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FIELD GUIDE

INPOST - 05

THE QUATERNARY GLACIAL CHRONOLOGY AND LANDSCAPE EVOLUTION OF THE BEAS AND CHANDRA BASINS, NORTHWESTERN HIMALAYA, HIMACHAL PRADESH, INDIA

Milap C. Sharma and Sheikh Nawaz Ali



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INQUA INDIA 2027

Field Guide Book

INPOST-05

The Quaternary Glacial Chronology and Landscape Evolution of the Beas and Chandra Basins, Northwestern Himalaya, Himachal Pradesh, India

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Dr Sheikh Nawaz Ali serves as Scientist E at the Birbal Sahni Institute of Palaeosciences, Lucknow, and Honorary Associate Professor at the Academy of Scientific and Innovative Research, New Delhi. A Quaternary geologist, he investigates the influence of climate change on surface processes and landscape evolution across centennial to multi-millennial timescales. His research encompasses Late Quaternary Himalayan glaciation, high-resolution palaeoclimate reconstruction from lake sediments using biotic and abiotic proxies, and paraglacial sediment dynamics following glacier recession. He also examines glacier-lake interactions, glacial lake outburst flood vulnerability, and Himalayan communities' perceptions of climate change to support more locally informed approaches to adaptation and environmental risk management. He combines field geomorphology, luminescence dating, remote sensing, palaeo-environmental proxies, and hazard modelling. Dr Ali has published widely and received notable awards for his contributions to Quaternary geology and climate-change research.

Abstract

The Beas and Chandra river basins of the northwestern Himalaya preserve one of the most important records of Quaternary glaciation in the monsoon–westerly transition zone. Located between the Pir Panjal and Dhauladhar ranges, these adjoining basins offer exceptional opportunities to investigate interactions among glacier dynamics, climatic variability, tectonics, and landscape evolution. Their contrasting climatic settings, influenced by both the Indian Summer Monsoon (ISM) and the Mid-Latitude Westerlies (MLWs), make them an ideal natural laboratory for examining spatial variations in Himalayan glaciation and the role of different moisture in governing glacial advance/retreat.

This field excursion traverses glacial, glaciofluvial, fluvial, and paraglacial landscapes extending from the Himalayan foreland to the upper glaciated valleys. Participants will examine a wide range of geomorphic features, including terminal and lateral moraines, glacial erratics, U-shaped valleys, hanging valleys, trimlines, glaciofluvial terraces, outwash plains, river terraces, lacustrine deposits, and active hillslope processes. The excursion also demonstrates how modern geochronological techniques, including Optically Stimulated Luminescence (OSL), Cosmogenic Radionuclide (CRN) exposure dating, and radiocarbon dating (14C), have been integrated with geomorphological and sedimentological investigations to reconstruct the Late Quaternary evolution of the Beas and Chandra basins.

Throughout the excursion, participants will explore the relationships between climatic forcing, glacier fluctuations, sediment transport, river incision, and post-glacial landscape adjustment. Particular emphasis is placed on field observations, discussion of landform evolution, and the contrasting geomorphic signatures preserved within the monsoon-dominated Beas Basin and the Westerly-dominated Chandra Basin. The excursion provides an opportunity to evaluate ongoing debates concerning Himalayan glacial chronology and the relative roles of the ISM and MLWs in controlling glacier behavior during the Quaternary.

Preamble

Welcome to the Western Himalaya!!!

Why study Himalayan glaciation?

The Himalayan–Tibetan region hosts the largest concentration of glaciers outside the polar regions and preserves one of the world's most extensive archives of Quaternary environmental change. Often referred to as the "Water Tower of Asia," it forms the headwaters of many of the continent's major river systems and stores vast quantities of freshwater in its glaciers and seasonal snowpack. Meltwater from these cryospheric reserves sustains millions of people downstream by supporting drinking water supplies, agriculture, hydropower production, ecosystems, and regional water security. Consequently, understanding the region's glacial history is essential not only for reconstructing past climate variability but also for predicting future cryospheric responses and their implications for water resources under a changing climate. Repeated episodes of glacier advance and retreat have sculpted a diverse assemblage of geomorphic and sedimentary landforms, including moraines, glacial troughs, outwash plains, glaciofluvial terraces, lacustrine deposits, and valley-fill sequences. Collectively, these landforms preserve a remarkable record of Quaternary glacier fluctuations and associated environmental changes spanning hundreds of thousands of years (Benn & Owen, 1998).

Despite substantial advances in geochronological techniques over the past three decades, including OSL, CRN exposure, and 14C radiocarbon dating, considerable uncertainty persists regarding the timing, extent, and climatic drivers of Himalayan glacier fluctuations. Although these methods have significantly improved the reconstruction of Quaternary glacial histories, glacier chronologies often vary between individual valleys, reflecting the complex interplay of local topography, glacier geometry, moisture availability, and atmospheric circulation. This spatial heterogeneity has hindered the development of a coherent regional framework for understanding the timing and controls of glaciation across the Himalayan–Tibetan region.

One of the central questions in Himalayan Quaternary research concerns the relative roles of the ISM and the MLWs in controlling glacier fluctuations. Spatial variations in the strength and seasonality of these atmospheric circulation systems have resulted in contrasting patterns of glacier advance and retreat across the Himalaya. Glaciers in regions dominated by monsoonal precipitation often exhibit glacial histories that differ markedly from those in areas primarily sustained by winter snowfall associated with the Westerlies, giving rise to pronounced spatial heterogeneity in Quaternary glacial chronologies. An intriguing exception to this regional pattern is the Chandra Valley in the western Himalaya, where evidence suggests the maximum glacier expansion on the southern slopes of the Himalaya during the Last Glacial Maximum (Eugster et al., 2016). This extensive glaciation contrasts with many other Himalayan records, in which glacier advances during the Last Glacial Maximum were comparatively restricted, making the Chandra Valley chronology an apparent anomaly that warrants further investigation to better understand the interplay among regional climate forcing, topographic controls, and glacier dynamics.

Why the Beas–Chandra Transect?

The Beas–Chandra transect provides an exceptional natural laboratory for investigating the timing, extent, and climatic controls of Quaternary glaciation in the Himalaya. Situated within a climatic transition zone where the influences of the ISM and the MLWs overlap, the two basins preserve contrasting glacial records that provide key insights into the relative roles of these atmospheric circulation systems in controlling glacier fluctuations (Bookhagen & Burbank, 2010; Azam et al., 2014, 2016; Murari et al., 2014; Owen & Dortch, 2014). The Chandra Valley, in particular, has been recognized as preserving one of the most extensive glacier expansions on the southern slopes of the Himalaya, contrasting with many monsoon-dominated Himalayan valleys where glacier advances during the global Last Glacial Maximum were comparatively restricted (Chand & Sharma, 2016; Eugster et al., 2016; Das et al., 2023). This distinctive glacial history makes the Beas–Chandra transect an ideal setting for investigating the interplay between regional climate, topography, and glacier dynamics.

The transect preserves a diverse assemblage of glacial, glaciofluvial, fluvial, and paraglacial landforms that document multiple phases of glacier advance, retreat, and post-glacial landscape evolution (Benn & Owen, 1998; Owen et al., 2002; Chand & Sharma, 2016). Integrated geomorphological investigations, together with chronologies established using different dating techniques, provide a robust framework for reconstructing Quaternary environmental change and evaluating the climatic controls on Himalayan glaciation (Fuchs et al., 2013; Murari et al., 2014; Owen & Dortch, 2014; Das et al., 2023). Beyond its scientific significance, the transect also illustrates the broader implications of glacier retreat for sediment dynamics, river evolution, natural hazards, and downstream water resources in one of the world's most rapidly changing mountain environments.

Regional Geology

The Beas and Chandra river basins are located within the northwestern Himalaya and preserve an exceptional record of tectonic activity, Quaternary glaciation, and landscape evolution (Fig. 1). The excursion traverses the major lithotectonic units of the Himalayan orogen, from the Himalayan foreland through the Lesser Himalaya to the Higher Himalayan Crystalline Sequence, allowing participants to examine the relationships among geology, structure, geomorphology, and glacial history.

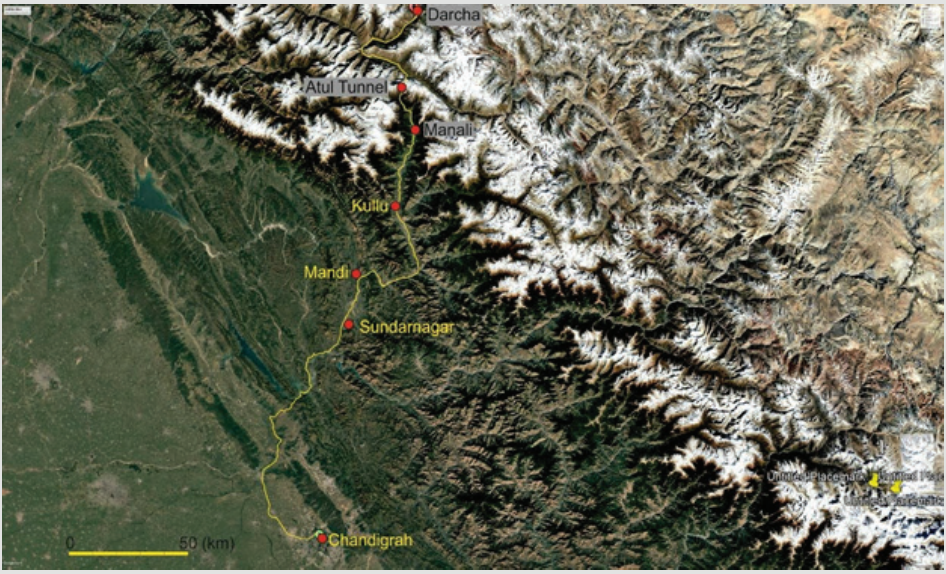

Fig 1. Location and route map of the proposed field basin, showing the geographical setting of the study area, major access roads, rivers, settlements, and the planned field traverse covering key geomorphological and geological observation sites.

The upper Beas Basin is underlain predominantly by the Higher Himalayan Crystalline (HHC) rocks of the Vaikrita Group, consisting mainly of high-grade gneisses, schists, migmatites, quartzites, and granitic intrusions. These rocks are exposed extensively along the upper valley and form the steep mountain slopes that have been repeatedly modified by Quaternary glaciation. North of the HHC lies the South Tibetan Detachment System (STDS), separating the crystalline rocks from the sedimentary successions of the Tethyan Himalaya. Southward, the HHC is tectonically bounded by the Main Central Thrust (MCT), which juxtaposes crystalline rocks against the lower-grade metamorphic rocks of the Lesser Himalaya.

The Tethyan Himalayan Sequence comprises metamorphosed sedimentary rocks, including schist, quartzite, slate, and carbonate units, as well as intrusive granitic bodies. The adjoining Salkhala Thrust Sheet consists of Proterozoic to Ordovician metamorphic rocks, including mica schists, quartzites, and gneisses. These lithological variations strongly influence valley morphology, slope stability, weathering characteristics, and sediment

supply throughout the catchment. One of the principal structural features influencing the Beas Valley is the Ropar–Manali Fault, a major regional lineament that largely controls the north–south orientation of the valley and continues to influence drainage development, river incision, and slope instability. Throughout the excursion, participants will observe several examples in which geological structure exerts strong control on valley geometry, river morphology, and hillslope processes (Fig. 2).

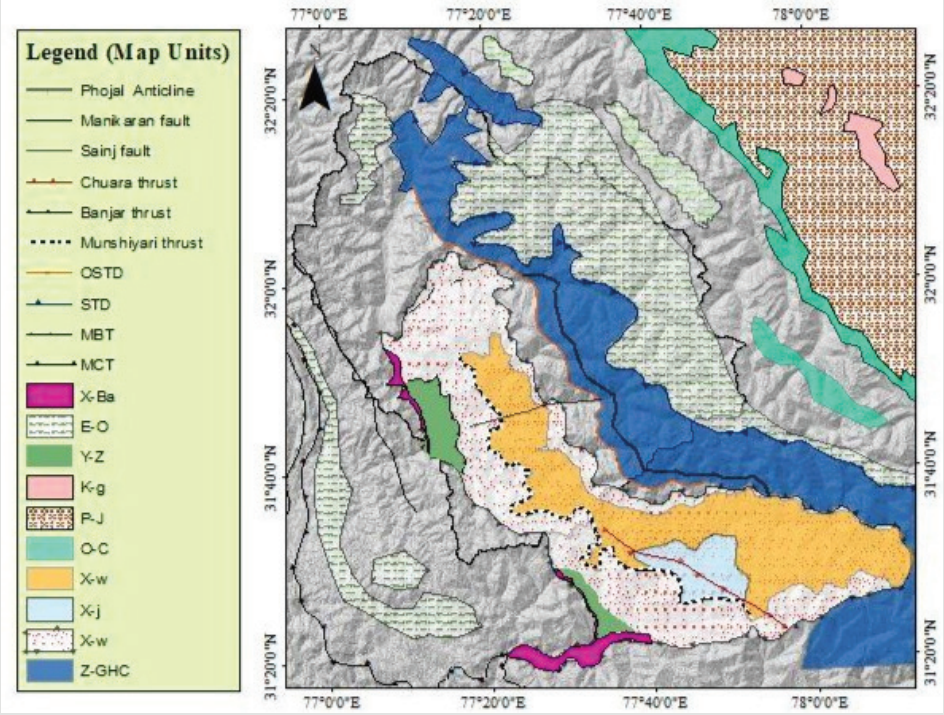

Fig 2. Regional geological framework of the study area, illustrating lithostratigraphic succession, major structural elements, fossil-bearing horizons, and the spatial distribution of Quaternary deposits.

The Quaternary deposits exposed throughout the excursion include terminal and lateral moraines, till deposits, glaciofluvial outwash, lacustrine sediments, debris-flow deposits, river terraces, and alluvial fans. These deposits collectively preserve a detailed record of repeated glacier advances and retreats, subsequent river incision, and post-glacial landscape adjustment. The excellent preservation of these landforms, combined with robust chronological control, makes the Beas and Chandra basins among the most important Quaternary archives in the northwestern Himalaya.

Geomorphological Setting

The field area is situated within the upper Beas and Chandra river basins of Himachal Pradesh, northwestern Himalaya, between the Pir Panjal Range to the north and the Dhauladhar Range to the south (Fig. 1). The Beas Basin occupies the southern flank of the Pir

Panjal and experiences a transitional climatic regime influenced by both the ISM and the MLW, whereas the Chandra Basin, located north of the Pir Panjal, is predominantly influenced by winter precipitation associated with the Westerlies (Azam et al., 2014, 2016).

The excursion begins in Chandigarh, then follows the Beas River upstream through the Kullu Valley to Manali, before continuing to Solang Valley, Dhundi, Palchan, and Kothi. Subject to favourable weather conditions, the route crosses the Atal Tunnel into the Chandra Basin, allowing participants to compare geomorphic landscapes developed under contrasting climatic regimes (the sub-humid southern region with the semi-arid northern region). Along this transect, the excursion encompasses elevations from the Himalayan foreland to more than 4,000 m above sea level (m asl), providing excellent exposures of Quaternary glacial, fluvial, and hillslope processes.

The Beas Basin has undergone rapid glacial retreat in recent decades, making it an important region for investigating the links between past glacial fluctuations and contemporary climate change. The combination of well-preserved geomorphic features, comprehensive chronological datasets, and excellent accessibility makes this one of the most informative Quaternary field transects in the northwestern Himalaya.

Previous Investigations

The northwestern Himalaya has attracted considerable attention owing to its extensive glacial deposits and its location within the transition zone between the Indian Summer Monsoon (ISM) and the Mid-Latitude Westerlies (MLW). Early geomorphological investigations recognised multiple phases of Quaternary glaciation preserved within the Beas and Chandra valleys, although the timing and extent of these glacial events remained uncertain because reliable chronological constraints were unavailable.

The pioneering work of Owen et al. (1996) established one of the earliest regional glacial stratigraphy for the Chandra Valley and demonstrated that the basin preserves one of the most spectacular assemblages of Quaternary glacial landforms in the Himalaya. Subsequent investigations across the northwestern Himalaya have increasingly utilized OSL, CRN exposure, and 14C radiocarbon dating to improve the chronological framework of Himalayan glaciation.

Recent studies within the Beas Basin have combined detailed geomorphological mapping, sedimentological investigations, and multiple dating techniques to reconstruct successive phases of glacier advance and retreat. These investigations indicate that glacier fluctuations were closely linked to variations in moisture availability, glacier dynamics, sediment supply, and changing climatic conditions. Chronological data derived from OSL, CRN exposure dating, and radiocarbon analyses have significantly improved our understanding of the evolution of glacial landforms, glaciofluvial terraces, lacustrine deposits, and post-glacial river incision within the basin (Figs. 3-5). Despite these advances, regional syntheses continue to demonstrate substantial variability in glacial chronologies across the Himalaya. Similar landforms occurring in neighbouring valleys frequently record different ages, highlighting the influence of local topography, glacier geometry, and contrasting atmospheric circulation systems. Consequently, the timing of maximum glacier extent and subsequent deglaciation remains one of the most actively debated topics in Himalayan Quaternary research (Benn & Owen, 1998).



Fig 3. A view of Beas Kund from Dhundi during the winter month.

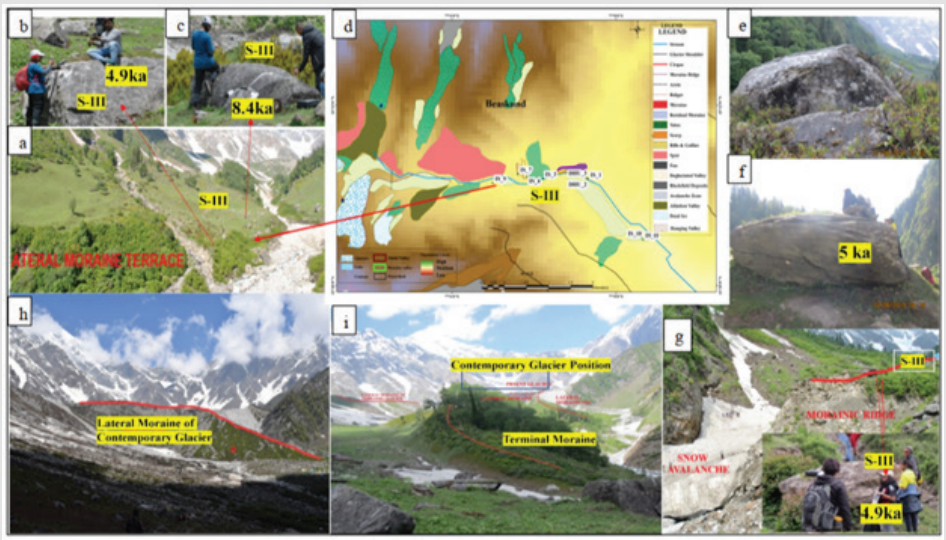

Fig 4. Chronological framework of the identified field sites in the Upper Beas Basin, showing their relative ages and associated phases of glacial, periglacial, fluvial, and tectonic landscape evolution.

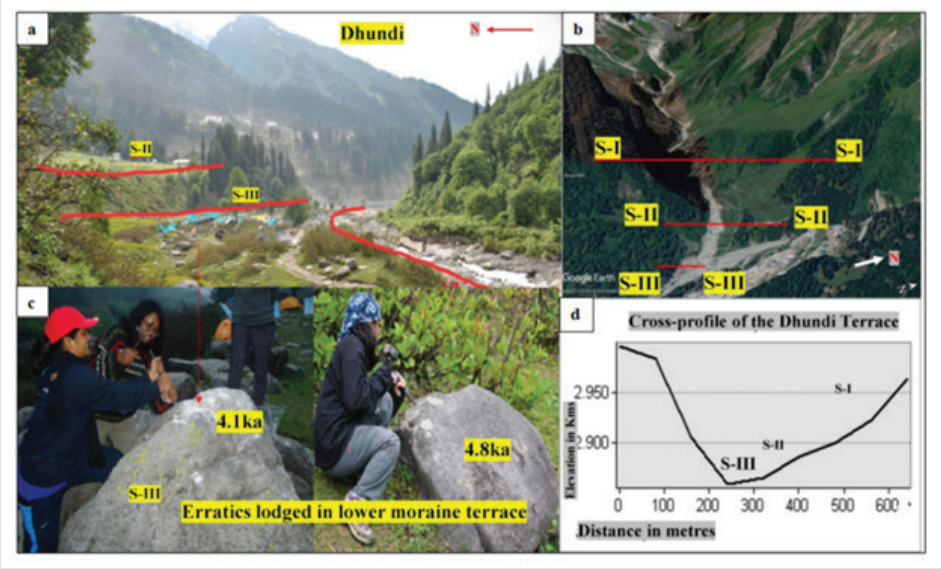

Fig 5. Reconstructed extent of the Dhundi Stage glaciation, showing the spatial distribution of associated glacial erratics with their cosmogenic exposure ages and a representative valley cross-profile illustrating the glacially modified landscape.



Fig 6. Fluvial and fan terrace deposits of the Beas River exposed along the highway, showing multiple terrace levels and their geomorphic expression as evidence of episodic incision and sediment deposition within the valley.

Outstanding Scientific Questions

Despite significant advances in reconstructing Himalayan glacial history, several fundamental questions remain unresolved.

The first concerns the timing of glacier expansion across the Himalaya. While some valleys record their maximum extent during Marine Isotope Stage (MIS) 3 or earlier (local last glacial maximum; ILGM), others indicate maximum advances during the global Last Glacial Maximum (LGM), suggesting that glacier response varied substantially between catchments (Ali & Juyal, 2013; Eugster et al., 2016). Equally intriguing is evidence for glacier advances during the enhanced ISM phases, when global temperatures were generally warmer than today. These "glacial anomalies" challenge conventional climate–glacier relationships and raise important questions regarding regional climatic forcing, precipitation seasonality, and glacier sensitivity.

A second question concerns the relative influence of the ISM and the MLWs. Variations in the strength, duration, and seasonal distribution of these atmospheric circulation systems are widely regarded as the principal controls on Himalayan glacier fluctuations, yet their respective roles remain debated because neighboring valleys often preserve contrasting glacial chronologies (Benn & Owen, 1998; Owen & Dortch, 2014; Azam et al., 2021).

Another unresolved issue involves the relationship between glacier fluctuations and downstream landscape evolution. Deglaciation triggers major changes in sediment production, river discharge, hillslope stability, and valley incision, yet the timing and magnitude of these responses remain incompletely understood. River terraces, alluvial fans, and lacustrine deposits preserved within the Beas Basin provide valuable archives for investigating these post-glacial adjustments.

Finally, the rapid retreat of Himalayan glaciers over the past century raises important questions regarding future sediment dynamics, river behavior, water resources, glacial lake development, and associated hazards. Observations during this excursion provide an opportunity to compare modern glacier recession with evidence from earlier Quaternary glacial and deglacial phases, offering insights into both past climate variability and future environmental change.



Fig 7. The Confluence of Chandra & Bhaga at Sangam Tandi (3000m asl) with the Largest Glacial Expansion dated ~87 ka-74 ka (OSL). We will be able to reach this point only if luck favors us.

Objectives of the Excursion

The principal objective of this excursion is to examine the Quaternary evolution of the Beas and Chandra river basins through direct observation of glacial, glaciofluvial, fluvial, and paraglacial landforms preserved within one of the most climatically sensitive regions of the northwestern Himalaya.

Specifically, participants will:

- Examine the geomorphic evidence for successive phases of Quaternary glaciation within the Beas and Chandra basins.
- Observe terminal moraines, lateral moraines, glacial erratics, U-shaped valleys, hanging valleys, trimlines, glacial troughs, lacustrine deposits, and glaciofluvial terraces.
- Understand how geomorphological mapping, sedimentology, and geochronological techniques (OSL, CRN exposure dating, and radiocarbon dating) have been integrated to reconstruct glacier chronology.
- Investigate the influence of the Indian Summer Monsoon and Mid-Latitude Westerlies on glacier evolution and landscape development.
- Examine the transition from glacial to fluvial environments and evaluate the role of river incision, sediment transport, and paraglacial adjustment following deglaciation.

- Discuss the implications of rapid modern glacier recession for sediment dynamics, hydrology, and natural hazards in the Himalaya.

These objectives provide the scientific framework for the field excursion and serve as the basis for discussions at each field stop throughout the transect.

Field Excursion Overview

The excursion begins in Chandigarh, traverses the Beas Valley to Manali, and then continues upstream to the glaciated valleys of Solang, Dhundi, Palchan, and Kothi. Subject to favourable weather conditions, the excursion proceeds through the Atal Tunnel into the Chandra Basin, allowing a comparison between two neighboring catchments influenced by contrasting climatic systems.

The traverse provides a unique opportunity to observe the transition from the Himalayan foreland to the Higher Himalaya while examining the geomorphic evidence of repeated Quaternary glaciations, river incision, glaciofluvial sedimentation, and ongoing landscape evolution. Throughout the excursion, discussions will integrate geomorphological observations with chronological constraints derived from Optically Stimulated Luminescence (OSL), Cosmogenic Radionuclide (CRN) exposure dating, and radiocarbon dating.

Day 1: Chandigarh – Manali

Stop 1. Himalayan Foreland and the Siwalik Hills

Location: Kiratpur–Bilaspur sector (31.40490° N, 76.74450° E)

Geological Setting

The excursion begins within the Himalayan foreland, where the Siwalik Group forms the youngest mountain belt of the Himalaya. These Neogene fluvial sediments represent deposition within the Himalayan foreland basin during continued uplift of the mountain chain.

Field Observations

Participants should observe: Thick fluvial sandstone and conglomerate successions (Fig.8), progressive increase in relief towards the lesser himalaya, active river incision, large alluvial fans, ongoing hillslope instability.

Scientific Significance

This stop provides an opportunity to discuss: Himalayan mountain building, foreland basin evolution, sediment transport from the higher himalaya, transition from tectonic to glacial landscapes encountered farther north.



Fig 8. Outcrop exposure showing a conglomerate unit stratigraphically overlying sandstone along the Kiratpur–Bilaspur National Highway.

Stop 2. Govind Sagar Reservoir (Bhakra Dam)

The Bhakra Dam (31.27536° N, 76.69814° E) impounds the Sutlej River to form the Govind Sagar Reservoir, one of India's largest multipurpose reservoirs situated within the tectonically active Himalayan mountain belt.

Field Observations

Participants should observe valley morphology, bedrock structure, reservoir-induced slope modification, river confinement, engineered slopes, sediment accumulation along the reservoir margins, and engineering adaptations to the rugged Himalayan terrain (Fig.9).

Scientific Significance

This stop provides an opportunity to discuss river regulation, sediment trapping, downstream geomorphic impacts, anthropogenic modification of Himalayan river systems, reservoir-induced landscape changes, and the influence of engineering structures on fluvial processes within an actively uplifting mountain belt.



Fig 9. Landscape view of the Govind Sagar Reservoir, formed by impoundment of the Sutlej River.

Stop 3. Beas–Sutlej Link, Pandoh

The Beas-Sutlej Link Project (31.68580° N, 77.10430° E) diverts water from the Beas River into the Sutlej Basin for hydroelectric generation, representing one of the largest river inter-basin transfer systems in the northwestern Himalaya.

Field Observations

Participants should observe deep river-gorge morphology, structurally controlled valley orientation, active river incision, steep hillslope processes, bedrock-controlled channels, and engineering works constructed in rugged mountainous terrain (Fig.10).

Scientific Significance

This stop provides an opportunity to discuss drainage modification, river diversion, structural controls on valley evolution, sediment transfer, fluvial adjustment within tectonically active mountain belts, and the geomorphic implications of large-scale hydropower development.



Fig 10. Deep, structurally controlled river gorge with steep hillslopes and bedrock-confined channel.

Stop 4. Dhauladhar Range Viewpoint

The Dhauladhar Range forms part of the Lesser Himalayan tectonic domain and provides an excellent panoramic view of the regional physiography, tectonic framework, and mountain architecture of the northwestern Himalaya.

Field Observations

Participants should observe regional relief, lithological contrasts, valley orientation, drainage development, elevational changes in vegetation, seasonal snow distribution, and the transition from fluvial to glacial landscapes.

Scientific Significance

This stop provides an opportunity to discuss the major Himalayan tectonic zones, climatic gradients, orographic precipitation, topographic controls on glacier development, and the relationships between tectonics, climate, and landscape evolution in the upper Beas Basin.

Stop 5. Bhunter River Terraces

Well-developed river terraces along the Beas River near Bhunter preserve an important record of Quaternary river evolution and document repeated episodes of valley aggradation and incision associated with climatic fluctuations and tectonic uplift.

Field Observations

Participants should observe multiple terrace levels, terrace risers, terrace treads, the modern floodplain, active river channels, sediment exposures, and the staircase morphology preserved along the valley margins.

Scientific Significance

This stop provides an opportunity to discuss valley aggradation, river incision, sediment storage, climate-driven river adjustment, Quaternary terrace development, OSL-based chronological reconstruction, glacial sediment supply to downstream river systems, and the combined influence of climatic fluctuations, sediment availability, and tectonic uplift on long-term landscape evolution.

Evening Discussion: Burwa

Accommodation is located on a broad outwash fan terrace near Burwa (~2,600 m asl), approximately 5 km north of Manali. This locality provides an excellent setting for introducing the geomorphic evolution of the upper Beas Basin before entering the glaciated landscapes visited on the second day of the excursion.

Discussion Topics

The evening discussion should focus on the formation of large alluvial fans in glaciated valleys, variations in sediment supply during glacial and interglacial periods, the geomorphic factors responsible for the high flood susceptibility of the Beas Valley, evidence for repeated Quaternary glacier advances, and the contribution of OSL, Cosmogenic Radionuclide (CRN), and radiocarbon dating to reconstructing valley evolution. Participants should also review the excursion route for the following day, during which observations shift from downstream fluvial environments to the glacial landscapes of Solang Valley, Dhundi, Palchan, and Kothi, where the principal Quaternary landforms of the upper Beas Basin are exceptionally well preserved.

Day 2: Solang Valley – Dhundi – Palchan – Kothi

Evolution of the Upper Beas Glacier System and Late Quaternary Deglaciation

The second day of the excursion focuses on the glacial geomorphology of the upper Beas Basin. The Solang–Dhundi sector preserves one of the most complete records of Late Quaternary glacier fluctuations in the northwestern Himalaya. Participants will examine the geomorphic evidence of three major glacial stages, evaluate their chronological constraints derived from Optically Stimulated Luminescence (OSL), Cosmogenic Radionuclide (CRN) exposure dating, and radiocarbon dating, and discuss the respective roles of the Indian Summer Monsoon (ISM) and Mid-Latitude Westerlies (MLW) in controlling glacier evolution. Unlike the first day, which emphasized downstream fluvial evolution, the second day concentrates on landforms produced directly by valley glaciation and the geomorphic processes associated with glacier retreat and post-glacial landscape modification.

Stop 6. Solang Valley

Elevation: ~2,500–2,700 m asl

Solang Valley occupies one of the widest sections of the upper Beas Valley and preserves exceptionally well-developed lateral moraine complexes that record former glacier extent (Fig.11). The valley floor, together with adjacent moraine ridges and glaciofluvial deposits, provides an ideal natural laboratory for understanding glacier dynamics, sediment transport, and Late Quaternary deglaciation.

Field Observations

Participants should observe paired lateral moraines, a broad U-shaped valley, an over-deepened valley floor, glaciofluvial outwash deposits, meltwater channels, and the characteristic cross-sectional geometry of a glaciated valley. The preserved landforms clearly demonstrate prolonged occupation by a valley glacier that was substantially larger than the present glacier system.



Fig 11. U-shaped glaciated Solang valley with paired lateral moraines and glaciofluvial deposits.

Scientific Significance

This stop provides an opportunity to discuss successive glacier positions during the final stages of deglaciation, moraine stabilization during the Late Glacial period (approximately 12.2–10.6 ka) based on Cosmogenic Radionuclide (CRN) exposure dating, glacier thickness, glacier flow direction, ice-surface reconstruction, moraine formation, post-glacial landscape modification, and equilibrium-line altitude (ELA) reconstruction as a valuable tool for palaeoclimatic interpretation. Participants should also consider the differences between lateral and terminal moraines, the factors that control moraine preservation and

degradation, and the reliability of CRN exposure ages for reconstructing glacier history.

Stop 7. Solang Ablation Valley

Between the two prominent lateral moraine ridges lies a broad depression interpreted as a former ablation valley that records the final stages of glacier down-wasting and stagnation during deglaciation.

Field Observations

Participants should observe subdued relief, hummocky topography, meltwater channels, glaciofluvial sediments, localized slope failures, and geomorphic evidence of stagnant ice and meltwater reworking.

Scientific Significance

This stop provides an opportunity to discuss glacier stagnation, progressive glacier thinning, dead-ice topography, meltwater drainage, sediment redistribution, and paraglacial landscape modification. The preserved morphology demonstrates that the landscape evolved through gradual ice decay rather than renewed glacier advance, highlighting the importance of meltwater processes during the final stages of deglaciation.

Stop 8. Dhundi Moraine Complex

Elevation: ~2,900–3,000 m asl

Dhundi preserves one of the most significant moraine assemblages within the upper Beas Basin and represents the principal locality for interpreting the youngest recognised glacial stage in the region.

Field Observations

Participants should observe terminal moraines, lateral moraines, glacial erratics, till exposures, meltwater channels, valley narrowing, and large boulders preserved along moraine crests that served as sampling sites for Cosmogenic Radionuclide (CRN) exposure dating.

Scientific Significance

This stop provides an opportunity to discuss the Dhundi Glacial Stage, the final major Late Glacial glacier advance, glacier stabilization, moraine construction, glacier retreat, meltwater incision, and the integration of geomorphological mapping with CRN exposure dating to reconstruct glacier chronology. Participants should compare the morphology of these moraines with those observed in Solang Valley to evaluate variations in glacier behaviour during successive phases of deglaciation.

Stop 9. Glacial Erratic Sampling Locality

Several large granitic and gneissic glacial erratics are preserved along the moraine crests, providing excellent sites for cosmogenic exposure dating and glacier reconstruction.

Field Observations

Participants should observe isolated erratic boulders, weathering characteristics, surface preservation, lichen development, fracture patterns, and the geomorphic setting of the sampled boulders within the moraine complex.

Scientific Significance

This stop provides an opportunity to discuss Cosmogenic Radionuclide (^10Be) exposure dating, sampling strategies, topographic shielding, inherited nuclide concentrations, surface erosion, snow-cover effects, analytical uncertainties, and the accumulation of cosmogenic nuclides following glacier retreat. The locality demonstrates how exposure ages are determined and applied to constrain the timing of deglaciation and moraine stabilization.

Stop 10. Palchan

Palchan marks the transition from predominantly glacial landforms to glaciofluvial environments, where sediments deposited by former glaciers have been extensively reworked by fluvial processes following deglaciation.

Field Observations

Participants should observe outwash terraces, braided-river deposits, valley-fill sediments, debris-flow deposits, alluvial fans, and geomorphic evidence of active sediment transport on the valley floor.

Scientific Significance

This stop provides an opportunity to discuss the transition from glacier-dominated sediment transport to fluvial reworking, glaciofluvial processes, sediment routing, valley aggradation, river incision, paraglacial sediment pulses, and the evolution of post-glacial river systems. Participants should compare the characteristics of till and glaciofluvial deposits to understand the changing depositional environments associated with glacier retreat.

Stop 11. Kothi Gorge

The Beas River flows through a narrow bedrock gorge near Kothi, downstream of the principal moraine complexes, where post-glacial fluvial processes have incised into resistant bedrock under the combined influence of tectonic uplift and declining sediment supply.

Field Observations

Participants should observe a deeply incised bedrock channel, strath surfaces, abandoned channels, rock-controlled valley narrowing, active fluvial erosion, bedrock exposures, and the transition from glacially modified to bedrock-controlled river morphology.

Scientific Significance

This stop provides an opportunity to discuss rapid post-glacial river incision following glacier retreat, threshold-controlled incision, changing sediment flux, bedrock channel evolution,

river adjustment to deglaciation, and the influence of tectonic structure on valley morphology and river evolution throughout the upper Beas Basin.

Integrated Discussion: Glacial Evolution of the Upper Beas Basin

At the conclusion of the day's traverse, participants should synthesize the geomorphic and chronological evidence for the three principal glacial stages recognized in the Beas Basin. The Beas Glacial Stage represents the oldest and most extensive preserved glaciation, during which a thick trunk glacier occupied the valley, and whose chronology is constrained primarily by Optically Stimulated Luminescence (OSL) dating. The Solang Glacial Stage records an intermediate glacier advance characterized by the formation of prominent lateral moraine complexes, a reduction in glacier extent relative to the Beas Stage, and excellent preservation of glacial and glaciofluvial landforms. The Dhundi Glacial Stage represents the youngest major Late Quaternary glacier advance and is distinguished by well-preserved terminal and lateral moraines, with Cosmogenic Radionuclide (CRN) exposure ages constraining the final phase of glacier stabilization during the Late Glacial period prior to Holocene glacier retreat.

Participants should evaluate how integrating geomorphological mapping, sedimentological evidence, OSL chronology, CRN exposure dating, and radiocarbon dating contributes to reconstructing glacier fluctuations in the upper Beas Basin. The discussion should also examine the relative influence of the Indian Summer Monsoon (ISM), the Mid-Latitude Westerlies (MLW), and their interactions in controlling glacier extent, deglaciation, and landscape evolution during the Late Quaternary.

End-of-Day Synthesis

By the end of the second day, participants should be able to distinguish between different moraine types and glaciofluvial deposits, interpret the geomorphic evidence of successive glacier advances and retreat, understand the principles and applications of OSL, Cosmogenic Radionuclide (CRN), and radiocarbon dating in reconstructing glacial landscapes, relate observed landforms to the established Quaternary chronology of the Beas Basin, and appreciate the combined roles of climate, tectonics, and sediment supply in shaping the evolution of high Himalayan landscapes.

Day 3: Chandra River Basin (Weather Permitting)

Sissu – Tandi – Darcha

Theme: Quaternary Glaciation in a Westerly-Dominated Himalayan Basin

Introduction

Subject to favourable weather and road conditions, the excursion continues through the Atal Tunnel into the Chandra River Basin. Crossing the Pir Panjal Range marks a distinct climatic transition from the Beas Basin, which is influenced by both the Indian Summer Monsoon (ISM) and the Mid-Latitude Westerlies (MLW), to the Chandra Basin, where glacier accumulation is dominated primarily by winter precipitation delivered by the Westerlies (Benn & Owen, 1998).

The Chandra Basin preserves one of the most spectacular glacial landscapes in the northwestern Himalaya and contains an extensive record of Middle and Late Pleistocene glaciation (Owen et al., 1996). Recent Optically Stimulated Luminescence (OSL) dating has refined the chronology of these glacial deposits, indicating that the extensive Chandra Glacial Stage developed between approximately 85 and 74 ka, providing an important chronological framework for interpreting glacier evolution in the basin.

This transect enables participants to compare two neighbouring Himalayan catchments that experienced contrasting climatic forcing yet preserve complementary records of Quaternary environmental change.

Stop 12. Atal Tunnel Portal

The Atal Tunnel (32.44009° N, 77.16482° E; Fig. 12) passes beneath the Pir Panjal Range, providing direct access between the Beas and Chandra basins while crossing one of the most significant climatic and physiographic boundaries in the northwestern Himalaya.



Fig 12. Exit portal of the Atal Tunnel opening toward the Chandra Valley in the Rohtang Hills.

Field Observations

Participants should observe abrupt changes in valley morphology, vegetation cover, snow persistence, slope processes, lithological variations across the Pir Panjal Range, and the transition from a relatively humid to a semi-arid mountain environment.

Scientific Significance

This stop provides an opportunity to discuss the role of topographic barriers in controlling moisture transport across the Himalaya; orographic effects; climatic gradients; glacier mass balance; precipitation seasonality; and the contrasting influences of the Indian Summer Monsoon (ISM) and Mid-Latitude Westerlies (MLW) on glacier accumulation and landscape evolution.

Stop 13. Sissu

The Sissu Valley (32.47676° N, 77.12719° E; Fig. 13) preserves an exceptional assemblage of glacial landforms formed during extensive Middle and Late Pleistocene valley glaciation, providing one of the finest examples of glacial geomorphology in the Chandra Basin.

Field Observations

Participants should observe a broad U-shaped glacial trough, polished bedrock surfaces, hanging valleys, lateral moraines, trimlines, glaciofluvial terraces, and evidence of large-scale glacial erosion and sediment deposition.



Fig 13. Synoptic view of Sissu village showing the Chandra River valley and settlements developed on fluvial terraces.

Scientific Significance

This stop provides an opportunity to distinguish glacial erosion from fluvial incision and to discuss glacier thickness, valley widening, abrasion, quarrying, glacial overdeepening, and long-term valley evolution. Participants should compare these landforms with those observed in Solang Valley to evaluate similarities and differences in glacier behaviour under contrasting climatic conditions.

Stop 14. Hanging Valley Waterfall

Several tributary valleys terminate abruptly above the floor of the Chandra Valley (32.46593° N, 77.12229° E), forming well-developed hanging valleys that record differential erosion during a former glacial period (Fig. 14).

Field Observations

Participants should observe hanging valleys, waterfalls, truncated spurs, glacial benches, steep valley walls, and the distinct elevation difference between the main valley floor and tributary valleys.



Figure 14. Glacial valley morphology characterized by hanging valleys, truncated spurs, glacial benches, steep valley walls, and prominent waterfalls.

Scientific Significance

This stop provides an opportunity to discuss differential erosion between trunk and tributary glaciers, the erosional power of glaciers, variations in ice thickness, tributary glacier dynamics, post-glacial river adjustment, and the geomorphic evolution of glaciated mountain valleys.

Stop 15. Dated Lacustrine Exposure

Well-preserved lacustrine sediments occur adjacent to former glacial margins, providing valuable stratigraphic records of glacial retreat and associated lake formation within the Chandra Basin.

Field Observations

Participants should observe laminated sediments, fine-grained lacustrine deposits, glacial diamicton, sedimentary contacts, stratigraphic relationships, and depositional features indicative of former glacial lakes.

Scientific Significance

This stop provides an opportunity to discuss lake formation, moraine-dammed lakes, sediment accumulation, depositional environments, and Optically Stimulated Luminescence (OSL) sampling techniques. The exposure also demonstrates how OSL chronology has constrained the extensive Chandra Glacial Stage to approximately 85–74 ka, providing an important chronological framework for reconstructing Late Quaternary deglaciation in the Chandra Basin.

Stop 16. Glacial Erratic Field

Large glacial erratics preserved across the valley floor and along moraine ridges provide direct evidence of former glacier extent, ice-flow pathways, and the transport capacity of valley glaciers.

Field Observations

Participants should observe isolated, erratic boulders; lithological contrasts between transported and local rocks; weathering characteristics; moraine crest morphology; and the spatial distribution of glacial erratics within the landscape.

Scientific Significance

This stop provides an opportunity to discuss glacier transport mechanisms, ice-flow reconstruction, Cosmogenic Radionuclide (CRN) exposure dating, sampling strategies, inheritance, topographic shielding, and the use of erratic boulders to reconstruct former glacier extent and deglaciation history.

Stop 17. Tandi Confluence

Chandra + Bhaga = Chenab River

The confluence of the Chandra and Bhaga rivers marks the origin of the Chenab River and

represents an important geomorphic junction where two glacier-fed river systems merge to form one of the major Himalayan rivers.

Field Observations

Participants should observe the river confluence, braided channels, terrace surfaces, active sediment bars, alluvial fan deposits, channel morphology, and variations in sediment characteristics contributed by the two catchments.

Scientific Significance

This stop provides an opportunity to discuss drainage evolution, sediment transfer, river competence, glaciofluvial processes, catchment integration, and the hydrological and geomorphic significance of river confluences. Participants should compare the sedimentological characteristics of the Chandra and Bhaga rivers and evaluate how glacier-fed rivers differ from non-glacial fluvial systems in terms of sediment load, discharge variability, and channel morphology.

Stop 18. Flow-Slide and Paraglacial Slopes

Numerous large slope failures occur along the Chandra Valley, reflecting the continued adjustment of mountain slopes following glacier retreat and the development of paraglacial landscapes.

Field Observations

Participants should observe flow slides, debris flows, rockfalls, talus accumulations, unstable valley walls, and active mass-wasting processes associated with steep, recently deglaciated slopes.

Scientific Significance

This stop provides an opportunity to discuss paraglacial landscape evolution, the loss of glacial ice support, frost weathering, permafrost degradation, slope instability, sediment delivery to river systems, and the increasing significance of post-glacial geomorphic hazards in high-mountain environments.

Stop 19. Darcha

Darcha (32.67410° N, 77.20000° E) lies within one of the most extensively glaciated sectors of the Chandra Basin and preserves an outstanding assemblage of glacial, glaciofluvial, and periglacial landforms that reflect repeated Quaternary glacial fluctuations.

Field Observations

Participants should observe extensive moraine complexes, glacial troughs, valley-floor outwash deposits, trimlines, hanging glaciers, active periglacial processes, and the overall geomorphic expression of a glacier-dominated mountain landscape.

Scientific Significance

This final stop provides an opportunity to synthesize observations made throughout the

Chandra Basin and compare them directly with those from the Beas Basin. Participants should discuss differences in glacier extent, climatic controls, the timing of glaciation, preservation potential, and long-term landscape evolution, while evaluating how contrasting influences of the Indian Summer Monsoon and Mid-Latitude Westerlies have produced distinct glacial chronologies and geomorphic signatures in these neighbouring Himalayan catchments.

Comparative Discussion: Beas Basin versus Chandra Basin

At the conclusion of the excursion, participants should compare the geomorphic evolution of the two neighbouring basins. The comparison (Table 1) highlights how atmospheric circulation patterns, glacier dynamics, and catchment characteristics interact to produce contrasting Quaternary landscapes within a relatively small geographic area.

Characteristic	Beas Basin	Chandra Basin
Dominant moisture source	**Indian Summer Monsoon + Mid-Latitude Westerlies**	**Mid-Latitude Westerlies**
Valley morphology	Glacial and glaciofluvial	Strongly glacial
Major landforms	Moraines, river terraces, outwash fans	U-shaped valleys, trimlines, hanging valleys, extensive moraines
Chronology	OSL, CRN, Radiocarbon	OSL and geomorphology
Principal scientific question	Climate transition zone	Westerly-controlled glaciation

Synthesis

By the end, the participants should be able to:

- Distinguish between glacial landscapes developed under monsoon-influenced and Westerly-dominated climatic regimes;
- Recognize the characteristic erosional and depositional landforms of alpine glaciers;
- Interpret OSL-constrained glacial chronologies within the Chandra Basin;
- Understand the geomorphic consequences of deglaciation and paraglacial adjustment; and
- Evaluate the broader implications of Himalayan glacier recession for sediment transport, river evolution, and natural hazards.

Flora, Fauna, Climate, and Cultural Landscape

Vegetation

The Beas and Chandra basins exhibit pronounced altitudinal zonation in vegetation, reflecting variations in elevation, temperature, and precipitation. During the excursion, participants will traverse ecological zones extending from temperate broad-leaved forests to alpine meadows.

The lower and middle elevations of the Beas Valley are dominated by mixed temperate forests comprising deodar cedar (Cedrus deodara), blue pine (Pinus wallichiana), spruce (Picea smithiana), silver fir (Abies pindrow), Himalayan oak (Quercus floribunda), maple (Acer spp.), and other broad-leaved species. At higher elevations, these forests gradually transition into subalpine scrub and alpine meadows.

The Chandra Basin, owing to its colder and drier climate, supports comparatively sparse vegetation dominated by alpine grasses, dwarf shrubs, and herbaceous communities. The contrasting vegetation between the two basins reflects differences in moisture availability associated with the Indian Summer Monsoon and the Mid-Latitude Westerlies.

Discussion Point

Participants are encouraged to consider how vegetation distribution responds to climatic gradients and how these ecological changes may influence sediment production, hillslope stability, and post-glacial landscape evolution.

Wildlife

Although wildlife observations cannot be guaranteed, the excursion passes through habitats supporting a diverse Himalayan fauna.

Species that may occur within the excursion area include:

- Himalayan ibex (Capra sibirica)
- Himalayan tahr (Hemitragus jemlahicus)
- Musk deer (Moschus chrysogaster)
- Himalayan black bear (Ursus thibetanus)
- Himalayan brown bear (Ursus arctos)
- Snow leopard (Panthera uncia) (rare and confined to higher elevations)
- Himalayan monal (Lophophorus impejanus)
- Lammergeier (Gypaetus barbatus)
- Himalayan griffon (Gyps himalayensis)

Birdlife is generally abundant, and participants should remain observant for raptors and high-altitude passerines during field stops.

Climate

The Beas Basin occupies a climatic transition zone influenced by both the Indian Summer Monsoon (ISM) and the Mid-Latitude Westerlies (MLW). Consequently, precipitation occurs during both summer and winter, resulting in highly variable seasonal snow accumulation.

In contrast, the Chandra Basin lies within the rain shadow of the Pir Panjal Range and receives most of its annual precipitation during winter through Westerly disturbances. The basin therefore exhibits a colder, drier climate with more persistent snow cover.

During the proposed excursion (March), participants should anticipate:

Location	Expected Day Temperature	Expected Night Temperature
Chandigarh	24–30°C24–30°C	15–18°C
Manali	15–22°C	5–10°C
Solang Valley	8–15°C	0–5°C
Chandra Basin	2–10°C	-5–0°C

Weather conditions in high mountain environments can change rapidly. Snowfall, strong winds, rainfall, and reduced visibility may occur with little warning, particularly near the Atal Tunnel and higher elevations.

Cultural Landscape

The excursion also provides insight into the cultural and historical heritage of the Kullu Valley.

Naggar

Naggar served as the historic capital of the former Kullu Kingdom and preserves traditional Himalayan architecture adapted to both seismic activity and mountain environments.

Participants visiting Naggar will have an opportunity to observe:

- Naggar Castle
- Traditional Kath-Kuni architecture
- Nicholas Roerich Art Gallery
- Krishna Temple

These sites illustrate the close relationship between Himalayan geology, natural resources, and traditional settlement patterns.

Manali

Manali represents one of the most important mountain tourism centres in the Indian Himalaya.

Discussion topics include:

- Rapid tourism development,
- Land-use change,
- Infrastructure expansion,
- Natural hazards,
- Sustainable mountain development.

Participants are encouraged to consider how increasing tourism influences slope stability, river systems, waste generation, and glacier-fed environments.

Agriculture

The lower Beas Valley supports extensive temperate horticulture, with orchards of apple, cherry, apricot, plum, peach, pear, walnut, hazelnut, and kiwi forming an important component of the regional economy. These orchards reflect the strong interplay between climate, geomorphology, and rural livelihoods, highlighting the suitability of the valley's environmental conditions for high-value fruit cultivation.

Practical Information

Accommodation

Accommodation will be provided at designated hotels in Chandigarh and Manali (Burwa). Participants should carry only light & essential field equipment during daily excursions.

Recommended Field Equipment

Participants should bring appropriate field gear, including waterproof trekking boots, an insulated jacket, thermal clothing, a waterproof outer layer, gloves, a woollen cap, sunglasses, sunscreen, a reusable water bottle, personal medications, a notebook and pencil, camera suitable for fieldwork. These items will help ensure safety, comfort, and effective participation during high-altitude field activities.

Field Conduct

Participants are requested to follow the excursion leaders' instructions at all times and remain with the designated group during field activities. To minimize environmental and social impacts, participants should avoid disturbing vegetation and wildlife, refrain from collecting geological or biological samples without prior permission, respect local communities and cultural practices, and dispose of all waste responsibly, ensuring that no litter is left at field sites.

Health and Safety

The excursion traverses elevations exceeding 3,500 m asl and involves travel through steep mountainous terrain. Participants should be aware of potential hazards, including altitude-related illness, rapidly changing weather conditions, slippery and uneven terrain, rockfall, unstable slopes, fast-flowing rivers, and traffic along narrow mountain roads. Anyone experiencing symptoms of acute mountain sickness (AMS), such as headache, nausea, dizziness, or unusual fatigue, should immediately inform the excursion leaders. While medical facilities are available in Manali, emergency medical assistance in more remote sections may be limited. Participants are therefore advised to obtain adequate travel insurance and carry any prescribed medications, along with essential personal medical supplies.

Emergency Contacts

Emergency contact numbers and local coordination details will be provided during the pre-excursion briefing.

Conclusions

The Beas and Chandra basins collectively preserve one of the most complete records of Quaternary glaciation in the northwestern Himalaya. The combination of well-preserved glacial landforms, extensive glaciofluvial deposits, river terraces, lacustrine sequences, and robust geochronological control provides an exceptional opportunity to examine interactions among climate, tectonics, glacier dynamics, and landscape evolution.

By traversing catchments influenced by contrasting atmospheric circulation systems, participants will gain first-hand experience of how regional climate, topography, and geological structure have controlled glacier behaviour through time. The integration of geomorphological observations with modern chronological techniques, including Optically Stimulated Luminescence (OSL), Cosmogenic Radionuclide (CRN) exposure dating, and radiocarbon dating, offers a comprehensive framework for understanding Quaternary environmental change in the Himalaya.

Beyond its scientific importance, the excursion highlights the sensitivity of Himalayan landscapes to ongoing climate change and emphasizes the need for continued interdisciplinary research to improve our understanding of glacier response, sediment dynamics, water resources, and associated natural hazards.

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We also express our sincere appreciation to the local communities of the Beas and Chandra valleys for their continued cooperation, hospitality, and logistical assistance during numerous field campaigns. Their support has been invaluable in advancing our understanding of the Quaternary geology and geomorphology of the northwestern Himalaya.

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Associate Members



Dr. Ishita Manna

Quaternary Geomorphologist,

Dr Ishita Manna is a Quaternary geomorphologist whose research focuses on reconstructing glacial and palaeo-environmental change in the north-western Himalaya. Her doctoral work in the Upper Beas Basin investigates the timing and extent of Quaternary glacial stages using detailed geomorphological mapping and geochronological methods, particularly cosmogenic radionuclide exposure dating and optically stimulated luminescence dating. She also examines sedimentary archives of high-intensity geomorphic and hydroclimatic events, employing radiocarbon dating to establish their chronology. Her wider research interests include glacial landscape evolution, sedimentology, stratigraphy, palaeoclimate reconstruction, and the response of high-energy Himalayan environments to climatic variability during the Late Quaternary.



Dr. Poonam Vishwas

Assistant Professor,
College of Military Engineering, Pune

Dr Poonam Vishwas is an Assistant Professor at the College of Military Engineering, Pune. She earned her PhD from Jawaharlal Nehru University, examining the formation and modification of river terraces in the Upper Beas Basin, Himachal Pradesh. Her research explores the evolution of Himalayan fluvial and glaciofluvial landscapes, particularly river terraces, debris fans, and alluvial fans. During her postdoctoral fellowship at Delhi Technological University, she incorporated Synthetic Aperture Radar into her field-based investigation of land-surface dynamics. Her broader interests include Himalayan geomorphology, landscape evolution, sedimentary processes, geochronology, remote sensing, and GIS, with an emphasis on integrating field observations and geospatial analysis.



Ms. Elora Chakraborty

Doctoral Researcher,

Elora Chakraborty is a doctoral researcher investigating the Late Quaternary evolution of the Chandrabhaga Basin in the north-western Himalaya. Her work establishes the chronology of glacial advances, deglaciation, palaeo-permafrost development, and paraglacial landscape adjustment since the Late Pleistocene. She integrates detailed geomorphological mapping with sedimentological and geochemical facies analysis, stratigraphy, and geochronology, employing cosmogenic radionuclide exposure dating, optically stimulated luminescence, and radiocarbon dating. She is associated with the Himalayan Permafrost Consortium (HiPERC), India's first permafrost-focused Action Group of the International Permafrost Association, contributing to collaborative research, scientific networking, and capacity-building in Himalayan permafrost science.

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.

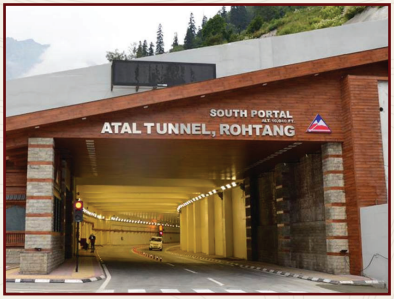
10. Do not leave valuables unattended or rely solely on mobile phone connectivity in remote areas.

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.

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ATAL TUNNEL, ROHTANG









Scan for
Field Guide Book

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