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Digital Documentation of the Rock Art Site of Isko, Hazaribagh District, Jharkhand

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***Abstract** The present study is aimed to make a digital documentation and analysis of Isko rock shelter with its geographic context by using photogrammetry and preliminary remote sensing techniques. This study is carried out for better understanding and preservation of Isko rock art site in Barkgaon block of Hazaribagh district, Jharkhand. In this study an attempt is also made to reconstruct the past lifeways and history by the decoding the symbols and paintings through digital documentation method. This study has made a preliminary attempt to interpret of prehistoric art and form of the proposed area.*

Keywords: Isko, Rock Art, Three Dimensional Documentation, Remote Sensing, Photogrammetry, Pictograph, Petroglyph

Introduction

The present work attempts to document, interpret and work out on the possibilities of preservation of Isko rock shelter in Barkagaon block of Hazaribagh district, Jharkhand. Isko is one of the well-known rock-art sites of Jharkhand which has both non-figurative and figurative pictographs and petroglyphs under one roof. The high density of superimposition of pictographs at the panels of Isko rock shelter indicates that this site had played an important role in the development of early human settlements and activities in northern Jharkhand.

But with the passage of time this heritage site is being destroyed by natural weathering process as well as by the anthropogenic activities. The Isko rock art shelter is badly affected by the chemical weathering processes (by rainwater dripping and humidity) and increase of tourism. Now, it has become imperative to document and preserve this unportable heritage which is deemed to be important for understanding human history of this region. The virtual 3D replica of Isko rock shelter can recode each and every rock art motifs with its location in rock shelter. This 3D digital model can be used

as a digital register of rock art motifs which can help us to preserve it (Bednarik and Seshadi, 1995).

This paper therefore attempts to have a comprehensive and detailed 3D documentation of the panels using photogrammetry technique and image enhancement tools for the identification, description and preservation of the rock art. It also aimed to locate new motifs by improving the comprehensiveness of the panels. The traditional analysis of prehistoric rock art has been widely focused on the direct observation of drawings and/or photo-graphic images. However, the advent and combination of geomatic techniques and digital image treatment can improve the results by providing non-invasive, qualitative and quantitative digital information, enhancing visualization and identifying possible superimposition of different paintings or the presence of previously unseen motifs.

Study Area

The work is concentrated on the documentation of rock art site of Isko village (32°48'20.22" N; 85°19'40.19"E) of Barkagaon block in Hazaribagh district, Jharkhand. The Isko village is a part of North Karanpura valley which is also known for its isolated residual hills, long hill ranges, forested valley landscape and North Karanpura coalfield belt. Isko village lies on the Hazaribagh plateau of northern Chotanagpur plateau. This village is surrounded by the thick forest of Hazaribagh-Chatra Forest range and hillocks and residual hills of *Sāthī* range.

The geology of study area belongs to Barren Measu formation and the hills are part of pre-cambrian sandstone and quartzite. The bedrock of this region is mainly Mahadeva sandstone and quartzite (yellow and pink). The major geology of this region composed of granite, gneiss and mica schist type of Precambrian rocks. The cementing materials of the sandstone largely govern its resistance to weathering and erosion. The iron oxide cemented sandstone is largely available in this region which is less resistant to chemical weathering and absorb water and turn into iron hydroxide. This geological factor has resulted in the formation of red soil of this region (Basu, 2008).

The topography of this area is dominated by residual hills, hillocks and undulating landscape. The Rani-Dahanala flows on north to western border of this village; this is a seasonal channel which is also connected with the myth of this village. The fluvial geomorphology of upper Damodar Basin makes this area potential for archaeological studies (Roy Choudhury, 1957).

Previous Research

The study of rock art in India began in 1867-68, when Archibal Campbell Carllyle discovered rock art on the ceilings and walls of Sohagi-ghat rock shelter in Mirzapurdistrict of Uttar Pradesh (Ahmed, 2006). The discovery of Bhimbetka by V.S. Wakankar gave a boost to the rock art research in India. The first archaeological and anthropological survey in Hazaribagh region was carried out by the anthropologist

S.C. Roy in 1928 (Roy, 1957), who documented the lifestyle, settlement pattern, art and hunting-gathering patterns of Munda, Birhor and Oraon communities, and discovered several prehistoric sites in Hazaribagh district. The Isko rock art site was discovered by Father Tony Herbert in 1992 and further archaeological investigation on this region was carried out by Bulu Imam (1992, 2014 and 2015) (IAR 1993-94). Somnath Chakraverty (1996) was the first person, who has documented the Isko rock art site. Shubham Rajak (2019) recently has tried to interpret and describe the rock art of Isko rock shelter through an ethnographic perspective (Bednarik, 2011). The three-dimensional documentation and remote sensing techniques have enhanced our perception about this site.

Aims of the Study

The present research is aimed to document the Isko rock shelter with its geographical characteristics. The remote sensing and GIS techniques have been used in this present research for a better understanding of the surrounding landscape of rock shelter, which may attract the prehistoric settlers of this region. Through the remote sensing techniques, the present authors tried to identify various geographical characteristics like the presence or absence of paleochannels, drainage system around Isko village, elevation of Isko rock shelter and Sathi hill (Banerjee and Srivastava, 2014). The FCC image (land use/ land cover) has helped us to identify past and present fluvial activities and drainage system which may have provided a suitable landscape for the prehistoric inhabitants to settle down in this rock shelter (Jaiswal and Saxena 1999).

The preservation of rock art is always problematic due to the disturbances of natural (i.e. geological factors, lichens, humidity, bacterial activity, thermal gradient, etc.) and anthropogenic processes. The Isko rock shelter is badly affected by the chemical weathering process (by rainwater dripping and humidity) and increased tourism at this site. It was deemed necessary for cultural heritage of this region, therefore, to make a digital model as a virtual replica of Isko rock shelter which can record each and every rock art with its location in rock shelter. This paper presents comprehensive and detailed 3D documentation of the panels using photogrammetry technique and image enhancement tools for the identification, description and preservation of the rock art. It is also aimed to identify the location of new rock art motifs, improving the comprehensiveness of the panels. The traditional analysis of prehistoric rock art has widely focused on the direct observation of drawings and/or photographs. However, the advent and combination of geometric techniques and digital image treatment have improved the results by providing non-invasive qualitative and quantitative digital information, enhancing visualization and identifying possible superposition of different paintings or the presence of previously unseen motifs.

Methodology

The present work is carried out with the help of archaeological and digital methodology. These include surface exploration on Sathi hill, close-range photogrammetry of site and remote sensing techniques. For the better understanding

on the rock art of Isko rock shelter, the rock art has been divided into two groups: pictographs and petroglyphs, which are further classified on the basis of their patterns or iconography (Figure 1) (Bednarik, 2006).

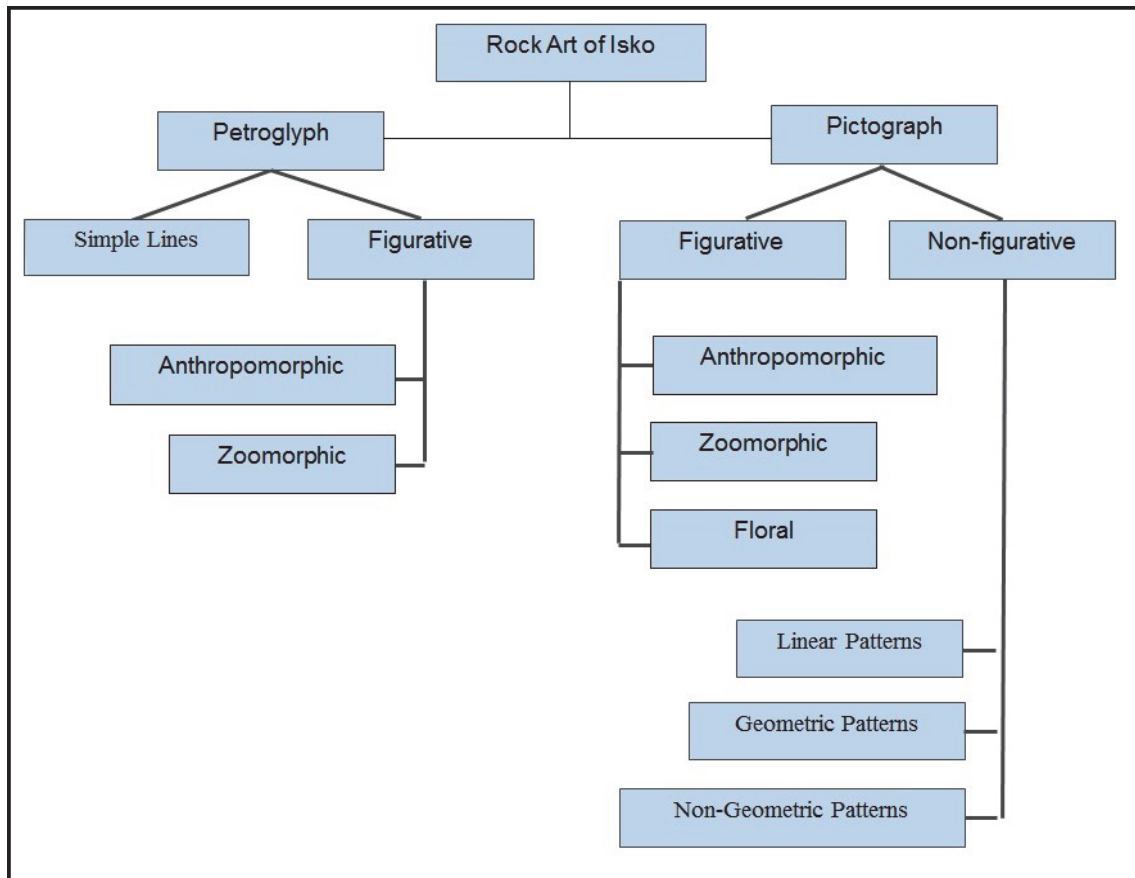


Figure 1: Flowchart Showing the Rock Art of Isko Rock Shelter



Figure 2: General View of Isko Rock Shelter (from Eastern Side)

The Isko rock shelter (Figure 2) has been documented by using structure-from-motion (SfM) close-range photogrammetry in Agisoft Photo Scan software. As the rock art motifs and rock shelter site is a fragile and unportable cultural heritage, the use of three-dimensional (3D) virtual model becomes important for creating a virtual replica which can be used for documentation of the site, intensively and for further archaeological research. The three-dimensional (3D) documentation of rock shelter and landscape is aimed to produce descriptive and analytic graphic document with metric scale and geospatial information for further analysis. The identification and analysis of faded rock art of Isko has been done with the help of DStretch plug-in for ImageJ™ software (Current version 8.3) (Mark and Billo, 2001). Moreover, the three-dimensional (3D) virtual model of full rock shelter further processed on DStretch plug-in for a better understanding of distribution of rock art in whole rock shelter (Bednarik and Seshadri 1995).

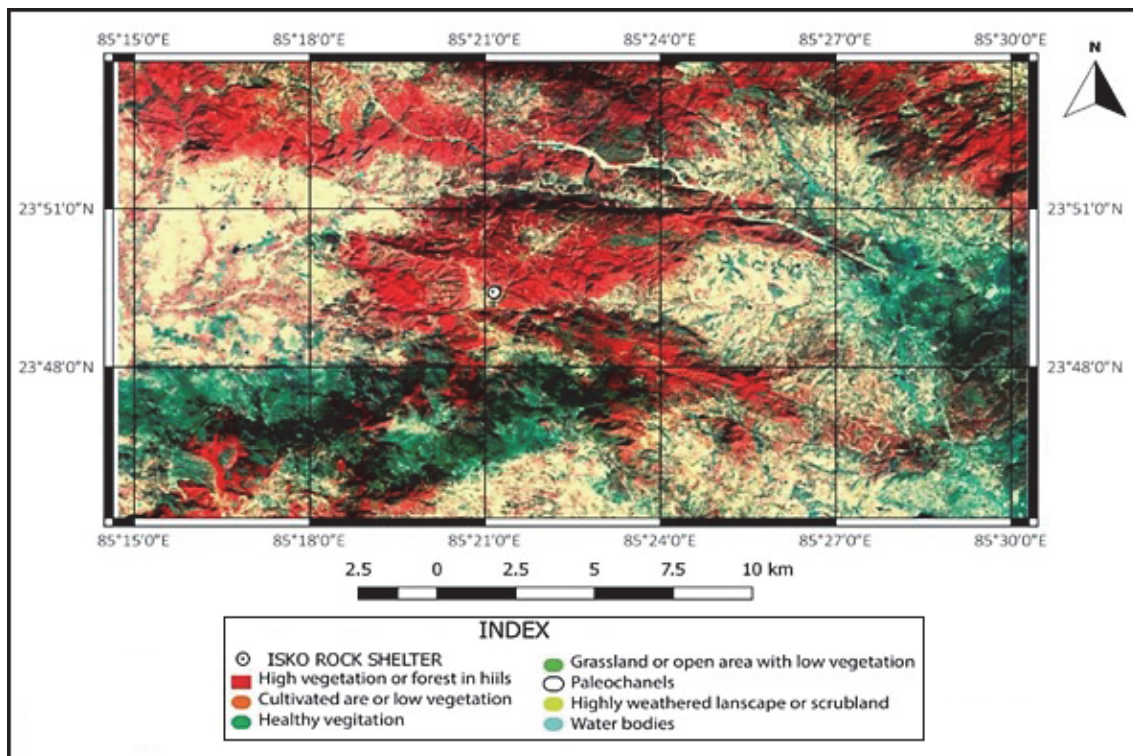


Figure 3: Location of ISKO Rock Shelter on False Color Composite of Land-use-land-cover Map with Band Combination of 1,4 and 7 (R=XS3-NIR Band, G=XS2-Red Band, B=XS1-Green Band) Source: IRS-Resourcesat-2 AWIFS, 56m, ISRO-NRSC)

The surrounding landscape of Isko rock shelter site has been studied by the surface exploration and remote sensing survey for a better understanding of man-land relationship and availability of natural resources who sustain the early human occupation and their activities at this site (Banerjee and Srivastava, 2014). The remote sensing survey of this region has been done by using raster data from Bhuvan portal of National Remote Sensing Centre (ISRO) and further processed on Q GIS software. For the present paper False Colour Composite (FCC) of land-use-and-land-cover map is

prepared for understanding the surrounding landscape of rock shelter site and available natural resources in its catchment area (20 km) (Figure 3). The Digital Elevation Model (DEM) and contour map are made to understand the elevation of the surrounding landscape and Isko rock shelter (Figure 4). These maps are applied for the identification of valley fills, floodplains, drainage patterns and paleo-channels during the field work (Banerjee and Srivastava, 2013).

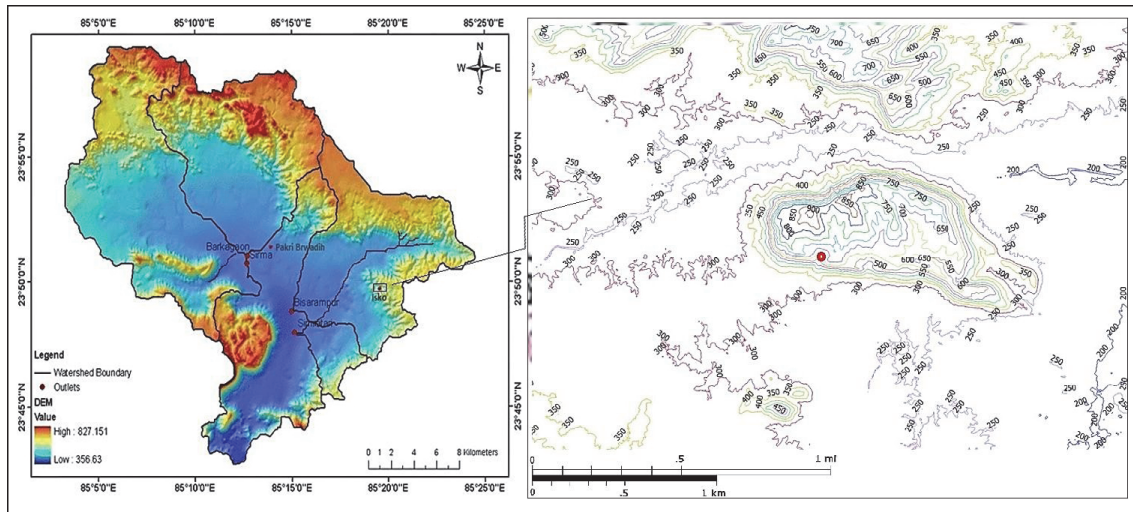


Figure 4: 2D DEM of Barkagaon block of Hazaribagh district, Contour map of Isko village and *Sathi* hill (with rock shelter) (Source- Bhuvan, Cartosat-1, PAN -2, NRSC)

3D Digital Documentation and Image Enhancement Integration into Schematic Rock Art Analysis

This sandstone rock shelter is located on the south-eastern portion of Sathi hill and the Isko village is settled 100 m west of rock shelter. The Rani-daha River flows 209 m north of the rock shelter. There are total three rock shelters in the Isko village where only one presently contains rock art motifs (on the south-eastern slope of Sathi hill) whereas other two rock shelter do not contain rock art (on the northern slope of Sathi hill). The rock shelter which contains rock art is called as *Khovar gufa* by the local villagers and other rock shelters are known as *Malwa-duari gufa* (Imam, 2014). Isko rock shelter is located in a long Nala kind of depression, where it contains a wide array of pictographs on the east facing the wall. The natural floor of this rock shelter has been destroyed by 150 cm wide cemented floor made by the state government (Figure 5). This activity has destroyed the archaeological deposits from the surface of the rock shelter. There are four steps made by villagers to reach the rock shelter easily. West of the Isko rock shelter is a *Thān* (sacred place) where the *Munda* and *Bihor* communities worship their village deities (Dalton, 1864. Roy, 1928 and Ghosh, 2003).

The total length of the Isko rock shelter is 28.70 m, height of the southern edge of rock shelter is 4.30m and height of the northern edge of the rock shelter is 5.30 m. The highest part of this rock shelter is in the centre portion which is 5.81 m high (Figure 6). From its roof to concave wall it is 1.23 m length. In general, most of the paintings are

located on the minimum height of 1.58 m from the cemented floor and the upper most rock art motifs are located about 5.54m on the ceiling of the rock shelter. Most probably, the early settlers had intentionally selected the middle and upper parts of the rock shelter for painting as it has better scope of preservation. By looking at these quantitative data of this rock art motifs and there locations on the wall, it can be proposed that for reaching this height in a rock shelter for making painting, one must have needed a ladder or scaffoldings or elevated platform to reach the ceiling portion. This hypothesis is also supported by the presence of vesicles or sinkholes. These might have given support to the upper part like a ladder on a vertical rock surface. The protruding lower surface of wall at section A and B might have been used as platform for climbing up on the wall of rock shelter.

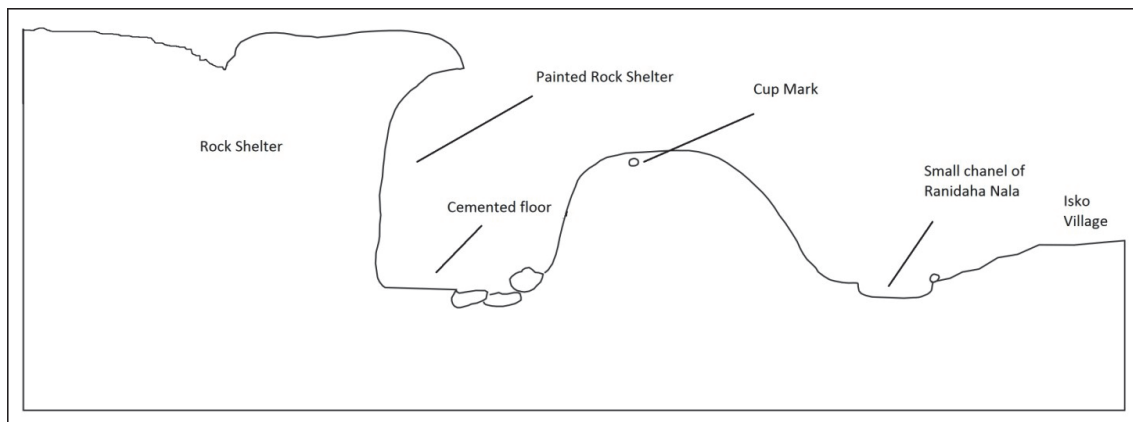


Figure 5: Cross Section of Isko Rock Shelter from Western Side (Not to Scale)

It can be postulated that those people, who had made these pictographs, intentionally selected the best possible part of this rock shelter. In the densest painted area, the rock surface is relatively more smooth, spacious, wide and protected by a narrow ledge blocking out direct sunlight. While in the non-painted or less painted part, the rock surface is relatively uneven and coarse-grained. A large number of the pictographs have been badly affected due to the chemical erosion of a rock surface by water leakage on the surface of the rock shelter and the anthropogenic activities.

For quantitative analysis of rock art depictions on the wall of the rock shelter, the full panel of rock shelter has been divided into six sections according to alphabetical order (from A to F) where each one has a length of 4.79 m (Figure 7). The total depictions on each section have been counted and sub-divided into polychrome and bi-chrome variety (shades of red and white) of pictograph and petroglyph (mainly engravings and cup marks). The natural circular depressions or natural vesicles are also noticed on the wall of the rock shelter, which has been mostly utilized by the people as a surface for making pictographs in floral and circular motifs. One of the sinkhole is decorated with a floral motif which has two large petals and twelve small petals (Figure 10).

Both pictographs and petroglyphs are found in the Isko rock shelter. The rock art of this site presents a unique realm of symbolic representation of behavioral and cognitive

aspects of early settlers in this region. The hunting sense is fully absent in this rock shelter whereas it carries symbolic, linear, some zoomorphic and some anthropomorphic depictions. In this site, pictographs carry more diversity of depictions, whereas petroglyphs are limited with one anthropomorphic, one zoomorphic and two linear carvings (Figure 11).

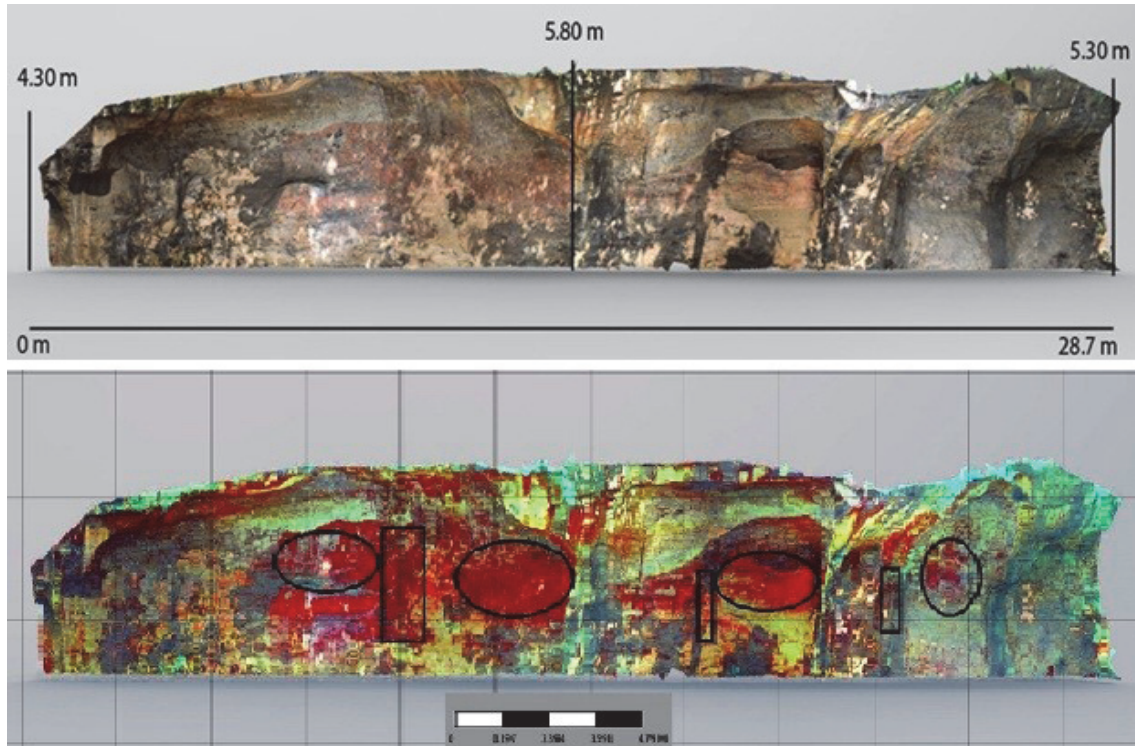


Figure 6: 3D model of Isko Rock Shelter with Measurements, 3D model of rock shelter processed in DStretch plug-in for identification of distribution of rock art

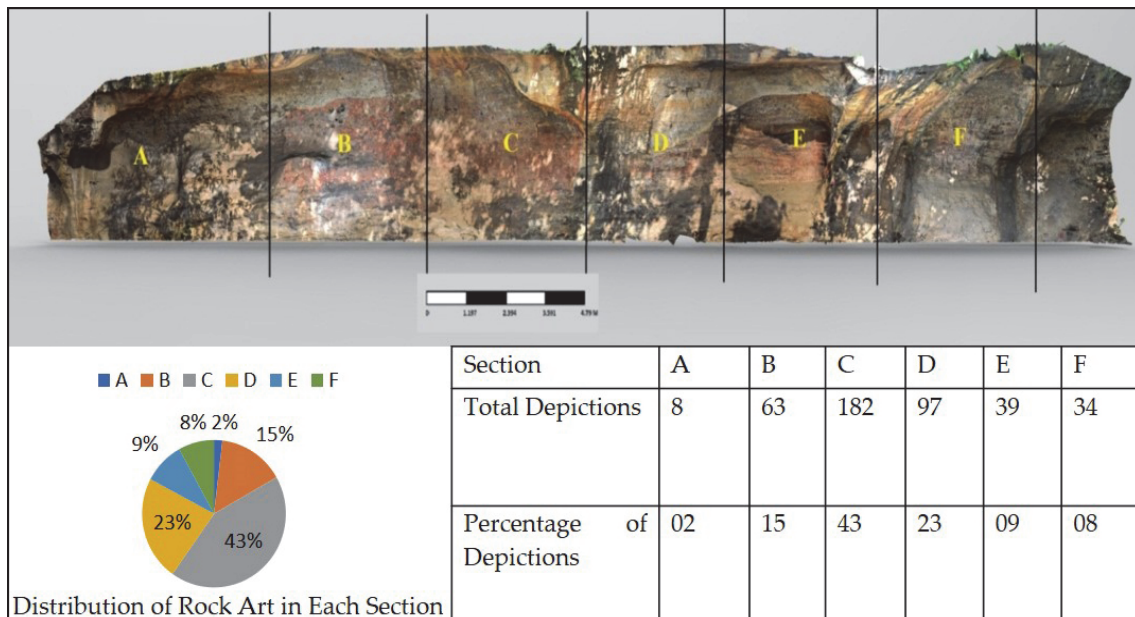


Figure 7: Six sections (A-F) of rock shelter

This rock shelter is mostly dominated by the pictographs whereas very few petroglyphs are present over this site. Somnath Chakraverty (1996) had identified only two petroglyphs (one anthropomorphic and one zoomorphic) at this site, but the recent study shows that there are presences of more petroglyphs (including single lines and circular patterns of inching) and most of them are superimposed by pictographs.

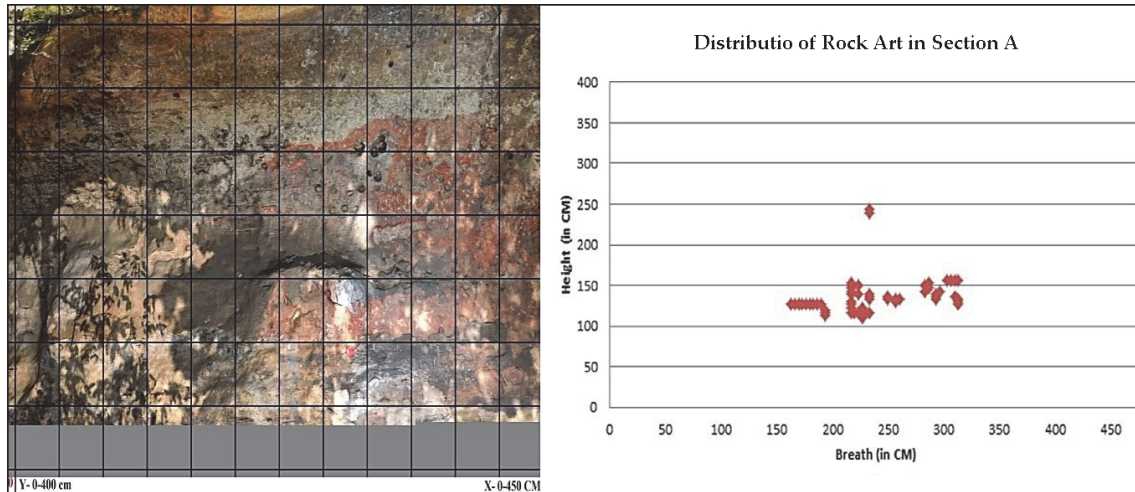


Figure 8: Distribution of rock Art in section A of Isko rock shelter (1 grid= 1, 00,000 pixels= 37.5× 37.5 cm, Y=0-400 cm and X=0-450 cm)



Figure 9: Pictographs on Isko rock shelter and digital tracing of rock art motifs

The quantitative analysis of rock art and its distribution pattern in rock shelter has been another major aspect of this study. The present research has revealed that most of the pictographs (Figure 9) are concentrated on the section C. It may be because of two probable reasons first could be that section C which has better preservation has longest

horizontal surface on the ceiling. This has provided a safeguard from rain and erosional activity; second could be that the early inhabitants have intentionally made high number of paintings over here which has a relatively smooth and plain surface in comparison to other sections. The section A has lowest number rock art motifs due to uneven rock surface and high chemical erosion. The distribution of rock art over section A can be understood by the given figure (Figure 8).

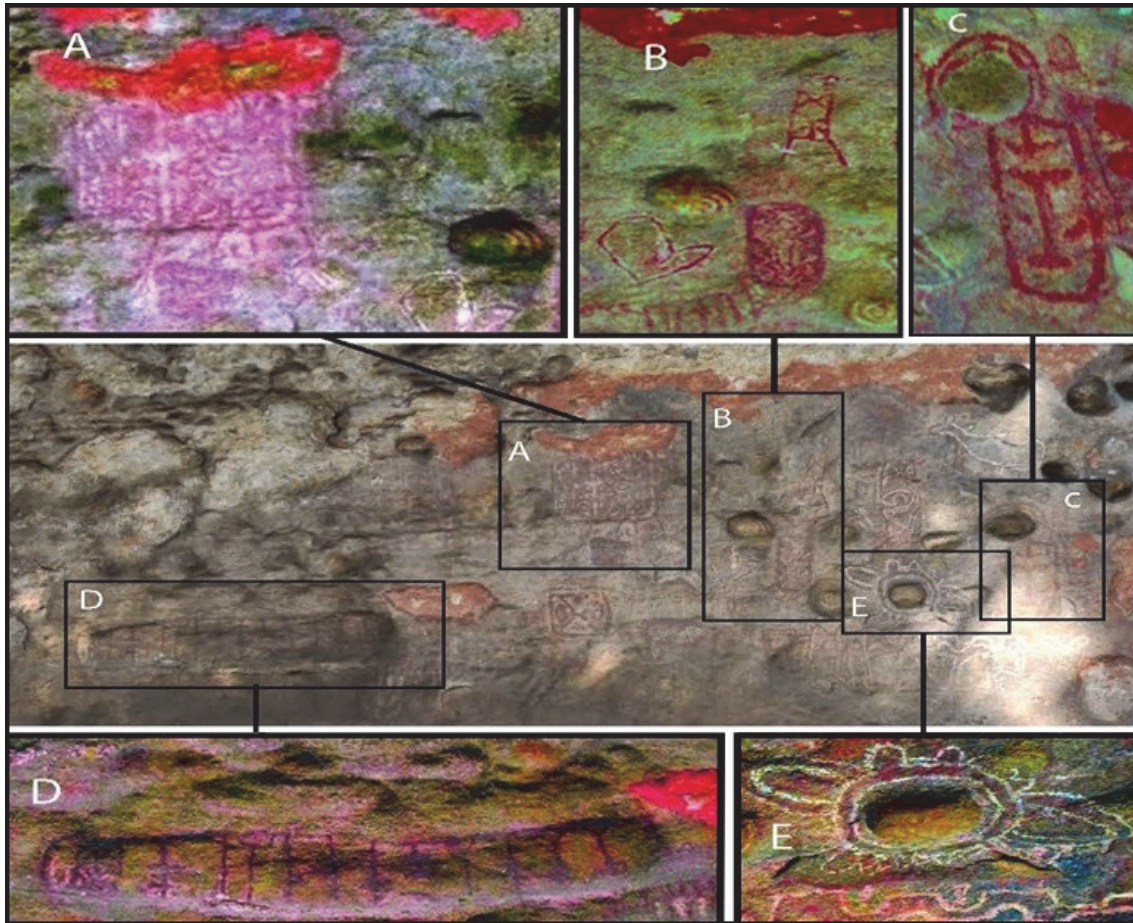


Figure 10: Section A of Isko rock shelter. A- symbolic anthropomorphic pictograph, B- anthropomorphic and circular pictograph made in natural vesicle, C- one tree like motif and a circle, D- linear pictograph (monochrome) of caterpillar or hunting trap, E- bi-chrome floral motif which has two large petals and twelve small petals

A petroglyph of one-horned rhinoceros (*Rhinoceros unicornis*) is present in 'section A'. This petroglyph is present at a height of 2.43m (8 feet) from the cemented floor of the shelter. Some of the pictographs in section B has provide information on the ancient hunting technique of humans in this region. The present ethnographic documentation has revealed the evidence of hunting by trap method. Figure 12 show the evidence of hunting trap and some faded pictographs from section B of Isko rock shelter. This rock shelter has only 13 (3.07% of total) zoomorphic motifs which includes three Assam Roofed Turtles (*Pangshurasyllhetensis*), one-horned rhinoceros (*Rhinoceros unicornis*), Indian Bison (*Bosgaurus*) and deer (Chakraverty, 1996, Rajak, 2019) (Figure 11).

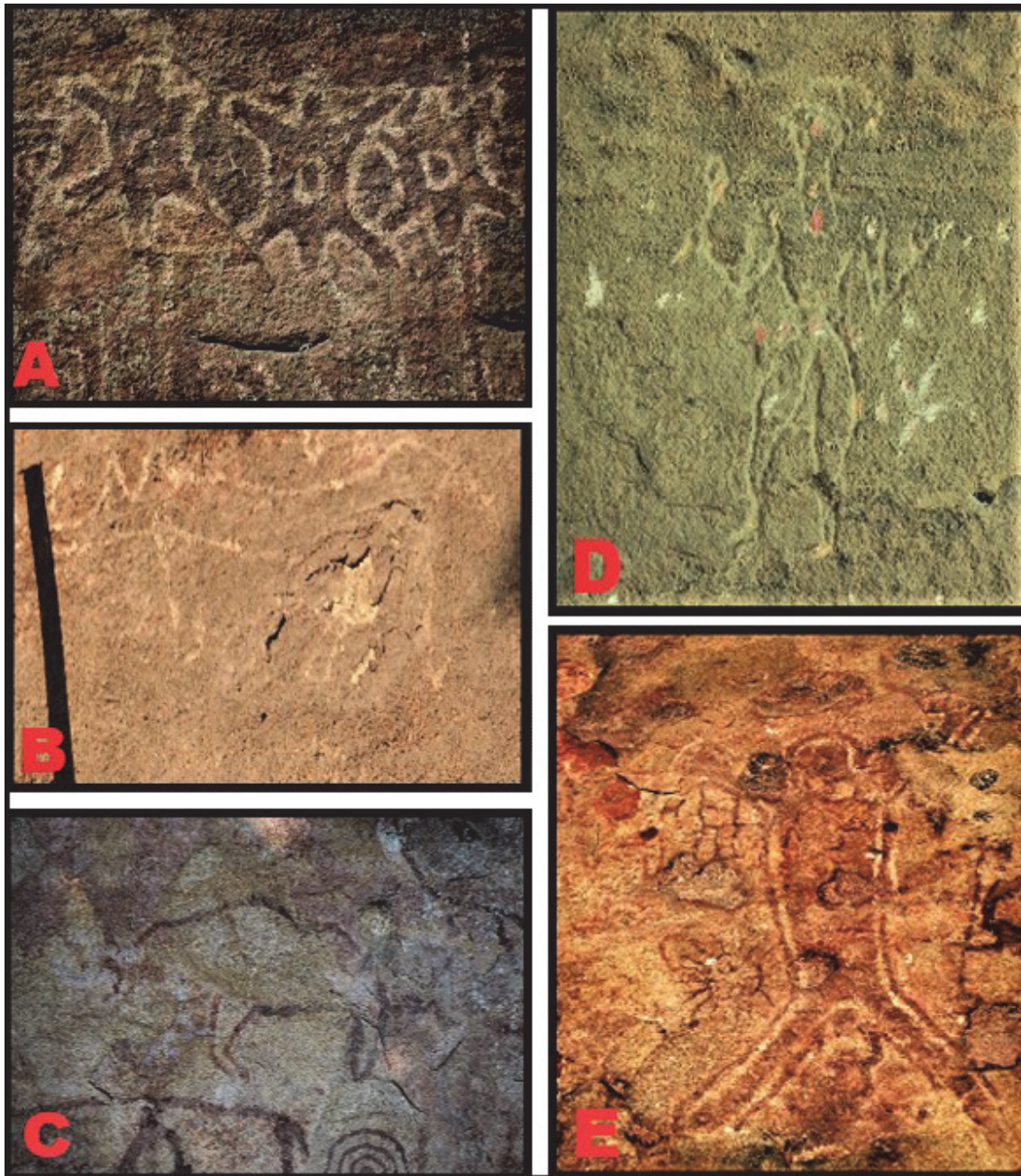


Figure 11: Section A of Isko rock shelter. A- pictograph of Turtles, B- petroglyph of one-horned rhinoceros, C- pictograph of Indian Bison, D- petroglyph of male anthropomorphic figure, E- pictograph of mother giving birth to child

This rock shelter has only 6 (1.42% of total) anthropomorphic figures where only one is petroglyph and others are pictographs. The largest anthropomorphic figure in this rock shelter is mother giving birth to child (Imam, 2014) which has total height of 40.6 cm. Somnath Chakraverty has interpreted this motif is a male figure where he argued the presence of genital organ between legs (Chakraverty, 1996) but the recent studies by Bulu Imam (2014) proposed that it is a female figure where the new born baby is coming out of uterus (Figure 11).



Figure 12: The Roof of the section B in rock shelter with evidence of hunting traps (Enhanced in D Stretch)

Isko rock shelter bears a total of 423 clear depictions among which 392(92.6%) are of non-figurative or symbolic. Now question occurs that why those early humans were using so many symbols in their rock art? Is it because of their ritualistic purpose (Rappaport 1999: 31) or something else?

Preliminary Observations

The application of photogrammetry and image enhancement technique helped us to find out and analyze almost 423 rock art depictions where maximum are non-figurative or symbolic. The Present authors have proposed to the possibilities of meta-communication, para-communication and ritualistic nature of symbolism Isko rock shelter on the basis of Rappaport's theory (1999) and their ethnoarchaeological exploration in Barkagaon.

An important petroglyph of one-horned rhinoceros (*Rhinoceros unicornis*) really a peculiar zoomorphic motif for this geographical area because in present time one-horned rhinoceros is not existing in Jharkhand. This petroglyph indicates that when this petroglyph was made, at that time one-horned rhinoceros (*Rhinoceros unicornis*) was probably existed in Jharkhand. Isko rock art has also provided us information on past environment of this region. The presence of Assam Roofed Turtles (*Pangshurasyllhetensis*) and one-horned rhinoceros (*Rhinoceros unicornis*) motifs indicates that when these rock art were being made the surrounding landscape was forested marsh land. Yet without absolute dating of these depictions, we cannot say about its date.

The image enhancement on 3D model and quantitative analysis of rock art clearly show that prehistoric settlers had a tendency to select the most fine and even rock surface in shelter for painting purpose. The high amount of superimposition and high number of rock art motifs at this rock shelter also indicate that probably this site was in use for a long time period.

The remote sensing data including FCC of land-use-and-land cover, 2D digital elevation model and contour map of Isko and surrounding region has helped us to understanding the physical properties of the surrounding landscape which has attracted the ancient people to occupy this region. The 3D virtual model of Isko rock shelter is made in present research which can be used for further reference and heritage management.

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