

**Macro Photography and Image Stacking**

By Charles Calkins

In the March 2011 issue of Rock Lore, I described my setup for photographing minerals. In that article, I discussed the macro mode of my camera, and the use of a close-up lens to reduce the minimum focusing distance. While this works for small samples, tiny ones require a true macro lens to image them successfully.

Christmas was good to me this past year, extending my photographic equipment as shown in figure 1. Items #1 (Panasonic Lumix DMC-FZ35 camera), #2 (DMW-LA3 extension tube), and #5 (Promaster SystemPro tripod), were shown in the previous article. #3 (Raynox MSN-202 macro lens) and #4 (Adorama MCFRS1 Macro Focusing Rail) are new additions.



Figure 1 Photo equipment

The lens ships with a universal adapter - the larger ring in which the lens is mounted - which clips onto the end of an extension tube. This allows the lens to be used with nearly any camera. The macro focusing rail allows the camera to be moved in very small increments which is necessary when very small subjects are to be photographed. This particular rail allows fine-grained movement in two dimensions, with an overall feel similar to focusing a microscope. The ball head of the tripod provides for motion in the third dimension, allowing the camera to be pointed in any direction. Although the camera positioning is flexible, a subject must be placed about an inch away from the macro lens to be in focus.

Figure 2 shows a ruler as photographed using my lens and camera at various magnifications. At 1x, the inside of the extension tube can be seen, and the

image through the lens occupies the center of the view. This zoom level shows 19mm of the ruler. Zooming in to 4x, so that the image fills the view, the area is reduced to 12mm wide. Zooming in to 8x, the imaged area is 7mm wide. At the full magnification of the camera (18x), the view area is 4mm wide. The camera's resolution is 12 megapixels, which produces an image that is 4000 x 3000 pixels. A zoom of 18x means a resolution of 1000 pixels per millimeter, allowing very small subjects to be imaged in detail.

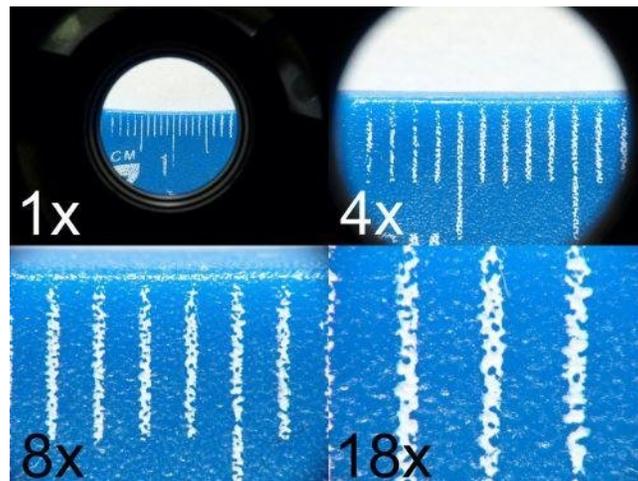


Figure 2 – Comparison of magnification.

The great magnification has one trade-off, however. Depth of field is reduced to less than a millimeter. That is, the range that a subject is in focus becomes very narrow. An image with a greater depth of field can be simulated, however, by using software to combine multiple images that were taken at varying focus ranges. All of the programs mentioned in this article are legally available for free at the web sites listed at the end.

Figure 3 shows six images that were taken of conichalcite crystals (the largest cluster is about 3mm across) at successive focus ranges.

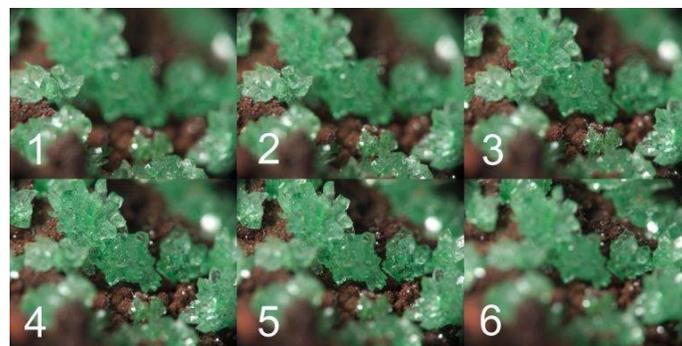


Figure 3 – Separate images of conichalcite at varying focal ranges.

The photos, in order from 1 to 6, show the area in focus moving from the nearest crystals to the farthest. This was accomplished by disabling the automatic focus of the camera and moving the camera a small

distance on the macro rail for each image. By disabling the auto-focus, the area that is in focus is determined by the distance of the camera to the subject, so varying that distance by small amounts allows the region in focus to be shifted.

Although JPEG images directly from the camera are suitable for stacking, I prefer to take images in RAW mode and use RawTherapee to convert the RAW image to a 16-bit PNG image. Working with 16-bit images allows for minimal data loss during the various image processing operations.

Once taken, the images can be combined into an image stack. Figure 4 shows the resulting combined image as produced by CombineZP. To use CombineZP, a series of images is named such that they are in order from nearest to farthest (or vice versa). If images are taken in sequence, the automatic numbering of the images by the camera is sufficient.



Figure 4 – Stacked images creating more depth

Images are loaded into CombineZP by selecting the New Stack button and then selecting the images to load. It is important that enough memory be free to support the loading of all of the images. Without enough memory, CombineZP may generate an error indicating that a file's format is not supported, even though the image is fine. Freeing additional RAM by closing other applications and loading the image again should work.

Once images are loaded, they must be aligned. First, select "Align and Balance Used Frames (Quick)" and press the "GO" button. Next, select the "Align and Balance Used Frames (Thorough)" and press "GO" again. Some stacks will align properly with only the second alignment operation, while others require both to prevent overlay issues in the resulting image. Figure 5 shows a nine-image stack, a close-up of Natrolite, where only "Align and Balance Used Frames (Thorough)" was selected.



Figure 5 – Natrolite photos stacked with one operation.

Figure 6 shows the same nine images aligned with both options, producing a much cleaner stacked image.



Figure 6 – Natrolite photos with better alignment. Ed. Note: To see these details more clearly, enlarge your view of your e-mailed Rock Lore.

Once aligned, the user chooses one of the stacking algorithms to apply. I have had the most success with the "Do Soft Stack" and "Pyramid Do Stack" algorithms, but multiple algorithms should be tried to see which produces the best effect for a given set of images. The final, combined image is then saved via the Save button.

Finally, Paint.NET can be used to produce the final image by performing operations such as cropping and image leveling adjustment, and, finally, conversion to an 8-bit JPEG for web presentation.

The number of images needed for a stack varies depending upon the subject. Six images of the conicalcrite crystals still resulted in out-of-focus areas, and nine images were used for the Natrolite crystals. Figure 7, showing bands of a Lake Superior agate, was composed of only two images. The Jeremejevite crystal in figure 8 was thin enough for the entire crystal to be in focus in a single image, and no stacking images was needed.



Figure 7 – Two stacked images produced this.



Figure 9 – Image under short-wave UV light.



Figure 8 –Jeremejevite



Figure 10 – Normal light

Image stacking isn't limited to photos taken in visible light. Figure 9, composed of 6 stacked images, shows Franklinite (black), Calcite (red) and Willemite (green) under short-wave UV light. Figure 10 shows approximately the same view under normal conditions.

Macro photography is an interesting and fun way to look at mineral samples in collections as they haven't been seen before. I am continually surprised at what is revealed when I am able to create images at the scale of a few millimeters.

For more mineral photographs, including macro photos, please visit my Mindat gallery. At the time of this writing, I have over 475 mineral photos on display. I am ranked 140th of 1541 in number of images posted to Mindat by users.

Links for items mentioned in this article:

Panasonic Lumix DMC-FZ35

<http://shop.panasonic.com/shop/model/DMC-FZ35K>

Raynox MSN-202 lens w/ UAC3500 universal adapter

<http://www.raynox.co.jp/english/digital/S2is/index.htm>

Adorama MCFRS1 Macro Focusing Rail

<http://www.adorama.com/MCFRS1.html>

Promaster SystemPro tripod

<http://www.promaster.com/products.asp?product=7812>

DMW-LA3 extension tube

<http://shop.panasonic.com/shop/model/DMW-LA3>

CombineZP focus stacking software

<http://www.hadleyweb.pwp.blueyonder.co.uk/CZP/Installation.htm>

RawTherapee image processing software

<http://rawtherapee.com/>

Paint.NET image processing software

<http://www.getpaint.net/>

A discussion of vignetting

<http://en.wikipedia.org/wiki/Vignetting>

Charles Calkins Mindat gallery

<http://www.mindat.org/user-10785.html>