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FIELD GUIDE

INPOST - 14

UNVEILING THE QUATERNARY ARCHIVES OF THE WESTERN BENGAL BASIN

Sujay Bandyopadhyay, Subhajit Sinha,
Priyank Pravin Patel, Manoj Kumar Jaiswal









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

NCPOR

INQUA International Union for Quaternary Research

AQUA 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

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Published under the overall supervision of:
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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
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Creative Team, Expression 360, New Delhi

INQUA INDIA 2027
Field Guide Book

INPOST-14
Unveiling the Quaternary archives
of the Western Bengal Basin

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Table of Contents

1.	Team Leaders	1-2
2.	Abstract	3-5
3.	Preamble	5-6
4.	Research Problem	7
5.	Regional Geology including Stratigraphy, Structure, Palaeontology, Quaternary Geology	7-10
6.	Flora, Fauna and Climate, Weather Conditions	11-12
7.	Literature Review	12-15
8.	Field Transect	15-28
9.	Location(s) Description	29-40
10.	Geoheritage, UNESCO Heritage, Other Archaeological Sites, Cuisines and Culture	41-42
11.	Local Conveniences	42-43
12.	Conclusion	44-45
13.	Acknowledgement	46
14.	References	47-50
15.	Annexure	51-52

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Abstract

Robust reconstruction of past environmental and climatic changes from proxy records requires an understanding of the processes controlling the formation, preservation, and transformation of sedimentary archives. The Western Bengal Basin in eastern India preserves a diverse suite of Quaternary archives that collectively record Quaternary landscape evolution, reflecting interactions among fluvial dynamics, monsoon variability, sea-level fluctuations, and human occupation. This field excursion guide presents an integrated perspective on the Quaternary environmental history of the region through representative fluvial, colluvial, archaeological, and fluvio-tephrostratigraphic successions preserved across the 'Jungle Mahal' physiographic region of West Bengal. The four-day excursion encompasses seven key field sites across multiple river systems: Gokulpura and Chilkigarh (Dulung River), Lalgarh (Kansabati River), Garhbeta (Silabati River), Bishnupur and the Susunia Hill region (Dwarakeswar River Basin), and Barakar (Barakar River). These sites expose a range of Quaternary deposits, including channel and floodplain deposits, hillslope colluvium, archaeological-bearing sequences, and tephra-associated fluvial sediments. Participants will examine sedimentary structures, stratigraphic relationships, and geomorphic features that record changing depositional environments and surface processes. Available Luminescence ages from a few sites provide chronological constraints on Late Quaternary depositional events, allowing interpretation of environmental transitions and landscape responses through time. Overall, this excursion is designed to provide participants with hands-on exposure to key Quaternary concepts, field methods, and stratigraphic records, while showcasing the exceptional geological, geomorphological and archaeological heritage and its significance for regional paleoenvironmental reconstruction.

Index of Figures

Figure 1 : Regional Map of the Western Bengal Basin (WBB).

Figure 2 : Geologic and seismotectonic setting of the Rarh plains in Western Bengal Basin.

Figure 3 : Excursion route map showing the field itinerary and principal geosites/ geomorphosites visited during the excursion.

Figure 4 : High, exposed riverbank due to rotational failure at Gokulpur, beside the Dulung River, showing multiple Quaternary depositional layers.

Figure 5 : Channel-lag deposits at Gokulpur. Fine-grained sediments have been flushed away by flash-flood events, leaving behind a coarse lag deposit dominated by iron oxide-rich geological concretions (iron-rich slags) on the river bed.

Figure 6 : Exposed conglomerate beds on the bed and lower terrace by the Dulung River at Chilkigarh.

Figure 7 : Field photograph showing a narrow strip of white shale and brownish-white sandstone (probable Mio-Pliocene age) in the Kangsabati Basin, fringing the Precambrian rocks in western Midnapore.

Figure 8 : Panoramic view of the Gangani (Garhbeta Badlands), a notable national geoheritage site, illustrating extensive gully dissection of ferricrete duricrust surfaces and a prominent river-cut escarpment along the right bank of the Silabati River.

Figure 9 : The medieval brick-built terracotta Pancha Ratna (five-towered) Shyam Rai Temple at Bishnupur exemplifies the architectural and artistic excellence of Bengal's temple tradition.

Figure 10 : View of the Dhankora River bed with the ridgeline of Susunia hill in the background.

Figure 11 : View of the Barakar cliff section showing ~6 m thick alluvial sediment succession at the right bank of the river.

Figure 12 : View of ~7.5 m high riverbank section at Gokulpur along the Dulung's middle course.

Figure 13 : Pebble deposits along the lower terrace surface at Chilkigarh denote past high energy flow events.

Figure 14 : Field photograph showing sequences of the Lalgarh Formation in the Kangsabati Basin, representing the onset of Quaternary sedimentation over the planation surface of Mio-Pliocene rocks; person (height 1.7 m) shown for scale.

Figure 15 : Lateritised caprock of the Gangani area along with intensely gullied and exposed (~22 m) scarp face.

Figure 16 : Photograph showing the incised main gullies and the differentially eroded and weathered escarpment that separates the upper and lower geomorphic surfaces at Gangani.

Figure 17 : Satellite image view of the Gangani gullied tract with notable geomorphic features.

Figure 18 : (a) Representative exposure of colluvio-alluvial channel gravels along the Dhankora River bed at Siulibona, characterised by coarse, poorly sorted clastic sediments derived from both fluvial reworking and hillslope processes. Colluvio-alluvial channel gravels in Dhankora River at Siulibana. (b) River-bed exposure of colluvio-alluvial deposits formed during extreme flood episodes, demonstrating the entrainment, downstream transport, and deposition of colluvial sediments sourced from the adjoining hill slopes.

Figure 19 : Stratigraphic section exposed in the trenched bed of the Dhankora River at Siulibona, Susunia region.

Figure 20 : Sedimentary succession exposed in the Barakar River valley with chronology and Toba ash layer.

Index of Tables

Table 1 : Summary of site-specific geomorphological, geoarchaeological, heritage, and Quaternary research conducted across the WBB.

Table 2 : Day-wise itinerary of excursion stops, corresponding locations, and associated key local geological and geomorphological features.

Table 3 : Lithostratigraphic succession of the typical section at Lalgarh, showing the vertical sequence and lithological characteristics.

Table 4 : Major oxide and elemental chemical composition of representative samples collected from the Susunia region.

Table 5 : Chemical composition of volcanic ash in the Barakar section.

Preamble

The Western Bengal Basin (WBB) is a classic pericratonic sedimentary basin that features a unique geological and geomorphological transition zone. It bridges the Precambrian hard rock terrain of the Chotanagpur Granite Gneiss province (Indian Craton) to the west and the Holocene Ganges-Brahmaputra-Meghna (also known as the Bengal delta) deltaic deposits to the east (Figure 1). Sedimentation in this area is predominantly influenced by the west flowing tributaries of the Bhagirathi-Hooghly river system, which is itself a major distributary of the Ganga. These tributaries, including the Kopai-Mayurakshi-Babla, the Ajay, the Damodar, the Dwarakeswar-Silabati-Rupanarayan and the Kangsabati-Keleghai-Haldi systems, along with contributions from the lower Subarnarekha, have collectively constructed thick successions of Quaternary fluvial deposits. These successions are composed of riverine and exposed submarine depositional lobes, later dissected by transverse river channels. Their architecture records repeated adjustments of fluvial systems to climatic oscillations, sediment flux, and Quaternary sea-level fluctuations. Episodes of sea-level fall promoted valley incision and sediment bypass, whereas subsequent transgressions and highstands favoured valley aggradation, floodplain development, and reworking of older deposits. These processes are reflected in the terrace sequences, palaeochannels, and stacked alluvial successions that characterise the geomorphology and stratigraphy of the region.

Commonly referred to as the Rarh plains, the region consists of gently undulating lateritic uplands, alluvial plains and alluvial fan systems, along with recent deposits. The River Damodar serves as a divider, bisecting the region into two distinct units: (i) the Northern Rarh plain and (ii) the Southern Rarh plain. The field excursion is focused exclusively on the Southern Rarh plain, with particular emphasis on its forested and laterite-dominated terrain,

locally known as the 'Jungle Mahal' physiographic province. The Quaternary sedimentary successions exposed along the river valleys of the Southern Rarh plain preserve a detailed record of changing fluvial dynamics and environmental conditions. The excursion will examine representative sections along the Dulung, Kangsabati, Silabati, Dwarakeswar, and Barakar river systems. Key localities, including Gokulpur and Chilkigarh (Dulung River), Lalgarh (Kangsabati River), Garhbeta (Silabati River), Bishnupur and the Susunia hill region (Dwarakeswar Basin), and the Barakar valley, collectively provide a spatially distributed transect across diverse geomorphic settings. These exposures encompass high-energy channel fills, overbank floodplain deposits, palaeoflood horizons, colluvial wedges, archaeological-bearing strata, and locally preserved tephra-associated units, documenting shifts in sediment routing, river behaviour, and surface stability through time. Luminescence ages from selected sections establish the chronological framework for these depositional episodes, enabling correlation of fluvial aggradation, incision, and landscape adjustment with regional climatic fluctuations and sea-level variability. The resulting stratigraphic framework illustrates how interactions among monsoon-controlled hydrology, sediment supply from the Chotanagpur plateau, and downstream base-level changes governed the evolution of the Southern Rarh landscape throughout the Late Quaternary, making the WBB an important archive for understanding tropical fluvial responses to environmental change.



Fig. 1. Regional Map of the Western Bengal Basin (WBB). (a) Location of the Ganga basin in India and division of the alluvial plains into Upper (UGP), Middle (MGP) and Lower (LGP) Ganga plains. The WBB, encompassing the LGP, serves as the cradle of sedimentary evolution. The thick red line represents the present-day tidal limit in LGP (compiled from Singh, 1994; Sinha and Sarkar, 2009). (b) Regional setting of the Bengal Basin (BB), including the LGP (Rarh plains), where the Ganges, Brahmaputra, and Meghna are the major rivers in the BB, which forms one of the largest delta systems in the world. During the initial phase of Holocene delta growth, the Bhagirathi-Hooghly River served as the primary conduit for sediment supply (dark grey shaded region), followed by eastward progradation of the deltaic system (Sarkar et al., 2009). Position of Hinge Zone is after Shamsudduha and Uddin (2007). Abbreviations for major rivers of the Rarh plains: M R.=Mayurakshi River; Ko R.= Kopai River; A R.=Ajay River; D R. = Damodar River; Dw R.=Dwarakeswar River; S R.= Silabati River; K R.= Kangsabati River.

Research Problem

The WBB preserves a comprehensive geological archive of Quaternary environmental evolution and associated sea-level changes. Situated south of the Ganga River at the interface of the Himalayas, the Indian Craton (Chotanagpur plateau), and the Bay of Bengal (Figure 1), it records the interplay of monsoon variability, sediment supply and sea-level fluctuations within a relatively compact geographical setting. These processes are expressed in a diverse geomorphic landscape of river terraces, floodplains, colluvial slopes, and coastal plains, together with stratigraphic successions of fluvial, colluvial, estuarine, and tephra-bearing deposits. This combination makes the basin unique for reconstructing Quaternary environmental change and human-environment interactions.

The field transect presented here showcases four complementary archive systems: (i) fluvial, (ii) colluvial, (iii) archaeological, and (iv) fluvio-tephrostratigraphic records. Together, they document river migration, flood events, hillslope instability, volcanic ash deposition, and human occupation across multiple spatial and temporal scales. Fluvial sequences record phases of aggradation and incision, colluvial deposits preserve episodes of slope erosion, archaeological horizons provide evidence of human adaptation to environmental change, and tephra layers serve as regionally correlatable chronostratigraphic markers. Combined with luminescence chronologies from several sites, these records establish a temporal framework for reconstructing regional environmental history. By integrating evidence from seven key sites, this excursion demonstrates the interactions among climate, sea-level change, geomorphic processes, sedimentation, and human societies in the WBB. The uniqueness of these sites for the field transect lies in their ability to provide, within a single sedimentary basin, an interconnected suite of Quaternary archives that collectively represent one of the most dynamic sediment-routing systems in South Asia.

Regional Geology including Stratigraphy, Structure, Palaeontology, Quaternary Geology

The Bengal Basin (BB), spanning Bangladesh and India, comprises of two depositional environments: (i) a relatively stable, thinly sedimented shelf zone comprising the Western Bengal Basin (WBB) mostly in India, and (ii) an exceptionally thick sedimentary deeper basin forming the Eastern Bengal Basin (EBB) largely in Bangladesh (Uddin and Lundberg, 1998; Uddin and Lundberg, 1999; Uddin and Lundberg, 2004; Mukherjee et al., 2009; Hossain et al., 2020). These two domains are separated by a narrow (between 25 and 100 km wide) NE-SW trending Eocene Hinge Zone or shelf-break (Figure 1), which marks the transition from the

stable shelf to the rapidly subsiding deeper basin (Sengupta, 1966; Banerji, 1984; Khandoker, 1989; Roy and Chatterjee, 2015). Two major tectonic domains are recognised in the WBB: the basin-margin fault zone along the western cratonic edge and the stable shelf zone extending eastward to the Hinge Zone (Sengupta, 1966; Narula et al., 2000). The Precambrian basement surface is dissected by buried ridges and normal faults, with a dominant ENE-WSW structural grain parallel to the Satpura trend (Sengupta, 1966; Alam, 1989). A north-south-trending basin-margin fault system delineates the western basin boundary and curves northeastward towards Bangladesh, where it merges with the Bogra Shelf (Hiller, 1988). These concealed fault systems (Figure 2), recognised through deep drilling, gravity modelling, and seismic surveys, have subsequently been delineated by the Geological Survey of India (Narula et al., 2000).

The post-congress field excursion will traverse several major river valleys of the WBB, including the Dulung, Kangsabati, Silabati, Dwarakeswar, and Barakar rivers (Figure 1), through a landscape characterised by extensive Quaternary alluvial cover, limited bedrock exposures, and a tectonically stable shelf setting profoundly shaped by Quaternary sea-level fluctuations. Throughout the Quaternary, these rivers have continuously transported sediments derived from the Chotanagpur plateau, which is composed predominantly of Precambrian crystalline rocks, including granite, granite gneiss, schist, amphibolite, granulite, and anorthosite, progressively infilling the WBB. These crystalline rocks are also exposed along the western margin of the basin and extend beneath the Quaternary alluvial cover, forming the Precambrian basement of the basin (Sengupta, 1966; Hunday and Banerjee, 1967; Sengupta, 1970). This basement is unconformably overlain by Gondwana, Mesozoic, Tertiary, and Quaternary successions. The Permian-Triassic Gondwana Supergroup deposited within fault-controlled intracratonic basins includes the Talchir Formation, Damuda Group (Barakar, Barren Measures/ Kulti and Raniganj Formations), Panchet Formation, and the Supra-Panchet succession (Figure 2) (Ghosh et al., 1996; Ghosh, 2002; Bhattacharya et al., 2012). Sandstone-shale-coal cyclothems dominate the Lower Gondwana succession, whereas the Upper Gondwana is characterised by ferruginous red-bed facies. Mesozoic rocks are represented by the Jurassic-Early Cretaceous Rajmahal Traps, composed predominantly of basaltic lava flows and associated volcaniclastic deposits (Prasad and Pundir, 2020). Isolated Tertiary erosional remnants preserve feldspathic and ferruginous sandstones, conglomerates, clays, and kaolinitic horizons, including the Miocene Durgapur Bed, Neogene Bhairab-Banki Formation, and Santiniketan Formation, recording prolonged subaerial weathering and lateritization (Biswas, 1963; Deb, 1993, 1995).

The Quaternary succession records the transition from a relatively stable Pleistocene landscape to Holocene fluvial aggradation and subsequent floodplain evolution. This evolution was governed by climatic fluctuations, sea-level changes, sediment supply from the Chotanagpur plateau, and the long-term tectonic stability of the western shelf of the BB (Roy and Chattopadhyay, 1997; Panja et al., 2015). The thickness of Quaternary deposits exhibits marked spatial variability, generally remaining <50 m in the western erosional terrain but increasing significantly eastward toward the basin axis (Alam, 1989; GSI, 1999). This progressive eastward thickening reflects increasing basin subsidence and a greater degree of marine influence in the vicinity of the Hinge Zone. Lithostratigraphically, the Quaternary succession is subdivided into four principal units: the Middle-Late Pleistocene

Laterite Formation (QS4), the Terminal Pleistocene-Early Holocene Calcrete Formation (QS3), the Middle-Late Holocene Older Floodplain Formation (QS2), and the active Present Floodplain Formation (QS1) (Niyogi and Mallick, 1973; Ghosh and Majumder, 1981, 1991; Goswami, 1993; Vaidyanadhan and Ghosh, 1993; Singh et al., 1998). The oldest unit, the QS4, consists of ferricrete-rich profiles developed over Precambrian, Gondwana, and Tertiary substrates, whereas the overlying QS3, comprising ferruginous sandy loam and clay with multiple caliche horizons, representing Late Quaternary pedogenesis. Together, these units

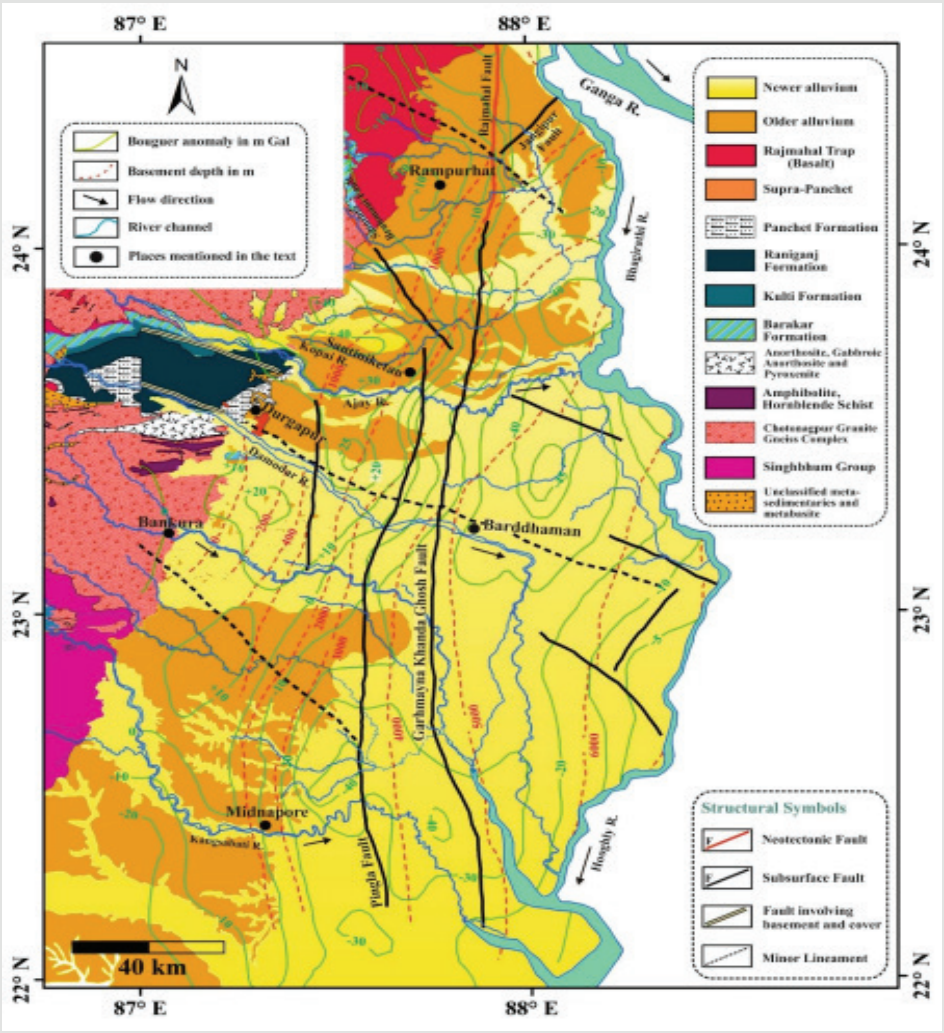

Fig. 2. Geologic and seismotectonic setting of the Rarh plains in Western Bengal Basin [modified after Geological Quadrangle Map of GSI (Map No. 73I, 73M, 79A, 79B); Narula et al. (2000)].

form the 'Older Alluvium', constituting the geomorphic surface of the Rarh Plainsfollowing Laterite Formation (QS4), the Terminal Pleistocene-Early Holocene Calcrete Formation (QS3), the Middle-Late Holocene Older Floodplain Formation (QS2), and the active Present Floodplain Formation (QS1) (Niyogi and Mallick, 1973; Ghosh and Majumder, 1981, 1991; Goswami, 1993; Vaidyanadhan and Ghosh, 1993; Singh et al., 1998). The oldest unit, the QS4, consists of ferricrete-rich profiles developed over Precambrian, Gondwana, and Tertiary substrates, whereas the overlying QS3, comprising ferruginous sandy loam and clay with multiple caliche horizons, representing Late Quaternary pedogenesis. Together, these units form the 'Older Alluvium', constituting the geomorphic surface of the Rarh Plainsfollowing marine regression. Subsequent Holocene sedimentation gave rise to the 'Newer Alluvium', represented by the QS2 and the QS1, through continued sediment supply from both the Chotanagpur plateau and the Older Alluvium. The QS2 consists of terrace deposits of sand, silt, and clay accumulated during the middle to late Holocene, as constrained by radiocarbon and thermoluminescence ages (Goswami, 1993; Singh et al., 1998). The youngest unit, the QS1, includes active channel, point-bar, meander-belt, and overbank deposits that have accumulated from the Late Holocene to the present day, reflecting ongoing fluvial processes across the basin.

The WBB also preserves an important palaeontological record spanning the Neogene and Quaternary periods. Mio-Pliocene silicified dicotyledonous woods recovered from the Bhairab-Banki formations indicate the presence of extensive humid forest ecosystems during the Neogene, reflecting warm and moisture-rich palaeoenvironmental conditions (Basak et al., 1998). Quaternary lateritic and calcretic deposits have yielded fragmentary vertebrate fossils, including Middle-Late Pleistocene mammalian remains, often associated with Acheulian and microlithic archaeological assemblages, highlighting the close relationship between faunal evolution and human occupation in the region (Basak et al., 1998; Panja et al., 2015). A regionally significant chronostratigraphic marker is the ~75 ka Toba Ash horizon preserved in the Barakar valley, providing a key correlation surface for Late Pleistocene environmental and archaeological reconstructions across eastern India (Acharyya and Basu, 1993; Acharyya et al., 2000; Mukhopadhyay et al., 2023; Mukhopadhyay et al., 2025). Systematic investigations have documented a diverse assemblage of vertebrate fossils from Middle Palaeolithic deposits of the basin, including Equus sp. (horse), Elephas sp. (elephant), Hystrix sp. (porcupine), and Crocuta sp. (hyena), providing valuable insights into Quaternary palaeoecology and faunal evolution in WBB (Sen et al., 1963; Dasgupta, 1967; Banerjee, 1982).

Flora, Fauna and Climate, weather conditions during field excursion

The field area lies within the 'Jungle Mahal' region of West Bengal, a physiographic zone characterised by broadly similar relief, soil, drainage, climate, vegetation, and terrain conditions. Although Jungle Mahal no longer exists as a formal administrative unit, the term remains widely used to denote the forested tracts of the Rarh plains that impart a distinct environmental and cultural identity to the region.

4.1. Climate

The region experiences a humid tropical climate with marked seasonal contrasts. Summer temperatures frequently exceed 40°C, while winter temperatures may fall below 5°C. The area receives an average annual rainfall of ~1400 mm, most of which is concentrated during the southwest monsoon season.

• Weather conditions during the field excursion

During the period of the field excursion, daytime temperatures are expected to range between 20°C and 25°C, while night-time temperatures may decline to around 10°C. Weather conditions are forecast to remain generally fair and pleasant, with little to no precipitation anticipated. These conditions are favourable for field observations, geomorphological investigations, and sedimentological studies.

4.2. Flora

The region supports extensive tropical dry deciduous forests, dominated by Sal (Shorea robusta), the characteristic tree species of the area. Other important arboreal species include Palash (Butea monosperma), Mahua (Madhuca longifolia), Kendu (Diospyros melanoxylon), Simul (Bombax ceiba), and Piyal (Buchanania lanzan). Agricultural anthromes predominate, with small towns. Local knowledge and traditional resource users indicate the presence of several medicinal and economically important herbaceous species, including Chirayita (Swertia chirayita), Safed Musli (Chlorophytum borivilianum), Shatavari (Asparagus racemosus), and Neem (Azadirachta indica), reflecting the rich ethnobotanical heritage of the area.

4.3. Fauna

The forests of Jungle Mahal support a diverse assemblage of wildlife. Asian elephants constitute the most prominent large mammal and frequently move through these forest tracts. Other fauna include foxes, small mammals, reptiles, and a variety of snake species. The mosaic of forests, agricultural lands, and water bodies also provides suitable habitats for numerous birds, insects, and other components of the biodiversity.

The combined influence of tropical dry deciduous vegetation, diverse wildlife, and a seasonally varying climate makes the region an ecologically significant landscape and an important setting for understanding the environmental context of the Quaternary archives of the WBB.

Literature Review

5.1. Literature review with brief on research publications available

This section presents a comprehensive review of the existing literature on site-specific geomorphological, geoarchaeological, heritage, and Quaternary research conducted across the WBB. It synthesises the findings of previously published studies to provide an overview of the current state of knowledge and the methodological approaches adopted by earlier investigators. The reviewed publications encompass investigations into landscape evolution, fluvial geomorphology, sedimentary records, archaeological contexts, palaeoenvironmental reconstruction, and the preservation of cultural heritage within WBB. A concise summary of the available literature, including the scope, methodologies, and principal findings of each study, is presented in the following table (Table 1).

5.2. Outstanding issues and future research directions

The existing research publications demonstrate substantial progress in understanding the geomorphic, sedimentary, archaeological, and environmental evolution of the WBB; however, several important questions remain unresolved.

Table 1. Summary of site-specific geomorphological, geoarchaeological, heritage, and Quaternary research conducted across the WBB.

Some Important Studies	Related Field Site	Key Approaches	Major Contributions
Jana, S. (2022). Tectonic and structural influences on the Dulung River system in the southwestern fringe of Bengal Basin. Arabian Journal of Geosciences, 15, 87. https://doi.org/10.1007/s12517-021-09344- w	Dulung River System	Morphotectonic analysis, drainage basin morphometry, remote sensing and GIS	Demonstrated strong tectonic and structural control on drainage evolution, channel alignment, basin asymmetry, and landscape development along the southwestern margin of the Bengal Basin.

Patel, P.P., Dasgupta, R., Mondal, S. (2020). Using ground-based photogrammetry for fine-scale gully morphology studies: some examples. In: Shit, P.K., Pourghasemi, H.R., Sankar, G. (eds.), Gully Erosion Studies from India and Surrounding Regions, Springer International Publishing, Switzerland, pp. 207-220. https://doi.org/10.1007/978-3-030-23243-6_12	Garhbeta Badlands	Ground-based photogrammetry, digital terrain modelling, high resolution geomorphic mapping	Established the utility of photogrammetry for quantifying gully morphology, erosion rates, and micro-topographic variability in lateritic badlands.
Patel, P.P., Dasgupta, R., Chanda, S., Mondal, S. (2021). An investigation into longitudinal forms of gullies within the "Grand Canyon" of Bengal, Eastern India. Transactions in GIS, 25 (5), 2501-2528. https://doi.org/10.1111/tgis.12828	Garhbeta Badlands	Remote sensing interpretation, geomorphological mapping, landscape analysis	Provided a comprehensive geomorphic atlas of the Garhbeta badlands and highlighted their significance as a classic lateritic erosional landscape.
Dasgupta, R., Das, S.K., Sengupta, S., Patel, P. P., Behera, P.K., Mahapatra, D. (2026). Characterisation of the microbial community of a ferruginous duricrust in Eastern India and its geomorphic implications. Discover Geoscience, 4(1), 75. https://doi.org/10.1007/s44288-026-00449- x	Garhbeta Badlands	Geomicrobiology, mineralogical analysis, microbial community characterisation	Demonstrated the role of microbial processes in ferricrete formation, weathering, and surface stabilisation, introducing a biogeomorphic perspective to laterite evolution.
Ghorai, M., Santra, S., Samanta, S., Purkait, P., Chanda, B. (2018). An Image Dataset of Bishnupur Terracotta Temples for Digital Heritage Research. In: Chanda, B., Chaudhuri, S., Chaudhury, S. (eds.), Heritage Preservation. Springer, Singapore. https://doi.org/10.1007/978-981-10-7221- 5_13	Bishnupur	Digital imaging, image datasets, heritage documentation	Developed a standardised image archive for digital heritage preservation and computer-vision based heritage studies.
Biswas, A. (2014). Revisiting Susunia: A Geomorphological Perspectives. Proceedings of the Indian History Congress, 75, Platinum Jubilee, 1150-115. https://www.jstor.org/stable/44158504	Susunia Hill Region	Geomorphological mapping, landscape interpretation	Reassessed the geomorphic evolution of Susunia Hill and emphasised its significance within the lateritic upland landscape of western Bengal.

Mukhopadhyay, S., Roy, B., Sangode, S.J., Jaiswal, M.K., Dutta, S. (2023). Late Quaternary sediments from Barakar Damodar Basin, Eastern India include the 74 ka Toba ash and a 17 ka microlith toolkit. Journal of Asian Earth Sciences, 9, 100135. https://doi.org/10.1016/j.jaesx.2022.100135	Susunia Hill Region and Barakar Sedimentary Section	Sedimentology, tephrochronology, geoarchaeology, luminescence dating	Identified the Youngest Toba Tuff (~74 ka) and documented a Late Pleistocene microlithic assemblage (~17 ka), establishing a valuable chronostratigraphic framework.
Mukhopadhyay, S., Gupta, A., Kumar, P., Sukumaran, P., Sabale, P.D. (2025). Understanding the Microlithic technology in the Lower Ganga Basin, Eastern India: A chronological and ecological perspective. Quaternary Environments and Humans, 3, 100059. https://doi.org/10.1016/j.qeh.2025.100059	Barakar Sedimentary Section	Chronological analysis, lithic technology, palaeoecological reconstruction	Developed an integrated framework linking microlithic technology, environmental change, and human adaptation during the Late Quaternary.

The morphotectonic study of the Dulung River highlighted the role of tectonic and structural controls on drainage evolution, yet the timing, magnitude, and recurrence of tectonic movements that influence Quaternary landscape development remain poorly constrained due to limited geochronological evidence. In the Garhbeta Badlands, detailed geomorphic analyses, photogrammetric surveys, and remote-sensing investigations have successfully characterised gully morphology and badland evolution, but the chronology of incision, rates of landscape denudation, and the relative contributions of climatic variability, lithological control, and human disturbance remain uncertain. Recent geomicrobiological studies have further revealed the significance of microbial processes in ferruginous duricrust formation; however, the interactions among biological activity, weathering processes, and long-term laterite landscape evolution are yet to be fully understood.

Research in the Susunia hill region has emphasised its geomorphological and geoarchaeological importance, but detailed palaeoenvironmental reconstructions and absolute dating of geomorphic surfaces are still lacking. Consequently, the relationships between landscape evolution, resource availability, and patterns of prehistoric human occupation remain inadequately explored. Similarly, investigations of the Barakar-Damodar Basin have provided crucial evidence of Late Quaternary environmental history through the identification of ~74 ka Toba ash layer and Late Pleistocene microlithic assemblages. Nevertheless, continuous, high-resolution sedimentary records remain scarce, limiting the reconstruction of climate variability, fluvial dynamics, and ecosystem responses across the basin. The recent synthesis of microlithic technology in the Lower Ganga Basin has improved understanding of human adaptation to environmental change, but significant gaps remain regarding settlement continuity, mobility patterns, resource exploitation strategies, and their relationships with regional climatic fluctuations.

A major challenge across the WBB is the lack of an integrated framework connecting climate change, sea-level fluctuations, river dynamics, sedimentation, lateritization, palaeoenvironmental evolution, and human responses. Future investigations should therefore emphasise interdisciplinary approaches combining geomorphology, sedimentology, geochemistry, geochronology, palaeoecology, geomicrobiology, and archaeology. Priority areas include developing robust chronological frameworks using luminescence, radiocarbon, cosmogenic nuclide, and tephrochronological techniques; establishing multi-proxy palaeoenvironmental records from fluvial and lateritic archives; and correlating Quaternary sequences across the Dulung, Silabati, Dwarakeswar, Damodar, and Barakar river systems. Such integrated investigations will provide a comprehensive understanding of Quaternary landscape evolution, environmental change, and human environment interactions along the western margin of the BB.

Field Transect

6.1. Excursion route

The field excursion route is illustrated in the accompanying map (Figure 3), which presents the complete itinerary for the transect and highlights the major geosites and geomorphosites to be investigated. The route originates in Kolkata and extends through the selected study areas, encompassing a series of designated excursion stops that represent diverse geological and geomorphological settings. The excursion stops mark the principal field locations where geological observations, geomorphological assessments, and site-specific investigations will be undertaken. The locations selected for overnight stays along the route are also indicated on the map. The transect has been designed to incorporate representative geological formations, distinctive geomorphic landscapes, and sites of geoheritage significance, and will facilitate systematic documentation, comparative evaluation, and interpretation of the features throughout the excursion.

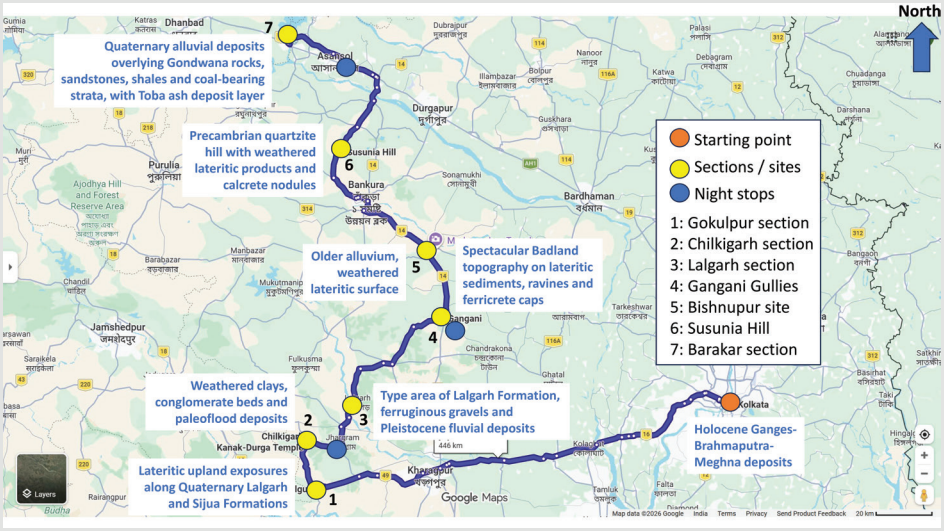

Fig. 3. Excursion route map showing the field itinerary and principal geosites/ geomorphosites visited during the excursion. Yellow circles indicate the main excursion stops and visited geosites/ geomorphosites, blue circles denote overnight stay locations, and the orange circle marks the starting point at Kolkata. The inset boxes summarise the local geological characteristics of the principal visited sites.

6.2. Day-wise details of excursion stops for field transect

The day-wise itinerary of the field transect is presented in Table 2, summarising the sequence of excursion stops, their corresponding locations, and the major geological and Quaternary geomorphological characteristics of each site. The itinerary provides an overview of the progressive exploration of different geological settings and landscape elements to be encountered during the field investigation. Each excursion stop is selected based on its scientific significance, including representative geological exposures, structural features, geomorphic landforms, sedimentary characteristics, and geoheritage values.

Table 2 : Day-wise itinerary of excursion stops, corresponding locations, and associated key local geological and geomorphological features.

Day	Stop	Location	Local Geology and Geomorphology
Day-1: 4th February	-	Kolkata	Holocene Ganges-Brahmaputra Meghna deltaic deposits (QS1), representing recent fluvial and deltaic sedimentation.

Day-2: 5th February	1	Gokulpur (Dahijuri/ Shalugura)	Exposure of lateritic upland belonging to the Quaternary Lalgarh Formation (QS4), characterised by ferricrete horizons, gravel beds, mottled clay, reworked fluvial sediments, and weathering profiles developed on older sedimentary units.
	2	Chilkigarh	
Day-3: 6th February	1	Lalgarh	Type area of the Lalgarh Formation (QS4), comprising Lower and Upper Lalgarh units. The succession includes lateritized boulder conglomerates, ferruginous gravels, reworked lateritic materials, and Pleistocene fluvial deposits.
	2	Garhbeta badlands	Spectacular badland topography developed on Pleistocene lateritic sediments (QS4), featuring deeply incised gullies, ravines, and resistant ferricrete-capped surfaces.
Day-4: 7th February	1	Bishnupur	Rarh lateritic plain (QS4) comprising ferruginous laterite, red soil cover, weathered upland surface, and Older Alluvium.
	2	Susunia Hill	Precambrian quartzite hill located along the margin of the Chotanagpur Gneissic Complex, locally overlain by QS4 deposits comprising lateritic weathering products and pedogenic calcrete nodules.
Day 5: 8th February	1	Barakar Type Section	Quaternary alluvial deposits and calcrete-bearing QS3 surfaces overlying Gondwana bedrock of the Lower Gondwana Barakar Formation (Early Permian). The Gondwana succession includes sandstone, shale, and coal-bearing strata of the Raniganj Coalfield.

Day-1: 04.02.2027

Journey from Lucknow to Kolkata after INQUA 2027

Stay in Kolkata

The first day will be spent on an informal gathering for a briefing on travel routes, logistics, and field protocols. The session will also provide an overview of the geological and geomorphological framework of the WBB, along with an introduction to the field sites included in the excursion. The proposed transect extends from the southernmost part of the basin to its western margin (Figure 3), traversing a diverse range of geomorphic and sedimentary environments (Table 2). Although the WBB is generally well connected by an extensive road network, road density is considerably higher in the coastal plain and midland regions than in the western sector, a factor that has been taken into account while planning the field itinerary.

Day-2: 05.02.2027

Transect-I: Kolkata to Jhargram via field spots at Gokulpur (Dahijuri/ Shalugura) and Chilkigarh along Dulung River and back to Jhargram

Night stay at Dulung Guest House (www.dulungguesthouse.com) in Jhargram or in Jhargram Palace Resort (www.jhargrampalaceheritage.com)

The second day of the field excursion will focus on the southern sector of the WBB through a detailed investigation of the fluvial archives preserved within the Dulung River Basin, an important tributary of the Subarnarekha River system. The excursion will commence with a brief overview of the geological and geomorphological framework of the basin, providing the necessary context for subsequent field observations. Notably, the transect from Kolkata to Jhargram traverses two major structural domains of the broader BB, the deeper basin sector and the shelf zone, providing an excellent opportunity to observe large-scale geomorphic and sedimentological transitions across southern West Bengal.

Stop 1: Gokulpur (Dahijuri-Shalugara sector)

Location: 22°17'41"N, 86°55'43"E

The first field stop will be at Gokulpur (Dahijuri-Shalugara sector), where prominent riverbank exposures (Figure 4) reveal well-preserved cut-and-fill terrace. These exposures provide an excellent opportunity to examine successive phases of river aggradation and incision, offering valuable insights into past hydrological regimes. Detailed observations of terrace morphology, sedimentary structures, grain-size characteristics, and stratigraphic relationships will enable participants to reconstruct the geomorphic evolution of the lower Subarnarekha Basin. Particular emphasis will be placed on understanding how Late Quaternary climatic and sea level changes influenced regional base-level changes and how these signals propagated upstream, leaving discernible signatures in the geomorphic response (Figure 5). The exposed terrace sequences may also preserve evidence of neotectonic activity, providing further insights into the tectonic controls that have contributed to the long-term evolution of the landscape.



Fig. 4 : High, exposed riverbank due to rotational failure at Gokulpur, beside the Dulung River, showing multiple Quaternary depositional layers.



Fig. 5 : Channel-lag deposits at Gokulpur. Fine-grained sediments have been flushed away by flash-flood events, leaving behind a coarse lag deposit dominated by iron oxide-rich geological concretions (iron-rich slags) on the river bed.

Stop 2: Chilkigarh

Location: 22°27'16"N, 86°52'51"E

The second stop will be at Chilkigarh, where the Dulung River flows through a relatively narrow valley, preserving a range of Quaternary fluvial landforms and sedimentary deposits. Here, participants will examine cut-and-fill terraces, pebble lag deposits, and conglomeratic beds (Figure 6) that document episodes of high-energy river activity linked to intense rainfall and extreme flooding. Analysis of sedimentary structures, clast characteristics, and terrace stratigraphy will provide insights into palaeoflood magnitude, river competence, sediment transport, and channel evolution during the Quaternary.

In addition to its geomorphological significance, Chilkigarh is renowned for its rich natural and cultural heritage. A well-preserved near-climax relict forest along the Dulung River supports diverse medicinal, sacred, and ecologically important plant species. The historic Kanak Durga Temple, constructed by the erstwhile feudal rulers of Chilkigarh, remains an important religious landmark. Across the river lies the abandoned Chilkigarh Rajbari, whose distinctive architecture reflects the region's royal legacy. Together, these features make Chilkigarh an ideal site for examining the connections between geomorphic processes, biodiversity, and cultural history.

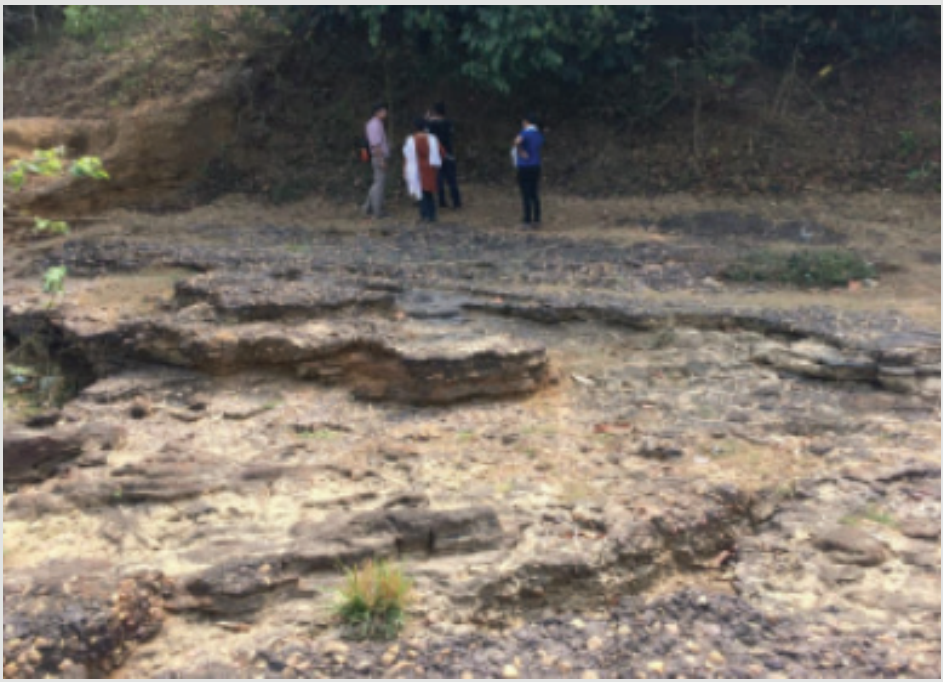

Fig. 6 : Exposed conglomerate beds on the bed and lower terrace by the Dulung River at Chilkigarh.

Day-3: 06.02.2027

Transect-II: Jhargram to Garhbeta via field stops at Lalgarh and Gangani field sites Night stay at Garhbeta in Gangani Ecotourism and Resort (www.ganganiresort.com)

The day's trip begins at Jhargram and follows State Highways (SH-5 and sections of SH-9) northeastward to Garhbeta. The route traverses rolling lateritic uplands and deeply dissected terrain before descending towards the relatively flat Midnapore plain beyond the Kangsabati River system. The transect records the transition from the Pleistocene lateritic uplands of the western fringe to the Recent alluvial sediments and Anthropocene landforms of the WBB. The main objective is to examine Quaternary colluvial archives preserved within gullies and erosional depressions. These unconsolidated slope-derived sediments, transported primarily by gravity-driven mass movement and slope wash, preserve valuable evidence of past environmental conditions, hillslope instability, climatic variability, and anthropogenic landscape modification. Their study provides important insights into long-term erosion, and sediment transport.

Stop 1: Lalgarh: the oldest Quaternary stratigraphic unit

Location: 22°35'N, 87°03'E

The first stop is Lalgarh, situated ~20 km northeast of Jhargram, which exposes the oldest recognised Quaternary stratigraphic unit (QS4) in this part of West Bengal. The Lalgarh Formation comprises a basal layer of lateritized pebbles, cobbles, and boulders derived from pre-Quaternary rocks, overlain by mature soil profiles and latosols with or without ferruginous duricrusts. The formation is named after this locality because the contact between the Quaternary succession and the underlying Mio-Pliocene Bhairab-Banki Formation (Figure 7) is exceptionally well exposed.



Fig. 7 : Field photograph showing a narrow strip of white shale and brownish white sandstone (probable Mio-Pliocene age) in the Kangsabati Basin, fringing the Precambrian rocks in western Midnapore.

These sediments are overlain by lateritized boulder conglomerate of Pleistocene age and rest either directly on Precambrian basement or on pre-Mio-Pliocene laterite developed over the basement. Ghosh and Majumder (1981) assigned this succession to the Bhairab-Banki Formation.

Quaternary sedimentation occurred upon the planation surface developed over the Bhairab Banki Formation (Figure 7). The occurrence of shale pellets along the eastern margin of the Chotanagpur plateau is interpreted as marking the probable Neogene-Quaternary boundary. Lalgarh remains the only documented locality where this important stratigraphic marker has been identified, making it a key reference section for regional Quaternary stratigraphy. Beyond its geological significance, Lalgarh is a tranquil ecotourism and heritage destination renowned for its dense sal forests, characteristic red-soil landscapes, and remnants of the region's historical royal heritage.

Stop 2: The Garhbeta Badlands

Location: 22°51'47"N, 87°21'13"E

The journey then continues for ~48 km from Lalgarh to Garhbeta via the Lalgarh-Ramgarh Pingboni and Goaltore-Hoomgarh roads. This segment crosses the geologically dynamic Rarh plains and enters the rugged erosional terrain of the WBB. The region is distinguished by a prominent NNE-SSW-trending belt of Pleistocene lateritic uplands characterised by distinctive lateritic morphology, dense forest cover, and deeply incised river valleys.



Fig. 8 : Panoramic view of the Gangani (Garhbeta Badlands), a notable national geoheritage site, illustrating extensive gully dissection of ferricrete duricrust surfaces and a prominent river-cut escarpment along the right bank of the Silabati River. Exposed sedimentary sequences and associated structures are clearly visible within the escarpment section.

The second field stop is the celebrated Gangani badland complex, one of the finest examples of badland topography developed on friable lateritic sediments in the Rarh region (Figure 8). Commonly known as the 'Grand Canyon of Bengal', Gangani derives its name from the striking orange, red, and brown hues of its exposed sedimentary sequences, coloured by abundant hydrated iron oxides. This spectacular badland landscape has evolved along the right bank of the Silabati River through intense fluvial erosion and slope degradation. In recognition of its exceptional geological value, Gangani was designated a geoheritage site by the Geological Survey of India (GSI) in 2025.

The site exhibits a remarkable three-tiered gully system developed through dominant colluvial processes: (i) above the upper duricrust surface, (ii) below the duricrust horizon, and (iii) within terrace levels formed by progressive cliff recession. Differential weathering associated with indurated horizons within the sedimentary profile has produced an impressive assemblage of erosional landforms, including pinnacles, buttes, cascades, alluvial fans, fluted sidewalls, caves, and overhangs. Gangani is also an important repository of palaeontological evidence, yielding numerous ichnofossils and petrified wood remains. The fossil-bearing sediments are considered to range in age from the Early Pleistocene to the Holocene. In contrast, the badland morphology itself is interpreted as a post-depositional feature that developed primarily during the Holocene under the influence of fluvial incision, slope retreat, and accelerated erosion.

Together, Lalgarh and Gangani provide a unique opportunity to examine Quaternary landscapes in WBB, from the earliest lateritic upland deposits and Neogene-Quaternary transition surfaces to actively evolving Holocene badlands shaped by colluvial and fluvial processes.

Day-4: 07.02.2027

Transect-III: Garhbeta to Asansol via field spots at Bishnupur and around Susunia Hill Night stay at Asansol in The Grand (www.thegrand.in)

This transect covers a geologically and culturally significant sector of western West Bengal, extending from the historic temple town of Bishnupur to the geoarchaeologically important Susunia hill region. The route provides an opportunity to examine the relationship among geology, geomorphology, archaeology, and human settlement across the transitional landscape of the Dwarakeswar River valley and the lateritic uplands of the Rarh region. From Garhbeta to Bishnupur (~26 km via NH 14), the route passes through Sal (Shorea robusta) forests and scrublands, marking the gradual transition from alluvial plains to gently undulating lateritic terrain. From Bishnupur, the transect continues northwestward towards Susunia hill (~65 km via NH 14), crossing the red-lateritic uplands through Bankura and Chhatna. The final segment from Susunia to Asansol (~52 km) follows the Mejia-Kusthalia road, crosses the Damodar River at Mejia Bridge, and joins NH 14 and NH 19. This section illustrates the transition from the lateritic uplands of Bankura to the industrial and coalfield landscape of the western margin of West Bengal.

Stop 1: Bishnupur: the historic temple town

Location: 23°04'1.92"N, 87°19'17.40"E

Bishnupur, located in the Bankura district of West Bengal, represents an outstanding convergence of geology, geomorphology, archaeology, and cultural heritage. The town illustrates the profound influence of the physical environment on settlement development and architectural traditions. Situated within the lateritic uplands of the Rarh plains, the region is characterised by ferruginous laterite, weathered red soils, and a scarcity of durable building stones such as granite, sandstone, and marble. This geological constraint strongly influenced local construction practices. In the absence of suitable stone resources, builders relied on laterite blocks, burnt bricks, and terracotta, giving rise to a distinctive architectural tradition unique to western Bengal.

The town served as the capital of the historic kingdom of Mallabhum, ruled by the Malla dynasty from ~7th century CE. Following the transfer of the capital to Bishnupur during the 10th century and the subsequent adoption of Vaishnavism under Maharaja Vir Hambir, an extraordinary phase of temple construction flourished between the 17th and 18th centuries. Today, the town preserves one of the finest concentrations of medieval temple architecture in eastern India (Figure 9). Notable monuments include the Rasmancha (1600 CE), Mallesvara Temple (1622 CE), Shyamray Temple (1643 CE) (Figure 9), Jorbangla Temple (1655 CE), Madanmohan Temple (1694 CE), and Jor Mandir (1726 CE). These structures exemplify the principal forms of Bengal temple architecture, including the deul, chala, and ratna styles. From an archaeological perspective, the temples are particularly significant for their richly decorated terracotta panels depicting scenes from the Ramayana, Mahabharata, Puranas, Krishna-lila traditions, and contemporary social life. These artistic narratives provide valuable evidence regarding religious practices, social customs, costume, warfare, trade, and everyday life in medieval Bengal. Among the monuments, the Rasmancha is especially noteworthy for its syncretic architectural design, which combines pyramidal superstructures, traditional Bengali roof forms, and Islamic-style arches. Its elevated laterite foundation reflects adaptation to local geomorphic conditions and seasonal climatic variability.

The broader cultural landscape of Bishnupur also includes a network of historic reservoirs or 'baandhs' excavated by the Malla rulers for water management, demonstrating sophisticated human modification of the lateritic terrain. The famous Dalmadol Cannon, dating to the 18th century, further illustrates the military history of the region. Many of the monuments have experienced deterioration due to weathering, biological growth, and material decay. However, systematic conservation and restoration undertaken by the Archaeological Survey of India (ASI) have significantly improved their preservation. Beyond its architectural heritage, Bishnupur remains renowned for its terracotta craftsmanship, Baluchari silk weaving, metalwork, wood carving, conch-shell artistry, and the celebrated Bishnupur Gharana of Hindustani classical music. Recognising its exceptional cultural and architectural significance, the town has been included in India's Tentative List of UNESCO World Heritage Sites since 1998 and is widely regarded as one of the most important heritage towns in eastern India.



Fig. 9 : The medieval brick-built terracotta Pancha Ratna (five-towered) Shyam Rai Temple at Bishnupur exemplifies the architectural and artistic excellence of Bengal's temple tradition.

Stop 2 : Susunia hill region: an important geosite

Location: 23°23'36"N, 86°59'E

Rising to ~440 m above mean sea level, Susunia hill is situated in the Bankura district of West Bengal, about 65 km northwest of Bishnupur. It represents one of the easternmost exposures of the Chotanagpur plateau along the western margin of the WBB and constitutes a geosite of exceptional geological, geomorphological, and geoarchaeological significance. The hill and its surrounding pediment surfaces are dissected by low-order seasonal streams, including the Gandheswari and Dhankora rivers (Figure 10), both tributaries of the Dwarakeswar River system. Quaternary deposits, generally <5 m thick, occur as hillslope colluvium, colluvio alluvial channel gravels, and overbank sands, silts, and clays resting unconformably upon weathered bedrock. Variations in sediment characteristics, including ferruginous lower horizons and calcrete-rich upper horizons, indicate significant changes in palaeoenvironmental conditions during the Quaternary.

The Susunia landscape preserves a rich record of prehistoric occupation and environmental evolution. Four important sites, Kulyara, Bamundiha, Ramnathpur, and Siulibana, will be examined to understand the broader geoarchaeological framework of the region. Archaeological investigations by P.C. Dasgupta in 1967 documented more than 2000 artefacts spanning the Acheulean to Neolithic periods, recovered from numerous Palaeolithic, Mesolithic, and Neolithic sites across the region. The stone-tool assemblages display advanced Acheulean characteristics and indicate repeated human occupation from the Upper Pleistocene through the Holocene. The availability of lithic raw materials, water resources, and biological resources likely supported long-term human settlement. Discoveries near Payrasol, including blackbuck remains associated with fire-darkened palaeosols, provide evidence of prehistoric habitation and possible hearth activity, offering clues to past subsistence practices and environmental conditions. Susunia also holds major historical significance. Protected by the Archaeological Survey of India, the site preserves the oldest known rock inscription in West Bengal, dating to the 4thcentury CE. The inscription was commissioned by King Chandravarman of Pushkarana (modern Pakhanna) and features a carved chakra (discus) motif, reflecting the political and religious history of the region. At the foot of the hill, the perennial stone-spout spring near the Narasimha Temple represents a continuing link between geology, groundwater systems, and cultural practices. The combination of Precambrian geology, Quaternary deposits, prehistoric archaeology, historical inscriptions, and living traditions makes Susunia hill one of the most important geoheritage and geoarchaeological sites in eastern India.



Fig. 10 : View of the Dhankora River bed with the ridgeline of Susunia hill in the background.

Day-5: 08.02.2027

Transect-IV: Asansol-Barakar transect and the Barakar type section, and onward journey to Kolkata.

Night stay at Kolkata for delegates with train or flight booked on 09th February or thereafter. The final transect of the field excursion begins at Asansol and proceeds westward to Barakar, crossing the geomorphologically important transition zone between the Chotanagpur plateau (Indian Craton) and the WBB. The transect culminates at the classic sedimentary exposures along the Barakar River. The primary objective of this transect is to examine the fluvio tephrostratigraphic succession of the Barakar valley at the western fringe of WBB. This succession provides an integrated framework for interpreting stratigraphic, palaeoenvironmental, archaeological, and chronological records within a single landscape context. Following field investigations, participants will proceed to Kolkata. Drop-off facilities will be arranged en route at Kazi Nazrul Islam Domestic Airport (Durgapur Airport at Andal), Asansol Railway Station, Barddhaman Railway Station, Howrah Railway Station, and Netaji Subhas Chandra Bose International Airport. Delegates with onward train or flight reservations scheduled for 09th February or later may opt for an overnight stay in Kolkata.

Stop 1: Barakar sedimentary section

Location: 23°44'45"N, 86°48'20"E

The Barakar sedimentary section (Figure 11), situated on the western bank of the Barakar River ~6 km upstream from its confluence with the Damodar River, represents one of the most significant Late Quaternary geoarchaeological localities in eastern India. The site preserves an exceptional stratigraphic archive containing volcanic ash horizons, palaeoenvironmental records, and archaeological materials that collectively document environmental and cultural developments spanning the Late Pleistocene and Early Holocene. At this locality, the exposed succession occurs at an elevation of ~116 m above mean sea level. The sedimentary sequence unconformably overlies Gondwana bedrock and comprises a laterally extensive accumulation of Quaternary alluvial deposits preserved along the riverbank. These deposits record a complex history of changing depositional environments, ranging from lacustrine and fluvio-lacustrine settings to fully developed fluvial conditions.



Fig. 11 : View of the Barakar cliff section showing ~6 m thick alluvial sediment succession at the right bank of the river.

Location(s) Description

7.1. Field sites along the Dulung River: Gokulpur and Chilkigarh

The Dulung River drains the eastern fringe of the Chotanagpur plateau. The basin is located within a complex morphotectonic framework along the western margin of the WBB. It is criss crossed by several lineaments whose control over the drainage configuration is evident from the incised valleys and sharp changes in river orientation. The northern and north-western parts of the basin are characterised by garnetiferous phyllites of the Singhbhum Group and Tertiary gravels of the Dhalbhumgarh Formation, respectively, while the river mostly flows over Quaternary sediments. The Quaternary succession of the basin includes the Pleistocene Lalgarh Formation (QS4), composed of oxidised lateritic gravels and pebble-cobble conglomerates, followed by the Terminal Pleistocene-Early Holocene Sijua Formation (QS3), represented by terrace deposits of compact sand, clay, and calcareous nodules. The present floodplain sediments belong to the Panskura Formation and consist mainly of fine sand, silt, and clay.

Two typical exposed river sections will be explored along the Dulung River:



Fig. 12 : View of ~7.5 m high riverbank section at Gokulpur along the Dulung's middle course.

• Gokulpur (Dahijuri/ Shalugura) (22°17'41"N, 86°55'43"E): high bank exposure with fill and cut terraces.

This site exposes a high riverbank section along the middle course of the Dulung River, developed through rotational bank failure during a high-flow event (Figure 12). The meandering channel is ~90 m wide, with an exposed bank height of ~7.5 m. The section consists mainly of thick sand beds overlain by fine silty clay layers with limited sedimentary structures. Newer clay deposits at the bank toe, interlayered with sand and containing pebble imprints, provide evidence of recent flood events in the region. Flash flows have also flushed away the finer bed sediments along this river section, leaving behind coarse lag deposits. This site is an ideal location to show the impacts of flash floods on channel reconfiguration, highlight signatures of persistent bank failure, and delineate the fluvial sedimentary processes.

• Chilkigarh (22°27'16"N, 86°52'51"E) - confined channel with fill and cut terraces, possible palaeoflood deposits, conglomerate beds.

At Chilkigarh, the Dulung River flows through a narrow, incised valley with a channel width of ~20 m. The site preserves unpaired cut-and-fill terraces with a combined height of ~4.5 m and exposes conglomeratic channel deposits containing large, poorly imbricated pebbles within a sandy matrix (Figure 13).



Fig. 13 : Pebble deposits along the lower terrace surface at Chilkigarh denote past high energy flow events.

The lower terrace comprises compact gritty sand with thin pebble horizons recording high energy flood events, whereas the upper terrace represents younger valley-fill deposits showing fining-upward sequences. These deposits provide evidence of episodic flooding, sediment transport, and channel evolution. The confined channel morphology in this site also allows reconstruction of palaeohydrological conditions through terrace geometry and grain size-based palaeodischarge estimation.

7.2. Field sites along the Kangsabati River and Silabati River

• Lalgarh (22°35'N, 87°03'E): the oldest Quaternary stratigraphic unit.

Lalgarh occupies a strategically important position along the eastern margin of the Indian Craton and preserves the type section of the Lalgarh Formation (Figure 14), the oldest recognised Quaternary stratigraphic unit in the WBB. The locality serves as the type area of the formation because the contact between Quaternary deposits and the underlying Mio-Pliocene sediments is exceptionally well exposed. The locality represents a key reference site for understanding the transition from Neogene sedimentation to Quaternary landscape development. Here, an unconformable contact between the Mio-Pliocene Bhairab-Banki Formation and overlying Quaternary deposits is exposed. A basal shale pellet horizon, interpreted as a possible Neogene-Quaternary boundary marker, is a distinctive feature of this locality.

The succession includes basal conglomerates, lateritized gravels, ferruginous duricrusts, mature lateritic soil profiles, and younger reworked fluvial sediments (Table 3). The sequence records prolonged tropical weathering, lateritization, surface stabilisation, and subsequent fluvial and colluvial modification.

Table 3. Lithostratigraphic succession of the typical section at Lalgarh, showing the vertical sequence and lithological characteristics.

Unit	Description
Recent soil	Thin organic-rich topsoil
Upper Lalgarh Formation	Reworked lateritic gravels, sands, silts, vertebrate fossil bearing horizons
Ferruginous duricrust	Indurated iron-rich laterite cap
Mature lateritic profile	Mottled and pallid zones with kaolinitic horizons
Boulder conglomerate	Pebbles, cobbles and boulders within sandy matrix
Basal shale pellet horizon	Probable Neogene-Quaternary boundary marker
Bhairab-Banki Formation	Mio-Pliocene sediments

Geomorphologically, this site is situated within the dissected lateritic upland belt characterized by elevated tablelands, remnants of planation surfaces, seasonal stream valleys, gullies, and colluvial deposits. The site provides important evidence for weathering processes, and erosion dynamics.



Fig. 14 : Field photograph showing sequences of the Lalgarh Formation in the Kangsabati Basin, representing the onset of Quaternary sedimentation over the planation surface of Mio Pliocene rocks; person (height 1.7 m) shown for scale.

Geomorphologically, this site is situated within the dissected lateritic upland belt characterized by elevated tablelands, remnants of planation surfaces, seasonal stream valleys, gullies, and colluvial deposits. The site provides important evidence for weathering processes, and erosion dynamics.

• Gangani (22°51'47"N, 87°21'13"E) - extensive sedimentary deposits, lateritisation and gully development, and noted geomorphosite.

The Gangani region near Garbeta (also spelled Garhbeta) in the Paschim Medinipur (or Midnapore) district represents a classic example of erosional landform development on lateritic and ferruginous sediments of the Rarh region. The landscape is developed on friable older alluvial deposits capped by ferricrete layers, with the Silabati River actively contributing to scarp retreat and gully expansion (Figure 8). The sedimentary succession consists of reddish-brown lateritic deposits rich in hydrated iron oxides, with ferricrete thickness ranging from approximately 6 to 25 m. The laterites display mottled, vermicular, and cavity-rich textures reflecting intense tropical weathering and iron enrichment.

Geomorphologically, Gangani is characterised by deeply incised gullies (Figure 15), where pipes and earth pillars have developed along the gully walls (Figure 16), with these being hollowed out to form small cave-like forms in some locations, alongside local mounds and other minor erosional and depositional features (Figure 17). These landforms have developed through the interaction of fluvial incision, slope erosion, and progressive headward gully expansion. The exposed stratigraphic sections (Figure 16) provide opportunities to investigate lateritization, sediment provenance, grain-size variation, and geomorphic connectivity between hillslopes and river systems. Geochemical indices indicate advanced chemical weathering and intense lateritization. The Chemical Index of Alteration (CIA) (82.6 - 88.9; 85.4 ± 2.1) and Modified Index of Alteration (MIAo) (83.3 - 93.3; 87.1 ± 3.4) reflect strong depletion of mobile cations and enrichment of Al-bearing phases under humid tropical-subtropical conditions. Similarly, the Index of Lateritization (IoL) (34.8 - 54.7; 39.5 ± 6.0) indicates moderate to strong lateritization, whereas the Index of Compositional Variability (ICV) (0.28 - 1.78; 0.71 ± 0.42) suggests predominantly mineralogically mature, clay-rich sediments with minor immature material. Low Weathering Index of Parker (WIP) values (19.5 - 33.1; 27.63 ± 4.23) confirm extensive leaching. Grain-size analysis shows ~98% coarse- to medium-grained sand, reflecting high-energy fluvial deposition and efficient removal of fine sediments. The stratigraphic sections also preserve palaeontological evidence, including ichnofossils and petrified wood, contributing to interpretations of Quaternary sea-level change. Further, this site represents an important geomorphosite for understanding active erosional processes and the evolution of lateritic landscapes in the WBB.

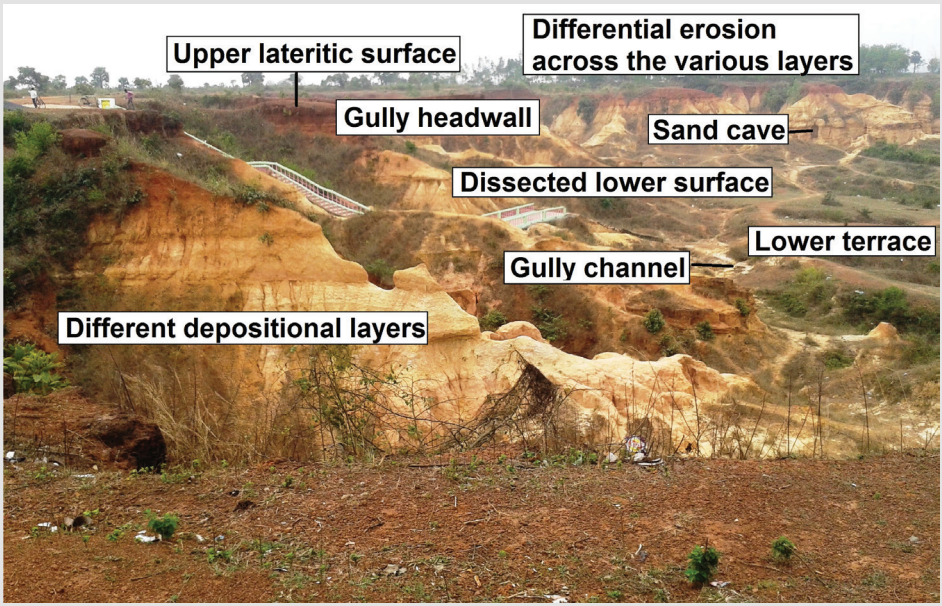

Fig. 15 : Lateritised caprock of the Gangani area along with intensely gullied and exposed (~22 m) scarp face (Patel et al., 2022).

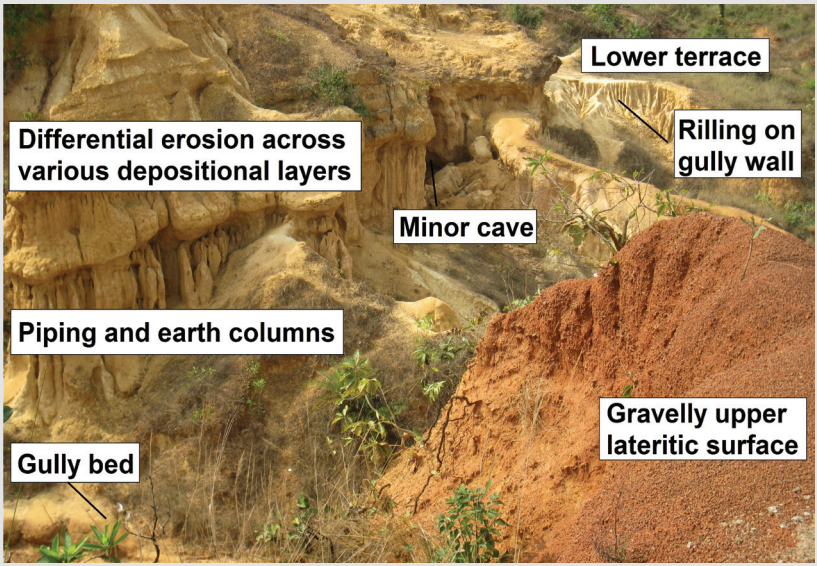

Fig. 16 : Photograph showing the incised main gullies and the differentially eroded and weathered escarpment that separates the upper and lower geomorphic surfaces at Gangani (Patel et al., 2022).

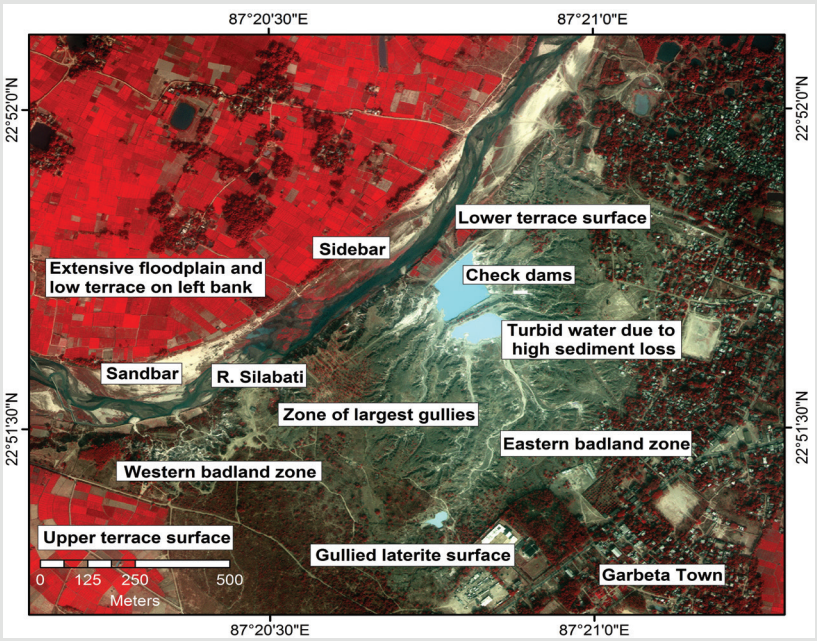

Fig. 17 : Satellite image view of the Gangani gullied tract with notable geomorphic features (Patel et al., 2022).

7.3. Field sites within the Dwarakeswar River Basin

• Bishnupur (23°04'1.92"N, 87°19'17.40"E): the historic temple town.

Bishnupur, situated in the Bankura district of West Bengal, represents an exceptional geo cultural landscape where geology, geomorphology, archaeology, architecture, and traditional practices are closely interconnected. It lies within the eastern fringe of the Rarh region, a transitional geomorphic zone between the Precambrian Chotanagpur plateau and the WBB. The regional landscape is characterised by gently undulating lateritic uplands, low-relief interfluves, shallow valleys, and seasonal drainage channels developed through prolonged tropical weathering and denudation. The underlying crystalline basement rocks of the Chotanagpur Granite Gneissic Complex are largely concealed beneath thick weathering profiles and ferruginous lateritic mantles. Elevated lateritic surfaces (locally known as danga lands) alternate with low-lying alluvial tracts, influencing settlement distribution and traditional water-management practices.

The dominant surficial materials include ferruginous laterite, lateritic gravels, red soils, and Quaternary alluvial deposits. Lateritic profiles commonly exhibit pisolitic textures, ferricrete horizons, and strong enrichment of iron and aluminium oxides due to prolonged chemical weathering and leaching. Valley floors preserve younger fluvial sediments consisting mainly of sand, silt, and clay. The local geological setting strongly influenced architectural development. The limited availability of durable building stones led to the use of laterite blocks, locally produced bricks, and terracotta elements, resulting in the distinctive architectural style of the town. The iron-rich lateritic materials provided construction resources, while clay-rich sediments supplied raw materials for brick and terracotta production. The mineralogical composition of these clays, containing quartz, feldspar, iron oxides, and aluminosilicates, contributed to the durability and characteristic colour of the terracotta artwork.

Historically, Bishnupur served as the capital of the Mallabhum kingdom and developed into a major cultural centre under the Malla rulers. The town preserves a remarkable group of medieval temples, mainly constructed during the 17th and 18th centuries, that represent the adaptation of human craftsmanship to local geological constraints. The integration of lateritic resources, geomorphic setting, and cultural innovation makes Bishnupur an outstanding example of a geo-cultural heritage landscape.

• Susunia hill region (23°23'36"N, 86°59'E): an important geosite.

Susunia hill, situated northwest of Bishnupur in the Bankura District, represents one of the easternmost exposures of the Indian Craton along the western margin of the WBB. It forms an isolated residual upland developed upon resistant Precambrian crystalline rocks, mainly gneisses and schists. The landscape surrounding Susunia is characterised by a gently sloping pediment-pediplain complex dissected by a network of low-order seasonal streams. The Gandheswari and Dhankora rivers, both tributaries of the Dwarakeswar River system, drain the region. Differential weathering and prolonged denudation have produced a variety of geomorphic elements, including residual hills, rock outcrops, pediments, colluvial foot slopes, alluvial valley fills, and ephemeral drainage channels. These landforms collectively preserve a long record of landscape responses to fluctuating Quaternary climatic conditions.

The Precambrian crystalline basement rocks exhibit varying degrees of weathering and lateritization and form the substrate upon which younger Quaternary sediments have accumulated. The contact between the Quaternary deposits and the underlying weathered bedrock is typically unconformable, indicating a significant temporal hiatus between the formation of the basement and subsequent sediment accumulation. The Quaternary sediments in this site generally attain thicknesses of <5 m and occur as hillslope colluvial deposits, colluvio-alluvial channel gravels (Figure 18), overbank sands, and silts and clay-rich floodplain sediments. The succession records multiple phases of sediment deposition, erosion, and soil development. Sedimentological investigations of the Dhankora River section show ferruginous lower horizons, reflecting intense weathering and iron mobilisation under humid conditions, overlain by calcrete-bearing, carbonate-rich horizons indicative of drier climatic phases and pedogenic carbonate accumulation (Figure 19).



Fig. 18. (a) Representative exposure of colluvio-alluvial channel gravels along the Dhankora River bed at Siulibona, characterised by coarse, poorly sorted clastic sediments derived from both fluvial reworking and hillslope processes. Colluvio-alluvial channel gravels in Dhankora River at Siulibana. (b) River-bed exposure of colluvio-alluvial deposits formed during extreme flood episodes, demonstrating the entrainment, downstream transport, and deposition of colluvial sediments sourced from the adjoining hill slopes. These deposits reflect episodic high-energy hydrological events that significantly influence channel sedimentation.



Fig. 19 : Stratigraphic section exposed in the trenched bed of the Dhankora River at Siulibona, Susunia region. (a) Calcretized silty sand horizon showing pedogenic carbonate development within the exposed stratigraphic sequence. (b) Close-up view of the lower part of the section, highlighting the ferruginous sand horizon and its sedimentological characteristics.

Table 4. Major oxide and elemental chemical composition of representative samples collected from the Susunia region.

Element (%)	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MgO	MnO	CaO	Na_2O	K_2O
Jamthol (23°23'16.296", 86°57'10.98")									
Granite pegmatite	71.95	BDL	16.93	0.328	BDL	BDL	1.764	7.003	1.224
Pegmatite	69.62	BDL	18.65	0.323	BDL	BDL	0.057	1.147	12.172
River bed sediments	70.49	BDL	8.77	17.607	0.257	0.625	0.972	0.527	2.18
Biribari (23°25'37.128", 86°56'29.976")									
Granite	74.71	BDL	16.06	1.247	0.2	0.007	0.746	4.252	5.308
Dolerite	51.51	1.42	12.08	14.433	5.519	0.191	9.361	2.229	1.146

The major oxide geochemistry indicates advanced chemical weathering of the source lithologies, characterised by progressive depletion of the mobile oxides CaO, Na_2O, and MgO through feldspar dissolution and leaching, accompanied by relative enrichment of the immobile components SiO2 and Al_2O_3 (Table 4). The elevated K_2O content of the sediments suggests preferential retention of K-bearing phases and/ or neoformation of illite during weathering. High Fe_2O_3 in the alluvial sediments reflects residual enrichment of Fe oxyhydroxides and heavy minerals following the breakdown of ferromagnesian minerals. These geochemical trends are consistent with moderate to intense chemical weathering under humid tropical conditions and indicate that sediments are predominantly derived from felsic granitoids, with subordinate mafic (doleritic) contributions. Localities such as Kulyara, Bamundiha, Ramnathpur, and Siulibana preserve evidence of repeated slope wash, channel activity, floodplain deposition, and soil formation.

The Susunia region also constitutes one of the richest prehistoric cultural landscapes in eastern India. Archaeological investigations have documented extensive lithic assemblages ranging from the Acheulean to Mesolithic and Neolithic periods, indicating repeated human occupation from the Late Pleistocene to the Holocene. The availability of lithic raw materials, perennial and seasonal water resources, diverse vegetation, and faunal resources likely contributed to repeated settlement and resource exploitation within the region. Particularly significant are discoveries from the Payrasol area, where blackbuck skeletal remains associated with fire-darkened palaeosols have been interpreted as evidence of prehistoric hearth activity. These findings provide important information regarding prehistoric subsistence practices, palaeoecology, and human adaptation to changing environmental conditions. Chronological studies from microlithic-bearing archaeological horizons have yielded radiocarbon ages ranging from approximately 13176 to 12845 years BP, indicating Late Pleistocene human occupation (Mukhopadhyay et al., 2025). Earlier investigations by S.R. Das reported a radiocarbon age of approximately 40000 years BP from fossil-bearing deposits, suggesting the presence of substantially older Late Pleistocene sedimentary sequences in the region (Das, 1968). Together, these dates demonstrate a long and complex record of human-environment interaction spanning multiple climatic phases of the Quaternary. Beyond its prehistoric significance, Susunia possesses considerable historical importance. The 4th century CE rock inscription attributed to King Chandravarman of Pushkarana represents the oldest known inscription in West Bengal. The perennial stone spout spring near the Narasimha Temple further highlights the connection between geological processes, groundwater systems, and cultural practices.

7.4. Field site along the Barakar River (Damodar River Basin)

• Barakar sedimentary section (23°44'45"N, 86°48'20"E).

The Barakar sedimentary section is exposed along the western bank of the Barakar River, opposite Barakar town. Situated at an elevation of ~116 m above mean sea level, the type section forms part of a preserved Late Quaternary alluvial terrace developed upon an unconformable Gondwana bedrock surface. The locality occupies a strategic position within the Damodar valley and provides exceptional Quaternary sedimentary and geoarchaeological records in eastern India.

The exposed succession is ~6 m thick and consists of laterally extensive Quaternary alluvial deposits representing a transition from lacustrine and fluvio-lacustrine environments to fully developed fluvial conditions (Figure 20). The sedimentary sequence records significant changes in hydrological regimes and monsoon-driven river dynamics during the Late Pleistocene. A prominent tephra horizon occurs within the lower lacustrine facies. Earlier investigations documented a ~1.83 m thick volcanic ash bed intercalated between weakly oxidised sands below and strongly oxidised red sands above (Acharyya and Basu, 1993). The ash-bearing lacustrine deposits indicate low-energy sedimentation within a stable waterbody developed in the Barakar River valley.

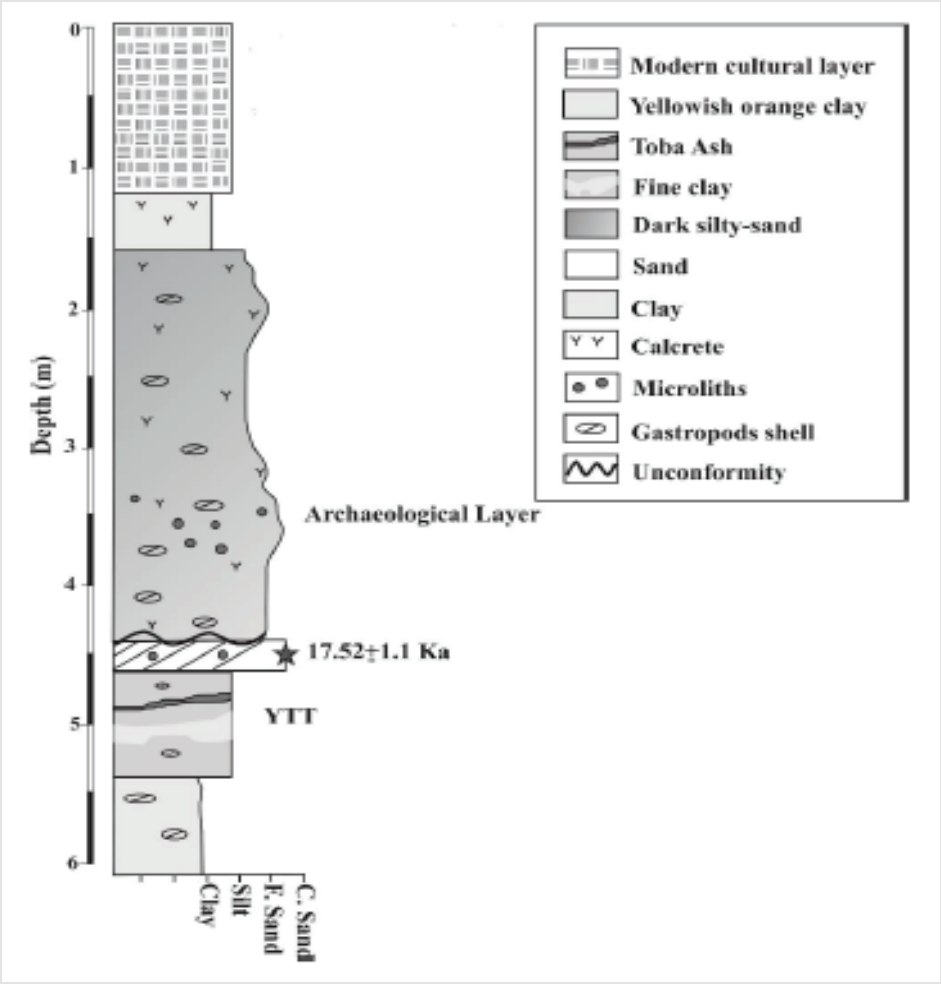

Fig. 20 : Sedimentary succession exposed in the Barakar River valley with chronology and Toba ash layer (after Mukhopadhyay et al., 2023).

The volcanic ash horizon has been identified as the Youngest Toba Tuff (YTT), providing a key chronostratigraphic marker for regional and intercontinental correlation (Acharyya and Basu, 1993; Mukhopadhyay et al., 2023; Mukhopadhyay et al., 2025). The YTT records fallout from the ~74 ka super-eruption of the Toba Caldera, Sumatra, and serves as an important datum within the Late Pleistocene stratigraphy of eastern India. The sedimentary succession documents major palaeoenvironmental fluctuations associated with changes in monsoon intensity, river behaviour, and climatic oscillations, including conditions preceding the Last Glacial Maximum (LGM) and the subsequent deglacial strengthening of the Indian Summer Monsoon. Microlithic artefacts recovered from overlying fluvial sands have yielded Optically Stimulated Luminescence (OSL) ages of 17.52±1.1 ka (MIS 2), indicating human occupation of the valley during the terminal Pleistocene and post-LGM environmental amelioration (Mukhopadhyay et al., 2023).

Geochemical analyses confirm the silicic composition of the Barakar tephra and its affinity with YTT deposits elsewhere in South Asia (Table 5). The ash is characterised by high silica content (SiO_2 = 67.15 wt.%) together with elevated Al_2O_3 (15.62 wt.%) and K_2O (5.11 wt.%), consistent with rhyolitic volcanic glass derived from the Toba Caldera. This section is one of the most important Late Quaternary geoarchaeological localities in eastern India. The co occurrence of YTT tephra, well-preserved sedimentary archives, and dated microlithic assemblages provides a rare opportunity to investigate the relationships among climatic change, landscape evolution, and human adaptation. The microlithic technology exhibits affinities with contemporary industries across the eastern margin of the South Asian monsoon domain, indicating widespread cultural interaction and population mobility during the terminal Pleistocene.

Table 5. Chemical composition of volcanic ash in the Barakar section (Data after Mukhopadhyay et al., 2023).

Element (%)	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MgO	MnO	CaO	Na_2O	K_2O
Percentage	67.15	0.11	15.62	3.46	0.58	0.11	1.67	3.36	5.11

Key field observations: unconformable contact between Gondwana bedrock and Quaternary alluvium; Lacustrine, fluvio-lacustrine, and fluvial depositional facies; Recognition and stratigraphic significance of the Youngest Toba Tuff (YTT); Evidence for Late Pleistocene monsoon variability and river dynamics; Context and chronology of microlithic archaeological assemblages; Human occupation and mobility during MIS 2 and the post-LGM period; Integration of geological and archaeological records for reconstructing Late Quaternary human-environment interactions.

Geoheritage, UNESCO heritage, archaeological sites in the vicinity, cuisines and culture

The Gangani Tract is locally called the Ganganir Danga (implying 'Land of Fire'), due to its ochre-red hues. The most prominent feature of the landscape is the network of gullies and ravines developed primarily on the right bank of the River Silabati (or Silai), which flows past Garhbeta. Owing to its exceptional scenic grandeur and geomorphic significance, Gangani is often referred to as the 'Grand Canyon of Bengal'. The site has gained increasing recognition among geologists, geomorphologists, and nature enthusiasts and is now regarded as one of India's notable geomorphosites. Acknowledging its outstanding geological importance, the Geological Survey of India designated Gangani as a geoheritage site in 2025, highlighting its scientific, educational, and geotouristic value. The exposures are composed of compacted sands and clays, with an indurated ferricrete at the top. A number of pipes, mounds, and other microstructures are found within the area.

Beyond its geological significance, the region possesses a rich cultural and historical heritage. Numerous ancient temples are scattered across the surrounding landscape, reflecting the area's long-standing religious and architectural traditions. Of particular importance are the renowned terracotta temples of Bishnupur, located not far from Garhbeta. Celebrated for their exquisite craftsmanship and unique Bengal temple architecture, these monuments constitute one of eastern India's most significant cultural treasures. Recognising their universal heritage value, Bishnupur was included in India's Tentative List of UNESCO World Heritage Sites in 1998 and continues to attract scholars, historians, architects, and visitors from across the world. Another noteworthy cultural and geological locality in the broader region is the Kanak Durga Temple situated along the banks of the Dulung River at Chilkigarh. Besides its religious significance, the area is of considerable geological interest due to the exposure of conglomerate beds containing well-preserved imbricated pebbles. These sedimentary structures provide evidence of ancient high-energy flood events and serve as important indicators for reconstructing palaeohydrological conditions in the region.

The wider landscape of the western fringe of WBB, including the Susunia hill region and its surroundings, is also renowned for its archaeological and palaeontological significance. Numerous prehistoric artefacts discovered in these areas attest to an extended record of human occupation dating back to the prehistoric period. Furthermore, palaeontological investigations have yielded fossil remains of several notable vertebrate taxa, including species of Equus (horse), Elephas (elephant), Hystrix (porcupine), and Crocuta (hyena), among others. These fossil assemblages, associated with Middle Palaeolithic deposits, provide valuable evidence for reconstructing the region's ancient ecosystems, faunal diversity, and climatic history.

Complementing its natural and cultural wealth is the rich culinary heritage of southern West Bengal. The region offers an impressive variety of traditional foods that cater to diverse

tastes and preferences. Rice is the staple, typically accompanied by an array of fish-based delicacies that reflect Bengal's enduring riverine culture. In addition, preparations involving meat, vegetables, lentils, and seasonal produce contribute to a vibrant gastronomic tradition. The culinary experience is further enriched by a diverse array of sweets and dairy products, including traditional confections and curds that have earned widespread acclaim for their distinctive flavours and craftsmanship.

In a nutshell, the cultural landscape of the WBB represents a remarkable convergence of geological, archaeological, historical, ecological, and gastronomic heritage. This unique combination of natural and cultural assets makes the region an outstanding destination for geotourism, heritage tourism, and scientific research, offering researchers a rare opportunity to explore Quaternary history alongside centuries of human creativity and cultural evolution.

Local Conveniences

The field trip commences in Kolkata, one of India's metropolitan cities, offering comprehensive healthcare facilities, emergency services, transportation networks, banking services, and administrative support. In the event of medical emergencies, participants will have access to a wide range of government and private hospitals, speciality clinics, pharmacies, and diagnostic centres. Assistance related to lost or stolen passports, travel documents, or other emergencies can be sought through local police stations, the relevant diplomatic mission, and district administrative authorities. Throughout the itinerary, important towns and urban centres such as Jhargram, Garhbeta, Bishnupur, and Asansol are equipped with hospitals, community health centres, pharmacies, police stations, and other essential public services, ensuring visitors have access to assistance whenever needed. Most settlements along the route also host local markets and commercial areas where everyday necessities, food items, medicines, and travel supplies can be readily obtained.

A distinctive attraction for visitors is the vibrant network of rural bazaars and traditional handicraft markets that reflect the rich cultural heritage of the region. Among these, the renowned Poramatir Haat (terracotta market), situated on the outskirts of Bishnupur, serves as a popular gathering place for artisans, traders, and tourists. The market offers an extensive range of handcrafted terracotta artefacts, decorative items, pottery, souvenirs, and traditional craft products, making it an important centre for the preservation and promotion of local craftsmanship. The villages surrounding Bishnupur also provide valuable opportunities to observe the production of the celebrated Baluchari saree, one of Bengal's most distinguished textile traditions. Participants may interact with weaving communities,

witness various stages of silk weaving and design creation, and gain firsthand insight into the skills and cultural practices that sustain this renowned craft. Such interactions enrich the field experience by fostering a deeper understanding of artisanal heritage, the local economy, and living craft traditions in rural Bengal.

Another notable cultural attraction is the stone-carving industry of the Susunia hill region, an ancient craft tradition with roots extending back to the Maurya and Gupta periods. Local artisans, predominantly from the 'Karmakar' community, transform locally available sandstone, marble, and other stones into finely crafted sculptures, religious icons, decorative objects, and utilitarian items. The bustling workshops and makeshift stalls situated at the foothills of Susunia Hill, particularly near the sacred medicinal spring and eco-parks, function as the principal marketplace for these products. Participants can observe artisans at work and gain valuable insights into a craft tradition that has been sustained for centuries and continues to contribute significantly to the cultural and economic life of the region.

Conclusion

The WBB preserves one of the most diverse and accessible assemblages of Quaternary archives in eastern India. Through a carefully designed transect spanning the Dulung, Kangsabati, Silabati, Dwarakeswar, and Barakar river systems, this field excursion demonstrates how fluvial, colluvial, archaeological, and fluvio-tephrostratigraphic records can be integrated to reconstruct the environmental history of a monsoon-dominated tropical landscape. The selected sites collectively document key aspects of Quaternary geomorphic responses, including river aggradation and incision, floodplain development, hillslope instability, lateritization, volcanic ash deposition, and long-term human occupation. Of particular significance is the preservation of geomorphic and stratigraphic evidence for Quaternary sea-level fluctuations and their upstream influence on river behaviour. Exposures at Gokulpur and Chilkigarh reveal the geomorphic responses of river systems to climatic variability and hydrological change; Lalgarh and Gangani illustrate the evolution of lateritic uplands and colluvial landscapes; Bishnupur and the Susunia hill region provide valuable insights into geoarchaeological and cultural landscapes; while the Barakar sedimentary section offers a rare opportunity to examine a well-preserved fluvio-tephrostratigraphic archive containing the Youngest Toba Tuff and evidence of Late Pleistocene human activity.

A major strength of the Western Bengal Basin lies in the coexistence of multiple archives within a single, interconnected sedimentary environment. The integration of stratigraphic observations, sedimentological analyses, geomorphological evidence, archaeological records, and luminescence chronologies highlights the complexity of interactions among climate, river dynamics, landscape processes, and human societies through time. Such an integrated approach is increasingly essential for understanding environmental change in tropical monsoon regions, where individual archives often preserve only fragmentary records. Beyond its scientific significance, the region also embodies a remarkable combination of geological, archaeological, ecological, and cultural heritage. The geoheritage landscapes of Gangani and Susunia, the historical monuments of Bishnupur and Chilkigarh, and the rich traditions of local crafts and rural communities collectively enrich the field experience and underscore the importance of conserving these valuable natural and cultural resources. Ultimately, the WBB serves as a natural laboratory for Quaternary research, offering exceptional opportunities to investigate Earth-surface processes, palaeoenvironmental change, and human-environment interactions across multiple spatial and temporal scales. It is hoped that this field excursion will stimulate further interdisciplinary research, foster collaboration among Quaternary scientists, and contribute to a deeper understanding of the environmental history and geoheritage significance of eastern India.

Day	Date	Places from - to	Stay
Day-1	04 February 2027	Lucknow to Kolkata by flight; Briefing and discussion	Kolkata
Day-2	05 February 2027	Field visit for geomorphology and Quaternary fluvial archives of Dulung River basin : Kolkata to Jhargram via field spots at Gokulpur (Dahijuri/ Shalugura) and Chilkigarh, and back to Jhargram	Jhargram
Day-3	06 February 2027	Field visit for examining Quaternary colluvial archives within Kangsabati and Silabati River basins : Jhargram to Garhbeta via field stops at Lalgarh and Gangani field sites, and back to Garhbeta	Garhbeta
Day-4	07 February 2027	Field visit for exploring historical and geoarchaeological archives preserved within Dwarakeswar River valley: Garhbeta to Asansol via field spots at Bishnupur and around Susunia hill, and onward journey to Asansol	Asansol
Day-5	08 February 2027	Field visit for exploring the fluvio tephrostratigraphic archive of the Late Quaternary in Barakar River Asansol to Barakar town, followed by departure from Asansol to Kolkata. En route drop-off facilities will be available at Kazi Nazrul Islam Domestic Airport (Durgapur Airport), Asansol Junction Railway Station, and Barddhaman Railway Station. Additional drop offs will be provided at Howrah Railway Station and Netaji Subhas Chandra Bose International Airport before proceeding to the hotel. Delegates with onward train or flight bookings on 09 February or later may opt for an overnight stay in Kolkata	Kolkata

Acknowledgement

We gratefully acknowledge the support of Kazi Nazrul University, the University of Calcutta, Presidency University, and the Indian Institute of Science Education and Research (IISER) Kolkata in the preparation of this field guide to the WBB. The research synthesised here was made possible through sustained financial support for Quaternary investigations from the International Association of Sedimentologists (IAS), the Quaternary Research Association (QRA), the Association of Quaternary Researchers (AOQR), the Department of Science & Technology (DST), the Ministry of Earth Sciences (MoES), and the Birbal Sahni Institute of Palaeosciences (BSIP). We also thank the many graduate students, collaborators, and institutions whose field, laboratory, and research contributions have significantly advanced Quaternary studies in the WBB.

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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

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