6th Workshop on

Luminescence Dating

and its applications

10-12 December 2025

Abstract Volume

DEPARTMENT OF SCIENCE & TECHNOLOGY

Wadia Institute of Himalayan Geology

(An Autonomous Institute of Department of Science & Technology (DST), Govt. of India)

33, G. M. S. Road, Dehradun-248 001

Uttarakhand (INDIA)

6th Workshop on

Luminescence Dating

and its applications

10-12 December 2025

Organized by

Wadia Institute of Himalayan Geology, Dehradun

(An autonomous research Institute of the Department of Science & Technology, Govt. of India)

and

Uttarakhand State Disaster Management Authority, Uttarakhand

In association with

Association for Luminescence Dating, India

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6^{th} Workshop on Luminescence Dating and its Application

(10-12 December 2025)

List of Resource Persons

S. No.	Resource Person		Affiliation
1.	Prof.	A. K. Singhvi	Physical Research Laboratory, Ahmedabad; Shantou University, Shantou, China.
2.	Dr.	Bo Li	University of Wollongong, Australia
3.	Dr.	Devender Kumar	CSIR- National Geophysical Research Institute
4.	Prof.	Edward Rhodes	University of Sheffield, United Kingdom
5.	Prof.	Javed N. Malik	Indian Institute of Technology Kanpur.
6.	Dr.	Madhav K. Murari	Inter-University Accelerator Centre, New Delhi
7.	Dr.	Manish Mehta	Wadia Institute of Himalayan Geology, Dehradun
8.	Dr.	Morthekai P.	Birbal Sahni Institute of Palaeosciences
9.	Dr.	Pradeep Srivastava	Indian Institute of Technology Roorkee
10.	Dr.	Rabiul Biswas	Indian Institute of Technology, Kanpur
11.	Prof.	Sheila Mishra	Deccan College Deemed to be University, Pune
12.	Prof.	Vimal Singh	University of Delhi, New Delhi.

Technical Program

6th Workshop of the Association for Luminescence Dating (ALD) 2025

‘Luminescence Dating and its Applications’

Day 1 (December 10, Wednesday)

Field Training [09:00 – 16:00] Dr. K. Luirie, Dr. Paramjeet Singh and Dr. Mahesh Kapawar
Dinner **Venue: WIHG Lawn** **Time: 19:00**

Day-2 (December 11, Thursday)

Venue: WIHG Auditorium

Inaugural Function 09:00 to 09:05	Welcome by the **Director, WIHG**
About the workshop 09:05 – 09:10	Aim and scope of the annual workshops and special about this workshop – **Dr. Madhav K. Murari**
Inaugural Speech 09:10 – 10:00	Luminescence Dating: Evolution, Present and the Future– **Prof. A. K. Singhvi**
10:00 – 10:05	Vote of Thanks by **Dr. Saurabh Singhal**

Tea Break (10:05 – 10:30)

Session-1 (10:30– 12:00)
Aeolian and Aquatic Systems
Session Chair: Dr. Pradeep Srivastava
Session Rapporteur: Mohd. Shahrukh

S. No.	Time	Speaker	Title
1.	10:30 – 11:15	Prof. Vimal Singh	Tracking Quaternary Progress and Research Gaps in India
2.	11:15 – 11:30	Dr. Sandeep Panda	Sea-Level Driven Alluvial Fan Evolution in the Brahmaputra Foreland Since the Last Glacial Maximum
3.	11:30 – 11:45	Mr. Jayesh Mukherjee	Addressing the challenges of quartz optical dating from a dryland river terminus in the Thar Desert, India
4.	11:45 – 12:00	Dr. Poonam Chahal	OSL and post-IR IRSL dating of fluvial and lacustrine sediments from the Himalayan rain shadow zone, central Nepal

Session-2 (12:00 – 13:30)
Glacial geomorphology and Palaeoclimate records
Session Chair: Dr. Anil Kumar
Session Rapporteur: Mr. Saurabh Gupta

S. No.	Time	Speaker	Title
1.	12:00 – 12:45	Dr. Manish Mehta	Evidence of past glaciation in the Himalaya and identification of glacier advance stages
2.	12:45 – 13:00	Dr. Mahesh Badnal	Paleo Lake Level Reconstruction for a Landlocked Lake in Schirmacher Oasis, East Antarctica

3.	13:00 – 13:15	Mr. Arbaz Pathan	Establishing post-glacial exposure age and erosion rate of stable moraine boulders using combined ^{10}Be and rock surface luminescence dating techniques in Jankar Valley, Lahaul Himalaya
4.	13:15 – 13:30	Mr. Akshay Kumar	Luminescence Chronology of Late Quaternary Palaeo-Lake Sediments in the Upper Alaknanda Basin, Uttarakhand
Lunch Break (13:30 – 14:30)			
Session-3 (14:30– 16:00) **Landscape evolution, Tectonics and Palaeoseismicity** **Session Chair: Dr. Devender Kumar** **Session Rapporteur: Ms. Shivani Choudhari**			
S. No.	**Time**	**Speaker**	**Title**
1.	14:30 – 15:15	Prof. Javed N. Malik	Significance of OSL dating technique towards identifying paleo-earthquake events: An example from Kumaon Himalayan foothills
2.	15:15 – 15:30	Dr. Atul Singh	Sediment Dynamics during a GLoF: A Case Study from Teesta Valley
3.	15:30 – 15:45	Mr. Parv Kasana	Forebulge Uplift and Late Quaternary Stratigraphic Development in the Southern Ganga Plains
4.	15:45 – 16:00	Mr. Mohd Shahrukh	Enhanced erosion and rapidly changing landscapes along the upper Satluj valley: complex interplay of climate-tectonic forces
16:00 – 16:15		**AOQR presentation for the upcoming INQUA 2027**	
Posters Session [16:15 to 17:55] with tea & snacks			
5.	18:00 – 19:00	Ed Rhodes	Potential application of luminescence dating in mountainous environments, sediment transport, and crack age analysis
Dinner **Venue: WIHG Lawn** **Time: 19:00**			

Day-3 (December 12 - Friday)

Venue: WIHG Auditorium

S. No.	Time	Speaker	Title
Session-4 (09:00 – 10:30) **Pre- and Historical Archaeology** **Session Chair: Prof. A. K. Singhvi** **Session Rapporteur: Dr. Sandeep Panda**			
S. No.	**Time**	**Speaker**	**Title**
1.	09:00 – 09:45	Prof. Sheila Mishra	Toba Tephra: Problems in dating it in India-observations over the last four decades
2.	09:45 – 10:00	Ms. Jougathi Basumatary	Establishing the Chronology of the Lithic Industry in West Tripura: A Luminescence Dating Approach
3.	10:00 – 10:15	Mr. Ningnung Jakoinao	"Ye Olde(?) Fossils": Preliminary Luminescence Dates from the Upper Karewas of Kashmir and its Implications
4.	10:15 – 10:30	Ms. Vaishali Gurjar	Luminescence Dating of Temple Materials and Insights of Architectural Evolution.
Tea Break (10:30 -11:00)			
Session-5 (11:00 – 13:00) **Advances in luminescence dating and emerging novel applications** **Session Chair: Dr. P. Morthekai** **Session Rapporteur: Dr. Poonam Chahal**			
S. No.	**Time**	**Speaker**	**Title**
1.	11:00 – 11:45	Dr. Bo Li	Pushing the limit of optical dating: accuracy, precision and resolution
2.	11:45 – 12:00	Ms. Malika Singhal	Importance of thermal fading and environmental dose rate in estimation of equivalent doses in luminescence dating
3.	12:00 –12:30	Dr. Rabiul H. Biswas	Overview of a few Novel applications of Luminescence to Earth Sciences developed in the last decade
4.	12:30 – 12:45	Mr. Prakash Jena	Luminescence Burial Dating of Cobbles to Reconstruct Late Quaternary Megaflood Events along the Saraswati River, Alaknanda Basin
5.	12:45 – 13:00	Dr. Monika Devi	Defects Responsible for Sensitisation of the OSL Signal in Quartz Grains and their Provenance Implications in Rocks from Diverse Regions Worldwide
Lunch Break (13:00 – 14:00) Venue: WIHG Lawn			
Inter-laboratory comparison project: Results [14:00 - 15:00] **Moderator: Madhav K. Murari**			
Panel Discussion and Conclusion [15:00 – 16:00] **Moderator: Dr. Rabiul H. Biswas and Dr Pinkey Bisht** **Concluding remarks: Prof. A. K. Singhvi** **Vote of Thanks: Dr. Pinkey Bisht**			
High Tea (16:00 – 16:30)			
Labs visit [16:30 – 17:30] **Coordinators: Dr. Pinkey Bisht, Dr. Paramjeet Singh and Dr. Anil Kumar**			

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A. ORAL PRESENTATIONS

Luminescence Dating: Evolution, Present and the Future

Ashok Kumar Singhvi[1,2]

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The discovery of luminescence from solids is now nearing its Quadricentennial anniversary. Its derivative, luminescence dating, is completing its platinum jubilee, and it is a time appropriate to recount and applaud the landmark contributions, milestones, and people in this journey. This journey has been a classic example of synergistic mutualism between Geosciences and Physics - each informing and refining the other rigorously. The groups of Martin Aitken at Oxford and Vagn Mejdahl at Riso contributed to the development through, a) instruments for reliable and reproducible measurements; b) understanding the mineral luminescence and their dependence of irradiation amount and type; c) computation of natural radiation dose in nature with spatially heterogeneous distribution of radioactivity and radiation types; d) experimental protocols and. e) the estimation of errors. These efforts established Thermoluminescence as a secured dating technique and a legally acceptable method for authenticity testing. In India, the first applications of thermoluminescence for dating were made by I.K. Kaul, followed by K.S.V. Nambi and C.M. Sunta.

G.Valladas, R. Visocekas and others in France, G. Houtremans, G.A. Wagner and others in Germany, and I. Liritzis in Greece made seminal contributions through novel applications. P. W. Levy, S.W.S. McKeever (USA), A. M Stoneham (UK), R. Chen (Israel), C.M. Sunta and K.S.V. Nambi (India) provided insights through spectroscopy and modelling. Parallelly, applications of luminescence to meteoritics and lunar sciences grew and interesting new applications - ranging from classification of meteorites, to perihelion of orbits, terrestrial ages, studies on lunar rocks were developed by S.A. Durrani (UK), Robert Walker and DW. Sears (USA) and many others [1].

Demonstration of Optically Stimulated Luminescence by D.W. Huntley and infrared stimulated luminescence from feldspars by Galina Huett revolutionised luminescence dating / dosimetric applications. Automated TL-OSL readers and automated single-grain luminescence measurements developed by Lars Boetter-Jensen and Geoff Duller at Riso enabled methodological rigour through the ease of reproducible measurements, buttressed by analytical protocols by R.F. Galbraith and others. S. Kreuzer and J. Durcan provide Open Access community software for data analytics. Presently, luminescence dating contributes ~ 4000+ publications annually to Quaternary geology, earth surface processes, archaeology and meteoritics, using ~800 + automated readers [2,3]. The community now needs inexpensive readers with higher data throughput for experimental rigour.

I shall retrace this journey of eight decades through my personal experience of five decades, provide examples from our work, identify recent developments, and discuss emerging possibilities. One of the novel possibilities will be to move away from our obsession with well- and poorly bleached signals, with a singular focus on dating, to using dispersion in paleodoses as proxies for geomorphic processes. In this conjunctive use, multiple luminescence signals (TL, OSL, IR, PIRIRSL and others) should also serve as a surrogate to distinguish between basic scale to local scale events.

Keywords: Thermoluminescence; Optically Stimulated luminescence; Meteorite luminescence; Geomorphology; Quaternary geology.

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Sea-Level Driven Alluvial Fan Evolution in the Brahmaputra Foreland Since the Last Glacial Maximum

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Understanding the interplay among climate variability, tectonic activity, and sea-level fluctuations is critical for reconstructing sedimentation histories in Himalayan foreland basins. Alluvial fans, acting as transitional zones between mountain sources and deltaic sinks, preserve stratigraphic records that reflect shifts in erosion, transport capacity, hydrology, and base-level. In this study, a relict alluvial fan in the western Assam lowlands is investigated using geomorphic mapping, lithofacies characterisation, sedimentological logging, Sr–Nd isotopic provenance analysis, and optically stimulated luminescence (OSL) dating to develop a chronostratigraphic framework for Late Quaternary sedimentation. The studied fan, presently situated ~40 m above mean sea level and incised into a regional terrace (T1), records three major depositional phases between ca. 27 and 3 ka. The basal gravelly cross-bedded facies indicate fan progradation during the Last Glacial Maximum, when reduced sea level and enhanced river gradients facilitated the downstream transport of coarse sediments. This was followed by sheet-flood-dominated deposition in the Late Pleistocene to early Holocene, associated with rising sea levels and intensified monsoonal precipitation. During the Mid–Late Holocene, further sea-level rise reduced river gradients, promoting sediment trapping and the development of muddy meandering channel deposits. Comparisons with modern river systems show that the present-day gravel–sand transition lies farther upstream, implying that the earlier fan extended further deeper into the foreland basin under lower sea-level conditions. The incision of the fan surface and the formation of terrace T1 are attributed to a late Holocene relative sea-level fall, coupled with increased discharge caused by intensified monsoon. Additionally, coarse gravel horizons encountered ~100 m below mean sea level in the Upper Bengal Delta are more plausibly related to fan progradation during lowered sea levels rather than extreme flood events along the axial Brahmaputra, as previously proposed. Provenance signatures derived from Sr–Nd isotopes further reveal that early to middle fan deposits were sourced primarily from the Higher and Lesser Himalaya, while the youngest facies reflect sediment compositions similar to the modern bedload dominated by Higher Himalayan contributions.

Addressing the challenges of quartz optical dating from a dryland river terminus in the Thar Desert, India

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Optical dating of quartz from different fluvial landforms in the Luni River floodout zone (LRFZ), located in the southeastern margin of the Indian Thar Desert, presents multiple sampling, methodological and analytical challenges. The primary aim was to capture the typical age range of landforms and associated sediments across the LRFZ, particularly palaeochannel fills and floodplain sediments exposed along modern channels. The strategy for field sampling for luminescence was to optimise the interpretive value of the obtained ages. Observation of fluvial features and site selection were based on high-resolution satellite images (Google Earth) and a hydromorphological assessment using digital elevation data (FABDEM, 30 m). As far as possible, samples were collected from geomorphologically distinctive landforms and sediments with known relative ages (e.g., based on superimposed or cross-cutting relationships) to allow internal checks on the plausibility of calculated ages, but high groundwater levels precluded sampling of deeper (older) sediments.

Sample preparation to obtain quartz for OSL measurement using a SAR method [1] followed standard procedures including acid treatment, density separation and HF etching. Preliminary age results suggest that the samples are geologically young (Holocene) and were likely deposited during short-lived high-energy monsoonal events (flash floods) [2], raising concerns about partial bleaching. Additionally, complete removal of feldspar proved difficult, as has been seen previously in this region [3, 4]. The impact of feldspar contamination was compounded by the low signal intensity of the quartz. Fortunately, a proportion of quartz grains exhibit a fast component luminescence signal suitable for dating; however, the majority are dominated by medium and slow OSL components, resulting in high rejection rates for individual aliquots.

These issues highlight the need for careful analytical approaches to enable reliable age estimates. This work aims to outline the strategies employed to address these challenges, including the selection of suitable grain sizes, the choice of aliquot size, and the criteria for rejecting unsuitable aliquots.

Together, these sampling, methodological, and analytical considerations offer insights into the complexities of quartz optical dating in this dryland river system and highlight the importance of integrating earth observation techniques with geomorphically informed field site selection and sampling strategies.

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OSL and post-IR IRSL dating of fluvial and lacustrine sediments from the Himalayan rain shadow zone, central Nepal

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The Optical Stimulated Luminescence (OSL) signal from Quartz has been widely used to estimate the dose of radiation acquired by the mineral since its burial. However, the use of quartz has been constantly challenged in certain geological regions, such as glacial environments, fluvio-lacustrine environments, and headwater regions. One such region is the upper Kali Gandaki River valley in western Nepal, which hosts widespread lacustrine sequences extending laterally up to 20 km and vertically ~400 m. The river flows through a wide alluvium valley in the Tethys Himalaya and forms the world's deepest gorge, flowing through the Higher Himalaya.

The saturation of quartz grains from the lacustrine sequence was a prominent challenge for paleodose estimation. The chronology of the lacustrine sediments was established using the quartz OSL signal and post-IR IRSL (pIRIR) signal from the K-feldspar grains. Dose recovery and bleaching tests carried out under natural light indicated pIRIR250 to be the most suitable signal for the feldspar of the Kali Gandaki Valley. A total of 10 OSL and 12 pIRIR ages were used to understand the stratigraphy of the fluvio-lacustrine landscape in the Kali Gandaki region. The chronology suggests that the lake was initiated around 120 ka and continued to accumulate sediment until ~80 ka. Between 80 and 30 ka, there was little sedimentation, corresponding to the Last Glacial period (MIS 2–4), associated with a weaker Indian monsoon and possible ice coverage of the lake's drainage basin down to the lake's elevation. The lake was breached at ~30 ka, and most sediments were evacuated within 10 ka. The study highlights the use of multiple approaches for luminescence dating of lacustrine sediments in the high reaches of the Himalaya.

Paleo Lake Level Reconstruction for a Landlocked Lake in Schirmacher Oasis, East Antarctica

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Well-preserved paleo-shoreline systems in the ice-free regions of Antarctica provide clear evidence of significant lake shrinkage, reflecting dramatic paleo-environmental changes. Lakes, particularly those in closed basins within arid environments, are highly sensitive indicators of geomorphic and climatic changes. These changes are closely linked to variations in the evaporation–precipitation balance, as well as contributions from snow and glacial meltwater input. Their water levels respond directly to changes in moisture balance, and pronounced fluctuations often leave behind fossil shoreline deposits and other geomorphic signatures that reveal the basin's past hydrological and climate history. The elevation and chronology of these shoreline features offer valuable records for reconstructing past lake-level fluctuations and regional paleo-climate conditions. In Antarctica, freshwater lakes undergo seasonal transitions—from ice-free states during the austral summer to ice-covered states in the austral winter—responding quickly to the prevailing climate. These seasonal changes, as well as the broader glacial–interglacial cycles, are archived in their sedimentary records, preserving long-term climate signals. Quantitative reconstructions of paleolake levels provide a deeper understanding of lake evolution, particularly during the Holocene, and can refine the timelines of climate and geomorphic events. As part of the 39th Indian Scientific Expedition to Antarctica, eleven samples were collected for optically stimulated luminescence (OSL) dating, while shoreline elevations were measured using differential GPS (DGPS). These datasets aim to improve the chronological accuracy of lake-level reconstructions, offering new insights into the timing, drivers, and regional responses of paleolake development, ultimately contributing to a deeper understanding of Late Quaternary climatic and geomorphic changes in the region.

Establishing post-glacial exposure age and erosion rate of stable moraine boulders using combined ^{10}Be and rock surface luminescence dating techniques in Jankar Valley, Lahaul Himalaya

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Reconstructing the timing of glaciations and post-glacial erosion rates is essential for understanding past climate variability, the interaction between climatic systems and landforms, and for predicting future glacier behaviour under global warming. Such reconstructions also provide quantitative chronological constraints on the evolution of the landscape. The terrestrial cosmogenic nuclide (TCN) dating technique using ^{10}Be is among the most widely applied methods for reconstructing glacial histories by constraining the exposure ages of moraine boulders that record past glacial activity. However, the measured nuclide concentration is sensitive to post-depositional rock surface erosion, which can lead to an underestimation of exposure ages if not properly corrected. While very low erosion rates ($<10^{-3}$ mm/a) exert a negligible influence on exposure-age calculations, higher rates ($> 10^{-2}$ mm/a) can significantly underestimate the apparent ages of sampled surfaces [1, 2]. Therefore, exposure and erosion rates are often evaluated using the paired-nuclide approach or complementary dating techniques. Furthermore, the selection of different scaling models for cosmogenic nuclide production introduces additional variability and can significantly affect the derived exposure ages [3]. This necessitated the development of a reliable complementary rock surface chronometer. Recently, rock surface luminescence dating (RSLD) has emerged as a promising technique for constraining exposure and erosion rates of rock surfaces. A few recent studies have used a combined approach integrating RSLD with ^{10}Be dating [4] to constrain post-exposure erosion rates and erosion corrected exposure ages. Rock surface, during burial, remains shielded from sunlight, allowing ambient ionising radiation to progressively fill electron traps within mineral grains until saturation [5]. Upon exposure to sunlight, photons penetrate the rock surface and induce the rapid de-trapping of trapped electrons, resulting in the bleaching of the luminescence signal near the surface. As the photon flux attenuates exponentially with depth, the bleaching rate decreases, resulting in a sigmoidal luminescence depth profile (LDP). The LDP is highly sensitive to both exposure duration and erosion rate. While prolonged exposure causes the LDP to propagate to deeper depths, erosion causes the LDP to propagate to shallower depths [4]. The accuracy of RSLD has been further improved through the application of General order kinetic (GOK) model [1], which incorporates the non-exponential decay of feldspar IRSL (Infrared Stimulated luminescence) signal within RSLD modelling. This advanced approach has been applied in Lahaul Himalaya to determine the timing of past glacial activity and quantify post-glacial erosion rates.

The Lahaul Himalaya represents a transitional climatic zone influenced by both the mid-latitude westerlies (MLW), which primarily affect the Semi-Arid Western Sector of the Himalaya, and the Indian Summer Monsoon (ISM), which dominates the central and eastern sectors. This dual climatic influence, as demonstrated in studies of the Chandrabhaga basin and adjacent valleys, makes Lahaul a natural laboratory for reconstructing past climatic variability. Investigations from this region are therefore critical for advancing our understanding of Late Quaternary climate dynamics and for informing water resource management strategies in high-altitude environments. In the present study, we attempted to integrate TCN dating (^{10}Be) with RSLD to determine the post-glacial exposure ages and erosion rates of stable moraine boulders in the Jankar Valley, Lahaul Himalaya. A total of nine granitic gneiss boulders were sampled from four morphologically distinct moraine ridges distributed across two catchments within the Jankar Valley.

Preliminary analysis revealed that the order of kinetics varied from 2.17 to 2.45, indicating the nonlinear behaviour of feldspar. Furthermore, the exposure ages derived from RSLD were significantly underestimated, suggesting the presence of relatively high surface erosion rates. The erosion rates were estimated by assuming a step function erosion history, and the values ranged from $0.075^{+0.020}_{-0.015}$ to $0.12^{+0.03}_{-0.03}$ mm/yr, which are considerably higher than the previously reported rates of 0.0008 mm/yr [6]. These elevated erosion rates are expected to exert a substantial influence on the apparent exposure ages obtained from TCN dating.

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Luminescence Chronology of Late Quaternary Palaeo-Lake Sediments in the Upper Alaknanda Basin, Uttarakhand

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Thick layers of lake deposits are frequently created when meltwater and sediments are collected in lakes that occur downstream of glaciers. In the Upper Alaknanda Basin, near Badrinath town, we discovered a palaeo-lake deposit. Although the majority of the sediments are lacustrine, some river strata break them up, indicating how the depositional environment changed throughout time. To understand the history of this lake, we used Optically Stimulated Luminescence (OSL) dating, which revealed that the lake sediments were deposited between 21.6 ± 4.7 thousand years ago and 10.5 ± 1.4 thousand years ago. Grain size analysis helped us interpret the sedimentation process, while valley morphometry gave clues about tectonic activity in the region. Based on the OSL dates, sediment characteristics, and field observations, we identified two phases of lake formation and outburst. The upper layers show a high rate of sedimentation, likely due to increased monsoon rainfall and glacial retreat after the Younger Dryas cold period. Cold phases are characterised by fine layers known as varves and rhythmites, whereas warmer phases exhibit thick, laminated sand deposits. Overall, this study shows that glaciers in the Upper Alaknanda Basin responded actively to past climate changes.

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Sediment Dynamics during a GLoF: A Case Study from Teesta Valley

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Climate change has led to global warming, resulting in the retreat of the Himalayan glaciers. This retreat forms glacial lakes, which have the potential to burst in the future, triggering a glacial lake outburst flood. In this paper, we assess the impact of one such GLOF event in the Teesta River basin of the Sikkim Himalayas. The retreat of the Lhonak glacier led to the expansion of South Lhonak Lake, which increased from 0.42 km^2 in 1990 to 1.35 km^2 in 2019. The lake breached on 3rd October, 2023, during heavy rainfall, leading to devastating floods in Sikkim. The Chungthang dam, a hydroelectric project, failed due to the flood, which added approximately 5 million m^3 of water to the river, intensifying the flood. The water level rose by 15-20 m at Singtam. The flood damaged several hydroelectric project dams, and many bridges collapsed. Several houses were washed away, and many lives were directly affected by the floods. The satellite images were used to estimate the reach of the floods and to calculate an approximate amount of sediment released into the Teesta River during the flood. The field survey shows that in some places, sediments 15-18 m thick have been deposited by the flood. The grain-size data reveal that flooding deposits exhibit a coarsening-upward sequence. Geochemical studies were conducted to determine the provenance of the sample; the results indicate that the sediments have a mixed origin. Luminescence signals, which were supposed to be partially bleached by movement and deposition during the night, have also shown mixed results. The possibility of applying different age models to obtain reliable ages for such deposits was also explored.

Forebulge Uplift and Late Quaternary Stratigraphic Development in the Southern Ganga Plains

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The collision between the Indian and Eurasian plates led to the development of the Himalayan ranges, the Indo-Gangetic Plains (IGP), and the Central Indian Forebulge (CIF) (flexural uplift of the Indian Plate due to loading of the Himalayas). The Indo-Gangetic Plains comprises the plains of the Indus and Ganga River systems. Within the Ganga Plains, the area between the central Indian plateau and the Yamuna and Ganga Rivers is called the Southern Ganga Plains (SGP). The cratonic rivers (such as the Chambal, Betwa, Ken, etc.) have deposited sediments to form these plains, whose thickness and lateral extent are directly influenced by forebulge dynamics and climatic fluctuations.

The present study focuses on the Chambal Basin, one of the largest craton-derived river systems in the region, to understand the nature and timing of sediment accumulation and incision in relation to forebulge activity. Sedimentary facies characteristics and optically stimulated luminescence (OSL) ages are used to reconstruct the stratigraphic framework of the valley. The late Pleistocene stratigraphy of the Chambal Valley consists of a basal paleosol/interfluve facies (~113 ka), overlain by younger channel facies, and capped by floodplain facies (~7 ka). The basal paleosols are laterally extensive and correlate with previously published records from Kalpi (~119 ka) and Dahelkhand (~120 ka) sections, as well as with borehole data from the Ganga–Yamuna interfluve.

The development of the basal paleosol facies around 113 ka represents a prolonged phase of non-deposition and landscape stability across the southern Ganga Plains. This phase is interpreted as a geomorphic response to forebulge uplift during MIS-5, which led to regional incision, detachment of floodplain systems and interfluve development. Our results highlight that forebulge uplift played a significant role in controlling the late Quaternary stratigraphic and geomorphic evolution of the southern Ganga Plains.

Enhanced erosion and rapidly changing landscapes along the upper Satluj valley: complex interplay of climate-tectonic forces

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The geomorphic and sedimentological evolution of the Satluj River valley has been reconstructed through a detailed analysis of morpho-sedimentary records, combined with optically stimulated luminescence (OSL) dating and lithofacies analysis. Together, these approaches provide insight into how the valley has responded to surface processes and active tectonics over time. Numerous types of landscapes, including mass wasting events, episodic channel damming, and the formation of temporary lakes, provide evidence of the region's dynamic nature [1, 2]. These features reflect distinct phases of enhanced erosion and sediment transport within the valley. Indicators such as morphotectonic indices and seismites preserved in fluvio-lacustrine deposits suggest that tectonic movements continue to exert a significant influence on valley development and sediment dynamics [3]. Based on detailed field mapping, sedimentology, lithofacies analysis, and optical chronology, two phases of valley aggradation are identified, occurring between 30 and 24 ka and 17 and 11 ka. During these aggradation episodes, the landscape became increasingly unstable, mass wasting occurred, channels were dammed, and lakes formed, leaving behind thick sedimentary deposits. The formation of dammed palaeolakes, active and stabilized/destabilized landslides, strath terraces, offsetting of incised channels, cascading, vertical gorges, and tilting and folding of Quaternary sediments are some of the remarkable geomorphic expressions that provide significant insight into the ongoing tectonic activities in the region. This comprehensive analysis not only unravels the region's history of surface processes but also sheds light on the interplay of tectonic forces, landslides, and river dynamics, thereby contributing to the advancement of late Quaternary landscape evolutionary models of the Himalaya.

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Establishing the Chronology of the Lithic Industry in West Tripura: A Luminescence Dating Approach

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The application of luminescence dating techniques to prehistoric archaeology has become crucial in establishing the chronologies, particularly in regions where radiocarbon dating is limited by the absence of organic materials. Archaeological and geo-archaeological surveys show abundant prehistoric tools and potteries on river terraces, tillas or mounds, open air sites in West Tripura. In 1986, NR Ramesh reported the remains of prehistoric tools in Tripura. The artefacts have been categorized under the pre-Neolithic to Neolithic period (Ramesh, 1989). The artefacts comprise several tool types such as scrapers, points, chopping tools, hammer stones, flake blades and cores showing close affinities to the Neolithic tools of Southeast Asia. The presence of archaeological artefacts suggests the prehistoric human occupation in the Quaternary landscape of Tripura. Debbarma (2017) has conducted research on the tool typology of the Saidra Valley in West Tripura. In 2019, Hazarika conducted geo-archaeological exploration in the Khowai-Saidra valleys of Tripura. Ramesh, in the Field Excursion Guide Book, discussed the Quaternary history and associated geo-archaeological remains in Tripura. Basumatary (2024) mentioned that Sonai in west Tripura has rich lithic and pottery assemblages, occupying a unique position in the prehistoric archaeology of the Indian subcontinent, suggesting evidence of cultural linkages with Southeast Asia. My proposed research aims to collect sediment samples from the stratigraphic profiles bearing lithic horizons in West Tripura in order to answer the chrono-stratigraphic questions and place the site within a temporal framework. Using Luminescence dating for sediments and artefacts, along with interdisciplinary research approaches, we can further clarify the chronology and cultural significance of West Tripura's prehistoric archaeology. This research proposal presents an approach to integrating West Tripura into the framework of Southeast Asian prehistory, clarifying the timing and nature. To shed light on the chronology and hominin dispersal, this research proposal aims to situate West Tripura within the context of Southeast Asian prehistory. The research outcome from the luminescence dating of West Tripura will help us establish a chronology and gain a deeper understanding of human habitation, environmental adaptation, and the cross-regional interactions of early people in prehistoric South and Southeast Asia. In the forthcoming research project, we intend to implement this approach in other regions of

Northeast India where the faculty and researchers of the department are already engaged, in order to construct a chronology of Northeast Indian archaeology.

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"Ye Olde(?) Fossils": Preliminary Luminescence Dates from the Upper Karewas of Kashmir and its Implications

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The Karewa formations of Kashmir are known for their rich fossil record, which includes mammalian taxa such as Bos, Elephas, Cervus, Canis, and others [1, 2, 3, 4, 5]. While these fossils and various other proxies — such as palynology, sedimentology, stable isotope analysis, and sediment geochemistry — have been investigated in past studies [6], the chronology of these sections remains poorly established. Past efforts have utilised luminescence dating methods to estimate the ages of certain deposits, providing a broad chronological framework that can be correlated with other proxies [7, 8]. However, the same has not been done for other Pleistocene sections across the valley, with most of the work focusing on relative dating methods, such as palaeomagnetism, to provide relative ages [9, 10]. Constraining the ages of the stratigraphic layers rich in fossils is essential, as it provides a robust temporal context for paleoenvironmental reconstructions and offers specific insights into the timing of faunal occupation and adaptations.

Recent geological and paleontological fieldwork in the Kashmir Valley, as part of the first author's doctoral research, has helped re-identify one such fossiliferous bed in the Samboora village of District Pulwama, approximately 22 km southeast of Srinagar city. These exposed sections in the Upper Karewa deposits (specifically, the Pampore Member of the Nagum Formation) consist of various in situ and ex situ fossils, predominantly belonging to proboscideans. Numerous fossil specimens have been recovered over five field seasons, from 2023 to 2025, and sediment samples have also been collected from the spatially associated sections. The fossils are being analysed for their taxonomy and taphonomy, while the sediment samples are being investigated for palaeoenvironmental data. Preliminary optically stimulated luminescence (OSL) samples collected from these sections have been analysed, and the results are unexpectedly young (~25–30 ka) for the sediments and associated fauna. One sample from the bottom layer yielded an age of ~200 ka, which poses interesting implications for the region's geology and geomorphological history. Further tests, along with the analysis of more OSL samples collected from a trench excavated in the most recent field season, and newer fossil-rich sections, need to be performed so that a more accurate chronology of these exposures can be substantially established, and which in turn can further substantiate the multiproxy methodologies being incorporated in this study.

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Luminescence Dating of Temple Materials and Insights of Architectural Evolution

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Temples are enduring symbols of cultural, religious, and artistic expression. Across India, temple architecture reflects the religious symbolism, regional traditions, and evolving construction technologies. From the early experimentation in structural forms during the Gupta period to the elaborate Nagara style complexes of the Chandella period, particularly in the Khajuraho temples of Madhya Pradesh, the evolution of temple design provides critical insight into the socio-cultural and technological advancements of the time. However, establishing precise chronological frameworks for these temples has been a persistent challenge due to the absence of consistent inscriptions, the presence of multiple renovation phases, and the reuse of construction materials over centuries. Traditional stylistic and epigraphic analyses, while invaluable, primarily provide relative dating, leaving a gap in establishing absolute timelines for temple construction, expansion, and restoration. Recent advances in luminescence dating techniques, including Optically Stimulated Luminescence (OSL)**,** Thermoluminescence (TL)**,** and Infrared Stimulated Luminescence (IRSL)**,** have opened new avenues for constructing absolute chronologies of ancient architectural sites. These techniques measure the last exposure of minerals to heat or sunlight, allowing precise dating of sediments, bricks, terracotta, and other fired materials used in temple construction. Such improvements enable scholars to distinguish between original construction phases**,** later restorations**,** and material reuse, providing a detailed temporal map of architectural evolution.

By dating a combination of construction sediments, baked bricks, and terracotta artefacts, the study reconstructs the sequence of temple building phases, helping to clarify the chronological relationships between different architectural components, such as sanctum walls, mandapas, and ancillary structures. The application of luminescence dating also provides critical insight into regional variations in construction techniques, including foundation methods, material sourcing, and decorative schemes, thereby offering a more nuanced understanding of how temple architecture evolved over several centuries. The integration of luminescence dating results with architectural typology, iconographic analysis, and historical records facilitates a multidimensional understanding of temple evolution. For example, early Gupta temples at Udayagiri and Tigawa reveal experimentation in square sanctums and flat roofs, while the transition to more complex Nagara-style temples at Khajuraho demonstrates innovations in vertical articulation, shikhara design, and sculptural ornamentation. Luminescence data enables researchers to assign absolute dates to these architectural milestones, confirming or revising previous relative chronologies derived from stylistic comparisons. Moreover, dating multiple construction materials across the same site allows for the identification of phased construction, renovation periods, and the reuse of older foundations, providing a comprehensive narrative of temple development over centuries.

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Importance of thermal fading and environmental dose rate in estimation of equivalent doses in luminescence dating

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A persistent challenge in luminescence dating of quartz, particularly for samples older than ~0.1 Ma, is the mismatch between natural and laboratory dose–response curves, which undermines reliability at higher doses [1,2]. To address this, we explore factors that may limit the growth of luminescence signals in nature. Traditionally, the upper dating limit is attributed to the saturation of charge-trapping sites [3,4]. However, theoretical considerations suggest that the equilibrium dose (maximum dose attainable in nature) is governed by a combination of factors, including dose rate, ambient temperature, trap activation energy, and laboratory saturation dose. We further propose a correction method for thermal fading, demonstrating that the maximum datable dose is not fixed but instead depends on these parameters. Nine quartz samples from the Tertiary Cheravathur Formation (>2.5 Ma) were analysed using both single-aliquot regenerative-dose (SAR) and multiple-aliquot additive-dose (MAAD) protocols. While the obtained equivalent dose with SAR could not be explained, MAAD provided a closer approximation of the observed equivalent level and equilibrium value. These findings highlight the need to refine existing protocols to better constrain the upper dating limits of quartz luminescence.

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Luminescence Burial Dating of Cobbles to Reconstruct Late Quaternary Megaflood Events along the Saraswati River, Alaknanda Basin

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Contemporary extreme floods demonstrate severe socio-economic and geomorphic consequences, underscoring the importance of reconstructing their prehistoric counterparts to improve our understanding of past climate–hydrology interactions. Optical dating of fluvially transported sediments, particularly coarse-to-fine sand and silt fractions, has been widely employed to constrain the timing of Late Quaternary flood events. Yet, the preservation of sand-silt deposits in high-altitude, upstream catchments is uncommon due to the dynamic nature of steep, narrow valleys, where even moderate floods can readily erode finer sediments and transport them downstream. In contrast, megafloods with exceptionally high-magnitude events with peak discharges exceeding 10^5 m^3/s and flow velocities of ~8 to 12 m/s or above, can drastically modify landscapes, depositing coarse cobble and boulder assemblages (ranging from centimeters to meters in size) tens of meters above the active channel [1]. These coarse deposits are comparatively resilient to erosion from regular seasonal floods, enhancing their preservation potential. Although numerous flood events have been documented across the Himalayas, many remain undated or unrecognized, primarily due to poor preservation of finer sediments or the limitations of conventional dating methods. To address these challenges, we employ a novel approach, "Rock Surface Burial Dating of Fluvially Driven Cobbles" [2], to reconstruct the timing of megaflood events along the Saraswati River in the upper Alaknanda basin, Uttarakhand Himalaya. Upstream of Mana town, near Balwan, the Saraswati River traverses a U-shaped valley along the hillslopes and a narrow V-shaped valley near the riverbed, with no evidence of active glaciers below 4500 m asl. A remarkable, well-preserved fluvial section, approximately 40 m thick, is present on the right river flank, comprising a distinct layer of rounded cobbles (3 to >30 cm in diameter) sandwiched between lacustrine deposits characterized by thin, laminated sand–silt layers capped by clay. Longitudinally, this section extends ~50 m down-valley, terminating near a gorge above Mana village. A large rock avalanche deposit near the gorge is hypothesized to have temporarily dammed the river, leading to lake formation. The cobble deposits, situated ~20 m above the present river stage and overlying the ancient lake sequence, indicate deposition by an extreme hydrological event.

The luminescence along the depth of the cobble depends on the ambient radiation history and the sunlight exposure history. The evolution of the depth-dependent luminescence signal in a cobble, at different stages of its transportation history, including pre-sunlight exposure, pre-burial (or pre-megaflood), and post-burial by a megaflood, is illustrated in Figure 1.

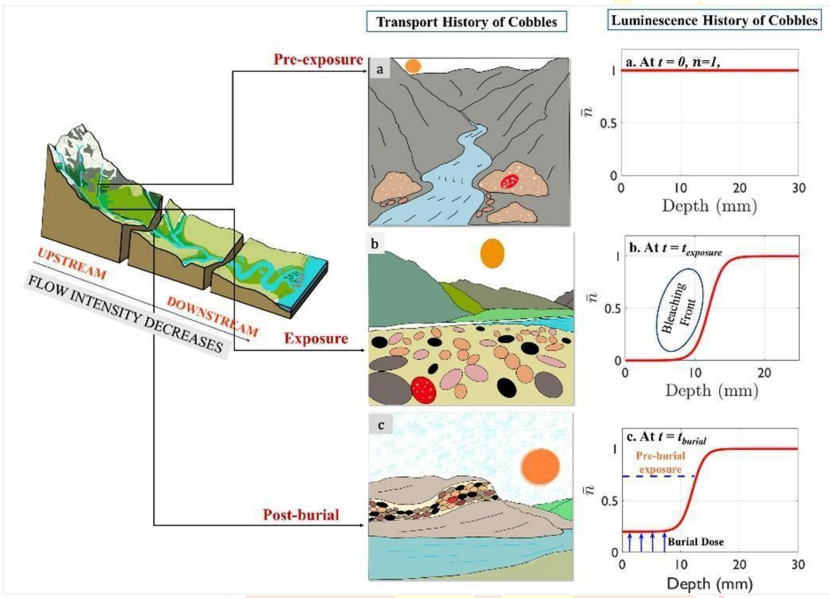

Fig. 1. Cobble (in red) history in the upstream part of the river, where (a) cobble, part of the host rock having saturated luminescence signal ($\bar{n}$ = 1), (b) cobble faces sunlight and luminescence signal bleaches with depth, and (c) cobbles deposited by a megaflood and the resultant LDP (Luminescence Depth Profile) of buried cobble.

We refined the existing methodology by introducing a more rigorous sample selection strategy, high-resolution data, and a rapid screening protocol to identify well-bleached cobbles prior to burial. Infrared Stimulated Luminescence (IRSL) signals, including IR_{50} and IR_{225}, are measured from thin rock slices (<0.7 mm) following the protocol of Elkadi et al. [3]. The LDP are modeled using General Order Kinetics (GOK)[4] to identify the bleaching depth. Subsequently, well-bleached slices are analysed using the Single Aliquot Regenerative (SAR) dose protocol to determine equivalent doses (D_e) that correspond to the burial age or the megaflood event [3]. Systematic luminescence analyses of the collected cobbles are ongoing to constrain the timing of the events and to assess the potential of cobble-based burial dating as a robust method for identifying high-magnitude palaeo-floods in the Higher Himalayas.

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Defects Responsible for Sensitisation of the OSL Signal in Quartz Grains and their Provenance Implications in Rocks from Diverse Regions Worldwide

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Quantitative provenance analysis plays a key role in understanding the tectonic, sediment transport pathways, and climatic processes that shape landscape of Earth. Quartz optically stimulated luminescence (OSL) sensitivity and electron spin resonance (ESR) signals have been empirically proposed as indicators for sediment provenance based on differences in quartz luminescence sensitivities. Luminescence sensitivity is defined as luminescence produced per unit dose per unit mass. Differences in quartz sensitivity are attributed to the intrinsic properties of the parent rock and to changes during transport and deposition [1]. The present study aims to understand the mechanism of sensitisation in quartz grains by analysing defect dynamics in rock and sediment samples collected from diverse geological settings worldwide. The samples include granites, sandstones, metamorphosed granites, volcanic rocks, and sediments, with ages ranging from millions (Ma) to billions (Ga) of years. We employed a multi-spectroscopic approach, combining thermoluminescence (TL), optically stimulated luminescence (OSL), electron spin resonance (ESR), and cathodoluminescence (CL) measurements with geochemical data obtained through laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS).

ESR data showed the presence of E' centres (an unpaired electron at an oxygen vacancy site, ≡Si·), peroxy centres (≡Si–O–O·), Al-related defects ($[AlO_4]^0$), and Ti-related defects ($[TiO_4^- Li^+]^0$). The SEM-CL spectra showed the presence of two emissions: a blue emission (~440 nm, attributed to Ti impurity) and a red emission (~650 nm, attributed to non-bridging oxygen hole centres, NBOHC, ≡Si–O·). Results showed that quartz grains exhibiting the $[TiO_4^- Li^+]^0$ paramagnetic centre in ESR had a notably high concentration of titanium and lithium impurities and had high blue emission in SEM-CL, showing sensitisation following repeated cycles of laboratory dosing and bleaching. Samples lacking these centres did not show any laboratory OSL sensitisation by dosing and bleaching. We find a strong correlation between the degree of laboratory OSL sensitisation and the [TiO4-Li+]0 electron centre from ESR signals, as well as the titanium and lithium concentrations measured by LA-ICPMS. These findings indicate that sensitisation in natural quartz originates from specific defect structures inherited from the parent rock. The Titanium and Lithium impurities, along with their associated paramagnetic centres, play a key role in the natural sensitisation of quartz following the detachment of the host rock.

These findings provide new insights into the role of quartz point defect in the sensitisation of grains in nature. At the conference, detailed results and their implications for provenance studies will be presented.

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B. POSTER PRESENTATIONS

The Need of OSL Dating in Advancing Flood Chronology within the Bedrock Reaches of the Kaveri River, Southern India

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Flood hazard management in monsoon-driven rivers is hindered by high spatiotemporal rainfall variability and the scarcity of long-term hydrometric records across the Indian subcontinent. In such data-limited settings, palaeoflood hydrology offers a rigorous framework for reconstructing the magnitude and frequency of extreme flood events from pre-instrumental periods, encompassing recent, historical, and prehistoric times, through detailed analysis of geomorphic and sedimentary flood archives. Quantitative palaeoflood discharge estimates are commonly derived using two principal approaches: palaeo-competence analysis, which infers flow strength from the calibre of coarse bedload transported during the flood, and hydraulic reconstruction, which calculates discharge from the elevation of flood deposits as well as trim lines relative to prevailing channel geometry.

This study integrates multiple palaeo-stage indicators (PSIs), including laterally continuous tree lines, slackwater deposits (SWDs), palaeo-competence analysis of coarse bedload, and historical maximum stages from documented and anecdotal sources, to constrain palaeoflood stages at five sites within the bedrock gorge section of the Kaveri River. Discharge estimation was supported by upstream and downstream gauging records, which were applied using the slope-area method and supplemented with one-dimensional steady-state hydraulic simulations in HEC-RAS. To assess the effects of large-magnitude floods, parameters of the hydraulics were computed.

The bedrock-confined channel reaches of the Kaveri River yielded palaeoflood discharges ranging from 5,641 to 13,420 m^3/s^{-1}. Validation against gauged peaks at Kollegal (upstream) and Biligundulu (downstream) reveals strong concordance, with reconstructed magnitudes closely matching those of the 2019 extreme flood. The historical inflow maximum at Mettur

Dam (12,912 m^3s^{-1}) aligns with the upper bound of the reconstructed envelope. The highest values of stream power (59,643 W m^{-2}) and bed shear stress (3,225 N m^{-2}) indicate a high erosive capacity. The Froude number, straddling unity, denotes subcritical and supercritical flows, while the high Reynolds number confirms extreme turbulence. Although these findings offer critical insights for flood hazard management in data-sparse fluvial systems, the application of OSL dating remains essential for advancing flood chronology within the bedrock reaches of the Kaveri River.

Refining the Chronology of Pebble Core Traditions: The Scope of Luminescence Dating at Lahchura, Uttar Pradesh

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South Asia holds a critical position in discussions of early human technological evolution; however, the chronological placement of several lithic traditions remains unresolved. Among these, the pebble-core or pebble-tool industry represents an important but poorly dated technological phase. The Lahchura site in Jhansi district, Uttar Pradesh, is a key example, characterized by pebble cores that reflect a distinctive technological behavior found only patchily across the Indian subcontinent [1][2][3][4] [5][6][7]. Globally, such industries have been interpreted either as pre-Acheulian [8][2] or post-Acheulian [9] [10] [11], but their absolute temporal range within South Asia remains uncertain.

Although a recent techno-typological study has documented the technological characteristics of the Lahchura assemblage [7], the absence of absolute dating limits its broader interpretation and regional correlation. Recent developments in luminescence dating methods now offer the potential to build a reliable chronological framework for the site. By applying Optically Stimulated Luminescence (OSL) to the sedimentary sequence, it will be possible to determine the age of deposition and the period of pebble-core tool use. Establishing this chronology will clarify the temporal position of the Lahchura industry within South Asia's prehistoric sequence and enhance our understanding of technological continuity, regional variability, and adaptive behavior among early human populations employing pebble-core technology.

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Luminescence Dating of Raised Beaches in the Schirmacher Oasis, East Antarctica: Toward Constraining Postglacial Shoreline Evolution

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Reconstructing the deglacial and Holocene history of Antarctic coastal oases requires establishing precise chronologies of geomorphic features such as raised beaches. These features preserve vital evidence of past ice-margin fluctuations, relative sea-level changes, and isostatic rebound following ice retreat. We propose conducting a field campaign during the 2026 Austral Summer season to determine the depositional ages of raised beach sediments in the Schirmacher Oasis, East Antarctica. The Schirmacher Oasis in central Dronning Maud Land, East Antarctica, preserves distinct geomorphic features, including depositional terraces, moraines, and raised shorelines, that record the dynamics of ice shelves and relative sea level fluctuations. These raised beaches represent valuable archives of postglacial uplift and ice-margin retreat. We propose using the OSL technique to date these beach raises, complementing it with radiocarbon dating. However, the former provides better age control while the later could be marked by uncertainties in marine reservoir corrections. Building upon successful OSL applications on Antarctic raised beaches (e.g., Simkins et al., 2013), this study aims to collect well-preserved sediment samples from raised beach deposits in the Schirmacher Oasis for subsequent luminescence dating. Fieldwork under the NCPOR's STAPLES project (Spatio-Temporal Investigation of Polar Lacustrine Systems) will involve careful light-shielded sampling to preserve luminescence signals, guided by geomorphic mapping of raised terraces and paleo-strandlines. The resulting chronological framework will help constrain the timing of shoreline emergence, isostatic rebound, and ice-sheet retreat in coastal Dronning Maud Land.

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Potential of Thermoluminescence Dating and Ichnofossils in Deciphering Pleistocene Environmental Change: Insights from Gangani Badlands, West Bengal

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Reconstructing paleoenvironmental conditions requires a robust chronological framework to contextualise ecological dynamics, sedimentary processes, and climatic oscillations. The lateritic badland terrain of Gangani, Garhbeta, in West Bengal, offers a unique archive where ichnofossils preserved in ferricrete (duricrust) horizons provide insights into past depositional environments, organismal behaviour, and substrate interactions. Our earlier investigations identified ichnogenera such as *Planolites*, *Skolithos*, *Thalassinoides*, and *Rhioliths*, representing diverse behavioural patterns, feeding, dwelling, and locomotion, within marginal to shallow fluvial depositional settings. These findings suggested significant oscillations in paleo-hydrological regimes, sediment dynamics, and diagenetic processes during the Late Tertiary to Quaternary period. However, the chronological placement of these ichnofossil-bearing strata remains largely inferential, dependent upon geomorphological correlation and indirect stratigraphic indicators.

Here, we propose the application of Thermoluminescence (TL) dating to establish an absolute temporal framework for the Gangani lateritic sequences. TL dating, by measuring the cumulative radiation dose retained in mineral grains, provides a direct and reliable chronology of depositional and diagenetic events. Integrating TL ages with ichnofossil evidence will significantly enhance our ability to correlate phases of organismal activity with climatic transitions and intensities of weathering. Such a combined approach addresses a long-standing gap in lateritic badland research, where the absence of radiometric age control has often constrained stratigraphic resolution. The significance of this approach is twofold. First, TL dating of ferricrete horizons, associated sediments, and embedded paedogenic features will help quantify the timing of surface stabilisation, soil formation, and subsequent erosional episodes. This will enable us to identify pulses of climatic reversals and geomorphic instability that governed the development of Badlands. Second, establishing a secure chronological anchor will refine palaeoecological interpretations of trace fossils by situating behavioural signatures of ancient organisms within well-defined temporal brackets. Such temporal precision is essential for distinguishing between long-term landscape evolution under Quaternary climatic forcing and localised environmental changes associated with episodic hydrological events.

The broader potential of TL dating in this context extends beyond regional geology. Lateritic terrains are widespread across tropical and subtropical regions, and their paleoenvironmental histories remain poorly constrained. By demonstrating the efficacy of TL dating in reconstructing the evolutionary history of the Gangani badland, this study contributes to methodological innovation in Quaternary science and opens new pathways for integrating iconological, geomorphic, and chronological datasets. Moreover, the ability to tie trace fossil records to absolute timelines enhances the use of ichnofossils as proxies in paleoclimate research, thereby bridging palaeobiological observations with geochronological precision. In conclusion, the synergy between ichnofossil analysis and TL dating holds immense promise for unravelling the timing, processes, and environmental shifts encoded in the Gangani lateritic badland. This integrated approach not only deepens our understanding of palaeoecological and geomorphic evolution in eastern India but also highlights the broader applicability of luminescence methods in decoding Earth surface processes in climatically sensitive landscapes.

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Chronologically Constraining Cobbles: Dating artefact-bearing gravel deposits in District Damoh, Madhya Pradesh using Optically Stimulated Luminescence

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The chronology for the earlier Palaeolithic of the central Indian region, which is covered by various formations of the Vindhyan series, is rather patchy. While rich sites have been reported, many of them are from a surface context that can't be easily subjected to absolute dating. In other cases, issues with stratigraphy or lack of resources have acted as deterrents to establishing robust timelines for the region's prehistory. While the study area of District Damoh in Madhya Pradesh is largely composed of exposed bedrock, at a few places the rivers cut through previously deposited gravel overlain by finer sediments. These gravels often served as a source of raw materials for the toolkits produced by hominins in the area, with typologically assigned Lower and Middle Palaeolithic artefacts associated with them in a secondary context. OSL samples collected from three locations, one each on the rivers Sajli, Baink and Kopra, were processed to provide a total of eight dates. The ages come mainly from the gravel-capping silty horizons, but also from within and below the gravels in a location, and each range from ~ 12 ka to ~ 94 ka. Although broad, the chronological bracket provided by these results for the artefact bearing secondary gravel does indicate the redeposition of Palaeoliths made prior to the early Late Pleistocene in the study area. Further, the temporality of the coarse member attributable to one or multiple flood events in relatively quick succession and previously used by prehistorians as a marker horizon in the area, is constrained chronometrically for the first time. This presentation provides the preliminary geochronological findings while discussing the implications for the Palaeolithic archaeology of District Damoh, Madhya Pradesh and beyond.

River Terrace Geochronology and Channel Migration Histories along the Lower Surbarnarekha River in Eastern India

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River terraces are notable geomorphic markers of past fluvial regime changes, while also preserving impacts of tectonic upheavals. Investigating terrace chronology through geomorphometric, geochronological and sedimentological methods can thus provide insights into how the riverine landscape has changed and river courses have shifted in response to climatic, eustatic or tectonic perturbations. Adjustments in river channel planform that have occurred during such events can also be examined through such analysis. Assessing these changes, particularly during the Holocene Period, is pertinent along river corridors that are intensively cultivated, as short to longer-term channel morphological adjustments can directly impact on the adjacent resident communities [1]. This study examines the geomorphic setting, morphology and chronological sequence of river terraces along the Subarnarekha River in Eastern India, along with the associated channel adjustments that have been undertaken by this river as it has dissected and cut down through the landscape, particularly during the Late Holocene Period [3]. The presence of incised meanders on upper terrace surfaces, steep successive terrace flanks, lateral meander migration signatures and well-defined scroll bar sequences along the adjacent floodplain all denote past changes in the river's hydrological regime, to which it has responded [2]. These exposed terrace sequences were mapped from high-resolution CartoDEM (2.5 metre) datasets, with the generation of Relative Elevation Models (REMs) to better highlight their individual alignments and topographic positions. The scroll bar sequences and paleo-meander cutoffs were studied using a combination of sediment textural analysis, ground-penetrating radar (GPR) surveys and optically stimulated luminescence (OSL) dating techniques, along with historical maps (1780–2000 CE), to reconstruct the evolutionary trajectory of this river and its possible paleoclimatic forcings. Cartographic analyses revealed the paleo-meander belt width to be about 2680 m, within which the present active channel width is about 1460 m. Bankfull paleo-discharge was estimated using channel dimensions of remnant cutoff meander bends. This was then related to changing monsoonal regimes during the Holocene, as discerned from various climate proxies. Initial results suggest that these meander cutoffs started forming during 1.0 – 2.5 ka in response to monsoon induced discharge fluctuations. The variations in dates discerned from tributary and trunk river terrace deposits denote differential incision rates and timelines in the region.

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Exploring Luminescence Dating for Understanding Settlement Continuity around Vikramshila, Eastern India

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The Vikramshila Mahavihara, located in the Bhagalpur district of Bihar, represents one of the foremost Buddhist monastic universities of early medieval India. Established under the Pāla rulers, it functioned as a major intellectual and cultural centre between the eighth and twelfth centuries CE. Despite the prominence of the main monastic complex, the surrounding hinterland—comprising smaller mounds and habitation sites—remains only partially understood in chronological and technological terms.

Oriup, situated a few kilometres from Vikramshila, has been the focus of my ongoing research aimed at reconstructing the long-term settlement history and ceramic technology of the region. Excavations and surface surveys have revealed multiple occupational phases beginning with the Black and Red Ware (BRW) horizon, followed by the Northern Black Polished Ware (NBPW) phase, and continuing through the early medieval period associated with the monastery's expansion. Detailed mineralogical and spectroscopic studies of the ceramics indicate gradual technological transitions rather than abrupt cultural breaks, suggesting sustained local traditions influenced by broader regional exchange networks.

To establish an absolute chronological framework for these sequences, Accelerator Mass Spectrometry (AMS) radiocarbon dating was attempted on charcoal samples obtained from controlled excavation contexts. Although the sample preparation and graphitisation followed established protocols, the resulting ages showed anomalies due to post-depositional alterations. Prolonged water percolation through the mound layers caused partial dissolution and incorporation of younger carbon into the samples, leading to unreliable radiocarbon values. These outcomes underscore the inherent limitations of C-14 dating in humid alluvial settings where organic preservation and isotopic integrity are often compromised. In this context, Optically Stimulated Luminescence (OSL) dating provides a promising alternative. By measuring the last exposure of quartz and feldspar grains to sunlight, OSL directly dates the depositional event of the sediment rather than its organic inclusions. The technique is therefore particularly suited for sites like Oriup, where sediment reworking and periodic inundation complicate the radiocarbon record. Applying OSL to well-defined stratigraphic layers can clarify the tempo of occupation, sedimentation, and site abandonment, contributing to a refined understanding of the environmental and cultural processes that shaped the Vikramshila region.

Having previously achieved successful AMS results from cultural contexts at Vikramshila itself, my present objective is to complement those data with luminescence ages from associated sites in its periphery. The integration of OSL with ongoing ceramic, mineralogical, and compositional analyses will help determine whether the observed material continuity reflects unbroken habitation or intermittent reuse within a shared cultural landscape.

Participation in the ALD-2025 workshop at the Wadia Institute of Himalayan Geology will provide essential training in luminescence dating methods, sample selection, dose-rate estimation, and age modelling. It will also allow discussion of interdisciplinary applications of luminescence techniques in archaeological chronology building. The experience will contribute directly to developing a robust chronological framework for early historic and medieval settlement dynamics in eastern India, particularly within the lower Ganga valley.

Role of Geomorphology and Paleoenvironment in the evolution of human settlements in the Ganga plain

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The Gangetic Plain is a part of the Northern Plains, just below the Shivalik ranges. This region features a diverse array of landforms. From North to South, these can be divided into four major zones: the Bhabar, the Terai, the Khadar, and the Bhangar. The geomorphic surface of the Ganga Plain is largely influenced by the depositional features of the Ganga River, which originates from the Himalayas. It is subdivided into three regions, characterised by specific tectonic settings and morphotectonic features, namely the Piedmont plains, the Central Alluvial plain and the Marginal Alluvial plain.

Remote sensing data of the Ganga plain has provided a synoptic regional view during the Quaternary period. This has helped shape human civilisation in the Ganga plain, as the first settlers during the advent of the Holocene period. The variations in the global average temperatures over the Holocene period have been relatively small compared to the ice age cycles, especially over the last 10,000 years. However, even these relatively small variations can be seen during the Holocene period. Many climatic fluctuations can be visible in this period through various earlier Geological studies. Changes such as higher rainfall, the emergence of grasslands, the development of food production, and a decrease in the size of animals led to the first human evolution in this region. Humans appear in this region during the late Pleistocene epoch, which is regarded as the Epi-Palaeolithic time period. Gradually, their population rose from the Mesolithic period to the Neolithic and to the Historical age. These paleoenvironmental changes have impacted humans, such that even today, this vast alluvial tract remains the most densely populated region of the nation.

Archaeological studies have provided evidence of the first human settlement on the natural soil in this region, attributed to climatic fluctuations. The life dynamics of these people is also affected by the changing climate. The domestication of animals and grains started because of their decreased size, which is itself the result of their morphological changes. The stone tools shape and size, the number and density of population and cultural practices are in one way or other are the results of these changes over a time period.

Reassessing Lower Palaeolithic Occupation in Central India: Acheulean Assemblages from the Rihand River Valley

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During recent fieldwork along the Rihand River in Surguja District, Chhattisgarh, a number of prehistoric sites were explored, but this study includes only four sites. The basic reason to select these sites is that the remnants from these sites remarkably belong to the Acheulean culture. At all four sites, a significant amount of handaxes was recovered. These handaxes belong to the Lower Palaeolithic Tradition and were made from the locally available Chert and Quartzite stones. The size, shape and wear patterns of the tools provide insights into their functional use and the technological skills of prehistoric communities of this region. Also, suggest that early humans in this region actively adapted to their environment for hunting and gathering. The presence of these sites along the Rihand River highlights the river's significance as a lifeline for prehistoric communities. River was not only offering them water and food but also providing access to mobility across the landscape. The presence of variety of stone tools in the vicinity suggests repeated or prolonged occupation of this riverine zone over a significant period. Although detailed analysis is still in process, the discovery of the prehistoric stone tools, mainly handaxes, during our exploration underscores that this region is the key area for understanding Lower Palaeolithic human behaviour in central India. These findings started the discussions on early human adaptations, technological innovation, settlement patterns and also emphasised the importance of riverine landscapes in shaping prehistoric lifeways. In the process of investigation, it is expected to throw more light on the chronology and tool typology.

Key Words- Rihand Region, Prehistoric Communities, Acheulean Culture, Stone Tools

Bridging Landscape Evolution and Buddhist Heritage of the Betwa Valley, Madhya Pradesh, India

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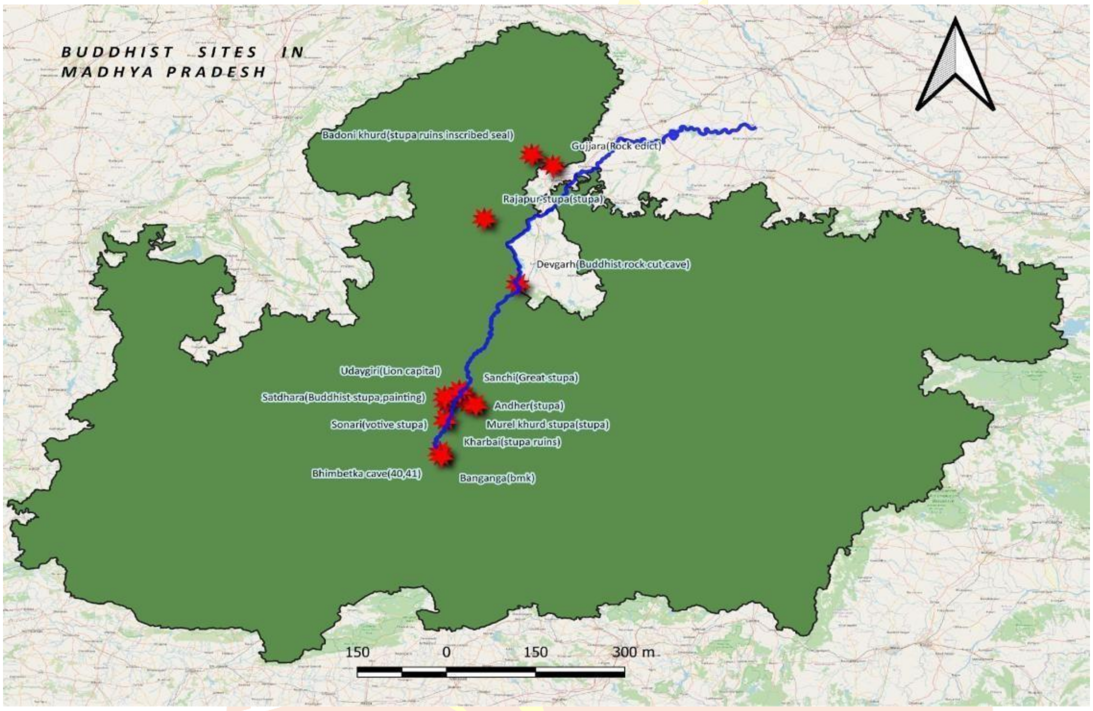
The Betwa is a river in central and northern India, and a tributary of the Yamuna. It rises in the Vindhya Range (Raisen kumaragaon) north of Hoshangabad (Narmadapuram) in Madhya Pradesh and flows northeast through Madhya Pradesh before entering Uttar Pradesh after flowing through Orchha. Nearly half of its course, which is not navigable, runs over the Malwa Plateau. The confluence of the Yamuna and the Betwa rivers is in Hamirpur district in Uttar Pradesh, where the Yamuna flows northward and the Betwa approaches from south of Hamirpur. Betwa River flows between two major rivers of India, the Narmada and the Yamuna.

The Betwa Valley in Central India holds significant historical importance, especially in relation to the development and spread of Buddhism. My research work explores how Buddhism flourished in the Betwa Valley during the Mauryan Empire (321-185 BCE) and the Gupta period (3rd century CE to mid-6th century CE), driven largely by trade and the active engagement of merchant communities. The natural beauty and tranquillity of the valley made it an ideal location for the establishment of Viharas, which served as centres of meditation, education, and community life for monks and followers.

The intricate relationship between the landscape evolution of the Betwa Valley and the establishment and development of Buddhist sites within the region would enrich my research investigation. While archaeological studies have focused on the tangible remains of Buddhist monasteries and stupas, a comprehensive understanding of the landscape context in which these sites flourished is lacking.

Through this workshop I would be able to argue that landscape evolution played a critical role in shaping the accessibility, resource availability, and strategic importance of locations chosen for Buddhist settlements. By integrating geomorphological analysis with archaeological and historical data, I am aiming to reconstruct the past landscape and its influence on Buddhist communities in the Betwa Valley. This would involve examining fluvial terrace formation, evidence of paleo-climatic shifts, and the distribution of natural resources relevant to the sustenance of monastic life. Understanding the dynamic landscape within which these sites were situated would provide crucial insights into factors influencing site selection, the sustainability of Buddhist communities, and the potential environmental challenges faced by these settlements over time. Ultimately, this interdisciplinary approach enriches my understanding of the complex interplay between human culture and the natural environment in shaping the Buddhist heritage of the Betwa Valley, revealing a more nuanced and holistic picture of its past.



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Geomorphological Implication of the Last Glacial Extensions in the Monsoon-Dominated Bhaba Valley, Himachal Himalaya, India

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Glaciers are known as one of the most reliable proxies for climate change. The present glacial landscape in the Himalaya is a perfect reflection of the paleoenvironmental changes vis-à-vis the glacial process, providing a major key to understanding the past glacio-geological history. Therefore, the present study aims to investigate the geomorphological repository of the glacial land system, which covers the most extensive glacial limits of the Last Glacial Maximum (LGM) in Bhaba Valley, Himachal Himalaya. The study area opens towards the south, allowing the moisture-laden ISM winds to enter directly into the valley, which is a major source of moisture for more than 90 glaciers. Thuskeo and Neugal Dhar are the largest and prominent glaciers in the study area. The study has used geo-spatial datasets (Landsat images, ArcGIS base map, and Google Earth Pro) for glacial geomorphological mapping with inputs from the field work. Fieldwork was conducted to gather photographic evidence of landforms and map locations using GPS. The magnitude of past glacial processes has been assessed by looking into the variation of the Equilibrium Line Altitude (ELA) estimated by the toe-to-headwall altitude ratio (THAR) and the toe-to-summit altitude method (TSAM).

The geomorphological mapping of the Bhaba Valley reveals a total glacierized area of approximately 45 km², currently dominated by cirque and valley-type glaciers. Although seasonal snow in the valley is more prominent. The detailed field mapping of the valley has identified landforms related to glacial, periglacial, proglacial, and paraglacial geomorphic processes. The upper portion of the valley is dominated by glacial landforms, including glaciers, serrated ridges/aretes, cirques, bergschrund, horns/pyramid peaks, and more. Periglacial landscapes, such as rock glaciers, talus/scree slopes, and moraines, are typically found near the present limits of glacierized areas. Proglacial landforms are characterised by glacial lakes, snout, braided channels, etc. Lastly, paraglacial processes have a strong influence on the down valley, reflected in alluvial fans, debris cones, truncated spurs, U-shaped valleys, and landslides. The presence of multiple moraine sets suggests at least four major glacial stages during the Late Quaternary period in the valley. The oldest and most extensive 1st glaciation

was identified based on truncated spurs, U-shaped valley, and trimlines which stretched up to ~21km downstream from the present-day snout, probably marking the LGM. Additionally, the 2nd, 3rd, and most recent 4th glacial advances extend up to ~11.32 km, 9.35 km, and 2.20 km downstream from the present snout position in the valley. The ELA depression for the 1st, 2nd, 3^{rd,} and 4th stages was ~817.50 m, ~425 m, ~307.50 m, and ~132 m, respectively.

The findings are consistent with previous studies on glacial chronology in adjacent Himachal Himalayan valleys, which have documented similar glacial advances during the Late Quaternary glaciation from LGM to LIA.

The Origin and Evolution of Burial Practices in India: From the Earliest Times to the Iron Age

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Burial practice has remained a significant aspect of human cultural and ritual behaviour since prehistoric times. Globally, evidence for intentional burial dates back to the Middle Palaeolithic period, notably exemplified by the 1938 discovery of a Neanderthal child's burial at the Teshik-Tash Cave in Uzbekistan, accompanied by pairs of Siberian ibex horns—a find attributed to A.P. Okladnikov. In the Indian context, early indications of mortuary behaviour appear during the Mesolithic period, particularly from sites in the Belan and Ganga valleys. This tradition continued and evolved through the Neolithic, Chalcolithic, Indus-Saraswati, Megalithic, and Iron Age phases, with elements persisting among certain tribal groups to this day. The continuity and transformation of mortuary traditions reflect shifts in social beliefs, ritual systems, and cultural identities over time. This paper critically examines the origin, evolution, typology, and underlying concepts of burial practices in India, tracing their development from the earliest evidence to the Iron Age.

Keywords: Indian Archaeology; Burial Practices; Mortuary Archaeology; Mesolithic to Iron Age; Ritual Behaviour; Cultural Evolution; Belan Valley

Archaeometric and Thermoluminescence Characterisation of an AMS-Dated Iron Age Lime Kiln from Pachkhed, Maharashtra, India

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The application of luminescence methods to archaeological combustion residues has increasingly illuminated ancient manufacturing technology practices, extending beyond their traditional chronological applications [1,2]. In this study, we present the first integrated archaeometric investigation of a rare lime kiln excavated at Pachkhed, Yavatmal District, Maharashtra, India. Accelerator Mass Spectrometry (AMS) dating places the kiln between 811 and 745 BCE, securely situating it within the Iron Age of peninsular India. Multi-analytical characterisation was undertaken using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), field emission scanning electron microscopy with energy-dispersive spectroscopy (FESEM–EDS), bulk geochemistry, and thermoluminescence (TL) measurements.

XRD revealed calcite and silica as dominant crystalline phases, with lime and silicate reflections indicative of sustained high-temperature operation and partial post-depositional re-carbonation [3]. FTIR spectra confirmed carbonate absorption bands (ν_3 at ~1420 cm^{-1}, ν_2 at ~875 cm^{-1}, ν_4 at ~712 cm^{-1}) alongside Si–O stretching (~1080–1100 cm^{-1}), consistent with coexisting calcite/lime and siliceous domains. FESEM–EDS analysis revealed marked micro-heterogeneity, characterised by discrete Si-rich and Ca-rich domains, which corroborates the bulk chemical composition dominated by CaO (46.8 wt%) and SiO_2 (35.5 wt%). TL analyses of irradiated samples (50–400 °C, up to 20 kGy) showed a stable high-temperature glow peak at ~310 °C, independent of dose, reflecting the presence of deep and thermally stable traps [4]. The dose–response was linear up to 15 kGy, beyond which concentration quenching was observed. Fading experiments indicated a 22% reduction in TL intensity over 20 days, after which the signal stabilised, suggesting moderate but acceptable stability for dosimetric applications [4].

These results collectively demonstrate deliberate high-temperature lime production in Iron Age peninsular India, representing a rare technological innovation in South Asia. The integration of mineralogical, microstructural, and luminescence datasets highlights the potential of

Combustion residues are not only chronological indicators but also proxies for reconstructing technological choices, firing conditions, and material behaviour in antiquity. This case study demonstrates the benefits of integrating archaeometry and luminescence physics to enhance our understanding of ancient manufacturing techniques.

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Human Settlement and Archaeology of Chandraprabha River Basin of Distt. Chandauli, Uttar Pradesh in the light of Paleo-Climatic Change in Late Pleistocene-Holocene

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The Chandauli district is located between 24˚42′ 35″ and 25˚ 31′ 55″ North latitude and between 82˚59′ 57″ and 83˚33′ 42″ East longitude. Chandauli district borders Bihar to the east, and as a result, there are numerous cultural influences and festivals similar to those found in Bihar. The district boasts great natural beauty, featuring the Chandraprabha Sanctuary and numerous waterfalls, including Devdari and Rajdari. The Chandraprabha River basin in Chandauli district is an important river of the upper Vindhayan upland plateau. This River is the main source of water for the lower plateau region of Chandauli district. The extent of the Chandraprabha River is 24˚45′ N to 25˚15′ N and 82˚55′ E to 83˚20′ E, and the total geographical area of the Chandraprabha basin is 1355.80 sq.km. The origin Point of the Chandraprabha River is Mirzapur district. It flows through the upper part of the Mirzapur and Chandauli districts. It circulates the Heartland of Naugarh and Chakia Forest and meets with the Karmanasa River near Mairahi. In the study area, Garai is also an important river. It flows parallel to the Chandraprabha River and meets it in the Chandauli district.

Preliminary studies indicate that human settlement in the basin was controlled by landform changes and monsoon rainfall variation. Recent studies indicate a period of increased aridity in the area around 5Ka, which is related to the weakening of the south-west monsoon system. Many studies have indicated weakening of the monsoon during the middle to late Holocene around 5ka. It is also postulated that around 5 ka, tectonic activity produced warping of the land and disruption of minor river channels in the study area. These factors likely caused the drying of small water bodies and river channels, as well as a lowering of the groundwater level. These geological factors likely influenced the settlement patterns and migration of humans in the Chandauli district, situated on the banks of the Chandraprabha River. As we know, over the last few decades, geo-archaeological studies in India have provided scientific databases for climate and vegetation changes during the late Pleistocene–Holocene period.

This workshop will help me to gain the necessary methodological and practical foundation for using OSL dating. This knowledge will be used to transform the relative or tentative chronology into a sturdy, absolute timeline, which is critical for making significant contributions to the archaeology and paleo-environmental history of the Chandraprabha River Basin. The workshop will also be helpful for collecting viable samples from the study area and for critically evaluating the results obtained by a luminescence dating lab. The image provided here shows the layered soil profile, which serves as the basis for the relative timeline, making the application of OSL dating essential to determine precise calendar ages for the human occupation and environmental shifts recorded in those layers.

Image 1: The Stratigraphy of Matigaon, Chandauli district, Uttar Pradesh, an archaeological site within the Chandraprabha River Basin (Courtesy: Vinay Kumar)

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Tracing Early Hominin Adaptations through Time: The Scope of Luminescence Dating at Paisra, Bihar, India

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The Indian Subcontinent holds a key position in studies of early human evolution and dispersal across Asia. Among the Lower Palaeolithic sites of eastern India, Paisra, located in the Munger district of Bihar, is one of the most significant Acheulian localities. Excavations conducted by Banaras Hindu University in different sessions revealed a rich assemblage of handaxes, cleavers, and flakes embedded within ferruginous and lateritic gravels, showing how early humans adapted to the Middle Ganga Valley environment [2][7].

Despite its importance, the chronological position of Paisra remains uncertain, as no absolute dating has yet been applied. Luminescence dating, particularly Optically Stimulated Luminescence (OSL) and Cosmogenic Nuclide Exposure Dating, provides a reliable approach to determine the age of these sedimentary deposits [4]. Establishing these dates will help to clarify when Acheulian populations occupied eastern India and how long this technological tradition persisted [1][3][6]. The results will strengthen the chronological framework for the Lower Palaeolithic in the Middle Ganga Basin and enhance our understanding of early hominin migration and adaptation to changing Quaternary landscapes.

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Lower to Middle Paleolithic transition (Nakjhar khurd, Ram Nagar Ghat)

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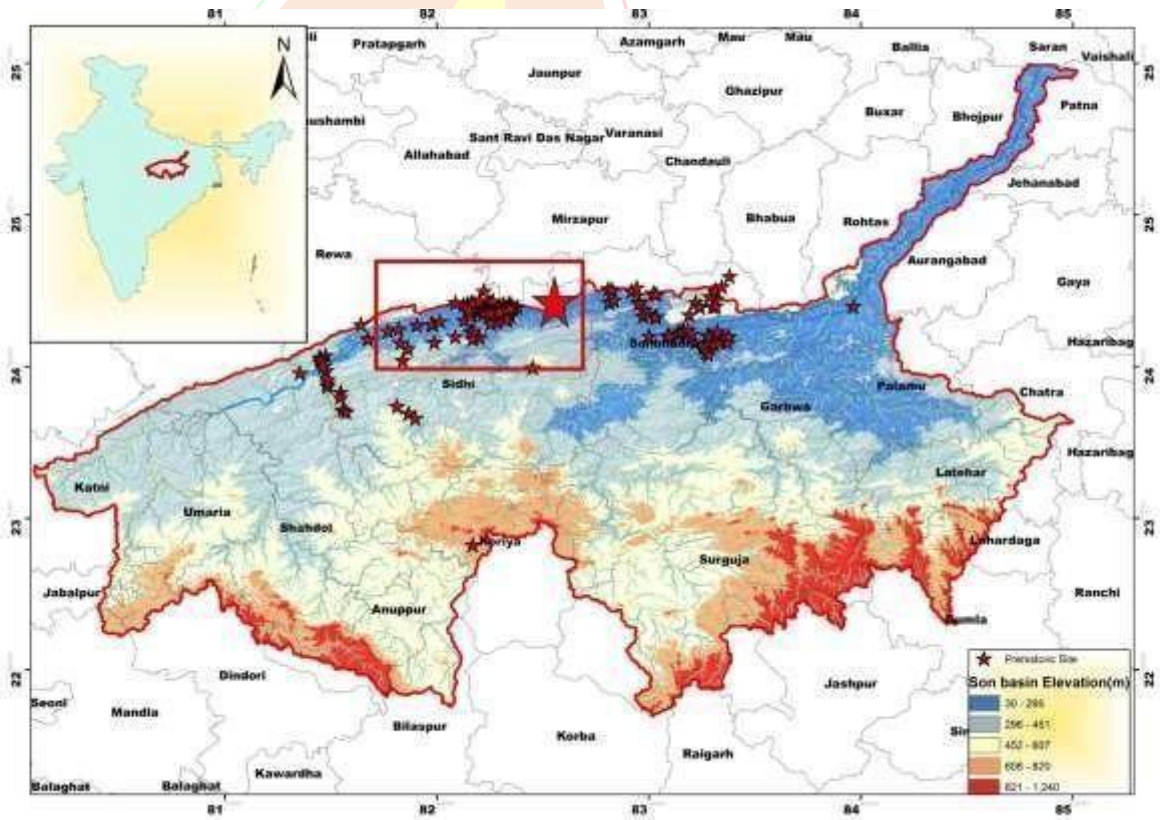
The Middle Son Valley in central India hosts a concentration of terminal-phase Acheulean sites, providing valuable insights into the behavioural and cognitive transformations that underpinned the transition from the Lower to the Middle Palaeolithic in the Indian subcontinent. The transition from lower to middle Paleolithic marks a pivotal evolutionary shift in technology, cognition, and social behaviour, shaping early human adaptability and cultural complexity. There was gathering miniature hand axes, scrapers, also found some large flakes which are related to the late Acheulian to middle paleolithic period. Most of the tools are made of siliceous material. And also found some tools which are made of chert.



The Problem of Chronology in Indian Archaeology

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Chronology remains one of the most critical yet contested dimensions in the reconstruction of India's archaeological past. This study seeks to address the methodological and interpretive challenges associated with establishing a coherent temporal framework from the earliest evidence of human activity to the Iron Age. The currently accepted earliest date of human presence in India—approximately 1.5 million years ago—derives from the Acheulean site of Attirampakkam, Tamil Nadu. Subsequent dates obtained from diverse regions across the subcontinent have yielded a wide range of chronological estimates for various techno-cultural phases. While some of these findings correspond with the conventionally accepted cultural sequence, others reveal significant overlaps and inconsistencies between successive stages of human technological and cultural development. This paper critically examines these chronological ambiguities, assessing both the limitations of existing dating methodologies and the interpretative biases that have shaped current frameworks. It further explores prospective avenues—such as improved stratigraphic control, multi-proxy analytical techniques, and cross-disciplinary correlation—that could contribute to refining the chronological scaffolding of Indian archaeology in the future.

Keyword: Indian Archaeology; Chronological Framework; Prehistoric Cultures; Radiometric Dating; Cultural Sequence; Stratigraphic Analysis; Technological Phases

Tracing Technological Transitions through Time: The scope of Luminescence Dating at Siddhpur, India

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South Asia occupies a pivotal position in debates surrounding the prehistoric dispersal of humans and their technological evolution. Despite its archaeological richness, the region still lacks a robust chronological framework for key cultural transitions. Two major interpretations dominate current discourse regarding early modern human occupation of the Indian Subcontinent: one associates the Middle Palaeolithic with the earliest arrival of modern humans during MIS 5 [1][2][3], while the other links the spread of microlithic technology to the expansion of these populations across South Asia [4][5][6][7].

Within this wider context, the Siddhpur site in Chitrakoot district, Uttar Pradesh, India, provides a significant stratified sequence reflecting a technological transition from Middle Palaeolithic to microlithic industries in this region. Excavated (Trial Trench) by Prof. V. P. Pant in the 1980s, the site remains undated, leaving its cultural phases and temporal placement uncertain. Luminescence dating, particularly OSL, provides a powerful tool for establishing an absolute chronology for Siddhpur and, by extension, refining the broader temporal framework of early modern human occupation in South Asia. The results will contribute to ongoing discussions on technological innovation, regional adaptation, and the timing of modern human dispersal across the subcontinent.

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Landscape and Chronology: A Geoarchaeological Synthesis of Human Settlement and Quaternary Evolution in the Purna Basin, Central India

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The Purna River basin in central India, a tectonically active half-graben formed by the east-west trending Gavilgarh Fault and filled with Quaternary alluvium, serves as a critical repository for understanding the interplay between landscape evolution and human history. Geoarchaeological investigations at sites like Tuljapur Garhi, Phupgaon, Bhon, and Paturda reveal a long sequence of human occupation, from the Chalcolithic (Malwa and Jorwe cultures, circa late 2^{nd} to mid-1st millennium BCE) to the Iron Age (7^{th} – 4^{th} century BCE) and into the Early Historical period (Satavahana era, 200 BCE–200 CE). These settlements, often located on river meanders, relied on a mixed agro-pastoral economy, as evidenced by material culture including distinct pottery, metal objects, beads, and palaeobotanical remains of rice, wheat, and millets.

Chronological frameworks for the region are built upon multiple dating techniques. 'Radiocarbon (C-14) dating' of charcoal from archaeological sites like Tuljapur Garhi provides absolute dates for cultural phases. For the deeper Quaternary record, 'tephrochronology' is pivotal, with the geochemically fingerprinted Youngest Toba Tuff (YTT, ~75 ka) providing a widespread isochron within the basin's alluvial sequences. Crucially, 'OSL dating' has been employed to directly date the sedimentary context of the YTT, yielding ages that bracket the tephra within fluvio-lacustrine deposits between approximately 70–57 ka, resolving debates about its stratigraphic placement. The application of '^{40}Ar/^{39}Ar dating' to YTT glass shards in the basin has proven problematic, yielding anomalously old ages likely due to post-depositional alteration, highlighting a key methodological challenge.

This synthesis demonstrates that the Purna Basin's geological evolution—characterised by tectonically and climatically controlled sedimentation—created the environments that attracted and sustained human societies. The integration of archaeological stratigraphy with a robust chronostratigraphic framework, underpinned by tephrochronology and OSL dating, establishes the basin as a key region for correlating Late Pleistocene and Holocene climatic events with the cultural trajectory of central India.

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Aeolian Blanketing as a Preservation Mechanism for Prehistoric Landscapes in the Delhi NCR, India

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The Delhi National Capital Region (NCR), situated at the confluence of the Aravalli Range and the Indo-Gangetic Plains, hosts a rich but critically under-dated prehistoric record spanning the Acheulian to Mesolithic periods. The region's Quaternary landscape is a complex palimpsest of fluvial (Yamuna paleochannels) and aeolian processes, the latter involving significant sediment influx from the Thar Desert. This aeolian sand, deposited across the Aravalli foothills, has paradoxically played a dual role: it has buried and preserved archaeological sites in situ, but also obscured them, contributing to a major research gap—the complete absence of absolute chronologies for the region's human occupation. This project utilises luminescence dating to establish a robust chronological framework for prehistoric sites in the Delhi NCR, directly testing hypotheses about hominin settlement in relation to late Pleistocene climatic and geomorphic changes.

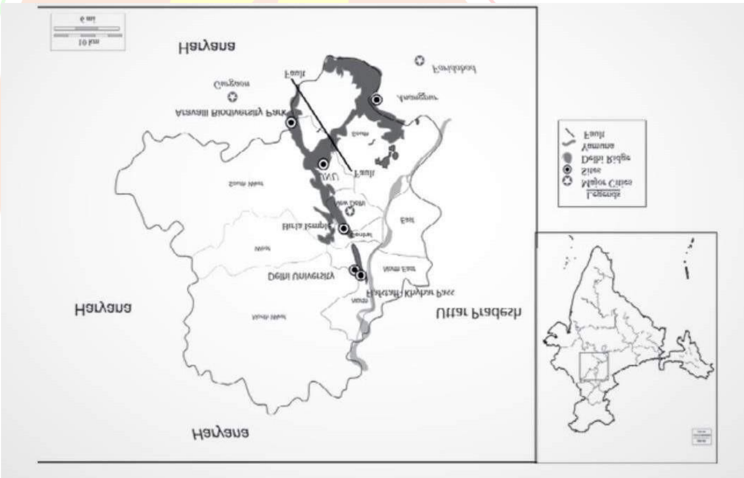
The physiography of the Delhi NCR is defined by quartzite ridges of the Delhi Supergroup, which are flanked by extensive deposits of brownish silt-clay and grey micaceous sands. Remote sensing studies have identified a network of SW-NE trending paleochannels (Y1-Y3), linked to the ancient Ghaggar-Hakra system, indicating a major avulsion of the Yamuna River to its present course post-dating 49 ka. Concurrently, geochemical provenance studies have confirmed that a substantial portion of the Quaternary sediments are aeolian in origin, derived from the Thar Desert and distinct from local weathering profiles or Yamuna alluvium. This suggests periods of intensified aridity and dust influx, which would have significantly altered the landscape available to hominin populations. These buried landscapes now contain a wealth of archaeological material, from Acheulian bifaces to sophisticated microlithic toolkits, yet their age remains speculative, relying solely on typological cross-dating.

Archaeological surveys, from the pioneering work of Sinha (1956) and Chakrabarty-Lahiri (1985-86) to recent explorations by the author, have identified dozens of Paleolithic and microlithic localities. The only systematically excavated site, Anangpur, yielded Acheulian artefacts within late Pleistocene deposits sandwiched between Yamuna paleochannels. Tragically, this site was destroyed by sand mining before any absolute dating could be conducted, emblematic of the severe conservation crisis facing the region's heritage. The pressing threat of urban expansion, quarrying, and deforestation underscores the urgent need not only for documentation but for securing numerical ages to anchor this cultural sequence within a regional and global context.

This research addresses this critical gap through a targeted application of Optically Stimulated Luminescence (OSL) dating. Our primary hypothesis is that the deposition of Thar-derived aeolian sands created a protective mantle over archaeological landscapes during arid phases (e.g., MIS 4 and late MIS 3), and that these depositional events can be directly linked to periods of site abandonment or occupation. We will collect sediment samples for OSL dating from two key contexts:

1. From stratified sedimentary sequences directly associated with archaeological horizons (lithic scatters and rock shelters) in the Aravalli’s.

2. From the basal and upper units of the aeolian sand layers that cap and preserve these archaeological sites.



(Fig. 1) All previously reported Paleolithic Localities in and around Delhi (map courtesy: https://www.jstor.org/stable/26264680?seq=3)

The OSL ages will provide direct dates for the sedimentation events that buried the sites, yielding a terminus ante quem for the human occupation. This will allow us to correlate the archaeological record with regional paleoclimatic proxies and the established chronology of river avulsions. Methodologically, this represents a novel application of luminescence dating in an urban, multi-process geological setting where aeolian deposition is a key agent of both landscape formation and heritage preservation.

The anticipated outcomes are threefold:

1. Chronological Resolution: Establish the first absolute timeline for Acheulian, Middle Paleolithic, and microlithic occupations in the Delhi NCR.

2. Paleoenvironmental Correlation: Determine whether specific technological phases (e.g., the proliferation of microliths) correspond to known periods of aridity and aeolian activity or to more humid phases.

3. Heritage Management: Provide scientifically rigorous ages that are crucial for advocating for the protection of these sites against ongoing urban encroachment.

By integrating OSL dating with geomorphological mapping and archaeological survey, this project will transform our understanding of the Delhi NCR from a region with a static inventory of sites into a dynamic model of human-environment interaction throughout the Late Pleistocene.

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Multi-Proxy Reconstruction of Late Quaternary Paleoclimate from Glacial Lakes and Moraines of the North and West Sikkim Himalaya

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The eastern Himalaya is one of the most climatically responsive sectors of the Himalayan arc, where glacial, lacustrine, and moraine sediments preserve high-resolution records of past climate dynamics. The Sikkim Himalaya, lying at the confluence of Indian Summer Monsoon and mid-latitude westerly systems, is expected to record sensitive responses of glacier fluctuations to climatic forcing. Precise age control and integration of multiple proxies are crucial for disentangling the roles of monsoon intensity, temperature variability, and atmospheric circulation in shaping the region's Quaternary environmental evolution.

This study aims to reconstruct the Late Quaternary paleoclimate using sediment cores and surface samples collected from glacial lakes and moraines of the North and West Sikkim Himalaya. A multi-proxy analytical framework is being applied to these sediments. Major and trace element geochemistry will constrain sediment provenance, degree of weathering, and paleo-hydrological fluxes, following approaches described by Rengarajan et al. (2017) and Tan et al. (2023). Ratios such as SiO_2/Al_2O_3, Fe_2O_3/K_2O, and MgO/CaO serve as indicators of chemical leaching intensity and monsoonal variability. Clay mineralogy, determined through X-ray diffraction, helps identify assemblages of kaolinite, illite, and smectite, each reflecting different climatic regimes and hydrothermal conditions (Singh et al., 2019; Chen et al., 2017). Particle-size distributions, obtained via laser diffraction, provide insights into depositional energy and transport dynamics, distinguishing high-energy glacial outwash from low-energy lacustrine sedimentation (Tripathy et al., 2016). Paleomagnetic measurements of magnetic susceptibility and remanent magnetisation will detect subtle changes in sediment source and provide internal stratigraphic correlation (Sangode et al., 2020). To complement inorganic proxies, phytolith analysis will document shifts in vegetation and moisture regimes, revealing ecological responses to climatic oscillations (Panda et al., 2020).

Chronological control will be obtained using Optically Stimulated Luminescence (OSL) and radiocarbon (^{14}C) dating. OSL dating of sandy and aeolian horizons will constrain depositional ages, whereas radiocarbon or carbon-isotope analysis of organic-rich layers will refine the temporal sequence of lake evolution. Previous Himalayan studies have demonstrated that OSL can reliably date glaciogenic and fluvio-lacustrine sediments up to ~200 ka, despite issues with partial bleaching (Spencer & Owen, 2004; Chaudhary et al., 2015; Rhodes, 2011). Integrating OSL ages with isotopic and sedimentological data will enable the construction of robust age–depth models, allowing for the correlation of local events with regional and global paleoclimate phases, such as the Younger Dryas, the early–mid Holocene Warm Period, and the Late Holocene cooling.

By coupling geochemical, mineralogical, magnetic, and biological proxies with geochronological evidence, this research will produce a continuous paleoclimatic sequence illustrating glacier–climate interaction and landscape evolution in the Sikkim Himalaya. The results will contribute to a refined chronology of glacier advances and retreats, enhance understanding of monsoon–westerly interplay, and provide valuable baseline information for future climate modelling and glacial-lake outburst-flood (GLOF) risk assessment in the eastern Himalaya.

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Integrating Facies Architecture with Luminescence Chronology: Fluvial Deposits of the Bhorla River, Himalayan Foreland, Assam

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Establishing a reliable chronological framework for fluvial successions in tectonically active forelands is crucial for deciphering the interplay between climate, tectonics, and sedimentary processes, and luminescence dating offers one of the most powerful tools for achieving this. The Bhorla River, a major tributary of the Brahmaputra that originates in the Bhutan Himalayas, has developed a substantial alluvial fan system in Assam. Situated within a neotectonically active foreland influenced by the Dhansiri–Kopili and Atherkhet faults, the basin records the interplay of tectonism, monsoonal variability, and seismic events in shaping fan architecture. To decode this record, we conducted facies analysis across proximal, medial,

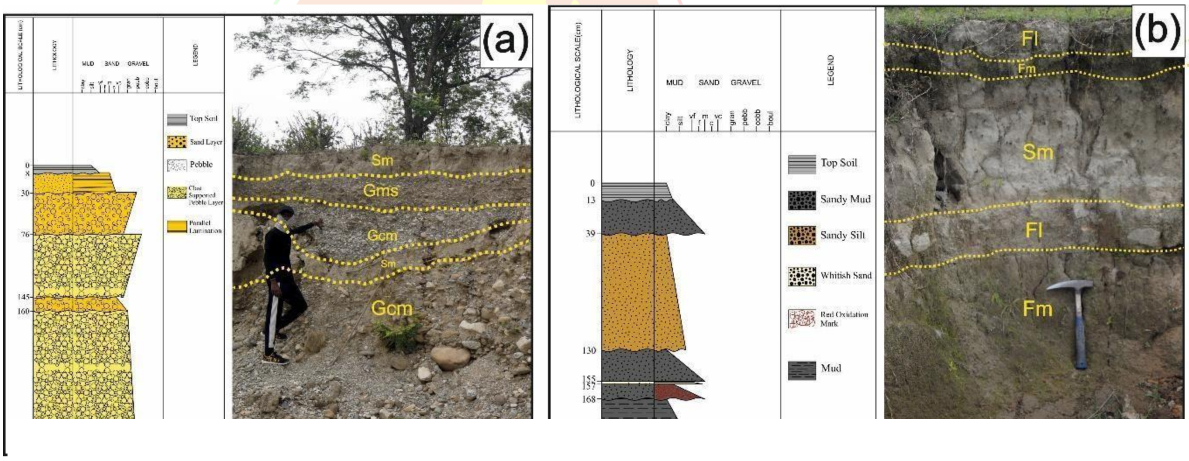

Figure 2 Contrasting nature of sedimentary facies in proximal and distal parts of the Bhorla river fan. (a) Proximal fan litholog showing massive sand (Sm), matrix-supported massive conglomerate (Gms) and clast-supported massive conglomerate (Gcm) facies. (b) Distal fan litholog consisting of facies laminated fine silt and clay (Fl), massive clay (Fm) and massive sand (Sm).

and distal sectors, documenting lithologs that reveal distinct depositional environments. Across 20 carefully logged stratigraphic sections, we identified a range of lithofacies including clast-supported massive conglomerate (Gcm), matrix-supported massive conglomerate (Gms), planar cross- bedded conglomerate (Gp), massive sand (Sm), planar cross-bedded sand (Sp), horizontally laminated sand (Sh), low-angle cross-bedded sand (Sl), trough cross-bedded sand (St), ripple cross-laminated sand (Sr), laminated fine silt and clay (Fl), and massive clay (Fm), which collectively define architectural elements such as channels (CH), gravel bars and bedform (GB), sandy bedforms (SB), fine-grained overbank or floodplain deposits (FM), lacustrine deposits (LA), sand sheets (SG), lobe deposits (LS), and overbank fines (OF). Proximal successions are dominated by stacked channel sands and gravelly sheetflood facies, medial sections preserve alternations of channel sands and overbank fines, while distal sectors contain finer silts and crevasse splay deposits. Correlation of these sections through panel diagrams highlights systematic vertical and lateral changes in facies, indicating phases of fan progradation and aggradation. Chronological control, however, is indispensable for relating these depositional patterns to regional forcing, as shown in earlier Himalayan fan studies where optically stimulated luminescence (OSL) dating constrained episodes of sediment aggradation to pulses of tectonic uplift and intensified monsoon activity [1].

To achieve such temporal resolution, we propose luminescence dating of quartz and feldspar grains from key stratigraphic intervals. Although fluvial deposits frequently suffer from incomplete bleaching, recent advances in small-aliquot and single-grain OSL techniques have significantly improved the ability to resolve depositional ages in complex sedimentary settings [2,3]. Our strategy involves targeted sampling at channel–overbank transitions and aggradational surfaces, with equivalent dose distributions modelled using Central and Minimum Age Models to address partial bleaching and heterogeneity [4]. Similar methodological approaches in foreland basins and Quaternary fluvial systems worldwide have successfully revealed multi-phase fan development spanning the late Pleistocene to Holocene, linking sediment pulses with both tectonic reactivation and climatic variability [5,6]. With lithologs and facies architecture already documented, and field collection for OSL samples scheduled, this project is poised to deliver one of the first integrated chronostratigraphic frameworks for a Bhutan Himalaya-derived alluvial fan in Assam.

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Accelerated Uplift of the Jwalamukhi Thrust since the Late Pleistocene

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The Jwalamukhi Thrust (JT) is a major active fault located in the eastern part of the Kangra re-entrant within the sub-Himalayan belt of northwest India. This region, part of the western Himalayas, is characterised by intense crustal deformation driven by ongoing convergence between the Indian and Eurasian plates [3,1]. The main Frontal Thrust (MFT) has been considered the primary locus of late Quaternary deformation in the Himalayan foreland. However, evidence from several re-entrants indicates that, out-of-sequence faults such as the JT continue to accommodate significant shortening, suggesting a complex and temporally variable deformation pattern [7,8,2].

This study integrates geomorphic analysis with optically stimulated luminescence (OSL) dating [6] of fluvial terraces developed across the JT to reconstruct its late Pleistocene– Holocene uplift history. Terrace chronology and elevation data from both the hanging wall and footwall domains show systematic variations in incision and uplift. Calculated incision rates range between ~2.1–5.7 mm yr^{-1} in the hanging wall and ~3.3–6.7 mm yr^{-1} in the footwall, with the hanging wall consistently showing higher values, indicating differential uplift (Δz) across the thrust zone [4]. Regression analysis of terrace height–age relationships reveal steeper slopes for the hanging wall (4.03 m kyr^{-1}) than the footwall (2.71 m kyr^{-1}), confirming accelerated uplift of the hanging wall block. Shortening rates derived from incision (assuming fault dips of 30°–35°) vary from ~3 to 11 mm yr^{-1}, consistent with regional estimates of crustal shortening in the northwestern Sub-Himalaya [8].

A distinct phase of rapid incision between ~10–15 ka BP suggests an episode of out-of-sequence reactivation of the JT [5,2], reflecting a temporary retreat of deformation from the Himalayan front. These results indicate that uplift along the JT has been episodic rather than continuous, characterised by alternating phases of tectonic quiescence and rapid slip. The terrace record thus captures multi-timescale deformation, highlighting the JT's active role in accommodating crustal shortening and reshaping the Himalayan foreland landscape.

Recognition of such out-of-sequence activity has important implications for understanding the dynamics of Himalayan wedge growth and assessing seismic hazards.

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Significance of OSL Dating in Deciphering Tectonic Controls on Fluvial Sedimentation in the Himalayan Foreland River Basin, Assam, India

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The interplay of tectonic activity, climate, and sediment supply has a strong influence on fluvial sedimentation in river basins. In tectonically active regions such as Assam, India, river dynamics and sediment architecture often record signatures of crustal movements and basin deformation. OSL dating has emerged as a robust geochronological tool to establish the depositional ages of fluvial sediments from fluvial terraces, floodplain deposits, and channel fills. OSL dating is critical because it provides the temporal framework to link fluvial sedimentation and terrace formation with neotectonic fault activity in the Quaternary [1]. Without precise ages, it is nearly impossible to separate tectonic

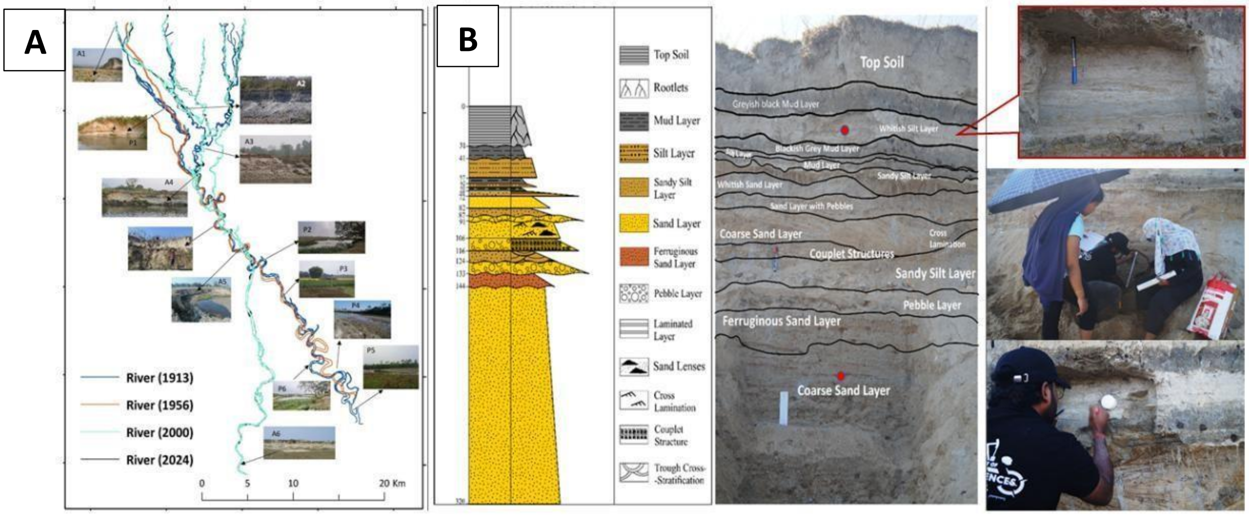

Figure: Left side image-A showing river Planform change over 112 years with its bank conditions, and image-B showing Lithology of river terrace and OSL sampling site, procedure during field visit.

signatures from climatic influences in river systems [2]. This study highlights the significance of OSL dating in deciphering the tectonic controls on fluvial sedimentation within the Dhansiri (North) River Basin in Assam. The Dhansiri (North) River Basin is located within the Himalayan Foreland basin, a tectonically controlled basin. Himalayan foreland basins are suitable for understanding the effects of climate-tectonic interactions on the evolution of these landscapes [3]. The Dhansiri (North) River has traversed several faults, including the Main

Central Thrust (MCT), Main Boundary Thrust (MBT), Main Frontal Thrust (MFT), Atherkhet Fault (AF), and Kopili Fault (KF). On the other hand, the Dhansiri (North) River ranks ninth among the major tributaries of the Brahmaputra, with an average sediment yield of 435 tons per square kilometre per year [4]. Therefore, the morphology of the Dhansiri (North) River channel is primarily shaped by climatic and geological controls. Due to ongoing tectonic activity and intense precipitation in the region, rapid erosion in the catchment area results in the deposition of a considerable thickness of sediments, particularly in the middle to lower reaches of the active Dhansiri River. Through systematic application of OSL dating, this study aims to generate precise depositional ages for terrace surfaces, floodplain units, and channel fills within the Dhansiri (North) River Basin [5]. These chronologies will be used to reconstruct the timing of aggradation–incision cycles and directly link them with activity along major neotectonic structures such as the MFT, AF, and KF. Establishing this temporal framework is crucial for distinguishing between tectonic forcing and climatic variability [6]. The findings will advance understanding of Himalayan foreland dynamics and provide insights into how active deformation governs fluvial sedimentation in seismically sensitive regions of Northeast India.

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Feasibility of Optically Stimulated Luminescence Dating of Boulder Beds

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Optically Stimulated Luminescence (OSL) Dating is a geochronological technique used predominantly for dating Quaternary sediments deposited under lower-energy conditions. What gives this method an edge over others is its use of minerals like quartz and feldspar, which are abundant in such sediments. Conventionally, using OSL has been challenging to date pebble, gravel and boulder deposits owing to problems regarding bleaching of signals and dose rate heterogeneity. Hence, the application of this method has been restricted to dating mostly sand lenses and aeolian deposits, as the sediments are well bleached, and the absence of a heterogeneous source of dose rate means a systematic protocol for dating coarse-grained sediments is still lacking. However, if coarser-grain deposits, such as matrix within the boulder beds, can be dated, it would give us insight into the paleoclimatic and tectonic conditions that prevailed in alpine regions like the foothills of the Himalaya. Dose rate is a measure of the total amount of radiation received by the sample. In the case of boulder beds, the primary hurdle is to determine a method that can quantify the radiation contribution of the boulders and the interstitial matrix.

To address this question, we have targeted areas with boulder beds containing sand lenses. Two types of samples were collected: a) the matrix sample from the boulder interstices and b) the standard sand sample from the lenses to validate the results obtained from the matrix samples. We have chosen the alluvial fan deposits of Northern West Bengal, Kangra, and Rait in Himachal Pradesh to carry out our experiment, as alluvial fans often exhibit an alternating layering of coarse and fine sediments. The dose rates of individual boulders and the enclosing matrix within the boulder beds were measured, and the bleachability of the matrix was assessed. This experiment aims to understand how the heterogeneous contribution of radiation by individual boulders affects the final dose rate of the sand matrix and if complete resetting of the OSL signal is possible in such settings. Early results indicate that interstitial matrix sediments of certain boulder beds appear to be well bleached, leading our experiment in a promising direction.

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Morphotectonic Analysis of the Purna Basin Using GIS Techniques

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Analysis of a drainage basin in response to the tectonic processes can provide insight into the past and recent deformational events of the region. Drainage networks are the most active and sensitive elements which can be used as a powerful tool to understand the neotectonic activities of an area. Morphotectonics deals with the landscape morphology that has evolved as a result of past or recent tectonic activity. An analysis of active structures can be done by using morphotectonic indices, which are sensitive to rock resistance, climatic changes and tectonic processes resulting in landscape evolution (Ahmed and Rao, 2016) [1].

The present study area is part of the Tapi River basin. The Tapi River is the second largest westward-draining interstate river of the Peninsula. The Purna River is the principal tributary of the Tapi River, originating in the Betul district in the Gavilgarh hills of the Satpura range. The Purna Basin, situated in Central India and bordered by the Gavilgarh, Purna, and Kaddam faults, plays a crucial role in understanding intraplate tectonic activity within the Deccan volcanic province (Raja et al., 2010) [2].

The Purna basin, a rhomb-shaped half-graben in a strike-slip regime, has the characteristics of high depositional rates, abrupt lateral facies changes, and margins bounded by normal faults. The geometry of the Purna basin is controlled mainly by frequent tectonic activities (Mishra et al., 1999; Tiwari, 1996) [3,4].

This research utilizes quantitative geomorphic indices viz., Channel Sinuosity (S), which is the ratio of channel length (CL) to the valley length (VL), as proposed by (Muller 1968) [5] to comprehend the role of tectonism (Susan 1993) [6]; Hypsometric integral (HI), which defines the elevational distribution of a certain area of land, especially drainage catchment (Pike and Wilson, 1971) [7]; Transverse Topographic Symmetry (T), which is calculated by measuring the deviation of the drainage basin midline from the active meander belt (Da) and the deviation of the basin midline from the basin divide (Dd) (Cox et al., 2001) [8]; and Mountain front sinuosity (Smf), the ratio between the length of the mountain front (Lmf) along its base at the distinct break in slope and the straight line length of the whole mountain front (Ls) (Bull and

McFadden, 1977; Keller and Pinter, 1996) [9,10] to assess tectonic activity through GIS techniques.

High-resolution digital elevation data and topographic analysis were employed to extract these indices across various sub-basins. Smf values along segments of the Gavilgarh and Kaddam faults suggest a range from high to low active topography, while hypsometric analysis indicates mature to old stages of various sub-basins. Channel sinuosity and T-index values also reflect differential tilting and tectonic influences on drainage morphology.

This research underscores the value of geomorphic indices in identifying neotectonic features in basalt-dominated terrains. The findings contribute to a better understanding of intraplate tectonics and landscape evolution in Central India and demonstrate the utility of GIS-based morphometric analysis for regional tectonic assessments.

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Late Quaternary history of the Suru and Doda Basin using OSL dating, Zanskar Himalaya

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This study focuses on reconstructing the Late Quaternary glacial history of the Suru and Doda basins using Optically Stimulated Luminescence (OSL) dating. OSL dating relies on the principle that minerals such as quartz and feldspar are reset to zero when exposed to sunlight during erosion and transport. The Suru and Doda basins, located within the transitional climatic zone influenced by both the mid-latitude westerlies and the South Asian monsoon, preserve an abundance of glacial landforms that are key to understanding past glacier fluctuations. Previous research in the Suru Basin identified five major phases of glacial advance of progressively reduced extent, dated to 33 - 23 ka, 16 ka, 13 - 11 ka, 10 - 7.3 ka, and 2.8 - 2.3 ka, along with a minor advance between 0.7 - 0.4 ka. These glacial stages, termed Suru-I to Suru-V, were established through optical dating, geomorphic mapping, moraine stratigraphy, and evidence from glacially polished bedrock surfaces. To reconstruct this chronology, we collected six morainic sediment samples - three from in front of the Durung-Drung Glacier and three from the Safat Glacier in the Doda and Suru basins, respectively.

By applying OSL dating to these samples, this study aims to reconstruct the paleo-glacial history in the region.

Reconstruction of the paleo-glaciation history of Upper Alaknanda Basin (using OSL dating), Uttarakhand Himalaya

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The OSL (Optical Luminescence dating) is based on the principle that chronometers like quartz and feldspars reset to zero during erosion and transportation when sediments are exposed to sunlight. Our study area, i.e. upper Alaknanda basin, ranging from Vishnupryag (1,450 m asl) to Devtal (5,664 m asl), features key glaciers such as Satopanth (3,800 m asl, 12 km in length) and Bhagirathi Kharak (3,831 m asl, 18.5 km long), which originate in the Chaukhamba massif (7,138 m asl). This basin encompasses various types of glacial geomorphological features, including U-shaped troughs, moraines, and outwash plains. This method will be used to collect morainic material samples for dating, which will aid in reconstructing the glacial history.
Previous geomorphological analyses identified three phases of Late Quaternary glaciation: Alaknanda, Alkapuri, and Satopanth. The oldest Stage I was the most extensive glaciation in the basin, which reached as far south as Badrinath (2604 m asl). Earlier OSL-based studies indicated two chronological ages from the moraine associated with the Satopanth Glacier's advancement, estimated to be approximately 12 ka and 4.5 ka, around Mana village, on the downstream side of Badrinath. The present research aims to provide improved chronological detail through extensive OSL sampling, enhancing the reconstruction of the Upper Alaknanda Basin's paleo-glacial history.

Multi-luminescence ages to date terrace formation in Loni River, Uttar Pradesh

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The Loni River, a minor tributary of the Gomti River in the Lucknow district of Uttar Pradesh, plays a crucial role in the geomorphology of the Central Ganga Plain. Although now reduced to a drain, it once supported irrigation and continues to contribute sediments to the Gomti River, which ultimately flows into the Ganga River. Like all the rivers of the Gangetic Plain, this river was also found to have different terraces (minimum two), using which climatic and tectonic information can be inferred. In this study, we aimed to determine the age of the terraces along this river.

A total of eight sediment samples were collected from two terraces (T_1 and T_2) of the river system and employed Optically Stimulated Luminescence (OSL) dating to establish the chronological framework of sediment deposition. We used fine-grain (4-11 µm) fraction of polymineral (5 no.), quartz (4), bulk feldspar (8) and K-feldspar (8) minerals of coarse-grain (90-150 µm) fractions. Appropriate chemical and physical treatments were used to isolate required mineral grains. The Single Aliquot Regenerative (SAR) dose protocol was applied to determine the equivalent doses (De) for each mineral type. Overall, similar ages were obtained irrespective of the methods we used within uncertainty except one sample of T_2 (as shown in the figure 1 – K-feldspar ages are not shown but will be presented in the workshop).

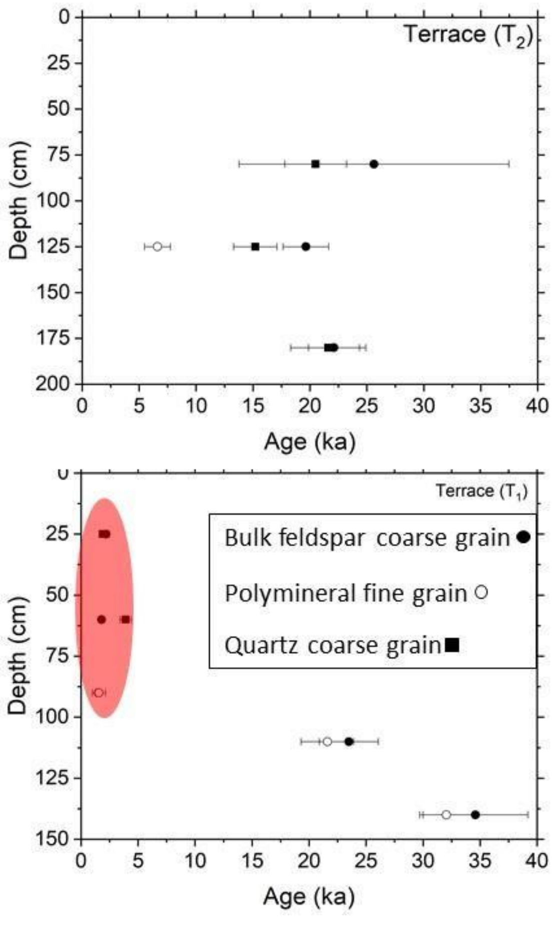

Figure 3: Age depth profiles of T_1 and T_2 terraces

Luminescence ages revealed two depositional phases: an older phase (35 – 20 ka) despite their different terraces, suggesting a single sedimentation phase, and a younger phase (1.5 – 2 ka) deposited after an erosional break (indicated by a red elongated circle). These results suggest a period of disturbance between the two phases, likely caused by flooding or erosion, followed by renewed sedimentation. The study highlights the value of combining chronological methods with field observations to better interpret the sedimentation process along the river.

Luminescence Dating and its Application in Prehistory to Historic Archaeology

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Luminescence dating has emerged as a crucial tool in archaeological research, providing the ability to date materials and contexts that fall beyond the range of radiocarbon dating and are independent of organic preservation. This technique measures the amount of light emitted from mineral grains, primarily quartz and feldspar, when they are stimulated, providing an estimate of the time since they were last exposed to sunlight or heat. Its application spans from prehistoric to historic periods, allowing archaeologists to construct more accurate chronologies for sites, features, and artefacts.

In prehistoric contexts, luminescence dating has been instrumental in determining the age of early human occupation, sediment deposition, and burial events. Luminescence dating is a geochronological technique that has significantly advanced the field of archaeology by enabling the direct dating of sediments and fired materials. It works by measuring the accumulated radiation dose in minerals such as quartz and feldspar, which is reset when the material is last exposed to sunlight (optically stimulated luminescence, OSL) or heat (thermoluminescence, TL). This method is particularly valuable in contexts where organic materials required for radiocarbon dating are absent. From prehistoric to historic archaeological contexts, luminescence dating has proven instrumental in establishing chronologies for human occupation, site formation processes, and cultural developments. In prehistoric archaeology, it aids in dating early human settlements, stratigraphic layers, and tool use. In historic periods, it contributes to dating construction materials like bricks and ceramics, especially where written records are limited or ambiguous. While the technique requires careful sampling and consideration of environmental factors, its ability to provide absolute dates across a wide temporal range makes it an essential tool in modern archaeological research.

In historic archaeology, it supports the dating of ceramics, bricks, and construction phases, particularly where written records are sparse or absent. The technique's ability to directly date sediments and fired materials offers a powerful means of validating or refining archaeological interpretations. Despite certain limitations, such as the need for careful sampling and considerations of partial bleaching, luminescence dating continues to expand its role in archaeological science, contributing to a deeper understanding of human activity across millennia. Luminescence dating is a powerful chronometric technique widely employed in historic archaeology to determine the age of mineral-bearing materials, such as sediments, ceramics, and burnt stones, by measuring the accumulated radiation dose since their last exposure to heat or sunlight. This method, which encompasses techniques such as OSL and TL, is based on the principle that certain minerals, notably quartz and feldspar, trap electrons over time due to environmental radiation. When stimulated, these trapped electrons release light, the intensity of which is proportional to the time elapsed since the last heating or exposure event. In historic archaeology, luminescence dating plays a crucial role in constructing accurate chronological frameworks, particularly in contexts where organic materials for radiocarbon dating are absent. It is instrumental in dating ancient ceramics, kiln structures, hearths, and burial sediments, thereby enhancing our understanding of technological developments, settlement dynamics, and cultural transitions. Recent advances in measurement precision and methodological refinement have further expanded its application, making luminescence dating an indispensable tool in archaeological research and heritage conservation.

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CoRSEER- The Calculator of Rock Surface Exposure Age and Erosion Rates for Rock Surface Luminescence dating

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Abstract:
Reconstruction of rock surface exposure and erosion history is crucial in geomorphology because it links climate, tectonic and surface processes to the landform we observe today. Generally, there are two major reconstruction scenarios. First, host rocks such as valley walls, bedrocks, or strath surfaces - the exposure ages of these surfaces can predict the age of the natural and anthropogenic events that remove the cover (e.g., deglaciation, stripping of the regolith, quarrying) and thereby begin a new exposure clock [1, 2]. Second – transportable clasts such as cobbles and boulders. We can infer transport, deposition and reworking histories if we establish these clasts' exposure age [3]. On the other hand, establishing erosion rates of these rock surfaces will provide information on climate interaction with the landforms [4]. Evaluating exposure-erosion history gives us a quantitative constraint on landscape evolution chronologically [5]. During burial (or shielding from Sunlight), the ambient ionising radiation fills electron traps to saturation [4]. When exposed to sunlight, it penetrates inside the rock surface, causing instantaneous detrapping of the electrons, i.e., bleaching of the luminescence signal on the surface of rock. As the photon flux attenuate with depth, the bleaching rate decreases, causing a sigmoidal distribution of luminescence signal in rock, also called luminescence depth profile (LDP). The LDP is highly sensitive to exposure and erosion. While exposure causes propagation of the LDP to deeper depth, the erosion causes propagation of the LDP to shallower depth Rock-surface luminescence dating (RSLD) provides a powerful, centennial to millennial chronometer for reconstructing exposure durations and erosion histories from luminescence-depth profiles (LDPs) [6]. Yet, practical adoption has been limited by the lack of a reproducible, user-friendly workflow that couple's calibration, age inversion, and erosion histories. We present CoRSEER (Calculator of Rock-Surface Exposure and Erosion Rates), a MATLAB App that (1) performs weighted logistic (three-parameter) sigmoidal fitting for automated plateau detection and normalisation; (2) implements a finite-difference forward model of LDP evolution using the general-order kinetics (GOK) framework [7, 8] with dose-rate growth, depth-dependent bleaching, and advective loss by erosion; and (3)

executes inverse problems for (a) kinetic parameter calibration, (b) apparent exposure age, and (c) steady and transient erosion histories.

In current work, we present the full methodology of — sampling, sample processing, data preparation and renormalisation, fitting diagnostics, forward-inverse modelling, and interpretation—using published case studies, and will highlight best practices and common pitfalls.

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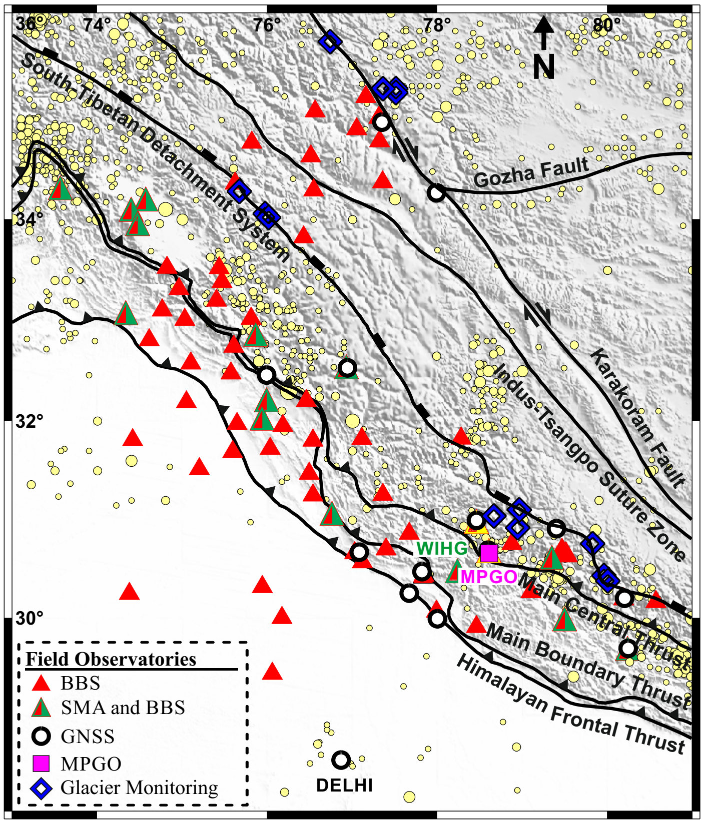

Mission

To significantly contribute in National development through sustained Geoscientific Research for secured living and sustainable development in Himalaya and, understanding the geodynamic evolution vis-à-vis climate variability in the orogen.

Vision

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- To foster a tradition of scholarship, dissemination and cultivation of knowledge and promote capacity building
- To develop National and International collaboration with research laboratories and academic Institutes for scientific exchange and resource generation
- To provide expert and/or consultancy services to meet the societal requirements
- To take up other activities that may be necessary, incidental or conducive in attaining the objectives or targets set by WIHG.

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1968: Establishment of the Institute as the " Institute of Himalayan Geology" in Delhi University

1970: Renamed as "Wadia Institute of Himalayan Geology (WIHG)" in the honour of Dr. D.N. Wadia

1971: Started a journal "Himalayan Geology"

1976: The Institute shifted to Dehradun

1983: The government released a postal stamp in the honour of Dr. D.N. Wadia to commemorate his contributions in Earth Sciences

1984: The Institute shifted to its building at 33, GMS Road, Dehradun

1986: Set-up the Wadia Sophisticated Analytical Instrumental Facilities (WSAIF), providing Geo-analytical services to academics, research institutes, and other private sectors

1991: Initiated the Glaciology Program to monitor Himalayan Glaciers

1997: Established field seismology research stations at Naddi (Dharmshala) and Kothi, Himachal Pradesh

2006: A state-of-art Multi-Parametric Geophysical Observatory (MPGO) established to study earthquake precursors at Ghuttu, Uttarakhand

2015: Organised 30th Himalayan-Karakoram-Tibet Workshop at WIHG

2016: Launched an annual calendar event "National Geo-Research Scholar Meet (NGRSM)": a congregation of research scholars of India in the field of geoscience

2021: Established a hostel facility for Ph.D. scholars

2025: National Geo-Technical Facility at the Annexed Building, SoI, Dehradun

Contact:

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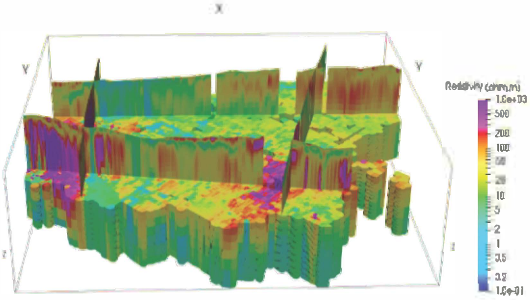

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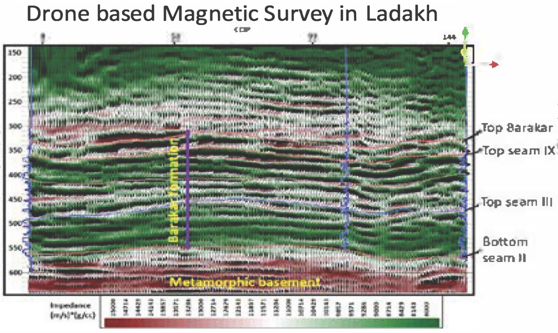
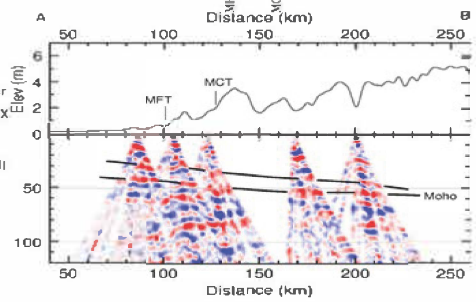
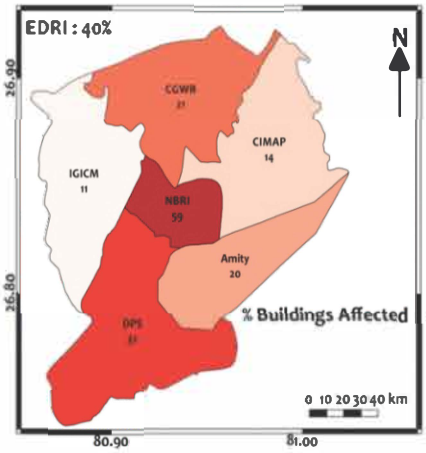


3D Seismic Data for CBM Exploration



Seismic image of the Moho in Kashmir Himalaya



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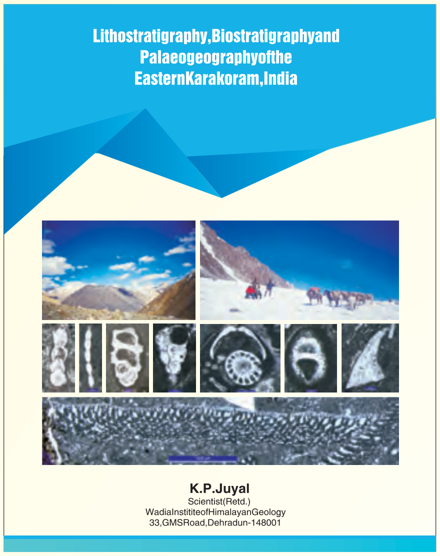

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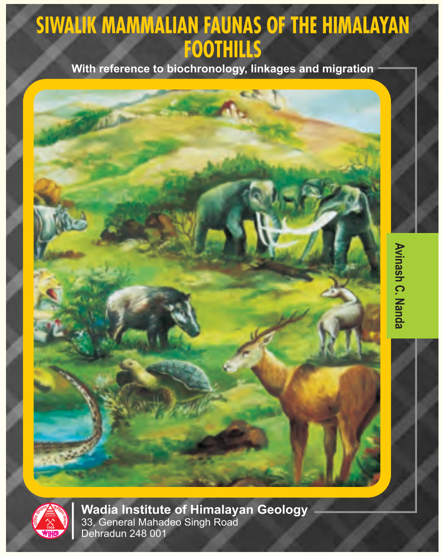

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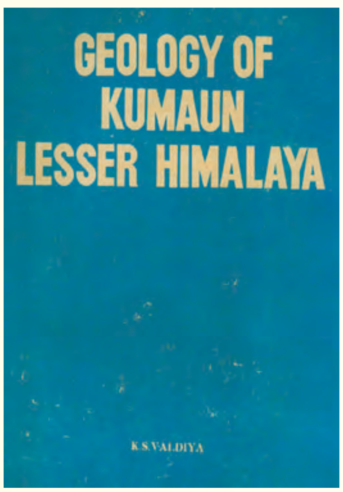

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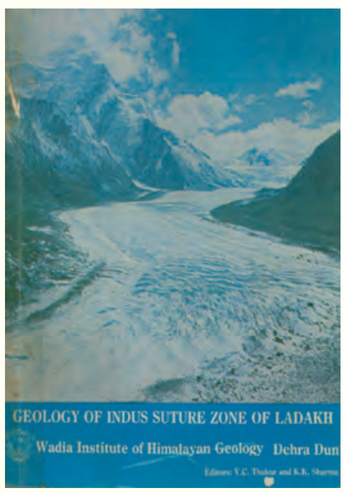

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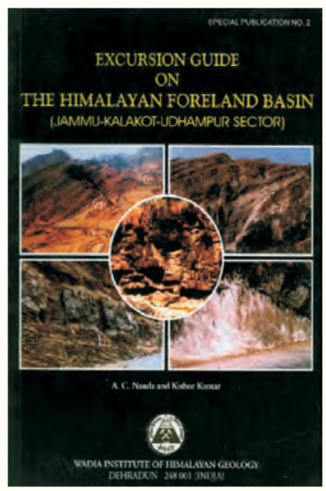

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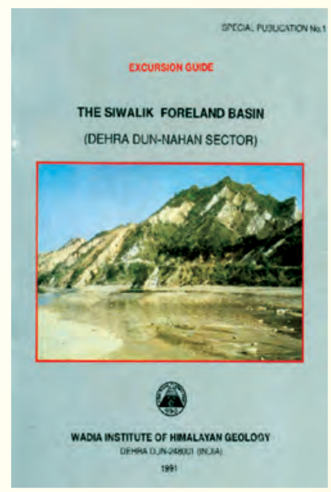

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