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REVIEW ARTICLE

THE FUNCTION AND SIGNIFICANCE OF THE COLOR RED IN PETROGLYPHS: A CASE STUDY OF THE BADAIN JARAN DESERT PETROGLYPHS

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ABSTRACT

Apart from time, red is the color closest to the essence of petroglyphs. The basic color tone of the natural physical and image field of the famous cave red handprint petroglyphs, represented by the Badain Jaran Desert petroglyphs, belongs to the red series. The main color tone of its raw materials, cliffs or stones, includes six colors: yellow-brown, earthy yellow, pink-brown, coral, dark-purple, and reddish-brown. The vivid and dazzling image field, full of various natural phenomena, such as the sun, moon, rainbow, fire, and clouds, is mixed with these six colors. This objectively demonstrates that early humans passively adapted to nature and actively created a humanized material and spiritual world. The rock painting producers carefully selected the raw materials of the petroglyphs and their natural physical environments. They preferred the material carriers and contexts with special colors. They used the colors of the red series and made artificial red pigments. The widespread existence of red series petroglyphs vividly demonstrates the rich emotions and spiritual world of early humans, including healing, worship, and sacrifice.

KEYWORDS

Red, Petroglyphs, Badain Jaran Desert Petroglyphs

Apart from time, red is the color closest to the essence of petroglyphs. Petroglyphs are a "living fossil" about the magical power of color. Since their earliest discovery, researchers have often defined petroglyphs in terms of red, such as the red ochre petroglyphs in northern Mongolia. 1The world's top ten famous rock painting sites are all associated with red to varying degrees, especially early cave petroglyphs. For example, the Altamira Cave, Lascaux Cave paintings, Bhimbetka Grottoes, Lasgala Stone Cave, Chauvet Cave, and Magura Cave were discovered relatively early in the world, as well as the Tadrart Acacus petroglyphs in the Sahara Desert, and the Bhimbetka petroglyphs in India. As part of the early human world material cultural heritage, these red petroglyphs have undergone thousands or even tens of thousands of years of wind and weather. Whether natural or artificially added², the colors we can see in petroglyphs today are certainly less bright than they were originally. Due to an evident fact, it is apparent that due to the passage of time, organic substances cannot be preserved, resulting in the substantial disappearance of many red pigments. The data we currently have are only a small part of the actual situation". Even so, in the 21st century, we still instinctively name them "red" petroglyphs, especially during field investigations. However, there are few systematic and in-depth studies on this important feature displayed by petroglyphs in domestic and foreign academic circles, and attention to their raw materials and the color of their natural physical environment. This paper aims to argue

from survival theory, existentialism, and color theory perspectives. Through a detailed analysis of the color system of the petroglyphs in the Badain Jaran Desert, particularly the red color system and its generation mechanisms, this paper seeks to understand the language of rock painting colors and the information they convey. Furthermore, the paper explores and reveals the significance of color for both petroglyphs and their producers and the early human spiritual world.

1. BASIC RED COLOR TONE IN THE NATURAL PHYSICAL FIELD OF PETROGLYPHS

Color and light are fundamental characteristics of everything in the world. They are a sensory, emotional, and psychological experience for humans, recording what people see and how their brains interpret it. Humans can distinguish four basic colors with the naked eye: red, yellow, blue, and green. Other colors are derived from these four basic colors. In this paper, the "red" discussed in terms of its basic color meaning strictly refers to the "red series" of colors, i.e. the various colors derived from the basic color of "red". Red is an important criterion for selecting the location for producing or making petroglyphs. This choice involves all rock art fields, defined as a relatively independent space unit where petroglyphs survive in their natural physical environments. For convenience in discussion, we use the term "field" to refer to all the

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natural physical environments where rock art resides. Many of the world's famous rock art sites are named after the natural geological fields in which they are located. For example, the Bhimbetka petroglyphs in India are named after the Bhimbetka Mountains. The mountain range where the Bhimbetka petroglyphs are located is the ancient Vindhya Range, which forms the north-south boundary of India. The unique geological features of this area, consisting of small mountains made of black and red sandstone, with numerous caves and crevices, have attracted the production of petroglyphs by the ancient inhabitants of the region from prehistoric times until the medieval period in India. The red handprints in the Inner Mongolia Badain Jaran Desert cave petroglyphs natural physical field, still clearly visible today, and the red pigments remaining in many similar caves, vividly illustrate this point. The large number of red and colored pottery unearthed from many neolithic sites discovered in this region also proves that the people who once lived here had a long and rich culture.

Red is the basic color tone of the natural physical field of petroglyphs in the Badain Jaran Desert. With it as the background color mixed with other colors, the extraordinary nature has modulated a rich and colorful series of red tones for the petroglyphs, endowing the already mysterious and incomprehensible Badain Jaran Desert petroglyphs with an outstanding and foreground aesthetic quality of the color beauty. The basic color tone of the natural terrain in the Badain Jaran Desert petroglyphs is a very light earthy yellow color formed by a combination of red and ochre. This is also the basic color tone of many natural environments in the Badain Jaran Desert petroglyphs. Under the shining sun, the colors of the Badain Jaran Desert are ever-changing, with many shades of orange-red, orange (a mixture of orange-red and yellow), and yellow (a mixture of ochre and red). The changing shades of orange-red and orange colors, in particular, make the vast Badain Jaran Desert even more awe-inspiring. Local people often use the term "golden" to describe it. The petroglyphs and natural environment distributed in and around it are the same. There are three basic colors: earthy yellow, ochre, and reddish-brown. All three colors contain different shades of red. Earthy yellow can be formed by a combination of red and ochre, or cinnabar and gamboge, or vermilion and gamboge, or dawn red and gamboge. Ochre is a color between red and yellow. Reddish-brown goes without saying. It can be regarded as the main color of the

natural geographic environment of the Badain Jaran Desert petroglyphs because most of the natural environment colors in the Badain Jaran Desert petroglyphs are like this. The Badain Jaran Desert petroglyphs are concentrated in the Yabulai Mountains southeast of the Badain Jaran Desert. This mountain range is an arc-shaped uplifted between the Badain Jaran Desert and the Tengger Desert. The entire mountain body is composed of reddish-brown wind-eroded rocks formed by crustal changes, which people call the reddish-brown mountain range. Under the sunshine, the entire mountain range often presents dazzling shades of reddish-brown and cinnabar.

By contrast, the specific natural geographical contexts in which each Badain Jaran Desert rock art survives, namely the specific cliffs or slopes on which they are situated, the individual stones that support them, and the colors of the faces of the stones on which the rock art is carved, are even more diverse. Under normal weather conditions, these colors mainly exhibit six hues: yellow-brown, ochre, pinkish-brown, coral, bluish-green, and reddish-brown. The first two mainly refer to the color contexts of rock art on cliffs, such as the Hulatugou and Xiadaysishan rock art located 6.8 km northeast of Jigede Natural Village in Alxa Right Banner, which are situated on yellow-brown cliffs near a riverbed. Rock art with ochre colors is found in Egutamu, Menggennuokuo, and Longshoushan. As for other rock art in the Badain Jaran Desert that is located on stones or rocks, there are few with yellow-brown or ochre colors. They are mostly scattered within certain rock art contexts, or found in rock art environments in hilly areas at the foot of mountains. The stones or rocks that support this kind of rock art are typically composed of high-sand content sandstone. For instance, there are many yellow-brown or similar ochre-colored rock art at the foot of Mandala Mountain, or a mixture of the two. In general, within the context of rock art sites located at the foot of mountains or on the mid-slopes, occasional occurrences of earthy yellow or yellow-brown rock art material can be observed, such as in the case of the Suhaisai rock art.

The petroglyphs in the Badain Jaran Desert exhibit shades of pale brown and light coral red, with occasional slight variations towards either brown or red. For instance, the handprint rock painting in the Bubu Cave is situated on a mountain peak with a seasonal river gorge to the east, connected to the Yabulai Mountains to the south, a north-south running river gorge to the west, and a desert sand dune zone to the north. The region experiences arid conditions with low rainfall and frequent



Figure 1: Petroglyphs in the Xiamala area

sandstorms, leading to severe land desertification. Nevertheless, the natural environment fosters the unique pale coral-red color of the petroglyphs. The basic colors of the petroglyphs in the Eleshentou Cave, Suhai Sai, Mandela Mountain, and Arijilengtai are similar. The Mandela Mountain paintings are predominantly found on stones with a high sand content at the foot of the mountain. These stones are generally pale pink-brown or earthy yellow. The petroglyphs of Xialamu, Xiarima, and Shibotu are typical examples of the pale coral-red color of the Badain Jaran Desert petroglyphs. This color is often revealed after the black basalt surface that supports the petroglyphs peels off. For instance, the Xialamu and Xiarima petroglyphs are on black stones at the top of Xialamu Mountain, at an altitude of 1,377 meters. However, the black

color on the surface of these stones is relatively light, akin to black paint. Once it weathers and peels off, the coral-red color appears in varying shades. The coral-red color is more pronounced when the black color has faded significantly. Some petroglyphs inhabit natural physical fields that present a dazzling red landscape, where the base material that supports the paintings has essentially transformed into a coral-red tone. The surrounding similarly sized stones are also the same. In particular, the original dark-purple color of the Xiarima petroglyphs has essentially transformed into a glorious, bright coral-red color, which is highly dazzling (as shown in Figure 1). Some Shibotu petroglyphs are bright coral-red, while others exhibit a light coral-red color.



Figure 2: Petroglyphs on Mountains in Mandara



Figure 3: Petroglyphs on Longshou Mountain

“Ganqing” (dark-purple) is also known as “Hongqing” or “Ganzi” in Chinese. It is a color that appears black but with a subtle hint of red. According to a color chart, it is considered to be intermediate between glaze cyan and Prussian blue. This color is the main hue of the natural physical field of petroglyphs throughout the entire Badain Jaran Desert, including those in Mandela Mountain. Whether viewed from a distance, from the center, or up close, the majority of rocks and stone walls adorned with these petroglyphs showcase the “Ganqing” color. This is also the case with the petroglyphs in Xialamu, Xiarima, and Xibotu, three famous rock painting sites located within Dunhuang, Jiuquan City, Gansu Province, China. This kind of “Ganqing” color is unique. It looks as if a layer of black paint was thinly or thickly coated on the surface of the original reddish-brown stone or stone wall, but this black layer fails to completely conceal the red beneath it in many cases. Most petroglyphs that are found in natural physical fields such as Yikerbuj, Qingazi, Huisentulei, Yamat, Daobotu, Huashitou Mountain, Kundaitu Northwest, Kundaitu, Kundaitu South, Xiaosumutu Mane Stone, and Hulesita Southeast predominantly exhibit the “Ganqing” color. However, the color degree varies in different locations. For example, the overall color of petroglyphs in Xibotu and Arigelongtai is darker than those in Kundaitu and Kundaitu Northwest. Also, the colors of petroglyphs in Shuangjingzi, Daobotu, and Huashitou Mountain are lighter than those in Kundaitu and Kundaitu Northwest.

However, as a result of the stone’s inherent characteristics and natural weathering, many Ganqing-colored petroglyphs have undergone a transformation in color, ranging in various shades of reddish-brown. They are scattered throughout the natural physical field and most of them are relatively light reddish brown. Generally speaking, petroglyphs with this reddish-brown color are found concentrated on the pinnacle of higher peaks. Figure 2 shows the petroglyphs located on the pinnacle of a hill on the western side of Mandela Mountain. Some of the originally Ganqing-colored stones have now taken on a light or dark reddish-brown shade, adorned with engraved paintings. Moreover, the rock faces adorned with painted carvings often exhibit the most distinct reddish-brown hue.

In summary, no matter the large natural terrain and environment, or the small context such as stone, rock wall, and image language, the petroglyphs found in the Badain Jaran Desert predominantly display colors from the red series, encompassing shades of yellow-brown,

earthy yellow, coral, pinkish brown, blue, and reddish brown. One thing to note is that the color mentioned in the above description and analysis is mainly in terms of its overall relative. In fact, the colors observed in the natural physical field of petroglyphs that survive in Badain Jaran Desert’s natural context are highly complex and not limited to a single hue. There are primarily two situations: (1) The colors of petroglyphs vary across natural physical fields. In the case of the petroglyphs located in the Yabulai Mountains, there are differences in color even among petroglyphs within the same physical field, let alone among the different physical fields. In addition to the Ganqing color and its metamorphic mahogany brown or reddish brown, there are also some brown or burnt yellow stones or stone walls with carved petroglyphs in the natural physical field of Mandela Mountain and Menggetu due to natural weathering³. (2) The colors of petroglyphs in the same natural physical field are also not consistent. For example, the handprint petroglyphs in Bubu Cave are actually distributed on the stone walls composed of huge multi-colored stones. The upper part of the boulder is mainly a mixture of yellow-brown, earthy yellow, black, and reddish brown, and the lower part is mainly light pinkish brown. As shown in Figure 3, the “white” of the Longshou Mountain Rock Painting, which is basically earthy yellow or brownish yellow, is mixed with pinkish brown “ribbons”. In the Badain Jaran Desert, the petroglyphs often exhibit two or more colors simultaneously within a specific natural physical field. This phenomenon arises due to the ever-changing nature of the environment, influenced by various factors such as seasons, day and night, wind, rain, thunder, and light. For instance, under the midday sunshine, a rock painting field may appear predominantly pink and brown, while it could take on a brownish hue during rainy days. However, these variations do not hinder our classification of the colors of petroglyphs. Instead, the presence of the above two inconsistencies adds to the interplay of multiple colors within the natural physical field of the petroglyphs, showcasing their multi-layered contrasting color beauty in the Badain Jaran Desert. These color interactions enhance the overall radiance and aesthetics of the surroundings: the golden-yellow Badain Jaran Desert against the maroon Yabulai Mountains, the maroon Yabulai Mountains juxtaposed with the earthy yellow Elsenhutle, the earthy yellow Mandela Mountain adorned with the Ganqing-colored ridges, and the Ganqing-colored stone walls adorned with reddish-brown petroglyphs. Such combinations illustrate the richness and variety of colors present in the petroglyphs of the Badain Jaran Desert. The full spectrum of colors is most vividly manifested within their image



Figure 4: Petroglyphs in Taolan Gaul cave

space fields. To fully illustrate the dazzling beauty of the petroglyphs in the Badain Jaran Desert, a specific image field is taken as a case study to provide a comprehensive description and analysis.

2. MOTTLED AND DAZZLING IMAGE FIELD

Just like a picture frame, the term “image space field” or “image field” mentioned here refers to the space where the image language is distributed on the surface of a relatively independent and complete stone or stone wall. The color composition of the image field consists of two main parts: one is the image language itself, which can be represented by engravings or printings; the other is the color of other spatial fields in the image field beside the image language. To facilitate discussion, we will continue to use terminology inspired by traditional Chinese painting, referring to these colors as “black” and “white” respectively. Generally, the color of the rock painting itself corresponds to the color of the engravings or printed dyes, which can be considered “black” in this context. The “white” color within an image field can either match or differ from the “black” color. Furthermore, the color of the “white” is intricate and variable, while the color of the “black” is relatively simple. In the image field of Badain Jaran Desert’s petroglyphs, there are relatively few “white” and “black” with a single color like this. On the contrary, in most cases, the image field colors of Badain Jaran Desert’s petroglyphs are relatively complex, with mottled and dazzling colors as their general characteristics. This point will be illustrated with an analysis of artificial colors, primary hues, and stone colors as follows.

2.1 Red Handprint Petroglyphs

In the petroglyphs of the Badain Jaran Desert, there exists a distinctive form of graphic language known as handprints. Similar to producing a seal, the producer applies a liquid pigment into a tubular object, presses their palm against the surface of the stone wall, and blows the pigment onto both their hand and the wall. After removing their hand, a handprint is left on the rock wall, either by the producer or other individuals. This image type of petroglyphs can be divided into two components: the interior and exterior of the handprint. During the production process, the palm of the hand used for making the handprint must face downwards and firmly press against the rock wall. Hence, the “inside” of the handprint petroglyphs actually refers to the palm or the palm’s center, primarily including the grain on the palm and occasionally accompanied by portions of the arm. Conversely, the “outside” of the handprint petroglyphs refers to the overall outline of the hand, which is colored by pigments, along with its surrounding context. Therefore, the handprint petroglyphs in the Badain Jaran Desert’s Rock Painting Cave essentially refer to images of human palms or palm centers that are printed and dyed with specific pigments. As a result, the internal color of

the handprint petroglyphs typically corresponds to the natural color of the stone wall itself (as the hand presses against it during production), while the external color represents the pigments artificially added. For instance, in Figure 4, the inner stone wall of the handprint petroglyphs appears as a darker earthy yellow color, contrasting with the reddish-brown paint sprayed by the creator on the outside, resulting in a vibrant red handprint image. However, the “white” color within the image field exhibits various layers of complexity. If the handprint is considered the focal point, there are at least four colors within the image field depicted in Figure 4, progressing from distant to near-white cyan, deep and light earthy yellow, orange, and reddish-brown. The rock walls surrounding the handprint images exhibit shades of deep or light orange, which may have been unintentionally smudged by the rock painting makers during the application of red pigments for the handprints or caused by natural weathering over time.

At the eastern and western ends of the reddish-brown Yabulai Mountains on the southern edge of the Badain Jaran Desert, there are currently five relatively large sites featuring cave handprint petroglyphs, with nearly a hundred distinct handprints. Regarding the “black” color of the existing handprint images, there are primarily four types: reddish-brown, pink-brown, orange-red, and black-red. Additionally, there are at least three variations of “white” present. Among these, reddish-brown handprints are the most common. The “white” in the handprint petroglyphs in Eresenhutle Cave typically exhibit a mixture of shades of darker earthy yellow, orange, and pink-brown, and there is a wide strip of the light earthy yellow area at the lower right of it. The “black”, also 12 clear handprint images found there, display a reddish-brown hue. Pink-brown, orange-red, and black-red handprints are relatively rare, mainly distributed in the caves of Bubu, Elsenhutler, and Tauranga. Scientific experiments have demonstrated that certain red pigments, especially reddish-brown ones, can undergo a chemical reaction and turn black (i.e., $\text{Fe}_2\text{O}_3 + 3\text{CO} = 2\text{Fe} + 3\text{CO}_2$). Field investigations and observations of handprint rock painting sites in the Badain Jaran Desert also indicate that some black and red, or even black handprints, are actually the result of the transformation of the original red series due to natural weathering. Therefore, their fundamental colors are red, regardless of whether they appear reddish-brown, pink-brown, orange-red, or black-red. The reason for presenting four or more different colors is due to natural weathering. Currently, there is a consensus in the research field of archaeology and petroglyphs that, similar to handprint petroglyphs found in Spain and France, the handprint petroglyphs found in the caves of the Badain Jaran Desert are the products of the Paleolithic Age. If this assertion is accurate, the initial color used by rock art producers during that time should have been a vibrant red, which is highly resistant to natural fading. Moreover, the substance capable of concocting this red pigment would also be extraordinary.

Table 1

Red image field	Yellowish brown image field	Ultramarine blue image field
red brown+ganqing+earthy yellow	yellowish brown+mahogany+ganqing+earthy yellow	ganqing+mahogany+earthy yellow
jacinth+mahogany+yellowish brown+earthy yellow	yellowish brown+mahogany+ganqing+earthy yellow	ganqing+pinkish brown+mahogany+earthy yellow
mahogany+yellowish brown+ganqing+earthy yellow	yellowish brown+purplish red+ganqing+earthy yellow	ganqing+mahogany+pinkish brown+earthy yellow
purplish red+ganqing+blue+white+mahogany	yellowish brown+reddish brown+ganqing+earthy yellow	ganqing+mahogany+earthy yellow+yellowish brown
Pinkish brown+mahogany+yellowish brown+ganqing+earthy yellow	yellowish brown+mahogany+ganqing+earthy yellow	ganqing+yellowish brown+mahogany+earthy yellow
pinkish brown+yellowish brown+pewter gray+earthy yellow	yellowish brown+pinkish brown+ganqing+earthy yellow	
pinkish brown+mahogany+pewter gray+earthy yellow		

2.2 Three Color Systems: Red, Yellow and Ganqing

The image field with complex colors is not random, but regular. In addition to the artificial addition of color, the complex color fields in the petrographic pictures of the Badain Jaran Desert can be roughly divided into three basic systems of red, yellowish brown and ganqing colors if we order them by the proportion of each color in the picture field. And, according to the same criteria, we can make the following distinctions again for each color system.

The color division of the above three color systems image fields further reveals the following four characteristics of complex color image fields of petroglyphs in the Badain Jaran Desert.

(1) Single “black”. In each color order, the last color listed is “black”. Everything else is “white”. Obviously, “black” is relatively simple. In addition to the mahogany or yellowish brown in the image field of red and ganqing, earthy yellow is its most basic color. The “white” ones are more complex, with as many as four colors and as few as two. The rock painting image field with complex colors is actually a combination of multi-color “white” and single-color “black”. The mutual reflection of the two adds to the complexity of the image field color.

(2) The basic hue is “white”. The order of colors is based on the proportion of each color in the “white” in the image field: the higher the color is arranged, the larger the proportion in the image field is, and vice versa. For example, those blue or white, 紺青, and blue-gray “white” that are arranged behind in the red image field, which are usually small in area, and some are only mixed in the color of a larger area in a linear form. The same is true for the yellowish brown, ganqing, etc. that are ranked behind. Therefore, the basic or dominant color of the image field is often referred to as “white”.

(3) The image field of the red series occupies a dominant position. Because the “white” with a relatively large area is basically a variety of reds, and there are many distributions, the image field of the red series is brighter and clearer. The fourth category, that is, the image field mainly composed of three colors of mahogany + ganqing + earthy yellow is one of the more common complex color image fields in the petroglyphs of the Badain Jaran Desert. The mahogany and ganqing colors here respectively refer to the overall color of the stone wall or a certain surface of the stone carved with petroglyphs. The mixed colors of the two constitute

the relatively large “white” in the image field. The earthy yellow refers to its “black” color. The red series of colors is also the dominant color in the other two image fields. In addition to the first type in the ganqing image field, that is, ganqing + yellowish brown + mahogany + earthy yellow, in the yellowish brown and ganqing image fields, mahogany, reddish brown and other red series colors occupy the second most important position. Therefore, the red color series is also the main color of the Badain Jaran Desert petroglyph image field as a whole.



Figure 6: Petroglyphs on Hipu Mountain



Figure 5: Petroglyphs on Mountains in Mandara



Figure 7: Petroglyphs on Su Saihai Mountain

2.3 Rich Stone Color

The “stone color” mentioned here refers to other colors mixed in the natural basic color of stone or stone wall. Judging from the current decomposed color, the original surface color of most rock art image fields in the Badain Jaran Desert is ganqing. In this kind of ganqing-colored stones, two types are quite special: one is those with brighter colors on the surface, such as mahogany, yellowish brown, earthy yellow, etc. These colors are usually distributed on the stone surface in various irregular shapes, forming irregular layers, bands, spots, lines and other irregular forms or figures mixed in the ganqing rocks. Among them, the most representative ones are those that resemble the natural rainbows (the linear red and orange figures at the top of the ganqing image field shown in Figure 5 and Figure 7 respectively), clouds (as shown in Figure 2, the top of the right stone wall is slightly square reddish-brown), fire (as shown in the lower image of Figure 7), waterfalls, and the Milky Way (the pinkish brown “ribbon” shown in Figure 3) and other natural objects. The other is those ganqing rocks mixed with a small amount of pinkish brown or earthy yellow sandy slate. The combination of some pinkish-brown or earthy yellow sandy slates and ganqing rocks forms some very peculiar natural graphics, the more common being dots or lines and circle-like forms. Like those natural cracks or dots, they are

inlaid in ganqing rocks, and the most unique ones are those that resemble natural sun and moon figures or images. Their shapes can be large or small, and the big ones are like the sun at noon or a full moon, as small as a soybean. There are also slightly larger semicircular shapes, but our visual perception will naturally restore them to a complete round image when we see them. These circle-shaped images are generally in a relatively light color relative to ganqing, such as light pinkish brown or earthy yellow or a mixed color of pinkish brown, ganqing and earthy yellow. Unlike a layer of natural color on the surface of the stone skin or the natural ganqing of the entire stone or block, these circle-shaped images like the sun or the full moon are not carved on the surface of the stone by people, nor are the circle-shaped shapes composed of a piece of light color on the surface of the stone, but are part of the natural structure of the entire stone. As shown in Figure 6, it is a rare natural image of double sun or moon. Although there are differences, the basic hue of the two types of stone colors is red. The more common ones are reddish-brown, purplish red, dark red, pink, bright red, rose red, yellowish red and jacinth, and relatively rare light dark red, pinkish white, earthy red and positive red. Apparently, their appearance not only makes the rock painting image language more colorful, but also has the charm of natural carvings.

In short, the existence of the three major color systems of red, yellow,

and ganging dominated by red, shows the basic tones of the red series in the image field of the Badain Jaran Desert petroglyphs. Compared with the natural physical field, it appears more weird and fantastic: it includes both the natural color of the material carrier stone that bears the petroglyphs, and the artificially added red. Moreover, just like the “eyes”, “colors” and “points” that Chinese traditional inkstone craftsmen say. In the petroglyph image field, there are natural images of the sun and the moon, rainbows, clouds, and waterfalls with red as the main tone. They are mixed with “white” of other colors at multiple levels, and complement the “black” with the main tone of the red series.

3. MAKER'S PAINT APPLICATION

The existence of the natural physical field and colorful image field based on red shows us an objective fact from different angles: the raw materials used by rock art producers and the site for painting are the results of their careful selection. Those material carriers and contexts

with special colors are their first choice. In particular, they used both coloring and artificial pigments. Like inkstone carving techniques, natural colorful stones or stone blocks, and stone walls are the favorites of Badain Jaran Desert rock art producers, who often make petroglyphs again based on color. Even if there is no “color” in the natural material or context, they will create color. Therefore, from the perspective of petroglyph producers, we can gain a further in-depth understanding of this phenomenon.

3.1 Utilization and Excavation of Red

3.1.1 Discovery and Use of Natural Red Pigment

The result of our comprehensive and detailed in-depth interpretation of the colors of the petroglyphs in the entire Badain Jaran Desert is that red has been pushed to the most prominent foreground position: whether it is its terrain, environment, context, or the material and image field that



Figure 8: Cultural relics unearthed from the Mandara Mountain site

bears it, whether it is a single color or a mixture of two or more colors, red is not only the most basic inartificial or natural color of petroglyphs, but also the basic color that rock art producers are striving for. Because when people choose the rock painting habitat and its material carrier in nature, the range of colors they can choose is almost infinite. In the vast Alxa region bordering Mongolia in northern China, there are many high mountains, river valleys, and the boundless Gobi Desert. Petroglyph producers focus on those substances containing red, and choose the natural physics of red petroglyphs, especially those materials or image fields with unique red series "color" for petroglyphs. They could be entire desert mountains, a rock wall or a single stone, or even a finite facet on a rock. Even the ones that don't have red, they add them themselves. What we are referring here is not only the red pigment added to the petroglyph image field by rock art producers from the outside (that is, the handprints made by artificially adding pigment), but other colors that do not appear to be red on the surface (such as ganqing) stone. By carving its surface, the stone or stone wall is artificially made to reveal the red color hidden under its surface (that is, the color of artificial inscriptions). In other words, petroglyph producers exploited or excavated the mahogany color beneath the stone skin. Bringing out the maroon beneath the surface of the stone is an important reason why they carved petroglyphs on the ganqing stone.

3.1.2 Addition of Artificial Red Pigment

The addition of red artificial pigments is the most powerful evidence that the makers of petroglyphs in the Badain Jaran Desert in the Paleolithic age consciously pursued red. As for what people used to make or concoct this kind of pigment, it is uncertain. Based on the fact that red is the basic color of other petroglyphs in the Badain Jaran Desert, as well as the sites discovered by archaeologists in the entire Badain Jaran Desert so far, we can speculate that rock art producers are most likely to use natural pigments, mainly red stones, to make handprint petroglyphs. Because of the natural physical environment of the petroglyphs, a large number of red stones, stone flakes, etc., as well as painted pottery with red patterns in the Neolithic Age were unearthed from many ruins (as shown in Figure 8). Archaeological discoveries in the world also prove that the "oldest color" of human beings is red. It is one of the most basic hues that human beings generally admired and pursued in the early days. We know a great deal of red natural pigments from archaeological sites from ancient times. In the early Paleolithic Peking Man discovered in Zhoukoudian, Beijing at the beginning of the 20th century, among the many stone tools with rich styles made of quartz stone, many colors belong to the red series. In fact, much hematite or ochre appears to have been brought to these sites in South Africa as early as 800,000-900,000 years ago. In Tanzania and Namibia, "dyes have been found in archaeological strata dating back at least 50,000 years ago, showing signs of use in cave interior petroglyphs".

3.2 The Law of Dharma Originates from The Natural World

How did the producers of petroglyphs in the ancient Badain Jaran Desert discover the red color? We are now unable to verify it. A large number of archaeological and ethnic folklore data prove that early humans, living in nature, almost completely dependent on nature and integrated with nature, are enabled with a strong ability to perceive and recognize everything in nature. Therefore, if you consider the story that "when the ancient Bao Xi rules the world, he looks up at the sky and observe the celestial phenomena; he overlooks the earth and observe the law of nature; he observes the behavior of birds and animals and the adaptability of the geographical environment. Take inspiration from things around you, take inspiration from things far away. In this way, eight diagrams can be created to convey the will of the gods and express the emotions of all creatures." (from Zhouyi, Section Xi Ci II) In the traditional Chinese culture, the phenomenon that "The shape of the clouds is similar to the environment in which they are created is called induction. Yang draws fire from the sun's rays, and Fang Zhu draws dew from the moonlight". The law of Dharma is like the survival rules in nature. It is sufficient for us to believe a fact that the discovery and application of the red series, as well as the further production of artificial red pigments, are the result of ancient humans observing nature, understanding nature, and imitating nature. The imitation mainly includes those actions of early human imitating three natural substances, blood, fire, and colorful stone, as well as the natural phenomena of the sun and rainbow.

3.2.1 Sun, Fire and Blood

Humanity's first awareness of color and understanding of red probably originated from the sun, fire and blood. The sun is the source of light. Sunlight, which travels at the speed of light, is filled with electromagnetic energy and feeds all living creatures on Earth. Contemporary scientists have found that red light has the best effect on promoting the growth of plants. The discovery and use of fire also prompted humans to know the red and black color at an early stage. Scientists in various fields have proved that the possible time of human beings is related to the geological era.

There were no fewer natural phenomena and natural disasters in ancient times than they are now. In many ancient myths and legends in the world, thunder and lightning were regarded as an important god by early humans. It frightens but at the same time benefits humankind. "It was lightning that first brought fire to the earth and to mankind, and, from there, the heat spread everywhere"⁴. The discovery of fire is of great significance to the reproduction of human beings. And the theory that blood creates man has a long history. People and animals will bleed, and humans must have known the simple truth of dying with blood. Therefore, sunshine, blood and fire are symbols of life for early humans. Xu Shen in his book "Shuo Wen Jie Zi" interprets the word "black" as "the color smoked by fire". It can be seen that in the context of ancient China, the colors of red or black blood, red flames, and the objects dyed by them are unified. Black is the product of fire which represents red. Therefore, black is closely related to red, "the two colors are the source of life, and the effect is multiplied when the two are combined". They both represent blood or fire, symbolizing life force.

After recognizing the importance of sun, fire and blood to survival, people began to worship and imitate natural objects related to them and tried to use red or black objects in nature to express some spiritual needs. When making petroglyphs, the painters in Badain Jaran Desert not only choose physical fields with a red tone, but prefer those stone colors that resemble images of the sun or fire (shown below in Figure 7), and those stone surfaces with various "colors" or fractures (as shown in Figure 2 and Figure 7), most of which seem to have been burned (such as the marks or cracks caused by natural fire such as lightning). They also use hands to facsimile the "torch" shape images with red hand prints in the cave (as shown in Figure 4 on the far right)⁵, and it's just like people sprinkle on it inadvertently. In addition to the patterns of red bars or blocks which are very similar to modern and contemporary abstract art, many red images of different sizes and shapes without fixed positions are added sporadically on the painted pottery as shown in Figure 8, which resemble "blood spots".

3. 2. 2 Rainbow and Colored Stone

The existence of the red petroglyphs in Badain Jaran Desert and the red pottery and stone pieces found on the site shows us how the petroglyphs producers understand the red color represented by fire and blood and how they use and imitate it. Furthermore, the spot they chose to make the red petroglyphs in the Batangjarian Desert, especially the site of these variegated and colorful images, shows how they understand natural phenomena and use natural substances represented by rainbows and colored stones. "Color occurs when the extreme forces of the universe, darkness and light meet, interact, and fuse together. In nature, we see the birth of a rainbow in the sky." The "rainbow" (among which the "waterfall" color is also a special "rainbow" because the real rainbows in nature often appear in waterfalls), a frequently used color in the colorful images of Badain Jaran Desert petroglyphs, is the strongest evidence that rock painting producers have discovered and made full use of natural rainbows. The rainbow falling from the sky has always been regarded as a bridge between heaven and earth, the communication between the material world and human's spiritual world. The seven colors reflected by rainbow are also regarded as sacred by scientists. The famous Newton's color wheel theory is based on the summary of rainbow. Rainbow is considered sacred in many myths and religions around the world. Similarly, colored stone is an important natural material that ancient people loved. There is a saying in the myth of Nvwa (a famous goddess in Chinese mythology) and her story mending the sky, that "Nuwa refines the five-color stone to mend the sky and breaks the tortoise feet to erect the four poles". The producers of Badain Jaran

Desert petroglyphs selecting the colorful rocks with a red base to paint on just manifest in specific their preference to this kind of stone.

From the above, the producers of Badain Jaran Desert petroglyphs have a thorough understanding of the mystery of red and know the stone. For them, the law of Dharma lies in the natural objects represented by blood, fire, rainbow and colored stone, and one of their key purposes is to explore and to use the red color series in nature to make petroglyphs. Those substances and phenomena in red or red-related colors in nature inspired them how to select the natural physical site to make petroglyphs and to express their spiritual world. Just as the American scholar Van Loon says, "Nature contacts human beings through everything on earth, and human beings express themselves by responding to everything. This kind of reflection, also expression, is the so-called art."

4. THE COLOR OF THE SPIRITUAL WORLD

French colorist Pastoreau once pointed out that "A color never exists independently; It has social, artistic, and symbolic value and significance only when it's interrelated with other colors and reflects each other. Therefore, never look at a color in isolation". The producers of Badain Jaran Desert ancient petroglyphs chose red series of colors from the many colors of nature and their original purpose must be far beyond simple aesthetic appreciation, but a metaphorical expression of the needs of their own spiritual world including emotions. To summarize, the producers of Badain Jaran Desert petroglyphs make full use of red energy for the following three purposes.

4. 1. To Heal

Relevant studies in color psychology, psychoanalysis and other disciplines since modern times have proved that color has energy. It can not only make people feel hot or cold, excited or calm, happy or unhappy, but also inspire or depress people's spirits. Especially since the 21st century, "different forms of color testing have been used to find new theories and methods for diagnosing mental illness. Colors are often used in the psychiatric practice to reveal complex personal psychological and emotional characteristics, and at the same time it provides the possibility of deeper exploration of the secrets of human spirits." The red color series, with its "happy", "excited", "excited" and "inspiring" energy that stimulates people's positive emotions, have long been the choice for color psychologists and psychoanalysts for treatment. Red is the first color in the spectrum, a synonym for physical pleasure and material attachment, also a representative of power, warmth, stimulation, excitement and will. It has the characteristics of subjective will and positive action, as well as entrepreneurship and pioneering, symbolizing new life and new beginnings. The red color with warm shades has the most energy compared to other colors. It "is a hot color, which has a good effect on blood and on the awakening of courage, to a certain extent." The producers of Badain Jaran Desert petroglyphs preferred the red color system and fully utilized the red color, which proves that red energy is not first used by contemporary people. Prehistoric humans have understood and developed it as a way to heal themselves by gaining life energy or overcoming pessimistic emotions such as fear and negativity.

French modern painter Henri Matisse once stated that "The chief function of color should be to serve expression". The most intense color in the color spectrum is red, which represents solidity, tension, and rigor. Judging from the complementary color wheel and the shapes of colors that people often use in the interpretation of color reactions, among the three colors people choose, the first one represents their essence and is the expression of their true self. It not only highlights their truest sides and reflects their basic personalities, but also shows how they deal with situations in their daily lives. Warm colors with longer wavelengths, including red, yellow and orange, symbolize the sun and fire, as well as vitality, strength and health, and can make people feel warm psychologically. In particular, "red matches the positive side of power, and is closely related to the unlimited self-worth, self-confidence and self-actualization ability". Therefore, the producers of Badain Jaran Desert petroglyph prefer red and rank it first, which also reflects their energetic, passionate, positive, outgoing, and adventurous personalities.

4. 2. Worship and Reverence

However, the energy of color is not only manifested in people's thinking, perception or behaviors, but also affects people's emotions from the external environment. All changes, whether physical or psychological, are related to changes in the electromagnetic fields around us. Everyone creates their own magnetic space, which truly presents the individual's state of health, temper, personality, etc. The red petroglyphs in the Badain Jaran Desert represent the spiritual construction of the petroglyph producers and the dominant color at that time. This color radiates like light and spreads into infinite space, further affecting other things. That is to say, the red color that mainly exists in the petroglyph field in nature, especially the artificially added one, directly affects its natural physical field, and vice versa. Therefore, the red series of petroglyphs reveal their awe and admiration for red rather than reflect the positive spirit of the producers: they used red to prove their existence, told their hardships and anxieties, and expressed their wishes. The petroglyphs in the Badain Jaran Desert are located in a high and sunny place next to water and tombs, which shows the direct impact of red energy on the senses of early humans from different angles. The petroglyphs represent their respect for natural physical phenomena such as the sun, fire, mountains and rivers, and the fear and awe of death. Therefore, the red series representing sensory content and emotions are the ubiquity in the Badain Jaran Desert petroglyphs, which is essentially a metaphorical expression of warmth, beauty, rebirth, a new beginning and so on.

In fact, as one of the oldest colors, red reigned supreme in ancient times. No matter in ancient Egypt, Rome, or China, red is not only a symbol of power and status, but also has great significance in religions. The significance of red to Chinese traditional culture is even greater. During festivals and holidays, the red series is commonly used. Strong red is a bright color, which represents auspiciousness and liveliness. Therefore, the cultural examination will change our initial general understanding of the preference of petroglyph producers for the red series in the interpretation of color responses. The petroglyph producers in the Badain Jaran Desert first choose those material fields with shades of red color on the top of mountains or in the context fields of high cliffs and rock walls. Even if they can't perceive it, they will try their best to find and excavate it. For example, in people's visual perception field, most of the rock art material field is almost dark midnight blue color. Rock art producers artificially hammered or chiseled on it to reveal the maroon under the surface. As for some special places where red cannot be found (such as a semicircular shallow cave like a sky dome), they will do everything possible to artificially add red pigment. Apparently, the selection of raw materials and natural physical fields for making petroglyphs originated from early humans' yearning and pursuit of red. Just as the sunflowers face the sun, those red rocks or cliffs on the top of the mountain are their favorite. The fundamental reason why they tend to red color is due to awe and worship of it. It is because "the essence of color is light, and light is closely related to life". The shades of red are the colors that determine their lives. They are the colors of blood, fire, and the sun that they love, fear, and awe, and the link between humans and gods like a rainbow.

4. 3. Blood Sacrifice

In the history of ancient cultures in the world, blood and fire are inseparable from all sacrificial offerings. Among the four elements of red, black, white and green, "red represents fire". The word "blood" in the context of Chinese culture refers to the blood of animals used in sacrifices. "Analytical Dictionary of Chinese Characters: Blood" says: "Blood(血) means the blood of the animal for sacrifice. The character originated from the shape of ware, and the left falling stroke came from the shape of blood. All characters related to blood need to take blood as a part of the character." Duan Yucai's note in the Qing Dynasty said: "Prehistoric humans drink the animal blood and offer blood sacrifice to the gods. After the creation of the character "blood", it gradually begins to be used to express human blood". In Rites of Zhou, blood is also used to sacrifice to gods of the earth and the five grains (sheji社稷), five gods and five sacred peaks (wuyue 五岳). Zheng Xuan commented: "Since the blood sacrifice appears, other things are not important anymore." Jia Gongyan said: "Blood is the sacrifice to the gods." The method of blood sacrifice is to smear or sprinkle the blood of animals on special wares. In addition to "blood sacrifice to gods", blood sacrifices in ancient China are also widely used in people's blessings and prayers for some things in daily life. "Bell" and "drum" are two important instruments in traditional

Chinese culture that represent auspiciousness and festiveness. To this day, people must ring the bell in a new year, and beat gongs and drums when singing and dancing. In ancient China, newly cast bells or drums must be through "blood sacrifice". In the blood section of Analytical Dictionary of Chinese Characters, there are three characters that clearly point out the "blood sacrifice" and how it is carried out. The first is the word Xin (衅) which means blood sacrifice. The blood of animals is used for sacrifices to the kitchen of god; The second one is Ji (𩚑), and the blood of animals is smeared on the gaps of wares for sacrifice; The third one is Xin (𩚑), and the blood of turtles is used for sacrifice. Ji (𩚑) means cutting and getting the animal blood for a sacrifice. It can be seen that "blood sacrifice" specifically refers to the behavior or process of cutting animals to get blood and coating the gaps of utensils with the blood of livestock. Duan Yucai noted that blood is used for the sacrifice to the kitchen of god, and further noted the word Xin (𩚑): In the chapter of King Hui of Liang of Mencius, Zhao Qi noted: "A newly casted bell needs the blood of animals to paint on the surface of the bell. The chapter of Emperor Gaozu of Han in History of the Han Dynasty, mentioned Xin Zhong (𩚑钟)". Ying Shao said: "The blood of animals is used to paint on the drum. It is said that the ancestral temple, the bell, the drum, jade ware, the biography of tortoise(guice), and the carriage of the ruling class are all painted by the blood of animals." Xin (衅) is a variant form of Xin (𩚑). In the context of ancient China, there are also some stories about "blood painted on the bell and drum".⁶ The reason why people perform blood sacrifices is based on the understanding that blood has a magical function to drive away demons and ghosts and keep people safe. Just like the blood sacrifice to the gods in ancient China, there are still some tribes who drink animal blood in the desert area of Guinea, Africa. When people are sick or encounter disasters, and when they plan to do some important things, the priest will drink a certain amount of camel's blood, and then pray to the gods.

For the thinking of early humans governed by the "law of participation", blood and its red color are identical. The oracle bone inscriptions do not have the character "red" denoting red color, but they have the characters "blood" and "fire" which specifically refer to the blood of animals in sacrifices. Apparently, human beings' early recognition of red substances and red colors in nature originated from blood and fire. The sanctity of the latter makes them regard all red-colored things in nature as awe-inspiring and sacred. In order to make something sacred and have the magical power to fight against all disasters, people will not only smear the blood of animals on wares or something else, but also regard similar red pigments as a blood-like existence. In other words, a red series of pigments similar to blood are used to replace the blood, and smear other things. As shown in Figure 8: the red pigment on the red abstract pattern of the clay pot is dripped with dots of different sizes. They vividly interpret Xu Shen's interpretation of "blood", "like the shape of blood". It can be said that the spots dripped on clay pots mean many "blood" characters. In ancient China, the first person who used the fire must be worshiped when there are some sacrifice activities. The word guan (燿) has the same meaning as xuan (烜) and xuan (暄), and its original meaning is to raise fire during sacrifices. Later, the word was extended to the person who first used fire in ancient times or the torch used in ancient sacrifices. Therefore, if we fully consider the characteristics of early human sacrifices and traditional Chinese sacrifice culture, then the red series of colors, nearing the tomb, standing tall and facing the sun, etc., especially the image field with natural objects like blood, fire and colorful clouds, As well as the addition of artificial red pigments, the natural physical field of petroglyph existence, all the characteristics show that sacrifice is not only the initial motivation and ultimate purpose of petroglyph production, but also its basic function.

In conclusion, colors themselves have their unique qualities. Warm colors with longer wavelengths, like red, yellow and orange, symbolize the sun and fire, as well as vitality, strength and health, which can make people feel warm psychologically. Petroglyph producers choose to use the red series of colors mainly for expressive purposes. Just as rhetoric is used to modify the language, red is a metaphorical expression for the petroglyph image. It vividly shows the rich emotional and spiritual world of early humans, including healing, worship and sacrifice. Of course, in the process of making full use of and discovering red energy, early humans must have greatly improved their aesthetic awareness of color⁷. It is an indisputable fact that the red series of colorful and dazzling petroglyphs exist in the Badain Jaran Desert.

5. CONCLUSION

If the unity of image and object is fully considered, one of the most prominent characteristics of petroglyphs is red. Whether it is the natural physical environment in which it lives or the stone or stone wall that carries it, the basic tone is the red series. From the perspective of human evolution, the discovery and utilization of colors, especially the use of artificial pigments, is of great significance to the development of the human spiritual world. It fully proves that while passively adapting to nature, human beings have actively created a humanized material and spiritual world of their own. Healing and enhancing self-knowledge may be the motivation and purpose of the petroglyph producers in the Badain Jaran Desert to fully discover, utilize and create red pigments. However, if the real physical field of natural existence and the historical and cultural background field of the petroglyphs in the Badain Jaran Desert are restored, the awe and worship, as well as the need of sacrifices (the production of petroglyphs is only a part of the sacrificial activities) are more likely to be the function and significance of the petroglyphs in the Badain Jaran Desert brought by the red color. This also shows from another perspective that petroglyph production is by no means pure art for art's sake like we do today. The love and pursuit of red in a purely aesthetic sense is a relatively late event for human beings.

ANNOTATION

1. The nature of rock art has already been discussed by the author in a previous article, and therefore will not be repeated here. For further reference, please see the author's work "Irreducible Nature of Rock Art" published in the 2017 edition of "National Art".

2. This dissertation focuses on the natural red color series in the petroglyph field. Regarding the artificially added red, there have been relevant discussions abroad, See M Angeles Medina-Alcaide, Diego Garate Maidagan, Jose Luis Sanchidrian Torti. Painted in red: In search of the multiple causes of Palaeolithic cave art. Quaternary International, (2017)1-13.

3. Black and cyan are rare colors. The mentioned "black" and "cyan" are in comparison to the most basic Ganqing color of the rock paintings in the Badain Jaran Desert. Compared with the overall Ganqing color in the topographic, environmental, and context fields, the Ganqing color in some instances appears dark blue, almost completely black, while the red color is absent from the entire field and any cracks within it. The colors rarely seen in rock materials in the entire desert are usually mixed in the Ganqing-colored contextual field of rock paintings. "Qing" in Chinese refers to shades of cyan in English. The cyan rocks in the Badain Jaran Desert are usually of a darker hue, blended with shades of green and black. The cyan hue is a rare find in the rock paintings of this desert and is usually mixed within a contextual field of dark or light cyan-colored rock paintings.

4. In one of the earliest surviving accounts in cuneiform about Sumerian mythology, man was created by God out of his own blood. For example, according to the record of Babylonian epic and myth Gilgamesh, the gods decided to create human beings after a meeting and the purpose of creating human is to enable them to undertake the work of previous gods. The gods after a meeting and deliberation decided to make man out of the blood of Ramuga, the god of carpentry, whom they had slain. Samuel Noah Kramer, Sumerian Mythology: A Study of Spiritual and Literary Achievement in the Third Millennium B.C. University of Pennsylvania Press 1972, P49.

5. It is 24 cm long and 18 cm wide. In the image of most likely a hand shape, the short little finger is separated from the thumb and the other three longer fingers kept together in a pictographic torch image.

6. Chapter of King Hui of Liang in Mencius said "The king was sitting aloft in the hall, when a man appeared, leading an ox past the lower part of it. The king saw him, and asked where is the ox going? The man replied that we are going to consecrate a bell with its blood. The king said let it go. I cannot bear its frightened appearance, as if it were an innocent person going to the place of death. The man answered, shall we then omit the consecration of the bell? The king said, how can that be omitted? Change it for a sheep. I do not know whether this incident really occurred." Xi, Zhu. Annotations to Four Books, punctuated by Meihua Gu. Shanghai Guji Press, 1995. Page 246.

7. Although the red energy has been discovered and used by human beings, red is more significant to the emotional and spiritual world of early humans. The petroglyphs in the Badain Jaran Desert have shown us. In the petroglyphs of Yamatu, Buyatu, Xiaosumutu and Kundaitu, which are generally bluish in color, there are also some relatively hard stones that are not related to the red series and are generally blue and sharp. Generally, there are Tibetan or Mongolian engraved with sharp metal. Obviously, after entering the written age, people's standards for selecting raw materials and contextual colors for petroglyphs are different from those of the Neolithic and Paleolithic Ages.

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