
Importance of Scientific Studies in Indian Rock Art: Problems and Future Perspectives

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Abstract: Upper Palaeolithic and Mesolithic cultures were prolifically associated with rock paintings in natural caves and rock shelters across many parts of India. The study of such paintings throws light on the life-ways of prehistoric people and provides information on their thoughts and beliefs, society, religion and rituals, material culture, technology, economy and also about the fauna and flora that was exploited and revered in the past. Rock paintings of Non-Iconic and Iconic phases were depicted in different styles, superimpositions, colours and covered with patina suggests that these caves and rock shelters were occupied by Late Pleistocene hominids for a long time and the antiquity of such paintings goes back to at least 30,000 years BP. This paper highlights the story of Indian rock art studies since beginning and the antiquity of rock art in India in the wake of recent developments that have taken place in the scientific study of rock paintings in India as well as in different parts of the world.

Keywords: Rock Paintings, India, Antiquity, Scientific Studies, Pigments, Conservation, Absolute Dating

Introduction

In India, prehistoric paintings were discovered as early as 1867, but knowledge about their precise antiquity and origin is not yet known (Mathpal 1984; 1992). Since then, due to the efforts of the scholars namely V.S. Wakankar (1955; 1973; 1975a; 1975b; 1976; 1978; 1983; 1984a; 1984b; 1992; Wakankar and Brooks 1976), Mathpal (1976; 1984; 1992; 1995; 1998; 2001), G. Kumar (1981; 1983; 1992a; 1992b; 1996a; 1996b; Kumar and Sharma 1995; *et al* 1988; 1990; 1991; 1992a; 1992b; *et al* 2005; 2006), D.H. Gordon (1958), D.H. Gordon and M.E. Gordon (1939) S.K. Pandey (1965-67; 1969; 1970; 1975; 1984; 1988; 1992; 1993; 2001), G.S. Tyagi (1988; 1992; 2001), V.H. Sonawane (1984; 1992; 1995-96; 1996; 1997; 2002a; 2002b), A. Sundara (1974; 1975; 1984; 1987; 1996; 2006), K. Rajan (1991a; 1991b; 1994; 1996; 1997; 2003, 2008; *et al* 2004), N. Chandramouli (1994; 1995a; 1995b; 1996; 2001; 2002; 2003; 2008; 2009), S. Pradhan (1995; 2001), R. Tiwari (1990; 1992), S. Tiwari (1975; 1984), Erwin Neumayer (1983; 1990; 1991; 1992a; 1992b; 1992-93; 1993; 2013), R.G. Bednark (1990; 1991a; 1991b; 1991c; 1992; 1993a; 1993b; 1994a; 1994b;

1994c; 1996; 1998; 2000-01; 2001a; 2001b; 2001c; 2003; Bednarik and Kumar 2002; *et al* 1991; 2005; 2006), B. Alchin (1985), C.W. Anderson (1918), N.P. Chakravarty (1939), S. Chakravarty (1996), J. Cockburn (1883; 1884), F. Fawcett (1892; 1901), A.H. Dani (1983), M. Ghosh (1932), C.A. Silberrand (1907), (Sathe 2007), (Badam and Sathe 2007), R.P. Kathuria (1975), B.M. Pande (1973), Abbas (2006; 2007-08; 2011 *in press*), Saleem (2008; 2014a; 2014b; 2015 *in press*), Saleem and Chauhan (2013), Vincent A Smith (1906), Gurukkal (1993), Gurusurthy and Sairaman (1996), Kumaravelu (2000), Pavithra (2002), Dubey (2011), A.K. Prasad (2003-2004; 2009), Sridhar (2007), Amarnath (1996), Padhan(2014), Pawar (2006; 2011a; 2011b; 2012a; 2012b; 2012c, 2013a; 2013b), Pawar and Saleem (2014a & b *in press*),etc useful information on various aspects of Indian rock art was brought to light and published.

On the basis of the study of style, superimpositions, theme, subject matter, patina, colour and context of the rock paintings, one can suggest a provisional and relative chronological sequence for Indian rock art until the paintings and other art forms can be dated directly. In the study of prehistoric rock art, it is essential to observe the stylistic features, superimpositions and colour of the paintings. The earliest paintings are often in a highly fragmented state and are covered with thick patina, in such conditions it is very difficult to study the subject matter in the rock paintings. Dating rock paintings is the most challenging part of the study of rock art research in India (as well as in other regions), but it is the most crucial aspect as well. Some of the rock paintings were dated to the later Palaeolithic period and a few have been assigned to the Historical period. Though, questions have been raised about assigning the rock paintings of human figures (e.g. 'S'/stick/square shaped human figures of Mesolithic period were shown as equipped with bow and arrows and the human figures of Chalcolithic period were shown as equipped with bow and arrows or metal axes) to certain cultural periods on the basis of the theme and subject matter of the rock paintings (Boivin 2011) as the practice of depicting rock paintings has been followed by certain tribal communities (Rajan 1991b; Selvakumar 2011).

Another aspect which has to be given importance in Indian rock art studies is that the studies of rock art in terms of ethnographic studies about the tribal people who live in the vicinity of the rock art sites still practice painting various types of designs and those of the animals. The study about the living practice of drawing rock paintings at Mallachandiram in Tamil Nadu suggests that the living practice of drawing rock paintings at Mallachandiram (Rajan 1991b), Miapur in central India and in Hazari Bagh region in upper Damodar valley in Jharkhand (Bulu Imam 2014). Such kind of ethnographic studies will be helpful in terms of building up ethnographic analogies. But such kind of ethnographic studies are helpful to understand the purpose of the rock paintings (in present day context), but it has to be observed carefully that what kind of paintings/motifs, symbols, animals etc are being drawn and it is evenly important to observe who is drawing the paintings and their purpose as well as meaning. Such kind studies will help in to formulate ethnographic analogies in order to build hypothesis or theories about the purpose of various types of rock paintings as

the study of rock art is still viewed as part of a shamanistic conception (Bulu Imam 2014) whereas the rock paintings are considered as the cognitive representations (Saleem 2014a & b, 2015 *in press*, Selvakumar 2011).

According to Bednarik (1994a; *et al* 2005) efforts have been made to directly date rock art, but estimating the precise ages of individual paintings remain as one of the most challenging tasks in South Asian archaeology. But the efforts in dating rock art as well as other related remains such as ochre processing activities found in Africa, Europe, dating of rock paintings in Africa, Europe, Australia and Indonesia have been successfully carried out (Table 1) and assigned to Pleistocene (Ambert *et al* 2005, Aubert *et al* 2014, Azema *et al* 2012, Clottes *et al* 1995, Gomes *et al* 2013, Henshilwood 2013, Henshilwood and Lombard 2013, Henshilwood and Niekerk 2012, Henshilwood *et al* 2003; 2012, Lorblanchet *et al* 1990, Loy *et al* 1990, Marean 2010, Rowe 2004, Russ *et al* 1990; 1991, Valladas and Clottes 2003, Valladas *et al* 1990; 1992, White *et al* 2012, Watchman 1985; 1987; 1990; 1993a; 1993b; 1993c, Watchman and Lessard 1992). But in this aspect India is still far behind to utilize such kind of scientific advances in terms of dating efforts and stresses for such kind of work in order to solve the disputes about the antiquity and origin of rock art in India (Saleem 2015 *in press*).

In 1957, V.S. Wakankar discovered hundreds of painted rock shelters around Bhimbetka in central India and started a broad survey of painted rock shelters in the country (Wakankar 1992). Later, Wakankar and V.N. Misra respectively carried out excavations in the rock shelters at Bhimbetka and revealed stratified cultural sequences from the Lower Palaeolithic to Historical periods (Wakankar 1975). Excavations here have also revealed petroglyphs or cupules on the floor of a rock shelter and their stratigraphic position in the Acheulian deposits suggests that they were carved during the Lower Palaeolithic period. According to Bednarik (1994; *et al* 1991), these petroglyphs are the oldest form of rock art in the world (Fig 1a).

The disputes about the origin and antiquity of Indian rock paintings have prevailed for several decades (Tyagi 1988; 1992; 2001, Mathpal 1984; 1992; 2001, Wakankar 1975; 1983; 1984a; 1992, Wakankar and Brooks 1976, Pandey 1988; 1992; 2001, Kumar 1981, Neumayer 1983; 1993, Saleem 2014a; 2014b; 2015 *in press*). According to Woodhouse (C.f. Tyagi 1992), these intricate spiral patterns are the result of a “trance experience” of the shamans, and were painted when the rock artist was in a trance or hallucination or that these designs were painted by the shaman. According to Prof. W. Davis (C.f. Tyagi 1992) these designs were painted when the artist was under the influence of physically stressful conditions and their close association with the animals and a part of their belief system, which is an important vision of hunters, shamans or artists of a particular community. However, the absence of ethnographic parallels in India makes it difficult to prove this proposition (Tyagi 1992). But the recent study on Indian rock art (Saleem 2014b; 2015 *in press*) does not support Woodhouse and Davis’s theories (C.f. Tyagi 1992), but suggests about the factors that have led to the emergence of rock art. Recent discovery of an engraving found in the Gorham’s cave in Gibraltar suggests

Table 1: List of Dated Rock Arts Sites in the World

Site	Analytical/Scientific Method	Reference
GodeRoriso, Ethiopia	X-microflourescence, Raman spectroscopy and microstratigraphy	Gomes <i>et al</i> 2013
Weld Range, Western Australia	LA-ICP-MS for Trace element classification of ochres	Scadding <i>et al</i> 2015
San/Bushman rock art, Africa and Andes mountain range in North Central Chile	Raman Spectroscopy	Prinsloo <i>et al</i> 2011, Troncoso <i>et al</i> 2015
Abrigodelos Oculados, Spain	Accelerator Mass Spectrometry	Ruiz <i>et al</i> 2012
Minadeta (Albacete, Spain)	Scanning Electron Microscopy-Energy Dispersive Spectroscopy (SEM-EDX), Raman Spectroscopy, Gas Chromatography-Mass Spectroscopy (GC-MS)	Marti Mas <i>et al</i> 2013
Altamira Cave, rock art sites in Southwest China, Sulawesi, Indonesia	Uranium series	Garcia-Diez <i>et al</i> 2013, Tacon <i>et al</i> 2012, Aubert <i>et al</i> 2014
Pecos River (Texas)	14c and Oxygen Plasma method	Russ <i>et al</i> 1991
Brandberg (Namibia)	14c	Conard <i>et al</i> 1988
FernCave, (North Queensland, Australia)	Raman Spectroscopy and FT-IR method for recording rock paintings	Goodall <i>et al</i> 2009
Lesotho river valley, South Africa	Spectrometry and Nuclear Analytical method	Peisach <i>et al</i> 1991
AleroHornillos 2, Argentina	TXRF-FT-IR and GC-MS	Vazquez <i>et al</i> 2008
Lascaux cave, France	Transmission Electron Microscopy and 14c	Chalmin <i>et al</i> 2004
Minas Gerais, Brazil	XRF, XRD, SEM-EDS, GIXRD, CEMS	Floresta <i>et al</i> 2015
Angola, Arizona, Australia, Belize, Brazil, California, Colorado, France, Idaho, Guatemala, Utah, Missouri, Mexico, Montana, Russia, Texas, Wisconsin, Wyoming	14c	Rowe 2004
European rock art	Radio carbon and Uranium series	Pettitt Paul and Alistair Pike 2007

about the cognitive perception of the Neanderthals (Rodriguez-Vidal *et al* 2014) whereas the rock art production has been attributed to the modern humans.

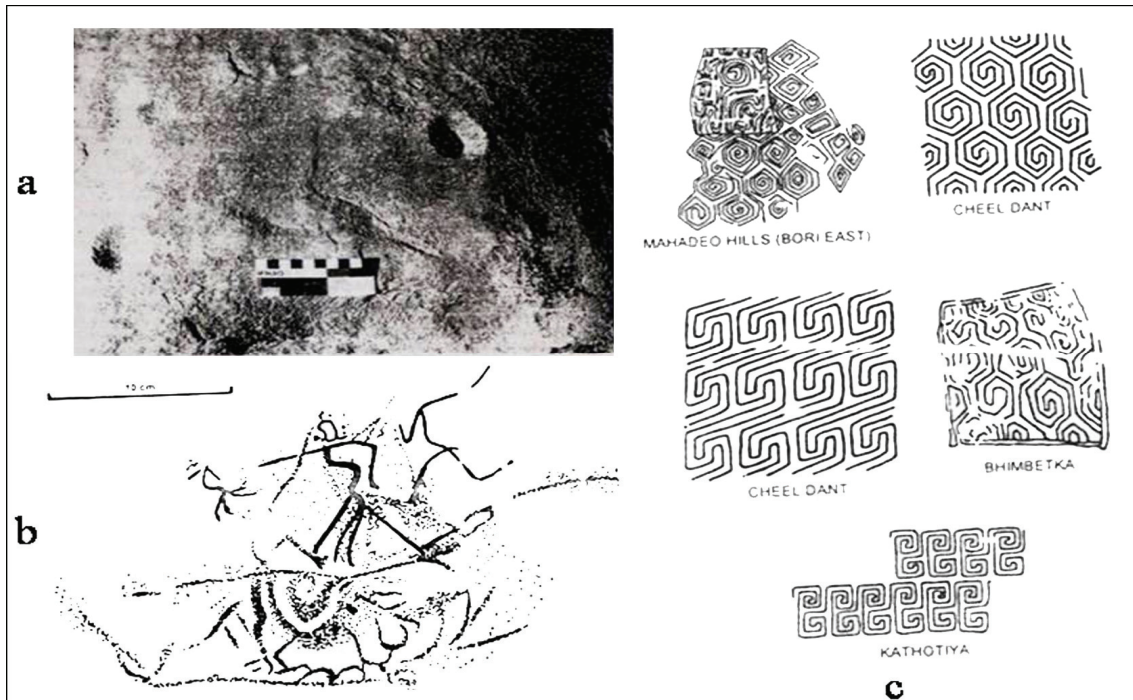


Figure 1: Cupules at Bhimbetka (a), 'S' shaped human figures superimposed on an intricate pattern at Jaora (b) and intricate patterns at central Indian rock art sites (c)

According to Wakankar, some of the rock paintings in green colour belong to the Upper Palaeolithic period. The reason behind this is the faceted green earth (called *terra verta*) that was found in the Upper Palaeolithic levels which was found in the excavations of one of the rock shelters (III A-28) at Bhimbetka. Based on this initial find, Wakankar (1975; 1983) suggested that these paintings at Bhimbetka and similar ones elsewhere were the earliest ones. According to Tyagi (1992), the rock paintings in green colour were sometime found overlapping with red paintings, and stressed more importance to the style of the rock paintings instead of their colour. In the past, rock paintings in green and yellow colours were distinguished from the younger paintings due to a very high degree of craftsmanship and a characteristic uniformity. The earliest paintings are well executed as seen by the quality of the application of the pigment in a fine and well controlled manner, which led to some scholars suggesting the beginning of rock art in India. On the basis of thematic analysis, the Upper Palaeolithic rock paintings can be classified into two phases, i.e., pre-figurative or non-iconic and figurative or iconic (Tyagi 1992).

Opinions among scholars differ in many aspects regarding the antiquity of the intricate pattern designs found at various rock art sites. The intricate pattern designs found in rock shelters are extremely fragmentary and almost merged with the surface of the rock. This might have led Mathpal (1984: 207) and Neumayer (1983: 14) to consider

them as the earliest rock paintings. Similar intricate and geometric pattern designs were found at number of rock art sites in central India such as Jaora, Kathotia, Bhimbetka, CheelDant, Bori-East in Mahadeo Hills, etc (Fig 1c). According to Wakankar and Brooks (1976: 31, 81; Wakankar1984a: 50), the 'S' shaped dynamic dancing human figures painted in green and dark red ochre belongs to earliest group of the rock paintings (Fig 4a). Kumar (1981: 279), who found a few more 'S' shaped dancing human figures has assigned these to the Upper Palaeolithic period (30,000-12,000 B.P). Despite recent research, the precise chronological bracket of the Upper Palaeolithic period in India is also yet to be established, thus adding to the confusion about the antiquity of the associated rock art whereas the microlithic tradition found in different parts of India has been dated between 45,000 years BP (Mishra *et al* 2013) and 35,000 years BP (Clarkson *et al* 2009). Interestingly, the 'S' shaped dynamic dancing human figures painted in green were found superimposed on some of the intricate pattern designs painted in red ochre, but were poorly preserved and could not be identified (Tyagi 1988: 50). The 'S' shaped dancing human figures in green and dark red were found superimposed on the intricate patterns in red were discovered at Jaora (Fig 1b), Ladi-Ki-Karar, CheelDant, Kathotiya and Firengi. They are poorly preserved and thus could not be photographed properly. But the recently developed techniques (Enrique and Pedro 2014; Enrique *et al* 2015; López-Montalvo *et al* 2014; Earl *et al* 2010; Rogerio-Candelera *et al* 2011; Ruiz and Pereira 2014; Bonneau *et al* 2012; Domingo *et al* 2013; Prinsloo *et al* 2013; José Luis Lerma *et al* 2010; Gonzalez-Aguilera *et al* 2011; Margarita *et al* 2006; Martí Mas *et al* 2013; Jezequel *et al* 2011; Heinz *et al* 2009; Goodall *et al* 2009; Olivares 2013; Defrasne 2014; Bonneau *et al* 2012; Cassen *et al* 2014; Scadding *et al* 2015; Pyatt *et al* 2005) in the digital detection as well as in the study of pigment binders will be helpful to document such kind of rock paintings in order to study the subject matter of the rock paintings found in the Indian Sub-continent and for the conservation of rock paintings (Earl *et al* 2010; Rütther *et al* 2009; Lacanette *et al* 2013) (see table 1 for various scientific analysis of pigments and dating efforts).

Engraved Ostrich eggshells found at Patne (Sali 1974; 1980), Bhopal, Ramnagar and Chandresal (Kumar *et al* 1988) (Fig 2a) as well as the Ostrich figures (Fig 2b) found in the rock art sites of central India (Gupta 1967) and in Rajasthan and the bone harpoon found at Lohanda Nala (Fig 3a) (Misra 1977: 49) were assigned to Upper Palaeolithic period whereas the engraved chert core found at Chandravati (Fig 3b) (Sonawane 1984; 1992) was assigned to Mesolithic period suggests about the mobiliary art forms in India which also suggests about the aesthetic sense and artistic abilities of the prehistoric people.

Chronometric or Absolute Dating in India

So far in India only four efforts were put forward to date the pigments of the rock paintings in order to know about the contents of the pigments as well as to establish absolute dates by employing scientifically advanced dating methods. For the first time in India the efforts put forward by Agrawal and Kharakwal (1994) have revealed the

contents of the pigments, but the efforts put in order to generate the absolute dates remained unsuccessful.

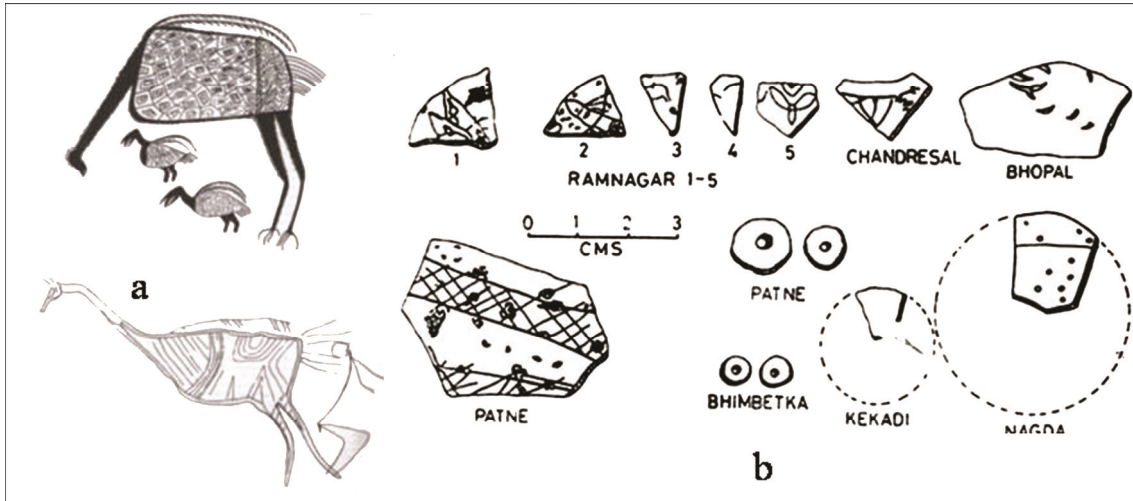


Figure 2: Ostrich figures in central Indian rock art sites (a) and Engraved Ostrich eggshells and beads made of Ostrich eggshells (b)

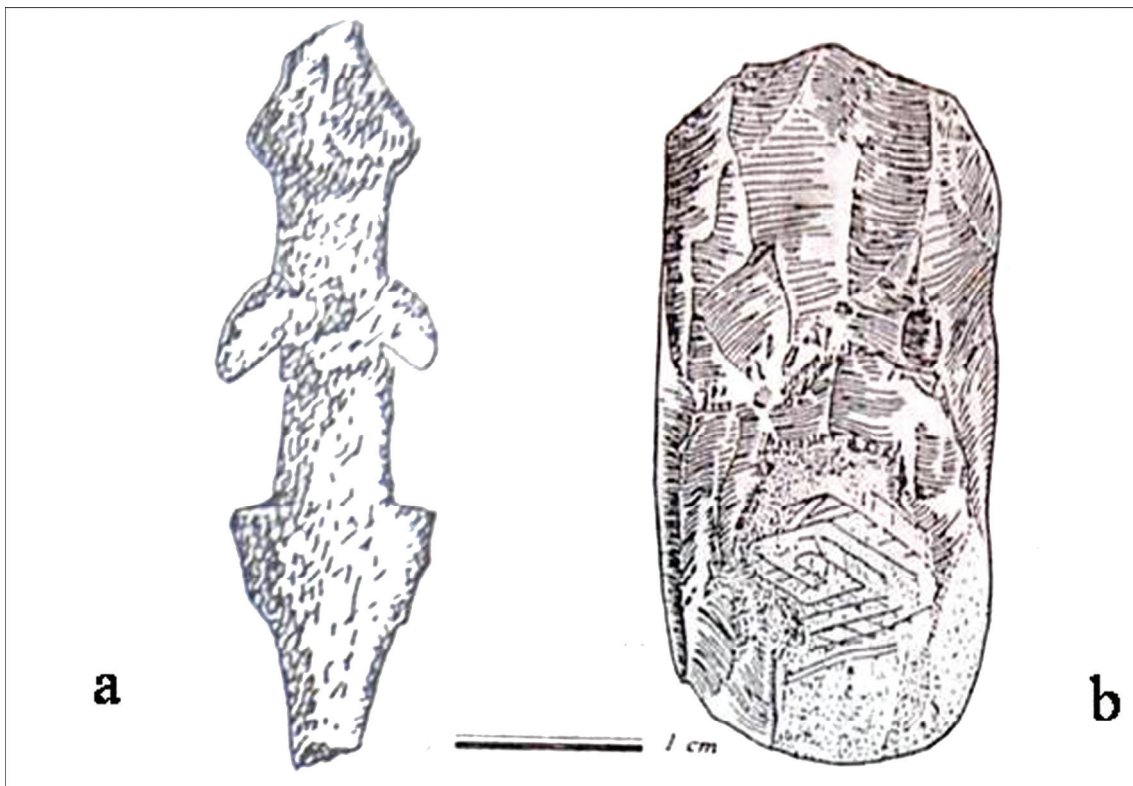


Figure 3: Harpoon made of bone from Lohanda Nala (a) and Engraved chert core from Chandravati (b)

A. K. Sharma who excavated the painted rock shelters of Jhiri, a rock art site in Madhya Pradesh tried to date the rock paintings scientifically by collecting the rock painting's pigment (Sharma 1996). Although this effort was successful in getting

information about the organic contents of the pigments, getting the results of absolute dates for the rock paintings of Jhiri yet remained awaited.

Third effort to date the rock paintings scientifically, were made by Bednarik's team (*et al.* 2005). In order to generate the absolute dates of the rock paintings their team has collected pigment samples from three rock art sites in central India. The three rock art sites from where Bednarik's team has collected pigment samples are located in Madhya Pradesh.

Bhimbetka

Oldest date from Bhimbetka (AS-122) is 5190 ± 310 years BP- pigment sample was collected from rock painting in white colour.

Another date from Bhimbetka (AS-144) is 1100 ± 60 years BP- pigment sample was collected from a rock painting in white colour.

Jamjori (J-52)

Pigment sample was collected from rock painting in white colour and the date is 1720 ± 310 years B.P.

Hathitol (Shelter B)

Pigment sample collected from rock painting in white colour and it was dated to 4810 ± 40 years BP and pigment collected from painting in red colour was dated to 2780 ± 40 years BP.

Fourth Dating Effort: Kurnool Caves

Another effort in generating the absolute dates for a petroglyph in honeycomb pattern design found in one of the caves at Billasurgam cave complex was successfully carried out by Tacon (*et al* 2013) and this effort has produced an absolute date of 5000 years BP.

Recent study of pigments using a portable Raman Spectrometer was carried out at Bhimbetka has resulted in the identification of the pigment binders such as calcite, gypsum, hematite, whewellite and goethite (Ravindran *et al* 2012) and this kind of study of the pigments using Raman Spectrometer is essential as it is a non-destructible method and can be carried out on-site.

Discussion: Pigments and Pigment Binders in Rock Paintings

Red Colour

The study of rock paintings found in India suggests that they were painted in red, green, white, yellow and black colours. Red pigment of different shades was obtained from iron oxide and it is the most profusely used mineral to draw the rock paintings. To obtain black colour either charcoal or manganese was used. Apart from red, white colour obtained from calcium nodules is also used as a coloring material. Crushed calcium clay as well as nodules and green chert and mineralized Chalcedony nodules were used in order to prepare the pigments. The study of physical properties of iron

oxides suggests that they have excellent adhesive properties. The haematite nodules were grounded and mixed with water in order to prepare the pigments (Wakankar 1975:8; Mathpal 1984:187-97; Neumayer (1993: 293-95). Binding materials such as egg white, plant juices, gum, blood, bone marrow and fat were thought to have mixed in order to prepare the pigments, but the study of rock paintings found in Mirzapur region (Tiwari1990) suggests that such kind of binding materials were not found. The study of pigment samples carried out by Agrawal and Kharakwal suggests about the contents of the rock paintings found in Almora area of Uttarakhand, and according to Agrawal bees wax was also used in the preparation of the pigments(1994)and the recent study of pigments using a portable Raman Spectrometer was carried out at Bhimbetka has resulted in the identification of the pigment binders such as calcite, gypsum, hematite, whewellite and goethite (Ravindran *et al* 2012) and this kind of study of the pigments using Raman Spectrometer is essential as it is a non-destructible method and can be carried out on-site. According to Wakankar the minerals were grounded and then mixed with bone marrow or animal fat and then the pigment was heated (Wakankar 1975:8), but according to Mathpal (1984:187-97) and Neumayer (1993: 293-95) the colours were obtained by rubbing the nodules and mixing with water. The pigments prepared by crushed haematite nodules mixed with water leaves the stain marks due to the mineral properties of the same material, but the rock paintings mixed with adhesives such as egg white, plant juices, gum, blood, bone marrow and fat and in the form of a solid paste remains for a long time, and the scientific study of such kind of pigments bearing charcoal in the rock paintings will help in producing the absolute dates to the rock paintings of Non-Iconic and Iconic category of rock paintings found in the Indian Sub-Continent which will help in the study of antiquity of such kind of rock paintings. The recent work carried out on the study of early rock art found in Hadoti Plateau in south-eastern Rajasthan (Saleem 2014b; 2015 *in press*) suggests that number of rock paintings in red, black and white colours were found containing solid pigments were found at Chattaneshwar, Ramtol, Chapria, Chamalia Nala, Golpur, Cable Nagar, Kavarpura and Kanyadeh (Fig 5a & b, Fig 6a & b, Fig 7a& b, Fig 8a & b, Fig 9a & b, Fig 10a, b & c, Fig 11). The study of the early rock art of Hadoti Plateau has also revealed small particles of charcoal, hair and plant fibres embedded in the rock paintings and the scientific study of such kind of pigment-bearing rock paintings can be carried out in order to generate the chronometric dates of the rock paintings (Saleem 2014b; 2015 *in press*). The published literature on Indian rock art and the study of early rock art in Hadoti Plateau in south-eastern Rajasthan suggests that number of rock paintings of intricate as well as geometric pattern designs, 'S' shaped, stick-shaped and square-shaped human figures and animal figures irrespective of their size in small or life size proportions with or without body decorations(Fig 4b, c and d, Fig 6a and b, Fig 7a and b, Fig 8a, b and c, Fig 9a and b, Fig 11)were found in various parts of the Indian Sub-Continent and the scientific study of such kind of rock paintings containing solid pigments will be helpful in the study of the antiquity of rock art in India as number of scholars have suggested that some of the rock paintings belongs to Upper Palaeolithic period (Wakankar1975;

1976: 31, 81; 1983;1984a: 50, Mathpal 1984; 1992, Kumar 1981, Tyagi 1988; 1992, Pandey 1992) whereas the antiquity of rock art in India still remains a contentious issue to solve as well as the Upper Palaeolithic itself is not yet established (Saleem2014a & b; 2015 *in press*).

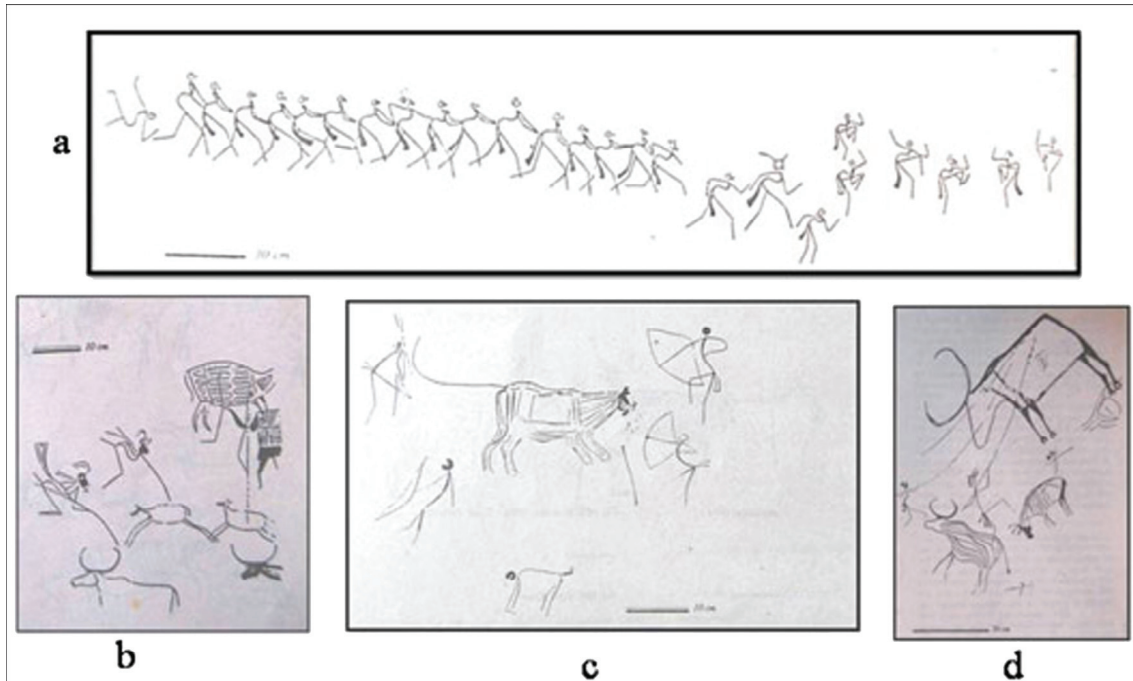


Figure 4: 'S' shaped human figures in dancing postures at Lakhjoar (a) and in hunting scenes equipped with spears at Kathotia (b) and with bow and arrows at Kathotia (c) and in association with stick-shaped human figure at Gupha Masir (d)



Figure 5: Intricate patterns at (a) Ramtol and (b) Chapria

White Colour

White colour was prepared from clayey soils or calcium carbonate nodules (Wakankar 1975:8; Mathpal 1984: 187-97; Neumayer1993: 293-95). White pigments prepared from mineralized white Chalcedony were also probably used. The efforts of EIP (Early Indian Petroglyphs) Project which has incorporated the scientific study of rock

paintings in central India was carried out by Bednarik's team (*et al* 2005) has generated absolute dates ranging from 5190±310 years BP, 4810±40 years BP, 1100±60 years BP and 1720±310 years BP to the rock paintings in white colour found at Bhimbetka, Hathitol and Jamjori and 2780±40 years BP to a rock painting in red colour was collected from Hathitol were subjected for the scientific analysis.

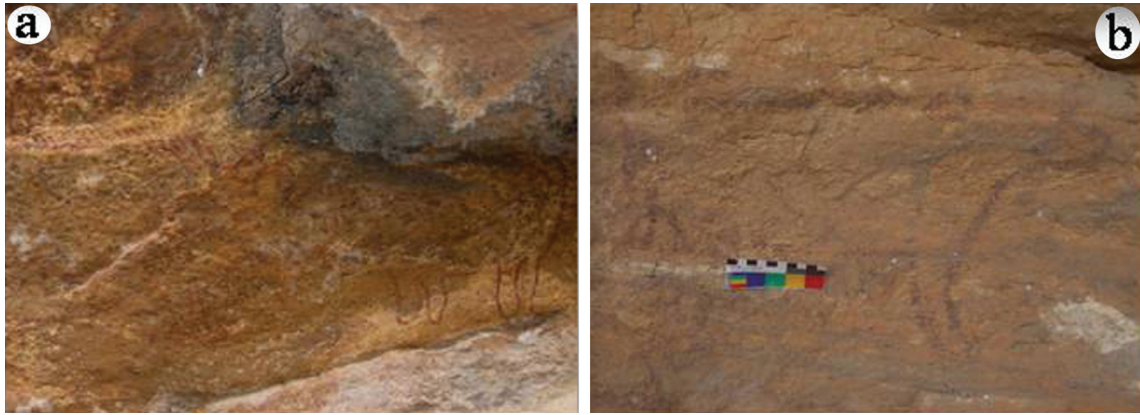


Figure 6: Animal figures (A and B) at Chamalia Nala

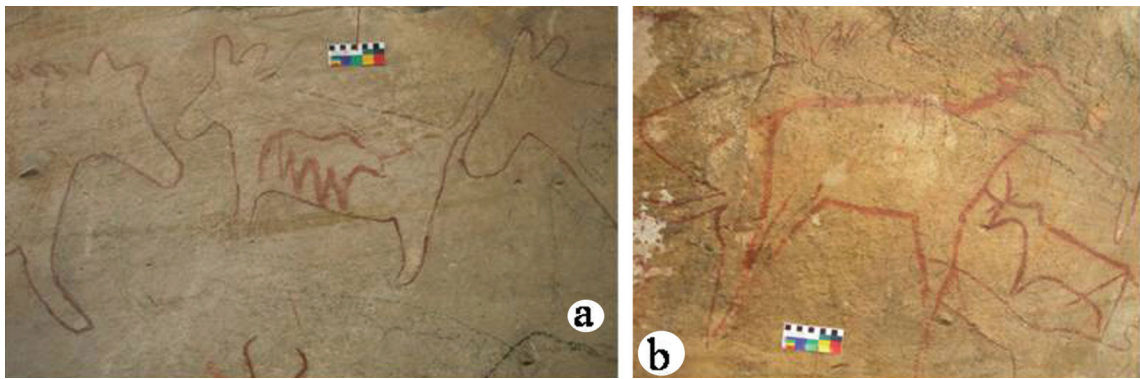


Figure 7: Animal figures (A and B) at Golpur

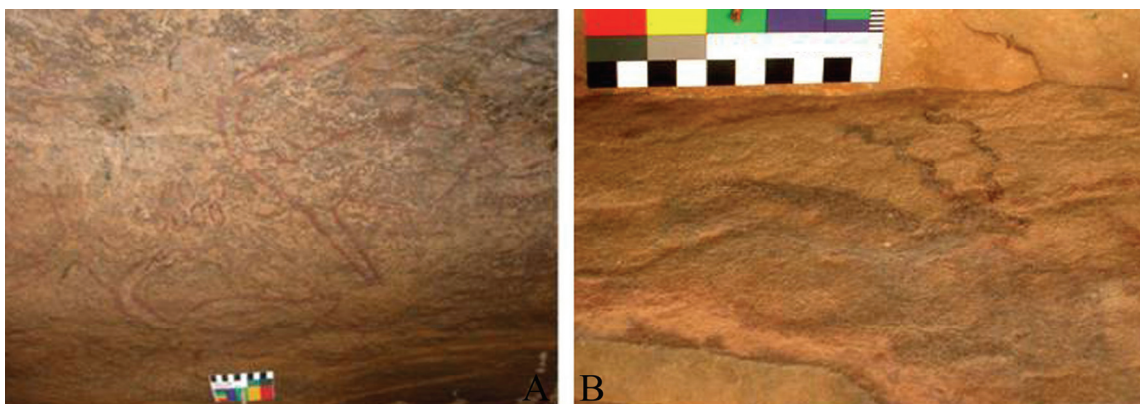


Figure 8: Animal figures at Chapria (A) and Cable Nagar (B)

Green and Yellow Colours

Green colour derives from chert nodules in green colour. White and yellow colours derive from mineralized Chalcedony and yellow colours which were only found in the

trap regions, and even in some regions these chalky minerals are not found frequently (Wakankar 1975:8; Mathpal 1984:187-97; Neumayer1993:293-95). But the dispute about the antiquity of rock paintings of 'S' shaped human figures in green colour found at Bhimbetka and other rock art sites in central India still remain a dubious issue as they were assigned to Upper Palaeolithic period (Wakankar and Brooks (1976: 31, 81; Wakankar 1984a: 50, Kumar 1981: 279, Tyagi 1988; 1992, Pandey 1992). Though the efforts of EIP Project (Bednarik *et al* 2005) has initiated and was successful in the scientific study of rock paintings in central India, but the dating of intricate as well as geometric pattern designs and 'S' shaped human figures and associated animal figures and stick-shaped human figures (Fig 4b, c and d) in green and red colours requires ones attention as such kind of rock paintings were thought to belong to the earliest phase of rock art.

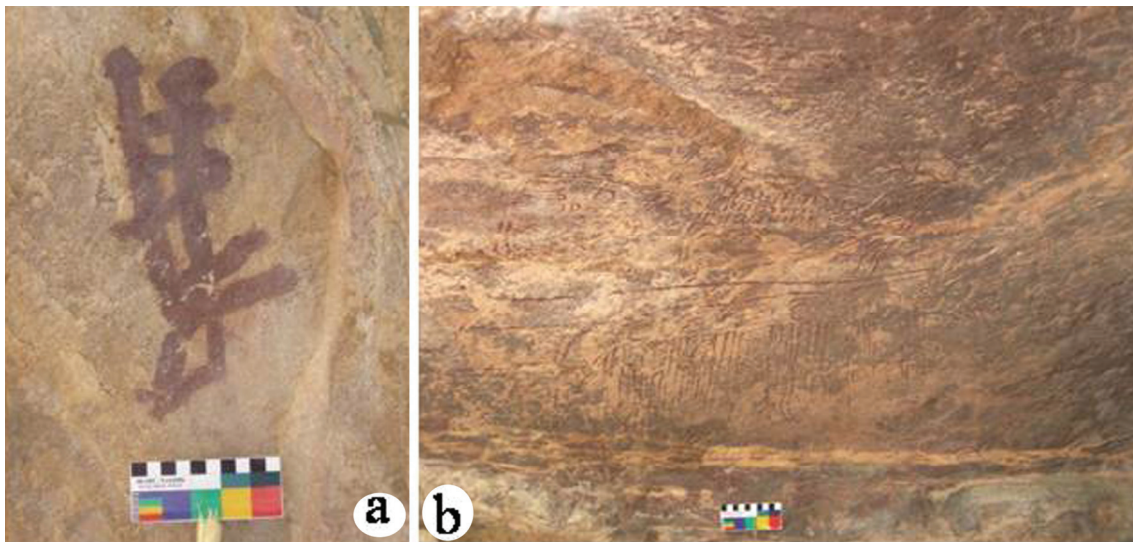


Figure 9: Stick-shaped (A) and Square-shaped human figures (B) at Chattaneshwar



Figure 10: Animal figures (A) and an alpina design (B) at Golpur and an unidentified painting at Kavarpura (C)

The scientific study of rock paintings found in Indonesia (Aubert *et al* 2014) were dated to 39.9 to 35.4 kyr, suggests about the dispersals of modern humans into Asia whereas the recent study carried out on the microlithic tradition found in different parts of India has been dated between 45,000 years BP (Mishra *et al* 2013) and 35,000 years BP (Clarkson *et al* 2009) and raises questions about the dispersal routes of the modern humans and about the arrival of art in India.



Figure 11: Hand prints at Kanyadeh

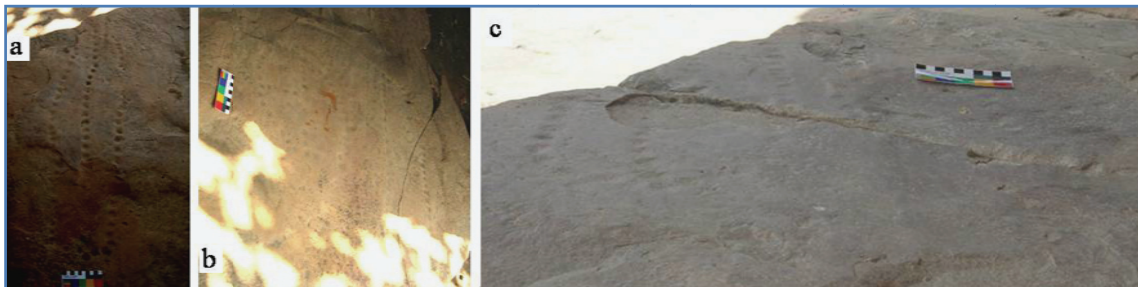


Figure 12: Petroglyphs in the form of designs (A and B) at Cable Nagar and at Chattaneshwar (C)

Conclusion

The study of the early rock art of Hadoti Plateau in south-eastern Rajasthan (Saleem 2014b) has revealed small particles of charcoal, hair and plant fibers embedded in the rock paintings and the scientific study of such kind of pigments bearing charcoal in the rock paintings can be carried out in order to generate the chronometric dates of the rock paintings. Study of similar pigment-bearing rock paintings found in the Indian Sub-Continent will shed a new light on the antiquity of rock art in India.

The petroglyphs found on the surface of the rock shelters of Cable Nagar (Fig 12a and b) and Chattaneshwar (Fig 12c) in Hadoti Plateau were found in the form of a design. Such kind of designs were probably prepared before the beginning of rock paintings, and so far such kind of petroglyphs in the form of designs were not found in the Indian rock art sites which may precede rock art.

The scientific study of rock paintings is required not only to know about the age of different types of rock paintings of both non-iconic and iconic categories, but it is evenly important to study about the binders of the pigments, and how they were collected and prepared, etc remains to be dealt with careful analysis, and this kind of heritage requires further steps towards the scientific studies in order to study to how to preserve and conserve the rock paintings for the forthcoming generations.

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