

Workshop

On
Suitable Dating
Technique for Indian
Rock Art

25th -26th February, 2014



Indira Gandhi National Centre for the Arts
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Workshop
On
“Suitable Dating Techniques for Indian Rock Art”

(25th -26th February, 2014)

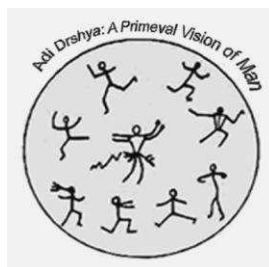


Indira Gandhi National Centre for the Arts
New Delhi

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Concept Note



WORKSHOP ON THE SUITABLE DATING TECHNIQUES FOR INDIAN ROCK ART

The Indira Gandhi National Centre for the Arts (IGNCA) is India's premier institution conceptualized and visualized as a Centre encompassing the study and experience of all the arts – each form with its own integrity, yet within the dimension of mutual interrelatedness with nature, social structure and cosmology. The Centre has conceived a major academic programme, which relates to exploring artistic manifestations emanating from man's primary sense perceptions. Amongst the senses that lead to aesthetic experience are vision (*Drshya*) and hearing (*Shravya*). The rock art forms a crucial component of the *Adi Drshya* programme. Its conceptual plan aims to open the doors to the realization that rock art is pure and absolute and hence capable of dispensing great experience beyond its original culture and time. The IGNCA's concern with prehistoric rock art is not restricted to the Archaeologists, and the pre-historians' concern with establishing a linear chronological order of prehistoric rock art, nor is it restricted to the identification of style and school as criterion for establishing chronology. Instead, it is a concern for man's creativity across time and space and civilizations and cultures through the perception of the sight. Briefly, the goal to

be set is not merely the development of a database and a multimedia gallery but also to establish *Adi Drshya* into a school of thought and research on alternate means of understanding prehistoric art.

Rock art is one of our greatest surviving art treasures. It possesses a largest body of evidence of human artistic, cognitive and cultural beginnings. The intrinsic efficacy of the rock art lies in the universality of appeal and to endure and sustain in a manner in which all can discern it. In the different parts of the world many international conferences have been held earlier on the general subject of the rock art but hardly a few on a specific theme in the global context. In India, the IGNCA organized a Global Rock Art Conference in 1993. In this conference the main stream of discussion followed the seminal issues like 'Universality' and 'Chronology'. Other problems highlighted were those of conservation and preservation of rock art sites, the safeguard of the natural environment and protection of the right of the indigenous people inhabiting in the proximity of rock art sites. On this issue an “Expert Meeting on the Conservation, Preservation and Management of Rock Art” was organized by the IGNCA in 1996. An International Rock Art Conference on the general subject was organized by IFRAO-RASI at Agra in 2004. Another important and well received International Conference on Rock Art was organized by the IGNCA in 2012. The main focus of this conference was to understand rock art in its context. The present workshop would mainly focus on a long due and much discussed and burning issue that what are the “Suitable Dating

Techniques for Indian Rock Art”. It will be a proud privilege for the IGNCA to host such a workshop of academic merit with an urge to analyze where we stand in the global context. Some of the topics hopefully to come under discussion in the workshop may include the minimum dating by archaeological excavation, radiocarbon analyses of mineral accretions or their inclusions, radiocarbon analyses of paint residues or their inclusions, geomorphological methods, minimum or maximum ages derived from biological accretions, lichenometry, colorimetry of patinae, radiocarbon analyses of charcoal and beeswax figures, and any other methods of “direct” dating of rock art.

Most of the rock art researchers’ main focus of their investigations for rock art dating at present has been to establish chronologies of different rock art sites, based on pigment analysis to direct dating to stylistic features. While dating rock art it has been related to stratigraphy. The style also has been used as a formal denominator. As the comparable contexts too have a rather imprecise dating, precise age is very difficult to identify. But the relative age is often easier to reach. Besides, a detailed chronology seems impossible to construct. An endeavour has been made by some scholars to approach rock art with a view to reconstruct the lifestyle and environment of the people who created this art. While agreeing that chronology is crucial for rock art, it was admitted that, as yet, no absolute dating, or definite chronological order had been established so far. Some scholars advocate re-assessing the acceptance of chronology as the sole

criterion of rock art studies. Doubts are raised on constructing a universal standard for dating in this field.

The age estimation of rock art has long been a key aspect of rock art research, but continues to be attended by difficulties over methodology, misinterpretation of findings and overconfidence in the reliability or precision of results. In this workshop it is intended to pursue not only new insights but also new dating results. The main course of discussion would be around the multitude of methods and approaches that have been used in securing age estimates, how they compare in determining the timing of rock art depictions, and how results of multiple method strategies might cluster around the target event. It is also intended to cover all new rock art dating results and developments, and to consider reviews of earlier determinations produced over the past few decades. The main objective would be to explore the reliable and appropriate dating methods/techniques for dating rock art in Indian context.

Dr. B. L. Malla
Project Director

**WORKSHOP
ON
“SUITABLE DATING TECHNIQUES FOR INDIAN ROCK ART”
(25TH -26TH FEBRUARY, 2014)**

Venue: Conference Hall, C. V. Mess, Janpath, IGNCA, New Delhi

25-02-2014

11.30 AM-1.00 PM INAUGURAL SESSION

**BOOK RELEASE BY CHIEF GUEST
Dr. SUBAS PANI**

**KEYNOTE SPEECH
SHRI B.M.PANDE**

1.00 PM-2.00 PM LUNCH BREAK

2.00 PM-5.30 PM ACADEMIC SESSION-I

SUITABLE METHOD FOR DATING THE INDIAN ROCK ART: PICTURE WISE ANALYSIS AND
THE DISTRIBUTION
A. SUNDARA

RECENT ADVANCES IN DATING ROCK ART OF PREHISTORIC SOUTHERN INDIA
RAVI KORISSETTAR

PRINCIPLES OF A NEW PROPOSED PIGMENT TRACE ELEMENT METHOD FOR DATING OF
INDIAN ROCK ART
SOMNATH CHAKRAVERTY

RELATIVE AND ABSOLUTE DATING OF INDIAN ROCK ART: WITH REFERENCE TO CENTRAL
INDIAN ROCK ART
KANTIKUMAR A. PAWAR

ABSOLUTE DATING OF A TIME MARKER FROM THE SATPURAS: AN APPRAISAL THROUGH
URANIUM SERIES FOR CENTRAL INDIAN ROCK ART
RUMAN BANERJEE & SOMNATH CHAKRAVERTY

26-02-2014

10.00AM-1.00 PM

ACADEMIC SESSION-II

RELATIVITY OF THE ABSOLUTE: DATING THE INDIAN ROCK ART
N. CHANDRAMOULI

DATING OF ARTISTIC DEPICTIONS IN ROCK SHELTERS: SOME ISSUES
R. C. AGRAWAL

DATING OF ROCK ARTSOME POSSIBILITIES
G. L. BADAM

INTERPRETING AND UNDERSTANDING ROCK ART SITES: THE IMPLICATIONS OF STABLE
ISOTOPE ANALYSIS IN ARCHAEOLOGY
V. N. PRABHAKAR

THE QUANTITATIVE DATING OF ROCK ART
C. M. NAUTIYAL

1.00 PM-2.00 PM

LUNCH BREAK

2.00 PM-3.00PM

ACADEMIC SESSION-III

SOME KEY ASPECTS OF ROCK ART DATING
B. L. MALLA

DATING ROCK ART
RAKESH TEWARI

3.00PM-5.30PM

VALEDICTORY SESSION

SUITABLE METHOD FOR DATING THE INDIAN ROCK ART: PICTURE WISE ANALYSIS AND THE DISTRIBUTION

A. SUNDARA

One of the most vexing problems in the study of Indian rock art sites ranging from the Upper Paleolithic to the Modern is fixing their chronology. Efforts are being no doubt made to determine an acceptable chronology of the sites. Among the usual methods applied in the matter are: a meticulous study of the types and kinds of animals depicted; human activities such as hunting, rituals, community dancing etc. that vary from time to time, region to region; overlap; circumstantial archaeological evidences, bruising etc.; styles of the pictures; colours used; the current condition of the paintings; ethnographical parallels etc. as well as archaeological excavations at promising sites. There are a few scientific techniques that may be used to find out the age of the paints of the pictures. However, in India they are hardly used. Of course efforts are being made to establish scientific laboratories for the purpose.

Till such time of establishing science laboratories for dating, some empirical techniques suitable for each of the regions may be developed apart from those mentioned above. As a case study in my region careful analyses of the each object from the sites and their distribution pattern in association with possibly related archaeological evidences wherever available, I think, would provide an acceptable framework for ascertaining approximate chronology. Even after the development of scientific techniques for dating it is always worthy of using the empirical techniques as well for

categorically confirming the dates are obtained from each other. The present paper discusses the method suggested here in by considering the rock art sites in northern Karnataka.

Dr. A. Sundara, is a retired professor in archaeology. He started his professional career in the Archaeological Survey of India as a technical assistant carrying out village-to-village surveys of antiquarian remains. He was also the dean of the social science faculty in the Department of Ancient Indian History and Epigraphy, Karnataka University, Dharwad.

Dr. Sundara has participated in many archaeological excavations and, on the basis of his field work and excavations, has published over 300 research papers and 16 books. He has also delivered several lectures as a resource person for orientation and refresher courses in universities and institutes.

Dr. Sundara is a recipient of many awards for his contributions in the field. He is also member of various national and regional academic societies.

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RECENT ADVANCES IN DATING ROCK ART OF PREHISTORIC SOUTHERN INDIA

RAVI KORISSETTAR

Dating of rock art, especially the landscape art is crucial to understanding the nature and development of behavioural modernity of modern human populations in the different regions of the world. Undoubtedly rock art and other forms of art are clear signs of symbolic expression associated with modern humans across the world. Earliest landscape art dates back to the Upper Palaeolithic in most parts of the Old World but its precise dating in the different regions has not been possible. While the South African evidence of art activity dates back to nearly 100 ka, in continental Europe and southern Asia rock art is spread over the Late Pleistocene largely covering the Upper Palaeolithic, and in the New World rock art has facilitated the dating the timing of modern human entry into the region. Symbolic expression through art had developed long before the New World was colonized by *Homo sapiens*. Hence its dating is critical to fix the entry of modern humans into different areas of the New World.

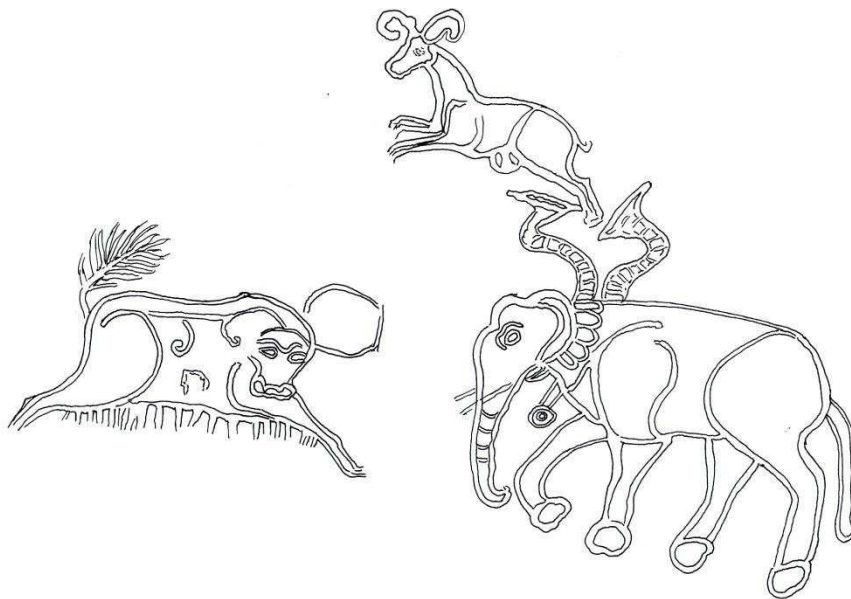
The vast body of prehistoric rock art in southern India has been broadly grouped into Mesolithic, Neolithic and Iron Age cultural periods. This dating is largely on style, content (theme) and pigment use. While themes could overlap in time as well as the use of pigment most chronological arguments were based on overall themes such as hunting gathering, agro-pastoral and so on. The possibility of some of it could be older than the Mesolithic was not considered for want of definite excavated and well dated Upper Palaeolithic contexts and identification of contexts (geological) potential for dating by chronometric methods.

The presentation takes stock of the nature of rock art in southern India, its variety and dating efforts in the light of new methods that are being applied for dating rock art in North America as well as AMS dating of rock art in the limestone caves of southern India. Obviously a firm chronology of symbolic expressions or objects of art is of help in tracing the evolution of symbolic behavior in hominines. Till recently, with the exception of rock art, other forms of art have been absolute dated. However the application of AMS dating technique for dating rock art on limestone surfaces has proved potential for dating Pleistocene contexts as well.

Dr. Ravi Korisettar is currently Dr DC Pavate professor of Art and Archaeology at Karnatak University, Dharwad, Karnataka, India. He obtained his post-graduated and Ph.D. degrees from Deccan College in Pune. He joined the Department of History and Archaeology at Karnatak University in 1989, and ever since he has been collaborating with institutions in India and abroad, particularly with Smithsonian Institution in Washington DC, the universities of Cambridge and Oxford and Institute of Archaeology, UCL-London. He has conducted a series of investigations into the Palaeolithic and Neolithic cultures of southern India and has been excavating a group of Later Pleistocene open air, rock shelter and cave sites at Jwalapuram in Kurnool District of Andhra Pradesh. In collaboration with archaeologists from the UK he has conducted investigations into the origins of agricultural economies in south India and excavated a large Neolithic site at Sanganakallu in Karnataka. In 2003 he brought to light hundreds of prehistoric painted rock shelters in the Errajari plateau of Proterozoic Kurnool sub-basin in Andhra Pradesh and has facilitated a systematic documentation and study of these paintings with Paul Tacon of Griffith University, Australia. His successful

collaborative work is well attested by a number of learned articles and edited books. He is co-editor of *Quaternary Environments and Geoarchaeology of India* (1995), *The Rise of Early Human Behaviour in global Context*, *Indian Archaeology in Retrospect* (4 volumes), etc. The hallmark his work is the successful international collaboration that has secured due place to India in current global debates on peopling of the world. He has successfully applied the Public Outreach Archaeology as a strategy to prevent the loss of heritage and an initiative to launch heritage consciousness among the inhabitants in the neighborhood of prehistoric archaeological sites.

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PRINCIPLES OF A NEW PROPOSED PIGMENT TRACE ELEMENT METHOD FOR DATING OF INDIAN ROCK ART

SOMNATH CHAKRAVERTY

Development of suitable technique and methods for dating is most urgent and essential for understanding the chrono-cultural milieu of rock art in India. In India, occurrence of rock art is most frequent in the rock shelters where the walls and sometimes even the overhang ceiling display rock art imagery. The principle of the present proposed method indicate that during its process of painting on the rock surface, drops and droplets of paints could have been accumulated on the floor and in its vicinity. Such in situ preserved evidences are basic sources to relate the pigments, paint or both to a particular stratum or sealed layer of a floor deposit, which may be enriched with tools, artifacts and other biotic as well as cultural remains of the respective period. Therefore, to follow this method, primarily a trial trench is essential to dig on the floor exactly below the surface of the painted part of any rock to trace the drops and other remnants from the prepared paint. It is possible that a portion of such trace element containing at least some nano-samples from the paint could be recovered. Possibility for finding of such trace element could be further enhanced by series of experiments. Several such experiments already conducted has revealed that the stone nodules, boulders and angular gravels etc. that generally remain spread over the floor in actual situation are more potential sources to contain and preserve the drops or splashes left from the paint, brush or both. Rather, the drops of paint left on sand and other

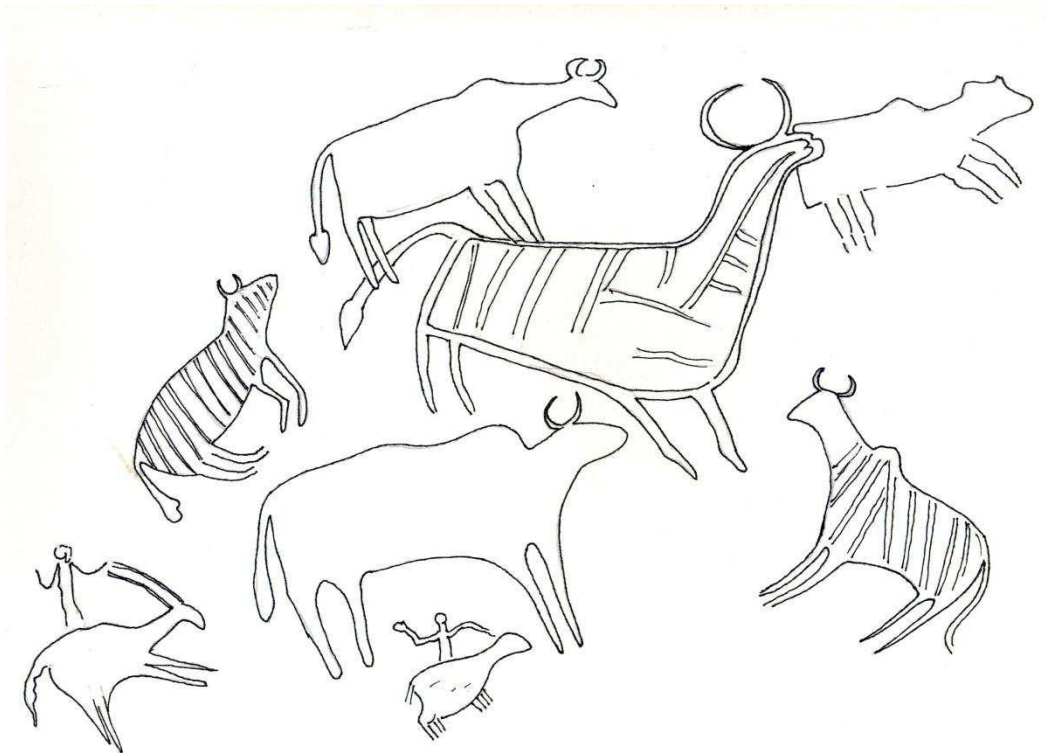
granular particles of the deposit could not be separated or detected from its matrix. The idea for such dating was inspired from the actual situation prevails in Pachmarhi. Such drops of paints were identified beneath the painted walls and roofs of several rock shelters located in Ghoranar groups of rock shelters located in the northern extreme of Pachmarhi, Mahadeo Hills. In this region, the occurrence of such trace element as residue of the paint are marked on large boulders that are covered by thin layer of upper deposit of fallen angular rocks, primarily of purple-coloured sand stone, and black soil admixed with plant remains, pit and other organic substances. This deposit is about 16” to 22” in average thickness and contains aceramic geometric type of microliths. This case study in Pachmarhi can further be related, followed by simulations and enhanced in the light of Hunter’s earlier excavation at Dorothy Deep rock shelter, Pachmarhi. That is attempted to reconstruct the chrono-cultural configuration of rock art in Mahadeo hills.

The above proposed method for ascertaining relative dating of rock paintings is primarily possible through digging trial trenches and finding of trace materials in the form of remnants of paints and pigments. Such traces ultimately help to relate rock art to a particular layer of deposit accumulated on the floor. It may also reveal some cultural evidences to co-relate both. Ultimately such method helps to determine, more convincingly the rock art to a geological deposit indicating an era, any industry, cultural period or both.

Dr. Somnath Chakraverty is an anthropologist and a former Fulbright Fellow and faculty member, University of Pennsylvania

and Michigan University. Dr. Chakraverty also served as the University Grant Commission's National Teacher Fellow in Anthropology and as the Project Director, Rock Art Research Programme of the Asiatic Society. He was also the Head of the Department of Anthropology, BEC, University of Calcutta.

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RELATIVE AND ABSOLUTE DATING OF INDIAN ROCK ART: WITH REFERENCE TO CENTRAL INDIAN ROCK ART

KANTIKUMAR A. PAWAR

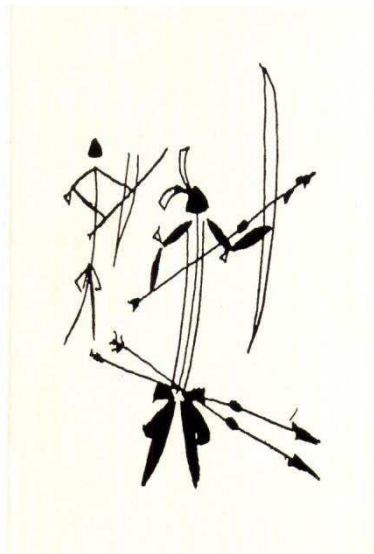
Scientific dating is the most vital issue in the Rock art whereas up to this date most rock art researcher relies on the stylistic chronology suggested by the senior Indian rock art researchers. The oldest form of known rock art, anywhere in the world, consists mostly of cupules, and the oldest known site is in India. The Petroglyphs in Auditorium Cave (Bhimbetka III F-24) are thought to be of Acheulian age. They occur contiguous with two Acheulian strata, with bifaces, cleavers and scrapers, which overlie a pebble tool industry of choppers and scrapers. These Acheulian Petroglyphs are the oldest rock art currently known in the world. There is no dating available from Auditorium Cave itself, but the Indian Acheulian is generally thought to be of the same antiquity as that of Africa and Europe. Most attempts of Thorium-Uranium dating have shown this tradition in India to be beyond the limit of the method, 350 000 years Kumar in 1996 has reported the discovery of 498 cupules in the cave of Daraki-Chattan, in the Chambal valley region. He has suggested that this rock art dates from the Acheulian or Middle Palaeolithic periods, essentially because the stone tools of these periods occur on the floor deposit within the cave.

In this present paper attempt has been made to interpret few Rock painting and Petroglyphs sites from central India and discussed them in details about relative and absolute dating of this form of rock art.

Kantikumar Anant Pawar is an Asst. Professor, Department of Archaeology, Deccan College Post-Graduate and Research Institute, Pune. His primary courses include Ancient Indian History, Culture and Archaeology.

Besides Kantikumar Anant Pawar's main contributions towards excavation, exploration and documentation of archaeological sites as well as rock art sites in India. To Kantikumar Anant Pawar's credits are more than 15 papers and he has been participated in several National and International Conferences.

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ABSOLUTE DATING OF A TIME MARKER FROM THE SATPURAS: AN APPRAISAL THROUGH URANIUM SERIES FOR CENTRAL INDIAN ROCK ART

RUMAN BANERJEE
&
SOMNATH CHAKRAVERTY

A few successful attempts have been made recently to date rock art using U-series. Rock art of Cantabria, Borneo, Cresswell, East Timor, Altamira, China and Britain (Bischoff *et al.*, 2003; Plagnes *et al.*, 2003; Pike *et al.*, 2005, 2012; Aubert *et al.*, 2007; Taçon *et al.*, 2012; Nash *et al.*, 2012) have been dated successfully by U-Th technique following a set of different methodologies. To date the samples from rock art the principles of radiogenic isotope dating, as mentioned above; analytical methodology following experimental procedure for U-Th dating, sample preparation, chemical separation and MC-ICPMS procedure have been dealt thoroughly in a stepwise fashion to obtain final, accurate and precise data, that inspire the configuration of basic chronology for rock art sites in Central India.

Uranium-series dating methods are based on the activity for ratio measurements of uranium and its various long-lived daughter nuclides and only applicable to materials that are currently in a state of disequilibrium. Recent research into U-series dating (Richards *et al.*, 1998) has demonstrated significant potential to extend the practical dating limits of speleothems and carbonates to many millions of years, nearly to the age of the earth. The ratio of ^{234}U and ^{238}U provides important information on Pleistocene climate change and rainfall (Robinson *et al.*, 2002, 2004). The uranium samples should contain more than 50 ppb to

over 5 ppm of U to get securely dated. A few assumptions must be valid if the result of the sample analysis is to represent the true age; firstly, the sample must remain as a closed system after its formation and secondly, while its formation the sample should not have ^{230}Th . The age of the sample could be determined from the ratio of $^{230}\text{Th}/^{234}\text{U}$. Pure and well crystallized calcites are better for U-series dating. The samples procured from the Indian rock art sites have been analyzed in the laboratory of the Bristol Isotope Group, University of Bristol, UK. All the shelters surveyed do not represent sealed geochemical context. Since the entrance is open, wide and the air temperature along with other micro-climatic variants are not constant. A total of eleven samples were measured following the methodology detailed in (Hoffmann *et al.*, 2007, 2008; Scholz and Hoffmann, 2008). Within the samples collected from the central Indian rock art sites, the Mount Rosa sample from Mahadeo hills, Pachmarhi has produced a date for one particular image of a quadruped painted in white pigment as: 3.56 ± 2.10 ka BP. It is also to be mentioned that for this sample, the error bar (\pm) is quite high.

An anthropological enquiry on the rock art imagery of the particular site as well as of the region reveals an insight into the antiquity of the cultural practices by early indigenous ethnic groups and its successive cultural continuum.

Mr. Ruman Banerjee is pursuing his Ph.D research from the University of Bristol, UK on 'The Rock Art of Central India'. Mr. Banerjee has extensive experience in morphometry and typology of prehistoric stone tools, scanning electron microscopy, X-ray

diffraction, X-ray fluorescence, mass spectrometry and micromorphology. Apart from being a student Fellow of the Royal Anthropological Institute and the Royal Asiatic Society of Great Britain and Ireland, he is also a member of few prehistoric and art societies. He has attended several national and international seminars and done field work in India, Spain, France, Portugal, Italy and the United Kingdom. His previous collaborative research work was published in the 2012 issue of the *Quaternary International Journal*.

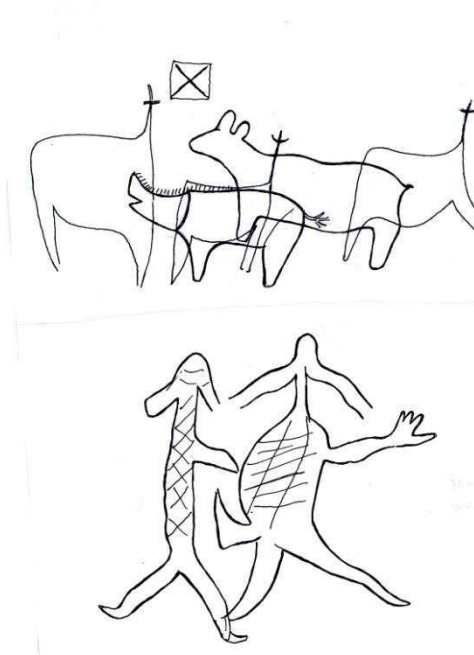
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RELATIVITY OF THE ABSOLUTE: DATING THE INDIAN ROCK ART

N. CHANDRAMOULI

Right from the beginning of research, context and chronology of rock art were the two major issues that went together in the effort to compartmentalize the data into various phases of prehistoric, proto-historical and historical period, on a temporal scale. In the absence of any scientific dating techniques the early pioneers of rock art research devised relative dating techniques based on stylistic classificatory method or on the basis of linear evolutionary concept progressing from simple aniconic/symbolic forms to iconic/abstract ones. Such linear evolutionary phases of rock art were sometimes substantiated by the excavated remains which were again dated on stratigraphical grounds. These efforts of relative dating were dubbed by some scholars as racially and geographically biased, unscientific and highly personal.

The second half of the 20th century saw the development and application of the scientific dating methods, leading to the preparation of extensive chronological charts for archaeological cultures across the world. The rock art phases of stylistic/linear evolutionary cycles began to be associated with the dated archeological examples in stratigraphical context. Criticism of the relative dating sequences in rock art aside, they continued to be applied by the rock art researchers.

With the emergence of AMS dating, rock art research witnessed tremendous upheavals as the established dates of the prehistoric phases were pushed back by thousands of years. This led to the clamour of finding the most ancient rock art in the world leading to heated intellectual debates. Multi-disciplinary teams fanned across the world to test various dating methods in rock art studies. India is no exception to these phenomena.

This paper will address the issue of absolutism in archaeological and rock art research. It will also debate the current developments in research such as the aesthetic appreciation of the prehistoric rock art (or just 'rock art') without any chronological underpinnings. When the known and established dates are being questioned and revised, the need to have a fresh appraisal of the entire issue of 'chronology' in rock art becomes pertinent and necessary too.

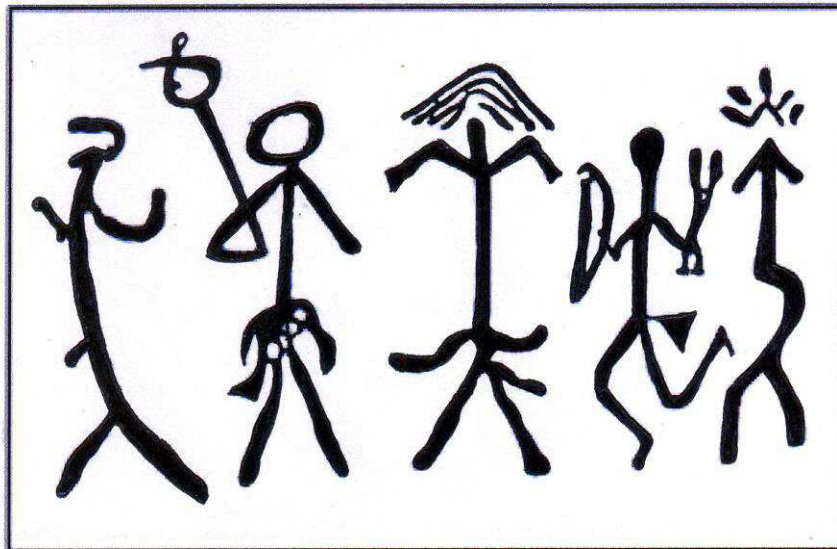
Dr. N. Chandramouli is Associate Professor in the Department of History, Pondicherry University, Puducherry. His academic interests include prehistoric archaeology, field archaeology, rock art studies, numismatics, tantric religion and terracotta art.

Dr. Chandramouli's field studies include regional traditions of rock art in India. He has published two books and 30 research papers in various national and regional journals on subjects including archaeology, history and rock art.

Dr. Chandramouli is a member of executive committees of many academic and professional organizations such as the Indian

Society for Prehistoric and Quaternary Studies (ISPQS), Rock Art Society of India (RASI) Historical Society of Pondicherry (HSP) and the Andhra Pradesh History Congress (APHC). He teaches early/ancient Indian history, epigraphy, rock art and numismatics to post-graduate students in Pondicherry University.

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DATING OF ARTISTIC DEPICTIONS IN ROCK SHELTERS: SOME ISSUES

R. C. AGRAWAL

Painting in different colors on the walls and ceiling of rock-shelters have been found in different parts of the country . More than two third of these paintings are available in Central India. Some of these shelters have been excavated in sixties and seventies and early nineties - particularly at Bhimbetka, Jhiri, Dar-ki-Chattan etc,. These shelters and paintings have been dated largely tentatively to Mesolithic, Chalcolithic, Megalithic-historical periods. How date these paintings perfectly is still a question before us?

The earliest attempt for developing the chronology of rock painting was initiated by Col. D. H.Gordon. He classified the paintings in four series. The first of the series was compared with those of Singanpur (Raigarh). The second was identified in Mahadev hills (Hoshangabad). The third was identified in Pachmari area and the fourth was from Jhalai and compared with early mediaeval sculptures dating between 9th and 13th century A.D. He also compared the copper harpoons from Ganga Valley with Mirzapur rock paintings and dated them around 800 B.C. These attempts by Gordon initiated a debate amongst Indian Archaeologist to date the paintings. Here an attempt has been made to develop the historiography of dating of rock paintings and what is the appropriate approach for developing the absolute dating.

Dr. R. C. Agrawal is presently a visiting faculty at the School of Planning and Architecture and the National Museum Institute of History of Art, Conservation and Museology.

Dr. Agrawal has a long association of working with the Archaeological Survey of India (ASI). He retired as Joint Director General of ASI and was also Principal Director, Architectural Heritage Division INTACH.

Dr. Agrawal has been a part of many conservation and documentation projects of built heritages in different parts of the country. He has executed conservation work at St. Anne's Church, St. Estevam Fort and supervised conservation work at the Reis Magos Fort (Goa), Mangyu Monastery (Ladakh) and Bhawal Di Baoli (Bundi).

Dr. Agrawal has participated and presented papers in various national and international conferences and seminars.

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DATING OF ROCK ARTSOME POSSIBILITIES

G. L. BADAM

Dating of Rock Art has been very problematic. However, in various parts of the world e.g., in S. Africa, Australia and some other countries, various techniques have been applied for dating of rock art with success. These include stylistic affiliation, association with datable deposits, amino acid study of protein in pigments, direct radiocarbon dating of the organic fraction of pigments, etc. In India there is, so far, no concrete technique which would help in determining the absolute date of the rock art. However, efforts, in this direction, some of these in collaboration with foreign collaborators, are under way.

The relative dating techniques have been applied in India with some success. These include degree of weathering, deterioration of paintings over time, superimposition analysis, colour combinations and other traditional methods of drawing etc.

In recent years the discovery of cupules on the panels of rock shelters, the appearance of immigrant faunal elements and disappearance of autochthonous fauna, and the presence of some habitation sites in the vicinity of rock shelters have also provided reliable source of information for chronology of the rock art.

In this presentation detailed account of the various absolute and relative dating techniques has been given which would throw

important light on the problematic area of dating of rock art especially in India.

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Dr. Badam was the faculty of the Deccan College Postgraduate and Research Institute, Pune where he established the Palaeontology Laboratory and also initiated an interest in rock art using his expertise in animal identification, palaeo-geographical distribution of animals in the past and man-animal relationships.

A leading quaternary geologist and palaeontologist, Dr. Badam has vast experience in excavating and studying various palaeontological sites throughout the country. He was Secretary and Editor of the Rock Art Society of India for several years, was a Fulbright Associate Professor at the University of Oregon, Eugene and Visiting Fellow in various museums and institutions.

Dr. Badam is the author of 150 research articles on various specialties published both in India and abroad. He has written 10 books and edited or co-edited several other publications.

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INTERPRETING AND UNDERSTANDING ROCK ART SITES: THE IMPLICATIONS OF STABLE ISOTOPE ANALYSIS IN ARCHAEOLOGY

V. N. PRABHAKAR

The artistic expressions of humans on various mediums since prehistoric times have been a subject of intensive research and debate ever since the first discovery of tools was made in the 19th century. Equal is the necessity to place these artistic expressions of past humans, particularly made on the walls of rock-shelters, caves, etc. which are termed generally as rock-art. In this regard, the advent of radiocarbon dating enabled several options to date rock-art. During the past decades, other techniques utilizing stable isotope analysis have been used by experts to understand not only the artistic expressions, but also the prehistoric past in terms of climate, migration, etc. This paper presents before the scholars the scope of stable isotope analysis in understanding the human past and its future implications on the rock-art.

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THE QUANTITATIVE DATING OF ROCK ART

C. M. NAUTIYAL

For thousands of years, human beings have given expression to their creativity in the form of art work like paintings and engravings in caves. Such art work is spread all over India also- from Assam, Bengal, Bihar and Manipur in the East and North East; Gujarat and Maharashtra on the west side; Madhya Pradesh in the centre; Uttar Pradesh and Uttarakhand in the North and Karnataka, Kerala, Tamilnadu in the South. However, such work in countries such as France, Germany and Spain in Europe, and in various parts of the North and South America has been scientifically analyzed, but such efforts for Indian sites are lacking. Their antiquity is a natural curiosity for anthropologists and those interested in the evolution of culture and society alike. Earlier, the efforts were limited to finding a relative chronology using evolution of style or trends such as use of charcoal to that of colours. Efforts for dating of such paintings received a boost with advent of Accelerator Mass Spectrometry (AMS) in eighty's in the last century and developments in mass spectrometry. The conservation of such sites has been now initiated in India in recognition of their significance for understanding the evolution of art and culture but there have been little effort to date them quantitatively.

For Grotte Chauvet cave paintings in France by AMS (C^{14}) method yielded radiocarbon dates as old as 32,000 BP. The dates for ivory figurines recovered from Hohle Fels cave, South Germany

yielded similar dates. This was a revelation because the quality of art with controlled lines, curves and sense of perspective was good. In India, AMS radiocarbon (C-14) dating has now been started and is in planning at several other places. It's time, therefore, that a concrete effort is initiated to select, working out methods for sampling, and agreeing on the procedures for collecting the appropriate material from cave sites. The paints used for art work may be scraped carefully from the cave wall as the sample requirement is small- a milligram or so of organic carbon. The half life of radiocarbon (5730 years) allows dating up to about 50,000 years. The sample requirement having come down by 3 orders of magnitude (from grams for Liquid Scintillation Counter to milligrams for AMS), dating the material in paint has come in the domain of possible. The charcoal in paints and the organic carbon in paints made from vegetation are suitable materials. However, it may not always be possible to find sufficient organic carbon in the paint without damaging the painting appreciably. In such situation, one may resort to U- Th decay series- based dating in favourable cases. The method was established in sixty's but the sample requirement was high (about 100 grams). With modern mass spectrometers such as Multi Ion Counting Multi- Collector Inductively Coupled mass spectrometer (MIC MC- ICPMS), tremendous improvement in sensitivity of mass spectrometers has been attained and 10 milligrams of material is now considered adequate. If the painting was done over the speleothems (like stalagmites, stalactites), then the painting has to be younger than the date of the speleothems. If the painting has speleothems growing over it, the painting has to be older than the date of the speleothems. The sample is generally collected using a micro drill. It is common to have such paintings in

carbonate caves so uranium is a likely element in the speleothems, making it a potential material to date. Hoffmann and colleagues have reported the involved chemical protocol and the dating process for speleothems in details using MIC MC- ICPMS. The method has been fairly successfully applied to dating many Palaeolithic cave paintings in Spain. There is need and scope for such work in India.

Dr. C. M. Nautiyal heads the radiocarbon laboratory at Birbal Sahni Institute of Palaeobotany, Lucknow. He took masters degree from the University of Roorkee (IIT- Roorkee) in Physics in 1977 followed by PhD and post-doctoral work at Physical Research Laboratory, Ahmedabad. He specializes in isotope-measurement by mass spectrometric and radiometric methods and applications to Earth, Planetary and Archaeological sciences. He has won several scholarships and fellowships and recognition from Meteoritical Society, USA; INSA (Young Sci. Medal-88); BSIP (Medal for Resource Generation), Vigyan Parishad (*Vigyan Vachaspati, Shatabdi Samman*) etc. He has been involved in organizing many conferences, workshops etc. and is a frequent invitee to universities, research and training institutions, colleges etc. for technical/popular lectures on science. He has ~100 publications in journals/ proceedings/ abstract books in addition to many popular articles/ chapters in books/ encyclopedia. He has presented research in many institutions in India as well as abroad and visited institutions in France, Germany, South Africa, Switzerland, UK and USA. He is a member of National Committee on Archaeological Sciences; Fellow of NCSTC- Network (also past Convener), Geological Soc. India, Soc. Earth Scientists; Member, LAC- RSC-L, Executive Committees of

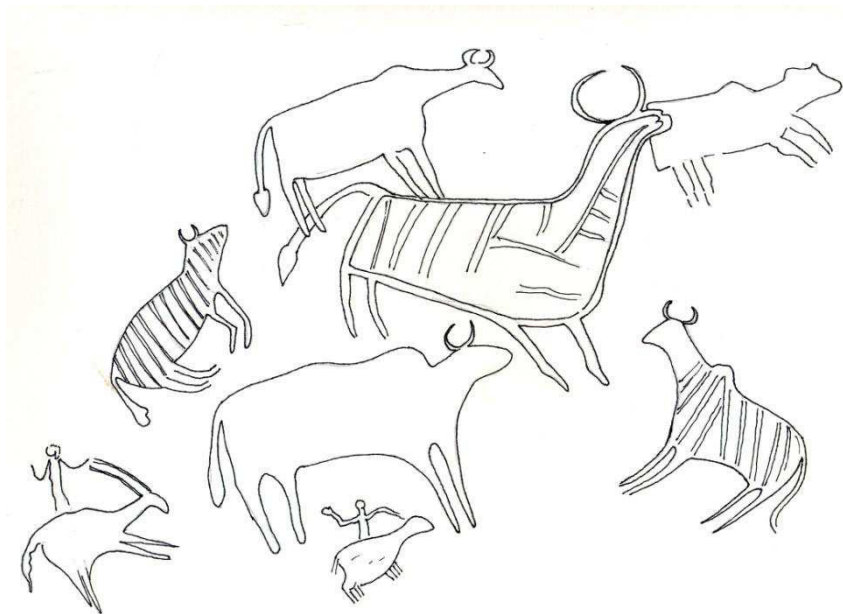
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SOME KEY ASPECTS OF ROCK ART DATING

B. L. MALLA

The age estimation of rock art has long been a key aspect of rock art research, but continues to be attended by difficulties over methodology, misinterpretation of findings and overconfidence in the reliability or precision of results. Most of the rock art researchers' main focus of their investigations for rock art dating at present has been to establish chronologies of different rock art sites, based on pigment analysis to direct dating to stylistic features. An endeavour has been made by some scholars to approach rock art with a view to reconstruct the lifestyle and environment of the people who created this art. While agreeing that chronology is crucial for rock art, it was admitted that, as yet, no absolute dating, or definite chronological order had been established so far. Some scholars advocate re-assessing the acceptance of chronology as the sole criterion of rock art studies. To seriously reconsider art studies within a linear time frame and an evolutionary framework. Doubts are raised on constructing a universal standard for dating in this field.

Dr. B. L. Malla, an Art Historian, with specialisation in Indian art and cultural studies, is presently associated with the Indira Gandhi National Centre for the Arts, New Delhi. His areas of interest include both classical and vernacular traditions. He has been associated with IGNCA-UNESCO-UNDP project on 'Village India'.

Currently, Dr. Malla is engaged in documentation and research of Indian Rock Art; and also in Himalayan Studies.

Dr. Malla is the author of *The Sculptures of Kashmir*, *Vaisnava Art and Iconography of Kashmir*, *Trees in Indian Art Mythology and Folklore*, *Conservation of Rock Art* (ed.), *Global Rock Art* (ed.), *The World of Rock Art: An Overview of the Five Continents* (ed.), *Rock Art Studies (Volume I): Concept, Methodology, Context, Documentation and Conservation* (ed.), *Rock Art Studies (Volume II): Interpretation through Multidisciplinary Approaches* (ed.), *Rock Art of Andhra Pradesh: A New Synthesis* by N. Chandramouli (General ed.), *Cosmology and Cosmic Manifestations: A Study in Shaiva Art and Thought of Kashmir* (in press) and of a number of research articles published in professional journals. He is in the editorial board of some of the important publications.

Dr. Malla has participated in many national and international conferences/workshops and has widely travelled in India, France, Italy and Iran in connection with his field studies and conferences.

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DATING ROCK ART

RAKESH TEWARI

In India rock paintings have been documented, detailed and analyzed which provide details of the subject matter, colours used, technique of execution of the paintings, super-impositions etc. Chronology of these paintings could be suggested between early Mesolithic to medieval periods, considering their comparative cultural contents depicted in a particular level of paintings (in order of lowest to upper most levels showing hunting gathering, food producing, use of metallic tools, association of inscriptions, etc.), available radiocarbon dates for the cultural deposits excavated in a few painted rock shelters, besides some circumstantial evidence. The earliest of them are placed in early Holocene. Though the quantity and quality and evolved forms of these paintings indicate even earlier beginning; but unless their absolute dating is established with some reliable device this issue will remain unsettled.

Dr. Rakesh Tewari, former Director of Uttar Pradesh States Archaeological Department and has a doctorate in History from Avadh University. Dr. Rakesh Tewari's vast experience and his contributions in the fields of archaeology specially Archaeology of the Ganga Plain, particularly beginning of agriculture and Archaeology, art and architecture in ancient Uttaranchal Himalaya. He has published more than 150 (including Books/ monographs/ research papers/ edited volumes/ reviews, general writings, etc.) publications. He is also Founder editor of the *Pragdhara: Annual*

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