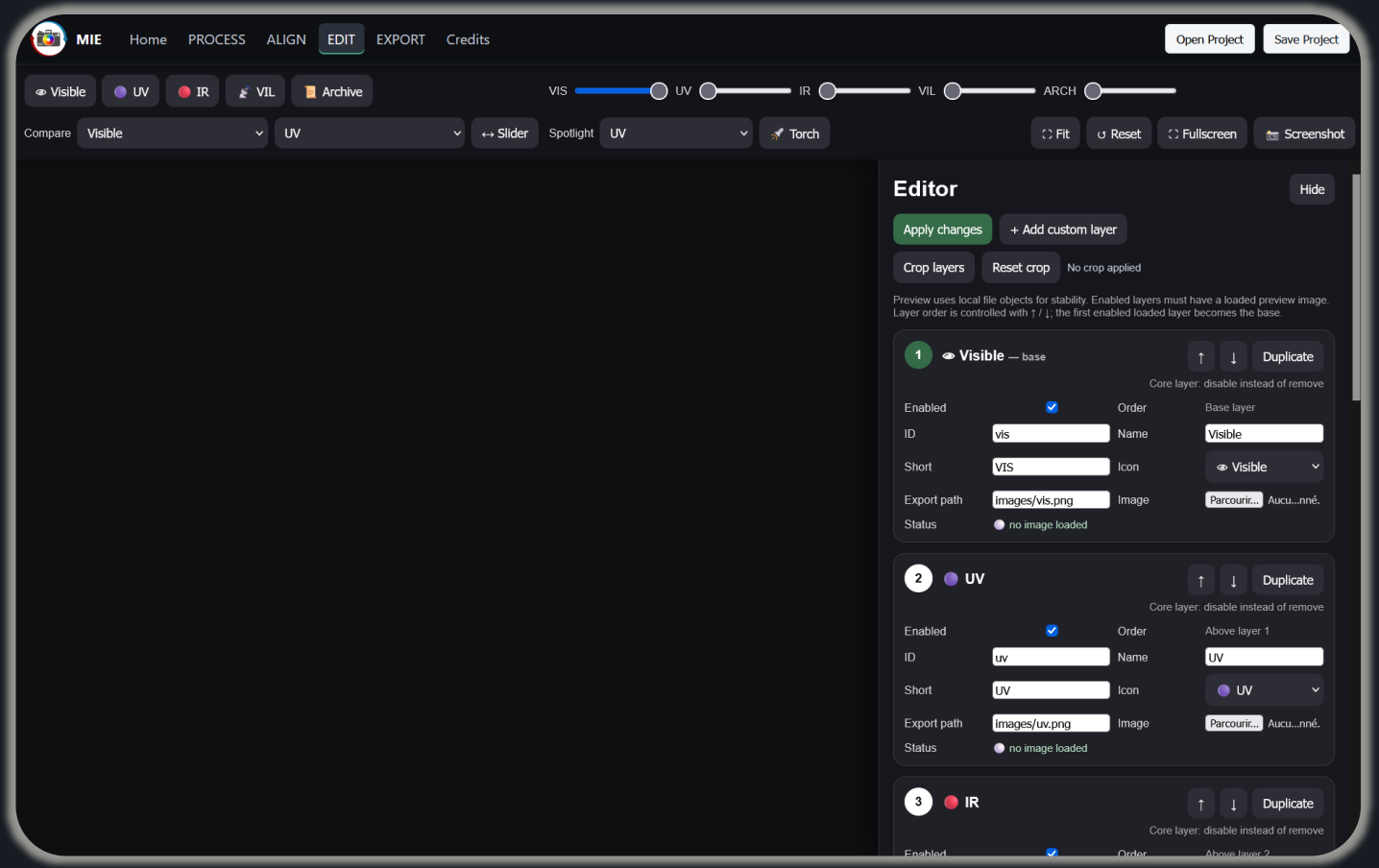
Define the base layer

Choose the reference image that will form the base of the Viewer (number **1**). Ensure that the other images are registered to the same reference.

4

Apply the imported layers

Click **Apply changes** to load the collection into the Viewer.



Customise the Viewer interface

Make each layer recognisable and organise the controls for your intended audience.

1 Name the layers

Use Name for the full layer label and Short for the compact identifier displayed in the toolbar.

2 Choose meaningful icons

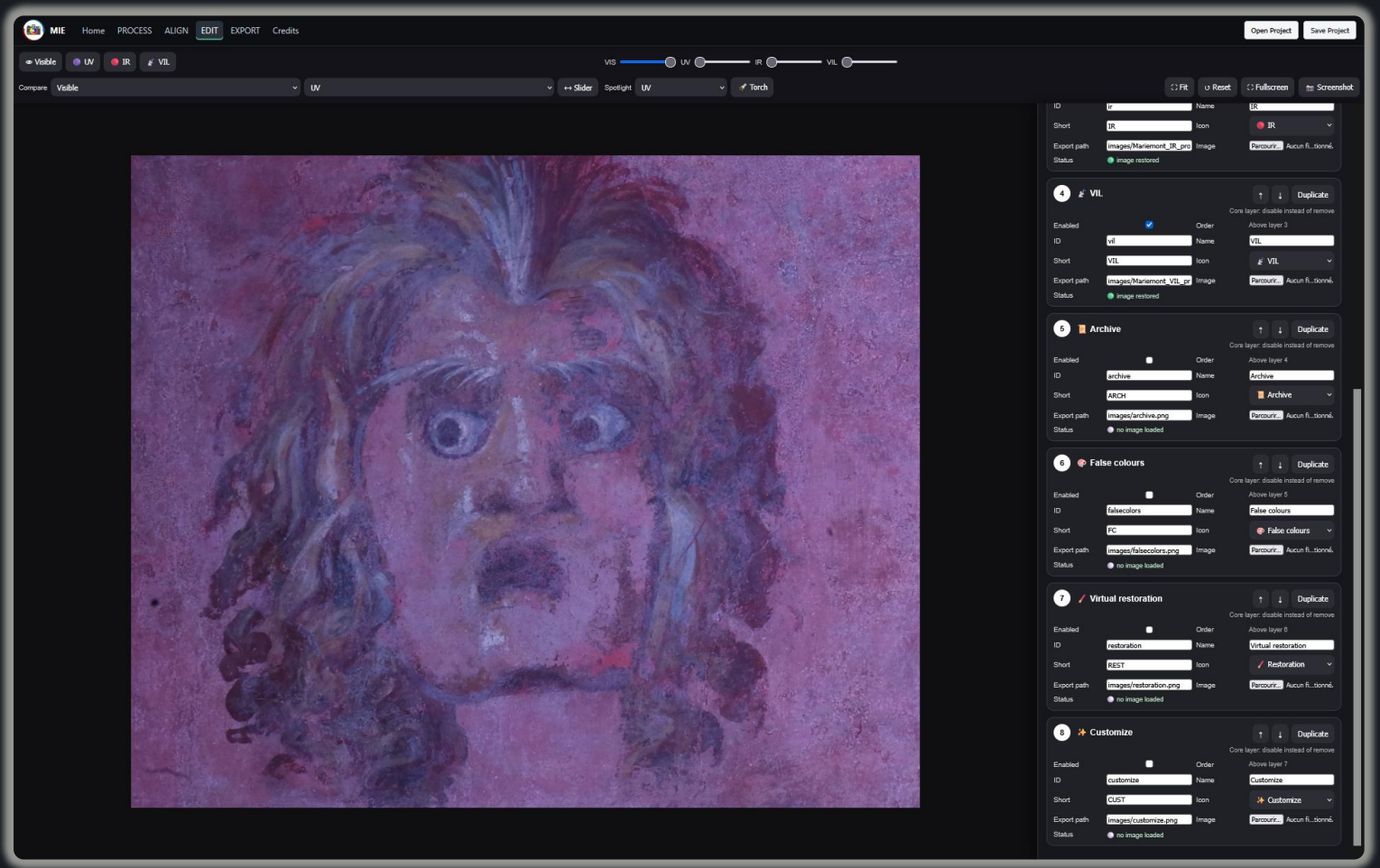
Assign each layer an appropriate Icon, distinguishing imaging modalities from drawings, reconstructions and other documents.

3 Set visibility and order

Use **Enabled** to show or hide layers and the **arrow buttons** to arrange their order. The order of the layers may influence what you see by superimposing them.

4 Review the interface

Click **Apply changes** after making any modifications, then check that the names, icons and layer controls are clear and consistent in the Viewer.



Use and configure the visualisation

Compare, reveal and inspect the image layers.

1 Test the comparison tools

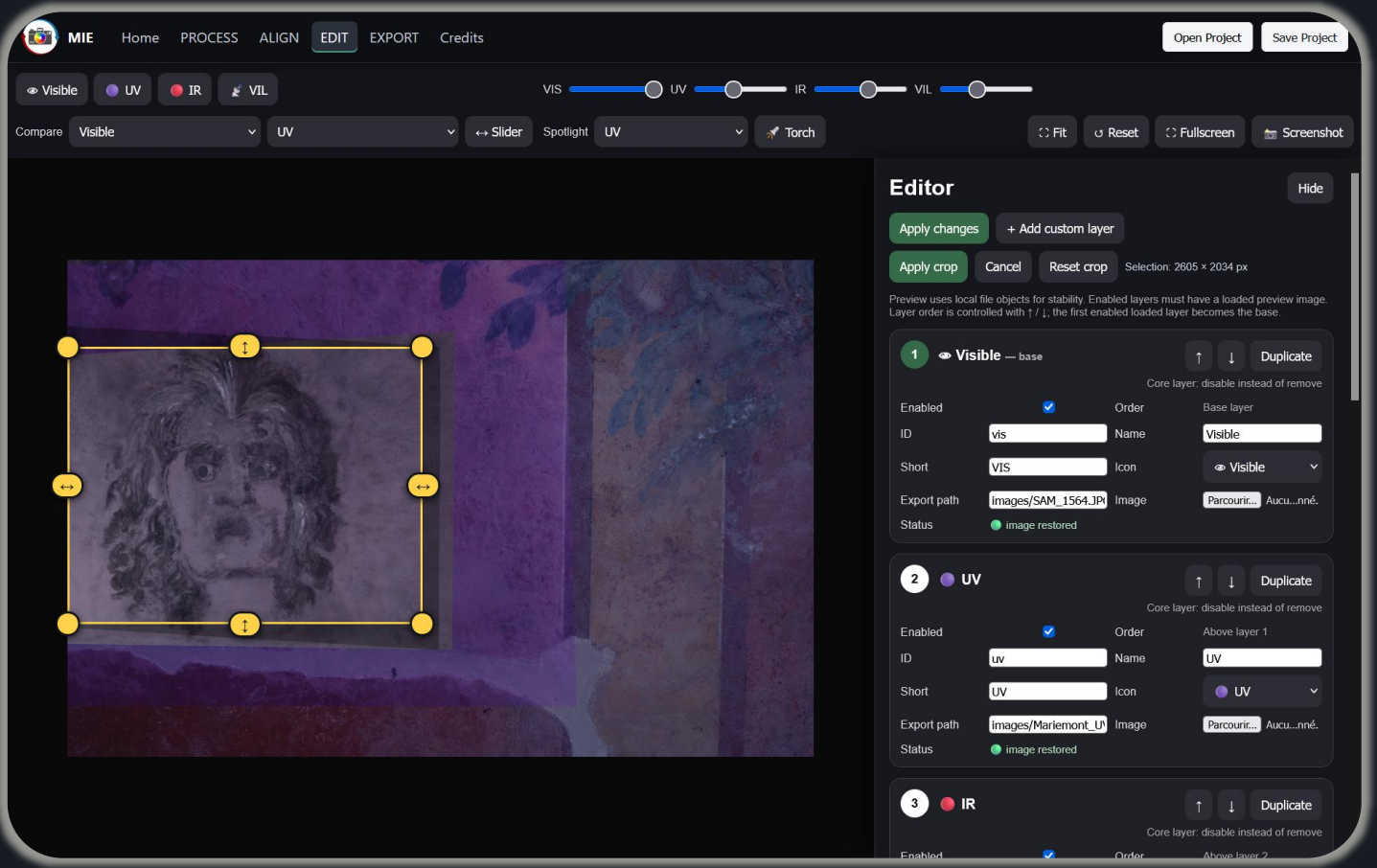
Use **Transparency** to adjust the opacity of individual layers, **Slider** to compare two images across a movable boundary, and **Torch** to reveal a selected layer within a circular area. Use **Fullscreen** or **Hide** for a less cluttered view, **Fit** to centre the image in the available space, and **Reset** to restore the initial view.

2 Crop the images

Use the **crop** tool to define the area to retain. The same crop is applied to all layers, preserving their spatial correspondence. Click Apply crop to confirm the selection, or **Cancel** to discard it. Use **Reset crop** to restore the original image boundaries.

3 Take a screenshot

Use **Screenshot** to capture the current image view.



WORKING TIP

Save before making major changes. Cropping, reorganising layers or changing the Viewer configuration can substantially alter a project. Save a new project file before experimenting so that you can return to the previous version.

EXPORT

Publishing a Viewer

MODULE OVERVIEW

EXPORT converts the prepared image collection into a standalone interactive Viewer. The Full Viewer retains a broader set of exploration and comparison controls, making it appropriate for research, teaching and detailed study. The Simplified Viewer offers a more focused experience for presentations, exhibitions or touchscreen kiosks, where a limited number of clear interactions may be preferable. Before distribution, choose the appropriate format, check the title and configuration, extract the generated package and test image loading and controls on the intended device.

KEY POINT

Choose the interface according to the audience and the context in which it will be used. An exported Viewer is not an editable project. Keep the MIE project file separately if you intend to take a screenshot, modify the layers, controls or presentation later.

Export an interactive Viewer

Choose the output that matches your intended use.

1 Open EXPORT

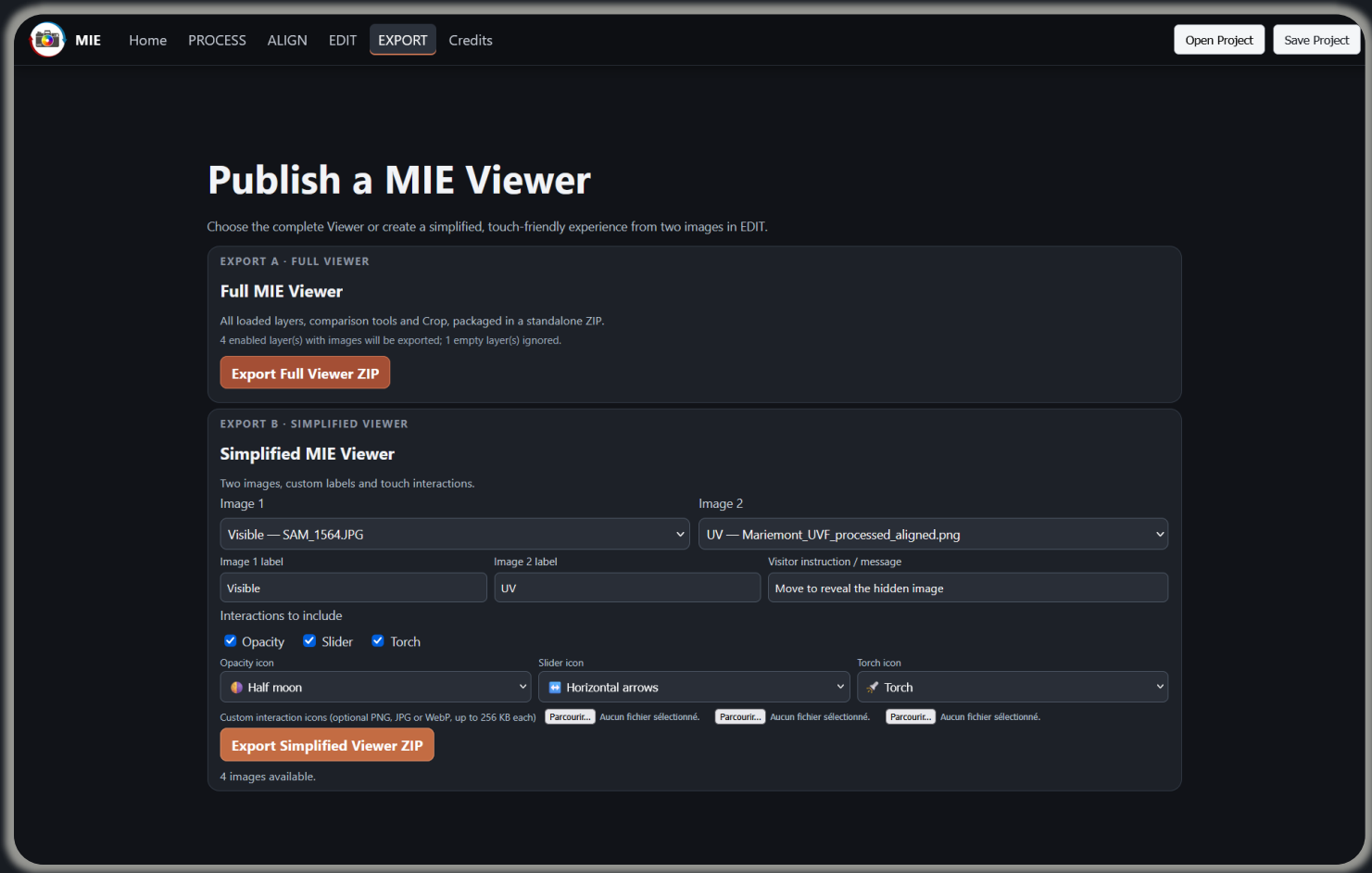
Select EXPORT from the main navigation after configuring your images in EDIT.

2 Choose the viewer format

Use Export Full Viewer ZIP for the complete interface or Export Simplified Viewer ZIP for a reduced set of controls.

3 Keep the exported package intact

Extract the ZIP, keep all accompanying files together and open **viewer.html** in your browser. When sharing the Viewer, distribute the entire extracted folder or the original ZIP package.



WORKING TIP

Test the exported Viewer before sharing it. Extract the ZIP, open viewer.html and check that all layers load correctly and that the comparison tools work as intended. Keep the entire exported folder intact.

Copyright and licensing

AUTHORSHIP AND LICENCES

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MIE v1.0 – User Guide

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Amoroso, N. & Tomassini, P. (2025). *Des études archivistiques aux analyses archéométriques : nouvelles perspectives de recherche sur les fresques de Boscoreale*, in : Carrive, M., Spühler, A. and Tomassini, P. (eds.), *Peintures et stucs d'époque romaine. Études toichographologiques. Actes du colloque de Mariemont* (Pictor 14), Bordeaux, pp. 267-284. https://hdl.handle.net/2078.5/220109

Tomassini, P. (2025). « La pittura antonina di Ostia. Rintracciare i pittori, capire i contesti», *Mélanges de l'École française de Rome - Antiquité* [Online], 136-1 | 2024, URL : http://journals.openedition.org/mefra/18553 ; DOI : https://doi.org/10.4000/1356b

SUGGESTED CITATION

Tomassini, P. (2026). *MIE – Multispectral Imaging Explorer v1.0: User Guide,* Louvain-la-Neuve.

Software: https://www.gnu.org/licenses/lgpl-3.0.html
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The research leading to the development of MIE – Multispectral Imaging Explorer was conducted at UCLouvain (Université catholique de Louvain, Belgium) with financial support from the F.R.S.–FNRS (Fonds de la Recherche Scientifique).