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The Rock Art of the Blood of the Ancestors Grotto (11SA557): A Natural History of the Imaging Methodology

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In the study of rock art in general, and pictographs in particular, how we collect and manipulate the images displayed on a canvas of nature determines both what is seen and what can be reposed for the future. The identification of an undocumented rock art site, primarily pictographic, in the Hill Section of southern Illinois afforded an opportunity to take a fresh look at the methodologies employed in data recovery and analysis. We herein detail a natural history of our investigations of 11SA557. Our methods involved the generation of five different types of image data, an eight-element protocol for the processes of image collection, and a ten-step protocol for the manipulation of the image data with Adobe Photoshop© (see Note 1). Some of the special issues associated with the long term archiving of digital images are also addressed. Our approach was ultimately driven by concerns over the fragile and dynamic properties of pictographs and the application of technologies and techniques that would result in minimal invasiveness, heighten interobserver reliability, replicable results, and the intergenerational availability of one's findings.

In March of 2005, while conducting a rock shelter survey in conjunction with the Shawnee National Forest, I had the uncommon archaeological experience of discovering an undocumented rock art site. Rock art in Illinois is rare. Of the more than 56,000 sites in the state's site files, fewer than 100 include prehistoric rock art. Of these, fewer than ten are either primarily or exclusively pictographic. Exploring a rugged little canyon, observing several intriguing rock shelters, and then finally homing on a rather noisy waterfall; I sensed that we had stumbled upon a special place. When I then noted a pool of a very thick, red slurry issuing from a block fault proximate to the base of the waterfall, I reflected that we were in a space that the ancients would have considered sacred. I returned in May of 2005 with a field crew (Figure 1) and instrumentation that

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would afford proper documentation (Figures 2, 3, and 4). I returned again in December of 2005 to gauge the play of sunlight at winter solstice.

Figure 1. Parkland College students documenting the rock art of 11SA557: (a) the so-called "pool of blood;" (b) *Osmunda regalis* ***(royal fern).***

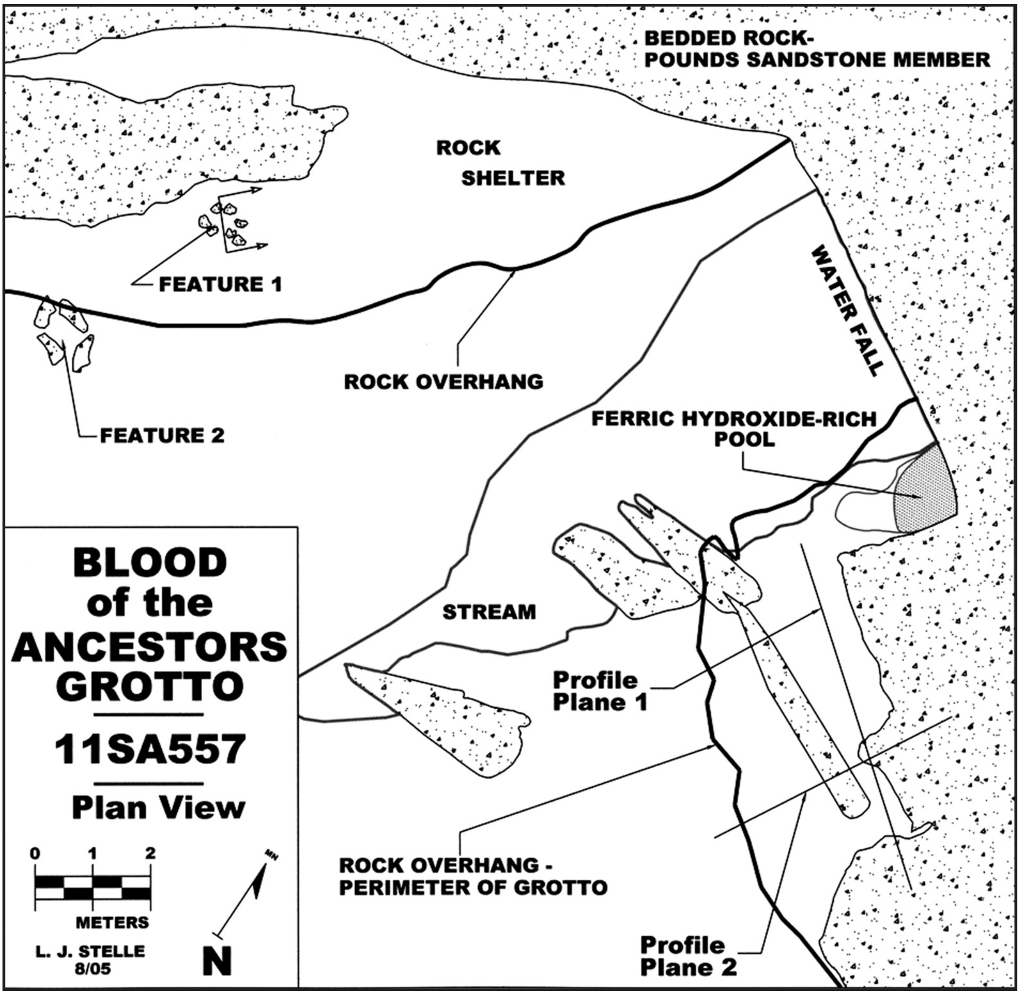

Figure 2. Plan view of 11SA557.

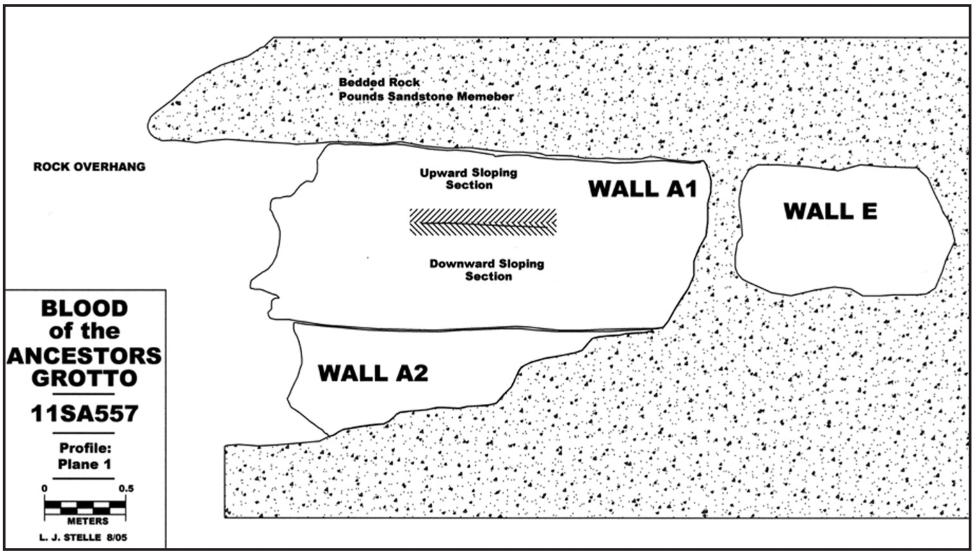

Figure 3. East-west profile of 11SA557.

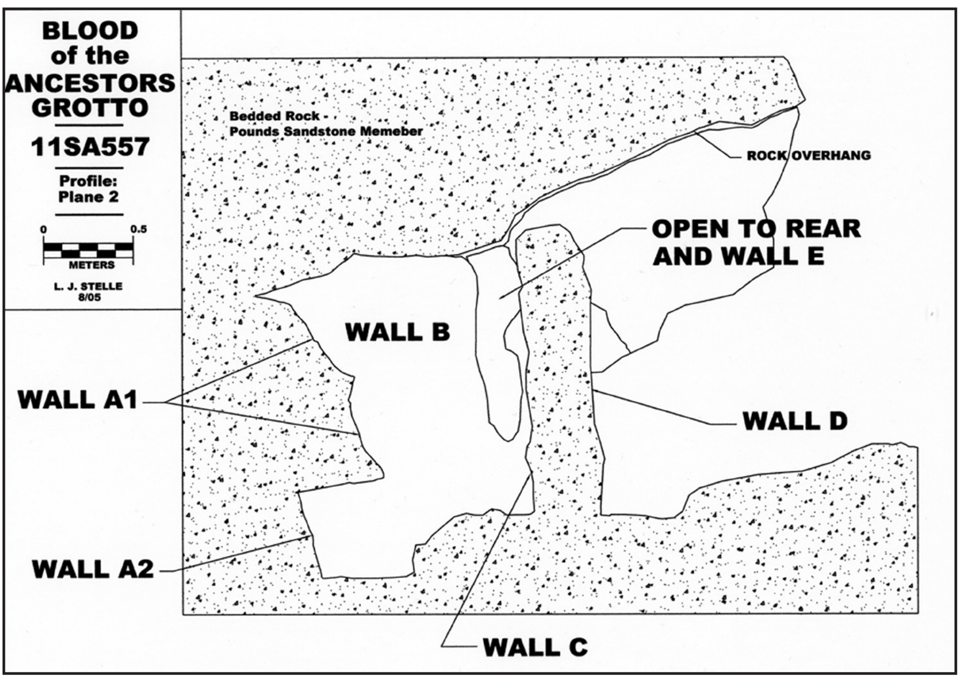

Figure 4. North-south profile of 11SA557.

Located within a rather robust physiographic expression of the Hill Section of southern Illinois (Figure 5), the mile and a half long canyon, of which the Grotto is but one element, was apparently never timbered. Formally designated a natural area by the Shawnee National Forest, one finds here remnant expressions of the oak-hickory forest that dominated the region until well into the historic period. The microenvironment of the Grotto's immediate locale suggests a more easterly mesophytic association that is reflected in the measurable expression of both sugar maple (*Acer saccharum*) and the royal fern (*Osmunda regalis*).

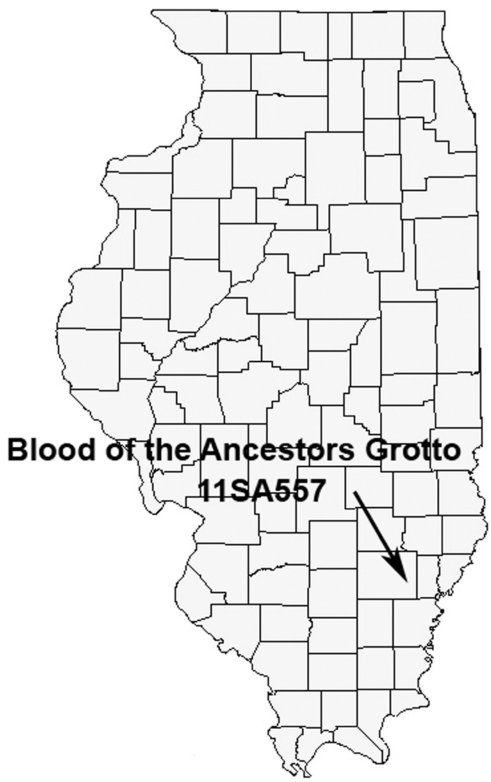

Figure 5. The location of 11SA557 in Saline County, Illinois.

Unlike the more familiar archaeological site type that provides material cultural items capable of repose in a museum collection, the critical cultural residues of pictographic sites must necessarily remain in the field, vulnerable to the actions of both nature and humans. Even between our March, May, and December visits, major human disturbance had occurred. Most noticeably, it took the form of graffiti. The pigment source that had served the prehistoric peoples so well continued to be available and presented an open invitation to all that visited the Grotto. The implication for the archaeology of pictographs, driven by the facts of fixed location and continued vulnerability, is that the archival image assemblage is a pictographic site's most basic archaeological data set. In general, it is of extreme importance that a complete imaging array be collected and that a detailed account of the techniques involved in its creation be reported.

Detailed descriptions of instrumentation, software, and image manipulation are required because variations in any one element of this troika impact what the observer is able to see and report. We would argue that imaging methodology be driven by considerations of interobserver reliability and replication. An open and empirical question centers on how other students, employing different techniques, might see other or different iconographic elements on the walls of SA557.

The overall methodology for capturing the cultural information displayed on the walls of the Grotto involved several distinct phases and procedures: (1) a photo reconnaissance, (2) an observe and sketch pencil and paper drawing, (3) a complete and detailed still image collection of all bedrock surfaces in the Grotto, (4) photomicrographs of the pigment, and (5) video captures. I would observe that for purposes of detailed analytical investigation, emulsion technology is now part of an archaeological past. Digital images are required. It is my hope to offer a relatively simple, direct, and cost effective system of pictograph documentation.

Digital Reconnaissance

The first operation was the digital reconnaissance. Of the many available cameras that could have been selected, our personal choice was a five megapixel, point-and-shoot, weather resistant, Olympus Stylus 500© (see Note 1). As all who have ever conducted rock shelter or cave surveys in eastern North America can attest, at certain times of the year these physiographic features can be quite wet. This was the case in March 2005. A compact, point and shoot, weather resistant camera was required. The Olympus is light, quick, and very water resistant. The current study involved the capturing of 233 images with this camera.

However, the photo reconnaissance extends beyond the application of light, fast, and durable hardware. Once images are collected we recommend an analytical reconnaissance as well. Bringing the images into the industry standard software for photo manipulation, Adobe Photoshop Creative Suite 2© (CS2) (see Note 1 and 2), we played with color without preexisting cognitive constraint and with a willingness to explore the full range of possible colorization. For instance, note what happens in the conversion of a reconnaissance photo (Figure 6a,b) to a Photoshop document (PSD) format, the color space to CMYK (cyan, magenta, yellow, and key or black) at 16-bits per channel, and then create an image by manipulating hue, saturation, lightness, and color balance. The product was a false color image that provided very useful insights into what was occurring in the panel. We had clearly identified elements that were not available to the unaided eye. Such discoveries drove our final image collection strategy.

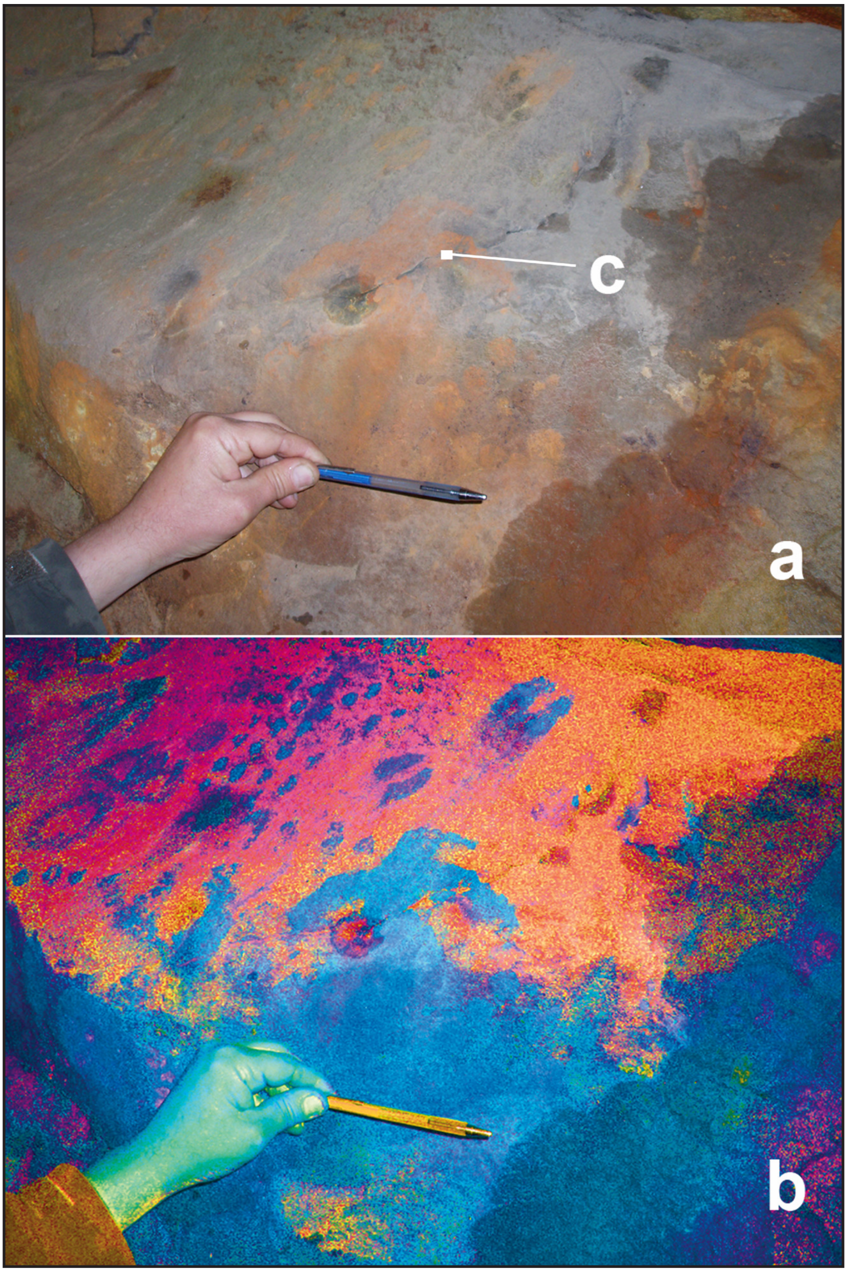

Figure 6. Fanciful experimentation with the color of a reconnaissance image of part of Wall A1: (a) unmodified reconnaissance capture taken with Olympus camera in jpeg format at 2.35 MB, dimensions 2560 x 1920 pixels; (b) note results when image is converted to PSD format, the color space to CMYK at 16 bites per channel, and then fancifully manipulating hue, saturation, lightness, and color balance. Several invisible icons become visible; (c) the small, rectangular shape at the end of the leader is exploded in Figure 7.

The image quality of the Olympus was more than adequate for providing basic documentation and allowing for the development of a refined image collection strategy. However, the critical limitations of these images were that they could be no more than five megapixels in depth and must be in JPEG format. Figure 7 illustrates the differences between the image depth of the Olympus and the digital single-lens reflex (DSLR) that we would later employ by examining a small section of the Thunderer's left wing at a maximum Photoshop zoom of 1600x. The two images reference the same section of the wall (Figure 6c). While a direct comparison is complex, the figure clearly illustrates the significant difference in detail and color information extant between the two imaging systems.

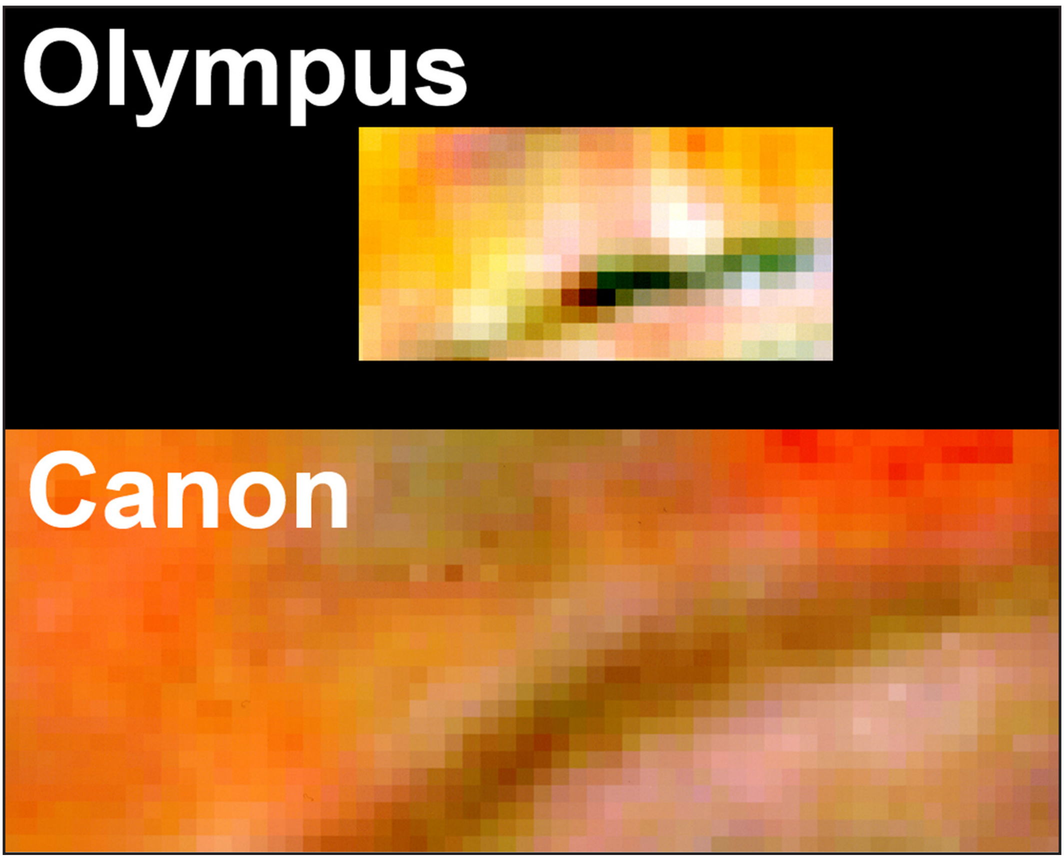

Figure 7. A comparison of depth of color information between the Olympus and the Canon images.

Observe and Sketch Document

The second step in the imaging methodology involved the production of a scaled, observe and sketch document. My strategy was to have one of my more advanced students, one that had some training in drawing technique, create such a sketch. I had two concerns: first, I was interested in what an informed observer could see of the art based upon a couple of hours' observation, and second, we would likely later require a graphic addressing the general layout and composition of the wall art. As anticipated, she was only able to identify (N=14) a third of what we would subsequently reveal using the cameras. While I fully realize that a more skilled and experienced observer (for instance, I found 23 elements) with more than two hours to study the subject area would undoubtedly have found and resolved more elements, I think her experience provides some informal measure of what is visible to the human eye. Indeed, I should point out that she actually recognized icons that I had failed to differentiate. Regarding my second goal of documenting general layout, the sketch proved very handy in maintaining my spatial orientation during later image manipulations. I would conclude by observing that I generally find pen and paper illustrations of prehistoric iconography to be dissatisfying. I always leave the drawing asking myself the question, "Yeah, but what was actually on the wall? How much of the illustration is artistic reconstruction and how much is truly wall applied pigment?" With this issue in mind, and being fully cognizant of the important reasons behind pen and paper illustration, let us now turn to my preferred way of capturing pictographs.

Archival Image Set

The third stage of our data image collection methodology involved a systematic still photographic imaging of all exposed bed rock surfaces. These images constitute our primary digital data set and include 514 frames. To date, this data set has allowed the identification of 47 discrete, prehistoric (or, at least, non-Euro-American), iconographic expressions. Some of the icons are simple but many more are compound. The two fold increase in our information base, relative to that which was observed with the naked eye, is significant. I would like to describe our procedures in some detail.

The goals of this work were both simple and few in number: visual acuity and replicability. First we needed to be able to see the art element. At least in this context, the color contrast between the wall and the applied pigment was frequently very low (Figures 8a and 9), thereby making visual distinctions difficult. Second, we wanted to minimize interpreting the now compromised original art and thereby maximize the interobserver reliability of our data set. We wanted to address as best as possible the reality of the pigment on the wall and the element thereby created. What we did not want to do is help the pictograph. Hopefully, we employed digital imaging techniques that other researchers can replicate and thereby discover the same cultural residues.

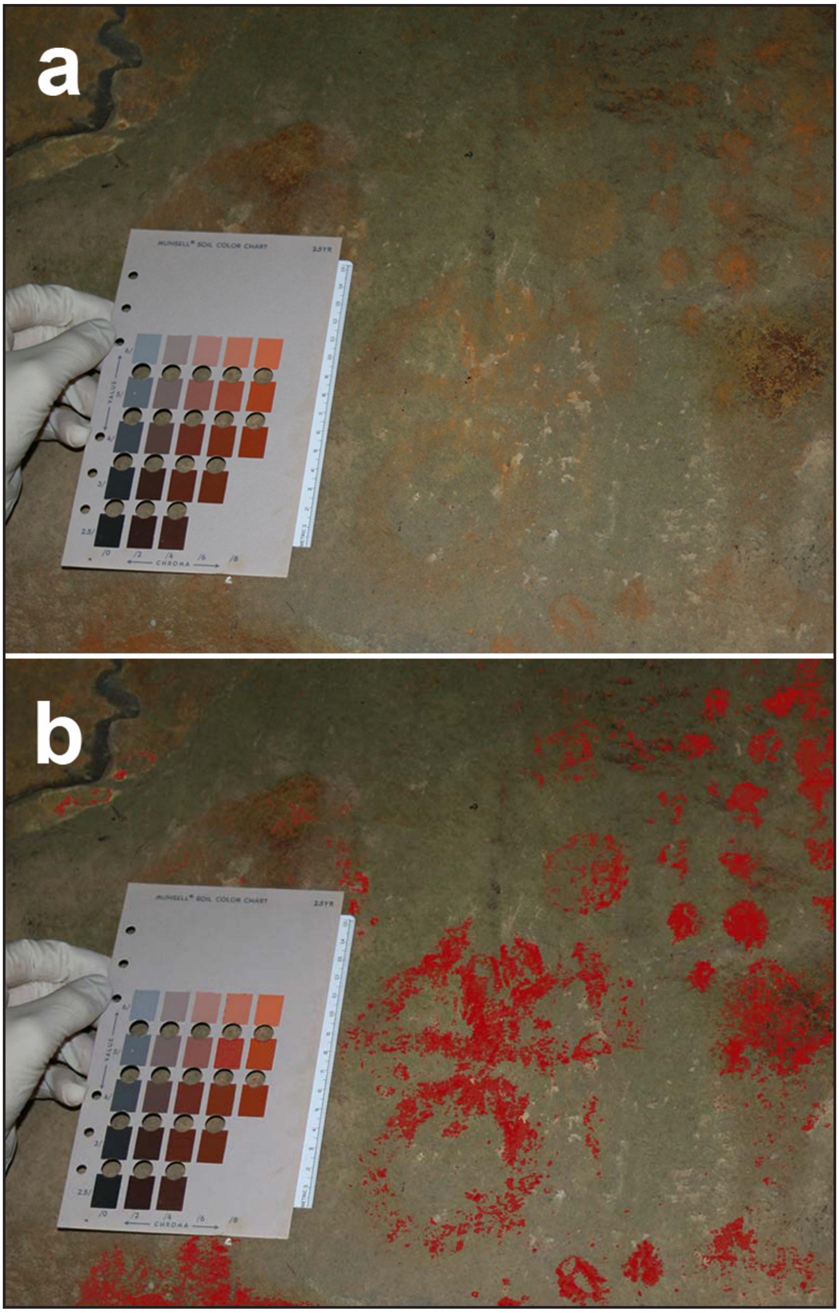

Figure 8. Medicine Woman icon from SA557; (a) the raw Canon image; (b) the rendered image.

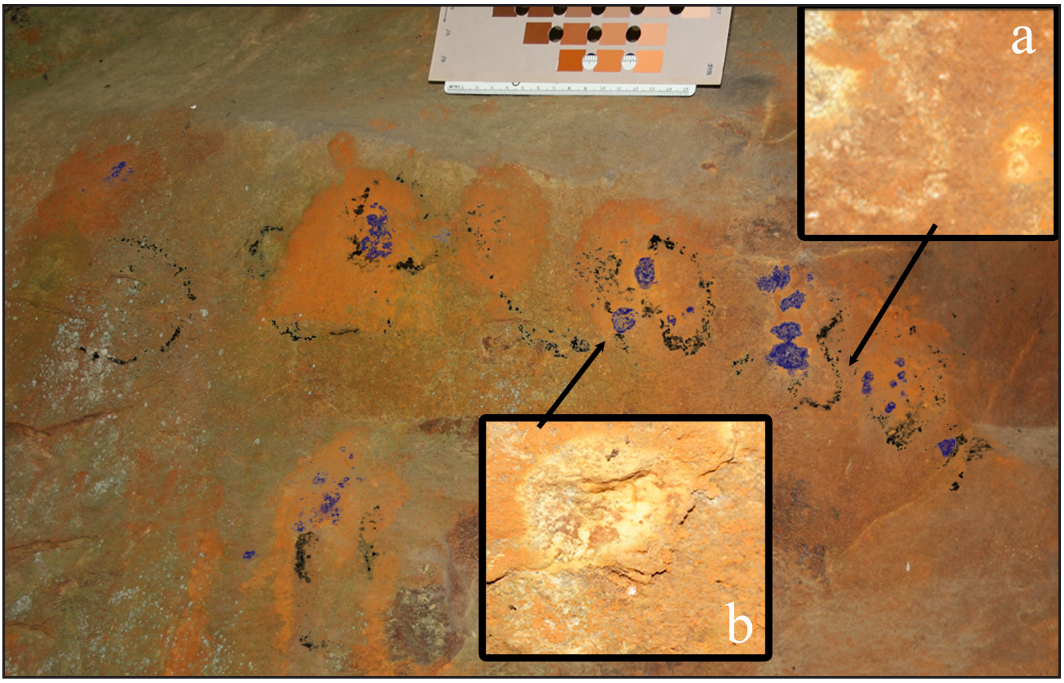

Figure 9. The several stages of icon application and modification displayed by the seven disks. In sequence of application: black is the micro-pecking/incising; orange is the paint; and blue indicates painted chips removed by robust striking: (a) unaltered detail of micro-pecking and robust strike; (b) unaltered detail of robust strike.

The instrument we selected for this work, the Canon Rebel XT© (see Note 1 and 2), is a relatively high-performance DSLR with an 8.0 megapixel complementary metal oxide semiconductor (CMOS) sensor and DIGIC II Image Processor© (see Note 1). An admittedly crude comparison of the camera to the human eye would note that the human eye has three million color receptors (cones) while the CMOS provides 7,962,624. Simply stated, the camera provides more than two and a half times as many receptors.

Insofar as Canon and others produce much more expensive ($6,000 to $7,000) and presumably more powerful DSLR's, the color depth of the images could in all likelihood be improved simply by employing the more expensive equipment. Nevertheless, as an experiment in what was possible with the current generation of cameras falling at a project-reasonable price point of $1,000, we opted for the Rebel XT digital (see Note 2).

The collection and manipulation of the systematic still image data set necessitated the application of two discrete methodologies: the first for image collection and the second for image rendering. I would like to review each of them in some detail.

Protocols of Image Collection

The protocols for image collection involved eight discrete requirements.

1. All pictures were taken at International Standards Organization (ISO) 200 with an EF-S 18–55 mm lens. An exception occurred when we employed a Canon EF-S 60 mm macro lens for documenting such extremely small expressions as the micro-pecking (Figure 9a and b, 10a). Nominal parameter settings included noise reduction off; auto white balance mode on; contrast, sharpness, and color saturation set at +1 (medium high); and color tone set at zero (normal). The camera recorded in standard color space (standard, red, green, and blue or sRGB).
2. All images were collected in camera RAW format (more correctly, in Canon's equivalent and proprietary CR2©, see Note 1) and were 3456 x 2304 pixels in linear dimension. Exact file sizes were dependent on the subject, ISO speed, processing parameters, etc.
3. Because it was necessary to measure, document, and describe the colors of both the art and the lithic background, the decision was made to employ Munsell Color Charts (Figures 8, 9, and 10) as the color scale. The chart's presence in the frame also facilitated later color manipulations. In my judgment, none of these goals could have been achieved using the International Federation of Rock Art Organization's standard scale (IFRAO). While it is very cool and quite prestigious, it would not have solved the color issues. In fairness, had the art been polychromatic, I might have decided differently.
4. A 15 cm white plastic scale (Carolina Biological Supply, price $.50) was attached to the rear of the Munsell color page using double sided tape (Figures 8, 9, and 10). It provided metrical information, a high contrast region of the composition useful as a point of focus, and a mechanism for correcting white balance. I wanted to have a capability of making accurate measurements within the image to at least the closest .25 millimeter. One of the technical problems of working in low light and low contrast environments is achieving correct focus. We hoped to rely on the Canon's six sensors and the auto focus function. We also hoped to facilitate the camera's auto focus process by giving it a helpful and high contrast place to look. Lastly, correcting white balance is arguably the single most important operation in achieving accurate color temperature and therefore, renderings.

I should point out that there was an exception to the use of both the color and the metric scale. When using the macro lens, both were abandoned. The color scale was abandoned because it was entirely too large for the composition and the metric scale because we could not determine how to employ it without having physical contact with the pictograph. While the application of scalar devices is standard drill, we have not yet satisfactorily solved these issues in this context.

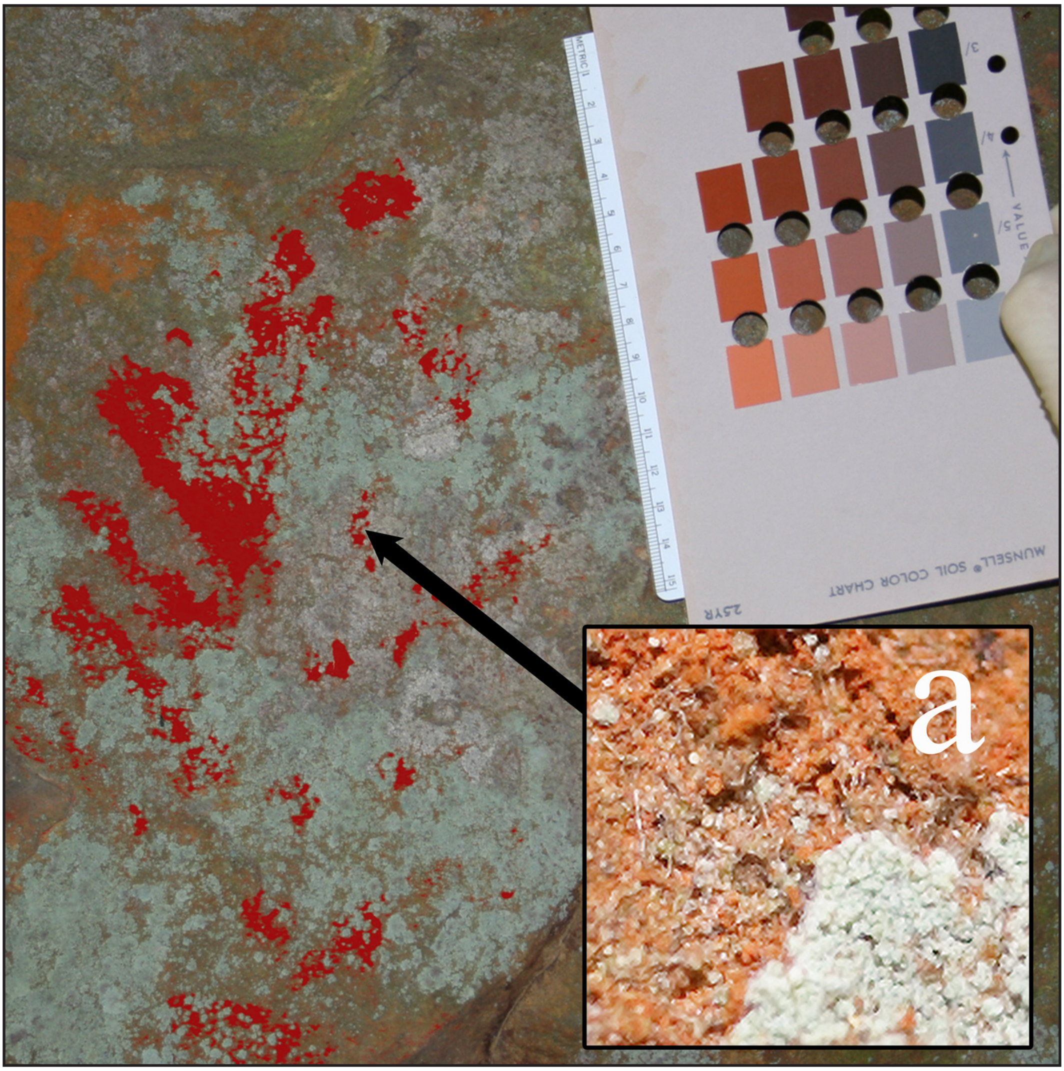

Figure 10. Likely icon of locally abundant Osmunda regalis (royal fern) overgrown by multiple species of lichen and moss. (a) Detail (0.25 mm square) revealing relationship between lichen and underlying pigment. Note lichen's exposed rhizines (filaments in upper left quadrant). Image taken with Canon EF-S 60 mm macro lens.

5. The rules of methodological invasiveness were several but simple. One, at no time would anyone have direct physical contact with the walls of the Grotto. Two, when inside of the Grotto, the student would wear latex gloves (see for instance, Figures 8 and 10) at all times in order to protect rock surfaces should one inadvertently violate rule one (for instance, stumble climbing around a tripod). Three, do as much imaging

as possible with available light. In low light situations use only the camera's small built-in flash. Lastly, because of the very limited interior space, no more than three people were to be inside the Grotto at one time.

6. While it is axiomatic in modern photography that "light is everything," we opted against the offer by one of my students to use her flash attachment. We remain uncertain about the potential negative consequence this type of light source might have on the pigment. To the extent that we are currently unable to estimate what fraction of the pigment owes its coloration to residues of iron-eating bacteria, we deemed it appropriate to err on the side of conservatism and employ only a minimum amount of artificial light.

7. We attempted to maintain some consistency in our distance from the subject so that areal dimensions and perhaps more importantly pixel densities might remain constant.

8. When possible a tripod was employed to stabilize the camera. Unfortunately, the elevations and exposure angles of the wall images often made this impossible.

Protocols of Image Manipulation

The protocols for the rendering of the images involved several additional considerations.The first of these centered on downloading the captured images and creating the archival data set. I used Canon's software program, Digital Photo Professional© (see Note 1), version1.6 (bundled with the camera) to download and convert files from Canon's CR2 camera RAW format, to Tagged Image File Format (TIFF). The resulting TIFF files were in an image mode of RGB color at 16-bits per channel and with an output resolution of 2000 dots per inch (dpi). These files are typically 46 megabytes in size. Many would argue that the image manipulations that we are about to describe should have been completed while still in the RAW format. Unfortunately, Photoshop CS2 did not recognize CR2 format. Fortunately, TIFF is both very robust and widely supported.

The archival image data set profits by the inclusion of both the RAW images and the initial TIFF conversion images. The metadata (date, lens, camera settings, etc.) stored as part of these files is extensive and complete. Currently the SA557 project includes some 51 gigabytes of archival image data. Given current technologies of data storage, we would recommend that the archival images be burned on DVD's. In its current iteration the basic archival data set is arrayed over 15 DVD's. Our recommendation is that the backup should occur as soon as the RAW images are downloaded and converted to TIFF's, and before the camera's memory storage device is erased.

The second consideration in the rendering of the captured images centered on their actual processing. For this task I employed Adobe Photoshop CS2. I do not consider myself particularly skilled in Photoshop. Given its incredible power, the learning curve seems very steep. I am sure that many of you reading this report could advise me of a better or more efficient way of managing the work flow. However, after some considerable experimentation, a generic protocol was derived that involved several discrete steps.

While there was also the realization that no one technique would likely be appropriate to all images, the basic process involved ten operational steps.

1. Open TIFF image (RGB color and 16-bits per channel), create a new layer, and save file under a new name.
2. Using the lasso tool select a region of the picture for modification. The initial strategy had been to simply select a specific hue, value, and chroma combination from the included page of the Munsell Color Chart for manipulation. We thought that by selecting particular color chips and converting them to our default dark red replacement color, a record of color manipulation could be maintained. While this was to an extent both true and useful, there were problems. One of the problems with this approach was that there was so much naturally included iron oxide in the sandstone walls that our attempt to tease out iconographic expressions remained compromised. We decided that after exploring a frame, better visual acuity could be achieved by only working with spatial subsets that evidenced cultural modification. One of the things that we discovered was that Photoshop CS2 provided much great tonal sensitivity than the Munsell Charts. After some experimentation we decided to color pick the pigment of a particular art element and then proceed with the color replacement. Small deposits of pigment (less than .1 mm in diameter), only visible to the human eye at what were commonly 800 magnifications (enabled by the zoom function), could consequently be efficiently located and modified.
3. Zoom the selected area to the point of pixelization.
4. Using the eyedropper tool, set for either a Point Sample (one pixel) or a 3 x 3 sample, click on a glob of pigment inside the area that you have lassoed. This color now becomes the foreground color.

While it is beyond the scope of the present report to discuss procedures by which the art can be refreshed or renewed, let me observe that Photoshop provides a mechanism by which these tiny .1 mm globs of pigment can be expanded in a controlled fashion. As part of Step 4, one can choose a quantifiable number of neighboring pixels for color replacement and thereby regenerate the presumably missing segments of pigment in a measured fashion. Doing so may be very important to the reconstruction and final interpretation of the compromised icon, but I feel that it is the responsibility of the researcher to specify these replacement or "growth" values. The caveat would be to start slowly and proceed with caution. The subjective projection of false pattern and shape on the part of the worker remains an unending danger necessitating the requirement of reporting.

5. Using the Eyedropper tool, click on the background color symbol, and then click on the dark red (red 157, our personal choice) of the color swatches. Red 157 now becomes the replacement color of the pigment.
6. From the drop-down Select menu, click on color range.
7. From this screen I first set the preview to gray scale and then address the issue of the fuzziness value. While a lower value is generally better, some experimentation with

the current image may be required. The fuzziness option controls the degree to which related colors are included in the selection and as such is the operation for separating the pigment from the background. Fuzziness determines the color range of the pixels to be transformed. Bear in mind that because the tonal qualities of the pigment are also likely variable, some concession to workflow efficiency is allowable. The fuzziness value is another point in the procedure where a false or creative reconstruction of the surviving pigment can be achieved. The concerns addressed in Step 4 obtain.

8. From the drop-down edit menu click on fill. From the associated pop-up, select background color. Lastly, click on OK. Color replacement will now be achieved. Observe the transformation to the shamanic image as we go from before to after (Figure 8a,b). Note, for instance, how much more distinct are the power balls emanating from the shaman's left hand and their trajectory.

9. Deselect and save the file.

10. Steps 2–9 may have to be repeated several times in order to achieve satisfactory output. In general, we advise an incremental approach rather than all at once.

A point of discussion regarding the ten steps of the image manipulation protocol, is that one of the special capabilities of high density digital images is the ability to work with eroded and weathered art. Having more information available and being able to massage the image, affords the opportunity to discover extremely small quantities of art residue and to rework these fragments into more meaningful wholes. In compound icons, such as the one illustrated in Figure 8, it is probably useful to begin the image analysis by selecting a glob of pigment and then doing a conversion for the entire surface captured in the photograph. Subsequently, one can perhaps tease out existing patterns of color and then go back to the original image for a final section-by-section work up. However, even digital imaging cannot replace what is missing. Filling in the blanks or connecting the dots by image manipulation is what we are trying to avoid in the archival image set. The conundrum is deciding the conditions under which connecting the dots and filling in the missing pigment becomes appropriate. Again, I would advise that we always inform the reader of when such decisions have been made with regard to a specific image and why. The goal would would be to not necessarily avoid an interpretative component in our renderings, but to be more specific in our differentiation of "their" art from "our" art. Doing so would result in heighten interobserver reliability and replicability.

In conclusion, our basic problem was how to make the surviving cultural expression more visible to the human eye. The problem was exacerbated by both the color similarities between the artistic application, bedrock wall, and the weathering of the original images. Simply stated, our goal was to locate the glob of pigment and convert it to a contrasting color that a human might better resolve it. We did not add to what was on the wall, we only rendered that which was present more visible. The achievement of these modifications obviously necessitated digital images and digital image manipulations. We think that the two protocols offered provided a viable solution. Before we leave this discussion of the creation of the basic image data set, I would draw the reader's attention to four special imaging problems that were encountered.

The first of these was the issue of layered and sequenced art. Some of the art, for instance the seven disks grouping, demonstrate sequencing. These seven elements indicate at least four episodes of activity (Figure 9). The first episode would have involved the application of a whitish pigment, likely in the geometry of what we can today see. The source of this pigment is unknown. It is the only place within the Grotto where it is found. A second episode involved the application of the red pigment over the white. The third modification (shown in black) involved micro-pecking or perhaps the use of an intermediate chisel-like tool to create curving, sometimes bounding, petroglyphs (Figure 9a). Lastly, the defined disks were robustly struck (shown in blue) leaving relatively large, cratered areas (Figure 9b) of petroglyphic modification.

The second problem was that of documenting the activity of lichens and mosses. While we have been able to document (Figure 10) the negative impact that lichens have had on the art, no immediate solution is forth coming. We cannot see through the lichen. This condition is in no way unique to the SA557. One observation that we can offer however, is people of the past were apparently willing to reapply icons over sheet inundations of lichen. The result may be a particularly unstable vertical series of lichen laminations. In fact, the organic component of the iron-rich pigment may lend itself to lichen growth.

The third issue centered on how to capture variations in light intensities created by the entry of sunlight into the Grotto. After it became apparent that a patch of sunlight was going to move across the face of Walls A1 and A2, photo documentation was necessitated. We were much intrigued by the potential relationship between (1) focused, spotlight type effects, (2) the movement of the spotlight over the Grotto's wall and the (1) location and meaning of specific icons and (2) iconographic directional indicators like deer tracks and power paths. The technical problems were of (1) high contrast, (2) movement, and (3) at winter solstice, low contrasts. While we feel that we were able to achieve baseline documentation, clearly, more work needs to be done.

The final special imaging problem concerned the creation of a panoramic view (Figure 11). While such images are not likely to be employed for detailed analysis of the art, they do serve the useful functions of providing the holistic overview and providing quantifiable information regarding spatial relationships between the elements of a panel or panels themselves. Our technique was fairly simple. Maintaining a constant distance and elevation from the wall segment being documented (which, because the Grotto's walls are irregular and curved, is not exactly possible) and including the metrical scaling device so that in later manipulations, scale could be corrected, we shot a complete series of overlapping images. The images were subsequently integrated within Photoshop to create a shingled, panoramic view. Our panoramic image is in TIFF, and is 105 megabytes in mass, has linear dimensions of 6031 x 3047 pixels, and can be readily projected to a close approximation of life size. Two unresolved and perhaps unanswerable difficulties were lighting and camera angles. These two factors produced the occasionally rather abrupt transitions between discrete photo margins that you can observe in the stitched composite.

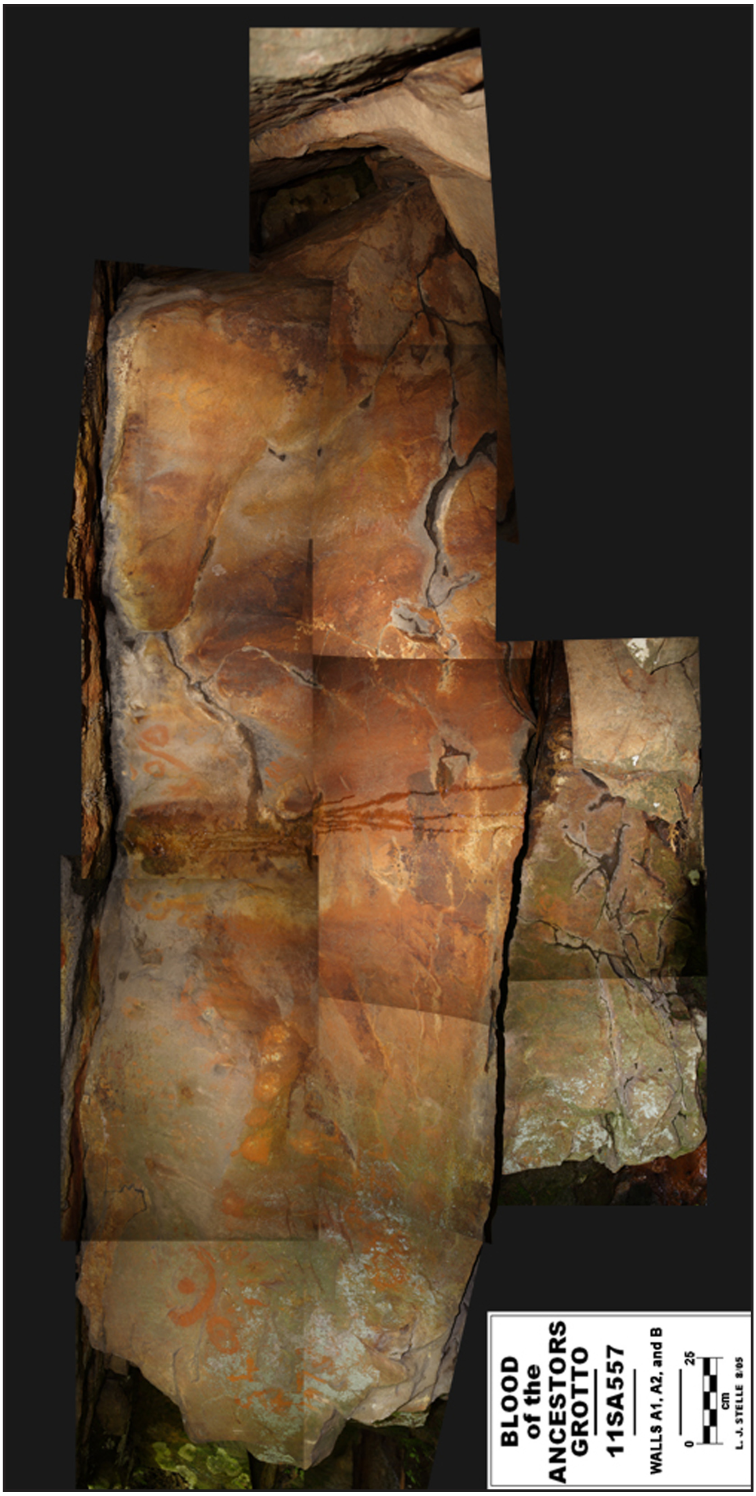

Figure 11. Panoramic view of the Grotto's art.

Microphotography

Returning to our discussion of the natural history of our imaging methodology, brings us to the fourth procedure, namely that of microphotography. While the pigment, as evaluated by examination of specimens collected from the Pool of the Blood of the Ancestors, was presumed to be hydrologic in nature, a further analysis reveals that it is primarily biogenic. Using a Reichert Microstar IV© (see Note 1) microscope connected to a digital photomicrographic system consisting of an Olympus 750 camera and ATI Multimedia Center software (see Note 1), we were able to identify significant quantities of the chemolithotrophic bacterium, *Gallionella ferruginea* (Figure 12). *Gallionella ferruginea* oxidizes dissolved iron. The iron is transformed into the insoluble precipitate ferric hydroxide [Fe(OH)3], or what we observe as the red pigment. If the red paint of the pictographs was sourced from the Pool, as we believe it to have been, then the paint may fractionally contain large quantities of bacterial residue. The prospect of each pictograph containing measurable amounts of organic carbon is both significant and intriguing.

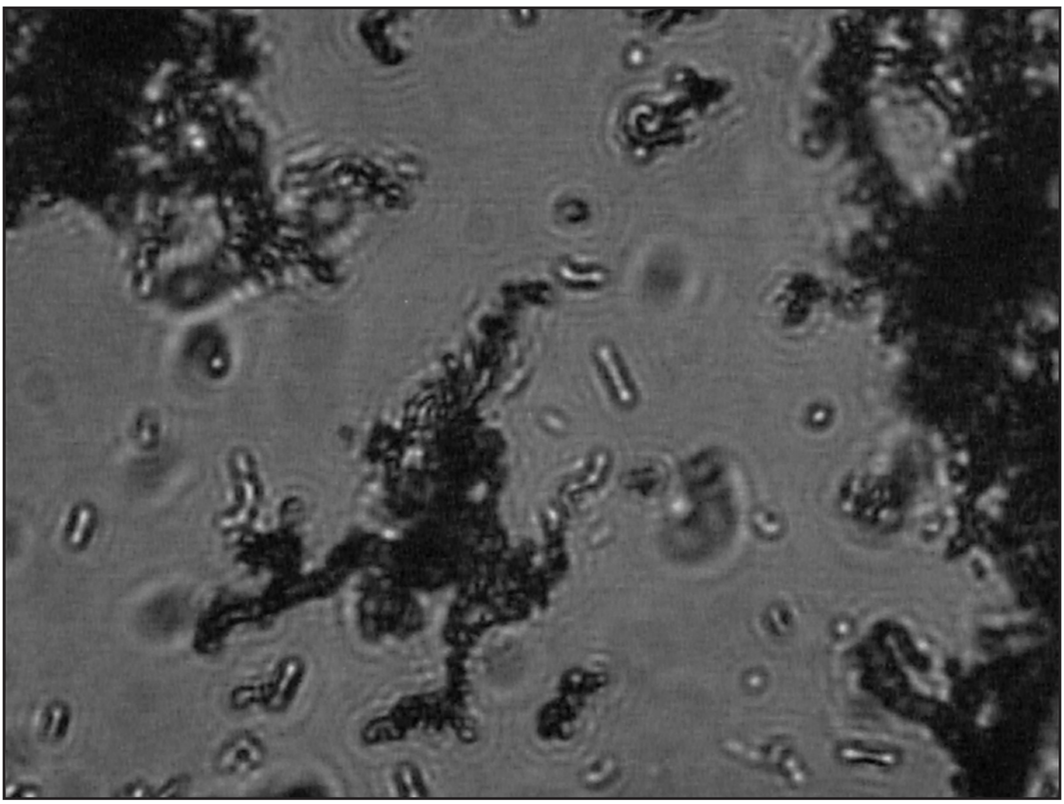

Figure 12. The chemolithotrophic bacterium Gallionella ferruginea recovered from the Pool imaged at a 40x magnification.

Video Reconnaissance

The last step in our methodology involved an exploration of video imagining and ought correctly be considered a video reconnaissance. Frankly, video was an afterthought, but the Olympus camera provides this capability, albeit of very low quality. However, having viewed the image we created, we think that it can provide both archival and operational utility. Certainly, video provides a mechanism for documenting the space in not just a flattened, two dimensional panoramic view, but in a full three dimensional perspective. Indeed, it affords a fourth dimension, time, as well as a second sensory channel—sound. We think that it has considerable potential. Video would be particularly useful in providing a holistic overview of a cultural expression like the Grotto. It would not replace still photography for the generation of the basic analytical data set, but three dimensionality and sound are definitely interesting avenues for further research.

Considerations for Long-term Storage of the Archival Image Set

A major concern for all students of pictographs centers on the artifact's continued erosion and loss as a consequence of both natural and human activity. We will continue to explore strategies that will enable future archaeologists to access iconographic expressions as they existed at some earlier way-point. In the present iteration, we have reposed with the Illinois State Museum's collections 51 gigabytes of image data in a variety of formats to include RAW (actually Canon's proprietary CR2), TIFF, JPEG, and audio video interleave (AVI). The storage medium we have selected is Digital Video Disk-Recordable (DVD-R), specification version 2.1, 1–16X speed, and affording a 4.7 gigabytes storage capacity. Fifteen such DVDs are required for the project's 51 gigabytes of image data. While we have been guided by a search for the functional cyber equivalents of "sharpies" and "archival paper," unresolved is how well these formats and storage media will weather future technological changes. I would encourage archivists to explore strategies by which such data can continue to be made accessible to future archaeologists. Cleary a viable strategy will necessitate the migration of the image data to as yet unknown formats and the image storage on media as yet unavailable. Judging from the rates of technological change that have occurred over the past twenty years, what seems likely required is a renewal cycle of five to seven years. Regardless of the many issues attendant to archiving, the field work must always be guided by the imperatives that more image information (taller, wider, and thicker) is better and that archival storage will require multiple formats and on-going attention.

An alternative or, arguably, complimentary strategy might have to do with storing the image data on a publicly available Internet server. For instance, Dr. George Sabo and the Arkansas Archaeological Survey (http://arkarcheology.uark.edu/rockart/index.html) are doing so already, as are hobbyists like Roger Haase at Digital Rock Art (http://www.digitalrockart.org/). Indeed, much material from SA557 is currently available on-line at (http://virtual.parkland.edu/lstelle1/len/center_for_social_research/BAG/

BAG_main.html). Internet postings have the salubrious effect of making the images infinitely more accessible to an exponentially greater body of investigators. Judging from our own experience, I would guesstimate that more than 100 people are visiting these three collections every day. While most visits are inconsequential, at least some represent focused searches and trained interests. Of moment is the fact that all visitors now have the loaded image available on their desktop computer to modify in such fashion as they deem appropriate. Ease of access enhances the prospect that the archival package will be usefully moved forward in time although in an admittedly informal and ad hoc fashion. The major evolutionary strides in both hardware and software that are being taken by such students of rock art as Sabo and Haase are to be applauded. Clearly their work represents, among other things, a significant frontier for the development of solutions to the problems of long-term storage and future accessibility.

Anyone that has spent time investigating rock art has at some point longed for an opportunity to see the art as it existed in even an historic past. Advances in technology now afford an opportunity to ameliorate this circumstance in a fashion unimagined scarcely a generation ago. It is a very exciting time to be doing rock art research.

Conclusion

In the study of rock art in general and pictographs in particular, how we collect and manipulate the images displayed on a canvas of nature determines both what is seen and what can be reposed for the future. The identification of an undocumented rock art site, primarily pictographic, in the Hill Section of southern Illinois afforded an opportunity to take a fresh look at the methodologies employed in data recovery and analysis. We herein detail a natural history of our investigations of 11SA557. Our methods involved the generation of five different types of image data, an eight-element protocol for the processes of image collection, and a ten-step protocol for the manipulation of the image data with Adobe Photoshop. Some of the special issues associated with the long-term archiving of digital images are also addressed. Our approach was ultimately driven by concerns over the fragile and dynamic properties of pictographs and the application of technologies and techniques that would result in minimal invasiveness, heightened interobserver reliability, replicable results, and the intergenerational availability of one's findings.

Lastly, our exploratory investigation of 11SA557 has obviated a simple fact: much of the rock art extant within the Grotto was unavailable to the unaided eye and to traditional techniques of pictograph recording and processing. Our protocols afforded a two-fold increase in what could be seen, documented, and rendered available for archaeological interpretation. The instrumental techniques employed in this study, when applied to weathered, faded, or otherwise compromised pictograph sites that have already been inventoried, would likely yield substantial increases in our knowledge of these most interesting cultural expressions of the past.

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Notes

1. Olympus Stylus 500, Canon Rebel XT, Adobe Photoshop CS2, Reichert Microstar IV, ATI Multimedia Center, Digic II Image Processor, Canon CR2, and Digital Photo Professional are trademarked products.

2. Since early summer 2005 when the image captures and manipulations were completed, both the Canon camera located at our $1,000 price point and the image editing software available from Adobe have undergone at least two iterations. If we were to repeat the activity today, we would employ the Canon EOS 50D (15.1 megapixels) and Adobe Photoshop CS4. The 18-month new release rule continues to find industry expression. Nonetheless, regardless of the relentless pursuit of technological innovation, the basic concepts and techniques presented in this article obtain.