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FIELD GUIDE

INPOST - 07

QUATERNARY LANDSCAPE EVOLUTION, ACTIVE TECTONICS AND DRAINAGE REORGANIZATION AT THE HIMALAYAN MOUNTAIN FRONT, NW HIMALAYA









Vimal Singh and Ananya Divyadarshini

बीरबल साहनी पुराविज्ञान संस्थान
Birbal Sahni Institute of Palaeosciences
विज्ञान एवं प्रौद्योगिकी विभाग के अंतर्गत स्वायत्त संस्थान, भारत सरकार
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Field Guide Book

INPOST-07

Quaternary Landscape Evolution, Active Tectonics and Drainage Reorganization at the Himalayan Mountain Front, NW Himalaya

Principal Investigator

Prof. Vimal Singh

Department of Geology, University of Delhi, Delhi – 110007, India

Co-Principal Investigator

Dr. Ananya Divyadarshini

Department of Geology, Utkal University, Bhubaneswar, Odisha, India

Email of Contact Person

vimalgeo@gmail.com

Mobile No.

+91 9560714063

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Team Leaders



Prof. Vimal Singh

Department of Geology,
University of Delhi,
Delhi – 110007, India

Dr. Vimal Singh is a Professor in the Department of Geology, University of Delhi, India, with research interests spanning tectonic geomorphology, fluvial geomorphology, Quaternary geology, and Critical Zone Science. His research focuses on understanding how tectonics, climate, lithology, and surface processes interact to shape landscapes, particularly in the Himalaya and adjoining foreland regions. His work combines field observations with geomorphic analysis, geochronology, and quantitative approaches to investigate active tectonics, landscape evolution, and drainage reorganisation. He has published extensively on Himalayan geomorphology and landscape evolution, and leads collaborative research involving students and researchers working across diverse aspects of Earth-surface processes.



Dr. Ananya Divyadarshini

Department of Geology,
Utkal University,
Bhubaneswar, Odisha, India

Dr. Ananya Divyadarshini is an Assistant Professor in the Department of Geology, Utkal University, Bhubaneswar, India. Her research focuses on tectonic geomorphology, active tectonics, Quaternary landforms and processes, and paleoseismology, with particular emphasis on the Himalayan region. She completed her Ph.D. from the Department of Geology, University of Delhi, on the morphotectonic evolution of the Chitwan Intermontane Valley and its bordering mountain fronts in central Nepal. Her research integrates geomorphic, structural, paleoseismological, and geochronological approaches to investigate active deformation, fault growth, landscape evolution, and earthquake-related processes. Her work contributes to understanding the interaction between tectonics and surface processes in actively deforming mountain landscapes.

Abstract

The northwestern Himalayan mountain front is one of the most tectonically active regions in the world, where ongoing convergence between the Indian and Eurasian plates produces active thrusting, landscape evolution, and drainage reorganization. This three-day field excursion examines the geomorphic and sedimentary record of Late Quaternary tectonic activity along the Himalayan Frontal Thrust and structures in the Pinjaur intermontane valley and the mountain–foreland transition at the Sutlej River mountain exit. Participants will observe fault-propagation folds, active and inactive thrusts, river terraces, alluvial fans, and geomorphic surfaces that record the interaction between tectonic uplift, sedimentation, and river incision. The excursion also explores the evolution of the Pinjaur intermontane valley and demonstrates how progressive growth of the Himalayan mountain front influenced the Late Quaternary reorganization of the Sutlej River through palaeochannels, abandoned valleys, and fluvial deposits. The excursion concludes with a visit to the archaeological site of Ropar (Rupnagar), highlighting the broader Quaternary landscape within which one of the easternmost settlements of the Indus Civilization developed. Together, the field localities provide an integrated perspective on tectonic geomorphology, fluvial evolution, and landscape development along the northwestern Himalayan mountain front.

Preamble

Understanding how active mountain belts evolve through the interaction of tectonics, climate, and surface processes remains one of the central challenges in Quaternary geology. Globally, studies have been carried out to determine how deformation at active mountain fronts generates new topography, modifies sediment routing, reorganizes drainage networks, and produces the geomorphic archives from which Quaternary environmental change is reconstructed. The Himalayan Mountain front provides one of the world's most suitable natural laboratories for addressing these questions because of its high rates of deformation, frequent large earthquakes, and exceptionally well-preserved Late Quaternary landforms.

This field transect across the northwestern Himalayan mountain front provides a rare opportunity to examine the complete geomorphic response to active tectonics within a single region. Participants will observe the style of deformation along the Himalayan Frontal Thrust and associated structures, the evolution of the Pinjaur intermontane valley, the development of river terraces and alluvial fans, and the preservation of successive Quaternary geomorphic surfaces. The excursion ends with evidence for the Late Quaternary reorganization of the Sutlej River, illustrating how progressive mountain-front growth influenced regional drainage evolution. Together, these localities demonstrate the coupling between tectonic deformation, sedimentation, fluvial processes, and landscape evolution at temporal scales ranging from individual earthquake cycles to Late Quaternary landscape development.

The uniqueness of this transect lies in its ability to present these interconnected processes within a short distance, allowing participants to follow the evolution of an active mountain front from deformation and basin development to drainage reorganization using well-preserved geomorphic and sedimentary records.

Regional Geology of the area

Introduction

Among the youngest orogenic belts on Earth, the Himalaya represent the classical example of continent-continent collision (Dewey and Bird, 1970; Dewey and Burke, 1973). Research in this mountain system spans a wide range of problems — from rates of tectonic processes and long-term structural evolution to feedbacks between crustal deformation and atmospheric circulation. The following provides a brief regional overview relevant to the themes of this field excursion.

Divisions of the Himalaya

Working in the Kumaun region of NW India, Heim and Gansser (1939) proposed the first systematic division of the Himalayan orogen into four east-west trending geographic belts: 1) the Sub-Himalaya (Tertiary strata), 2) the Lower Himalaya (low-grade metamorphic rocks), 3) the Higher Himalaya (crystalline gneisses and aplitic granites), and 4) the Tethyan Himalaya (predominantly Precambrian to Eocene rocks) (Fig. 1). The Lower and Higher Himalaya are alternatively referred to as the Lesser and Greater Himalaya respectively (Le Fort, 1975). This four-fold scheme carries direct structural implications: the Sub-Himalaya occupies the footwall of the Main Boundary Thrust (MBT), the Lesser Himalaya the footwall of the Main Central Thrust (MCT), and the Tethyan Himalaya forms the hanging wall of the South Tibet Detachment (STD) (Fig. 1; Yin, 2006).

Several inconsistencies in the Heim and Gansser (1939) classification prompted Yin (2006) to propose an alternative two-fold scheme dividing the orogen into North and South Himalaya — the former equivalent to the Tethyan or Tibetan Himalaya of earlier workers (Heim and Gansser, 1939; Gansser, 1964; Le Fort, 1975). The South Himalaya is further subdivided into Basal (<1500 m asl), Middle (1500–3500 m asl) and Upper (>3500 m asl) belts on the basis of mean elevation. Despite these revisions, the four-fold classification of Heim and Gansser (1939) remains the standard reference framework.

The principal stratigraphic sequences in the Himalayan orogen are (Yin, 2006): (1) Paleogene to Neogene Subathu, Dagshai, Kasauli and Siwalik sequences; (2) Proterozoic Lesser Himalayan sequences; (3) Proterozoic to Ordovician Greater Himalayan Crystalline Complex; and (4) Precambrian to Eocene Tethyan Himalayan sequences. This field excursion is focused on the frontal Sub-Himalaya, where Neogene and Quaternary rocks are the primary subject.

Major Structures

Four fault systems define the internal architecture of the Himalayan orogen (Fig. 1): the Himalayan Frontal Thrust (HFT) or Main Frontal Thrust (MFT), the Main Boundary Thrust (MBT), the Main Central Thrust (MCT), and the South Tibet Detachment (STD) (Heim and Gansser, 1939; Gansser, 1964; Le Fort, 1975).

The MFT/HFT marks the present-day deformational front. Its absolute age is poorly constrained; since the Boulder Conglomerate Formation of the Upper Siwalik Subgroup forms its hanging wall and no younger sediments are preserved, thrust initiation likely

post-dates ~1.5 Ma. The HFT is not a continuous structure along strike — it is emergent in places and blind in others (Nakata, 1989). The MBT has been placed at either >11 Ma based on changes in foreland subsidence rates (Meigs et al., 1995) or <5 Ma based on the arrival of coarse clastics in the foreland basin (DeCelles et al., 1998); total slip is poorly constrained, with estimates exceeding 100 km proposed in the literature (Powell and Conaghan, 1973; Molnar, 1988; Treolar and Coward., 1991; Meigs et al., 1995; Burbank et al., 1996). In the western Himalaya, the MCT carries a minimum slip of ~95 km (Vannay and Grasemann, 2001), was active between 22 and 14 Ma (Metcalfe, 1993), and shows renewed activity between 6 and 2 Ma (Macfarlane, 1993; Harrison et al., 1997, 1998; Catlos et al., 2001, 2020; Wobus et al., 2005). The STD, extending from western Nepal into NW India, is locally known as the Malari or Trans-Himadri fault in the Garhwal Himalaya (Valdiya, 1980, 1989) and was active between 23 and 21 Ma (Searle et al., 1999). Also referred to as the north Himalayan normal fault (Burg et al., 1984; Searle, 1986; Herren, 1987; Pêcher, 1991), it is best expressed in south-central Tibet, where it juxtaposes unmetamorphosed or low-grade Tethyan Himalayan Sequence against high-grade Greater Himalayan Crystalline Complex.

Himalayan Foothills — A Sedimentary Repository

The Siwalik Group accumulated in a flexural basin generated by underthrusting of the Indian plate beneath the Himalayan orogen. Reaching a total thickness of 4–6 km, the Group is divided into Lower, Middle and Upper Siwalik Subgroups (Fig. 1), dominated by siltstone, sandstone and conglomerate (e.g., Pilgrim, 1913; Raiverman et al., 1983; Tandon et. al., 1988; Kumar and Tandon, 1985; Kumar and Nanda, 1989).

The Lower Siwalik Subgroup rests on the Kasauli Formation along a gradational contact. It includes the Kamlial Formation — variegated shales, grey sandstones and red siltstones, the latter yielding vertebrate fossils and occasional silicified tree trunks up to ~8 m in length — and the Chinji Formation, comprising alternating red shales and grey sandstones that are also fossiliferous. The Middle Siwalik Subgroup, subdivided into the Nagri and Dhokpathan Formations, consists of multi-channel sand bodies with a characteristic salt-and-pepper texture. Although absent within the Pinjaur Dun, the Middle Siwalik Subgroup is well exposed on the left bank of the Markanda River. The Upper Siwalik Subgroup is divided into the Tatrot, Pinjaur and Boulder Conglomerate Formations; the Pinjaur area serves as the type section of the Pinjaur Formation. Within the dun, the Pinjaur Thrust places Lower Siwalik rocks in contact with the Upper Siwalik Subgroup. The Tatrot Formation — red clays and pink sandstones in its lower part, grading up to grey siltstones and sandstones — is Late Pliocene in age on faunal grounds. The Pinjaur Formation consists of red clays, grey sandstones and minor yellow sandstone beds, with pronounced lateral facies variation and cyclic clay–sandstone–conglomerate alternations. The uppermost Boulder Conglomerate Formation comprises boulders, cobbles and pebbles of granite, quartzite, slate and limestone sourced from the Lesser and Higher Himalaya, and generally rests unconformably on Late Pleistocene and Holocene alluvial deposits.

A comprehensive Quaternary stratigraphy for deposits above the Siwalik Group has yet to be established. OSL dating of dun gravels in the southeastern Pinjaur Dun, however, indicates deposition spanning ~70 ka to the present; river terraces within the dun, comprising thick conglomerate units interbedded with thin siltstone or fine silty layers, fall within this age range (Suresh et al., 2007).

The MFT, bounding the outermost Siwalik Hills, constitutes the most seismically hazardous structure in the region. Three great earthquakes struck the Himalayan front in the past century — the 1905 Kangra, the 1934 Bihar-Nepal and the 1950 Assam events. At least nine earthquakes exceeding magnitude 5 have been recorded within 150 km of Ropar. While the Chandigarh area was previously regarded as free of major surface-rupture events, paleoseismic investigations along the Himalayan frontal zone have since identified two large surface-rupturing earthquakes, both occurring after ~AD 1200 and before ~AD 1700 (Kumar et, 2006).

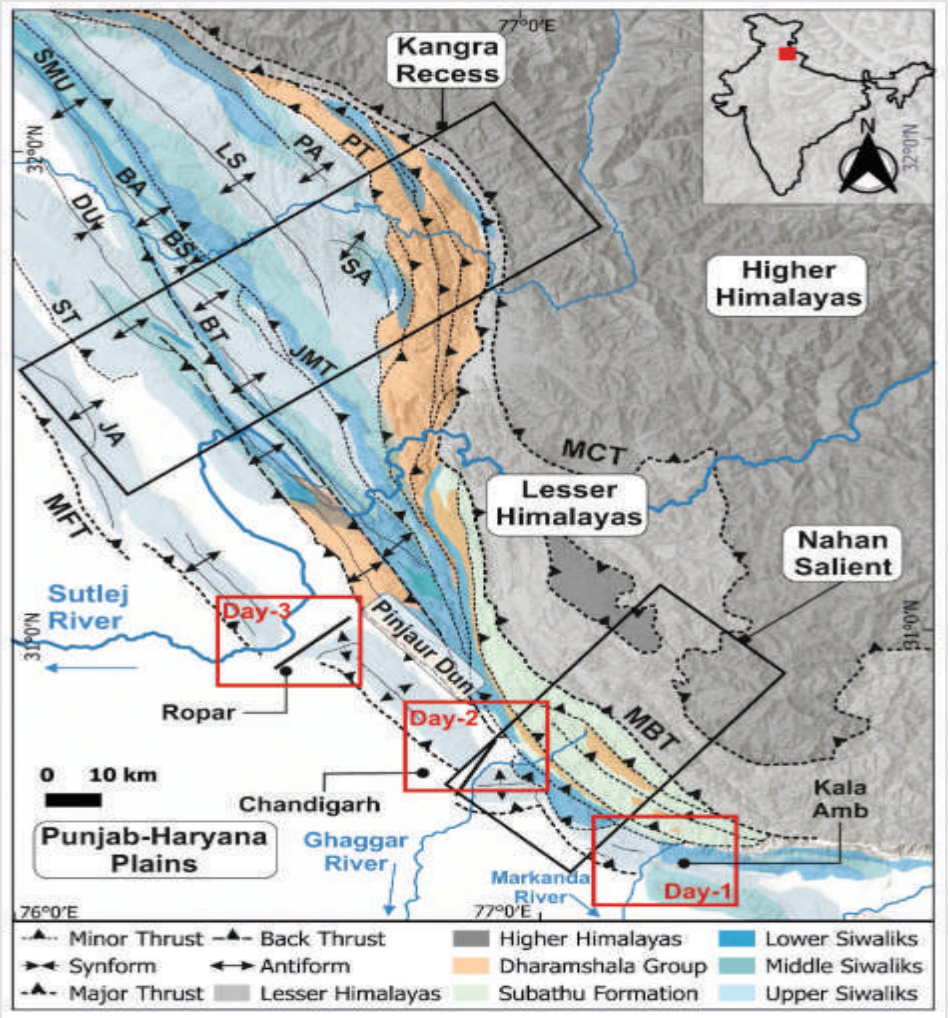


Fig.1 Regional Geological Map of the area showing the structures and distribution of geological formations in the area (modified after Powers et al., 1998 and Webb et al., 2011).

Regional Geomorphology

Four major geomorphic units are recognized in the field area (Figs. 1 & 2) : a) the Sub-Himalayan Mountains, b) the intermontane valley, c) the outermost Siwalik Hills, and d) the Indo-Gangetic Plain (IGP).

Sub-Himalayan Mountains — These NW-SE trending ranges define the northern margin of the intermontane valley and exceed 900 m in places. Several tectonic structures dissect them, including the Barsar, Bilaspur and Surajpur Thrusts and the Taksal Fault. The Ghaggar, Koshallia and Balad Rivers are antecedent to the Barsar Thrust, which marks the mountain–valley boundary. Exposed lithologies span the Subathu, Dagshai and Kasauli Formations and the Lower Siwalik Subgroup.

Intermontane Valley — The Pinjaur Dun occupies a position between the Sub-Himalayan mountains to the NE and the outermost Siwalik Hills to the SW, extending approximately 180 km along strike (Fig. 1). It is naturally divided into a wider northwestern sector (~20 km) and a narrower southeastern sector (6–8 km). In the northwestern portion, the Soan River is the axial drainage — this segment is also referred to as the Soan Dun — before the Sutlej River takes over as the axial river farther northwest. Both rivers flow broadly through the valley centre except near the Sutlej's mountain exit, where it shifts toward the outermost Siwalik Hills. The Sirsa River, a Sutlej tributary, drains the southeastern dun and flows along the rear of the outermost Siwalik Hills before joining the Sutlej ~3 km northeast of village Chak Dera. A drainage divide within the southeastern sector separates the Sirsa from the Jhajara River, a tributary of the Ghaggar, which together with its tributaries occupies ~80 km^2 of the valley floor. Valley fill is predominantly fluvial, producing depositional landforms — alluvial fans and piedmont surfaces — with isolated inliers of Lower Siwalik rocks projecting from the mountain flanks.

Outermost Siwalik Hills — These hills, immediately southwest of the intermontane valley, are divided into three segments by the major transverse rivers: Segment I (right bank of the Sutlej), Segment II (between Sutlej and Ghaggar) and Segment III (left bank of the Ghaggar) (Fig. 1). Mean elevations are ~480 m, ~490 m and ~740 m for Segments I, II and III respectively; Segment III elevations increase eastward where the hills merge with the Sub-Himalayan mountains. Segments I and II trend NW-SE, Segment III trends E-W. Widths of approximately 7, 8.5 and 7.5 km and lengths of ~110, ~40 and ~10 km characterize the three segments in sequence. All segments are highly dissected, with ridges, valleys, terraces and fault scarps as the dominant landform elements.

Indo-Gangetic Plain — The proximal IGP flanks the outermost Siwalik Hills to the southwest, lying between 280 and 340 m in elevation. The surface is largely under cultivation and dissected only locally. Drainage in the plains is predominantly foothill- and plains-fed, with the Sutlej being the main mountain-fed exception. Recognized geomorphic elements include active channels, paleochannels, floodplains, interfluves and terraces.

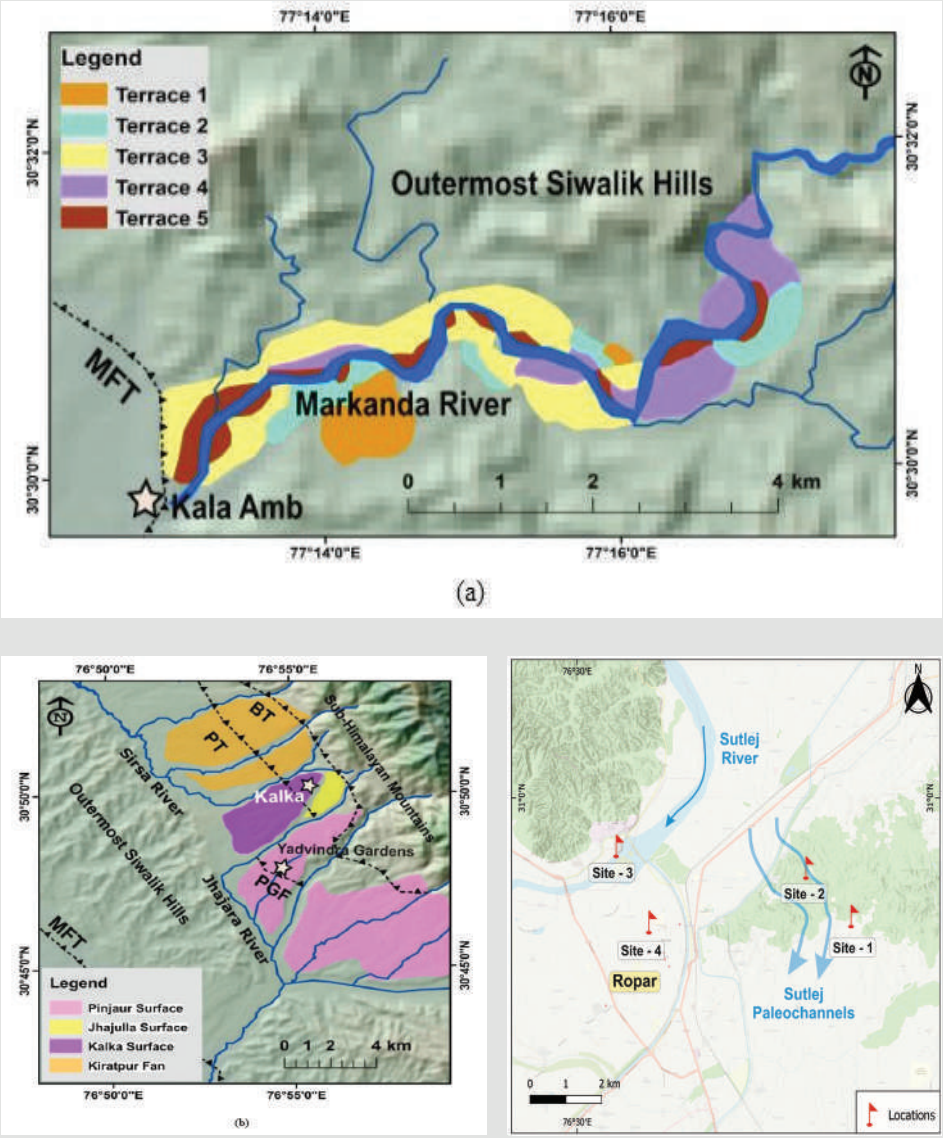


Fig. 2 Geomorphic map of the field area at (a) showing terrace levels along the Markanda River (Highest T1 to Lowest T5) near the Himalayan Mountain exit (modified after Singh et al., 2021): Day1, (b) eastern part of Pinjaur Dun showing Landforms and structures in the intermontane valley: Day 2, and (c) Sutlej River Exit showing Drainage reorganisation: Day 3.

Flora, Fauna, and Climate, weather conditions during the field excursion

The excursion traverses the northwestern Himalayan foothills from Kala Amb through Pinjaur–Kalka, Chandigarh, and Ropar (Rupnagar). The region experiences a subtropical climate, characterized by hot summers (April–June), a southwest monsoon (July–September), and cool, dry winters (December–February). The excursion is scheduled during the first week of February, when weather conditions are generally pleasant, with daytime temperatures of 10–15°C and cooler mornings and evenings (0–5°C). Participants are advised to wear layered clothing suitable for cool mornings and warm afternoons.

The natural vegetation is typical of the Siwalik foothills, comprising tropical dry deciduous forests and scrub vegetation (Forest Survey of India, 2023). Common tree species include Sal (Shorea robusta) in the adjoining foothill forests, Shisham (Dalbergia sissoo), Khair (Acacia catechu), Kikar (Acacia nilotica), Jamun (Syzygium cumini), Peepal (Ficus religiosa), Banyan (Ficus benghalensis), and Mango (Mangifera indica), spread with grasses and thorny shrubs. Riparian vegetation is locally developed along the Sutlej and seasonal streams.

The excursion route does not pass through wildlife habitats. Commonly encountered fauna includes Indian Peafowl, Red-vented Bulbul, Common Myna, Black Drango, House Crow, and Rose-ringed Parakeet, together with small mammals such as squirrels and rhesus macaques. Around Ropar Wetland, participants may also observe a variety of resident and migratory waterbirds during winter. No significant wildlife hazards are anticipated during the excursion.

Literature Review

The northwestern Himalayan mountain front has been studied extensively because it preserves a remarkable record of Quaternary tectonic activity, river evolution, and landscape change (e.g., Malik and Nakata, 2003; Mukhopadhyay and Mishra, 2004; Delcaillau et al., 2006; Singh and Tandon 2007, 2008; Barnes et al, 2011; Thakur et al 2014; Dey et al., 2016; Chauhan et al., 2026). Continued convergence between the Indian and Eurasian plates drives crustal shortening along south-verging thrusts, leading to uplift, folding, and faulting (e.g., Powers et al., 1998; Wesnousky et al., 1999; Kumar et al., 2006). These processes have shaped river terraces, alluvial fans, intermontane valleys, fault scarps, and abandoned channels, making the region an important natural setting to study how tectonics, climate, and surface processes interact.

Evolution of the Pinjaur Intermontane Valley

Early studies outlined the stratigraphy of the Pinjaur valley and identified major geomorphic surfaces (Nakata, 1972; Mukerji 1976, 1990; Suresh et al., 2007). They showed that the valley records successive phases of deposition, incision, and deformation during the Late Quaternary. Many surfaces are displaced by active faults, providing early evidence of ongoing tectonic activity. Later work demonstrated that the valley evolved through progressive deformation involving multiple thrusts, not just a single frontal fault (Malik and Matthew, 2005; Philip and Virdi, 2007; Singh et al., 2008; Singh and Tandon 2007, 2008, 2010). Uplift shaped mountain fronts, terraces, and fans, while repeated incision and aggradation produced the stepped landscape seen today. The valley is now recognized as an actively evolving basin that preserves an important archive of Quaternary landscape change.

Active Tectonics and Paleoseismology

The Himalayan foothills provided some of the earliest evidence for active faulting and surface-rupturing earthquakes. Paleoseismology has shown that the Himalayan Frontal Thrust can generate repeated large earthquakes with measurable surface deformation (Wesnousky et al, 1999; Malik et al., 2003). Trenching near Kala Amb revealed multiple Late Holocene ruptures, while displaced terraces helped estimate uplift rates and fault slip (Kumar et al., 2001, 2006). More recent studies highlight that deformation is spread across thrust and strike-slip structures. A key finding is the identification of the Khetpurali–Taksal Fault, an oblique-slip fault that marks a boundary between seismic domains. It influences the geometry of the Himalayan Frontal Thrust, accommodates strike-slip motion, and plays a role in rupture propagation.

Climate, Sedimentation, and Landscape Evolution

While tectonic uplift is the main driver of long-term landscape change, climate strongly affects sediment production and deposition. Luminescence dating has helped reconstruct the timing of deposition and incision in the Pinjaur valley, showing repeated phases of aggradation followed by tectonic incision. Studies of alluvial fans suggest that long phases of aggradation were linked to monsoon-driven transport capacity rather than sediment supply alone (Suresh et al., 2002, 2007). The geomorphic record therefore reflects the combined influence of climate and tectonics (Singh and Tandon, 2008).

Drainage Evolution and Geomorphic Response

Rivers along the Himalayan front respond quickly to changes in gradients caused by active deformation. Uplift influences incision, terrace formation, channel migration, and fan development. Growth of folds and thrusts forces rivers to adjust through migration, bifurcation, avulsion, and abandonment of old channels (Gupta, 1997; Divyadarshini et al., 2025). The Sutlej River at the mountain–foreland transition is a prime example. Mapping, sediment studies, dating, and subsurface data show repeated drainage reorganization linked to tectonic evolution during the Late Quaternary (Delcaillau et al., 2006; Malik and Mohanty, 2007; Singh et al., 2017; Singh and Sinha, 2019; Basuroy et al., 2021; Suresh and Kumar, 2020; Kordt et al., 2025).

Relevance of the Present Field Transect

This field transect has been designed to examine, within a single excursion, the fundamental processes that govern Quaternary landscape evolution at an active mountain front. The selected localities collectively document the progression from active tectonic deformation to basin evolution, sedimentation, fluvial adjustment, and ultimately drainage reorganization, providing an integrated perspective on how mountain-front landscapes evolve over Quaternary timescales.

The excursion follows this evolution sequentially. Day 1 focuses on active deformation along the Himalayan Frontal Thrust, where participants will observe fault-propagation folding, uplifted river terraces, and evidence of repeated surface-rupturing earthquakes. Day 2 examines the Pinjaur intermontane valley, where a succession of geomorphic surfaces, active and inactive thrusts, alluvial fans, and fault-controlled landforms records the outward propagation of deformation, the interaction between tectonics and sedimentation, and the progressive evolution of an intermontane basin. Day 3 explores the mountain–foreland transition of the Sutlej River, where palaeochannels, abandoned valleys, fluvial deposits, and the present river course provide an opportunity to evaluate the relationship between tectonic uplift and Late Quaternary drainage reorganization.

The transect is distinctive because it integrates multiple complementary datasets — including structural geology, geomorphology, sedimentology, geochronology, and paleoseismology — within a relatively small geographic area. The well-preserved geomorphic record enables participants to examine both established concepts and emerging questions concerning active tectonics, climate–tectonic interactions, basin evolution, and the response of major Himalayan rivers to mountain-front deformation. As a result, this excursion not only illustrates classic examples of Quaternary landforms and active structures but also provides a framework for discussing ongoing research and future directions in Himalayan Quaternary science.

Unresolved Issues and Future Research Directions

Even after more than fifty years of geological, geomorphological, and paleoseismological work, many key questions about the Quaternary evolution of the northwestern Himalayan mountain front are still open. The coupling between tectonic uplift and climate in shaping sedimentation, incision, and alluvial fan growth remains debated. Studies of landforms and dating methods have helped clarify when deposition and erosion occurred, but how climate and tectonics interact to drive landscape change still remains to be addressed.

The nature of deformation along the Himalayan Frontal Thrust is also not fully understood. Active movement is spread across several thrusts, folds, and transverse structures in the Sub-Himalaya, yet their timing, interaction, and shifting through earthquake cycles are poorly constrained. Recent work points to the role of transverse faults, especially the Khetpurali–Taksal Fault, in handling oblique convergence and dividing strain. But their impact on seismic segmentation, rupture behaviour, and long-term mountain-front growth requires more geomorphic, geodetic, and paleoseismological research.

Another unresolved issue is how major Himalayan rivers respond to tectonics. Evidence suggests that the steady growth of the mountain front has influenced river migration and drainage reorganization, but the timing, processes, and regional scale of these changes are not yet clear. To understand this better, geomorphology, sedimentology, geochronology, and subsurface records must be brought together.

Improved dating methods, especially high-resolution geochronology and subsurface studies, are essential to measure rates of deformation, sediment storage, and landscape evolution in the Himalayan foothills. The field sites included in this excursion give us a chance to look at these questions directly and to discuss future directions in Quaternary research along the mountain front.

A growing area of interest is how active mountain-front growth reorganizes Himalayan drainage networks. Increasing evidence shows that tectonics have altered the courses of major rivers during the Late Quaternary, but the extent, timing, and mechanisms of these changes are still uncertain. The Sutlej River offers a natural example to explore these processes.

Field Transect

3rd February 2027

8:30 AM - Assemble at Lucknow Airport (Tentative)
10:45 AM – Flight departs for Delhi (Tentative)
12:00 PM – Arrival at Delhi Airport (Tentative)
12:30 PM – Departure from Delhi for Chandigarh by road
18:30 PM – Arrive at the Hotel in Chandigarh

4th February 2027

8:00 AM – Breakfast
9:00 AM – Depart for the field
5:30 PM – Arrive at the Hotel
7:30 PM – Dinner

5th February 2027

7:30 AM – Breakfast
8:30 AM – Depart for the field
5:30 PM – Arrive at the Hotel
7:30 PM – Dinner

6th February 2027

7:30 AM Breakfast
9:00 AM Check out from the Hotel and Depart for the field
2:00 PM Leave for Delhi
7:30 PM Arrive at Delhi

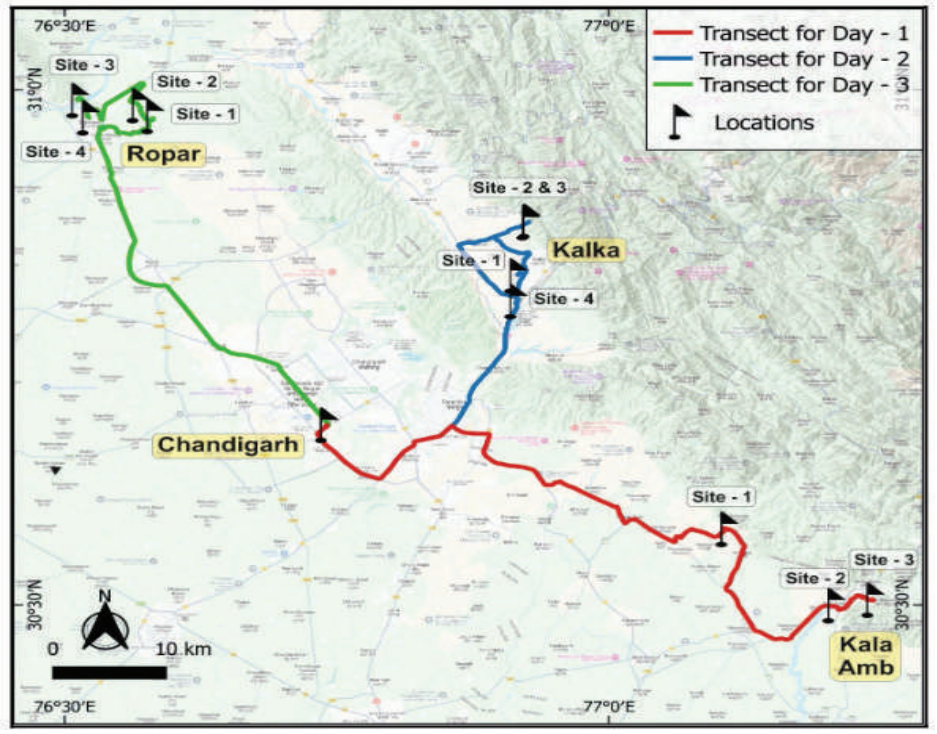


Fig. 3 Map showing the field transects.

Day 1: The Himalayan Front

Site 1: Fault propagation fold

Coordinates: 30°34'8.80"N; 77° 6'9.87"E

Elevation: 392 m

Location: Near Bhood village in the tributary of Begna River

This exposure illustrates the interaction between active thrusting, folding, erosion, and sedimentation at the Himalayan mountain front. Middle Siwalik sandstones and mudstones are folded into the forelimb of a fault-propagation fold developed above the Himalayan Frontal Thrust (Fig. 4). The folded bedrock is truncated by an erosional unconformity and overlain by Quaternary gravels. A second gravel body caps the tilted beds within the damage zone, demonstrating progressive uplift during continued deformation (Fig. 4). A plough zone developed suggests thrust movement. The outcrop provides an excellent example of syntectonic landscape evolution at an active continental mountain front.

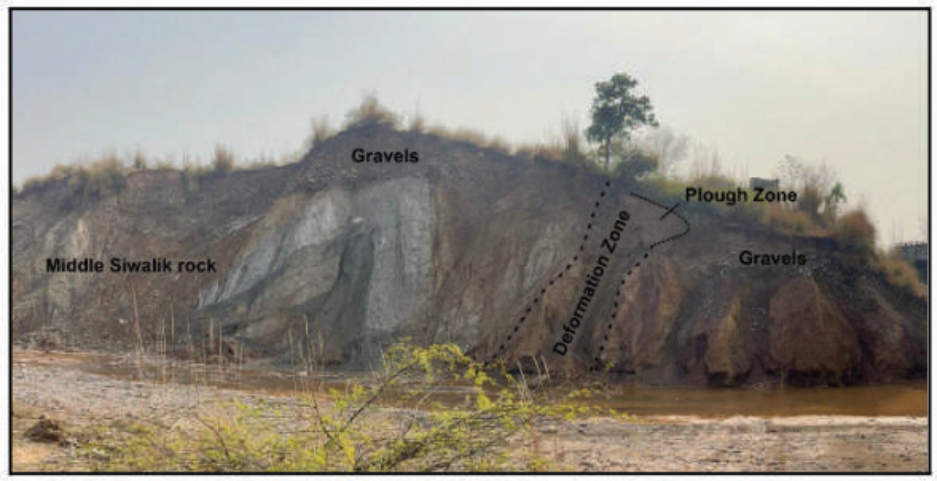


Fig. 4 Photograph of a fault-propagation fold. Notice the gravel bed lying on top of the fold. Also, towards west another layer of gravel bed is lying indicating faulting in the region.

Site 2: Markanda River exit

Coordinates: 30°29'54.89"N; 77°12'26.56"E

Elevation: 354 m

Location: Kala Amb town, along the Markanda River

The Markanda River exits the Himalaya at the Kala Amb. At its exit and in the valley upstream the river has made several levels of terraces (Figs. 2a and 5). Most of these terraces truncate at the Himalayan front (Fig. 5) indicating that these have developed in response to the uplift along Himalayan Frontal Thrust (also called as Main Frontal Thrust or MFT).

Paleoseismic investigations by Kumar et al., (2001) at the Markanda River exit indicate repeated surface-rupturing earthquakes along the Himalayan Frontal Thrust (HFT) during the late Holocene. At least two major earthquakes occurred after AD 1294 and AD 1423, with evidence for an earlier event around AD 260. The adjacent fluvial terraces preserve cumulative uplift associated with repeated fault movement, indicating sustained activity of the HFT during the mid- to late Holocene. Estimated uplift rates of ~4.8 mm yr^{-1} correspond to crustal shortening rates of approximately 8–10 mm yr^{-1}, demonstrating that this segment of the Himalayan mountain front remains tectonically active (Kumar et al., 2001).

Despite being tectonically active and high vulnerability to large earthquake, this region is heavily modified by the anthropogenic activity.



Fig. 5 Photograph of terraces along the Markanda River near Kala Amb indicating response of the river to uplifting surface.

Site 3: Suketi Fossil Park

Coordinates: 30°30'16.43"N; 77°14'35.48"E

Elevation: 433 m

Location: Suketi village

Suketi Fossil Park, also known as the Siwalik Fossil Park, is a National Geo-heritage Monument (Fig. 6) in the Sirmaur district of Himachal Pradesh. It is named after Suketi village and covers about 1.5 square kilometres. The park has fossils and skeletons of prehistoric vertebrates collected from the sandstones and clays of the upper and middle Siwalik ranges in the Sub-Himalaya.

The park displays these fossils along with six life-sized fiberglass models of extinct mammals in an open-air setting that recreates the Siwalik Hills of the Plio-Pleistocene period, nearly 2.5 million years ago. A museum inside the park preserves and exhibits the fossils. The museum was set up to protect the site and to provide scientific information for research.

The Geological Survey of India, with the support of the Himachal Pradesh government, established the park on 23 March 1974 and continues to maintain it. The fossils are identified as vertebrates that lived about 2.5 million years ago. Scientists note that the Siwalik Hills, formed around 2.5 million years ago, show stages in human evolution. The mammalian fossils found here are among the richest collections in the world.

Source: Adapted from Wikipedia



Fig. 6 Suketi Fossil Park at Suketi village having life-sized models of fossils found in the Middle and Upper Siwaliks.

Day 2: Landforms and structures in the intermontane valley (Pinjaur Dun)

Site 1: Panoramic View of the Pinjaur Dun from the Kalka Surface

Coordinates: 30°49'10.08"N; 76°54'52.78"E

Elevation: 620 m

Location: Kalka surface near Basdevpura village, Pinjaur

This viewpoint provides an excellent overview of the stepped geomorphic surfaces preserved within the Pinjaur Dun (Figs. 7). On a clear day, all major Quaternary surfaces can be identified, recording successive phases of sedimentation, incision, and tectonic deformation over the last >50 ka. The Pinjaur Surface, dissected by the Pinjaur Thrust, dominates the central part of the valley (Fig. 7), while the deeply incised Koshallia Surface occupies the southeastern sector. Towards the NNE, the apex of the Kiratpur alluvial fan (Fig. 7) marks the transition from the Sub-Himalayan mountain front into the intermontane basin.

The Kalka Surface, on which this viewpoint is located, is the oldest and highest geomorphic surface in the dun (Fig. 7a). It consists of coarse dun gravels deposited by streams draining the Sub-Himalayan ranges before deposition ceased around 55 ka, probably in response to tectonic uplift.

The Pinjaur Surface (Fig. 7b) represents the next major phase of aggradation and is the most extensive geomorphic surface within the basin. It is disrupted by several active structures, including the Batinan Fault, Pinjaur Thrust, and Pinjaur Garden Fault, demonstrating continued deformation after its deposition. (Fig. 7c). In contrast, the younger Jhajulla Surface is not known to be tectonically displaced, suggesting that major deformation had shifted towards more frontal structures by the time of its formation.

Subsequent incision by the Jhajara and Koshallia streams produced the youngest terrace levels preserved within the dun. Collectively, these geomorphic surfaces record the interplay between sedimentation, river incision, and progressive outward propagation of deformation across the Himalayan frontal fold-and-thrust belt.

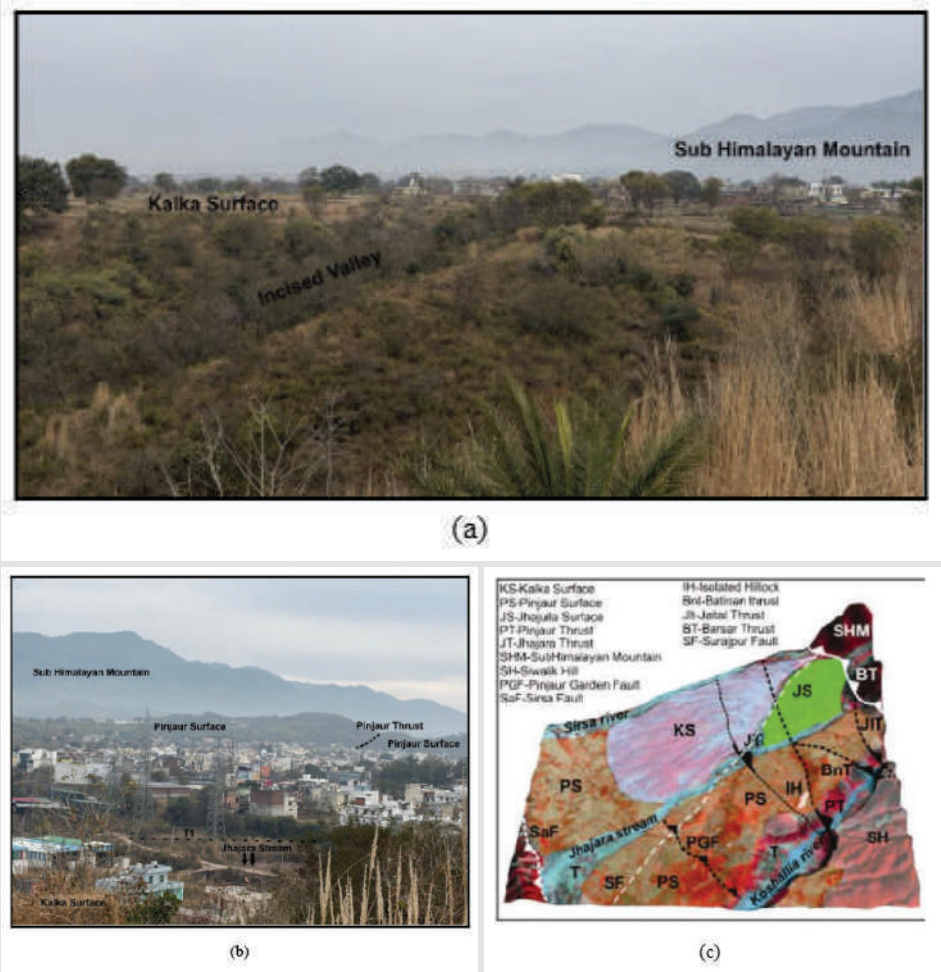


Fig. 7 (a) Photograph of Kalka surface showing deep incision by stream originating over it; (b) Panoramic view of surfaces and terraces from the Kalka surface; and (c) 3-D surface model showing distribution of the surfaces and structures in the southeastern part of the Pinjaur Dun.

Site 2: Jhajjara Thrust: An example of Neotectonic deformation in the Pinjaur Dun

Coordinates: 30°49'10.26"N; 76°54'58.11"E

Elevation: 610 m

Location: Jhajara stream near Basdevpura village

The Jhajara Thrust is a subsidiary thrust developed within the southeastern part of the Pinjaur Dun (Fig. 7c), representing an imbricate structure in the Sub-Himalayan fold-and-thrust belt. At this locality, Lower Siwalik rocks are thrust southwestward over unconsolidated Quaternary dun gravels, providing clear evidence that deformation continued after sediment accumulation within the intermontane basin. The exposure is characterized by brecciated Lower Siwalik rocks, fault gouge, and a well-defined thrust contact (Fig. 8).

The geomorphic expression of the thrust is equally instructive. The Jhajara Stream narrows dramatically from about 35–50 m upstream to only 4–7 m across the fault zone, where enhanced incision has produced paired fluvial terraces. These features illustrate the adjustment of an alluvial stream to localized tectonic uplift. Although the channel has now attained a graded profile across the thrust, geomorphic evidence preserves the imprint of past deformation.

Optically Stimulated Luminescence (OSL) dating of sediments overlying the thrust indicates that movement along the Jhajara Thrust ceased around ~55 ka, after which deformation propagated towards the more frontal Pinjaur Garden Fault. This locality therefore provides an excellent example of progressive outward migration of deformation within the Himalayan frontal wedge and demonstrates how tectonic activity influences river morphology and terrace development.

Key observations: (i) thrust contact between Lower Siwalik rocks and Quaternary dun gravels; (ii) fault gouge; (iii) fault-controlled stream narrowing and incision; and (iv) fluvial terraces recording tectonic adjustment.



(a)

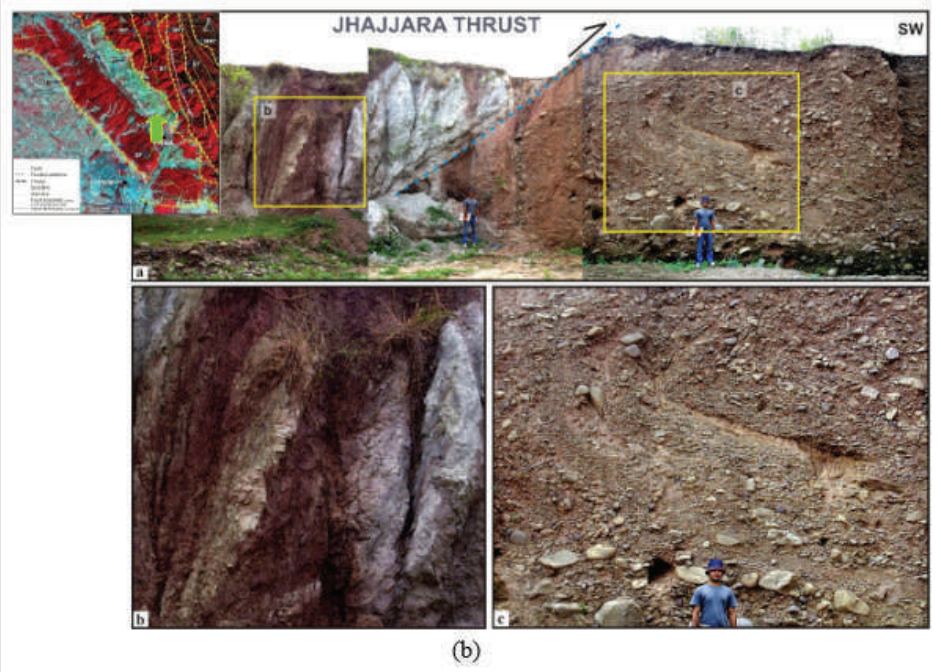


Fig. 8 (a) New outcrop of the Jhajara thrust exposed at the base of the Kalka surface on the right valley margin of the Jhajara stream; (b) An old photograph of the Jhajara thrust that was exposed on the left bank of the Jhajara stream but it is now covered due to anthropogenic activity (from Singh et al., 2008).

Site 3: Barsar Thrust

Coordinates: 30°52'20.44"N; 76°55'37.88"E

Elevation: 794 m

Location: Near Thana ki Sher near the apex of the Kiratpur fan.

The Barsar Thrust marks the northeastern margin of the Pinjaur Dun and represents an active imbricate within the Himalayan fold-and-thrust belt. It is well exposed along the Koshallia River and the Kiratpur and Ramnagar streams, where it places Dagshai and Kasauli Formation rocks against younger deposits. The fault zone consists of intensely fractured and crushed rocks, fault breccia, and gouge, reflecting repeated episodes of brittle deformation (Fig. 9). The hanging-wall strata are folded, illustrating progressive shortening during thrust propagation.

Uplift associated with the Barsar Thrust initiated incision at the head of the Kiratpur alluvial fan, abandoning the oldest fan surface and forcing the depocentre to migrate progressively downstream, where younger fan lobes were subsequently constructed. The resulting

succession of fan lobes, together with asymmetric river terraces and fan-head incision, provides an excellent example of the interaction between active tectonics and alluvial fan evolution along the Himalayan mountain front.

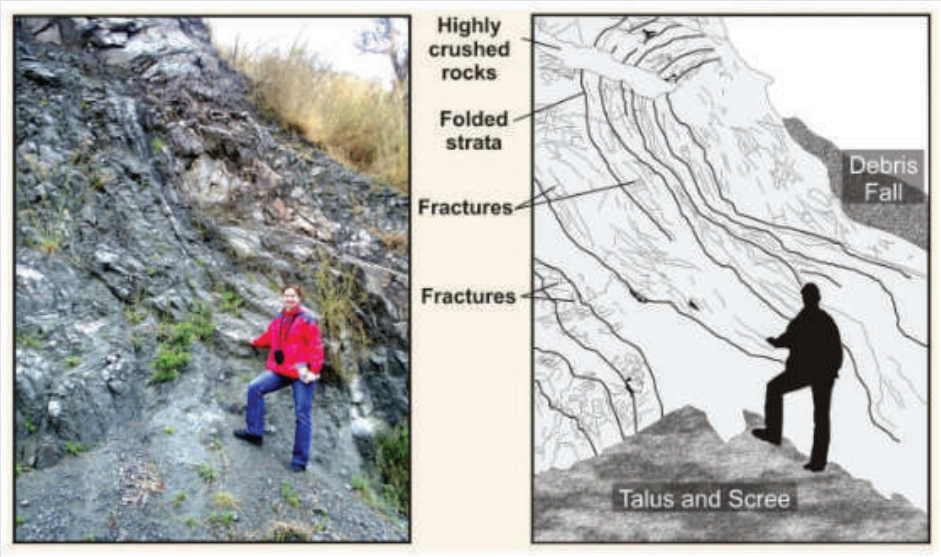


Fig. 9 : Field exposure of Barsar thrust zone on the northwestern bank of the Kiratpur stream. Dashed lines show folded strata near the thrust zone, and the sketch of the field exposure show, different observed fault elements. The hanging wall of the Barsar thrust is composed of rocks of Subathu, Dagshai, and Kasauli Formations and the Lower Siwalik Subgroup. The footwall of the Barsar thrust is composed of lower Siwalik rocks that are overlain by dun gravels (from Singh and Tandon, 2010).

Site 4: Kiratpur fan

Coordinates: 30°52'16.15"N; 76°55'33.02"E

Elevation: 780 m

Location: Near Thana ki Sher; the apex of the Kiratpur fan.

Towards the NNE lies the Kiratpur alluvial fan, one of the largest alluvial fans preserved within the Pinjaur Dun. Constructed by the Kiratpur River emerging from the Sub-Himalayan mountain front, the fan records repeated phases of aggradation, incision, and renewed deposition in response to changes in tectonic activity and sediment supply. Morphologically, the fan comprises four distinct lobes that can be recognized both in the field and on satellite imagery.

The oldest and steepest fan lobe, visible from this viewpoint (see photograph: Fig. 10), is deeply incised by the Kiratpur River. Recent chronological investigations indicate that this fan surface formed during the Late Pleistocene and was abandoned following a major phase

of incision, probably during the Last Glacial Maximum. Incision shifted the depocentre progressively downfan, leading to the construction of three younger, more gently sloping lobes during the subsequent phase of aggradation. Ongoing chronological studies indicate that these younger lobes were deposited during the Late Glacial–Early Holocene transition.

The fan also preserves clear evidence of tectonic modification. It is tilted southwestward, with uplift concentrated near the fan head, resulting in pronounced incision, asymmetric development of unpaired terraces, southwestward migration of the axial channel, and systematic reorganization of the drainage network. Together, these geomorphic features illustrate how climatic variations influenced sediment supply, while active tectonics controlled fan tilting, incision, and the migration of depositional loci across the Pinjaur Dun.



Fig. 10 Photograph showing gently sloping surface of the Kiratpur fan. Notice the degree of incision (>40 m) at the fan head.

Site 5: Pinjaur Garden Fault or Big step fault

Coordinates: 30°47'38.36"N; 76°54'52.66"E

Elevation: 562 m

Location: Yadvindra Gardens, Pinjaur

The Pinjaur Garden Fault (PGF) is one of the most prominent active faults within the Pinjaur Dun. It was first recognized by Nakata (1970) from geomorphic evidence, who interpreted the prominent break in the Quaternary surfaces as a fault scarp. Subsequent geomorphic mapping demonstrated that the fault extends for more than 45 km through the Pinjaur Dun,

displacing the Kalka, Pinjaur and younger geomorphic surfaces, while paleoseismic trenching confirmed repeated surface-rupturing earthquakes along this structure.

This stop is unique because the fault scarp has been incorporated into one of the northern India's best-known historic gardens. The Pinjaur Garden, now known as Yadavindra Garden, was commissioned during the early reign of the Mughal emperor Aurangzeb (r. 1658–1707) by his foster brother and architect Nawab Fidai Khan. After a prolonged period of neglect, the garden was restored by Maharaja Yadavindra Singh of the former princely state of Patiala, after whom it is now named.

The garden occupies a series of Quaternary river terraces. The prominent 'Big Step' forming the central axis of the garden is, in fact (Fig. 11), a natural fault scarp approximately 12 m high, interpreted by Nakata (1970) as the surface expression of the Pinjaur Garden Fault. Rather than modifying the landscape, the Mughal architects ingeniously incorporated this tectonic landform into the garden's design, using it as the principal terrace and water cascade.

Paleoseismic investigations across the fault at Ratpur have revealed evidence for at least two large prehistoric surface-rupturing earthquakes, indicating that the Pinjaur Garden Fault has remained active during the late Quaternary (Malik and Mathew, 2005). Together with the displaced geomorphic surfaces observed elsewhere in the Pinjaur Dun, these studies demonstrate progressive outward migration of deformation across the Himalayan foothills and highlight the continuing seismic hazard associated with active faults within the Sub-Himalayan fold-and-thrust belt.



Fig.11 Photograph showing Pinjaur Garden Fault across which the a big drop is seen (marked as fault displacement).

Day 3: Drainage reorganization

Site 1: Paleo-exit of the Sutlej River

Coordinates: 30°58'26.53"N; 76°34'51.88"E

Elevation: 340 m

Location: Near Sanana village, Ropar (also called as Rupnagar)

This exposure preserves deposits of the palaeo-Sutlej River (Fig. 12), demonstrating that the river once flowed through this part of the mountain–foreland transition before migrating westwards to its present course. The outcrop consists of thick grey, micaceous sand bodies interbedded with gravel layers rich in quartzite and granitoid clasts, a sediment assemblage characteristic of the Sutlej River and distinct from the deposits of local Siwalik-fed streams.

Further downstream in the plains thick sediments of the Sutlej River dating upto 70 ka has been identified. Younger sediments, deposited up to about 17 ka, are reported from this locality, reflecting continued fluvial activity prior to complete abandonment of the channel.

This locality lies close to the junction of two segments of the Main Frontal Thrust, where progressive deformation modified regional gradients and influenced the evolution of the river system. Together with the sites visited later in the excursion, these deposits provide key evidence for tectonically driven drainage reorganization and the progressive westward migration of the Sutlej River.

Key observations: (i) thick grey Himalayan sand bodies, (ii) quartzite-rich gravel beds diagnostic of the Sutlej River, (iii) repeated phases of deposition and reworking, and (iv) the relationship between palaeodrainage and active deformation.

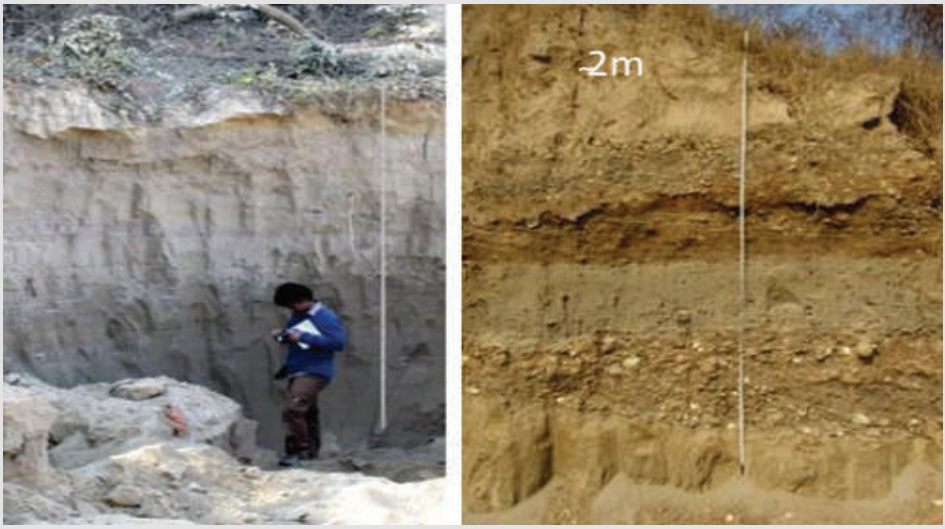


Fig. 12 Photograph showing lithosection along paleo valley of Sutlej River near Sanana village, Ropar

Site 2: Paleovalley of the Sutlej River

Coordinates: 30°59'4.52"N; 76°34'4.10"E

Elevation: 314 m

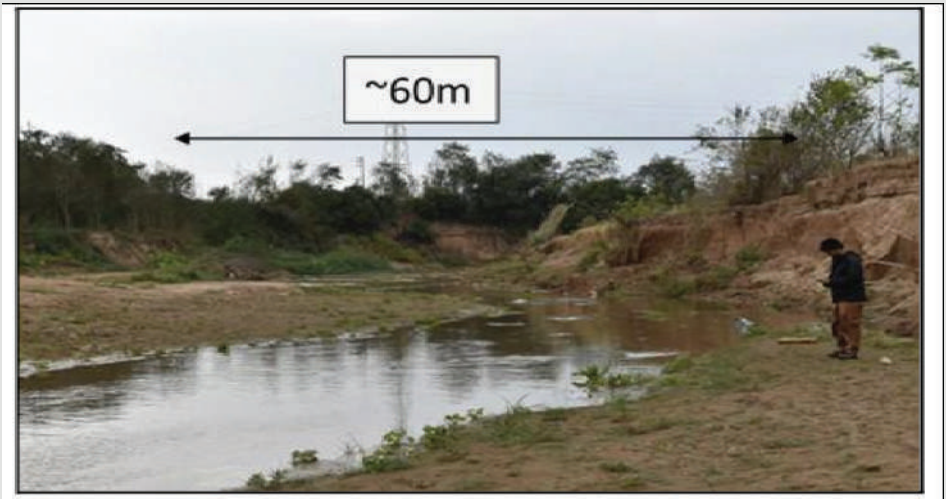
Location: Near Ladhal

This locality preserves one of the abandoned palaeovalleys of the Sutlej River, providing direct evidence for the former course of the river across the mountain–foreland transition. The present-day stream is markedly underfit, flowing within a valley nearly 60 m wide that is much larger than required by the modern discharge, indicating excavation by a substantially larger river in the past.

Topographic profiles across the area reveal two broad palaeovalleys, approximately 350 m and 400 m wide, separated by an intervening high comprise of late Pleistocene sediments (Fig. 13). These valleys contain thick grey Himalayan sands and gravels identical to those observed at the previous stop, confirming their origin as former Sutlej channels.

Geochronological investigations indicate that the river occupied this valley during the Late Pleistocene, before abandoning it following progressive westward migration of the drainage system. The abandonment of this channel marks an important stage in the reorganization of the Sutlej River in response to tectonically induced changes in regional gradients at the mountain front.

Key observations: (i) an underfit stream occupying an oversized valley, (ii) broad palaeovalley morphology visible in the cross-section, (iii) Himalayan fluvial deposits filling the valley, and (iv) evidence for former occupation by the Sutlej River prior to its westward migration.



(a)

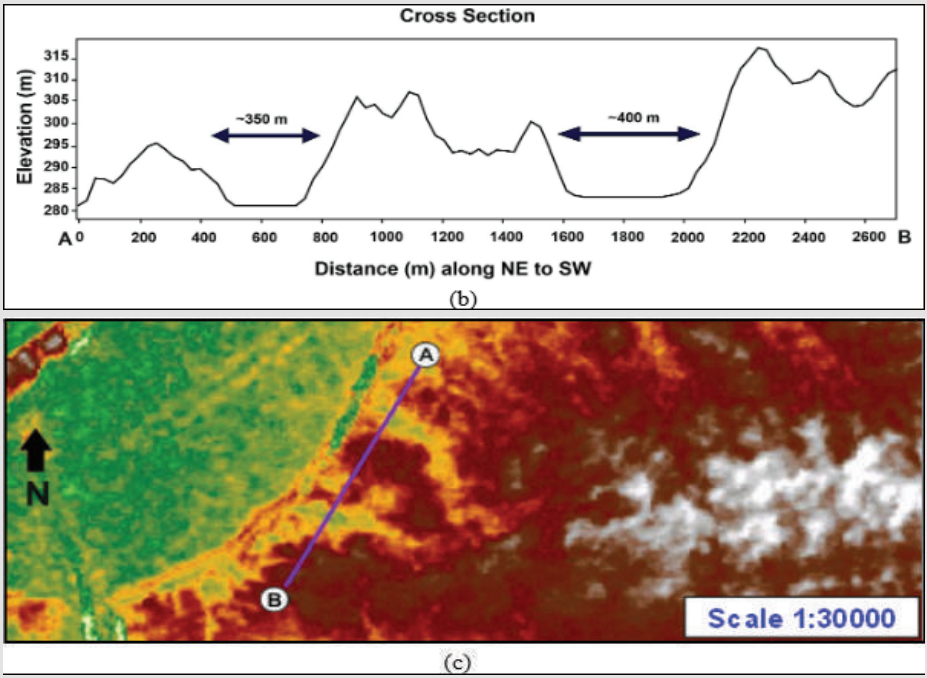


Fig.13 (a) Photograph of the paleovalley showing misfit stream; (b) Two prominent NW-SE trending Paleovalleys identified within the Ropar Surface. The width of the valleys are quite high compared to the width of the valleys made by Siwalik streams flowing down the Outermost Siwalik hills; (c) The DEM clearly shows the decrease in width of the paleovalleys with increasing elevation towards SE. The cross-section profile of the two paleovalleys at its NW entrance. The transect profile shows the width of the P1 is ~ 350m and the width of the P2 is ~ 400m

Site 3: Sutlej River water gap: Evidence for Progressive Drainage

Coordinates: 30°59'22.07"N; 76°30'43.88"E

Elevation: 315 m

Location: Gurudwara Tibbi Sahib

This stop overlooks the present-day Sutlej River water gap, where the river cuts across the growing mountain front. Four distinct terrace levels are preserved along the valley sides, recording successive phases of incision and valley-floor abandonment during the Late Quaternary (Fig. 14). Geochronological investigations indicate that these terraces range in age from approximately 20 ka (oldest) to 4 ka (youngest), documenting episodic adjustment of the river to changing boundary conditions.

Field and chronological evidence indicate that between ~24 and 17 ka, the Sutlej River bifurcated upstream of this locality. One branch flowed southward through the palaeovalley visited at the previous stop, while the other continued westward through the present water gap. Progressive tectonic growth at the mountain–foreland transition modified regional

gradients, resulting in increased discharge through the westward-flowing branch. As this channel became progressively entrenched, the southern branch was abandoned, establishing the modern course of the Sutlej River.

Key observations: (i) four Late Quaternary terrace levels, (ii) deeply incised water gap, (iii) evidence for progressive river incision, and (iv) the relationship between terrace development, channel bifurcation, and tectonically driven drainage reorganization.



Fig. 14: Photograph of the Sutlej River water gap showing three levels of terraces on the right bank of the Sutlej River. Youngest terrace level is observed on the left bank and on both the banks further downstream towards west.

Site 4: Ropar mound

Coordinates: 30°58'17.38"N; 76°31'25.34"E

Elevation: 315 m

Location: Ropar town

The Ropar (Rupnagar) marks the northeastern extent of the Indus Civilization and was the first Harappan site excavated in independent India. Excavations initiated by Y. D. Sharma in 1953 revealed a remarkable cultural sequence spanning nearly four millennia, from the Mature Harappan period (ca. 2500 BCE) through the Painted Grey Ware culture and later Saka, Kushana, Gupta, and medieval periods. This uninterrupted succession makes Ropar one of the most important archaeological sites in northwestern India (Fig 14).

The Harappan occupation yielded characteristic artefacts including steatite seals, pottery, terracotta figurines, beads, ornaments, copper tools, and structural remains constructed using river pebbles and mud bricks. Excavations also uncovered well-preserved burials with ceremonial pottery and personal ornaments, providing valuable insights into the funeral practices of the Harappan inhabitants. The site museum displays these discoveries and illustrates the long cultural history of the region.

Located at the Himalayan mountain–foreland transition, Ropar occupies a strategic position where the Sutlej River emerges onto the Indo-Gangetic Plain. This landscape offered perennial water, fertile floodplains, and access to both Himalayan and plains resources, making it favourable for repeated human occupation over thousands of years.

Ropar represents the end of the geological story explored over the previous three days. The active deformation, mountain-front uplift, and drainage reorganization observed during the excursion shaped the landscape through which the Sutlej River evolved during the Late Quaternary. This evolving landscape ultimately provided the environmental setting for one of the easternmost urban centres of the Indus Civilization. Ropar therefore exemplifies the close relationship between tectonic processes, river dynamics, landscape evolution, and the development of human societies in northwestern India.



Fig. 14 Photograph of a mansion located on the top of Ropar archaeological mound.

Key Takeaways

1. Mountain fronts grow through distributed deformation involving multiple active structures rather than a single fault.

2. Intermontane valleys are dynamic geomorphic systems that record repeated phases of tectonic uplift, sedimentation, and erosion.

3. Drainage networks are highly sensitive to tectonically induced changes in gradient and can undergo large-scale reorganization during the Quaternary.

4. Quaternary landscapes are best understood by integrating structural geology, geomorphology, sedimentology, and geochronology.

Conclusion

The Himalayan mountain front and adjoining intermontane valleys preserve an exceptional record of the interaction between tectonics, climate, and fluvial processes during the Late Quaternary. The field transect presented in this guide provides an opportunity to examine the geomorphic and sedimentary signatures of active deformation, landscape evolution, and drainage reorganization across a range of geological settings, from the Himalayan mountain front to the foreland plains.

The field stops illustrate how tectonic structures influence landscape development, how rivers respond to changes in accommodation space and base level, and how sedimentary archives preserve evidence of past environmental and tectonic events. Together, these localities demonstrate the value of integrating geomorphology, sedimentology, stratigraphy, geochronology, and paleoseismology to reconstruct Quaternary landscape evolution.

Many aspects of the evolution of the Pinjaur intermontane valley, the Himalayan mountain front, and the adjoining foreland continue to be the subject of active research. We hope that this field excursion will stimulate discussion, encourage new collaborations, and inspire further investigations into the complex interactions between tectonic processes, climate variability, and surface processes that have shaped this dynamic landscape.

Emergency Services

Day	Site	Hospitals	Police Station
Day-1	Site - 1	CHC Raipur Rani, Panchkula, Haryana Ph. +91 94170 95466	Raipur Rani Police Station, Shahpur, Panchkula District, Haryana – 134204 Ph. +91 97299 90503 | +91 1734 256626
	Site - 2,3	Civil Hospital, Naraingarh, Haryana Ph. +91 1734 277155 YSPGMC (Zonal Hospital), Nahan, Sirmaur Himachal Pradesh Ph. +91 1702 222209, +91 1702 224011	Raipur Rani Police Station, Shahpur, Panchkula District, Haryana – 134204 Ph. +91 97299 90503, +91 1734 256626
Day-2	Site - 1,4	Primary Health Centre Pinjore, Kalka-Baddi Highway Road, Kalka, Haryana Ph. +91 89264 84848	Pinjore Police Station, Kalka-Baddi Highway Road, Pinjore, Panchkula District, Haryana-134102 Ph. +91 97299 90502, +91 1733 231403
	Site - 2,3	Sub Division Hospital Kalka (Civil Hospital), Near Kurari Mohalla, Kalka, Haryana Ph. +91 94681 88869	Kalka Police Station, Gandhi Chowk, Kalka-Shimla Road, Sohan Nagar, Kalka, Panchkula District, Haryana-133302 Ph. +91 97299 90501, +91 1733 220875

Day-3	-	District Hospital Rupnagar, Near Bela Chowk, Civil Hospital Road, Rupnagar, Punjab Ph. +91 1881 228102 Parmar Hospital, Bela Rd, Bal Sanda, Rupnagar, Punjab Ph. +91 9814024442	Rupnagar City Police Station, Near Old Sabzi Mandi, Main Bazar, Pakka Bagh, Rupnagar, Punjab - 140001 Ph. +91 85588-10964, +91 1881 221177, +91 97794-64100
Hotel	-	PGIMER Chandigarh, Madhya Marg, Sector 12, Chandigarh Ph. +91 172 2746018, +91 172 2747585, +91 172 2755454 Fortis Hospital Mohali, Sector 62, Sahibzada Ajit Singh Nagar, Punjab Ph. +91 1724 692222 Park Hospital, Sector 69, Sahibzada Ajit Singh Nagar, Punjab Ph. +91 1724 696699	Sohana Police Station, Sector 79, Sahibzada Ajit Singh Nagar (Mohali), Punjab – 140308 Ph. +91 77101 11941, +91 91155 16029

Safety and General Guidelines

Safety

• Wear sturdy walking shoes suitable for uneven ground and loose gravel.
• Carry layered clothing, as mornings and evenings in early February can be cool (0–5°C), while daytime temperatures are generally pleasant (10–15°C).
• Carry drinking water and any personal medications.
• Take care while walking near steep river banks, quarry faces, and road cuttings.
• Cross roads only under the guidance of the excursion leaders.
• Follow all instructions provided by the excursion leaders throughout the field trip.

Field Guidelines

• Respect geological outcrops and avoid unnecessary hammering or damage.
• Sample collection is NOT permitted unless approved by the excursion leaders.
• Leave all field localities clean; do not litter.
• Respect local communities, agricultural land, and private property.
• Photography is encouraged; however, follow any restrictions at museums and archaeological sites.

Emergency Information

• No significant hazards related to landslides, flash floods, or wildlife are anticipated during the scheduled period of the excursion.
• In case of any illness or emergency, immediately inform the excursion leaders.

Acknowledgement

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

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

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

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

Disclaimer

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













Scan for
Field Guide Book

Contact Details:

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

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

Phone: +916386696896 | +916392507990