

EXAMINING PETROGLYPHS IN THE BIRCHAM UPLANDS THROUGH THE USE OF DIGITALLY ENHANCED IMAGERY

ANDREA CATACORA
ASM AFFILIATES

Color-enhancing tools in Adobe Photoshop® can be applied to digital photographs of complex rock art panels to identify different color densities of patination in petroglyphs and to delineate their extent and frequency in an objective and consistent manner. The resulting image produced is a digital reproduction of the rock art panel, which serves to analyze, layer-by-layer, sets of elements with a shared color value assumed to be from a single production event. For individual sites, this technique can help us understand how rock art panels were reused over time, based on element superimposition, modification, rejuvenation, and integration. The implications of reuse suggest that rock art was not a “fixed” product, but was really an active process. Comparative studies may reveal patterns representing widespread changes or continuity in rock art styles, function, and meaning through time. This study is based on the assumptions that, in an arid environment, desert varnish accumulates in a more regular and consistent manner on an individual rock art panel and that older petroglyphs are more heavily varnished or patinated and darker in color than younger ones, which are unpatinated and lighter in color.

THE PROJECT AREA

The Bircham Uplands are located on the North Range at the Naval Air Weapons Station (NAWS) China Lake, California, within the southern Argus Range, approximately 12 km southeast of the Coso Rock Art Landmark, in the western Great Basin. This area is an isolated volcanic tableland composed primarily of well-varnished basalt. Most of this parent rock consists of small to moderate-size boulders situated within broad, horizontal distributions, but some occurs as vertical outcrops on the mesa tops or as an escarpment along the mesa rims.

In association to the rock art found across the upland region of the southern Argus Range, a diverse assemblage of archaeological sites and features also exist, based on the preliminary results of a cultural resources inventory totaling nearly 2,055 acres in size that was recently conducted by ASM Affiliates, Inc.

As a result of this effort, a large density of approximately 240 prehistoric sites was found across the entire flat tops and rims of the 1,600-1,900-m-high mesas. These sites include a complex assortment of rock art panels and bedrock milling stations, flaked lithic tools and debitage, ground stone implements (millingstones and handstones), and at least three types of constructed rock features (hunting blinds, windbreaks, and rock rings).

Several unique items were also recorded and include a large abalone pendant with drilled and incised decorations, *Olivella* shell and glass trade beads, and two culturally distinct ceramic sherds: Owens Valley brownware and Ancestral Puebloan redware. Although these items are few in quantity, their rarity contributes to the diversity and complexity of Bircham site use and function.

Given the types of artifacts and features found, it is evident that repeated and often intensive use of the upland region was a cross-culturally significant occurrence throughout the prehistoric and even historic times. There are several factors in the archaeological data besides site density that suggest a more frequent upland occupation; however, since only certain constituents at one site may show signs of reuse, it is still uncertain if and how site function was affected over time.

Nonetheless, this pattern of reuse is based on the presence of several diagnostic artifacts, including point forms, ceramic sherds, shell ornaments, and glass trade beads. Additional evidence

includes the assortment of residential features (rock rings) found in association to complex rock art features, the large density of bedrock milling facilities with single to multiple slick surfaces, and the number of these features showing either heavy to light use wear and, in some cases, a repatinated use surface. Several of the milling slicks are superimposed with petroglyphs or vice versa (Giambastiani and Lechner 2010). In terms of the rock art, at least three stylistic traditions have been identified. Individual panels may encompass pecked or abraded petroglyphs in abstract and representational styles, or as “scratched” patterns. Differences in the degree of patination among elements across a single panel indicate contrasting rock art production periods. Without a change in color to make this distinction, one could assume that the rock art was similar in age or from a single production event. However, our findings suggest the opposite.

Efforts to improve the definition of elements exhibiting patina color differences on individual rock art panels was accomplished by utilizing Color Range in Adobe Photoshop, a technique that manipulates digital imagery through built-in color enhancing and replacement methods.

THE PROCESS

This technique requires digital photography and uses Adobe Photoshop (version 7) software to process and enhance digital imagery. There are four basic steps to complete the Color Range process. To lead you through this process, a brief description of each step, followed by technical instructions, is provided below.

Step 1. Define Element Shape and Design

Apply the Color Range command in Adobe Photoshop to select a specific individual or set of repatinated surface colors, working in stages from darkest to lightest. The way in which the command matches color is based on how it is expressed numerically in four different modes or models: HSB (hue, saturation, brightness), RGB (red, green, blue), CMYK (cyan, magenta, yellow, black), and CIE L*a*b (Commission Internationale d'Éclairage) (Adobe Systems Incorporated 2002). The Color Range command, in a sense, then measures the color selected and delineates areas in the image that share the same color value.

It may be advantageous to use a light meter when taking digital images of petroglyphs in order to produce a more consistent set of measurements and readings of numeric color values before applying the Color Range command.

- Open and save the JPG image as a PSD file in Photoshop.
- Under Layer, select New then Layer. Default to layer name, color, mode, and opacity settings.
- Under Select, click on Color Range and select Sampled Colors. Set the Fuzziness Slider in the range from 15 to 30 (out of 100), the Image to Selection, Selection Preview to None; Eyedropper Icon. (The Fuzziness Slider gives you the option to increase or decrease the range of color values on a 0 to 100 scale. To decrease the range of colors in a selection, a smaller value is set, and to increase the range, a larger value is set. Most of the images enhanced were produced in Color Range with the scale set between 15 and 25.
- Drag the Eyedropper tool over the image and right-click to make a color selection. View the results in the Color Range menu box; white space means a positive color match, and black space indicates a negative color match.
- Click OK after examining these results against the original image. An outline of shimmering lines will appear on the main screen, marking the extent of the selection.

Step 2. Enhance Color Selection

After the pixels with a shared color value have been defined, the next step involves replacing the initial color (in the digital image) to enhance the shape and visibility of the element (Figure 1). The color selected is arbitrary and should maximize contrast with other elements in a panel. The Color Picker palette tool allows you to choose a solid color from a broad color spectrum, or by entering a numeric value (Adobe Systems Incorporated 2002).

Since the enhanced image should be a visual translation of the original one, the infill colors chosen should follow a color scheme that corresponds to the natural varnish color density or hue. For instance, three different colors of the same hue may be selected to account for the natural gradation seen in surface weathering. The color “red” is used for elements with a dark varnish color to represent initial panel use, while the color “pink” is selected for those with medium to light varnish hues. This would apply if more than three rock art production events were recognized in the image. However, this intermediate color may suggest secondary reuse or simply account for the unevenness in varnish accumulation across a panel surface. Lastly, “white” is used for varnish colors exhibiting little to no patination, which is a more recent indication of panel reuse. Ultimately, when all surface colors have been processed and replaced through the Color Picker, distinctions between elements of varying rock art production periods are better defined. Each of these expressions is considered a Layer in Adobe Photoshop.

- Under Layer, select New Fill Layer and Solid Color.
- In the New Layer menu, click OK. Default to layer name, color, mode, and opacity.
- Select a new infill color from the Color Picker menu, a color spectrum chart with the numeric values of color in HSB, RGB, L*a*b* and CYMK modes. Click OK after selection.
- Repeat steps 1 and 2 until all surface colors have been processed and enhanced through Color Range.

Step 3. Emphasize Layer Visibility

The purpose of this step is to emphasize the visibility of the color enhancements in each layer in order to increase the visibility of the rock art. Replace the panel surface or the “background” with a solid, flat color such as true black (Figure 2). It is important to identify how natural features in the panel were incorporated in the rock art before taking this step, since they will be masked in black.

- In the Layers window box, select the first (or original) layer, also known as the “Background” layer. Click on this layer box to select (highlighted blue).
- At the bottom margin of the Layers window box, find and click on the icon (a circle, split half white and half black), which is the command to Create New Fill. This command can be used to “replace” the color of the background layer.
- Select Solid Color.
- In the Color Picker menu, select the color “black,” and click OK.

Step 4. Change Layer Visibility

This last step is designed for analytical purposes. Multiple versions of one image can be studied or reviewed in Adobe Photoshop, since the final product will consist of a set of visible layers that can be opened or closed at your discretion (Figure 3).

- In the Layers window box, find the icon (an eye), located on the left side of the column margin. This command changes the visibility of a layer; it will open or hide it. Note: the icon appears when a layer is visible and disappears when it is hidden.

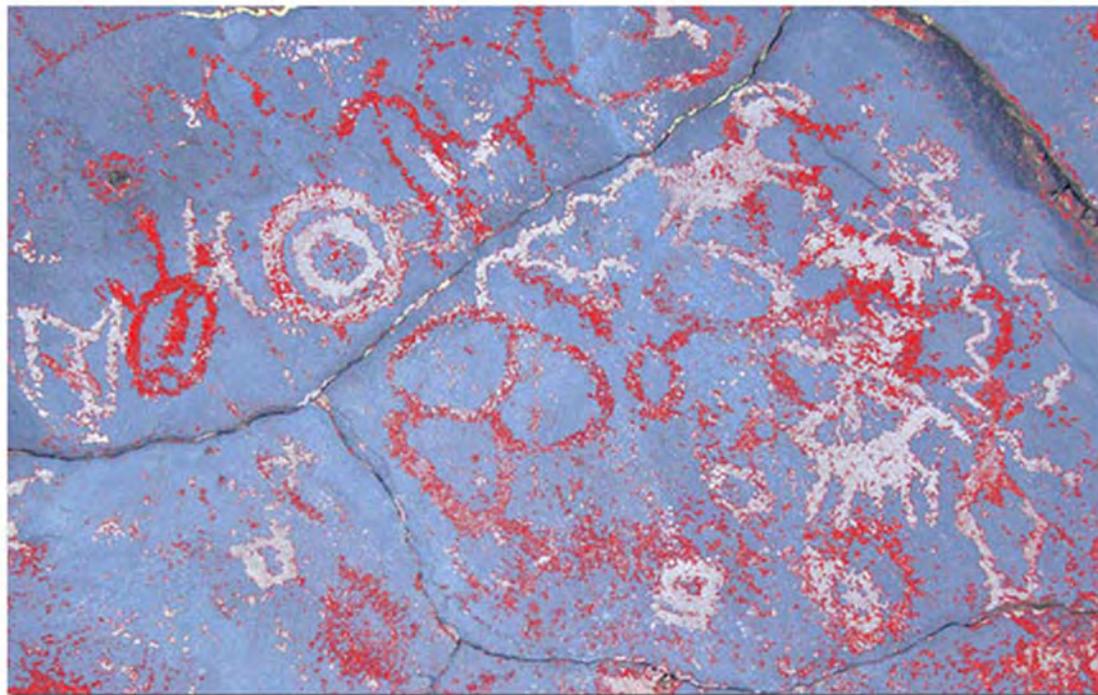


Figure 1. In the original image (top), the complex panel exhibits at least two production events with heavily or moderately repainted elements. In the enhanced image (bottom), the Color Range tool was applied to define areas with the same color value and then replaced with an infill color from the Color Picker palette. The results in “red” represent the earliest rock art production period. Image reference: Site No. ML-BF-27, Feature 7.

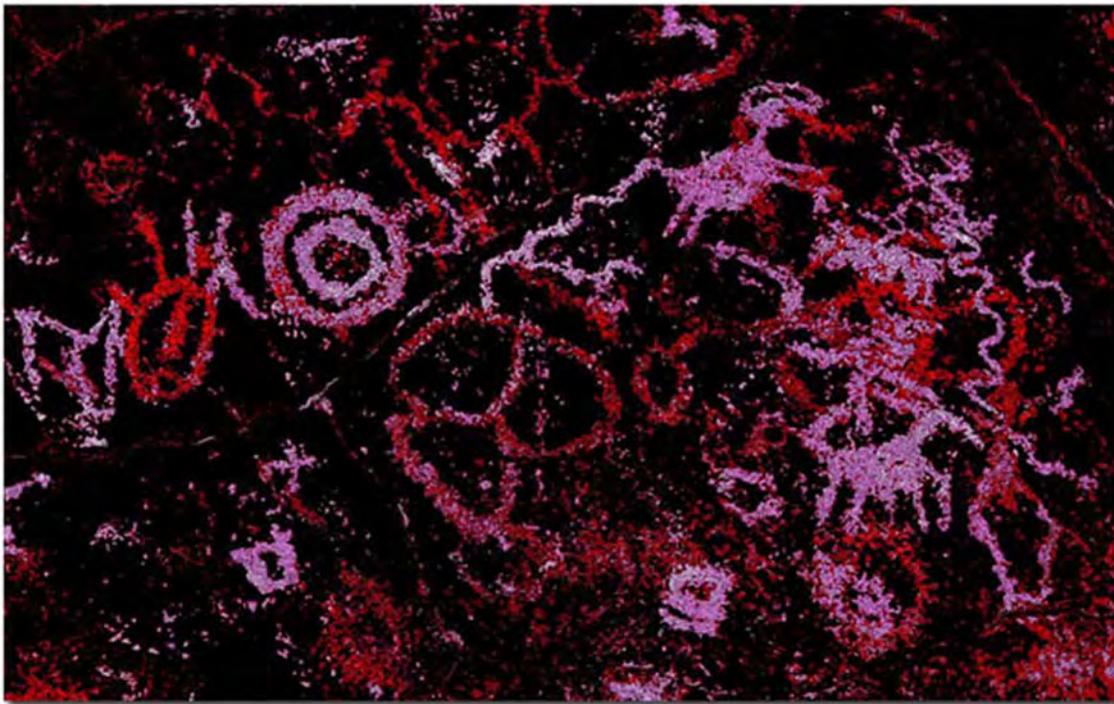
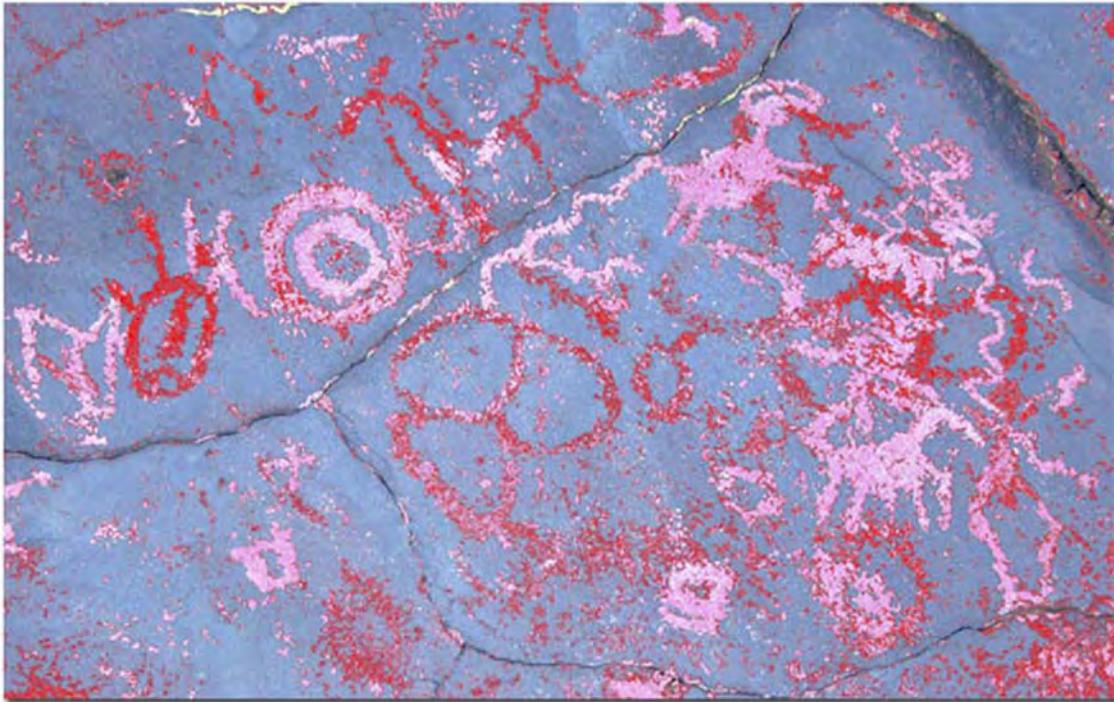


Figure 2. The enhanced image (top) has been processed through Color Range to emphasize the earlier (red) and later (pink) rock art production periods. The natural silvery-blue panel surface is converted to a flat, black background (bottom). It is apparent that the older rock art (bottom) is an abstract composition of circular elements, some with patterned interiors or branching lines (red) and the more recent production, as seen in pink, incorporates representational elements. Image reference: Site No. ML-BF-27, Feature 7.

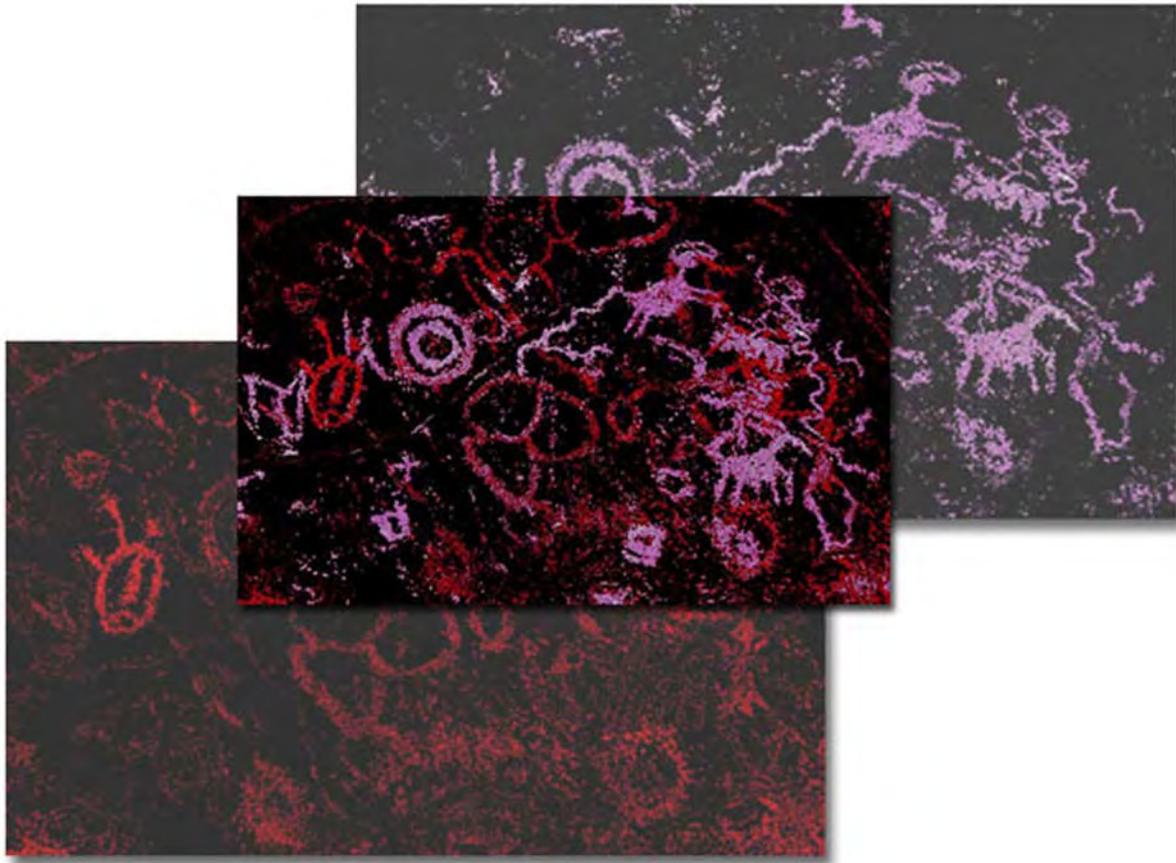


Figure 3. In this example, three visible layers were produced from one image. The main image (center) shows the panel in its entirety, the accumulation of elements from two different events. The earliest (bottom left) and latest (top right) events of rock art are separated. Image reference: Site No. ML-BF-27, Feature 7.

- To “open” layer visibility, simply click on this (empty) box, and it will reappear on the screen without affecting the other layers.
- Experiment with changing the visibility of a set of layers with the same color value and then reworking the combination of those with varying color values to find where elements overlap and are present or absent across a panel.

RESULTS

The analysis of digital enhancements reveals an interesting range of behaviors associated with panel reuse over extended periods of time. The ways in which these behaviors are expressed in the rock art is based on evidence of element superimposition, modification, rejuvenation, and integration. These findings suggest that individual panels were intentionally altered on multiple occasions for various reasons -- perhaps to improve, maintain, revise, or even cancel out images that had been created previously. Other, more subtle expressions of panel reuse appear in the methods of application utilized to produce rock art, the composition of elements across the rock surface medium, and the incorporation of natural features in a rock art panel.

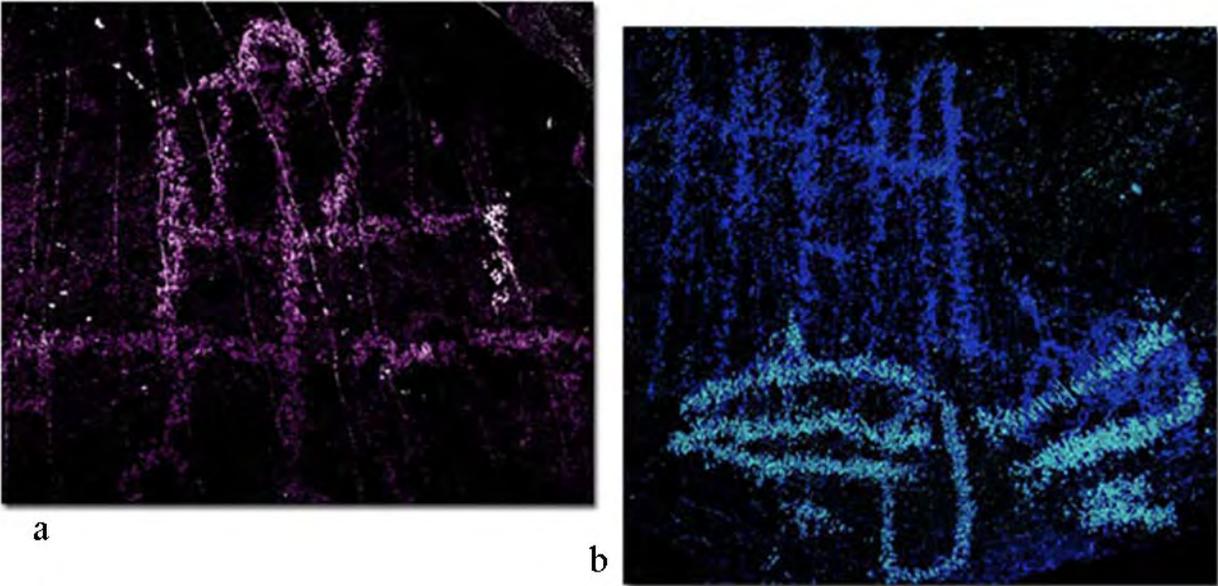


Figure 4. (a) A partially pecked line (white) and a lightly scratched cross-hatch pattern (pink) are superimposed upon a large, geometric grid-like form (purple). The overlapping pink areas across the older element may represent re-pecking or an irregularly patinated surface. Note the use of natural pits incorporated in the design (purple). Image reference: Site No. KS-BF-112, Feature 12. (b) A set of horizontal lines, in fine dash marks (light blue) are superimposed on an irregular pattern of scratched lines and a bold, linear (mostly vertical) geometric grid-like pattern (dark blue). Image reference: Site No. ML-BF-67, Feature 21.

The images presented in this section have been enhanced through the use of Color Range in Adobe Photoshop. In order to show the intricate details and complexity of reuse in rock art, portions of each image have been enlarged and cropped.

Superimposition. Patterns of element superimposition in complex and simple compositions of rock art may combine both abstract (geometric) and representational rock art styles. An exception in the methods of application is notable in both images (Figure 4). These enhanced images exhibit up to three production events; two repatinated, and two superimposing.

Modification. This form of reuse appears as subtle expressions in the way in which components or features of an older element are modified. Minor changes or additions to an existing shape or line may serve to accentuate the overall design. It is uncertain how meaning or function is compromised with modification. Enhanced images show two distinct rock art productions (Figures 5a and 5b).

Rejuvenation. In contrast to modification, specific features or a single component of an older element are re-pecked without being altered. This form of reuse places an emphasis on the reappearance of an element or a particular feature in the element. The function behind rejuvenation is not clear, but it may represent a form of maintenance, as a way to retain an important aspect in the original art. The enhanced images show two main production events (Figures 6a and 6b).

Integration. New elements may be integrated into an existing composition. In this case, not all of the additions made to the rock art panel necessarily superimpose or modify the shape of the older elements. Styles appear to replicate older forms on a shared panel. At least two episodes of productions are evident (Figures 7a and 7b).

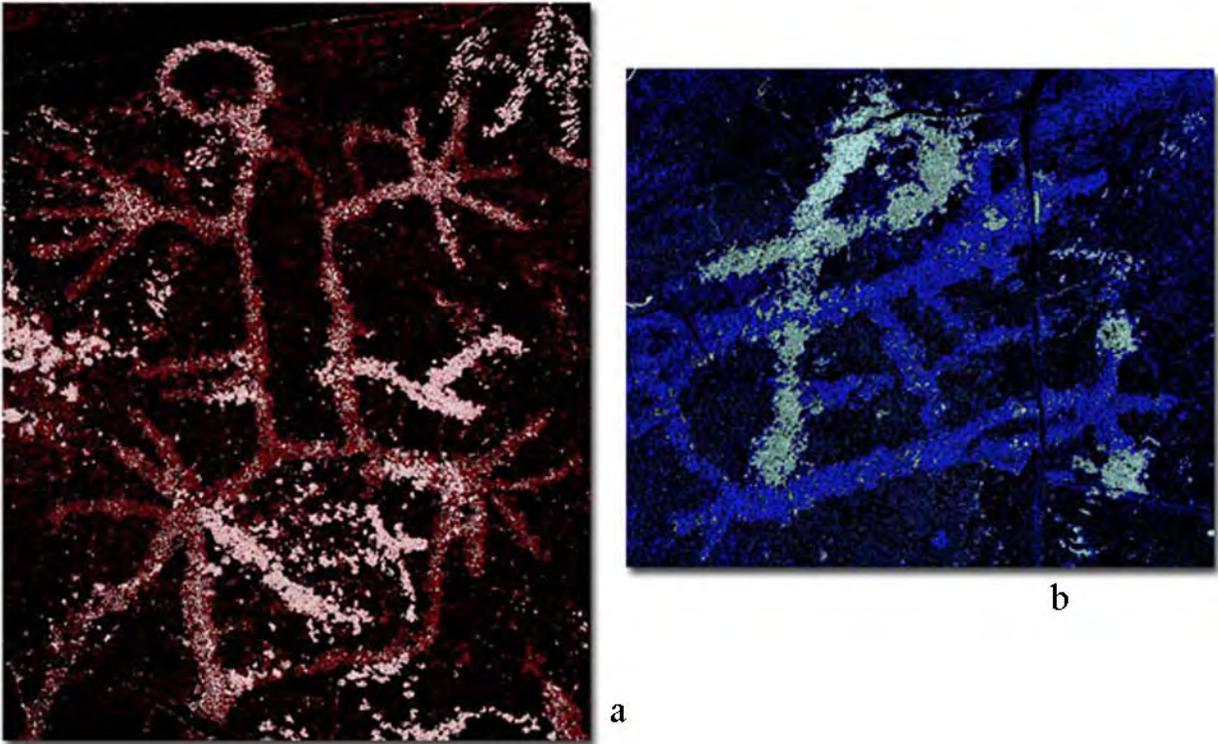


Figure 5. (a) A forked appendage (light pink) extends from the right side of the older form, an anthropomorphic, hollow-bodied figure (red), in the same style, depth, and thickness. Image reference: Site No. ML-BF-10, Feature 9. (b) In this example, two “dots” (light blue) were added to either end of the heavily patinated, branching linear form (dark blue). The “loop” (light blue) may have been incorporated as an extension to the branching linear form (dark blue). Image reference: Site No. ML-BF-70, Feature 2.

CONCLUSION

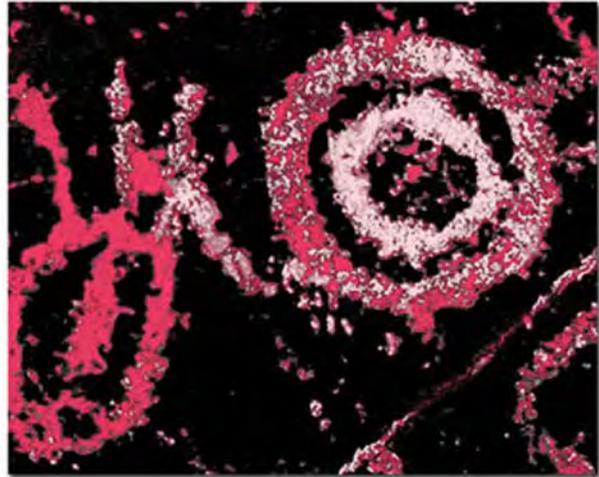
The Color Range technique in Adobe Photoshop is an important tool for the study of panel reuse in digital imagery of rock art, since it has the capability to distinguish between varying densities of desert varnish colors in a consistent and objective manner and to capture minute details in the rock art that may otherwise be overlooked or obscured to the naked eye.

The significance of this process is that it gives us the ability to identify different production events within a single panel, assess their relative ages based on the degree of patination, and define patterns of panel reuse, which may provoke key insights to the long-term continuity, transition, or replacement of stylistic traditions, rock art function, and meaning.

Digital enhancements show that the production of rock art in the Bircham Uplands was an active process. It appears that over time, individual or groups of elements were incorporated into an existing composition by means of superimposition, modification, rejuvenation, or integration during different production events (Figure 8). The intention behind reuse likely depends on the way in which it occurs on an individual panel. Preliminary examination shows that superimposed elements may have “canceled out” older ones, while modification could have functioned to accentuate, revise, or improve a specific aspect in an element. Rejuvenation places an emphasis on the reappearance of an element shape, as a form of maintenance, and the integration of elements appears to be a direct contribution to the greater design or composition.

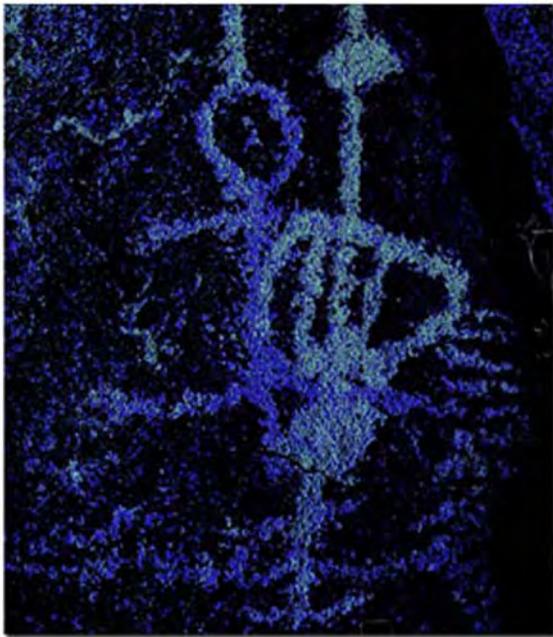


a

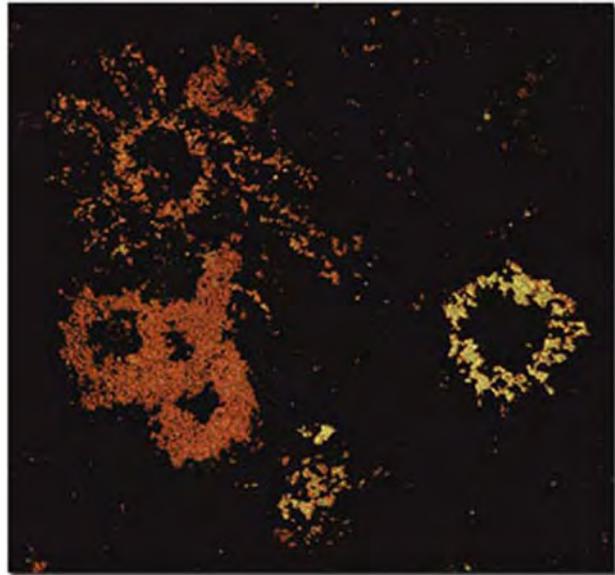


b

Figure 6. (a) Only the head and curling horns of this bighorn sheep (side view, full-bodied form) were rejuvenated (light blue). This element is an isolated feature on the vertical panel. Image reference: Site No. KS-BF-5, Feature 9. (b) The inner and outer circular forms are re-pecked (light pink), one more thoroughly than the other. Traces of the original pecked surface (dark pink) are still apparent. Image reference: Site No. ML-BF-27, Feature 7.



a



b

Figure 7. (a) An anthropomorphic figure (light blue) is integrated in the design and appears to adjoin the older figure (dark blue), but differs in shape and style with a patterned body/form. It is likely that the “head” (or top) of the older form (dark blue) was modified with the placement of a vertical line or extension (light blue), matching the latter one. Image reference: Site No. ML-BF-19, Feature 23. (b) Three abstract elements are integrated in a distinct composition. All of these share similarity in style, shape, and size as circular forms. Two main productions are observed, the former (orange) and latter (yellow). Image reference: Site No. ML-BF-69, Feature 22.



Figure 8. In this image, evidence of panel reuse in the form of element superimposition, modification, rejuvenation, and integration is apparent; however, a greater concentration was placed on the integration of elements within the existing composition. The placement of rock art in both early (purple) and later (pink) works is similar; elements rarely overlap but are more spatially set in composition. Stylistically, the entire assemblage consists of abstract and representational elements in both periods of production (purple and pink); an emphasis on zoomorphic forms in the later art is notable. In addition, a different method of application was used to produce the fine dash-dot marks (top and bottom left) in an effort to rejuvenate the large zoomorphic form. This may be an artistic touch used in rock art or an actual cultural trait. The same may be said about the use of natural features. The margin of a small, oval-shaped pit (bottom center) was pecked. Image reference: Site No. ML-BF-84, Feature 11.

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