AgiSoft Metashape Rock Modeling Workflow

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Photography Materials

Having the right tools makes all the difference in the world when creating high definition rock samples. One of the biggest lessons I've learned is that the lighting needs to be as even and consistent as possible. Using a photo tent, turntable and multiple small photography lights like the LumeCube Air alongside bigger LED lights has made the modeling process much easier.





Lightbox Photo Tent Link	• Diffuses outside light sources.
Black or White background fabric	• Whichever contrasts most with specimen. (comes with lightbox)
Lighting Option #1: **4 or 5 LumeCube Air lights w/ diffusers**. Link	• Recommended because individual brightness can be controlled via smartphone.
Mini Tripods for each light source (photo #2) Link	• I've also used canning lids as a magnetic backing to attach LumeCubes directly to ceiling of photo tent. (photo #1)

Lighting Option #2: **Neewer 2 X 660 LED Video Light and Stand Kit** Link	• I used two of these in my most recent models and light is much better diffused. ***I would suggest three or four of these lights*** to make a fairly uniform light that cancels most shadows.
Multi-port USB charger Link	• Used to charge all LumeCubes at once. • LumeCubes can also be plugged into charger while "on" so battery capacity isn't an issue.
Manual Turntable Option Link	• Used to rotate samples. • Wrap the circumference of the turntable with blue painters tape. Take tape off, measure its length and divide by 72. • Measure and mark the 73 lines on the tape and then wrap it back around the turntable. Use a silver Sharpie to extend the marks on the tape to the turntable. • This will give you reference marks for every 5 degrees of rotation.
Automotive Turntable Option ComXim Link Iconasys Link	• Automatically turns samples and takes photos at predetermined increments. Can be useful in some circumstances, limiting in others.
Black & White posterboard **Or** **Black & White Felt**	• Traced and cut-out to lie on top of turntable. • Creates a smooth and even surface which is important for editing later on in the production process.
High Resolution Digital Camera (24mp +) and sharp lens. **Recommend Nikon 850 or Z7.**	• I used 24mp Nikon D750 for most models I've made. • I usually shoot between 50 and 70mm lenses. Would love to use macro lens for smaller samples less than 10cm. • Photogrammetry is about matching pixels, so more resolution = better results! • I upgraded to a 45mp D850 for all models made since 02/2019.

Tripod to support your camera. Link to well-reviewed tripod	• Imperative that there is ZERO wiggle in your camera for the sharpest possible images.
Specimen to Make the Model	• If it fits in the light box it can be made into a model. If it doesn't fit you can circle the model outside and make pretty good models.
***Circular polarizer - lens mounted.** Link (You have to choose correct size for your lens diameter)	• Recommended to help reduce glare on samples with reflective surfaces. • Sing-Ray filters are best on the market.
Clay or Kinetic Sand in spandex **Or** **Small plastic display stands**	• Used to support and hold smaller samples on turntable OR to prop larger samples that have unbalanced surfaces. • Lately I have 3D printed stands that have worked well.
RECOMMENDED HARDWARE & SOFTWARE	
Screaming-Fast Computer **Link (to get an idea of what's needed)**	• Video cards are key in processing Dense Clouds. Really need a system with at least one NVIDIA GeForce 2080 Ti. Running TWO in one system = 25% faster.
Adobe Lightroom	• Used to process RAW images from the camera to ensure color is accurate. It's also useful for reading strong shadows and glaring highlights. Images are then saved as JPEG2000 files.
Adobe Photoshop	• Used to batch-process image masks before use in Agisoft. Photoshop can both "Subject Select" and "Focus Area Select" regions of the images. In my opinion it is superior to Metashape's masking but it takes longer. Focus Area Select is key to flawlessly-focused model texture.
Focus Stacking Program • Zerene Stacker • Helicon Focus	• Required for small models with extremely varied depths-of-field. Multiple images are taken from a

	single camera position at slightly different depths of field and stacked to make one focused image. Like this Desert Rose model.
Agisoft Metashape **Link**	• The standard-bearer. Get the PRO educational version so you can add volumetric scale to models. There are other photogrammetry programs out there too, but Metashape is still the highest rated.

How Photogrammetry Turns Images into 3D Models.

Photogrammetry works by finding matching pixels from a series of several hundred photos of a rock specimen (or any object) that were taken at slightly different angles. Thanks to physics and geometric wizardry, programs like Metashape are able to use the slight change in position of matching pixels to triangulate the camera's position when the photo was taken. After calculating the camera positions for each image, Metashape can then calculate a 3D surface of the rock. The photos used to create the model can then be overlayed on the model to create a convincing 3D representation of the rock.

Camera Settings

1. **Record images in RAW format at maximum resolution. (Don't Overlook This Step).**
   RAW images are unprocessed and uncompressed. Two benefits of shooting in RAW:
   - You can apply color adjustments in Adobe Lightroom to every image and ensure each image will be processed exactly the same. This is needed to make sure that the same points in different photos have the exact same color. Automatic camera settings change from one picture to the next.
   - Compressed JPEG images have less pixel data, making it harder for Metashape to precisely match points in different photos.
   - *If your camera doesn't shoot in raw, make sure the camera is turned to manual mode so you can make every image will have the same exposure and same white balance/saturation applied to it.
2. **Set Your Camera to Manual Mode** (Usually an "M" on your camera)
   This will allow you to set the next steps...
3. **Set ISO to lowest setting. (100 to 200 in most DSLR's)**
   ISO determines the "graininess" and light sensitivity of the image sensor. Shooting at a low ISO will produce very little graininess and thus create a much more detailed image that will help Metashape align matching points.
4. **Set Aperture between F11 and F14.**
   The aperture number on a lens describes the opening size of the aperture. The larger

the aperture number (11-22), the greater the depth of field. This means more of the rock will be in focus for each photo. That's important because you want to have as many in-focus pixels as possible to match between photos. This also means that you'll need a tripod to give your sensor more time to catch all the light it will need coming through the very small opening in the aperture. (Big F numbers mean the aperture diameter is getting smaller to create sharper images). It just so happens, many lenses are actually sharpest between F11-F14

5. **Use your camera's light meter to determine an appropriate shutter speed.**
   The shutter speed controls the amount of time your image is exposed on the camera sensor. Shutter speed will vary based on the brightness of the lights illuminating the model. Take a test shot and adjust until you find an exposure you like!
6. **Keep All Settings Exactly the Same for Each Image!**
7. **Turn-off "Auto" white-balance setting if shooting JPEG images.**
   Auto white-balance makes individual images potentially have different colors. Which is bad when trying to match images that are the same. Instead, set the white balance to temperature that works. It may take a test photo or two to find the right temperature.

Image Capture Procedure

1. **Place photo-tent on a solid table.**
   Make sure the height of the table is taller than the shortest setting of your camera's tripod. In other words, the camera will need to be able to be at table height for one series of photos.
2. **Install appropriate turntable top and background colors in photo-tent.**
   If the sample to be photographed is fairly dark in color use the white turntable top and white cloth background. If the sample is light in color, use the black turntable cover and black cloth. The goal is to create a lot of contrast between the specimen and the background so the computer can differentiate between the specimen and the background. I frequently use black.
3. **Center the sample on the turntable.**
   Place the sample on its holder in the center of the turntable. This is usually done the long axis of the specimen. Rotate the table to make sure the sample is actually in the center.
4. **Set-up the Lights**
   (See image at top of page). Hang one light from the top of photo tent. Make sue the other lights are lighting the middle and bottom of the sample. The goal is to get as little shadow as possible on the specimen.
5. **Place the camera.**
   Put the camera on its tripod and aim it at the specimen from about 5 degrees above the horizon (looking slightly down). Make sure that the rock sample fills as much of the frame as possible. (more pixels = easier match)
6. **Take the images!**
   Take one image, rotate the turntable to the next marker and take another image...Repeat

until you've made one rotation of the table. I use a remote so that there is no camera shale induced.

7. **Choose your Focus Area for each shot.**
   As your sample rotates, you'll need to focus on the parts that are generally closest to the camera for best model reconstruction later on.
   a. For samples that have a greatly varied depth of field I highly recommend focal stacking if your camera (like my D850) allows it. This process takes multiple images at the same spot, but at different focal lengths and then are merged into one completely focused image.
8. **Follow either Step 8A or Step 8B**
   a. Pick up the sample and rotate it about 30-45 degrees along its long axis and place it back on the holder. Take another set of images rotating the turntable every 5 degrees. Pick up and rotate the rock again about 30-45 degrees and take more images every 5 degrees on the table. Repeat until all sides of the specimen have been thoroughly covered.
   b. If the rock sample is too unwieldy to rotate nicely along its own axis, raise the tripod about 5". Angle the camera down and capture another complete-rotation series of photos. Raise the camera again, this time to its highest tripod setting, and angle the camera down to capture the specimen from this highest angle.
      i. Ideally, you'd like to be able to rotate the sample along its long axis at least three times and take a series of tripod height-adjusted photos as listed above.

Process Your Photos in Lightroom.

1. Download the images to your computer and import them into Lightroomor a similar program.
2. Adjust ONE photo to your liking. I adjust vibrance, shadows, highlights and hue saturation to most closely resemble what the specimen looks like.
3. Copy the image adjustment setting of the photo by highlighting the photo, then selecting “Copy” on the left side of screen.
4. A pop-up box will appear. Select “Check All” on the bottom left, and then “Copy” on the bottom right.
5. Click “Ctrl-A” to select all photos.
6. Right click mouse on any of the selected photos. Select “Develop Settings” and then “Paste Settings”. This will apply the same adjustments to every single photo. This may take several minutes depending on your computer speed.
7. Click “export” on the left side of screen.
8. Save the images as a .TIF or high resolution JPG file. This may take up to ten minutes but ensures that Metashape will easily be able to create models.

Automated Masking in Photoshop (in progress...)

Metashape uses masks to ignore extraneous areas of an image. Although it takes a bit more time to make the masks on the front-end, it will make Metashape more efficient in the long-run since it won’t try to match background pixels from the turntable. There are multiple ways of creating masks, including in Metashape. I find the easiest and most accurate masking technique is to create a Photoshop automated task. Once created it will automatically open the TIF image and mask out the background. It takes about 20 minutes with very large TIF files.

You can also try this suggestion of background suppression:
https://www.agisoft.com/index.php?id=49