XXII INQUA India 2027

QUATERNARY SCIENCE AS SOCIETAL SERVICES

XXII INQUA INDIA 2027

FIELD GUIDE

INPRE - 11

LITHICS AND LANDSCAPES PREHISTORY AND QUATERNARY PALAEOENVIRONMENTS IN SOUTHEAST INDIA

Linto Alappat and Shanti Pappu









बीरबल साहनी पुराविज्ञान संस्थान
Birbal Sahni Institute of Palaeosciences
विज्ञान एवं प्रौद्योगिकी विभाग के अंतर्गत स्वायत्त संस्थान, भारत सरकार
An autonomous Institute under the Department of Science and Technology, Government of India
1946

विज्ञान एवं प्रौद्योगिकी मंत्रालय
MINISTRY OF SCIENCE AND TECHNOLOGY
सत्यमेव जयते

पृथ्वी विज्ञान मंत्रालय
Ministry of Earth Sciences
सत्यमेव जयते

1946

INQUA International Union for Quaternary Research

ASSOCIATION OF QUATERNARY RESEARCHERS

Published in 2026 by

XXII INQUA Congress, India
Birbal Sahni Institute of Palaeosciences (BSIP)
53, University Road
Lucknow – 226007, Uttar Pradesh
India

Website: www.inquaindia2027.in
Email: inqua.india@bsip.res.in

© 2026 BSIP, Lucknow

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.

Published under the overall supervision of:
Mahesh. G. Thakkar, Director, Birbal Sahni Institute of Palaeosciences, Lucknow
Binita Phartiyal, Organising Secretary, INQUA India 2027
Pradeep Srivastava, President, INQUA India 2027
Rahul Mohan, Vice-President, INQUA India 2027

Field Trips Committee
Chairperson: Malay Mukul
Convener: Anupam Sharma
Members: Vimal Singh, Y. P. Sundriyal, Navin Juyal, Pradeep Srivastava, R. J. Perumal, U. K. Shukla, Shanti Pappu, Yogesh Ray

Compilation and editing: Field Trips Committee in collaboration with the INQUA 2027 Secretariat.

Design and Production:
XXII INQUA Congress 2027
Anupam Sharma, BSIP, Lucknow
Akhilesh K Yadava, BSIP, Lucknow
Rakesh Rao, Goa
Creative Team, Expression 360, New Delhi

INQUA INDIA 2027
Field Guide Book

INPRE-11
Lithics and Landscapes Prehistory and Quaternary Palaeoenvironments in Southeast India

Principal Investigator

Linto Alappat

Department of Geology and Environmental Science,
Christ College Autonomous, Irinjalakuda, Thrissur Dist., Kerala, India- 680125

Co-Principal Investigator

Prof. Shanti Pappu

Sharma Centre for Heritage Education, No.4 School Road, Shollinganallore, Chennai 600004, Tamil Nadu, India & SIAS, Krea University, 5655, Sri City, Andhra Pradesh 517646

Team Members

Late Dr. Kumar Akhilesh, Naveen Chauhan, Prachi Joshi, Sutonuka Bhattacharya, K. Anupama and P. Morthekai

Email of Contact Person

alappatlinto@christcollegeijk.edu.in

Mobile No.

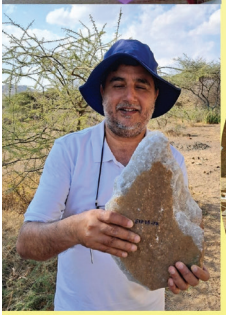
+91 8547201311

Dr. Kumar Akhilesh

05.01.1975 to 25.09.2026

a life in prehistory










Sharma Centre For Heritage Education




Sharma Centre For Heritage Education



Remembering the Legacy of Dr. Kumar Akhilesh (5 Jan 1975 – 25 Sep 2026)

In his brief and yet deeply fulfilled life, Dr Kumar Akhilesh established himself as one of the world's leading prehistorians and lithic knappers. He will be remembered for his boundless passion for prehistory and his joy in sharing it with children, students and teachers alike. He was a key person in the research that forms the foundation of this field excursion, as well as in planning it. We dedicate this field trip to his memory and legacy.

From a small village and town in Jharkhand, eastern India, he excelled academically, studying at Banaras Hindu University, Varanasi, and at Deccan College, Pune, where he completed his PhD (2007) under Prof. V.N. Misra on the Upper Palaeolithic 'Damin Industries' of the Bansloi River Basin, Jharkhand. During this time, he joined Dr Shanti Pappu and the Sharma Centre for Heritage Education (SCHE), first as a student volunteer and then as co-director of the research project at the prehistoric site of Attirampakkam. He went on to become Director of the SCHE and stayed despite lucrative offers elsewhere, often working without a salary. Through great personal sacrifice, he built the institute from a single table and chair into what it is today.

His contributions towards Quaternary studies in India were remarkable, with major publications and new contributions achieved at a very young age. Working with Professor S.N. Rajaguru and Dr Shanti Pappu, he established the framework for the Quaternary stratigraphy of prehistoric sites in the 'Damin region' of Jharkhand. Later, he dedicated his life to the Quaternary of Tamil Nadu, co-directing excavations and ongoing research at the Palaeolithic site of Attirampakkam and its surroundings. Here, his contributions spanned every aspect of the project, from managing large excavations and regional surveys to analysing lithics and other data. Papers in Science (2011) and Nature (2018), among others, transformed the understanding of the Indian Acheulian and Middle Palaeolithic: their chronology, implications for hominin dispersals and behaviour, lithic reduction sequences, cultural transitions, and perspectives on cultural nomenclature. Working with colleagues, he used satellite remote sensing, GIS and predictive modelling for both research and heritage management. Recent excavations at Sendrayanpalayam, a Palaeolithic site he co-discovered, are yielding new insights into the Indian Palaeolithic. In his last fieldwork with colleagues, he could resolve long-standing debates on the stratigraphy, chronology and technology of microlithic sites in the Teri dune sites of southern Tamil Nadu.

Dissatisfied with traditional typological studies in India, he trained in lithic knapping in France (2008). He went on to establish SCHE's experimental laboratory, train colleagues and hundreds of students, children, and interested people across India, Sri Lanka, and South Korea, and develop structured knapping programmes to address technological questions arising from excavated assemblages. At the time of his death, he was in the process of documenting and writing up this work. He was also the first Indian prehistorian to work at Olduvai Gorge, Tanzania, where he co-authored a paper with colleagues. His keen interest in ethnoarchaeology led him to collaborate on issues related to plant exploitation, grinding stone technology, and hunter-gatherers. Convinced that research must reach the wider community, he co-developed public outreach modules and in-house and travelling workshops for children, students, faculty and the public, establishing the centre's science communication programs. He held an ICHR fellowship and the Homi Bhabha Fellowship (2014–2016) for a project on experimental archaeology and prehistoric behaviour at Attirampakkam, received grants to collaborate with CENIEH in Spain, and expanded his institute's network through MoUs with leading institutions.

For all his achievements, he remained at heart a simple, joyful, humble and compassionate man, whose unique sense of humour endeared him to people from all walks of life around the world. His greatest achievement was the ability to unite people to work for a purpose in prehistoric archaeology- a dream that we will keep alive and continue with his legacy.

Shanti Pappu, Prachi Joshi and Sutonuka Bhattacharya
Sharma Centre for Heritage Education, Chennai, India

Table of Contents

1.	Team Leaders	1-2
2.	Abstract	3
3.	Preamble	4-7
4.	Regional Geoarchaeology-1	7-15
5.	Regional Geoarchaeology-2	15-25
6.	Fauna, Climate and Weather Conditions	26
7.	Literature Review	26-33
8.	Program for the Field Excursion	34-37
9.	Field Transects	38-63
10.	Geoheritage, UNESCO Heritage, Other Archaeological Sites, and Culture	64
11.	Conclusion	66
12.	Participating Institutions	66-68
13.	Associate Members	69-72
14.	Acknowledgement	73
15.	Annexure	74-75

Team Leaders



Linto Alappat, Ph.D.

Dean of Research and Assistant Professor in Geology
Dept. of Geology and Environmental Science
Christ College Autonomous, Irinjalakuda
Thrissur District – 680125, Kerala, India

alappatlinto@christcollegeijk.edu.in; alappatlinto@gmail.com

+91 8547201311

Dr. Linto Alappat is Assistant Professor and Dean of Research in the Department of Geology and Environmental Science at Christ College (Autonomous), Irinjalakuda, Kerala. He earned his Ph.D. in Quaternary Geology (2010) from Freie Universität Berlin and the Leibniz Institute for Applied Geophysics, Hannover, on a Leibniz–DAAD Fellowship, with a thesis on optically stimulated luminescence (OSL) dating of coastal sediments from the southern North Sea and south India, followed by postdoctoral research at the Physical Research Laboratory, Ahmedabad. His expertise spans luminescence dating, Quaternary geology, coastal geomorphology, sedimentology, geoarchaeology, and palaeo-flood studies. His research reconstructs coastal dune evolution- including the Teri red dunes - sea-level change, land–sea interactions and deltaic sedimentation across southern India, published in reputed journals. He holds Academic Visitor status at the University of Oxford (2025–2027) and has received fellowships and grants from the ANRF- SERB, Geological Society of India, UNESCO–IGCP, Bar Ilan University, Israel, Zululand University, South Africa and the Korea Basic Science Institute. He guides doctoral students, convenes the GEM conference series, other outreach and extension activities, and co-leads the present field excursion.



Prof. Shanti Pappu, Ph.D, FBA

Sharma Centre for Heritage Education,
No.4 School Road, Shollinganallore, Chennai 600004,
Tamil Nadu, India & SIAS, Krea University, 5655, Sri City, Andhra Pradesh 517646

pappu.shanti@gmail.com

Professor Shanti Pappu is an archaeologist and educationist. She completed her PhD at Deccan College, Pune, on prehistoric adaptive strategies in northern Tamil Nadu, and in 1999 founded the Sharma Centre for Heritage Education (SCHE) for research and public outreach in archaeology. She is a Corresponding Fellow of the British Academy, UK. Dr. Pappu directs interdisciplinary research on prehistory and palaeoenvironments in southeast India, spanning 1.7 million to around 2,000 years ago, leading a team of scientists from India and

abroad. She has published two books and over 30 research papers, including in Science and Nature, and other peer-reviewed journals and edited volumes. At SCHE, she leads educational programmes on prehistory, lithic studies, and experimental knapping, and organised "Down Ancient Trails" (2020), an online archaeology forum with over 100 lectures and workshops during the pandemic. She consults for the Tamil Nadu State Department of Archaeology and has presented at Planning Commission meetings. She has guided two PhD and two Master's students, serves on a PhD committee at the Hebrew University of Jerusalem, and reviews for several journals and funding bodies. A former Homi Bhabha and Charles Wallace Fellow, her honours include the Prof. H.D. Sankalia Gold Medal and Earthwatch Institute's Young Scientist Award. She is also a scuba diver.

Abstract

The southeast coast of India, in the state of Tamil Nadu, has a long and rich record of Quaternary deposits and prehistoric sites spanning the Early to Late Pleistocene and the early Holocene. From inland areas near the outliers of the Eastern Ghats to sites along the Bay of Bengal, we note geomorphological, palaeoenvironmental, and archaeological evidence of almost continuous hominin and later modern human occupation, beginning in the Early Pleistocene. Here, we seek to introduce delegates to the Quaternary formations and the associated archaeological record of key areas of northern and southern Tamil Nadu, SE India. These are regions where various members of our team have conducted geological, geochronological, and geoarchaeological studies at sites with deposits in fluvial-lacustrine, colluvial, aeolian, and coastal formations, reflecting long-term hominin adaptive strategies in response to paleoenvironmental changes and major debates on hominin migration.

We introduce delegates to the oldest conclusive evidence of hominin occupation in India, documented at the sites of Attirampakkam and Sendrayanpalayam in northern Tamil Nadu, where Lower and Middle Palaeolithic tool-making hominins may have migrated "Out of Africa" to India. We highlight the Late Palaeolithic record of this landscape, and introduce delegates to the complex formations of laterites and ferricretes across the study region.

In southern Tamil Nadu, we introduce delegates to the magnificent red dune formations locally termed 'Teri', with thick aeolian sequences that provide a unique opportunity to study terrestrial processes from the Last Glacial Maximum to the Holocene. Their association with prehistoric microlithic tool assemblages raises interesting questions on parallels seen with similar deposits and tools in parts of Sri Lanka. We also take delegates on scenic coastal drives to examine older and younger formations that testify to the complex story of sea-level variability and land-sea interaction in this region.

Beyond prehistory, we introduce delegates to the UNESCO World Heritage monuments of Mahabalipuram and to local museums that display the magnificent heritage of later cultures and kingdoms in the region, with evidence of ancient ports, seafaring activities, and complex cities. Immerse yourselves in local culture, observe ancient customs and explore the southern tip of India.

Preamble

(Research problem as it stands globally and how the field transect is unique in the context of Quaternary Geology)

PalaeoWorlds: An Introduction to the Field Excursion

1. Sand, Sea, Stones and Beyond

The southeast coast of India, in the state of Tamil Nadu, has a long and rich record of Quaternary deposits and prehistoric sites spanning the Early to Late Pleistocene and the early Holocene. From inland areas near the outliers of the Eastern Ghats to sites along the Bay of Bengal, we note geomorphological, palaeoenvironmental, and archaeological evidence of almost continuous hominin and later modern human occupation from the Early Pleistocene onwards. Our multidisciplinary research projects in this region seek to address questions about hominin adaptation to changing climates, geoarchaeological questions, palaeoclimates, and the potential dates and migration routes from South India to Sri Lanka.

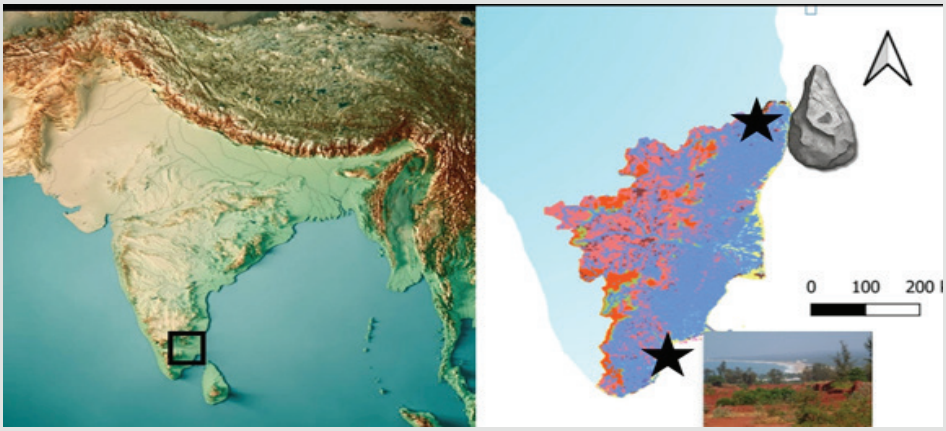
The sites to be visited comprise areas where our team has conducted extensive geological, geochronological, and geoarchaeological studies on deposits in fluvial-lacustrine, colluvial, aeolian, and coastal formations that reflect long-term hominin adaptive strategies in response to paleoenvironmental changes. We introduce delegates to the oldest conclusive evidence of hominin occupation in India, documented at the sites of Attirampakkam and Sendrayanpalayam in northern Tamil Nadu, where Lower and Middle Palaeolithic tool-making hominins may have migrated from Africa and parts of Asia to India. We then highlight the Late Palaeolithic record of this landscape, and introduce delegates to the complex formations of laterites and ferricretes across the study region. In southern Tamil Nadu, we introduce delegates to the magnificent red dune formations locally termed Teri, with thick aeolian sequences that provide a unique opportunity to study terrestrial processes from the Last Glacial Maximum to the Holocene. Their association with prehistoric microlithic tool assemblages raises interesting questions on parallels seen with similar deposits and tools in parts of Sri Lanka.

We also take delegates on scenic coastal drives to examine older and younger formations that testify to the complex story of sea-level variability and land-sea interaction in this region. Beyond prehistory, we introduce delegates to the magnificent heritage of later cultures and kingdoms in the region, with evidence of ancient ports, seafaring activities, and complex cities. Immerse yourselves in local culture, observe ancient customs, and explore the southern tip of India.

2. Time, Tools, and Terrain

We seek to address geochronological and geoarchaeological studies of selected Quaternary (Early Pleistocene to Holocene) deposits with dated prehistoric sites in fluvial-lacustrine, colluvial, and aeolian deposits across parts of Tamil Nadu, reflecting long-term hominin adaptive strategies in response to paleoenvironmental changes. In northern Tamil Nadu (12°15′-13°30′N; 79°30′-80°22′ E), Early to Middle Pleistocene deposits at the excavated site of Attirampakkam (~1.5 Ma to ~72 ka) bear India's oldest Acheulian and Middle Palaeolithic cultures within fluvio-lacustrine sediments (Akhilesh et al. 2018; Pappu et al. 2011). Sites in the vicinity occur within ferricretes and ferruginous gravels sourced from Cretaceous and Tertiary deposits requiring precise geochronological estimates. The Teri red dunes of southern India (8°00′ to 9°30′ N; 77°18′ to 79° 00′ E) offer a thick succession of aeolian deposits, providing a unique opportunity to study the terrestrial processes dating from the Late Pleistocene to early- to mid-Holocene (Alappat et al., 2013, 2016; Jayagondaperumal et al., 2012). These are associated with prehistoric sites comprising microlithic artefact assemblages. The Teri dunes and microlithic assemblages resemble similar formations in Sri Lanka, suggesting similar cultural and palaeoenvironmental changes and routes of migration (Singhvi et al., 1986; Akhilesh et al., 2017).

Processes involved in their formation comprise a complex sequential evolution of lagoons and offshore bars. The sands were potentially deflated from the exposed continental shelf, probably under the influence of a strengthened NE wind regime and arid conditions during the peak of the last glacial period (Alappat et al., 2013, 2016; Jayagondaperumal et al., 2012). The internal sedimentary structures of the dunes are largely obliterated due to intense chemical weathering and are reddened throughout the profile due to chemical leaching of Fe- bearing silicates, releasing iron oxides and forming authigenic kaolinites and illites. Other marine formations (Ovari and Idindakarai series; ≥38 ka, 25ka BP and 21 ka BP) remain to be studied in relation to the dunes. and microlithic sites (Akhilesh et al. 2018; Gardner, 1981, 1986; Gardner and Martingell, 1990; Sabu et al.,1999; Jayagondaperumal et al. 2012).



The field excursion region, Tamil Nadu, South India

3. Debating Migrations and Adaptation

3.1 Palaeolithic Occupation and Hominin Migrations

Attirampakkam (ATM) (13°13′ 50″N, 79°53′ 20″E, elevation: 38 m a.s.l.) is the oldest Lower Palaeolithic Acheulian site in South Asia, where dates of ~1.5 to 1.7 Ma from deeply stratified fluvial-lacustrine sediments challenged prevalent notions in hominin dispersals on hominin migrations 'Out of Africa' (Pappu et al., 2011; see Dennell, 2011). Overlying deposits (~380 ka-72 ka) within stratified layers of ferruginous gravels and clayey silts, associated with an early Middle Palaeolithic (MP) culture, suggest hominin adaptation to changing local environments, marked by population dispersals and the adoption of new technological strategies and local innovations (Akhilesh et al., 2018). Together, this research placed the Indian Palaeolithic record within the national and international palaeoanthropological landscape, prompting a rethink of existing models of the dispersal of Homo erectus s.l. and modern humans, and underscoring the importance of Indian data in global debates. Paleoenvironmental studies suggest hominin adaptation to changing palaeovegetation, monsoon and fluvial contexts from the Allikuzhi hills to the region around ATM. Neighbouring sites (Sendrayanpalayam, Mailapur, Placepalayam, Kunjalum) provide a sequence of occupation spanning the Early to Late Pleistocene (hilltop, colluvial, pediment surface and fluvio-lacustrine), providing landscape scales for investigating past behaviour and landform evolution during the Early to Late Pleistocene) (Akhilesh et al., 2018; Gunnell et al., 2006; Pappu, 2007, 2008; Pappu et al., 2010; Pappu et al., 2011; Premathilake et al., 2017; Sreedhar et al., 2008; Warrier et al., 2011). Palaeoenvironmental studies suggest adaptation to changing rainfall patterns and vegetation at this site. The archaeological record terminates ~72 ka, when human occupation decreased drastically, possibly because of increased aridity and/or greater environmental variability.

3.2 Red Dunes, Sea Level Changes and Modern Humans

Further south, microlithic cultures occur in the red Teri dunes extending across parts of south India and up to Sri Lanka (Fig.1) with distinct morphological similarities in the two regions (Jayangondaperumal et al., 2012; Alappat et al., 2013, 2016; Wallace, 2016; Singhvi et al., 1986). These deposits provide information on palaeoenvironments and are economically important for placer heavy minerals. Current understanding about the red dune sands of Sri Lanka is limited to a few studies on Total Heavy Mineral (THM) content of these aeolian placer sands (e.g., Wallace, 2016) in the NW province and chronological information is based on limited TL dating (Singhvi et al., 1986) of dune sands in the SE province. Similar studies dated selected pockets of the Teri dunes, India (Alappat et al., 2013, 2016; Srivastava et al., 2016; Jayangondaperumal et al., 2012) and studied economic mineral concentration (Laxmi et al., 2012; Babu et al., 2009). Many studies have attempted to investigate the origin and source of dune colouration using sedimentology and geochemistry, but the weathering of U-and Th-bearing heavy minerals and the mobility of these elements within the section have not yet been studied. Available radiocarbon and OSL dates for Teri sands (Gardner, 1981; Singhvi et al., 1986; Alappat et al., 2013, 2016; Jayagondaperumal et al., 2012) show a much older depositional age (Late Pleistocene). This is significant for dating associated microlithic sites (see Akhilesh et al. 2017) and for correlating dated sections with the archaeological record,

thereby situating prehistoric occupation and migration to Sri Lanka within a secure geochronological framework. In the Teri microlithic context, the microliths occurring on stabilised dune surfaces being dated (see Akhilesh et al. 2017, ongoing research) have clear implications for phases of human occupation under conducive climatic conditions. This study would further examine the chronology of the evolution of microlithic cultures in this region, primarily through luminescence dating and analyses of lithic technological strategies.

As our research in these regions continues, we add to the pieces of the great puzzle of human evolution, migration, and adaptation to changing environments across coastal, near-coastal, and inland landscapes of southeast India.

Welcome to our journey down ancient trails ...

Regional Geoarchaeology-1

(Regional Geology including stratigraphy, structure, palaeontology, Quaternary geology and where this field trip fits)

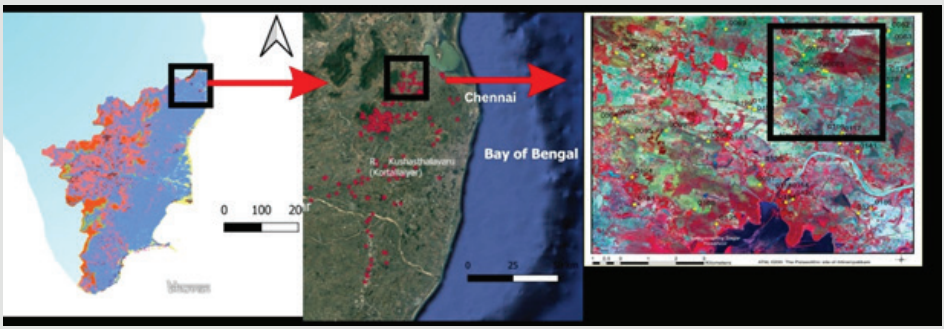
Palaeolithic Landscapes of Northern Tamil Nadu

1. Introduction

Northern Tamil Nadu, located along the southeast coast of India, has rich evidence of prehistoric occupation spanning the Pleistocene and early Holocene. These sites range from the earliest Lower Palaeolithic occupation associated with Homo erectus s.l. to the Late Palaeolithic assemblages made by modern humans. This region witnessed the first discovery of a Palaeolithic stone tool in 1863 by the geologist, Robert Bruce Foote; a discovery that, at one stroke, pushed back the antiquity of human occupation in the Indian subcontinent (see Pappu 2001). Early studies in this region beginning in the late 19th century (for a review, see Pappu, 2001) were followed by surveys (Pappu, 1999, 2001) and excavations at the multicultural stratified Palaeolithic setting of Attirampakkam – a flagship site for South Asia (Blackwell et al., 2007; Gunnell et al., 2006; Pappu, 2007; Pappu and Kumar, 2006; Pappu et al., 2003a, b, 2004; Sreedhar et al., 2008). Research is still ongoing, with new excavations at other sites and multiple surveys underway. Here, we take delegates through slices of time and space, introducing them to the fascinating world of Indian prehistory.

The area covered in this field excursion is a piedmont linking the elevated topographic barrier formed by the Eastern Ghats in the hinterland to the Bay of Bengal coastal zone. Capping Archean and Cretaceous outcrops (Geological Survey of India, 2006), primary laterites of Cenozoic age are widespread across the landscape (Kumaraguru and Trivikrama Rao, 1994; Muralidharan et al., 1993; Pappu, 2001; Subramanian and Selvan, 2001). Prehistoric sites occur on the surface of these formations and are primarily contained within a range of sedimentary units of Quaternary age, resulting primarily from localised fluvial and colluvial processes leading to redistribution of lateritic weathering products. This landscape would have been attractive to hominins, with a mosaic of contrasting environments ranging from hills to coastal plains and riverine tracts.

In northern Tamil Nadu, Early to Middle Pleistocene deposits at the excavated site of Attirampakkam (~1.5 Ma to ~72 ka) host India's oldest Acheulian and Middle Palaeolithic cultures within fluvio-lacustrine sediments (Akhilesh et al. 2018; Pappu et al. 2011). Sites in the vicinity are embedded in ferricrete gravel deposits, and Quaternary ferruginous gravels sourced from Cretaceous and Tertiary deposits still require precise geochronological estimates. The findings at Attirampakkam have challenged prevalent notions about the chronology and palaeogeography of hominin dispersals out of Africa (Pappu et al., 2011; see Dennell, 2011).



The study region in northern Tamil Nadu. Red and yellow dots indicate the distribution of prehistoric sites. The rectangles indicate the areas to be visited.

2. Attirampakkam: Oldest Acheulian and Middle Palaeolithic Cultures of India

The site of Attirampakkam (henceforth ATM) is located ca. 47 km inland from the modern coastline on the banks of a small gully, an ephemeral stream that joins the Kosasthalaiyar (formerly Kortallayar) river <1 km downstream. Here, Early Pleistocene Acheulian tools (age: ca. 1.5 Ma) occur throughout 6 m of thick argillaceous sediments derived from the erosion of Cretaceous shale and sandstone outcrops in the catchment. These floodplain sediments aggraded over time during site occupation, leading to repeated burial of artefacts discarded at the site. Alternating sand and silty clay beds lacking unequivocal evidence of paleosols suggest periodic cycles of sediment deposition without lengthy interruptions. The suspended silt particles settled out under conditions of low-velocity, laminar overbank streamflow, burying the stone tools without displacing them.

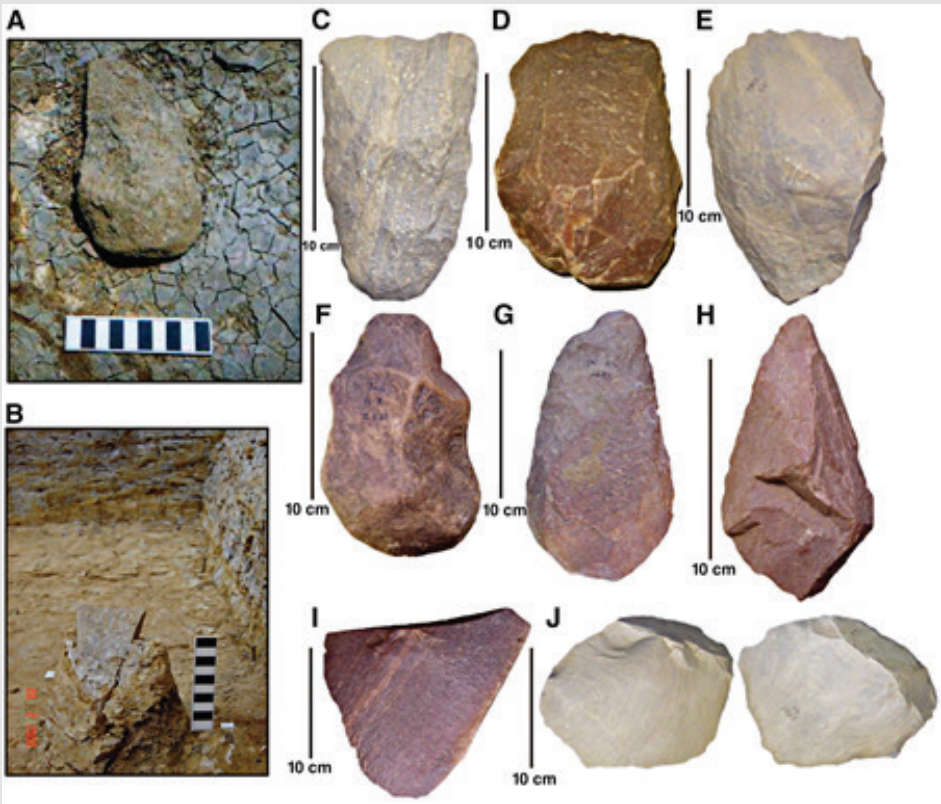


General view of Attirampakkam

Stratified deposits resting unconformably over the clay-rich Acheulian sequence, with ferruginous gravels and clay-rich silts (layers 5 to 2), contain an early Middle Palaeolithic culture of estimated IRSL ages ranging from ~380 to ~72 ka. Resumption of occupation during this period after a hiatus indicated by the geological unconformity between layers 6 and 5 suggests hominin adaptation to changing local environments, marked by population dispersals and the adoption of new technological strategies and local innovations (Akhilesh et al., 2018). The luminescence- based chronology has revealed that processes signaling the end of the Acheulian culture and emergence of a Middle Palaeolithic culture occurred ca. 385 ± 64 ka, much earlier than conventionally presumed for South Asia. Middle Palaeolithic technologies prevailed at ATM until 172 ± 41 ka.



Excavations at Attirampakkam



Acheulian artefacts from excavations at Attirampakkam (after Pappu et al. 2011).

Chronologies of Middle Palaeolithic technologies in regions distant from Africa and Europe are crucial for testing theories about the origins and early evolution of these cultures, and for understanding their association with archaic hominins or modern humans, their links with earlier Acheulian cultures, and the spread of Levallois lithic technologies such as encountered at ATM. The geographic location of India and its rich Middle Palaeolithic record are well suited to addressing these issues, but progress has been limited by the current paucity of excavated sites, of hominin fossils (mostly for taphonomic reasons), as well as by the limited range of geochronological constraints given the (often) unsuitable nature of the regolith. As during the Acheulian period, Middle Palaeolithic populations used locally available quartzite to make tools because other siliceous rock sources were absent in the region. The stratified sequence highlights a gradual disuse of bifaces, a growing predominance of small tools, the appearance of distinctive and diverse Levallois flake and point strategies, and a blade component during the 380–72 ka interval. These all indicate an emphatic shift away from the earlier Acheulian large-flake technologies. These findings

document a process of substantial behavioural change in southern India ca. 385 ± 64 ka and establish its contemporaneity with similar processes recorded in Africa and Europe. The evidence of change suggests interactions between local developments and ongoing global transformations. Together, these observations call for a re-evaluation of models that restrict the origins of Indian Middle Palaeolithic culture to the incidence of modern human dispersals out of Africa and into India after ~125 ka.



Excavations at Attirampakkam

Based on the clay mineralogy of the various sedimentary layers, it has been inferred that during the Acheulian, hominins experienced a semi-arid climate with mean annual precipitation (MAP) < 1000 mm, which changed to a more humid climate with MAP > 1000 mm throughout the early Middle Palaeolithic phases. The topmost layer in the sequence, which is archaeologically sterile (OSL age: ~72 ka), was deposited under semi-arid conditions similar to those of the present day, or perhaps even drier. From the Sr isotope composition of calcretes, it is inferred that Sr as well as Ca were predominantly derived by water–sediment interactions in the vadose zone of the Pleistocene sediments of this site.

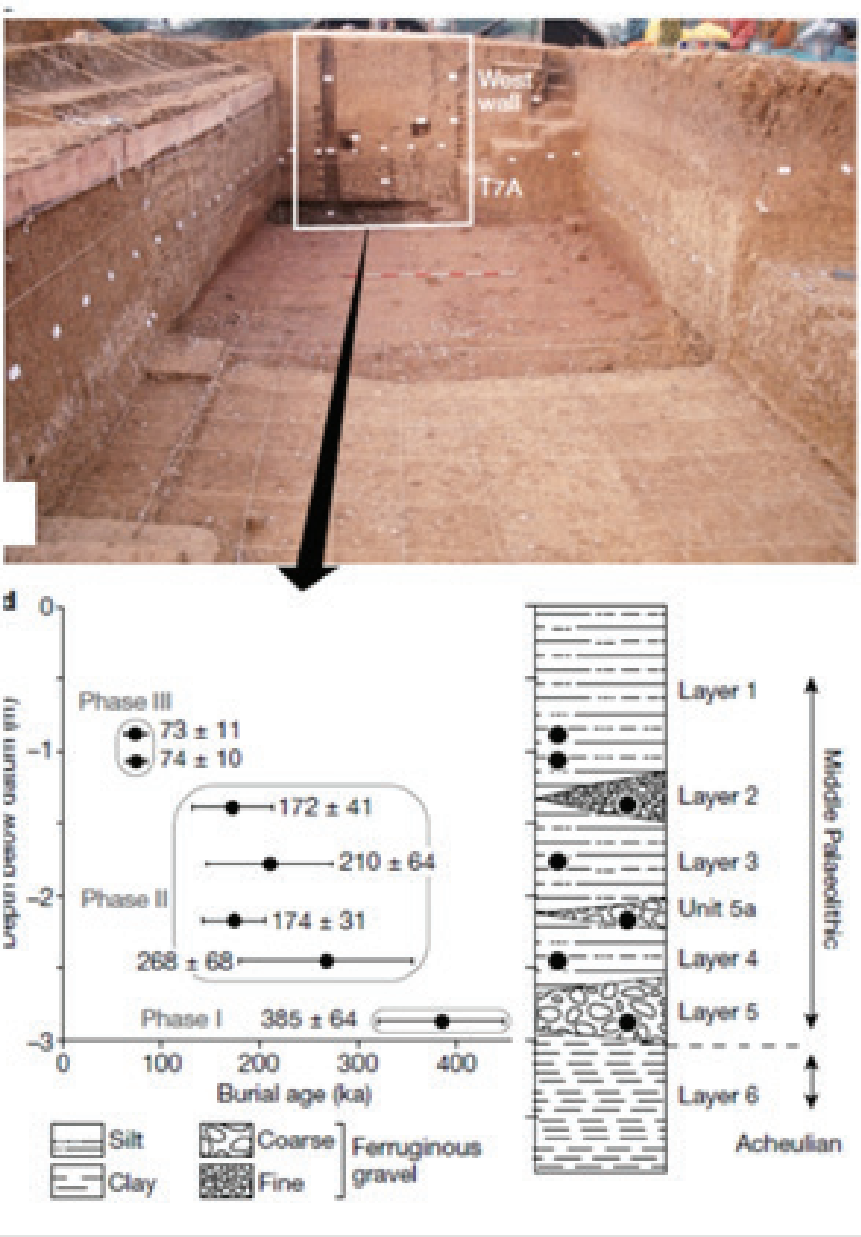
Studies of phytoliths have also suggested that the region was arid during the earlier stages of the Early Pleistocene, and was occupied by hominins living in a landscape locally lacking woody plants. Herbaceous vegetation was dominated by C4 Chloridoid grasses. In the later phase of the Early Pleistocene, the landscape was more wooded and dominated by C4 Panicoid grasses, with a significant reduction of C4 Chloridoid grasses indicating a shift

from a drier to a relatively more humid climate. A diverse husk and leaf phytolith assemblage of wild Oryza spp. (rice), occurring as natural annual or perennial components of the vegetation in the area; the additional occurrence of other herbaceous plants such as Cyperaceae (sedges); and the continuous presence of blackened phytoliths collectively suggest the establishment of a grassland landscape with enclaves of wetland habitat affected by seasonal flooding and frequent fires. The transition from the Early to the Middle Pleistocene was marked by a moderately humid climate, followed by a shift towards aridity during the Late Pleistocene (as evidenced by phytolith assemblages dominated by C4 Chloridoid grasses, a sharp reduction in C4 Panicoid grasses, and a rise in woody taxa). During the Middle to Late Pleistocene, Middle Palaeolithic populations would have encountered water bodies near the site, as evidenced by the presence of plants adapted to swampier conditions, such as Cyperaceae and Oryza spp. The archaeological record terminates at ~72 ka, when human occupation declined sharply, possibly due to increased aridity or greater environmental variability.

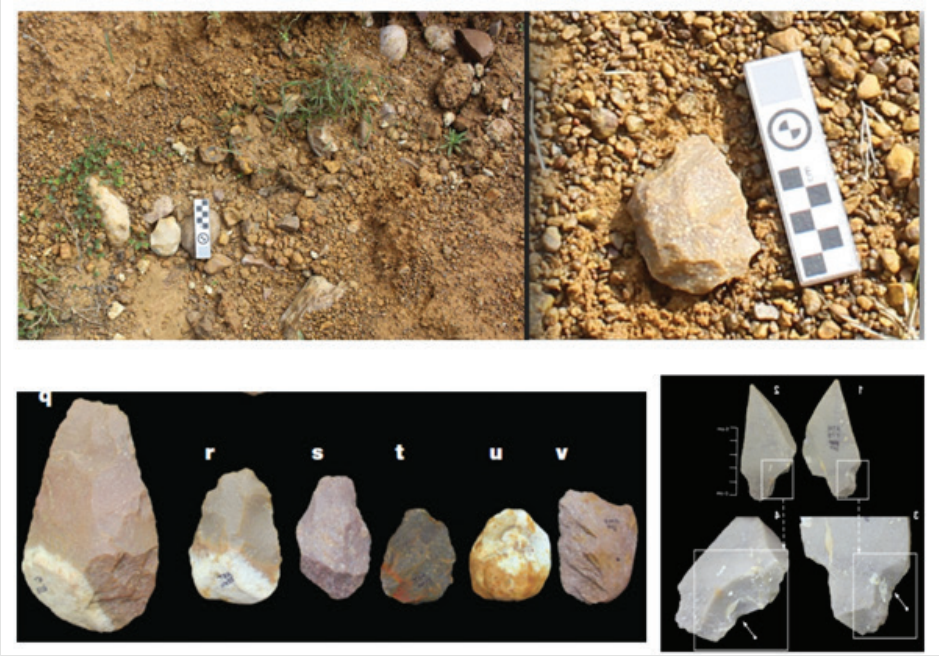
Other sites in the vicinity of ATM display artefacts embedded within ferricrete and ferruginous gravels sourced from Cretaceous and Tertiary deposits, which still require precise geochronological estimates. One such site, Sendrayanpalayam (SEN), was excavated by the SCHE. It is an open-air Palaeolithic site also situated in the foothill zone of the Allikuzhi hills. Excavations revealed a sequence of stratified deposits reaching a maximum thickness of ~4 m.

The stratigraphic sequence comprises four layers of varying thickness preserved across the site, and presumably extends beyond it across the plateau surface. The uppermost horizon, layer 1, is a sandy silt and is archaeologically sterile. This overlies layer 2, a ferruginous gravel. This is rich in ferricrete pisoliths and nodules, and contains a dense concentration of pebble- to cobble-sized clasts. The underlying Layer 3 is exclusively ferricrete gravel with occasional post-depositional duricrust formation as a result of cementation by seasonal groundwater processes in the regolith. Layers 1 to 3 cap layer 4, i.e. the bedrock - here the boulder conglomerates of the Satyavedu Formation, which constitute one of the chief sources of raw material (quartzite, sandstone) used by hominins. The site is currently being dated using terrestrial cosmogenic nuclides, optically stimulated luminescence, and magnetostratigraphy. Palaeoenvironmental proxy studies are also in progress.

The site comprises two cultural horizons. The upper levels (layer 2) are a characteristic Large Flake Acheulian comprising handaxes, cleavers, large cores, and are conspicuous by the occurrence of a complete reduction sequence indicative of tool-manufacturing activities. The lower levels (layer 3), in contrast, contain an assemblage lacking bifaces and primarily dominated by small cores and flakes. Unlike layer 2, tools in layer 3 are on sandstone. We also encountered many conjoined artefacts, highlighting the site's pristine state of preservation.



Geochronology of the Middle Palaeolithic layer at Attirampakkam (after Akhilesh et al. 2018)



Middle Palaeolithic artefacts (bottom row after Akhilesh et al. 2018).

3. Regional Geoarchaeological Record

The region also comprises many other sites located within ferricretes and ferruginous gravels (e.g. Mailapur and Kunjaram). These comprise localities with artefacts spanning the Acheulian, Middle and Late Palaeolithic. To the west lie the Azhikulli hill range, running NNE to SSW and rising to 200–380 m amsl. They consist entirely of Cretaceous alluvial fan deposits, i.e., a clast-supported and strongly cemented Cretaceous boulder conglomerate rich in rounded quartzite pebbles and cobbles. These outcrops constituted the principal regional source of raw lithic material from the Acheulian onwards, and similar outcrops are extremely scarce elsewhere in peninsular India. Rock shelters such as Gudiyam, with primarily Middle Palaeolithic artefacts, lie within these hills. Other sites (see Pappu, 2001) occur eroding out of Pleistocene gravels on the slopes and foothills, as also on the pediment zones. One such site is Kunjaram, located on a pediment, i.e. a gently sloping bedrock surface, extending eastwards from the Azhikulli hills, with Early and Middle Palaeolithic artefacts encountered at elevations of 45–60 m asl along this intermediate belt between the hills and the coastal plain, often embedded in ferricrete gravel beds resulting from eroding laterite outcrops generated by a more humid climate in the geological past. Middle to Late Palaeolithic artefacts erode out of ferricretes noted here and lie in low-density spreads across the surface. These in turn rest on bedrock consisting of Cretaceous shales, suggesting that the laterite caprock developed more readily on the shale than on the boulder

conglomerates, where evidence of regional lateritization across the landscape is mostly expressed in the iron-enriched matrix that surrounds the remarkably unweathered quartzite clasts. The ferricrete gravels at Kunjaram are capped by rubified sands in the vicinity and dated to ~9 ka. The entire region, ranging from Mailapur to Kunjaram, was found to display generally similar stratigraphy. Extensive quarrying of the ferricrete for the construction of canals and roads has led to the exposure of new sections. The stratigraphic sequence comprises Cretaceous shales that underlie a ferricrete unit of ~2 m in thickness. Acheulian to Middle Palaeolithic artefacts erode out of the ferricretes, while the surface contains Late Palaeolithic tools in a low-density spread across the site. Many of these sites were quarried for infrastructure development. The SCHE implemented a program in collaboration with scientists, using satellite data and fieldwork to map and quantify impacts at these sites, develop predictive models to find new sites rapidly, and suggest protocols for conservation (Pappu et al. 2010). The SCHE is also actively working to develop public awareness amongst local stakeholders on the importance of these sites.

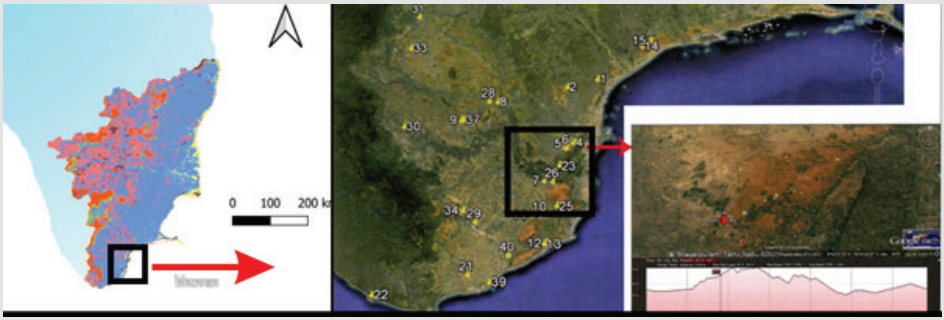
Regional Geoarchaeology-2

(Regional Geology including stratigraphy, structure, palaeontology, Quaternary geology and where this field trip fits)

Red Dunes and Prehistoric Tools. Coastal Landscapes of Southeast India

1. Introduction

The coastal plains of southern India, especially along the Tamil Nadu coastline, are characterised by prominent brick-red aeolian sand deposits referred to as Teri, derived from the Tamil term meaning “sandy waste” or “heap of sand.” These crimson dune sands signify one of the most thoroughly studied occurrences of pedogenic reddening in coastal dune fields within a tropical context, attracting scientific attention for more than a century, beginning with Foote’s (1883) initial geological survey. The red colour, heavy mineral abundance, connection to prehistoric microlithic societies, and sensitivity to palaeoclimate and sea-level fluctuations make the Teri sands a significant repository of late Quaternary environmental history. Gardner and Pye (1981) conducted an initial examination of the nature, origin, and the palaeoenvironmental relevance of red coastal and desert dune sands worldwide. Evidence shows that the Teri sands of Southeast India originated from in-situ weathering of coastal dune sands, rather than the previous argument of detrital transfer of preexisting red sediments. These fundamental studies set the platform for subsequent chronological studies using luminescence dating and palaeoenvironmental research (Jayangondaperumal et al., 2012; Alappat et al., 2013; Alappat et al., 2016).



The study region in southern Tamil Nadu. Yellow dots indicate the distribution of prehistoric sites. The rectangles indicate the areas to be visited.



General view of the Teri sand dunes.

2. Geological and Tectonic Framework

The Teri dune fields are situated on the coastal lowlands of the southernmost Indian Peninsula, mostly in the state of Tamil Nadu. The area is supported by Archaean granulitic basement rocks, which include peninsular gneiss (garnet-sillimanite-biotite-graphite gneiss, sometimes referred to as khondalite) and charnockite gneiss, which are part of the Khondalite belt within the Southern Granulite Terrain. Metapelites, calc-silicate rocks, and unmetamorphosed mafic dykes are also present within the charnockite massif. The lithological variety of the Archaean basement is directly reflected in the heavy-mineral suite of the Teri sands, described in Section 5 (Chandrasekharan and Murugan, 2001; Alappat et al., 2016). The coastal sedimentary sequence overlying the basement consists of Pleistocene and Holocene fluvial, fluvio-marine, and marine deposits. To the northeast, there are exposures of the Cuddalore Mio-Pliocene age formations (Alappat et al., 2016). The tectonic setting is a passive margin, characterised by the eastern coastline along the Bay of Bengal and the western coastline adjacent to the Arabian Sea. Both coastal regions are considered tectonically stable, rendering the region especially susceptible to eustatic sea-level

fluctuations. Gardner (1981) observed that the southeastern coast of Tamil Nadu, spanning from Kanyakumari to Rameswaram, is distinctive for several reasons: it endures a sub-desert environment, which is in stark contrast to adjacent humid monsoonal regions, with an average annual precipitation of roughly 600 mm; It possesses abnormally elevated concentrations of heavy minerals along the shorelines and retains an extended succession of coastal Quaternary sedimentation.

3. Stratigraphy of the Coastal Quaternary Sequence

The formal lithostratigraphic framework for the Quaternary coastal deposits in southeastern Tamil Nadu was established by Gardner (1986) and subsequently revised by later researchers. The stratigraphic succession, arranged from oldest to youngest, includes the following units (Jayangondaperumal et al., 2012; Alappat et al., 2013):

Ovari Series: The most ancient coastal sediments within the study region, situated unconformably atop the basement Igneous and metamorphic rocks. These consist of coarse marine sandstones, corals, siltstones and shell pieces from near-shore shallow-water marine facies; they are prevalent around Ovari, Tisaiyanvillai, and Panamparai, and are found in patches over the majority of the coastline.

Idindakarai Series: Superimposes the Ovari Series and consists of terrigenous gravels and sands, fragments of shells originating from shallow marine environments. Marine shells from this unit provided U-series dates ranging from roughly 112 to 124 ka (Brückner, 1988, 1989), indicating a sea-level highstand during the latest interglacial period.

Kanyakumari Series (Aeolianite): overlays the Idindakarai Series and comprises fossilised coastal dunes bound by calcium carbonate (aeolianite). The aeolianite reaches a thickness of up to 30 meters in certain areas (Gardner, 1981) and is situated above both elevated marine levels. The clastic mineral assemblage in the aeolianite includes quartz, zircon, sillimanite, opaque minerals, plagioclase, orthoclase feldspars, and garnet (almandine), mirroring those of contemporary dunes, indicative of a coastal aeolian origin (Gardner, 1981).

Poochikkadu Series (Calcrete): features an aeolianite layer topped by a calcrete stratum rich with Helix vittata (land-snail) shells within the upper 0.3 meters. Aragonite land-snail shells from the upper 0.3 m of the aeolianite/calcrete at approximately 30 m above sea level provided radiocarbon dating chronologies of 21,000 ± 400 and 25,450 ± 750 ^{14}C years BP (calibrated: 26,162–24,081 cal years BP and 31,244–28,694 cal years BP), offering minimum age estimations for this unit (Gardner, 1981; Jayangondaperumal et al., 2012). An aragonite pelecypod from the 8 m elevated marine/lagoonal sediments yielded a ^{14}C date of 38,100±1,260 years BP (Gardner, 1981).

Teri Series (Red Dunes): The Teri sands represent the uppermost and most distinctive geological unit, stratigraphically situated above the Poochikkadu Series or directly over the crystalline basement, Ovari marine sandstone, or Kanyakumari aeolianite (Jayangondaperumal et al., 2012). They are superimposed toward the shore by more recent Holocene sediments of the Mandapam Series. Gardner (1981) observed that brick-red dune

sands superimpose the aeolianite in southeastern India, with an aragonite shell from the aeolianite dated to approximately 25,000 years before present.

4. Geomorphology and Spatial Distribution

The Teri sands encompass over 500 km^2 along the southeastern coast of Tamil Nadu, situated between Kanyakumari (8°N) and Rameswaram (9°30′N), extending 15–16 km inland from the contemporary shoreline (Gardner, 1986; Jayangondaperumal et al., 2012). Thicknesses vary from 1 meter to over 12 meters. Red dunes are notably present on the southwest coast at Muttom (8°07′N; 77°19′E), where a heavily eroded dune field extends in a NNW-SSE orientation.

This area exhibits badland terrain characterised by significant gully erosion within approximately 3 km^2 (Alappat et al., 2013; Alappat et al., 2016). Facies-equivalent red dune deposits are located in Sri Lanka across the Gulf of Mannar (Singhvi et al., 1986; Reuter et al., 2020), illustrating the regional extent of this coastal aeolian system.

The Teri sands typically display an absence of internal macroscopic sedimentary features in the consolidated (older) layers, manifesting as massive, structureless deposits (Gardner, 1981; Gardner, 1983; Alappat et al., 2016). The sands are uniformly reddish to their full depth. Dune morphologies encompass barchans, transverse dunes, and blowouts of diverse sizes and orientations, specifically in proximity to Sattankulam and Kudiramoli (Jayangondaperumal et al., 2012). The coastal terrain in the Kudiramoli region features isolated mounds that are erosional relics of previously broader ridges.

At Muttom on the southwestern coast, two separate terrace levels exist (terrace I at 30–75 m above MSL, approximately 1 km inland; terrace II at 20–30 m, roughly 300 m inland, retains a stratified record of dune accretion (Alappat et al., 2013; Alappat et al., 2016). The near-coastal Teri dunes (characterised in the classification below) are shaped by winter winds from the east and northeast, featuring barchan formations near Kayamoli. Conversely, the contemporary white dunes are located along the current shoreline and are in a state of active migration.

The overall topography of the Teri region illustrates a multifaceted coastal geomorphological past. The red sands create a ridge approximately parallel to the current shoreline, flanked seaward by younger Holocene deposits and landward by the foothills of the Eastern Ghats. The sand is predominantly stabilised by bushes, palmyra, cashew nut, acacia trees, and various other crops. The coastal plain between the Teri belt and the contemporary shoreline is flanked by several discontinuous, coast-parallel lagoons, swales, and river floodplains, limiting dune development to fragmented areas. This may also serve as proof of former shorelines. The sand for the dunes is primarily derived from the coastal ridges, linked to ancient coastlines.



General view of the Puttan Tharuvai dune

Jayangondaperumal et al. (2012) proposed a geomorphological classification of Teri deposits, predicated on their origin and spatial distribution, expanding upon prior categorisations by Joseph et al. (1997). This classification has since gained widespread acceptance:

Inland Fluvial Teri: Restricted to the foothills of the Western Ghats, situated between 110–135 m amsl and roughly 25 km from the contemporary coastline. The deposits, abundant in kaolinite and haematite (Jayangondaperumal et al., 2012), are located near Panakkudi, Vadakkankulam and the settlements of Moopandal. They manifest as sand sheets consisting of medium to coarse-grained sand interspersed with silt and clay, together with sand-filled veins. The deposits generated by mass wasting and fluvial processes (Joseph et al., 1997). An OSL age of 15.4 ± 1.0 ka was determined at the apex of inland fluvial Teri deposits in proximity to Moopandal (Jayangondaperumal et al., 2012).

Coastal Teri: These represent the primary consolidated red dune deposits situated at altitudes ranging from 30 to 60 m amsl and extending up to 15 kilometres inland. They are of aeolian origin, dark red in hue (Munsell hues 10R 3/6), with a thickness ranging from 2 to 12 meters, and are stabilised by vegetation enclosure. On the east coast, the coastal Teri was deposited before 11.4 ± 0.9 ka (Jayangondaperumal et al., 2012). At Muttom on the west coast, OSL ages suggest aggradation occurred between 16 and 9 ka (Alappat et al., 2013), with sections MT-I, MT-II, MT-III, and MT-IV producing ages that cluster around 9-16 ka.

Near-Coastal Teri: These are discontinuous patches of sand deposits aligned with the current shoreline, characterised by a yellowish-red hue (5YR 4.5/6), unconsolidated, with a thickness of 4 to 6 meters, and elevations ranging from 10 to 25 m amsl, occurring roughly 5 km from the shoreline. Near-coastal Teri dunes were developed during a period of elevated relative sea level, with an OSL age of 5.6 ± 0.4 ka determined from a sample above the calcrete unit of the Poochikkadu Series, indicating its deposition during the mid-Holocene (Jayangondaperumal et al., 2012). Alappat et al. (2013) likewise obtained an age of 9–3 ka for near-coastal Teri on the eastern coast.

This classification effectively delineates the Teri into discrete generations characterised by varying source regions, transport modes, and depositional ages, each of which is influenced by various palaeoenvironmental factors.

5. Mineralogy and Geochemistry

The Teri sands are exceptionally abundant in heavy minerals. The southeastern Tamil Nadu coast's beaches possess key minerals such as ilmenite, rutile, zircon, monazite, sillimanite, and garnet (almandine), derived from the Precambrian khondalite, charnockites, and granite gneiss basement (Chandrasekharan & Murugan, 2001; Alappat et al., 2016). Conversely, the Teri sands exhibit nearly complete depletion of feldspars and garnet compared to the aeolianite and contemporary dunes (Gardner, 1981). This significant reduction of garnet and feldspar in the reddish sands, recorded through thin section examination, serves as a crucial piece of evidence for in-situ weathering. Clay Mineralogy, X-ray diffraction study indicates that the clay mineral fraction of the Teri sands is predominantly composed of kaolinite (80–85%) with minor proportions of illite (15–20%); gibbsite and montmorillonite are missing (Gardner, 1983; Alappat et al., 2016). The average free iron concentration is 1.6%, varying from 0.7% to 2.6%, with haematite (ferric oxide) being the predominant type of iron oxide, supplemented by minor traces (less 10%) of goethite (Gardner, 1981). Transmission electron microscopy (TEM) reveals that kaolinite forms tiny particles (<0.5 µm in diameter), exhibiting few signs of physical degradation, indicative of authigenic production in situ rather than aeolian reworking of detrital clay flakes (Gardner, 1981; Gardner, 1983). XRD examination of older indurated units verifies the existence of kaolinite and haematite as trace to minor phases, with ilmenite being detected. In the finer fraction (<100 µm) of older units, quartz, kaolinite, and haematite predominate in descending order (Alappat et al., 2016).

The predominant geochemical composition of Teri sands is characterised by SiO_2 (mean ~86%), followed by notable amounts of Al_2O_3, Fe_2O_3, and TiO_2, in descending order (Alappat et al., 2016). Nearly total depletion of MgO, CaO, Na_2O, and K_2O in comparison to both the country rock and Upper Continental Crust (UCC) values denotes severe chemical weathering. The Chemical Index of Alteration (CIA) values for Teri sands typically range from 96 to 98, significantly exceeding the country rock values (38–59) and the Upper Continental Crust (UCC) average (~51), showing advanced chemical weathering and the near-complete elimination of feldspars (Alappat et al., 2016). This aligns with the XRD and IR spectroscopy data, indicating the predominance of kaolinite. Elevated levels of Zr, Hf, La, Th, and REEs indicate significant heavy mineral fractionation during aeolian sorting, namely the

concentration of zircon and monazite (Alappat et al., 2016). The red hue is closely associated with hematite in the fine portion of the ancient indurated units, while the less weathered, younger loose sands comprise ilmenite with less kaolinite content.

6. Origin of the Red Colour

The origin of the red hue has been contested since the initial geological observations. Foote (1883) proposed a detrital aeolian origin wherein the sands were conveyed by wind from the haematite and kaolinite-rich lateritic soils and red earths of the Eastern Ghats. Zeuner and Allchin (1956) proposed in-situ weathering of coastal dune sands in Tuticorin, albeit without laboratory evidence. Gardner (1981) presented conclusive microscopic, SEM, TEM, and geochemical evidence that settled this argument in support of in-situ weathering. The principal evidence against a detrital origin comprises: (1) SEM surface textures of Teri quartz grains demonstrate characteristics of immersion in a high-energy marine environment (chemical etching, V-pits, chattermarks), analogous to those of the underlying aeolianite and contemporary dune sands, yet significantly distinct from the angular, subtly pitted quartz grains seen in red earth soils in the Eastern Ghats region (Gardner, 1981); (2) thin sections exhibit no indication of illuviation of iron oxides and clay minerals, which would be anticipated if the matrix were detrital red soil permeating dune sands; (3) The kaolinite flakes exhibit flawless hexagonal formations, devoid of any breakage or fracturing that would typically arise from aeolian reworking (Gardner, 1981); (4) The aeolianite, Teri sands, and contemporary dunes comprise a same clastic mineral assemblage, indicating a shared coastal provenance for the sand.

Gardner and Pye (1981) delineated five fundamental prerequisites for reddening to occur: (1) a supply of iron; (2) the presence of moisture; (3) oxidising conditions; (4) sediment availability; and (5) adequate time for the accumulation of iron oxides. In the Teri sands, the primary source of iron is garnet (almandine), an iron-bearing silicate that is notably prevalent in the Archaean basement rocks and the beach placer deposits along the southeast coast (Gardner, 1981). The warm, moist yet well-drained, oxidising and mildly acidic dune micro-environment facilitates garnet disintegration (Gardner, 1983). The decomposition of opaque minerals and feldspars into kaolinite and illite also releases supplementary iron (Gardner, 1981). Haematite provides the distinctive deep red hue (Gardner and Pye, 1981). The kaolinite, resulting from feldspar degradation, subsequently stabilises the haematite by adhesion. Gardner and Pye (1981) observe that reddening occurs significantly faster in moderately humid settings compared to hyper-arid conditions due to the increased availability of moisture for weathering and the uninterrupted processes of dune stabilisation, pedogenesis, and iron oxide formation.

Gardner (1981) established that the Teri sands could attain brick-red hues within approximately 20,000–25,000 years, as evidenced by radiocarbon dates of 21,000 ± 400 and 25,450 ± 750 ^{14}C yr BP derived from aragonite land-snail shells situated in the underlying aeolianite/calcrete, directly beneath the reddened sands. This duration was markedly less than the previously estimated timeline of 100,000 to one million years for brick-red hues resulting from in-situ mineral degradation (Walker, 1967; Folk, 1976; Turner, 1980).

Jayangondaperumal et al. (2012) subsequently established constraints on reddening timelines by OSL dating, indicating that: coastal Teri reddening is post-depositional, occurring after 11.4 ± 0.9 ka; near-coastal Teri reddening transpired after 5.6 ± 0.4 ka. Reddened sands with optically stimulated luminescence (OSL) dates of about 100–200 years were discovered along the contemporary coastline (samples B1 and B2), and laboratory bleaching experiments suggested near-opacity of the red coating, which resulted in the work of Jayangondaperumal et al. (2012). Reddening in this region can therefore occur within a few hundred years, favoured by high temperatures, alternating arid–humid conditions, and suitable source rocks. Alappat et al. (2013) similarly determined that dune reddening in the western coastal region was promoted by stability resulting from a humid climate and occurred roughly 9,000 years ago. Gardner and Pye (1981) observed that under optimal conditions, vibrant red hues may be achieved within 10,000 years. The rate is highest in stable sands rich in ferromagnesian minerals under seasonally humid tropical conditions, characterised by around 500–1200 mm of rainfall annually.

7. Correlation with Sea-Level Variations

The correlation between Teri dune formation and fluctuations in relative sea level is crucial for comprehending the paleogeographic importance of these deposits. Jayangondaperumal et al. (2012) contended that coastal Teri dunes were formed during a phase of reduced relative sea level (about 24 to 11.4 ka), when the continental shelf of the southeast Tamil Nadu coast was exposed, providing a sediment supply for vigorous NE monsoon winds. During this era, the sea level was roughly 80 to 120 meters below current levels. The termination of coastal Teri deposition around 11 ka coincides with the swift early Holocene transgression, characterised by an approximate eustatic sea level rise of 9 mm/year before 8.0 ka (Lambeck et al., 2014), which inundated the shelf and exhausted the sand reserves (Alappat et al., 2013).

Reuter et al. (2020) validated this interpretation throughout the Gulf of Mannar, demonstrating that coastal dune aggradation in Sri Lanka was predominantly influenced by the exposure of extensive sand reservoirs on the continental shelf of Sri Lanka and southern India, associated with the sea-level lowstand of the Last Glacial Maximum. The ensuing aggradation of near-coastal Teri around 5.6 ka (eastern coast) and Terrace II happened at roughly 4.5 ka (west coast, Muttom) during the mid-Holocene sea-level highstand. Numerous lines of evidence indicate three Holocene highstands in relative sea level in the region, sea level reached a maximum of 2–3 meters above modern levels around 6,000 years ago (Brückner, 1988, 1989; Banerjee, 2000). The raised stand is situated above the present shoreline, corroborated by coral dates from Rameshwaram of 4,020 ± 60 BP and radiocarbon dates of lagoonal shells near Tuticorin of around 4,680 ± 50 BP. The elevated sea level along the coastline would have created a system of lagoons and sheltered embayments beyond the Teri dune formations, providing abundant fish, shellfish, and brackish-water resources readily accessible from the stable, vegetated Teri surfaces.

Jayangondaperumal et al. (2012) characterise the near-coastal Teri as a reconstituted variant of the coastal Teri, with red coatings removed during the reworking process, facilitating OSL signal bleaching, which occurred, followed by re-deposition at the

backshore during the sea-level highstand, and subsequently re-reddening after 5.6 ka. Alappat et al. (2016) likewise analyse the Muttom Terrace II deposit due to sand accumulation in the backshore area during the late Holocene highstand, with the higher headland terrain capturing sand-laden onshore winds.

The aged, hardened calcrete of the Poochikkadu Series exhibited erosion resistance, resulting in the conservation of the land-snail shell-bearing calcrete beneath the near-coastal Teri sands, while soft coastal terrene sands were eroded by subsequent erosion. The geological record of sea-level fluctuations in the wider region, encompassing radiocarbon dates of corals and beach rocks from Rameswaram, Mandapam, and the Sri Lankan coastline (summarised in table 1 of Jayangondaperumal et al. (2012) records highstands at roughly 6.2–5.1 ka, 4.4–3.9 ka, and 3.3–2.3 ka, along with a subsequent decline in sea level after around 4.2 ka. The shift to consistently semi-arid conditions around 2.3 ka signifies the beginning of contemporary climatic conditions (Jayangondaperumal et al., 2012).

8. Palaeoenvironmental Implications

The Teri system reacts acutely to fluctuations in monsoon conditions. The southeastern coast of Tamil Nadu is situated in the rain shadow of the Western Ghats; it receives precipitation primarily during the northeast winter monsoon, accounting for 60% of the total, around 700 mm yearly. The western coast at Muttom has both southwest and northeast monsoon precipitation, totalling roughly 1300 mm. Consistent NE winds during the Last Glacial Maximum facilitated aeolian sand transport from the exposed shelf to the coast, resulting in the formation of the coastal Teri. Jayangondaperumal et al. (2012) show evidence indicating heavy Northeast monsoon around 15 ka, as documented by the inland fluvial Teri, which aligns with enhanced NE monsoon activity between approximately 19 and 17 cal ka BP (Tiwari et al., 2005). Alappat et al. (2013) delineated three principal climate stages from the regional record: (1) Late Pleistocene to terminal Pleistocene (about 24–12 ka) arid interval characterised by aeolian processes; (2) Early Holocene (roughly 10–6 ka) humid to hyper-humid phase marked by heightened southwestern monsoon, associated with dune stabilisation and reddening; and (3) Middle-Late Holocene (about 6–2 ka) arid period, coinciding with increased dune movement and the development of near-coastal Teri. Alappat et al. (2016) observed that the thick vegetation cover in the early Holocene humid phase would have limited sand movement, resulting in the end of west coast dune formation.

The palaeo surface layers, dating to around 9,000 years ago, were linked to increased southwest monsoon precipitation. The prevalent belief associating red aeolian sands with hyper-aridity is therefore erroneous, since (as noted in Section 6) reddening proceeds faster under moderately humid than hyper-arid conditions. They determined that colour alone is an inadequate indicator of dune age and an ineffective method for establishing stratigraphic correlations across regions, and that confident paleoclimatic interpretations of red dune sands requires dating and independent climate evidence in specific regions.

The integrated palaeoenvironmental model for the Teri system can be summarized as follows (Gardner, 1983; Gardner and Pye, 1981; Jayangondaperumal et al., 2012; Alappat et al., 2013):

Phase 1 (>24 ka): Calcrete formation on aeolianite under semi-arid sub-aerial conditions. Land-snail colonization of the calcrete surface. Low sea level exposes the continental shelf.

Phase 2 (~24–11.4 ka): Stronger NE monsoon winds transport sand from the exposed continental shelf inland, building the coastal Teri dune ridges under arid-to-semi-arid conditions. Simultaneously, stronger NE monsoon rainfall deposits inland fluvial Teri at the foothills of the Western Ghats.

Phase 3 (~11.4–5.6 ka): Rapid early Holocene sea-level rise floods the shelf and depletes the sand supply. Dunes stabilize. Humid early Holocene conditions, with intensified SW and NE monsoons, promote deep weathering and reddening of the stabilized coastal Teri. Microlithic cultures occupy the surface of the Teri dunes during this period.

Phase 4 (~5.6–4.2 ka): Mid-Holocene sea-level highstand (approximately 2–3 m above present level) inundates coastal areas. Coastal Teri sands are reworked and redeposited as near-coastal Teri dunes in the backshore region. Reddening of near-coastal Teri begins after 5.6 ka. Microlithic occupation ceases.

Phase 5 (~4.2 ka-present): Fluctuating climatic conditions, with semi-aridity dominant since approximately 2.3 ka. Sea level stabilizes near present levels. Near-coastal Teri stabilizes and develops soil. Modern white dunes remain active and are persistently exposed to reworking.

9. Microlithic Tools from the Teri Dunes

The correlation between phases of dune deposition and occupation of prehistoric populations with a microlithic tool assemblage has been a matter of great debate (Akhilesh and Pappu, 2017). From early discoveries by Foote to current research, interpretations of the context and nature of lithic assemblages have varied greatly (Table 1; Akhilesh and Pappu, 2017). Akhilesh et al. (2017) re-examined this region and proposed that the artefacts do not rest on the surface of the modern dunes, but within older stabilised horizons in association with a gravel. This research is continuing and provides a literature summary of novel field data that complicate and significantly broaden the temporal perspective. Delegates will be introduced to these debates in the field. Recent preliminary discoveries at Sawyerpuram, where Akhilesh et al. (2017, ongoing project) discovered artefacts within a sandy gravel with angular quartz nodules and iron-rich pisoliths associated with indurated dune sands and overlaid by sterile loose sands, have challenged previous interpretations of artefact contexts, and are able to place artefact horizons within a stratigraphic context. The recent findings indicate that a segment of the assemblage predates the significant dune deposition sequence, perhaps placing certain occupancy eras at or exceeding 16–20 ka. Scattered, low-density distributions of finished tools and debitage extend across most of the Teri surfaces and into sections of the alluvial plains further inland, indicating a landscape-scale utilisation of the environment rather than merely localised site-specific usage. Further, many sites where tools were reported were, on re-examination, found to lack artefacts but comprise natural quartz shatter (Akhilesh and Pappu, 2017).





Artefacts eroding out on the surface at the site of Sawyerpuram

10. Summary

The red dunes (Teri sands) of southern India constitute a geomorphologically, sedimentologically, and palaeoenvironmentally significant coastal landform system. Key results from the studies show that:

• The Teri sands are coastal aeolian deposits derived from the erosion and aeolian reworking of heavy mineral-rich beach sands sourced from the Archaean basement rocks of the Khondalite Belt, now exposed in three genetically and chronologically distinct categories: inland fluvial Teri, coastal Teri, and near-coastal Teri.

• The red colour results entirely from in-situ pedogenic weathering of iron-bearing minerals, principally garnet (almandine), within the dune sands, producing a hematite- kaolinite matrix; detrital origin from pre-existing laTeritic red earths is rebutted by multiple lines of microscopic, geochemical, and textural evidence.

• Reddening can occur on surprisingly short timelines- from a few hundred to a few thousand years under humid tropical conditions- defying older ideas of million-year periods.

• The depositional history spans the last glacial maximum to the mid-Holocene, with coastal Teri accumulating between roughly 24 and 11 ka during low sea-level stands, and near-coastal Teri forming around 5.6 ka during mid-Holocene highstands.

• The Teri system is a sensitive recorder of monsoon variability and sea-level variations, with dune generations intimately related to changes in continental shelf exposure (sand supply), wind strength, and moisture availability over glacial-interglacial and Holocene climatic cycles.

• The Teri landscape offers the geological framework for microlithic human occupancy that is currently being re-examined by our team with potentially new dates and information.

• The system has regional relevance extending to Sri Lanka and the greater Gulf of Mannar coastal zone, offering a framework for linking late Quaternary environmental changes over the northern Indian Ocean rim.

Fauna, Climate And Weather Conditions: Modern Environments During The Field Excursion

Delegates will land in Chennai, the capital city of the state of Tamil Nadu, India. Field excursions near Chennai, will be conducted in Thiruvallur district (https://tiruvallur.nic.in/), and Thoothukudi districts (https://thoothukudi.nic.in/). The weather in January is warm with temperatures ranging from 20° to 28° or 30°C, and rare chances of rain. Further information on the weather may be tracked on https://mausam.imd.gov.in/chennai/

The vegetation comprises Tropical Dry Evergreen Forests, with coastal and mangrove vegetation along the coastline and thorn and scrub forests scattered across the landscape. As you drive along the route to the sites in Northern Tamil Nadu (Thiruvallur district) you will also see cultivated rice and groundnut fields, vegetable fields and plantations. In southern Tamil Nadu (Toothukudi district, https://thoothukudi.nic.in/), you will drive along the coastline with salt pans and cultivated fields. You will see a range of domesticated animals, and numerous birds (https://ebird.org/region/IN-TN-TL/bird-list?rank=hc; https://ebird.org/region/IN-TN-TK/bird-list).

Literature Review

(Literature review with Brief on Research Publications available and outstanding issues)

What has and has not been done in the study regions

The first Palaeolithic stone tool was discovered by Robert Bruce Foote at Pallavaram, Northern Tamil Nadu, thereby establishing the antiquity of human occupation in the Subcontinent. Subsequently, he discovered the site of Attirampakkam, and proceeded to research numerous prehistoric sites in Peninsular India. Subsequent research was sporadic, with few publications. From 1991 onwards, research was initiated by S. Pappu. A long-term research project with multidisciplinary inputs and excavations commenced at the site of Attirampakkam in 1999, ongoing. This led to a revision of previous ideas about the stratigraphic sequence of Lower and Middle Palaeolithic cultures, establishing their chronology, analyzing the lithics, and constructing paleoenvironments from numerous proxies. The neighbouring site of Sendrayanpalayam is also being excavated, and research is

underway to establish its chronology. The region has numerous Lower, Middle and Late Palaeolithic sites, and a team led by the Sharma Centre for Heritage Education is collaborating with multiple agencies to develop regional frameworks for geochronology, paleoenvironments and lithic studies. These will establish patterns of hominin adaptation to Quaternary climatic changes and will provide regional geoarchaeological and palaeoclimate frameworks for Palaeolithic landscapes in this region (see Chapter 2).

In Southern Tamil Nadu, geoarchaeological studies were initiated by R. B. Foote, who discovered microlithic sites and also proposed theories related to the evolution of the Teri sand dunes. Subsequent archaeological research was conducted by various Indian and foreign scholars, leading to conflicting views on the position of microlithic sites within the dunes and their formation. No clear chronological controls could be established for the lithics owing to divergent opinions on their stratigraphic position. Current work being conducted by L. Alappat, Naveen Chauhan, Shanthi Pappu, Akhilesh Kumar, Prachi Joshi and Morthekai P. (see Chapter 3).

Future directions are planned in terms of 1. Establishing of the geochronology of sites using multiple methods; 2. Studies of the stratigraphic context of the lithics and their analysis; 3. Building models of palaeoenvironments and human responses to the same.

Further Reading

Pleistocene and Holocene Archaeology: Southern India and Northern Tamil Nadu

Akhilesh, K., Joshi, P., Sivanantham, R., Bakialakshmi, K., Bhattacharya, S., Yeshaswini, R., Rajan, K., & Pappu, S. (2025). Parikulam, Tamil Nadu, a catalogue of Palaeolithic bifaces. Department of Archaeology, State Government of Tamil Nadu

Akhilesh, K., & Pappu, S. (2015). Bits and pieces: Lithic waste products as indicators of Acheulean behaviour at Attirampakkam, India. Journal of Archaeological Science: Reports, 4, 226–241

Akhilesh, K., Pappu, S., Rajapara, H. M., Gunnell, Y., Shukla, A. D., & Singhvi, A. K. (2018). Early Middle Palaeolithic culture in India around 385–172 ka reframes Out of Africa models. Nature, 554, 97–102. https://doi.org/10.1038/nature25444

Blackwell, B. A. B., Montoya, A., Blickstein, J. I. B., Skinner, A. R., Pappu, S., Gunnell, Y., Taieb, M., Kumar, A., & Lundburg, J. (2007). ESR analyses for teeth from the open-air site at Attirampakkam, India: Clues to complex U uptake and paleoenvironmental change. Radiation Measurements. https://doi.org/10.1016/j.radmeas.2007.05.040

Chatterjee, M., Akhilesh, K., Pappu, S., Ravindranath, S., & Udayaraj. (2017). A Late Palaeolithic assemblage at Kunjaram, southeast India. Antiquity Project Gallery, 91(360)

Foote, R. B. (1916). The Foote collection of Indian prehistoric and protohistoric antiquities: Notes on their ages and distribution. Superintendent, Government Press

Foote, R. B. (1866). On the occurrence of stone implements in lateritic formations in various parts of Madras and North Arcot districts. The Madras Journal of Literature and Science, 3(2), 1–41

Gunnell, Y., Durand, N., & Pappu, S. (2024). Regional soil patterns as indicators of Late Cenozoic change in the critical zone: A baseline synthesis for the landscapes of Peninsular India. Earth Science, Systems and Society, 4(1). https://doi.org/10.3389/esss.2024.10097

Gunnell, Y., Rajashekar, C., Pappu, S., Taieb, M., & Kumar, A. (2006). On the depositional environment of Lower Palaeolithic horizons at the prehistoric site of Attirampakkam, Tamil Nadu. Current Science, 91, 114–118

Pappu, S. (1996). Reinvestigation of the prehistoric archaeological record in the Kortallayar Basin, Tamil Nadu. Man and Environment, XXI(1), 1–23

Pappu, S. (1999). A study of natural site formation processes in the Kortallayar Basin, Tamil Nadu, South India. Geoarchaeology: An International Journal, 14(2), 127–150

Pappu, S. (2001a). A re-examination of the Palaeolithic archaeological record of northern Tamil Nadu, South India (BAR International Series 1003). British Archaeological Reports

Pappu, S. (2001b). The environment in prehistoric research: A case study from the Kortallayar Basin, Tamil Nadu. In K. K. Misra & M. L. K. Murty (Eds.), People and environment in India: Essays in environmental anthropology (pp. 24–38). Discovery Publishing House

Pappu, S. (2001c). Middle Palaeolithic stone tool technology in the Kortallayar Basin, South India. Antiquity, 75(287), 107–117

Pappu, S. (2001d). Recent research into the Palaeolithic archaeology of Tamil Nadu, South India. Praehistoria, 2, 85–96

Pappu, S. (2002). Excavations at the Palaeolithic site of Attirampakkam, 2002. Avanam: Journal of the Tamil Nadu Archaeological Society

Pappu, S. (2004). Down ancient trails: Hunter-gatherers in Indian archaeology. In A. Barnard (Ed.), Hunter-gatherers in history, archaeology and anthropology (pp. 129–142). Berg

Pappu, S., & Akhilesh, K. (2003). The Palaeolithic archaeology of the Kortallayar River Basin, Tamil Nadu. Kalvettu, 16–23

Pappu, S., & Akhilesh, K. (2006). Preliminary observations on the Acheulian assemblages from Attirampakkam, Tamil Nadu. In N. Goren-Inbar & G. Sharon (Eds.), The axe age: Acheulian toolmaking from quarry to discard (pp. 155–180). Equinox Publishing

Pappu, S., & Akhilesh, K. (2007). Recent research into the Palaeolithic archaeology of northern Tamil Nadu. In A. R. Sankhyan & V. R. Rao (Eds.), Human origins, genome and people of India (pp. 309–316). Allied Publishers

Pappu, S., & Akhilesh, K. (2016). Methodological issues in excavating a prehistoric site in India: Examples from Attirampakkam, Tamil Nadu. In N. Dasgupta & P. K. Chattopadhyaya (Eds.), Methodologies of interpreting the ancient past of South Asia

Pappu, S., & Akhilesh, K. (2019). Tools, time and trails: Debating Acheulian group size at Attirampakkam, India. Journal of Human Evolution, 130, 109–125

Pappu, S., Akhilesh, K., Gunnell, Y., Braucher, R., Taieb, M., Demory, F., & Thouveny, N. (2011). Early Pleistocene presence of Acheulian hominins in South India. Science, 331(6024), 1596–1599

Pappu, S., Akhilesh, K., Gunnell, Y., Taieb, M., Brugal, J.-P., & Touchard, Y. (2003). Ongoing excavations at the Palaeolithic site of Attirampakkam, South India: Preliminary findings. Current Anthropology, 44(4), 591–597

Pappu, S., Akhilesh, K., Gunnell, Y., Taieb, M., Brugal, J.-P., Anupama, K., Sukumar, R., & Akhilesh, K. (2003). Excavations at the Palaeolithic site of Attirampakkam, South India. Antiquity, 77(297)

Pappu, S., Akhilesh, K., Gunnell, Y., Taieb, M., & Akhilesh, K. (2004). Preliminary report on excavations at the Palaeolithic site of Attirampakkam, Tamil Nadu (1999–2004). Man and Environment, XXIX(2), 1–17

Pappu, S., Akhilesh, K., Ravindranath, S., & Raj, U. (2009). A forgotten heritage: Impact assessment studies at prehistoric sites in Tamil Nadu. In Space, time and place: III International Conference on Remote Sensing in Archaeology (17–21 August 2009, Tiruchirappalli)

Pappu, S., Akhilesh, K., Ravindranath, S., & Raj, U. (2010). Applications of satellite remote sensing for research and heritage management in Indian prehistory. Journal of Archaeological Science, 37, 2316–2331

Pappu, S., Akhilesh, K., Ravindranath, S., & Raj, U. (2011). From stone tools to satellites: Recent research into the prehistory of Tamil. Ancient India: Bulletin of the Archaeological Survey of India, New Series 1, 87–100

Pappu, S., Akhilesh, K., Ravindranath, S., Raj, U., & Gunnell, Y. (2010). Research and management of Palaeolithic resources in Tamil Nadu, South India. Antiquity Project Gallery. http://antiquity.ac.uk/projgall/pappu325./

Pappu, S., Kshirsagar, A., & Sathe, V. (1994). Discovery of a Middle Holocene sub-fossil bone from Tiruvallur Taluk, Chingleput District, Tamil Nadu. Current Science, 67(6), 431–433

Premathilake, R., Akhilesh, K., Anupama, K., Pappu, S., Prasad, S., Gunnell, Y., & Orukaimani, G. (2017). Phytoliths as indicators of Quaternary vegetation at the Paleolithic site of Attirampakkam, India. Journal of Archaeological Science: Reports, 14, 479–499

Premathilake, R., Akhilesh, K., Anupama, K., Prasad, S., Gunnell, Y., Orukaimani, G., & Pappu, S. (2022). Issues of phytolith taphonomy at Palaeolithic sites: Investigation and results from Attirampakkam, India. Journal of Archaeological Science: Reports, 42, Article 103357. https://doi.org/10.1016/j.jasrep.2022.103357

Sreedhar, A. K., Balakrishnan, S., Pappu, S., & Akhilesh, K. (2008). Clay mineralogical studies of sediments and strontium isotope analyses on calcretes at the prehistoric site of Attirampakkam, Tamil Nadu. Current Science, 94(6), 779–786

Warrier, A. K., Sandeep, K., Harshavardhana, B. G., Shankar, R., Pappu, S., Akhilesh, K., Prabhu, C. N., & Gunnell, Y. (2011). A rock magnetic record of Pleistocene rainfall variations at the site of Attirampakkam, southeastern India. Journal of Archaeological Science, 38(12), 3681–3693

Historiography

Pappu, S. (1991–1992). Robert Bruce Foote and the formation processes of the archaeological record. Bulletin of the Deccan College Post-Graduate and Research Institute, 51–52, 647–665

Pappu, S. (2001). In the footsteps of Foote: Recent excavations in South India. PAST: The Newsletter of the Prehistoric Society, 37

Pappu, S. (2007). Changing trends in the study of a Palaeolithic site in India: A century of research at Attirampakkam. In M. D. Petraglia & B. Allchin (Eds.), The evolution and history of human populations in South Asia: Interdisciplinary studies in archaeology, biological anthropology, linguistics and genetics (pp. 121–137). Elsevier

Pappu, S. (2008). Prehistoric antiquities and personal lives: The untold story of Robert Bruce Foote. Man and Environment, XXXIII(1), 30–50

Pappu, S., & Akhilesh, K. (2022). The 'Madrasien': On the trail of a terminology in Indian prehistory. Antiquity, 96(390), 1443–1459. https://doi.org/10.15184/aqy.2022.140

Lithic Knapping and Pedagogy

Akhilesh, K., & Pappu, S. (2023). Let's knap: Experiences in teaching lithic studies in South Asia. Lithic Technology, 48(3), 278–290. https://doi.org/10.1080/01977261.2022.2142386

Akhilesh, K., Joshi, P., Bhattacharya, S., Rajagopalan, Y., Baisla, S., Dey, A., Ghaskadbi, S., Karthick, B., Mane, M., Pandey, A., Perur, S., Roy, C., Sharma, A., Sharon, A., Thakar, C., Verma, S., Kashikar, A. S., & Pappu, S. (2024). Flakes, feelings, and finesse: Experiential studies of skill acquisition in novice knappers. Paleoanthropology.
https://doi.org/10.48738/2025.iss1.1087

Pappu, S. (2022). Intersections: From research to outreach in Indian prehistory [Editorial]. Journal of the Indian Anthropological Society, 57(2), 97–102.
https://www.sharmaheritage.in

Science Communication

Pappu, S. (2000). Archaeology in schools: An Indian example. Antiquity, 74, 485–486

Pappu, S. (2006). Prehistory in Tamil Nadu: The need for links and communication. In M. Kannan & C. Mena (Eds.), Negotiations with the past: Classical Tamil in contemporary Tamil (pp. 1–24). Institut Français de Pondichéry; University of California

Pappu, S., & Akhilesh, K. (2005). Prehistoric archaeology and community education: Learning from excavations at Attirampakkam, Tamil Nadu. Humankind, 1, 131–145

Pappu, S., Raman, K. V., & Ghosh, N. C. (1999). Archaeology for children: A note on the Sharma Children's Museum. Man and Environment, XXIV(2), 91–92

Traditional Crafts/Ethnoarchaeology

Bhattacharya, S., Joshi, P., Akhilesh, K., & Pappu, S. (2025a). Crafting traditional granite grinding stones in South India. Lithic Technology, 1–18. https://doi.org/10.1080/01977261.2025.2562261

Bhattacharya, S., Joshi, P., Akhilesh, K., Goren-Inbar, N., Shelach-Lavi, G., & Pappu, S. (2025b). Breaking it down: Ethnographic studies on the manufacture of basalt grinding stones in India. Journal of Archaeological Science: Reports, 62, Article 104988. https://doi.org/10.1016/j.jasrep.2025.104988

Further Reading

Southern Tamil Nadu: Red Dunes and Prehistoric Tools. Coastal Landscapes of Southeast India

Aiyappan, A. (1945). Mesolithic artefacts from Sawyerpuram in Tinnevelly District, South India. Spolia Zeylanica, 24, 145–154

Akhilesh, K., Pappu, S., Ravindranath, S., & Raj, U. (2017). Shifting sands: A review of research on microlithic sites associated with Teri Dunes of Tamil Nadu. In K. Paddayya & B. Basak (Eds.), Prehistoric research in the Indian subcontinent: A reappraisal and new directions (pp. 215–236). Primus Books

Alappat, L., Seralathan, P., Shukla, A. D., Thrivikramji, K. P., & Singhvi, A. K. (2013). Chronology of red dune aggradations of South India and its palaeo-environmental significance. Geochronometria, 40(4), 274–282. https://doi.org/10.2478/s13386-013-0118-5

Alappat, L., Joseph, S., Tsukamoto, S., Kaufhold, S., & Frechen, M. (2016). Chronology and weathering history of red dunes (Teri Sands) in the southwest coast of Tamil Nadu, India. Zeitschrift der Deutschen Gesellschaft für Geowissenschaften, 168, 183–198. https://doi.org/10.1127/zdgg/2016/0055

Banerjee, P. K. (2000). Holocene and Late Pleistocene relative sea level fluctuations along the east coast of India. Marine Geology, 167, 243–260

Brückner, H. (1988). 'Indicators for formerly high sea levels along the east coast of India and on the Andaman Islands.' Hamburger Geographische Studien, 44: 47–72

Brückner, H. (1989). 'Late Quaternary Shorelines of India.' In: Scott, D.B. (Ed.), Late Quaternary Sea Level Correlation and Applications. Kluwer Academic, New York, pp. 169–194

Chandrasekharan, S., & Murugan, C. (2001). Heavy minerals in the beach and the coastal red sands (Teris) of Tamilnadu. In R. Dhana Raju, M. A. Ali, & S. Krisnan (Eds.), Beach and inland heavy mineral sand deposits of India (Exploration and Research for Atomic Minerals, Vol. 13, pp. 87–109)

Dennell R. (2011) Archaeology. An earlier Acheulian arrival in South Asia. Science. Mar 25;331(6024):1532-3. doi: 10.1126/science.1203806. PMID: 21436430

Folk, R. L. (1976). Reddening of desert sands: Simpson Desert, N.T., Australia. Journal of Sedimentary Research, 46, 604–615

Foote, R. B. (1883). On the geology of Madura and Tinnevelly District. Memoirs of the Geological Society of India, 20, 1–103

Gardner, R. A. M. (1981). Reddening of dune sands — evidence from southeast India. Earth Surface Processes and Landforms, 6(5), 459–468. https://doi.org/10.1002/esp.3290060506

Gardner, R., & Pye, K. (1981). Nature, origin and palaeoenvironmental significance of red coastal and desert dune sands. Progress in Physical Geography, 5(4), 514–534. https://doi.org/10.1177/030913338100500402

Gardner, R. (1983). Reddening of tropical coastal dune sands. Geological Society, London, Special Publications, 11, 103–115. https://doi.org/10.1144/GSL.SP.1983.011.01.12

Gardner, R. A. M. (1986). Quaternary coastal sediments and stratigraphy, south-east India. Man and Environment, 10, 51–72

Gardner, R. A. M., & Martingell, H. (1990). Microlithic sites and their palaeoenvironmental setting, south-east India: A revaluation. Geoarchaeology, 5(1), 1–13

Hari Babu, N., Vasumathi, N. & Bhima Rao, R. (2009). Recovery of Ilmenite and Other Heavy Minerals from Teri Sands (Red Sands) of Tamil Nadu, India. Journal of Minerals and Materials Characterization and Engineering, 8(2): 149–159. https://doi.org/10.4236/jmmce.2009.82013

Jayangondaperumal, R., Murari, M. K., Sivasubramanian, P., Chandrasekar, N., & Singhvi, A. K. (2012). Luminescence dating of fluvial and coastal red sediments in the SE coast, India, and implications for paleoenvironmental changes and dune reddening. Quaternary Research, 77(3), 468–481. https://doi.org/10.1016/j.yqres.2012.01.010

Joseph, S., Thrivikramji, K. P., & Anirudhan, S. (1997). Textural parameters, discriminant analysis and depositional environments of Teri Sands, Southern Tamil Nadu. Journal of the Geological Society of India, 50, 323–329

Joseph, S., Thrivikramji, K.P. & Anirudhan, S. (1999). Mud content, clay minerals and oxidation states of iron in Teris of southern Tamil Nadu: Implication to the origin of Redness. Journal of the Indian Association of Sedimentologists, 18: 83–94

Reuter, M., Harzhauser, M., & Piller, W. E. (2020). Coastal landscape evolution in the Wilpattu National Park (NW Sri Lanka) linked to changes in sediment supply and rainfall across the Pleistocene–Holocene transition. Geological Journal, 55(10), 6642–6656. https://doi.org/10.1002/gj.3826

Singhvi, A. K., Deraniyagala, S. U., & Sengupta, D. (1986). Thermoluminescence dating of Quaternary red-sand beds: A case study of coastal dunes in Sri Lanka. Earth and Planetary Science Letters, 80, 139–144

Srivastava, P., Sangode, S.J. & Parmar, N. (2016). Mineral magnetic characteristics of the late Quaternary coastal red sands of Bheemuni, East Coast (India). Journal of Applied Geophysics, 134: 77–88. https://doi.org/10.1016/j.jappgeo.2016.08.005

Tiwari, M., Ramesh, R., Somayajulu, B. L. K., Jull, A. J. T., & Burr, G. S. (2005). Early deglacial (~19–17 ka) strengthening of the Northeast monsoon. Geophysical Research Letters, 32, Article 19712. https://doi.org/10.1029/2005GL024070

Turner, P. (1980). Continental red beds. Elsevier

Venu, U. A., & Velmayil, P. (2021). Texture, mineralogy and geochemistry of Teri sediments from the Kuthiraimozhi deposit, Southern Tamilnadu, India. Arabian Journal of Geosciences, 14(5). https://doi.org/10.1007/s12517-021-06549-x

Walker, T. R. (1967). Formation of red beds in modern and ancient deserts. Geological Society of America Bulletin, 78, 353–368

Wallace, H. (2016). Geology of the PQ deposit, Sri Lanka. Applied Earth Science, 125: 168–173

Zeuner, F. E., & Allchin, B. (1956). The microlithic sites of Tinnevelly District, Madras State. Ancient India, 12, 4–20

Program For The Field Excursion

Arrival in Chennai	- Arrival in Chennai on January 22: Friday, 2027 - Pick up at the airport by the SCHE - Check into the hotel (Novotel at Shollinganallore) and relax (Please follow Route-1 in the map from the Airport to the Hotel)
Ice Breaker	07:00 PM, Reception in the hotel Novotel, Shollinganallur

DAY-1: 23rd January	Time	Program	Destination/Venue	Route
	9:30 AM to 10:30 AM (after breakfast in the hotel)	Orientation to the field trip by: Prof. Shanti Pappu, Dr. Kumar Akhilesh, Dr. Linto Alappat, Dr. Naveen Chauhan, Dr. P. Morthekai Dr. K. Anupama	Sharma Centre for Heritage Education, Shollinganallur, Chennai	Route 2
	10:30 AM to 11:00 AM	Tea and Refreshments		
	11:00 AM to 1:00 PM	Observation of artefacts from sites in Northern and Southern Tamil Nadu (Lower, Middle and Late Palaeolithic artefacts) Demonstration and "hands-on" experience in how prehistoric stones were made	Sharma Centre for Heritage Education, Shollinganallur, Chennai	-
	1:00 PM to 2:30 PM	Traditional South Indian lunch	-	-
	2:30 PM	Departure for the UNESCO World Heritage Site of Mahabalipuram	Mahabalipuram	Route 3
	3:30 PM	Arrival in Mahabalipuram	Mahabalipuram	-
	3:30 PM to 6.00 PM	Discussion with experts on the stone architecture and coastal landscapes around Mahabalipuram	Mahabalipuram	-
	6:00 PM	Departure for the hotel and dinner along the way at Citadine complex hotel, Delhi Highway	Chennai	Route 4
	9:00 PM	Arrival at the hotel and rest	Chennai	-

END OF DAY-1

DAY-2: 24th January	Time	Program	Destination/Venue	Route
	6:00 AM	**Early to Middle Pleistocene Landscapes of Northern Tamil Nadu** Departure to Thiruvallur district and visit to the Early and Middle Pleistocene site of Attirampakkam (ATM)	-	Route 5
	7:00 AM to 8:00 AM	Breakfast stop en route at Sri Motel Highway	-	-
	8:00 AM	Continue journey to the Early and Middle Pleistocene site of Attirampakkam (ATM)	-	Route 5
	9:30 AM	Arrival at the nearest village to the site of Attirampakkam (ATM)	Attirampakkam	Route 5
	9:30 AM to 10:30 AM	Attirampakkam: site visit and discussion (with refreshments)	Attirampakkam	-
	10:30 AM	Departure from Attirampakkam to Sendrayanpalayam (SEN)	-	Route 6
	11:15 AM to 12:00 NOON	Site Visit: Palaeolithic site of Sendrayanpalayam (SEN) (with Refreshments)	Sendrayanpalayam	-
	12:00 NOON	Departure from Sendrayanpalayam (SEN)	Sendrayanpalayam	-
	12:30 PM to 2:00 PM	Packed field lunch box and experiences in an Indian village	-	-
	2:00 PM	Departure for examination of laterites and ferricretes with Palaeolithic artefacts at the sites of Kunjaram/Mailapur	-	Route 7
	2:20 PM to 3:00 PM	Site Visit: Kunjaram	Kunjaram	-
	3:00 PM	Departure for Mailapur	-	-
	3:20 PM to 4:00 PM	Site Visit: Mailapur	Mailapur	-
	4:00 PM	Departure for Chennai	-	Route 5
	6:00 PM	Arrival at the hotel	Hotel	-
	8:00 PM	Dinner at the hotel and rest	Hotel	-

END OF DAY-2

DAY-3: 25th January	Time	Program	Destination/Venue	Route
	6:30 AM	Departure from the hotel in Chennai to Thoothukudi 9.25 AM flight	Please note that domestic flights permit only 15 kg of check-in baggage and 7 kg of cabin baggage, as two pieces only. Additional bag and weight are chargeable.	Route 8
	11:05 AM	Arrival at Thoothukudi Airport	-	-
	12:00 NOON	Check into the hotel.	-	Route 8
	12:30 PM to 1:30 PM	Lunch at Thoothukudi	-	-
	1:30 PM to 3:00 PM	Rest at the hotel.	-	-
	3:00 PM	Departure for the Porunai Museum for an overview of the local archaeology.	Porunai	Route 9
	4:00 PM to 6:00 PM	Museum Guided Tour	Porunai	-
	7:00 PM	Return to the hotel and dinner.	Thoothukudi	Route 9

END OF DAY-3

DAY-4: 26th January	Time	Program	Destination/Venue	Route
	6:00 AM	Departure to examine the Teri Red dunes at Therikkudiyiruppu, Kuthiraimozhi Teri (Theri Kaadu)	We also celebrate India's Republic Day!	Route 10
	7:30 AM to 8:30 AM	Teri Site Visit: Discussion on the Teri sands, palaeoenvironments, archaeology and Dune formations (with refreshments)	Therikkudiyiruppu, Kuthiraimozhi Teri (at Kuthiraimozhi Therikkudiyiruppu (Theri Kaadu)	-
	8:30 AM	Departure for Tiruchendur	-	Route 11
	9:00 AM to 10:00 AM	Breakfast at Tiruchendur	-	-
	9:00 AM to 10:00 AM	Departure for Coastal Red Sand Dunes at Puttan Tharuvai	-	Route 12
	10:45 AM	Arrival at Puttan Tharuvai	-	-
	10:45 AM to 12:00 NOON	Observations and discussions of formations at Puttan Tharuvai	-	-
	12:00 NOON to 12:30 PM	Packed lunch at Puttan Tharuvai	-	-

DAY-4: 26th January	Time	Program	Destination/Venue	Route
	12:30 PM	Departure for Manappad to observe coastal formations	-	Route 13
	1:30 PM	Arrival at Manappad	-	-
	1:30 PM to 2:30 PM	Observations and discussion at Manappad	-	-
	2:30 PM	Departure to see the prehistoric site of Sawyerpuram	-	Route 14
	4:30 PM	Arrival at Sawyerpuram	-	-
	4:30 PM to 6:00 PM	Observation of the prehistoric artefacts and Teri dunes at Sawyerpuram	-	-
	6:30 PM	Return to the Toothukudi hotel for dinner	-	Route 15

END OF DAY-4

DAY-5: 27th January	Time	Program	Destination/Venue	Route
	6:30 AM	Departure for Velayudhapuram to examine coastal geomorphological formations	-	Route 16
	7:30 AM	Arrival at Velayudhapuram with a packed breakfast	-	-
	8:00 AM-9:00 AM	Observation and discussions	-	-
	9:00 AM	Departure to Tuticorin airport for Lucknow via Bengaluru at 12:15 PM Arrival at Lucknow by 8:05 PM	-	Route 16

END OF DAY-5

Field Transects/Locations

Palaeolithic Landscapes of Northern Tamil Nadu

Northern Tamil Nadu, along the southeast coast of India, has a rich archaeological record, comprising some of the oldest Pleistocene Palaeolithic sites in India. This landscape is marked by a diversity of geomorphological formations extending from the western Azhikulli hills to the east coast, within the basins of the rivers Arani, Kushasthalaiyaru and Palar. From fluvio-lacustrine deposits to ferricretes, Palaeolithic sites occur in varied sedimentary contexts dating back to around 1.5 Ma. Delegates will traverse these landscapes, observe sites and discuss their significance in terms of the story of human evolution and the historiography of Indian prehistory. They will be accompanied by experts who have worked on the archaeology, geomorphology, geochronology and palaeobotany of these sites. They will also experience traditional food-processing tools in a local village and witness Indian hospitality at its best.

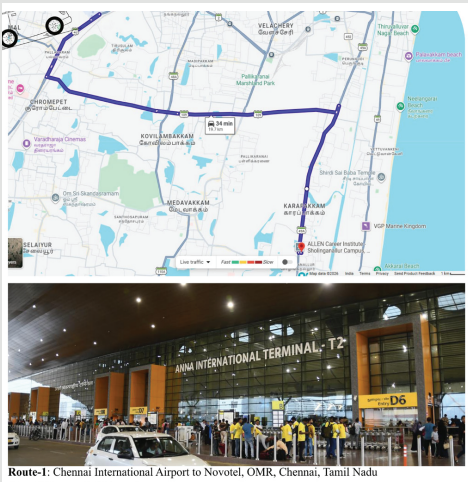
DAY-1: Saturday, January 23, 2027

Sites/Sections to be Visited: Orientation program at the Sharma Centre for Heritage Education, Chennai, Tamil Nadu

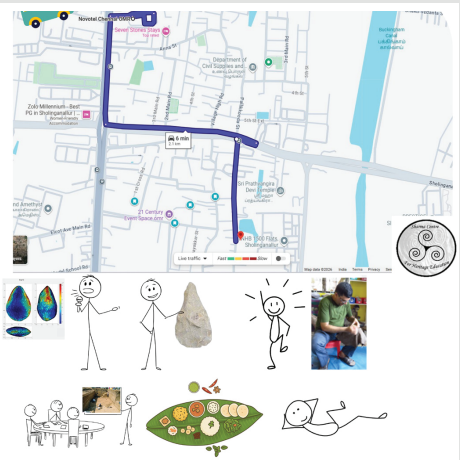
Departure Time: 8:45 AM

Meeting Point: Lobby of the hotel after breakfast

Vehicle: A bus will be organised to bring you to the SCHE campus



Route-1: Chennai International Airport to Novotel, OMR, Chennai, Tamil Nadu
(Travel Time: ~ 35 Minutes)



Route 2: Novotel hotel, OMR to Sharma Centre for Heritage Education, Chennai
(Travel Time: ~ 10 Minutes))

Item	Time	Details
Orientation	9.30-10.30 AM	Orientation to A. Early- to Late Pleistocene and early Holocene prehistoric heritage and palaeoenvironments of the regions to be visited in northern and southern Tamil Nadu; B. Orientation to the Coastal geomorphology of southern Tamil Nadu
Refreshments	10.30-11:00 AM	Refreshments and interaction
Observation of prehistoric stone artefacts from the sites and discussions	11.00 AM-1:00 PM	Observation of Lower, Middle and Late Palaeolithic artefacts Immersive experiences of stone tool manufacture ('knapping') and discussion
Traditional South Indian lunch	1:00 PM to 2:30 PM	Lunch break
Departure for the UNES CO World Heritage Site of Mahabalipuram and a guided tour of the site, including refreshments	2:30 PM -6 PM	Visit to Mahabalipuram
Return to Chennai with dinner en route at Delhi Highway, Citadine complex	2:30 PM -6 PM	-

Immersive experiences: 'Knapping Stone'

Observations of Lower to Late Palaeolithic stone tools from excavations and surveys conducted by the SCHE will enable delegates to discuss the archaeological record of the sites they will visit in northern and southern Tamil Nadu. Discussions on hominin migration, stone tool technologies and cognitive evolution will be held with experts. Delegates will also discuss raw maTerials used to make tools with implications for hominin mobility and decision-making. Aspects of patination, abrasion, and weathering of different rock types will be discussed.

Following this, delegates will be given a hands-on immersive experience of trying their hands at knocking flakes off 'cores' and using them. They will be guided by Dr Kumar Akhilesh, an expert knapper, who will facilitate an appreciation of prehistoric skills, geological knowledge and cognitive abilities.



Stories in Stone: From Flaking Handaxes to Carving Monuments

Traditions of stone working have continued in India, and we move from handaxes to sculptures and monuments. The UNESCO World Heritage Site of Mahabalipuram/ Mammalapuram. This group of monuments was carved from rock by master craftsmen and architects during the 7th-8th century CE under the Pallava dynasty. These monuments comprise a magnificently carved group of rock-cut cave temples, monolithic temples, bas-relief sculptures, structural temples, and excavated temple remains. Carved from the Archaean rock formations in this area, they represent early examples of marvellous rock-cut architecture. In addition to the monuments, delegates can witness traditional modes of sculpture- and do some shopping!

More information is available here:

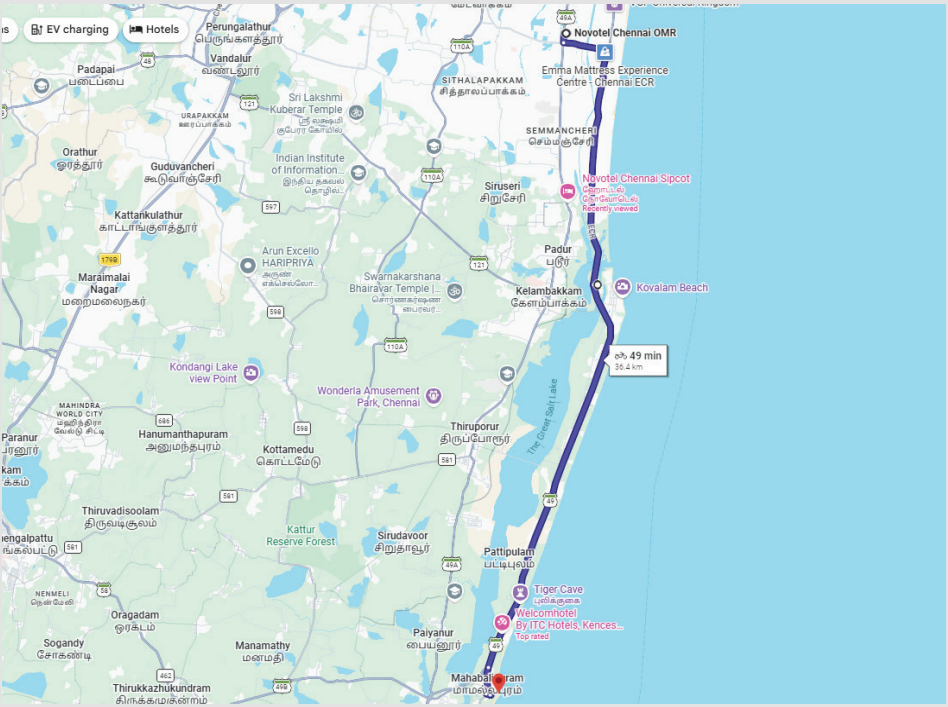
https://whc.unesco.org/en/list/249/

https://www.tamilnadutourism.tn.gov.in/destinations/mahabalipuram

https://www.youtube.com/watch?v=BbwqXwHABG8&list=PLWDZ_ZQCAoimpnK2mhZoNMBkjOtmciF_D&index=5

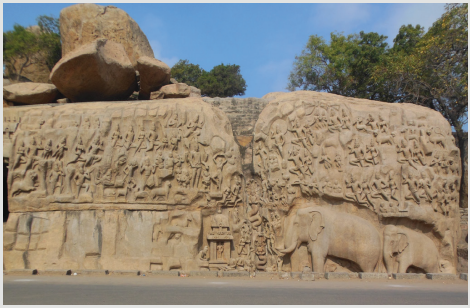
https://www.youtube.com/watch?v=KxBZN_JxuK8&list=PLWDZ_ZQCAoimpnK2mhZoNMBkjOtmciF_D&index=4

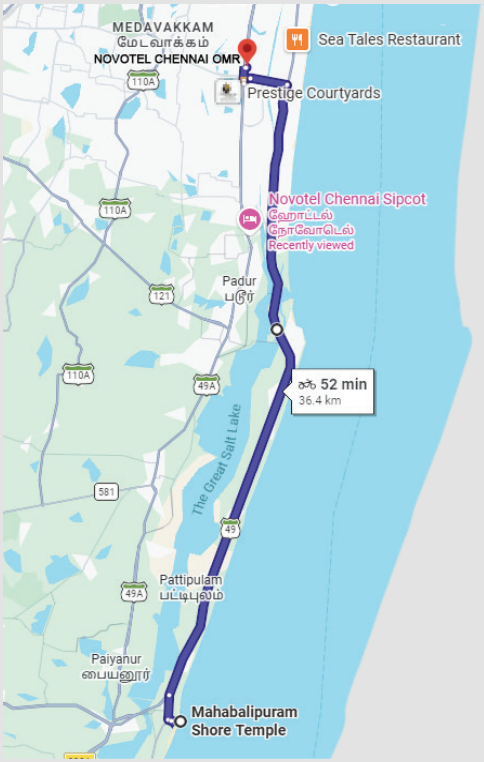
Watch a reel made by our interns (SCHE):

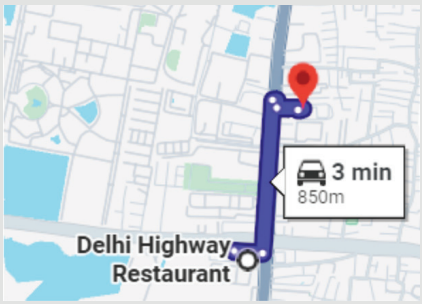


Route 3: Novotel hotel, OMR to Mahabalipuram (Travel Time: ~ 50 Minutes)









Route 4: Mahabalipuram to Delhi Highway, Ditadina Complex for dinner (Travel Time :~45 Minutes) and return to the hotel for the restaurant (Travel Time :~ 5 Minutes)

DAY-2: Sunday, January 24, 2027

Sites/Sections to Be Visited:

Locality 1: Attirampakkam (ATM), Thiruvallur district, Tamil Nadu

Locality 2: Sendrayanpalayam (SEN), Thiruvallur district, Tamil Nadu

Locality 3: Kunjaram/Mailapur complex (KNJ/MLP), Thiruvallur district, Tamil Nadu

Departure Time: 6:00 AM

Meeting Point: Hotel lobby

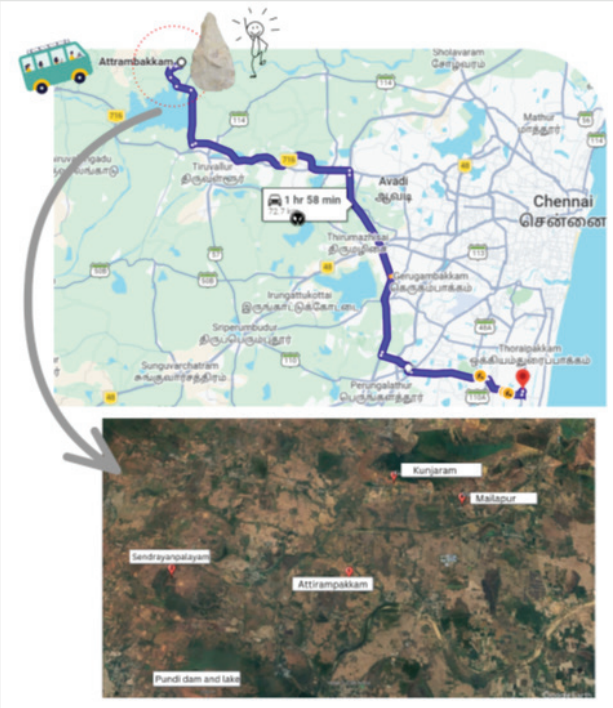
Vehicle: A bus will be organised for the excursion, accompanied by a guide vehicle. You will be accompanied by Professor Shanti Pappu, Dr Kumar Akhilesh, Dr Prachi Joshi and Ms Sutonuka Bhattacharya (SCHE). Scientists working on this project will be invited to join for special lectures.

Food and Refreshments

Food	Location
Breakfast	Shri Motel Highway en route to the site complexes
Lunch	Packed box lunch at the village of Manamedu, along with an experience of an Indian village
Refreshments and water	These will be available at all times within the vehicle
Tea and refreshments	Hotel Sangeetha on the route back to Chennai

Site Location

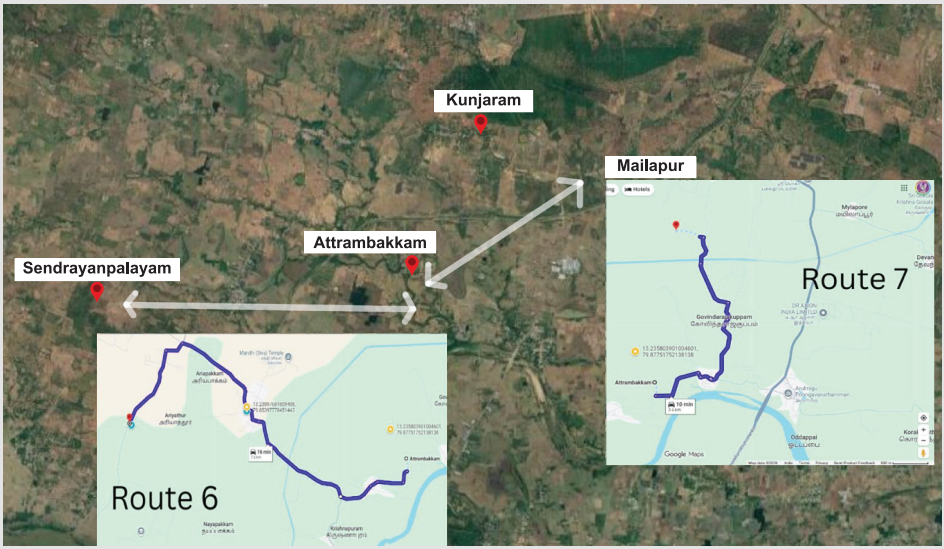
Site Name	Latitude	Longitude
Attirampakkam (ATM)	13°14'10.33"	79°52'38.49"
Sendrayanpalayam (SEN)	13°14.453'	79°50.274'
Kunjaram/Mailapur complex (KNJ/MLP)	13°15'40.12"	79°53'20.97"



Route 5: Novotel hotel, OMR, Chennai to the prehistoric site complex in Northern Tamil Nadu

(Attirampakkam, Sendrayanpalayam, Kunjaram and Mailapur)

(Travel Time to Attirampakkam:~ 2 Hours)



Route 6 and 7: Local travel to visit sites around Attirampakkam

Locality 1: Attirampakkam (ATM), Thiruvallur District, Tamil Nadu

Departure post-breakfast: 8:00 AM

Arrival at the village of Manamedu: 9:30 AM

Commencement of walk to the site and arrival at the site: Duration of around 15 minutes.

Observations: This site was discovered by the British geologists Robert Bruce Foote and William King in 1863. A long-term interdisciplinary research program, including excavations, is being directed by the SCHE in collaboration with multiple institutions in India and abroad (see references). ATM is an open-air Palaeolithic site situated near a meandering tributary stream of the river Kushasthalayaru, formerly Kortallaiyar, and is one among a cluster of sites constituting the southernmost extension of the South Asian Acheulian and Middle Palaeolithic cultures. Extensive excavations since 1999 have exposed a sequence of stratified deposits reaching a maximum thickness of ~9 m.

The stratigraphic sequences comprise the bedrock of Cretaceous shale and sandstone deposits, named the Sriperumbudur and Avadi series. These sediments were eroded and deposited in low-energy fluvio-lacustrine contexts at the site (layers 6, 7 and 8). Sediments aggraded during occupation, leading to repeated burial of artefacts discarded at the site. Alternating sand and silty clay beds with no unequivocal evidence of palaeosols suggest periodic cycles of sediment deposition without lengthy interruptions. The suspended silt particles presumably settled out during low-velocity, laminar overbank streamflow, burying the stone tools without displacing them. A disconformable upward sequence of coarse

laTeritic gravels, clay-rich silts, and finer ferruginous and lateritic gravels overlies layer 6 and contains early Middle Palaeolithic assemblages. Palaeomagnetic measurements and direct 26Al/10Be burial dating of stone artefacts now position the earliest Acheulian levels as no younger than 1.07 million years ago (Ma), with a weighted average age of 1.51 ± 0.07 Ma.

The overlying layers yielded a sequence ranging from transitional assemblages marking the development of an early Middle Palaeolithic culture (layer 5) to a Middle Palaeolithic technology (layers 4, 3, 2), culminating in the virtual abandonment of the site in layer 1 (an archaeologically sterile deposit). The layers 5 to 2 comprise clay-rich silt alternating with ferruginous gravels. Palaeoenvironmental studies based on a variety of proxies suggest a seasonally dry tropical climate that was wetter during the deposition of layers 4 and 3, which are low-energy overbank silt deposits, and drier during the deposition of layers 5 and 2, which are gravel beds, with relative aridity persisting through layer 1.

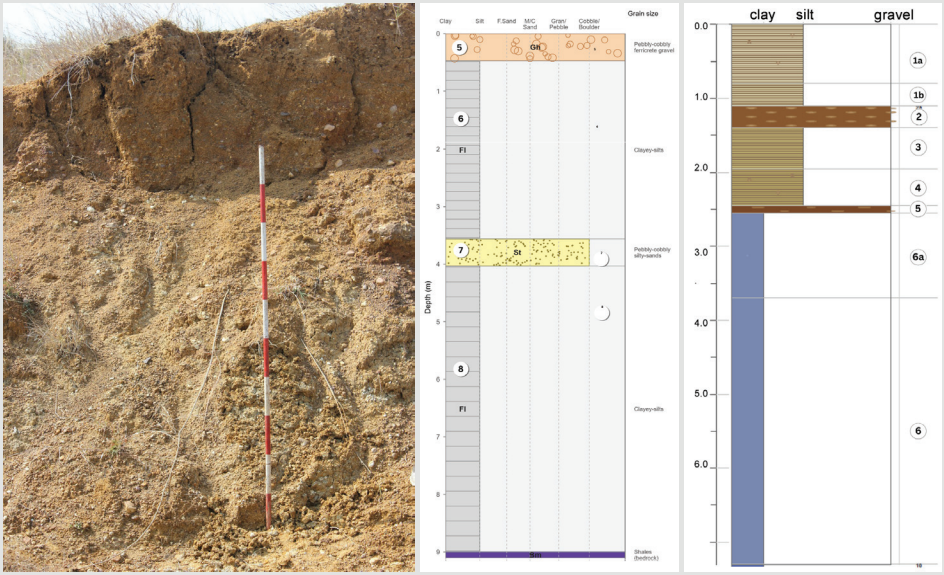
Acheulian and Middle Palaeolithic artefacts were all made from coarse-to fine-grained quartzite, locally available in cobble and boulder deposits in the near hinterland, and derived from outcrops of the Satyavedu and Sriperumbudur formations, which form the rugged hills to the west. You will observe artefacts eroding out on the surface and embedded in differing sedimentary layers in the adjacent gully sections.

What will you see? As the excavation trenches are now backfilled and closed in compliance with government norms, you will be walking across the undulating surface of the site examining artefact spreads eroding out of various sedimentary layers onto the surface. You will then observe the stratigraphic sequence along natural sections in the gullies dissecting the site. You will have already observed and handled some artefacts from the Attirampakkam excavations at the Sharma Centre for Heritage Education, in Chennai.





Atefacts eroding out of different layers on the surface



Stratigraphic layers showing: layers 2 to 5 - Middle Palaeolithic; layers 6 to 8 - Acheulian

Locality 2: Sendrayanpalayam (SEN), Thiruvallur District, Tamil Nadu

Departure from Attirampakkam: 10:30 AM

Arrival at the site: 11:15 AM

Walk to the site: Duration around 5 minutes

Observations: This site was discovered by Shanti Pappu and Kumar Akhilesh in 2007 during explorations to research new prehistoric sites in this region. Subsequent excavations were directed by the SCHE in collaboration with multiple institutions in India and abroad. SEN is an open-air Palaeolithic site located in the foothills of the Allikuzhi hills. It lies close to the Attirampakkam site and to many other Palaeolithic sites in the vicinity. Excavations revealed a sequence of stratified deposits reaching a maximum thickness of ~4 m.

The stratigraphic sequence comprises four layers of varying thickness preserved across the site. The uppermost horizon, layer 1, consists of sandy silt and is archaeologically sTerile. This overlies layer 2, a ferruginous gravel. This is rich in ferricrete pisoliths and nodules, and contains a dense concentration of pebble- to cobble-sized clasts. Layer 3 consists of loose ferricrete gravel with occasional indurations into iron-cemented duricrust. The entire sequence of layers 1-3 caps layer 4, i.e., the bedrock. Layer 4 consists of boulder conglomerates (Satyavedu Formation). This geological formation constitutes one of the

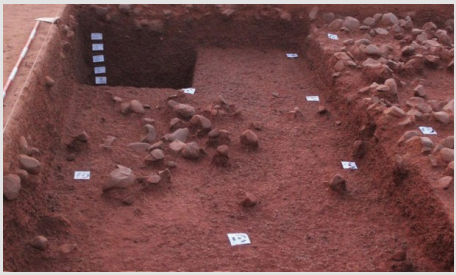
chief sources of raw maTerial used by hominins. The site lies on a pediment extending out as a spur from the base of the Allikuzhi hills. The site is currently being dated using terrestrial cosmogenic nuclides, optically stimulated luminescence, and magnetostratigraphy. Studies of palaeoenvironmental proxies are in progress.

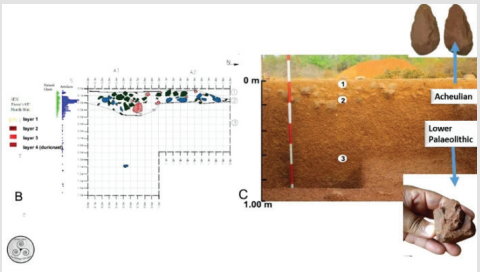
The site displays two cultural horizons. The upper levels (layer 2) contain a characteristic Large Flake Acheulian, comprising handaxes, cleavers, large quartzite cores, and a complete reduction sequence of local tool-manufacturing activities in situ. The lower levels (layer 3) yielded an assemblage lacking bifaces and primarily dominated by small cores and flakes. Tools in this deeper level are on sandstone. Many conjoined artefacts highlight the site's high level of preservation.

What will you see? Given that the excavation trenches themselves have been backfilled in compliance with official regulations, you will be walking across the irregular surface of an abandoned quarry where Quaternary sediments can be inspected in quarry-face sections. You will examine artefact spreads eroding out of various sedimentary layers onto the surface and embedded within Pleistocene sediments. You will also be able to observe the Cretaceous Satyavedu Formation, where raw material in the form of cobbles and boulders is available at the site. You will have already observed and handled the artefacts from the Sendrayanpalayam excavations at the Sharma Centre for Heritage Education, Chennai.

Lunch Break

A packed box lunch will be provided at the village of Manamedu. Delegates will be able to get some rest in the village. In addition to lunch, they will interact with villagers who are collaborating with the SCHE team on archaeological fieldwork. The villagers will demonstrate the use of traditional grinding stones, and delegates can try their hands at ancient food-processing methods that date back to the Indian Neolithic (around 5000 years ago). They will gain more information on the earliest food-producing agro-pastoral communities of India from Ms Sutonuka Bhattacharya, and will observe a range of spices, vegetables and grains that have been used since the Neolithic in South India. They can avail of the village's restrooms and view its traditional temples (Bhattacharya et al. 2025a,b).





Locality 3: Kunjaram (KNJ) and Mailapore (MLP), Thiruvallur District, Tamil Nadu

Site 1:

Arrival at the site of Kunjaram: 2:20 PM

Commencement of walk to the site and arrival at the site: Duration of around 10 minutes

Observations: The Kunjaram complex comprises several localities with artefacts spanning the Middle to Late Palaeolithic. To the west of the site lie the Azhikulli hill range, running NNE to SSW and rising to 200–380 m amsl. They consist entirely of Cretaceous alluvial fan deposits, i.e., a clast-supported and strongly cemented Cretaceous boulder conglomerate rich in rounded quartzite pebbles and cobbles. These outcrops constituted the principal regional source of raw lithic maTerial from the Acheulian onwards, and similar outcrops are extremely scarce elsewhere in peninsular India. Kunjaram is located on a pediment, i.e. a gently sloping bedrock surface, extending eastwards from the Azhikulli hills, with Early and Middle Palaeolithic artefacts encountered at elevations of 45–60 m amsl along this intermediate belt between the hills and the coastal plain, often embedded in ferricrete gravel beds resulting from eroding laTerite outcrops generated by a more humid climate in the geological past. Artefacts encountered on the land surface often correspond to Late Palaeolithic tools that have eroded out of the uppermost levels of ferricrete gravel. At Kunjaram, these occur in the upper horizons of a ferricrete profile where, in some sections, underlying Middle Palaeolithic artefacts are also reported. These, in turn, rest on bedrock consisting of Cretaceous shales, suggesting that the laTerite caprock developed more readily on the shale than on the boulder conglomerates, where evidence of regional laTeritization across the landscape is mostly expressed in the iron-enriched matrix surrounding the remarkably unweathered quartzite clasts. The ferricrete gravels at Kunjaram are capped by rubified sands in the vicinity and are dated to ~9 ka.

A low-density scatter of artefacts occurs across the site, with tools produced from medium- to fine-grained quartzite cobbles – sources of which occur off-site within a radius of ~4 km. Nodules of quartz and chalcedony occurring on-site were also used. The assemblage suggests a culture with a distinct blade technology. Regional mobility strategies and indications of planning are reflected in the transport of quartzite to the site for further reduction, and in the removal of blades and blade tools from the site (research into the transport of these tools to other local sites is ongoing). Reuse of blade-rejuvenation flakes and extensive core reduction suggest conservation of raw material. It also lacks microblade technologies, standardised blade-reduction sequences and microlithic assemblages, occurrences of which have been dated to ~38–48 ka in other parts of India and Sri Lanka. Kunjaram thus differs from sites to be visited in the Teri region of southern Tamil Nadu later during this field excursion. This site adds new dimensions to the study of the Late Pleistocene in India, demonstrating variability in the chronological development and regional distribution of blade technologies across South Asia.

What will you see? You will walk across the surface of a modern quarry cutting into Quaternary sediments. You will examine artefact spreads eroding out of various sedimentary

layers onto the land surface as well as still embedded within Pleistocene sediments. You will have already observed and handled the artefacts from the Kunjaram excavations at the Sharma Centre for Heritage Education, Chennai.







Site 2:

Arrival at the site of Mailapur: 3:20 PM

Commencement of walk to the site and arrival at the site: Duration of around 5 minutes

Observations: The entire region, from Mailapur to Kunjaram, was found to exhibit a generally similar stratigraphy. Extensive quarrying of the ferricrete for the construction of the Krishna Canal has led to the exposure of new sections. The stratigraphic sequence comprises

Cretaceous shales that underlie a ferricrete unit of ~2 m in thickness. The Acheulian to Middle Palaeolithic artefacts erode out of the ferricretes, while the surface contains Late Palaeolithic tools in a low-density spread. The existence of pebble lenses and gravel beds, as likewise the existence of numerous randomly distributed clasts within the ferricrete at varying densities across the site, indicates localised fluvial activity (concentrated channel flow) and perhaps short-range transport processes under high-energy sheetwash.

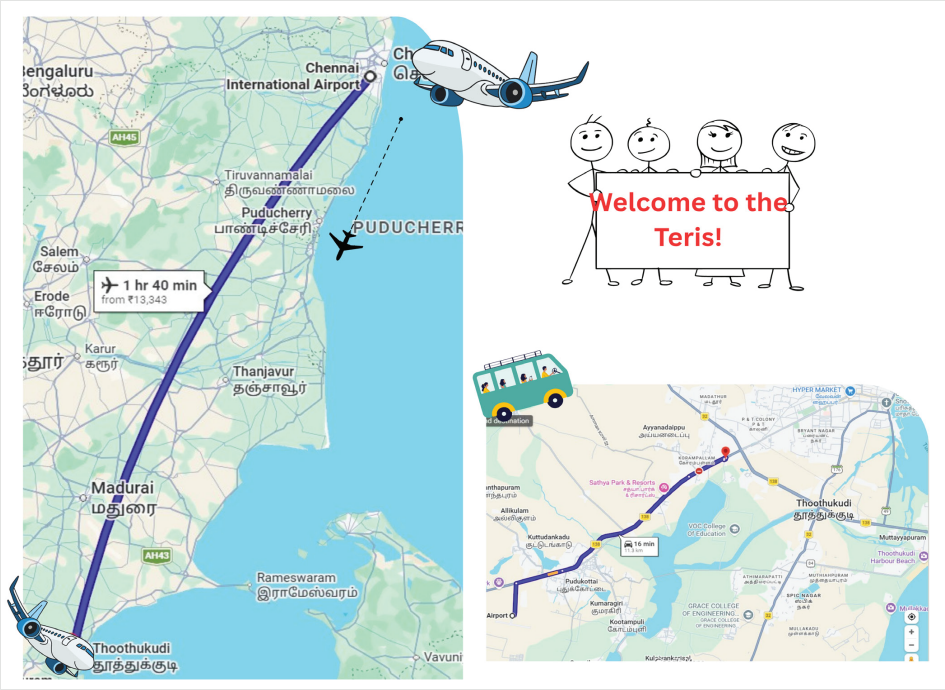
What will you see? You will be walking across the surface of a modern quarry where laTerite profiles are visible. You will also observe Quaternary ferricretes with tools ranging from the Late Acheulian/Early Middle Palaeolithic to the Late Palaeolithic. You will have already observed and handled a range of artefacts retrieved from the Mailapur excavations at the Sharma Centre for Heritage Education, Chennai.

Field Transects In Southern Tamil Nadu

Red Dunes and Prehistoric Tools: Coastal Landscapes of Southeast India

The coastal plains of southern Tamil Nadu are characterised by prominent brick-red aeolian sand deposits known as Teri (from the Tamil term for 'sandy waste' or 'heap of sand'). Covering over 500 km^2 between Kanyakumari and Rameswaram, these crimson dunes represent one of the most thoroughly studied occurrences of pedogenic reddening in coastal dune fields in a tropical context, attracting scientific attention since Robert Bruce Foote's initial geological survey of 1883. Their red colour, heavy-mineral abundance, association with prehistoric microlithic societies, and sensitivity to monsoon and sea-level fluctuations make the Teri sands a significant repository of late Quaternary environmental history. Over the next three days, delegates will examine coastal and near-coastal Teri dunes, aeolianite and calcrete sequences, coastal geomorphological formations, and prehistoric microlithic sites complemented by a guided tour of the Porunai Museum.

Site Name	Latitude	Longitude
Porunai Museum	8°40'37.55"	77°45'23.04"
Kuthiraimozhi Teri (Theri Kaadu)	8°31'9.34"	78° 0'58.90"
Puttan Tharuvai	8°19'55.86"	77°57'29.04"
Manappad	8°22'23.58"	78° 3'50.19"
Sawyerpuram	8°41'37.70"	78° 1'28.52"
Velayudhapuram	9° 3'3.11"	78°16'16.01"



Route 8.1: Flight route from Chennai to Thoothukudi

Route 8.2: Route from airport to hotel (Toothukudi)

DAY-3: Monday, January 25, 2027

Sites/Sections to be Visited: Travel from Chennai to Thoothukudi; guided tour of the Porunai Museum, Tirunelveli, Tamil Nadu

Departure Time: 6:30 AM from the hotel lobby, Chennai (flight at 9:25 AM)

Meeting Point: Lobby of the hotel

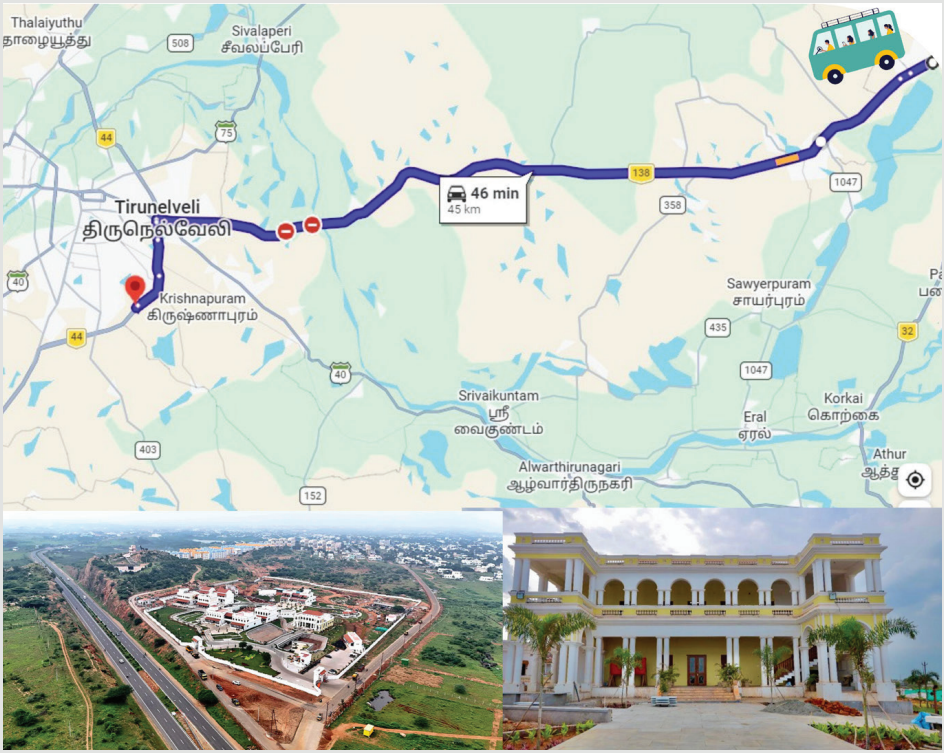
Vehicle: A bus will be organised for the airport transfer in Chennai. On arrival at Thoothukudi, a bus and a guide vehicle will accompany the group throughout the southern Tamil Nadu excursion.

Locality 4: The Porunai Museum: An Orientation to the Deep Past of the Porunai (Thamirabarani River Valley)

Departure from Toothukudi hotel: 3:00 PM

Arrival at the Museum: 4:00 PM

Observations: The Porunai Museum presents the archaeological and cultural heritage of the Porunai (Thamirabarani river valley), the river basin that drains the region of southern Tamil Nadu. The river is a significant part of the landscape over which delegates will be guided over the following days. The guided tour will provide an orientation to the archaeological heritage of this landscape, complementing the field visits to the Teri dunes and associated prehistoric sites. Exhibits relating to the antiquity of human occupation in the river valley and along the coastal plains will be discussed by accompanying experts, who will situate the museum collections within the framework of the Quaternary environmental history of this region.



Route 9: Toothukudi to Porunai Museum, showcasing the archaeology of this region

DAY-4: Tuesday, January 26, 2027

Locality 5: Kuthiraimozhi Teri (Theri Kaadu) at Therikkudiyiruppu, Thoothukudi district, Tamil Nadu

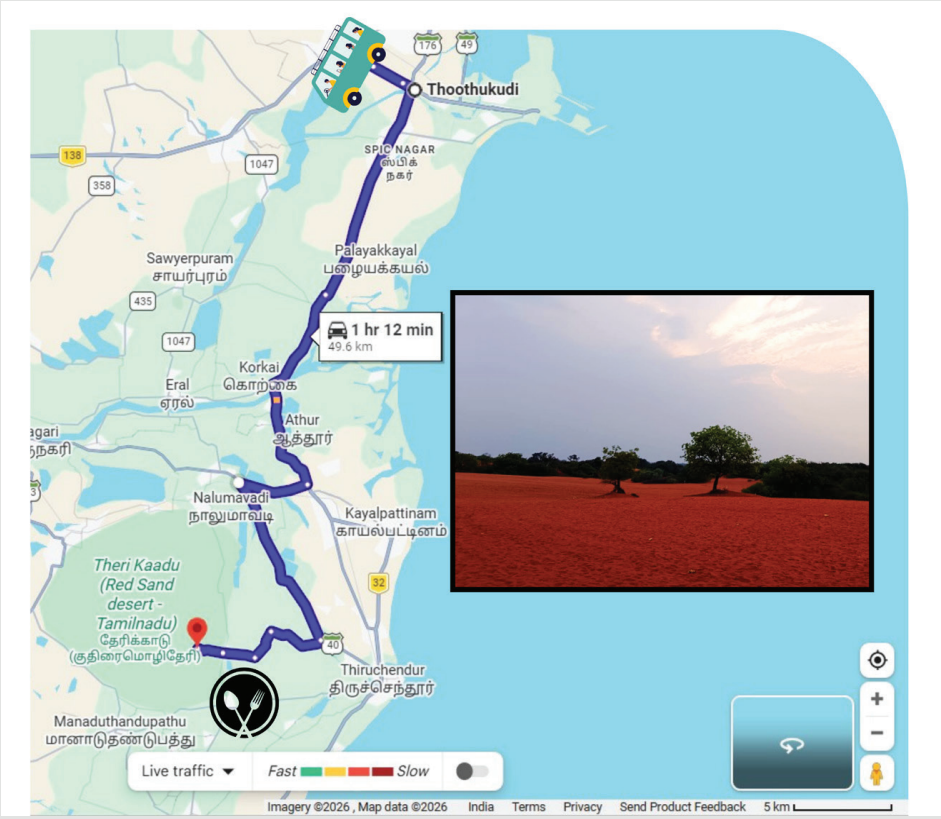
Departure time: 6:00 AM

Meeting Point: Hotel lobby, Thoothukudi

Arrival at the site: 7:30 AM

Commencement of walk to the site and arrival at the site: Duration of around 10 minutes

Vehicle: A bus will be organised for the excursion along with another guide vehicle. You will be accompanied by experts on the coastal geomorphology and prehistory of the Teri region. Scientists working in this region will be invited to join special discussions at the sites.



Route 10: Route form Thoothukudi to the Teri rad sand dunes of Therikkudiyiruppu

Food	Location
Light refreshments	At the Kuthiraimozhi Teri site, Therikkudiyiruppu, during the early-morning site visit
Breakfast	Tiruchendur (9:00 AM – 10:00 AM), en route to Puttan Tharuvai
Packed lunch	Packed box lunch at Puttan Tharuvai (11:45 AM – 12:30 PM)
Refreshments and water	These will be available at all times within the vehicle and will be provided at the sites
Dinner	At the Thoothukudi hotel on return

Observations: The Kuthiraimozhi (Kudiramoli) Teri is a major consolidated red dune field, part of a >500 km^2 Teri belt between Kanyakumari and Rameswaram, extending 15–16 km inland with a thickness of 1–12 m. This 'coastal Teri' dune (30–60 m amsl) is dark red (Munsell 10R 3/6), 2–12 m thick, and is stabilised by vegetation. It displays barchan, transverse and blowout dune forms with erosional remnant ridges. These dunes formed ~24–11.4 ka during low sea levels, when an exposed continental shelf supplied sand to strong NE monsoon winds; deposition ended with the early Holocene marine transgression, after which humid conditions drove deep in-situ weathering. The red colour comes from pedogenic weathering of garnet (almandine) from the Khondalite basement into a haematite–kaolinite matrix (not wind-blown lateritic dust, as older theories held), with CIA values of 96–98 showing near-total feldspar breakdown.

What will you see? You will walk across the surface of the red dune field at first light, examining dune morphologies (barchans, transverse forms and blowouts), gullied and eroded badland surfaces, and the deep, uniform reddening of the structureless consolidated sands. You will discuss the palaeoenvironmental significance of the Teris with accompanying experts over light refreshments.



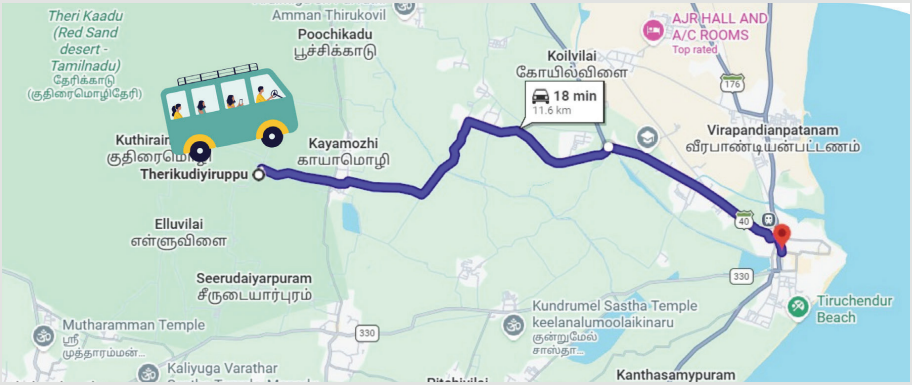


Locality 6: Coastal Red Sand Dunes at Puttan Tharuvai, Thoothukudi District, Tamil Nadu

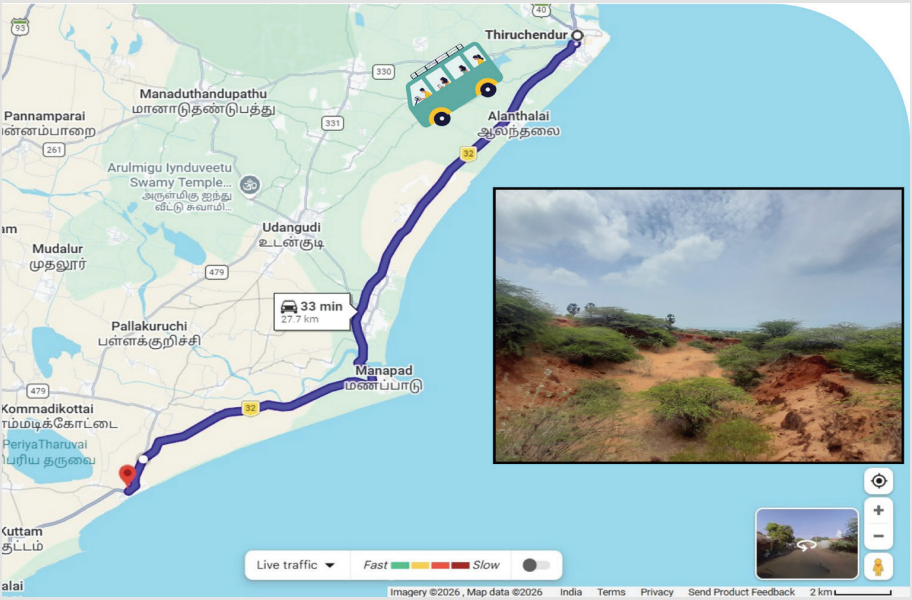
Departure from Tiruchendur (post-breakfast): 10:00 AM

Arrival at the site: 10:45 AM

Commencement of walk to the site and arrival at the site: Duration around 5 minutes.



Round 11: From Therikkudiyiruppu to Tiruchendur for breakfast



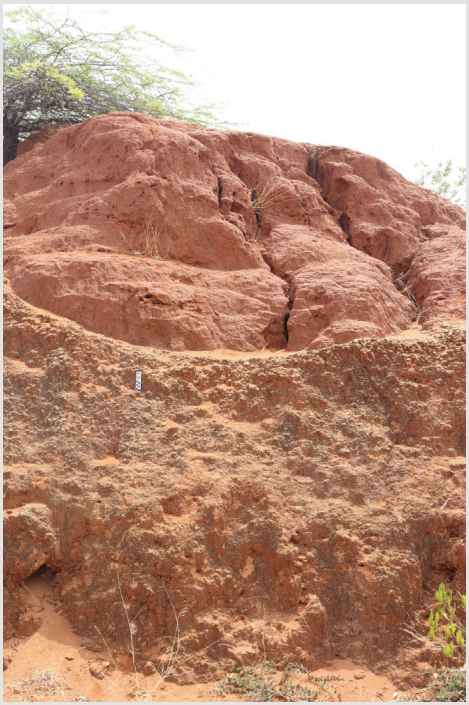
Round 12: Tiruchendur to Puttan Tharuvai

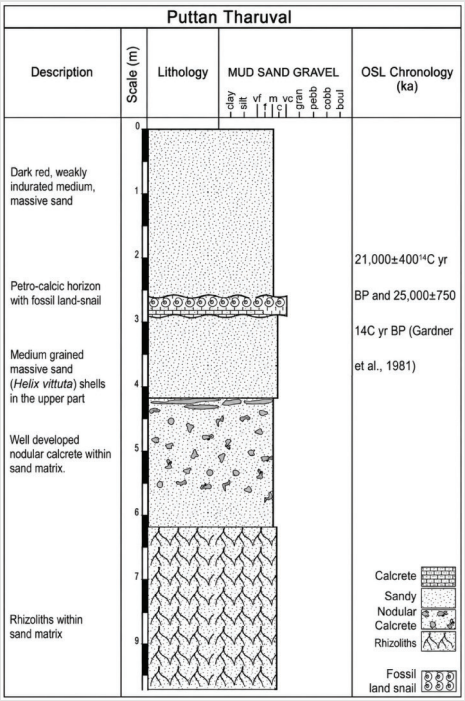
Observations: Puthan Tharuvai is a near-coastal Teri dune, yellowish-red (5YR 4.5/6) in colour and unconsolidated. These 4–6 m thick dunes occur at elevations of 10–25 m amsl, and are formed close to today's shoreline. They are distinct from the inland fluvial and coastal Teri generations. These dunes date to a mid-Holocene high sea-level phase. An OSL age of 5.6 ± 0.4 ka on sand (noted above the Poochikkadu calcrete) reflects deposition when sea level stood ~2–3 m above present, around 6 ka. They are considered to represent reworked coastal Teris, i.e. older red coatings were stripped (resetting the OSL signal) during reworking, redeposited at the backshore during the highstand, then again reddened after 5.6 ka.

The Puthan Tharuvai section itself is an 8.8 m natural cut near the tip of a near-coastal dune system, <1 km from the coast, showing four units: (1) an upper 2.4 m of dark red, slightly indurated ferruginous sand (2.5YR 3/6–3/8); (2) a ~30 cm bedded calcrete layer (10YR 6/4–7/4) with abundant fossil land-snail shells, marking a stabilized palaeosurface with subaerial carbonate formation; (3) reddish-brown to dark reddish-brown sand (2.5YR 3/4–4/4) down to ~4.9 m, grading into red-brown sand with scattered calcrete nodules; and (4) the lowest 2.1 m, a dark reddish-brown sand (2.5YR 3/4) riddled with fossil root casts (rhizoliths) infilled with pale carbonate (10YR 8/2). Overall, the sequence records repeated cycles of dune accretion, stabilisation, carbonate precipitation, and vegetation growth in a near-coastal, lagoon-influenced backshore environment. Although artefacts were noted in the vicinity by previous scholars, none are seen in this section.

What will you see? You will examine the 8.8 m section exposed in a natural cut, observing the vertically differentiated red-sand succession: the dark red indurated sands of the upper unit, the bedded calcrete palaeosurface with fossil land snails, the underlying ferruginous sands with calcrete nodules, and the spectacular rhizolith network of the basal unit. You will also compare the near-coastal red dunes with the consolidated coastal Teri seen at Kuthiraimozhi, and observe the relationships between the red sands, the Periya Tharuvai palaeolagoon, and the active white coastal dunes – evidence bearing on Holocene sea-level highstands and rates of pedogenic reddening. A packed lunch will be provided on-site (11:45 AM – 12:30 PM).






Puttan Tharuval
Description
Scale (m)
Lithology
MUD SAND GRAVEL
clay
silt
vf
f
m
c
vc
gran
pebb
cobb
boul
OSL Chronology (ka)
Dark red, weakly indurated medium, massive sand
Petro-calcic horizon with fossil land-snail
Medium grained massive sand (Helix vittuta) shells in the upper part
Well developed nodular calcrete within sand matrix.
Rhizoliths within sand matrix
0
1
2
3
4
5
6
7
9
21,000±400 14C yr BP and 25,000±750 14C yr BP (Gardner et al., 1981)
Calcrete
Sandy
Nodular
Calcrete
Rhizoliths
Fossil land snail



Locality 7: Coastal Formations at Manappad, Thoothukudi District, Tamil Nadu

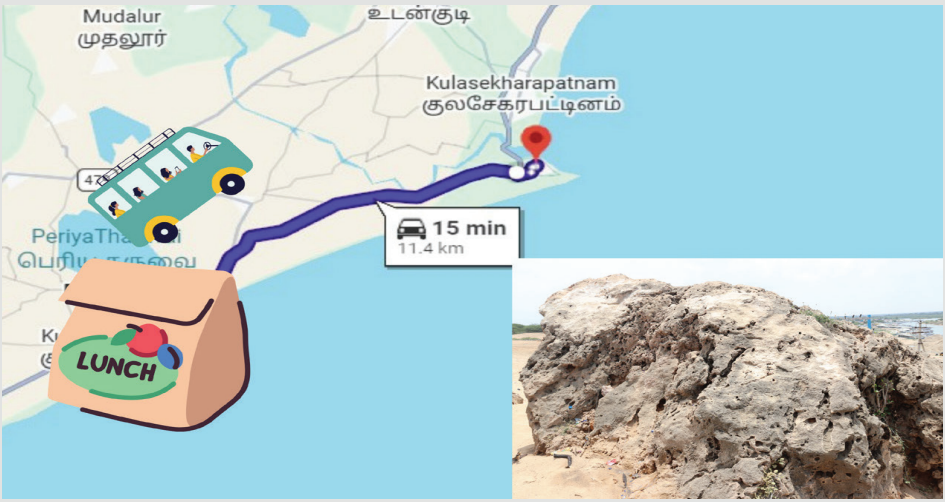
Departure from Puttan Tharuvai: 12:30 PM

Arrival at the site: 1:30 PM

Commencement of walk to the site and arrival at the site: Duration of around 5 minutes.

Observations: The Manappad Terrace, located along the Gulf of Mannar coast of southern Tamil Nadu, represents a well-preserved record of the Last Interglacial (MIS 5e) highstand. The terrace consists of a fossil beach deposit occurring up to about 3 m above the present high-tide level, overlain by approximately 30 cm of aeolianite and capped by a calcrete horizon, indicating a transition from marine deposition to dune formation and subsequent subaerial exposure under semi-arid conditions. A Balanus sp. shell collected from the fossil beach at 1.25 m above present sea level yielded a Th/U age of 120 ka (110–127 ka), providing robust chronological evidence for correlation with the Last Interglacial sea-level highstand. The relatively low terrace elevation compared to the globally inferred MIS 5e sea level suggests that the southern Tamil Nadu coast has remained tectonically stable or experienced only slight subsidence during the Late Quaternary. Together with similar deposits at Kanyakumari, the Nambiyar coast, and Rameswaram, the Manappad Terrace constitutes an important geomorphic and stratigraphic marker for reconstructing Late Quaternary sea-level fluctuations and coastal evolution along the southeastern margin of India (Bruckner, 1989).

What will you see? You will observe coastal formations exposed along the Manappad coast, including carbonate-cemented dune sands (aeolianite), calcrete horizons, and the relationships between marine, aeolian and pedogenic units. Discussion will focus on reading sea-level history from coastal stratigraphy and on the palaeogeographic setting of prehistoric occupation along this shoreline.



Route 13: Packed lunch at Puttan Tharuvai and then travel to Manapad









Locality 8: The Prehistoric Site of Sawyerpuram, Thoothukudi District, Tamil Nadu

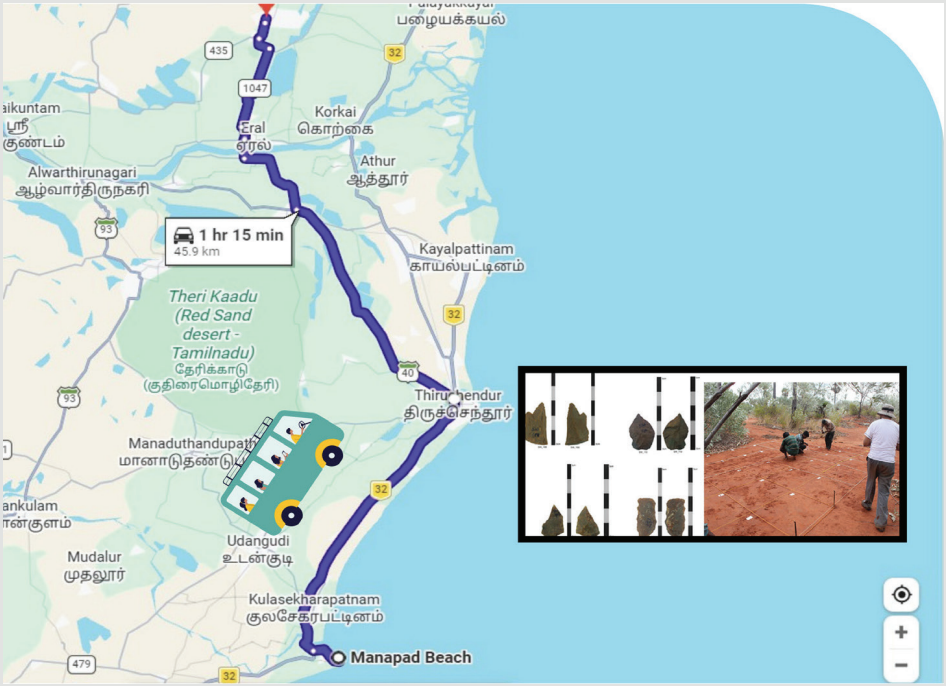
Departure from Manappad: 2:30 PM

Arrival at the site: 4:30 PM

Commencement of walk to the site and arrival at the site: Duration of around 10-15 minutes

Observations: Sawyerpuram is historically significant for Indian prehistory. The site has a long history of research (see Akhilesh and Pappu, 2017). Microliths on chert and quartz have been collected from this site and are termed the "Tinnevelly Teri industry". Despite this long history of research, the site was never dated directly. Test pits and surveys by K. Akhilesh, S. Pappu, and ongoing research have led to discoveries regarding the context of artefacts, with samples collected for luminescence dating. A new research project in progress noted that the context of artefacts was gravel with angular quartz nodules and iron-rich pisoliths, linked to indurated dune sands and capped by sterile loose Teri dunes, suggesting that these assemblages may be older than previously thought.

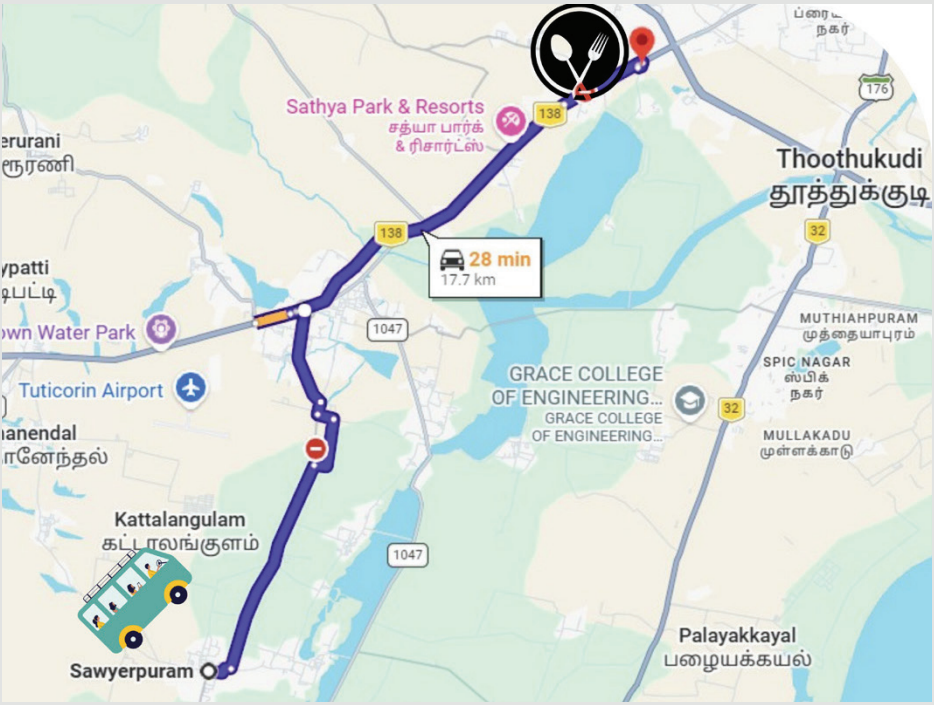
What will you see? You will walk across the Teri dune surfaces at Sawyerpuram, examining microlithic artefact scatters, cores, finished tools and debitage, eroding out onto the deflated surfaces, and observe sections where artefact-bearing gravels and indurated dune sands are exposed. The stratigraphic relationships between artefacts, dune sands and underlying units, central to the ongoing debate over the age of the industry, will be discussed at the site. The escalating destruction of Teri sites by quarrying and construction, and the urgency of systematic documentation, will also be considered.



Route 14: Departure to Sawyerpuram to observe the prehistoric artefacts and teri dunes







Route 15: Return to the Thoothukudi hotel and dinner

DAY-5: Wednesday, January 27, 2027

Sites/Sections To Be Visited: Coastal geomorphological formations at Velayudhapuram, Thoothukudi district, Tamil Nadu and onward travel to Lucknow

Departure Time: 6:30 AM

Meeting Point: Hotel lobby, Thoothukudi (check out before departure)

Vehicle: A bus will be organised along with a guide vehicle

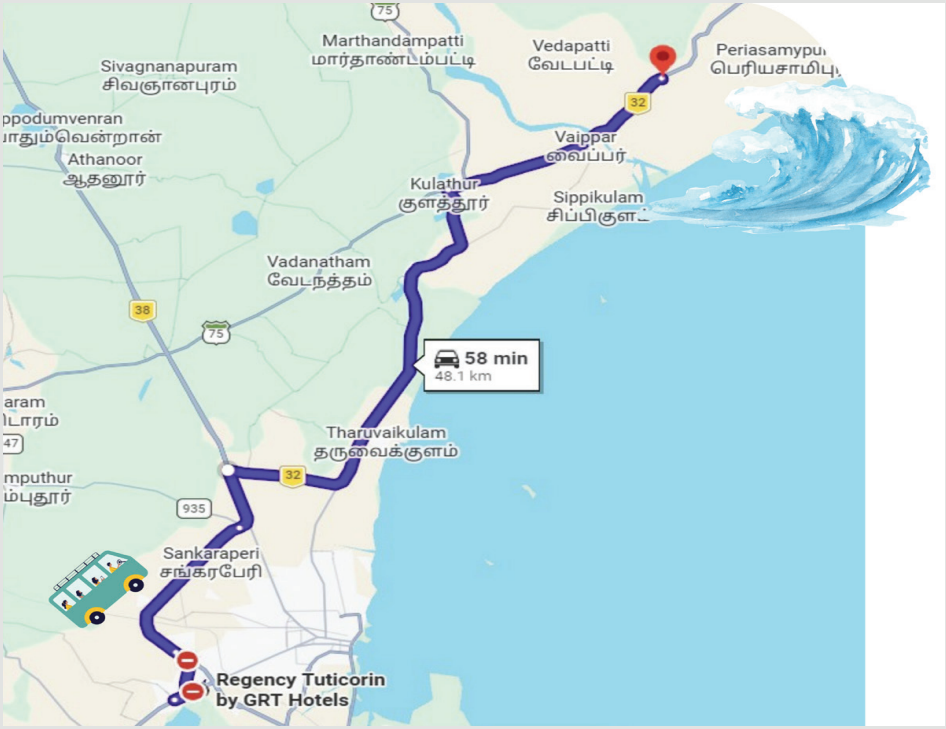
Locality 9: Velayudhapuram, Thoothukudi District, Tamil Nadu

Observations: The Velayudhapuram stop synthesises the trip's themes: the red Teri ridge runs roughly parallel to the modern shoreline, bounded seaward by younger Holocene deposits and landward by alluvial plains, while the intervening coastal plain preserves discontinuous coast-parallel lagoons, swales, and floodplains that mark former shoreline positions. The exposed section is ~2 m of ferruginous red aeolian sand over a fluvio-marine gravel-sand sequence. The upper 0.95 m is a dark red to dark reddish-brown aeolian cap

(2.5YR 3/4–3/6) with strong pedogenic features (burrows, root structures), grading down into red to reddish-brown aeolian sand (2.5YR 4/6–4/8) with nodular calcretes lower down. A ~0.2 m undulating bedded calcrete horizon (5YR 6/4–7.5YR 8/2) sharply separates this aeolian cap from the underlying pale sequence: ~1.2 m of alternating gravel and fine sand beds (7.5YR 6/4–6/3) with semi-parallel to wavy stratification, representing a fluviomarine depositional environment, becoming progressively paler (10YR 6/3–6/4) and more gravel-dominated toward the base.

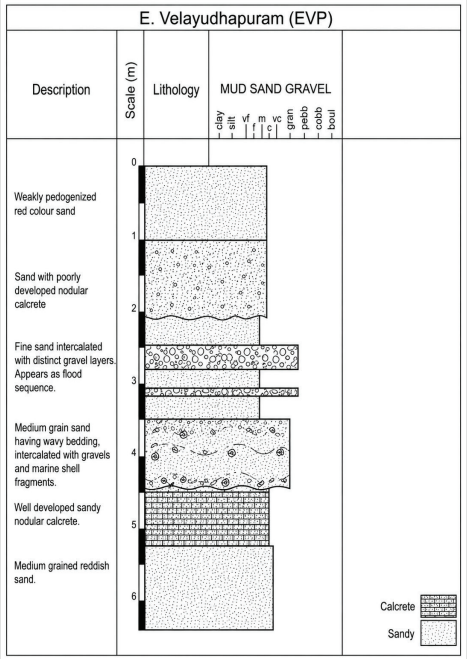
The site discussion ties this stratigraphy into the broader integrated palaeoenvironmental model of the Teri system developed over the field trip.

What will you see? You will examine the ~2 m-thick section here, observing the pedogenically modified red aeolian sand cap with burrows and root penetration structures, the nodular calcretes in its lower part, the undulating bedded calcrete marker horizon, and the underlying fluviomarine gravel–sand succession with semi-parallel to wavy stratification. The contact between the aeolian red sands and the fluviomarine sequence will be discussed in relation to the regional Teri chronology, consolidating the field observations of the excursion before departure. The group will then proceed to the airport for the onward flight to Lucknow.



Route 16: Departure to Velayudhapuram




E. Velayudhapuram (EVP)
Description
Scale (m)
Lithology
MUD SAND GRAVEL
clay
silt
vf
f
m
c
vc
gran
pebb
cobb
boul
0
1
2
3
4
5
6
Weakly pedogenized red colour sand
Sand with poorly developed nodular calcrete
Fine sand intercalated with distinct gravel layers. Appears as flood sequence.
Medium grain sand having wavy bedding, intercalated with gravels and marine shell fragments.
Well developed sandy nodular calcrete.
Medium grained reddish sand.
Calcrete
Sandy



Geoheritage, Unesco Heritage, Other Archaeological Sites And Culture

Sites associated with prehistoric cultures and issues related to Quaternary palaeoenvironments constitute the foundation for this field excursion.

However, beyond stone tools and sections, lie a wealth of places of interest associated with Tamil Nadu's magnificent cultural and natural heritage. You can read more about these here: https://www.tamilnadutourism.tn.gov.in/

Close to the prehistoric sites of northern Tamil Nadu, you can also experience:

The UNESCO World Heritage Site of Mahabalipuram (Mamallapuram) (https://www.tamilnadutourism.tn.gov.in/destinations/mahabalipuram), where magnificent monuments- temples and sculptures, some carved out of single rocks- testify to the skill and brilliance of the ancient Pallava dynasty (4th-9th c CE). You will be visiting this complex and witnessing aspects of the rock cut monuments, free-standing temples and more.

Kancheepuram (https://www.tamilnadutourism.tn.gov.in/destinations/kancheepuram) is famous for its magnificent and holy temple complex with its grand sculptures and inscriptions that attracted pilgrims and tourists from ancient times. In addition, it is famous for its weavers, who produce the renowned silk and cotton saris, that are a must for every household in the South.

In the deep south, near Toothukudi, you can experience:

A wealth of important temples and churches in and around the city (https://thoothukudi.nic.in/tourism/places-of-interest/). From ancient rock-cut caves, to temples and churches, the region has a range of experiences to offer.

In addition to the monuments and sites of archaeological interest, you can experience the unique culture and hospitality of Tamil Nadu (https://www.youtube.com/watch?v=Tgdo9I2Z-n8), appreciate the ancient dance forms, such as Bharatanatyam to diverse folk dances (https://szccindia.org/index.php/tamil-nadu/tamil-nadu-artform).

You will experience the unique cuisine of Tamil Nadu and take back with you recipes to try at home (https://www.tamilnadutourism.tn.gov.in/food/recipes).

Sanctuaries and protected forests form an important part of the landscapes of Tamil Nadu (https://www.forests.tn.gov.in/pages/view/WildlifeSanctuaries), and have something to offer for all interested in exploring both past and present interactions of humans with their environments.

Experience the Soul of South India in Tamil Nadu



Conclusion

This field expedition will take you on a complex journey through time and across space, traversing a 1.5-million-year-old journey of prehistoric human populations and Quaternary landscapes in this part of the world, relate it with similar global conditions. At the end of the excursion, you should have obtained an overview of topics related to landscape evolution, cultural adaptive strategies, and be able to debate issues related to population migration, local and regional spatial and temporal diversity of cultures, sea level changes and formation of coastal landforms.

In addition to academic knowledge, you will experience local cultures, hospitality and traditional ways of life that are still preserved across these ancient landscapes. You will explore the heritage of varied kinds- from sections to monuments and museums, and will gain glimpses of traditional village life.

Above all, you will gain a chance to build networks- professional and personal, interacting with local and foreign scholars and people from different walks of life, making memories that will last forever.

Participating Institutions

Department of Geology and Environmental Science, Christ College (Autonomous), Irinjalakuda

Christ College (Autonomous), Irinjalakuda, established in 1956, is a premier institution affiliated to the University of Calicut and re-accredited by NAAC with the highest grade 'A++', and is ranked 87th in the National Institutional Ranking Framework (NIRF). Its Department of Geology and Environmental Science is among the leading Earth science departments in Kerala, offering undergraduate, integrated and postgraduate programmes in Geology, Applied Geology and Environmental Science (B.Sc., Integrated M.Sc. and M.Sc.). The department is supported by fifteen faculty members with diverse research expertise, striving to become a Centre of excellence in Earth science education. The department integrates classroom teaching with field training, funded projects and industry engagement, drawing on modern analytical and geochronological approaches. Faculty members lead ANRF, KSCSTE, ILDM- and other agency-funded research and maintain active international collaborations with the University of Oxford (UK), the Weizmann Institute of Science, Bar-Ilan University (Israel), Leibniz Institute for Applied Geophysics (Germany) and the University of Zululand (South Africa), alongside national partners such as the Physical Research Laboratory (PRL), the Birbal Sahni Institute of Palaeosciences (BSIP), NCPOR, IISER Pune, IIT Bombay and the Geological Survey of India. The department's Quaternary geology and geochronology group, led by Dr. Linto Alappat, co-organises the present field excursion, contributing expertise in OSL dating, coastal evolution, sediment provenance and palaeo-environmental reconstruction.

Sharma Centre for Heritage Education (SCHE)

The Sharma Centre for Heritage Education was established in 1999 with the aim of advancing both research and public outreach in archaeology and other aspects of Indian heritage. Since then, it has carried out cutting-edge multidisciplinary research programs at the Palaeolithic sites of Attirampakkam, Sendrayanpalayam and other prehistoric sites in northern and southern Tamil Nadu. In addition, research into early agro-pastoral communities are areas of interest. These research projects unite archaeology, geochronology, palaeoenvironmental studies, satellite remote sensing, GIS, 3D Geometric morphometrics, and experimental and ethnoarchaeology, and have led to high-impact publications in Science and Nature, amongst other journal publications, book chapters, and the like. The research has been presented in conferences and workshops in India, the UK, France, Spain, the USA, South Korea, Thailand, Vietnam, China, Australia, Israel, Sri Lanka, and Nepal. Researchers have also been invited to collaborate in projects in the world-famous UNESCO World Heritage region of Olduvai Gorge, Tanzania (funded by Spanish collaborators), and at other sites across India. The Institute has established scientific collaborations with universities and departments in India and abroad. A key goal of the SCHE is to focus on public outreach activities, particularly for children and teachers, to communicate lesser-known aspects of India's glorious ancient heritage. These programs are conducted both in Chennai and in the form of travelling workshops across the country. The SCHE has also developed training modules in prehistory, palaeoenvironments, and other topics for undergraduate, post-graduate, PhD, postdoctoral students and faculty, and organises periodic capacity building workshops and training programs. It has a strong focus on experimental archaeology; in particular, lithic knapping (manufacture of stone artefacts) forms the core of our modules in prehistory. The SCHE is committed to researching India's prehistory and Quaternary heritage and generating an awareness of the same across urban and rural India.

Physical Research Laboratory (PRL), Ahmedabad

The Physical Research Laboratory (PRL), Ahmedabad, founded in 1947 by Dr. Vikram A. Sarabhai, is one of India's premier institutions for fundamental scientific research. An autonomous institute under the Department of Space, Government of India, PRL has played a pioneering role in advancing research across diverse disciplines, including Atomic, Molecular and Optical Physics, Geosciences and Planetary Science, Astronomy and Astrophysics, Solar Physics, Space and Atmospheric Sciences, and Theoretical Physics. Over the decades, PRL has earned an international reputation for excellence in basic science while contributing significantly to India's space and planetary exploration programs.

PRL operates from two campuses at Navrangpura and Thaltej in Ahmedabad and maintains world-class observational facilities at Mount Abu and Udaipur, enabling cutting-edge research in astronomy, atmospheric sciences, and space physics. The institute fosters a vibrant interdisciplinary research environment, encouraging collaborations among physicists, geoscientists, chemists, engineers, and computational scientists to address fundamental scientific questions and develop innovative technologies. The institute has been a pioneer in luminescence research in India, establishing the country's first dedicated laboratory for luminescence dating. Today, it hosts one of the most advanced luminescence research facilities in the country. Researchers from the Atomic, Molecular and Optical

Physics, Geosciences, and Planetary Science divisions work collaboratively to investigate the fundamental physics of luminescence and its applications in geochronology, Earth surface processes, radiation dosimetry, archaeological dating, sediment provenance, and space radiation studies. The interdisciplinary nature of this research enables the development of novel methodologies, improved dating protocols, and advanced instrumentation.

PRL's luminescence laboratory is equipped with state-of-the-art facilities, including multiple TL-OSL readers, gamma-ray spectrometers, alpha counters, beta irradiation systems, and supporting sample preparation and characterization laboratories. These facilities support high-precision measurements of natural and synthetic materials and enable research spanning crystal defect studies, retrospective and environmental dosimetry, paleoclimate reconstruction, tectonic and geomorphological investigations, and planetary science. Through its strong emphasis on innovation, interdisciplinary collaboration, and scientific excellence, PRL continues to remain a leading center for fundamental and applied research in India and an important contributor to the global scientific community.

The French Institute of Pondicherry (IFP)

The French Institute of Pondicherry (UMIFRE 21 CNRS-MEAE) is a leading research institution jointly supervised by the French Ministry for Europe and Foreign Affairs and the French National Centre for Scientific Research. Established in 1955, the Institute is dedicated to the study of indology, ecology, social sciences, and geomatics. Its long-term programmes across South Asia contribute to the production, preservation, and transmission of knowledge.

Birbal Sahni Institue of Palaeosciences (BSIP), Lucknow

Birbal Sahni Institute of Palaeosciences (BSIP) is an autonomous research organization under the aegis of the Department of Science and Technology (DST), Ministry of Science and Technology, Government of India. Originally established as Birbal Sahni Institute of Palaeobotany in 1946 with an objective to explore and develop the subject of palaeobotany, visualizing its potential in solving issues of origin and evolution of plant life and other geological issues including exploration of fossil fuels. Recently, the institute expanded to combine it with other areas of palaeosciences, and creating modern facilities to achieve this end and has been rechristened as the Birbal Sahni Institute of Palaeosciences (BSIP).

Associate Members



Late Dr. Kumar Akhilesh, Ph.D.

Director,
Sharma Centre for Heritage Education,
No.4 School Road, Shollinganallore, Chennai 600004,
Tamil Nadu, India

akhilarchaeo@gmail.com; sharmaheritage@gmail.com

+91 9003022629

The late Dr. Kumar Akhilesh was the Director of the Sharma Centre for Heritage Education (SCHE), India, and had over 18 years of experience in prehistoric archaeological research. His work focused on Palaeolithic archaeology, particularly lithic analysis and the experimental replication of stone tools.

He served as Joint Director, alongside Prof. Shanti Pappu, of the project "Prehistory and Palaeoenvironments along the Southeast Coast of India," which integrated archaeological, geochronological, and palaeoenvironmental studies. He directed lithic research at Attirampakkam, covering the Acheulian to Middle Palaeolithic periods, and coordinated research on prehistoric assemblages across Tamil Nadu.

His research was supported by prestigious organisations, including the Leakey Foundation, the Earthwatch Institute, and ISRO's Geosphere–Biosphere Programme, among others. A Homi Bhabha Fellowship (2014–2016) supported his research in experimental archaeology at Attirampakkam, as well as his training in lithic microwear analysis at CENIEH, Spain.

The late Dr. Kumar Akhilesh also applied GIS and remote sensing technologies to prehistoric archaeological research and heritage management in Tamil Nadu. He received training in prehistoric stone-tool knapping in France in 2008 and subsequently established the experimental archaeology programme at SCHE.

He was associated with several archaeological organisations and served on the editorial boards of two academic journals. His research was published in leading international scientific journals, including Science (2011) and Nature (2018), alongside numerous other scholarly publications.

Beyond his academic research, the late Dr. Kumar Akhilesh played an important role in community heritage education and contributed his expertise as a consultant to the Tamil Nadu State Department of Archaeology. His work made significant contributions to the understanding, documentation, and preservation of India's prehistoric archaeological heritage.



Naveen Chauhan, Ph.D.

Associate Professor,
Atomic, Molecular and Optical Physics Division
Physical Research Laboratory (PRL)
Ahmedabad, Gujarat, India

naveen@prl.res.in

Dr. Naveen Chauhan is an Associate Professor at the Physical Research Laboratory (PRL), Ahmedabad, specializing in luminescence physics and its applications to radiation dosimetry, geochronology, and Earth system science. His research focuses on crystal defects, charge trapping processes, and luminescence signals in natural and synthetic materials to advance radiation dosimetry, luminescence dating, and environmental reconstruction. His expertise includes developing improved luminescence dating protocols, extending dating limits, spatially resolved luminescence for in-situ dose estimation, and innovative approaches for sediment fingerprinting and provenance studies. He investigates geological and archaeological archives to reconstruct paleoclimate, tectonic evolution, and tsunami-related events by integrating luminescence techniques with field observations, radiation transport, numerical simulations, and mathematical modeling. His research also encompasses instrumentation development, microscopic characterization of luminescent materials, and space radiation dosimetry, employing interdisciplinary approaches to address challenges in Earth and materials sciences while advancing the applications of luminescence science in geoscience, archaeology, materials research, and future space missions.



Prachi Joshi, Ph.D.

Sharma Centre for Heritage Education,
No.4 School Road, Shollinganallore, Chennai 600004,
Tamil Nadu, India

prachinjo@gmail.com

Dr. Prachi Joshi is an archaeologist researching Lower Palaeolithic lithic technological strategies from assemblages excavated at Sendrayanpalayam, Tamil Nadu. She was awarded the Homi Bhabha Fellowship (2022–2024) for her project "Geometric-morphometric approaches to the study of Handaxe Variability at Palaeolithic sites in Tamil Nadu." She completed her PhD at Deccan College Postgraduate and Research Institute, on "Prehistoric investigation in the Wainganga Basin, Maharashtra: Issues in continuity and change," under the guidance of Professor Shanti Pappu and Dr. S.B. Ota. Her research examined the

behavioural implications of Palaeolithic site distribution and technological strategies during the Acheulian and Late Palaeolithic phases. She has participated in numerous national and international conferences and published in journals including Antiquity and Quaternary International. During the COVID-19 pandemic, she organised two online conferences: "Archaeology from Home: Connecting Things and Thoughts," for Early Career Researchers in prehistory and Quaternary sciences, and "Bones and Beyond: Introduction to South Asian Pleistocene Fauna." She has participated in excavations at Sendrayanpalayam, Tamil Nadu, and Dhansi, Madhya Pradesh, and studied animal bone microstructure under Prof. Vijay Sathe. Her research interests include Palaeolithic hominin behaviour, Quaternary sciences, and geo-mythology. She serves as the Early Career Researcher representative in the HABCOM community of INQUA.



Sutonuka Bhattacharya, ECR

Sharma Centre for Heritage Education,
No.4 School Road, Shollinganallore, Chennai 600004,
Tamil Nadu, India

sutonuka.b05@gmail.com

Sutonuka Bhattacharya is an archaeologist and Project Fellow at the Sharma Centre for Heritage Education, Chennai, focusing on the origins of neolithization in India. She submitted her PhD at the Institute of Archaeology, Hebrew University of Jerusalem, examining early food technology through analysis of grinding stones in Southern India, combining material culture studies with ethnoarchaeological perspectives. She holds a background in history from Presidency University, Kolkata, and a Post Graduate Diploma in Archaeology from the Archaeological Survey of India, graduating with distinction. She has fieldwork experience across India, Israel, and Mongolia, spanning the Acheulian to historical periods. Her accolades include the SAS Research Support Award (2023), and she has contributed to projects funded by institutions such as the Asian Sphere Foundation, the Government of Tamil Nadu, and IIT Kharagpur. She has presented at conferences including the World Neolithic Congress and INQUA, and published in journals such as Antiquity, Journal of Anthropological Archaeology, Paleoanthropology, and Journal of Archaeological Science: Reports. She co-hosted the virtual conference "Archaeology from Home," fostering dialogue among prehistoric researchers during the pandemic, and aims through her work to deepen understanding of early societies and their environmental interactions.



K. Anupama, Ph.D.

Former Palynologist and Palaeoecologist,
The French Institute of Pondicherry, India
11, St Louis St, White Town, Puducherry, 605001

anupama.k@ifpindia.org

Dr. K. Anupama is a former palynologist and palaeoecologist at the French Institute of Pondicherry, Puducherry. For more than 30 years, she has been carrying out research in the fields of Palaeovegetation reconstruction, Pollination Ecology and Aerobiology employing pollen grains and phytoliths as key tools. She has guided/co-guided several doctoral and Masters Students on various aspects of Quaternary Palynology, melisso – & entomo - palynology and in diverse topics linked to palynology. She has been actively involved with the Humans and Biosphere Commission of INQUA and is a member of the PAGES Landcover6K Working Group.



Morthekai, P., Ph.D.

Scientist, Luminescence Dating Laboratory (LumDL)
Birbal Sahni Institute of Palaeosciences (BSIP)
Lucknow, Uttar Pradesh, India

paa.morthekai@bsipres.in

P. Morthekai is a Scientist in Birbal Sahni Institute of Palaeosciences, Lucknow, and he works in Luminescence Dating Laboratory (LumDL) that provides dates to geological sediments and archaeological artefacts of, typically, less than 200 thousand years old. He completed his fieldwork in the Teri Sand Deposit (red dunes) in the south-eastern part of India by 2012. Apart from determining accurate ages using the luminescence of quartz and feldspar, his research also involves dating other materials such as diatom and mica.

Acknowledgement

We thank the Birbal Sahani Institute of Palaeosciences, the Ministry of Earth Sciences and DST for their support for this field excursion. We thank the Sharma Centre for Heritage Education for financial and logistic support. We thank all our respective Institutions for their support. We thank Professor Yanni Gunnell, Department of Geography, Université Lumière Lyon 2, CNRS UMR 5600, France) for his inputs on geoarchaeological issues in northern Tamil Nadu.

Annexure

Field Excursion Guidelines: Do's and Don'ts

To ensure the safety of all participants and to promote responsible scientific field practices, all participants are requested to adhere to the following guidelines throughout the field excursions.

Keep a valid passport (for international participants) or a government-issued photo ID (for Indian participants) with you at all times during the field excursion.

Do's	Don'ts
1. Follow the instructions of the excursion leaders, coordinators, and local authorities at all times.	1. Do not collect rocks, fossils, archaeological artefacts, biological specimens, or any other materials without prior authorization.
2. Remain with the group and inform the excursion leader before leaving the designated route.	2. Do not damage, deface, or remove material from geological outcrops, caves, monuments, heritage structures, or other natural features.
3. Wear appropriate field attire, including sturdy closed-toe footwear, full-length trousers, a hat or cap, and weather-appropriate clothing.	3. Do not wander alone or separate from the excursion group without informing the field leaders.
4. Carry sufficient drinking water, personal medications, sunscreen, insect repellent, and other essential field supplies.	4. Do not climb unstable slopes, cliffs, rock formations, or enter hazardous areas unless specifically instructed or supervised.
5. Keep a valid photo identification and your excursion registration details with you during travel.	5. Do not swim or enter rivers, lakes, lagoons, or coastal waters unless expressly authorized by the excursion leaders.
6. Respect local customs, religious sites, cultural heritage, and private property.	6. Do not consume alcohol, recreational drugs, or engage in unsafe or irresponsible behaviour during the excursion.
7. Follow the Leave No Trace principles by carrying back all waste and helping to keep field sites clean.	7. Do not operate drones or other restricted equipment without obtaining the necessary permissions.
8. Use designated trails and approved observation areas to minimise environmental disturbance.	

9. Observe geological, ecological, archaeological, and cultural features carefully without causing any damage.

10. Record field observations systematically and collect samples only with prior permission from the excursion leaders and the relevant authorities.

11. Exercise caution near cliffs, riverbanks, caves, unstable slopes, road cuts, and other potentially hazardous terrain.

12. Respect wildlife by maintaining a safe distance from animals, birds, reptiles, insects, and their habitats.

13. Immediately report any illness, injury, emergency, or hazardous situation to the excursion organizers.

14. Be prepared for changing weather conditions and comply with all safety advisories issued by the excursion leaders.

8. Do not photograph restricted installations, sensitive locations, or local residents without prior permission.

9. Do not create excessive noise or disturb local communities, religious activities, wildlife, or natural habitats.

10. Do not leave valuables unattended or rely solely on mobile phone connectivity in remote areas.

11. Do not undertake any activity that may compromise your safety, the safety of fellow participants, or the conservation of the area's geological, ecological, archaeological, or cultural heritage.

Disclaimer

Participation in the field excursions is entirely at the participant's own risk. While the Organising Committee and excursion leaders will make every reasonable effort to ensure participant safety and provide appropriate guidance, they shall not be held responsible for any personal injury, illness, loss of personal belongings, property damage, delays, or unforeseen incidents arising during travel or field activities. Participants are expected to act responsibly, follow all instructions issued by the excursion leaders, and comply with applicable local laws and regulations throughout the excursion.













Scan for
Field Guide Book

Contact Details:

INQUA Secretariat
Birbal Sahni Institute of Palaeosciences (BSIP),
53, University Road, Lucknow-226 007 U.P, India

Email: inqua.india@gmail.com | inqua.india@bsip.res.in

Phone: +916386696896 | +916392507990