Which Images Should I Use?

This document explains strengths and weaknesses of various images from a user's perspective, focusing primarily on different choices for the same manuscript page (a.k.a. "Folio").

To access these choices: Open a page of interest. Click ☰ in the upper left corner of the window, then select the "**Layers**" tab. (For illustrated guidance, see **§1.4** in "Navigating This Site.")

Layers lists image options by filename. The first part of each filename identifies the manuscript and page. The final part, highlighted below, identifies the **type of image**.

FEATURES PER FILENAME

For each of the more than 6,800 pages imaged in the Sinai Palimpsests Project, the Research Site provides multiple images—often more than ten per page!

How should you decide which one(s) to use? The following guidelines describe the strengths and weaknesses of the various images.

1. Start with the visible color image: _PSH_**color**

This image appears first when you choose a page to view. It depicts the page as seen in visible light and offers excellent color accuracy.

Do you want ***to study erased texts*** *(undertexts)*? Examine this image first to get a sense of what the page looks like under normal visible light. Then continue with steps 2–6.

Do you want ***to read the overtext of a palimpsest***? This image is usually your best choice.

Do you want ***to examine physical features of the writing surface, such as texture or scribal rulings and prickings***? Although the documentation of such physical features was not a goal of the project, evidence for such features can be found in the visible color image and the images explained in steps 6 and 7 below.

2. Review the average pseudocolor first: _KTK_**pseudo_avg**UV-MB780IR _KTK_**pseudo_avg**UV-VIS

For many palimpsest pages, this image will help you ***read the greatest amount of erased ink***. It combines many strengths of the images explained below in steps 3–4 while ***suppressing interference from surface features of the parchment*** (e.g., texture, abrasions, and hair follicles).

"Pseudo" refers to pseudocolor, because this image **uses false color (red) to distinguish erased ink** from the overtext and from other features of the page. Some users find that toggling **Invert Colors** helps further with legibility (see below under step 6[†]).

To work on ***areas where erased material still eludes you***, see steps 3–6.

3. Try color-filter pseudocolors next:

_KTK_pseudo_**WBUVB47**-…
_KTK_pseudo_**WBUVG58**-…
_KTK_pseudo_**WBUVO22**-…
_KTK_pseudo_**WBUVR25**-…

These pseudocolors occur in four varieties. Each combines one image that captured the response of the page to ultra-violet (UV) illumination through a color filter with one red or infrared (IR) image. The color filters are identified in filenames with matching letters: **Blue = B**47 / **Green = G**58 / **Orange = O**22 / **Red = R**25

NOTE: Different options may help with ***different parts of the same page***.

a. Start with these considerations:

To ***read faint erased ink***, you must balance two factors: CONTRAST and INTERFERENCE. For most palimpsests with iron gall ink, the color-filter pseudocolors offer complementary strengths and weaknesses:

CONTRAST between ink and writing surface makes it easier to see faint erased ink. **Blue-** and **Green-**filter images are usually better here:

HIGH CONTRAST >——>——>——> LOW CONTRAST
Blue > Green > Orange > Red

But **INTERFERENCE** from surface features—hair follicles, stains, abrasions, wrinkles, dirt, etc.—can obscure faint erased ink! **Blue-**filter images are worst here:

LOW INTERFERENCE >——>——>——> HIGH INTERFERENCE
Red > Orange > Green > Blue

Patterns observed:

_WBUVB47-… provides high contrast and is **often the best image of the erased text**, but it sometimes includes too much interference from surface features of the parchment.

_WBUVG58-… provides nearly the same contrast, but with less interference. Sometimes this is **a better image on a folio's hair side**, ***where hair follicles obscure text***.

_WBUVO22-… and **_WBUVR25**-… provide lower contrast but greatly reduce interference from surface irregularities.

b. Review red- and orange-filter pseudocolors in the following situations:

Stains or abrasions. In areas where the parchment is stained or abraded, erased ink is often legible only in **_WBUVO22**-… and **_WBUVR25**-…

Erased red ink. Palimpsested material written in red—e.g., ***titles***, ***enlarged capitals***, and ***rubrications***—usually shows up most clearly in **_WBUVO22**-… and **_WBUVR25**-…. In these images, erased red ink tends to appear lighter than the parchment. (To darken it, try **Invert Colors**, per details below under step 6[†].)

The preceding observations fit most iron gall ink palimpsests of St. Catherine's Monastery. But there are exceptional cases—"outliers."

4. If you encounter a case that does not match the observations above, your palimpsest may be an "outlier." Check for these phenomena:

Reflected UV light. Sometimes erased ink that is not sufficiently legible in the color-filter options may appear more legibly in one of these two pseudocolors that depend on reflected UV light:

_KTK_pseudo_**WBUVUVP**-…

_KTK_pseudo_**MB365UV**-…

"UVP" stands for an ultraviolet-pass filter, which passes reflected UV light to the camera, while "MB365UV" represents no filter.

Erased text that appears brighter than the parchment. Occasionally erased ink appears brighter than the parchment in **_WBUVO22**-… and **_WBUVR25**-… and, with less contrast, in **_WBUVG58**-…. Such erased ink may still appear dark in **_WBUVB47**-….

If you find *a page that is most readable in one of these "outlier" patterns*, then try the same image choices first for other pages of the same undertext.

5. Review one or more "Sharpies":

KTK**sharpie_avg**UV-MB780IR

KTK**sharpie_avg**UV-VIS

"Sharpies" are monochrome (grayscale) images to which the **guidelines for reviewing pseudocolors** in steps 2–4 apply. (Start with "average," then try color-filter options, etc.) Their filenames simply replace "pseudo" with "sharpie":

_KTK_sharpie_**WBUVB47**-…

_KTK_sharpie_**WBUVG58**-…

_KTK_sharpie_**WBUVO22**-…

_KTK_sharpie_**WBUVR25**-…

Unlike pseudocolors, Sharpies ***suppress overtext*** instead of making erased text a different color. Some researchers prefer these images; others prefer pseudocolors for showing where overtext obscures undertext.

_KTK_sharpie_WBUV**UVP**-…

_KTK_sharpie_**MB365**UV-…

To combine strengths of both options, try using **Layers**: add a helpful pseudocolor, add a helpful Sharpie on top, then make the Sharpie partly transparent by reducing its opacity (see **§1.4** in "Navigating This Site").

6. Review the "TX ratio" image:

KTK**txratio_TX**940IR-MB940IR

The TX ratio image reveals ***areas where iron gall ink***—over many years—***ate into the flesh side of the parchment***, leaving letter-shaped channels where the parchment is thinner.

"TX" in the filename refers to "transmitted" illumination, meaning that the parchment was backlit (with IR illumination) to reveal thinner areas. Erased writing thus appears lighter than the parchment.†

Often ink did not eat into the parchment at the same rate across the page or even within a single letter. ***Some lines*** may be visible in the TX ratio image, while ***other lines*** appear more clearly in a pseudocolor, and likewise ***for different parts of the same letter***. For best results, you should toggle back and forth between the two images, or **Layer** them and adjust opacity (see **§1.4** in "Navigating This Site").

†Some researchers find **Invert Colors** especially helpful for increasing legibility. This tool ***changes light letters on dark background into dark letters on light background***, and vice versa. To try it, simply click the translucent droplet icon near the top of your viewing window (see "**Navigating This Site**," especially **§2.4.2**).

The TX ratio is also best if you want ***to check for small holes*** in the parchment, whether you are ***looking for intentional scribal activity*** (e.g., prickings) or ***evaluating whether an ambiguous mark represents ink or a small hole***.

7. Review the "raking" image on its own or in combination with others

KTK**raking_**RE870IR-RS870IR

Raking images focus on the parchment's surface texture rather than its color. Very rarely does a raking image show any writing (except as slightly raised areas on the substrate, or where iron gall ink thinned the surface of the parchment).

On its own, this image is best for ***identifying scribal ruling*** and for ***understanding the complex surface of the parchment***, since other images tend to convey the false impression of a flat surface.

To ***examine color and texture at the same time***, try using **Layers** (see **§1.4** in "**Navigating This Site**") to combine a raking image with one or more of your choices from above. Such combinations can help you ***evaluate how surface features of the parchment may be affecting the legibility of erased ink in specific areas***.

Further processed images will become available in the online library in future, so check back for updates on Folios of interest! See the Research Site's **WELCOME** page for announcements.

HOW WERE THESE IMAGES PRODUCED?

All images provided on the Research Site are “**processed**” images. Imaging scientists produced them by combining data from two or more of the raw spectral images that the camera “**captured**” on site at St. Catherine’s Monastery.

Image processing combined data mathematically, because every digital image is fundamentally a vast array of numbers. Such processing attempts to reverse distortions to reveal text that is hidden. Imaging scientists did not use any tools to adjust images manually (which could bias results toward personal preferences). Imaging scientists processed capture data from the camera in two stages:

> **Batch processing** involved routines that could be applied in a semi-automated procedure. Each routine combined two “capture” images to produce a more useful “processed” image. The two capture images are recorded in the resulting filename (e.g., TX940IR and MB940IR for TX ratios). Such pairings take advantage of the behavior of iron gall ink under different wavelengths of illumination, in order to distinguish and highlight erased ink. (The “average” pseudocolors and Sharpies each combined seven such pairings.) Scientist Keith Knox (KTK) applied batch processing to every page imaged by the project.
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> **Statistical processing** involved a variety of manual and labor-intensive methods. Scientists Roger Easton (RLE), William Christens-Barry (WCB), David Kelbe (DJK), and others used a variety of methods including principal component analysis (PCA), independent component analysis (ICA), and spectral angle mapping (SAM) to recover erased ink in cases where batch processing failed to yield a sufficiently legible result.

For additional details about both image capture and image processing in this project, see “**Technologies**” on the Project Homepage.