JOHN BETTS FINE MINERALS

Digital Mineral Photography

by John H. Betts,

Introduction

Digital photography, the capturing of an image and storing in an electronic media rather than on film, is starting to become accessible to the average consumer. Camera prices are falling and image quality is improving. Compared to conventional 35-mm photography, there is no film or processing costs, and results are immediately viewable so a re-shoot can be made quickly if needed. Plus there are more and more applications where digital images are more convenient and cost effective. Mineral collectors can create online web sites of their collections to share with others, send images of minerals via email to potential traders, or print a catalog for their own home use. Commercial uses for digital images include advertising, online auctions like Ebay, and e-commerce web sites.

This article will review camera selection, techniques specific to digital mineral photography, and using image editing software. It does not address creative or stylistic elements in creating mineral photographs, nor address fundamental mineral photograph techniques. The reader is referred to Photographing Minerals, Fossils & Lapidary Materials by Scovil (1996) for learning more about these basic techniques.

Final Use Determines Equipment Needs

There are three ways to create digital images: scan a conventional photographic print, scan a 35-mm slide, or capture the image with a digital camera (either digital video camcorder or digital still camera).

Table 1. - Comparison of methods of capturing digital Images

	Digitally scan 35-mm slide	Digitally scan 35-mm prints	Photograph with digital camera
step 1	Setup and photograph using 35-mm camera and slide film	Setup and photograph using 35-mm camera and print film	Setup and photograph using digital camera
step 2	Process the slides (1 to 3 days)	Process the prints at a one hour photo processor.	Transfer digital image to computer (2 minutes)
step 3	Scan the images with a slide scanner (5 minutes)	Scan the images with a flat bed scanner (5 minutes)	
step 4	Transfer digital image to computer (2 minutes)	Transfer digital image to computer (2 minutes)	
Equipment cost	$300 (and up) digital slide scanner + 35-mm equipment	$100 flatbed scanner + 35-mm equipment	$500-700 for digital camera
Average time per image	15 minutes + time to get film processed	15 minutes + time to get film processed	5 minutes

The final use of the images will determine which method is best. If the images will ever be used to make a presentation to a large group, then using 35-mm slides may still be the best way to make the initial image because they are much higher resolution. It is true, that digital projectors are becoming more prevalent and it is also possible to create slides from digital images. But it is advisable to start with 35-mm then scan to create digital images (high resolution to low resolution), rather than the other way around.

If the images will be reproduced in a catalog or book someday and the final image size will be larger than 3" then 35-mm may also be the best way to make initial image because of better photographic quality.

If you already have a large volume of existing photographs, 4x6" prints for example, then scanning the images with a flatbed scanner will be the easiest way to transfer the images to digital format.

However, if the final application is posting images of minerals to an online auction or e-commerce site, and a high volume of photos is anticipated, then capturing the images with a digital camera will be more cost effective and less time consuming.

The bottom line is the trade off between quality, cost and convenience. If you anticipate 100 images per year then either 35-mm slides or prints will suffice. If you anticipate shooting 50 images a week then convenience and time savings will be more important than the higher cost of a digital camera. The task of photographing a mineral collection of say 1000 specimens is not insignificant. Obviously, it pays to buy the best equipment for the job. It will save time, effort and ensure image quality. For the purposes of this article, focus will be on using a digital still camera, the most likely method used by mineral collectors/photographers. Much of the same applies to using digital video camcorders.

Camera Resolution

Digital image resolution is measured in pixels (short for Picture Elements). A pixel is an individual point of color in an image and is the equivalent to the film grain in conventional photography. It is expressed as a length x width number. Cameras are often sold as megapixel cameras meaning they capture one million pixels of information. The length multiplied times the width yields the total pixel count.

Pixels vs. DPI

Image pixels are independent of the common specification used in printing known as DPI for dots per inch (or LPI for lines per inch). DPI/LPI have no relation to the image quality captured by the camera. They are a control of the printer and the size of the print image. As an example, a 600 x 300 pixel image printed at 300 DPI will output a 2x1" image on paper. The same 600 x 300 pixel image printed at 150 DPI will produce a 4x2" image. The content captured by the camera (600 x 300 pixels or 180,000 total pixels) and stored as the digital image is exactly the same in both cases, even the file size is the same. But the print size will be different. Print resolution of 300 DPI is minimum before print quality starts to degrade, 600 DPI is common on laser printers, and 1200 DPI is readily available.

The pixel count does effect how large an image is printed before there is apparent degradation. DPI has no effect on the inherent image quality of the digital image. This a major source of confusion and important to understand. The bottom line is the important measure of image quality is pixel count expressed as length x width (i.e. 600 x 300 pixels). See Table 2. for the file and print size comparisons.

As a point of reference, a 35-mm Kodachrome slide captures the equivalent of about 1 billion pixels of information, which is why Fuji and Eastman Kodak is not too worried that conventional photography will ever disappear.

Table 2. - A summary of typical image and camera specifications and their equivalents:

Typical image resolutions:	Total pixel count:	Camera advertised as:	Typical JPEG file size:	Printed image size at 150 DPI:	Printed image size at 300 DPI:

640 x 480 pixels	=	307,200 pixels	=	300k pixels	130 kb	4.2x3.2"	2.1x1.6"
1024 x 768 pixels	=	786,432 pixels	=	786k pixels	260 kb	6.8x5.2	3.4x2.6"
1280 x 1024 pixels	=	1,310,720 pixels	=	1.3 megapixels	520 kb	8.6x6.8"	4.3x3.4"

How Many Pixels Do I Need?

The answer is simple: as many as you can afford. The price of digital cameras is directly related to the resolution, and therefore image quality. But why buy a camera that makes images at 1280 x 1024 pixel resolution when a typical image on a web site or online auction is 300 x 400 pixels? Because of an artifact of digital image capturing devices called the edge effect.

The edge effect (similar to Mackie Lines in conventional photography) grew out of the television industry as a way of artificially enhancing the apparent sharpness of a low resolution image. It creates artificially accentuated edges on areas of contrasting color or brightness. (See Figure 1.)

Figure 1. Enlarged portion of a digital image. Note the white fringe around the crystals and the exaggerated dark edges of the gray crystals. This is due to the edge effect inherent in digital imaging. Higher resolution cameras will minimize this effect.

By capturing images at high resolution, then reducing the resolution using image editing software, the final image will look more natural and professional. See Figure 2 for a comparison of the exact same image capture at different resolutions.

Another reason to use a high resolution camera is unforeseen future needs. The Internet might be faster in the future allowing larger images to be sent, or you may want to print a catalog of your collection. Therefore, it is highly recommended to purchase a high pixel count camera, store images in a high resolution size for the future, and create image copies at lower resolution for final applications if required.

Figure 2. The same specimen photographed with a low resolution camera (left) and a higher resolution camera (right), with enlarged details of a portion of the photo below. Notice the white halo visible around the outside of the crystal on the left due to the edge effect and the sharper detail of the higher resolution image on the right.

Camera Requirements

Digital cameras are getting better every day. Any specific camera recommendation made in this article would be obsolete as soon as it is printed because every camera manufacturer has several new digital cameras in the product development pipeline. Instead, discussion will focus on the minimum set of camera features recommended specifically for mineral photography.

Every digital camera has a basic lens, sometimes a zoom lens, built-in flash, automatic focus, automatic exposure meter and LCD viewfinder. However, when shopping for a digital camera look for the following features:

Macro Photography (Close-Up)

For photographing minerals, the camera should focus to a minimum of 1". This allows photographing thumbnail specimens or individual crystals on larger specimens (See Figure 3.). There are many cameras on the market that can focus to 1 cm (.4") without the need of any attachments.

A poor alternative is using a camera that permits attaching "close-up filters" which are diopter lenses that come in +1, +2, +4 strengths. By using them alone, or in combination, any value up to +7 can be obtained. But every mineral is unique, sizes and focus distance vary greatly. The hassle of switching filters for every specimen, is tolerable but time consuming. For the last year the author has used a camera that focuses continuously down to less than 1cm and finds it highly preferable to using to his previous camera that required close-up filters. Close-up focus is highly recommended as a fundamental requirement for a digital camera.

Figure 3. Close-up image of a 1/16 to 1/8" crystals. Any camera used for mineral photography should be able to focus to 1" minimum to capture this sort of detail, ideally without any additional attachments or filters.

Adjustable Exposure

The camera should offer manual exposure compensation of plus or minus 1 stop minimum (plus or minus 1.5 stops is optimum). This allows the photographer to make fine adjustments in exposure. Many shortcomings in an image can be fixed later with image editing software, but if the exposure is not correct then the information will never get recorded properly and digital enhancement may not be successful.

Spot Metering

All digital cameras have built-in exposure meters. These "averaging" meters measure the overall image to determine exposure. A camera with "spot" metering is recommended for mineral photography. This feature allows the photographer to meter a small area of the image to determine the proper exposure rather than averaging the entire image. This is important when photographing a dark specimen on an light background or a light specimen on a dark background. Often the spot metering is a separate "mode" that must be setup before using the camera.

Manual Focus

Manual focus control is especially important for close-up photography where depth of field is shortened. It is also useful when the camera’s autofocus misbehaves for some reason and insists on focusing on the matrix or the background rather the crystals you are trying to capture. One shortcoming of digital cameras is the relatively small LCD viewfinder makes it difficult to tell whether the image is in focus. When in doubt take multiple exposures, varying the focus in each, to make sure there will be one good image.

Flash Control

All digital cameras come with built-in flash for general photo use. However, lighting control is important with mineral photography. The camera must have the ability to shut off the built-in flash. Simply covering up the flash with tape will not work as the camera’s automatic exposure system will likely overcompensate and produce a bad image.

AC Adapter

Digital cameras consume batteries at a very high rate. Invest in an AC adapter if photographing more than 20 specimens at a time. The adapter will pay for itself in savings on batteries.

Self Timer

All digital cameras have a self timer. It is recommended to use the self timer for close-up images to eliminate camera vibration during exposure. Also, there will be times when you need both hands free to hold diffusers or reflectors. The self timer can be used the take the exposure while holding the props.

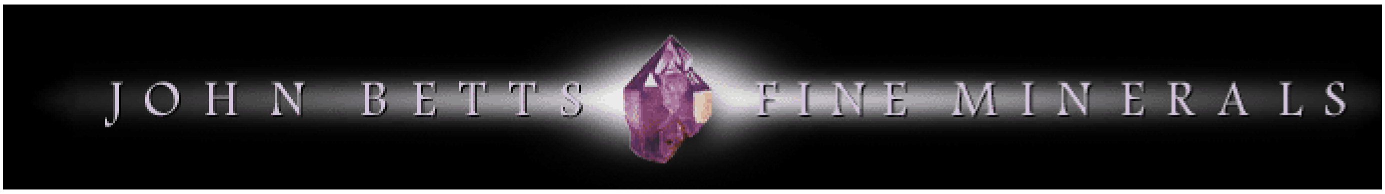
Accessible Shutter Release When Mounted On A Tripod

This seems obvious, but make sure the shutter release is located where it will be convenient. Imagine photographing a specimen up close, will fingers get in the way of lighting or is the shutter release around on the front where it is not easily located?

Memory Media Is Not Critical - But Transfer Should Be Fast.

Every camera manufacturer uses a different way of storing the images once they have been captured. Some use inexpensive floppy disks, some use memory sticks, some use smart cards. None of these are perfect. Make sure to understand the cost for the media, special hardware required to read the media, and the transfer to computer process. Most importantly, run a trial to see how long it takes to capture an image and transfer it to your computer. All cameras are not equal in this respect.

It may be possible to skip storing the image on any media and transfer the image through a cable directly to the computer. While this may be a time saver, it is not always convenient to locate computer adjacent to the photo stage.



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Features That Are Not Relevant

Digital cameras come with many other features. While these features may come in handy for other applications, they are not important for mineral photography. These features include zoom lens, digital zoom, interpolated high resolution, special effects modes, and red-eye reduction. While having an optical zoom lens on the camera may seem important, for mineral photography all images will be composed by moving the camera closer to and farther away from the subject. Digital zoom enlarges the image digitally without changing the optics. Digital zoom leads to image degradation and is not advisable to use, even if the camera comes equipped with the feature.

At the time this article was written, both Sony and Nikon offer the best digital cameras that meet the criteria for digital mineral photography.

Other Equipment

In addition to the camera, there is other equipment needed. Some of the same equipment used in conventional photography will suffice. A sturdy tripod is very important because camera movement is the enemy of a sharp photograph. Tripods have improved greatly in the last 20 years. It might be worth upgrading to a better tripod with more convenient features.

The same backgrounds, reflectors, diffusers as conventional photography will be needed. This author prefers photographing on black glass or Plexiglas because of the relative ease of keeping clean and its moderate resistance to scratches. An assortment of small Mylar reflectors, mirrors, and diffusers are used to create controlled reflections off crystal faces to define the crystal shape.

Lighting

Probably as important as camera selection is lighting. Digital cameras have built in white balance to compensate for the color temperature of the light source. It is relatively easy to compensate the color for a specimen illuminated under incandescent light, something not easily accomplished with conventional photography. However it is important to use a full spectrum light source. For example, a 60 watt incandescent bulb has very little blue/purple in the spectrum of the light it outputs. A mineral specimen with dark blue (i.e. azurite) on a black matrix illuminated under incandescent light will render both colors as black. No amount of photo manipulation on the computer will ever differentiate the two colors. By using a full spectrum light source that problem can be minimized.

Also the light sources should be small, adjustable/moveable lights that produce a broad illumination without strong hot spots, either by use of frosted bulbs or additional diffuser. This is required to control the reflections off individual crystal surfaces, without harsh hot spots - very important in mineral photography.

The one light source that meets all of these needs is the new SoLux halogen bulbs. This is a new technology lamp based on MR-16, 50 watt halogen bulbs, but with proprietary technology to produce a full spectrum light output. SoLux has been so successful, they have been adopted by several museums as the standard light source for their paintings and exhibits. SoLux bulbs are available in several different color temperatures. The Solux bulb best for photography is the 4700° version which is the equivalent to daylight at 10:00 A.M. and very close to 5000° Noon daylight. (35-mm photographers can use an 80D filter to convert SoLux illumination to conventional daylight film.) For digital photography, Solux bulbs are perfect, yielding accurate rendition of difficult to photograph minerals like dioptase and azurite. They are 12 volt bulbs and fit in any light fixture that can accept an MR-16. Solux also manufacturers a task light to hold Solux bulbs with highly adjustable swivel arm that works well in photography, display or even illuminating specimens under a microscope.

Image Editing

It is a mistaken assumption that a photograph can be used "straight" or not retouched. Even in conventional 35-mm photography color balance, exposure adjustments, and contrast control are manipulated to produce a satisfactory image by the photo processor.

Image exposure (lightness and darkness) is the most commonly manipulated variable. Digital camera built-in exposure meters try to balance the image exposure to produce a medium value. This works well when the subject is a medium value - like skin tones. But if you are photographing a dark mineral like azurite, the camera will lighten the exposure in an attempt to yield a medium value, making the image overexposed. If you are shooting a bright white subject like okenite, the camera will attempt to darken the exposure to yield a medium value, making the image underexposed.

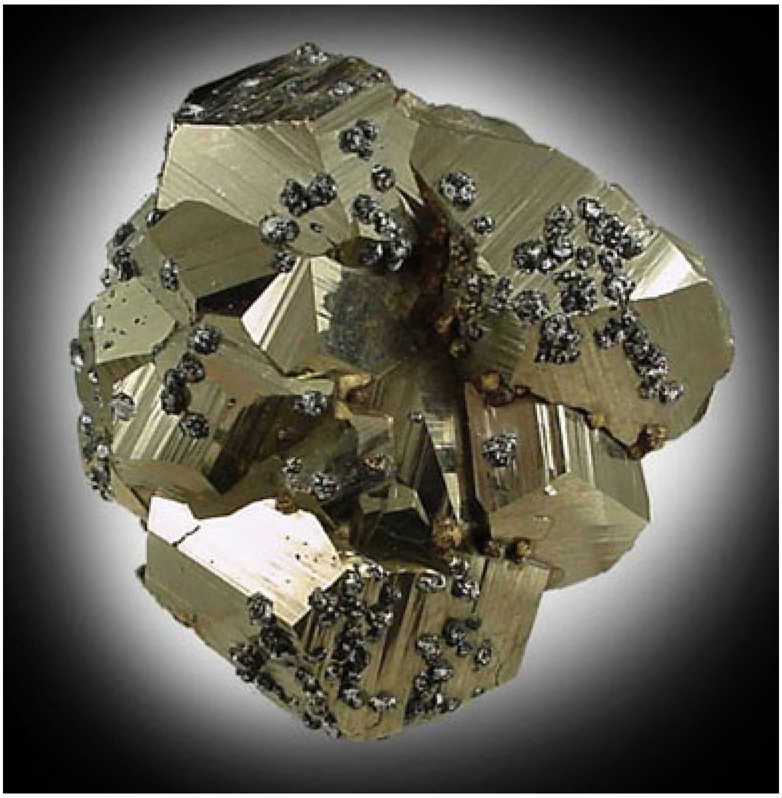
Similar problems occur with color balance. Digital cameras have an automatic "white level" control to achieve normal color balance. This works well with a normal subject. But if the subject is a specimen of etched green prehnite with no brilliant highlights, the camera will not see any white highlight pixels in the image and think color correction is necessary. The camera in this instance will shift the color from green towards white (usually by adding red/pink/magenta) and fail to accurately capture the green prehnite.

Lastly, images need to be adjusted because digital sensors may artificially enhance one particular color. This is common with 35-mm slide films too, Kodachrome has exaggerated reds, Fujichrome has exaggerated green, Ektachrome has subdued neutrals, etc. So the image may need adjusting to accurately represent the subject. The author’s camera overly saturates reds, probably because camera manufacturers artificially enhance the reds to produce better skin tones.

Image retouching varies from simple to extreme. Following are some typical operations:

Simple	Moderate	Radical
Crop image and adjust for any tilt	Retouch dust or lint on subject	Combine multiple exposures
Adjust lightness/darkness	Cleanup background	Add airbrushed background
Color correction	Remove digital artifacts	Sharpen focus

Retouching can improve an image only to a limited extent. The beginning image, before adjustments and retouching, must still have a good pose, sharp focus, good exposure, and descriptive shadows and reflections. These cannot be faked or added at a later time.



Software

There are many software packages available for editing the images after they have been captured by the camera or scanner. Many come bundled with the camera or scanner and are all about equal. The industry standard is Adobe Photoshop. All other software is attempting to emulate Photoshop and make it easier for novice users. If you are creating a large quantity of images, it pays to invest in Photoshop and learn to use it.

It is possible to avoid paying the full cost of the latest version of Photoshop if you have an older version of Photoshop that came bundled with a scanner or other peripheral (this was very common a few years ago). You can purchase the latest "upgrade" version of Photoshop at a fraction of the regular retail price. Also, Adobe makes an introductory version called Photoshop LE that is an excellent way to get started and learn the basic tools without paying full price for Photoshop.

Commonly, very few commands in Photoshop are actually used when regularly editing images: cropping, adjusting exposure, retouching flaws, re-sizing. However, Photoshop also has productivity features built in that make it much more convenient. One convenience is it retains the history of the last 20 changes and can selectively go back and undo any changes you have made along the way. Photoshop also allows recording any sequence of actions to be saved and used on other images, for example resizing images to create the small preview images known as "thumbnail" views.

Best of all, Photoshop allows batch processing of multiple images. This is a real time saver if you need to perform the same command on many images, for example resizing images to a particular size or adding a company logo to the image. Using Photoshop's batch command it is possible to perform a command or series of commands to a group of images without any user interaction. Simply select the images to process and the commands to perform, and let Photoshop do the work while you get a cup of coffee.

Typical Process

There are two parts to creating digital mineral photographs: capturing the image with the camera and processing the image on the computer with image editing software. Capturing the image is much the same as conventional photography. Image editing is where much of the work is done.

Camera Setup

Before starting a session, you will need to set up your camera. This is done once, when first using the camera, then never has to be done again.

For almost all applications the camera should be set to save images in JPEG format, which is short for Joint Photographic Experts Group. This is a method of saving the image pixels by compressing the data. Some cameras also allow the selecting high resolution (large file size) or low resolution (small file size) allowing more images to be stored in the camera. For mineral photography select the highest resolution option.

Newer digital cameras may have a digital zoom feature, that magnifies the image electronically (independent of zoom optics) to create the illusion of a telephoto image. In fact, the camera is enlarging the same basic pixel data and image quality is not actually improved. Set the camera to turn off the digital zoom.

Some cameras have a high resolution interpolation feature that takes a standard pixel count and expands it to a higher resolution. For example, a standard camera resolution (native resolution) may be 1024 x 786 pixels, but with interpolated enhancement the camera will boost the pixel count to 1280 x 1024 pixels. This feature is solely for marketing and advertising purposes, to boost the pixel count and does not actually enhance the picture quality. Set the camera to disable this feature.

Finally, turn off the built in flash and set the camera to the macro mode. Now everything is set to go.

Making The Image

The basic steps are as follows:

1. Clean the visible area - Eliminating any dust now will save time spent retouching later. Carefully clean all visible dust on the backdrop or lint on the specimen.

2. Pose the specimen - No amount of image editing can adjust for a poorly posed specimen. Support the specimen securely on a stand or use non-staining putty. Posing the specimen to conceal the support reduces time and effort later spent retouching the image. One advantage of a digital camera is the convenient LCD viewfinder that facilitates rotating the specimen while simultaneously previewing the image.

3. Adjust the camera angle to capture the image - Though it is possible to handhold the camera, it is definitely not advisable. Camera motion is the single biggest contributor to blurry images. Set the camera on a sturdy tripod and compose the image by adjusting the tripod. It is best to fill the image as completely as possible with the mineral specimen. Digital cameras have an LCD screen as the viewfinder. This provides the exact view the camera is seeing similar to conventional SLR camera.

4. Adjust the lights and add reflectors for reflections and shadows - Reflections off crystal faces and shadows cannot be added later during image editing. Arrange the lights to describe the form, and crystal luster of the specimen. This usually involves primary and secondary reflections, but is a matter of personal taste to the photographer. See Jeff Scovil's book for further discussion on how illuminate a specimen for photography.

5. Adjust the exposure - Using the LCD viewfinder, preview the image to adjust the lightness and darkness using the cameras exposure control. It is important to try to get the exposure as close as possible at this time to capture all the information in the image. If the exposure is too dark the shadows will merge into a big, dark mass. Similarly, the highlights will wash out if overexposed. Fortunately previewing and adjustment is easy with the LCD viewfinder. Be aware that the image on the LCD viewfinder can vary as viewing angle changes. This may lead to the mistaken belief that exposure is correct. It is best to make sure you are looking straight at the viewfinder screen to avoid this problem.

6. Pre-focus or manually focus - The shutter release is a two-stage switch. Depressing the shutter release halfway will focus the camera. Depressing the shutter release fully will capture the image and record it. The user should closely inspect the image after focusing the camera. If the image is not properly focused then switching to manual focus may be necessary.

7. Make exposure - Finally, depress the shutter release fully. The camera will capture the image and record it to the memory. An image 1024 x 768 pixels will vary in size from 50k to 280k bytes of memory depending on the image detail. An image with lots of small detail, like drusy crystals, will create a larger file than an image with soft contours and little detail, such as botryoidal malachite.

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Image Editing On The Computer

1. Transfer image to computer - After all the images in a session are captured in the camera then transfer them to the computer. Every camera/computer combination is different, so the process will vary. Basically, copy the images from the memory of the camera into a directory/folder on the computer.

2. Make sure the computer monitor is properly adjusted - When image editing software is first installed there will be a routine to calibrate the computer monitor, often this is referred to as the Gamma. Make sure to go through this process, otherwise images may look great on your computer, but not on anybody else's. If the monitor is set too dark, adjusted images will look good on your monitor, but they will be washed out on a "normal" monitor. If Photoshop is used for image editing it has an excellent Gamma calibration built in, as do most Macintosh computers. Unfortunately, not everyone calibrates their monitors so there is no control over what the viewer actually sees. In instances where color balance is critical the best alternative is to create a color print to send.

3. Open the image - This involves opening the directory/folder where the images are saved on the computer. Each image will be listed with a name like "MV1607.jpg". The characters before the dot are the file name. The "jpg" after the dot refers to JPEG file format. If the image editing software is properly installed, double-clicking on a file will open the program and open the image.

4. Crop the photo - The very first step is to closely approximate the final cropping of the image. A window is made around the image, after adjusting the boundaries to final position hit "enter" to complete the crop. Re-cropping can be done later, but eliminating extraneous background is an important first step. Also at this time the image can be rotated if the camera was set for a vertical image. Photoshop has a great

cropping feature: the cropping window can be rotated to correct for camera misalignment saving an additional step.

5. Adjust levels - A very powerful tool in Photoshop is the image adjustment command called Levels. This command expands the dynamic range of the image to cover the full span of light to dark, which results in the best combination of brightness and contrast for most subjects. Basically it modifies the image so there is at least one black pixel in the image and one white pixel in the image and all other pixels somewhere in between. Most images can benefit from letting Photoshop automatically adjust the levels using the Auto Levels command. In certain instances though, the auto levels command will cause an unsatisfactory color shift. In this instance, simply undo and manually adjust the levels. The command cannot be fully covered in an introductory article like this, but is an important tool that should be learned and understood.

6. Adjust the Color Balance - Now is the time to make any adjustments in the color balance if necessary. In Photoshop there is a large selection of image adjustment tools or commands. For beginners, there is a nifty tool called Variations that displays the current image surrounded by variations on the image. Each variation is changing the color balance in one direction (i.e. more blue, more green, more magenta, etc.) Also there is a lighter and darker version of the image to choose from. The variations can also be controlled to make fine or coarse (lesser or greater) changes. It is a great tool for making any changes to the color balance, especially for novices.

7. Save the image - At this point the image is in a useable condition. Go to the command bar, click on "File" , then "Save As" and type in a file name, make sure the file type is set to JPEG format, then click "OK". The software will usually prompt for selecting an image quality value, a higher the number means higher quality but also larger file size. A value of 7 or 8 is best for master image files which should be kept at the high resolution in anticipation of any future use. For maximum image quality, save the image in TIFF format instead of JPEG. TIFF is an uncompressed file format, and unlike JPEGS, there is no image loss or degradation in quality due to compression.

8. Reduce resolution to useable size and save - A smaller, lower resolution, copy is needed of the master image if sending via email or posting to an online auction or e-commerce web site. In Photoshop, go to the command bar at the top, click on "Image" , then click on "Image Size". A dialog box will come up. There are two sections: Pixel Dimensions and Print Size. As discussed before, the Print Section is not important to image quality or file size, what matters is the length x width pixel count. Select "pixels" as units of measurement in the Pixel Dimension section (this only has to be done once, after that Photoshop will use the same settings.) A typical full size image may be 850 x 650 pixels depending on how the image was cropped and the quality of the camera. A good target size for emailing or Internet use is 400 x 300 pixels. Simply type in new values. Make sure the "Constrain Proportions" box at the bottom is checked, this will automatically adjust the width as the height is changed and vice versa to keep the proportions constant and prevent distortion. Then repeat step 8 to save the newly sized image. Remember to keep a master file at high resolution. Reducing resolution is irreversible - you cannot satisfactorily increase resolution from a low resolution image.

Advanced Techniques

Photoshop has many sophisticated image editing tools to improve poor images or overcome difficult photographic situations. Many operations are very easy to do, including retouching out dust or lint, improving focus, selectively adjusting brightness, retouching backgrounds and removing artifacts of digital imaging like the edge effect. Very few commands must be learned to perform these tasks including: Image Adjustments, Magic Wand, Lasso, Dodge & Burn, Rubber Stamp, and Filters. Fortunately, the Photoshop users manual has an excellent tutorial on each of these tools, and it is possible to learn all of them in about 20-40 hours of practice. It is not within the scope of an introductory article like this to explain these operations in detail. However, some commonly performed techniques will be discussed.

Retouching Backgrounds

Over the years this author tired of retouching dust out of the background or scratches on the black glass that support the mineral. As a result the author's process ignores background completely and instead the background is added later during image editing. (See Figure 4.)

The specimen is posed, lighted, and the image is captured as described previously. After cropping the image and adjusting the levels, the part of the image surrounding the specimen is selected using various Photoshop tools. Most handy is the Magic Wand that selects similar pixels all at once. Also the Lasso tool can be used to manually grab the background part of the image. Once all the background has been selected any operations performed in Photoshop will only affect the background pixels, not on the mineral part of the image. Next the background area is filled using the Fill command with a solid background color, in this instance black. It is possible to stop at this point if the image looks acceptable. However, in the example here, the translucency in the crystal resulting from the white background when photographed, looks unnatural. By airbrushing in a white glow around the crystal the translucency looks more natural. Again, this is done with only the background pixels selected so nothing is enhanced on the mineral portion of the image.

4a.

4b.


4c.

Figure 4. Sequence of retouching an image. From left to right: A. Original image cropped with all extraneous lighting and photo props visible. B. The background dropped out in black. C. Diffuse halo added to the background.

It is important to have the final image in mind when creating the initial image with the camera. If translucency of the crystals is the goal it is best to use a white background. Or if the specimen is opaque and final image will have a dark background with only a colored "glow" then it is best to shoot on black or other solid color.

Combining Multiple Exposures

Good images can be made of difficult to photograph specimens by using multiple images and combining them using Photoshop. For example, a close-up image where the depth of field is shallow. Two images can be captured, one where the matrix is in focus, the other where the crystals are in focus. By combining the focused parts of each image into one image a satisfactory final image can be created. The combining of various parts of images is extremely easy with image editing software.

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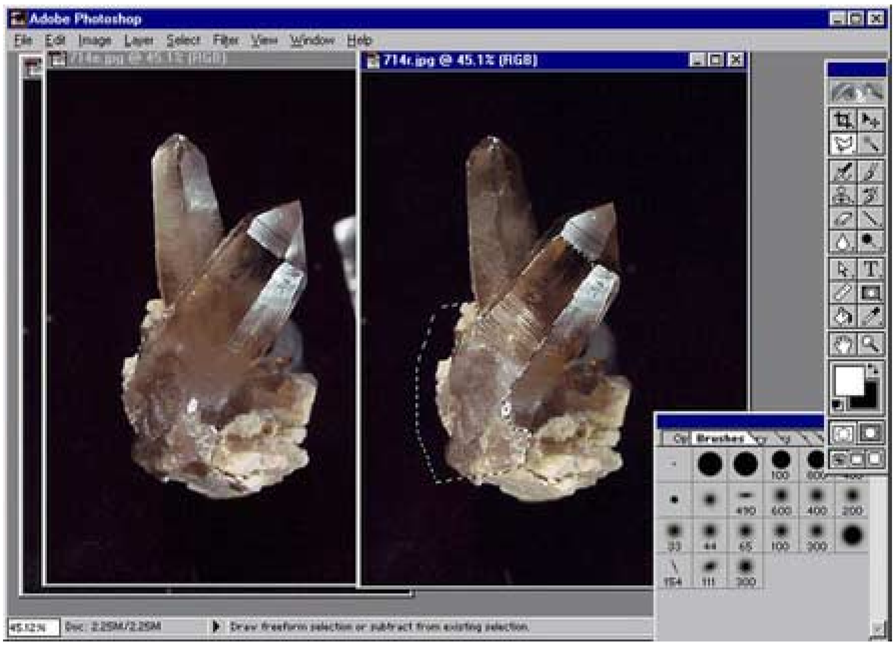
An area from one photo is selected using the lasso tool, then it is copied onto the other image, finally the two are merged together. (See Figure 5.) The Photoshop manual has an excellent tutorial on this common technique.

Another common problem when photographing minerals is getting adequate reflections off of all desired crystals. Taking several images with various light position will give a variety of reflections. Combining various parts of these images into a single image will give a final effect that better describes the specimen. This is not artificially enhancing the specimen image, it is overcoming lighting limitations to capture an honest description.



5a.

5b.


5c.

Figure 5. A. two different images of the same specimen as seen in Photoshop. The left version has good reflections on the termination and the rear crystal. The right version has a better reflection off the central face of the front crystal. Using Photoshop's editing tools the central face on the right crystal is selected (dotted line) and copied onto the left photo. B. The composite image after copying the reflection onto the image. C. The final photo after retouching.

Conclusion

Digital photography is not very difficult, in spite of the intimidating nomenclature and unfamiliar tools. More control than ever is directly in the hands of the photographer and the creative potential is enormous. When learning to use digital cameras and software, start with your best specimen available, and shoot it 20 different ways. It is easier to take a great photograph of a good specimen. Try to copy the style of an image in a magazine or on the web to emulate the lighting or background.

No single article can teach all the steps of making digital mineral photographs. Similarly, observing an expert only illuminates the techniques used, but does not teach an individual to make good images. Only practice can teach when and how to use various techniques.

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Author’s Equipment

· Sony MVC FD-83 digital camera. Captures 1024 x 768 pixel images in native mode, focuses to 1 cm, stores images on common floppy disks. 8-12 images per disk depending on image/subject.

· Two 50 watt / flood SoLux 4700º halogen bulbs for illumination with frosted mylar diffusers over the bulbs

· Minerals are photographed on black glass or white backgrounds.

· The images are cropped, cleaned up, and optimized in Adobe Photoshop 5.0.

· Computer: Dell XPi CD 166 MHz with 48 MB RAM

· Iomega Zipdrive for storing images. Each disk is capable of storing 100 MB of images.

· Epson Stylus 800 color inkjet printer prints at 1440 DPI though regularly used at 720 DPI.

Figure 7. The author's photography setup. Flexible arm lights were adapted from track lighting fixtures and mounted to a small chest of drawers. This elevates the specimen off the table top to a good working height to avoid back discomfort during prolonged photo sessions. Each SoLux bulb is covered with frosted Mylar diffusers. The top drawer contains the transformer for the lights. The middle drawer is for the AC power adapter and camera storage. The bottom drawer hold props, diffusers, and computer disks. The top of the case is covered with gloss black laminate. Note the typical tripod pan head has been replaced with a universal ball mount to simplify camera angle adjustment.

Follow up:

Occasionally emails are received asking how I get the backlighting in my photographs. More disconcerting are the complaints that is is wrong to backlight the specimens because they are never illuminated that way when displayed.

I would like to clarify the misunderstanding: My photos are not backlit or rear illuminated.

My photos are vignetted.

I like the look of borderless galleries, where it is hard to tell where the photo ends. Because my page backgrounds are solid black I vignette the photos to fade them to black around the edges. See the example below.

The raw image on the left was taken on a plain white background. I find this is best to illustrate translucency in crystals.

The final image on the right has the background vignetted to black around the edges. If you look at the mineral portion of the photograph you will find no difference.

So another of my secrets has been revealed. I welcome viewer comments on whether this technique is misleading. I do it so the web pages look nice. If the web pages had a white background then my technique would change.

More Follow up:

I welcome questions from beginning mineral photographers, and freely share my tools and techniques. The most common question I get is, "How many megapixels is your camera."

I smile. As a camera designer, I created conventional and digital cameras for Polaroid and Kodak. I had to work with marketing people that were always trying to one-up the competition and therefore were always trying to boost the performance statistics of the cameras. Their favorite statistic to tout is "megapixel resolution" of the cameras.

As a result of this emphasis on performance statistics, buyers focus on them too. Plus, buyers are often confused by the vast array of variables in features versus cost of the many digital cameras on the market. Simple, measurable statistics like pixel count, make objective decision-making simpler. So everybody uses them to compare cameras. In fact, camera features like close-up focus, spot metering, white balance control, etc. are much more important than pixel count at creating quality images.

The other reason I get a giggle out of the question of megapixels is that my images are ridiculously low resolution. On average, the mineral images on this site are around 400 x 350 pixels. That equals 1/7 of a megapixel. If larger images were used it would take forever for the images to download through the Internet. Using a 3 megapixel camera to create my images would be overkill. Instead I use a camera that captures a 1024 x 768 pixel image. That equals .7 megapixel. For web images that is all you need.

Lastly, your photo technique contributes more to quality images than your camera. The saying, "It's not the tools, it's the carpenter" sums up why some photographers can create beautiful images with simple cameras.

John Betts, 4/30/2002

About the Author

Mr. Betts, an avid mineral collector, is a product design consultant living in New York City. He has designed slide scanners, instant cameras, 35-mm cameras and digital cameras for both Polaroid and Eastman Kodak as well as infrared thermal imaging cameras for Inframetrics. As a photographer, he has photographed thousands of mineral specimens using Kodak, Nikon and Sony digital cameras, using several different models of each brand over the years. A gallery of his mineral photographs can be found on the Internet at: http://www.johnbetts-fineminerals.com/jhbnyc/bestgall.htm

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