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FIELD GUIDE

INPRE - 12

FROM CRETACEOUS VOLCANISM TO PRECAMBRIAN KARST: A COASTAL-TO-WESTERN GHATS GEOLOGICAL TRANSECT ACROSS KARNATAKA, INDIA.

Anish Kumar Warrier, Aditya Udayraj Joshi, K. Balakrishna and Saurodeep Chatterjee



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INQUA INDIA 2027

Field Guide Book

INPRE-12

From Cretaceous Volcanism to Precambrian Karst: A Coastal-to-Western Ghats Geological Transect Across Karnataka, India.

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Abstract

This field excursion presents a unique geological transect across the western margin of Peninsular India, linking the Late Cretaceous volcanic province of St. Mary's Island with the spectacular Precambrian karst landscapes of Yana in the Western Ghats of Karnataka. The excursion traverses a diverse range of geological environments, providing participants with an opportunity to examine nearly 2.7 billion years of Earth history preserved within a compact geographic corridor.

The excursion begins at St. Mary's Island, a nationally recognized geoheritage site renowned for its spectacular columnar jointed felsic volcanic rocks. These volcanic units, dated to approximately 88–90 Ma, record magmatism associated with the breakup of the Indo-Madagascar landmass and provide critical insights into Late Cretaceous tectono-magmatic processes along the western Indian margin. The coastal setting also offers excellent exposures of Quaternary geomorphic features, including wave-cut platforms, rock pools, shell-rich beaches, and active shoreline processes that continue to shape the landscape.

The transect then proceeds northward along the Karnataka coast and into the Western Ghats, crossing geological domains of the Archean Dharwar Craton and the structurally significant Kumta Suture Zone. Along this route, participants will examine the tectonic architecture of one of the oldest continental nuclei on Earth and explore the role of major crustal-scale structures in shaping regional landscape evolution.

The excursion culminates at Yana, where towering carbonate monoliths and cave systems represent one of India's most remarkable tropical karst landscapes. Developed within Precambrian dolomitic carbonates, these landforms provide a natural laboratory for investigating karst geomorphology, structural controls on dissolution, tropical weathering processes, and Quaternary landscape evolution. Together, St. Mary's Island and Yana illustrate the interconnected roles of tectonics, volcanism, climate, weathering, and surface processes in generating and preserving geologically significant landscapes.

By integrating volcanology, tectonics, geomorphology, Quaternary science, and geoheritage conservation, this excursion offers an exceptional opportunity to examine the long-term evolution of the western Indian margin and highlights the scientific and educational value of Karnataka's diverse geological heritage.

Preamble

Karnataka occupies a unique position within the geological framework of the Indian subcontinent, preserving an extraordinary record of Earth history that spans from the Archean to the present day. The state encompasses some of the oldest continental crusts on Earth, remnants of major tectonic events associated with the breakup of Gondwana, and diverse Quaternary landscapes shaped by ongoing coastal, fluvial, and weathering processes. This remarkable geological diversity makes Karnataka an ideal natural laboratory for investigating the interactions between deep-time tectonic evolution, surface processes, climate, and landscape development.

This field excursion is designed as an integrated geological transect extending from the Arabian Sea coast at St. Mary's Island to the tropical karst terrains of Yana in the Western Ghats. Along this route, participants will explore geological features that collectively document nearly 2.7 billion years of Earth history. The excursion begins with the Late Cretaceous volcanic rocks of St. Mary's Island, which record magmatism associated with the separation of India from Madagascar during the final stages of Gondwana fragmentation. These volcanic exposures provide valuable insights into continental rifting, mantle processes, and the tectonic evolution of the western Indian margin.

The coastal sector of the transect also provides opportunities to examine Quaternary geomorphic processes, including marine erosion, sediment transport, wave-cut platform development, and shoreline evolution. Continuing inland and northward, the excursion traverses geological domains of the Archean Dharwar Craton and the tectonically significant Kumta Suture Zone, offering a window into the assembly, stabilization, and subsequent modification of the Precambrian continental crust.

The excursion culminates at Yana, where spectacular carbonate monoliths and cave systems exemplify tropical karst development within Precambrian dolomitic carbonates. These landforms illustrate the long-term influence of climate, groundwater circulation, structural controls, and chemical weathering in shaping the landscapes of the Western Ghats. Together, the field localities provide an integrated perspective on Precambrian cratonic evolution, Cretaceous rifting, Quaternary coastal dynamics, and tropical weathering and karstification, highlighting Karnataka as one of South Asia's most important regions for geological research, geoeducation, and geoheritage conservation.

(Research Problem as it Stands Globally and How the Field Transect is Unique in the Context)

The western margin of India preserves a unique geological archive that records the interplay of tectonic, magmatic, geomorphic, and climatic processes operating over billions of years. This field excursion integrates two contrasting but complementary geological systems—St. Mary's Island and Yana—to address key scientific questions related to continental evolution, landscape development, and geoheritage preservation.

The volcanic rocks exposed on St. Mary's Island provide critical evidence for the tectono-magmatic events associated with the Late Cretaceous separation of India and Madagascar during the final stages of Gondwana fragmentation. Despite significant advances in geochronology and geochemistry, important questions remain regarding the petrogenesis of the felsic volcanic rocks, their relationship to regional magmatic provinces, and the tectonic processes that governed volcanism along the western Indian margin. The exceptional exposure of columnar jointing and brittle structures offers opportunities to investigate post-emplacement deformation and the broader geodynamic evolution of the Indo–Madagascar rift system.

In contrast, the Yana karst complex represents one of the most distinctive carbonate landscapes within the Western Ghats and provides an opportunity to examine the role of tectonic inheritance in karst evolution. Situated within the Kumta Suture Zone, the carbonate monoliths preserve evidence of structural controls on weathering, groundwater circulation, and cave development. The relationship between lithology, deformation, fracture systems, and karstification remains insufficiently understood and requires further investigation to establish a comprehensive model for tropical karst evolution in Precambrian carbonate terrains.

Taken together, these field localities provide an exceptional framework for examining long-term landscape evolution along the western margin of Peninsular India. The excursion explores how tectonic events associated with Precambrian crustal assembly and Cretaceous continental breakup have influenced subsequent geomorphic development, and how tropical weathering, coastal processes, and karstification have modified the landscape through the Quaternary to the present day. By linking deep-time geological processes with modern surface dynamics, the excursion highlights the importance of integrated geological investigations for understanding Earth-system evolution and conserving internationally significant geoheritage sites.

Regional Geoarchaeology

(Regional Geology including Stratigraphy, Structure, Palaeontology, Quaternary Geology)

The geology of the excursion area records a long and complex history spanning from the Archean to the present day and encompasses some of the most significant geological provinces of Peninsular India. The transect from St. Mary's Island to Yana traverses ancient cratonic crust, major tectonic boundaries, Late Cretaceous volcanic centres, and actively evolving Quaternary landscapes, providing an exceptional opportunity to examine Earth processes operating across multiple temporal and spatial scales.

The geological foundation of the region is provided by the Archean Dharwar Craton, one of the oldest and best-preserved continental nuclei in the world. The craton comprises tonalite–trondhjemite–granodiorite (TTG) gneisses, greenstone belts, schists, quartzites, and associated supracrustal sequences that record early crustal growth, stabilization, and tectonic reworking during the Archean. These rocks form the basement framework upon which subsequent geological events were superimposed.

Along the western margin of the craton lies the Karwar Block and the Kumta Suture Zone, a region characterized by intense deformation, metamorphism, and tectonic juxtaposition of diverse lithological units. The Kumta Suture Zone represents a major crustal-scale tectonic boundary containing schists, marbles, quartzites, and metasedimentary rocks that preserve evidence of Precambrian tectonic assembly and crustal accretion processes. Structural fabrics, shear zones, and deformation features within this zone exert an important influence on present-day landscape development.

Within this tectonic framework the Precambrian carbonate successions that host the Yana karst system. These dolomitic limestones and marbles, interpreted to have formed in shallow marine environments during the late Archean to Paleoproterozoic, subsequently experienced metamorphism and deformation associated with regional tectonic events. Owing to their Precambrian age, these carbonate rocks predate the evolution of complex multicellular organisms and therefore do not contain conventional macrofossils. Nevertheless, they are of paleontological significance because ancient carbonate successions provide valuable archives of early Earth's environments, microbial activity, and ocean chemistry, making them important for studies of Precambrian life and biospheric evolution. The carbonate units are particularly significant because they preserve one of the most spectacular examples of tropical karst development in India, including caves, dissolution features, and towering carbonate monoliths.

A major chapter in the geological evolution of the region occurred during the Late Cretaceous, when the Indian Plate separated from Madagascar during the fragmentation of Gondwana. This rifting event was accompanied by extensive magmatism along the western continental margin and generated volcanic centres associated with the Madagascar–India breakup. The magmatic activity reflects mantle processes linked to lithospheric extension and provides important evidence for the geodynamic evolution of the northern Indian Ocean region.

St. Mary's Island preserves one of the best exposures of this tectono-magmatic event. The island is composed predominantly of felsic volcanic rocks, including rhyolites, rhyodacites, and dacites, dated to approximately 88–90 Ma. These rocks display spectacular columnar jointing produced during cooling and contraction of silicic lava bodies. Their geochemical and isotopic characteristics indicate formation in an anorogenic within-plate setting related to continental rifting, making the island a key locality for understanding the magmatic consequences of Indo-Madagascar separation. Paleontologically, the exposed volcanic rocks are devoid of fossils because they crystallised directly from magma rather than accumulating as sedimentary deposits that can preserve biological remains. Consequently, the scientific importance of St. Mary's Island lies in its exceptional volcanological, petrological, geochemical, and tectonic record rather than its fossil content, providing a unique archive of Late Cretaceous continental rifting and magmatism.

The modern landscape is largely the product of Quaternary processes that continue to modify both the coastal and inland environments. Along the coast, marine erosion, wave action, sediment transport, and shoreline evolution have produced wave-cut platforms, beach ridges, shell-rich deposits, and rocky intertidal habitats. Within the Western Ghats, prolonged tropical weathering and groundwater-mediated dissolution have generated the karst landforms of Yana, including caves, sink features, and carbonate towers. These Quaternary processes represent the latest phase of landscape evolution and demonstrate how ancient geological structures continue to influence modern geomorphic systems.

Together, these geological elements provide a coherent narrative linking Archean crustal evolution, Precambrian tectonics, Gondwana breakup, Late Cretaceous volcanism, and Quaternary landscape development, making the western Karnataka transect an exceptional natural laboratory for interdisciplinary geological research.

Flora, Fauna and Climate, Weather Conditions During Field Excursion

The field excursion traverses two contrasting ecological and climatic settings along the western margin of India: the Arabian Sea coast at St. Mary's Island and the tropical evergreen forests of the Western Ghats surrounding Yana. Together, these environments provide an opportunity to examine the influence of climate, geomorphology, and geology on ecosystem development across a relatively short geographic distance.

Fieldwork is scheduled for the end of January 2027, which represents one of the most favourable periods for geological investigations in Karnataka. The post-monsoon dry season is characterised by stable weather, low precipitation, excellent visibility, and moderate humidity. Along the coast, temperatures typically range between 21°C and 33°C, while inland temperatures in the Western Ghats generally vary between 28°C and 32°C.

The coastal environment of St. Mary's Island is dominated by marine and littoral ecosystems adapted to saline conditions and strong seasonal climatic influences. Vegetation is sparse, consisting primarily of coconut palms, coastal scrub, and salt-tolerant plant communities. The intertidal zone supports diverse assemblages of algae, crabs, barnacles, molluscs, sea anemones, and small fish inhabiting rock pools developed within the columnar volcanic outcrops. The surrounding marine environment provides habitat for numerous bird species including Brahminy kites, gulls, terns, sandpipers, and grey egrets.

In contrast, Yana lies within the biodiversity-rich Western Ghats, a globally recognised biodiversity hotspot characterised by tropical evergreen and semi-evergreen forests. The region supports a rich assemblage of flora including teak, rosewood, bamboo, lianas, mosses, ferns, and lichens that thrive under humid tropical conditions. The surrounding

forests provide habitat for Indian Giant Squirrels, Malabar Pied Hornbills, bats, butterflies, amphibians, reptiles, and numerous invertebrate species. The interaction between climate, lithology, groundwater circulation, and vegetation plays a critical role in promoting tropical weathering and karst development within the carbonate terrain.

The excursion therefore offers participants a unique opportunity to observe the transition from coastal marine ecosystems to montane tropical forest environments while examining the geological processes that underpin landscape and ecological evolution across western Karnataka.

Literature Review

St. Mary's Island

St. Mary's Island has attracted considerable scientific attention owing to its distinctive columnar volcanic rocks and its significance in reconstructing the tectonic evolution of the western Indian margin (Bhushan et al., 2010). Geochronological studies have established crystallization ages of approximately 88–90 Ma and linked the volcanic activity to the breakup of India and Madagascar during the Late Cretaceous (Pande et al., 2001; Torsvik et al., 2000). Geochemical and isotopic investigations indicate that the rocks are predominantly felsic volcanic units, including rhyolites and rhyodacites, generated in an anorogenic within-plate setting (Melluso et al., 2009). These studies have demonstrated affinities with contemporaneous volcanic provinces of Madagascar and have helped constrain the timing and nature of Gondwana fragmentation (Torsvik et al., 2000). Geomorphological investigations have further documented active coastal processes, including marine erosion, wave-cut platform development, beach-ridge formation, and shoreline evolution along the Karnataka coast (Bhushan et al., 2010; Sowmya et al., 2019).

Yana

Although widely recognized as one of India's most spectacular karst landscapes, Yana remains comparatively understudied. Previous investigations have focused primarily on the regional geology of the Kumta Suture Zone, the petrology of associated carbonate rocks, and the geomorphological significance of the karst towers and cave systems (Naqvi & Rogers, 1987; Chadwick et al., 2000). Existing studies suggest that the carbonate monoliths developed within Precambrian dolomitic carbonates that were subsequently deformed and metamorphosed during regional tectonic events (Naqvi & Rogers, 1987). The present landscape reflects prolonged tropical weathering and groundwater-mediated dissolution that has produced caves, solution grooves, sink features, and isolated carbonate towers, consistent with established models of tropical karst evolution (Ranawat & George, 2019). However, detailed studies addressing structural controls, hydrogeology, and long-term karst evolution remain limited.

Outstanding Scientific Questions

Despite substantial progress in understanding both field areas, several important scientific questions remain unresolved. At St. Mary's Island, further work is required to understand the petrogenesis of the felsic volcanics, the origin of brittle structures preserved within the volcanic rocks, and the broader geodynamic implications of Indo–Madagascar rifting (Torsvik et al., 2000). At Yana, the influence of tectonic structures on karst development, groundwater pathways, and landscape evolution requires detailed investigation (Ranawat, P. S., & George, S. 2019).

A broader challenge is to understand how ancient tectonic events continue to influence modern geomorphic systems. The field excursion provides a unique opportunity to explore links between Precambrian crustal architecture, Late Cretaceous magmatism, Quaternary coastal evolution, tropical weathering, and geoheritage preservation. These themes align closely with current international research priorities in tectonic geomorphology, landscape evolution, geoconservation, and Earth-system science.

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Field Transects

Day 1: Coastal Volcanism and Quaternary Coastal Processes

Time	Location / Stop	Activities and Scientific Themes
08:00 hrs	Departure from Manipal	Departure and briefing on excursion objectives.
08:30 hrs	Malpe Harbour (Stop 1)	Introduction to the geology of the western continental margin; overview of coastal geomorphology, tectonic setting, and field programme.
09:00 hrs	Ferry Transfer	Ferry transfer from Malpe Harbour to St. Mary's Island.
09:30–13:00 hrs	St. Mary's Island (Stop 2)	Examination of columnar rhyolitic and rhyodacitic volcanic rocks; discussion of Indo–Madagascar rifting and Late Cretaceous magmatism; structural observations of cooling joints and brittle deformation features; study of wave-cut platforms, rock pools, shell-rich beaches, and active coastal processes.
13:00 hrs	Ferry Transfer	Return ferry from St. Mary's Island to Malpe Harbour.
14:00 hrs	Lunch	Lunch break.
15:00 hrs	Return to Manipal	Return journey to Manipal; evening discussion and synthesis of observations from the day.

Day 2: Cratonic Evolution, Tectonics and Tropical Karst

Time	Location / Stop	Activities and Scientific Themes
06:00 hrs	Departure from Manipal	Departure towards the Karnataka coast and Western Ghats.
08:00 hrs	Maravanthe Beach (Stop 3)	Examination of coastal geomorphology; discussion of barrier systems, shoreline dynamics, sediment transport, and coastal evolution.
09:30 hrs	Murdeshwar (Stop 4)	Observation of coastal landforms and landscape evolution along the Arabian Sea margin; discussion of interactions between tectonics, sea-level fluctuations, and coastal processes.

Time	Location / Stop	Activities and Scientific Themes
11:30 hrs	Kumta Region (Stop 5)	Introduction to the Karwar Block and Kumta Suture Zone; examination of regional tectonic architecture, deformation patterns, and crustal evolution.
13:00 hrs	Lunch	Lunch break.
14:00–16:00 hrs	Yana Caves (Stop 6)	Examination of carbonate petrology and structural fabrics; study of karst geomorphology, dissolution features, cave systems, and carbonate monolith development; discussion of tropical weathering, groundwater processes, and geoheritage conservation.
17:00 hrs	Return Journey	Return to Manipal or overnight stay in the Kumta–Yana region, depending on logistical requirements and field conditions.

Summary of Excursion Stops

Stop	Locality	Principal Geological Themes
Stop 1	Malpe Harbour	Western continental margin geology and coastal geomorphology
Stop 2	St. Mary's Island	Late Cretaceous volcanism, Indo–Madagascar rifting, coastal geomorphology
Stop 3	Maravanthe Beach	Coastal sedimentary processes and shoreline dynamics
Stop 4	Murdeshwar	Coastal landscape evolution and marine geomorphology
Stop 5	Kumta Suture Zone	Precambrian tectonics, crustal evolution, structural geology
Stop 6	Yana Caves	Tropical karst geomorphology, carbonate petrology, structural controls on karstification

Stop 1: Malpe Harbour (13°21′ N; 74°42.5′ E)

Gateway to the Arabian Sea and the starting point of the excursion. This stop provides an introduction to the physiography of the Karnataka coast, regional geological setting, and the relationship between coastal geomorphology and offshore geological features.

Stop 2: St. Mary's Island (13°22′ 46″N; 74°40′ 23″E)

A National Geological Monument preserving spectacular columnar rhyolitic and rhyodacitic volcanic rocks formed during the Late Cretaceous breakup of India and Madagascar. Key themes include volcanology, tectonics, structural geology, coastal geomorphology, and geoheritage conservation.

Stop 3: Maravanthe Beach (13°42′ N; 74°38′ E)

An excellent locality for examining coastal sedimentary processes, shoreline dynamics, barrier development, and the interaction between marine and fluvial systems along the Karnataka coast.

Stop 4: Murdeshwar (14°05′ 37″N74°29′ 02″E)

A prominent coastal promontory offering insights into coastal geomorphology, marine erosion, landscape evolution, and the role of geological controls on shoreline morphology.

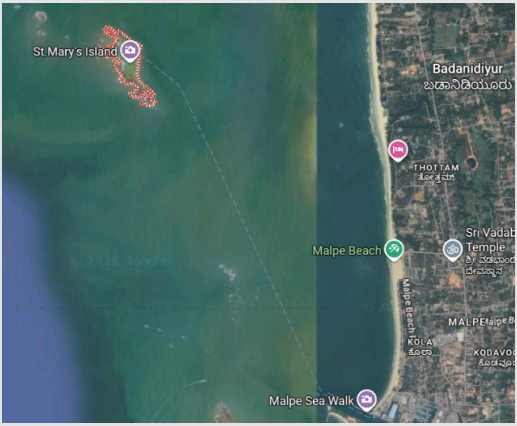
Stop 5: Kumta Suture Zone (14°25′ 33″N; 74°24′ 42″E)

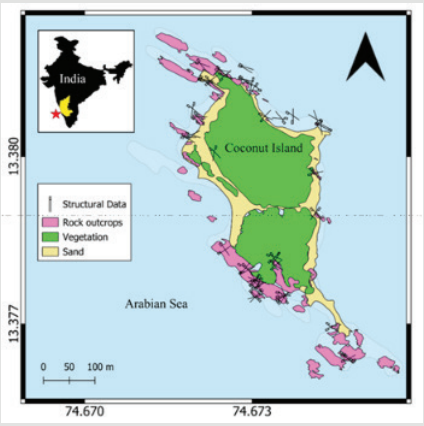
A regional-scale tectonic locality illustrating the structural framework of the western Dharwar Craton. Discussions focus on Precambrian tectonics, crustal assembly, deformation, and the geological evolution of the Karwar Block.

Stop 6: Yana Caves (14°35′ 23″N; 74°33′ 58″E)

One of India's finest tropical karst systems developed within Precambrian carbonate rocks. Participants will examine carbonate petrology, structural controls on karstification, dissolution features, cave development, and tropical weathering processes.

Field Map Showing Local Geology, Road and Excursion Stops





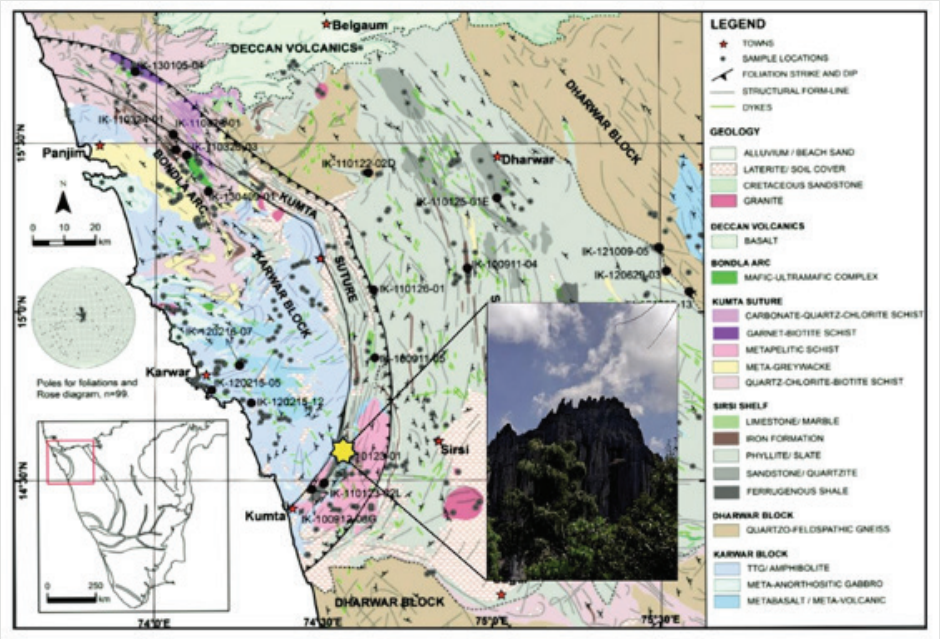


Figure 3 - Location of the Study area (yellow star) overlain on the geological map.

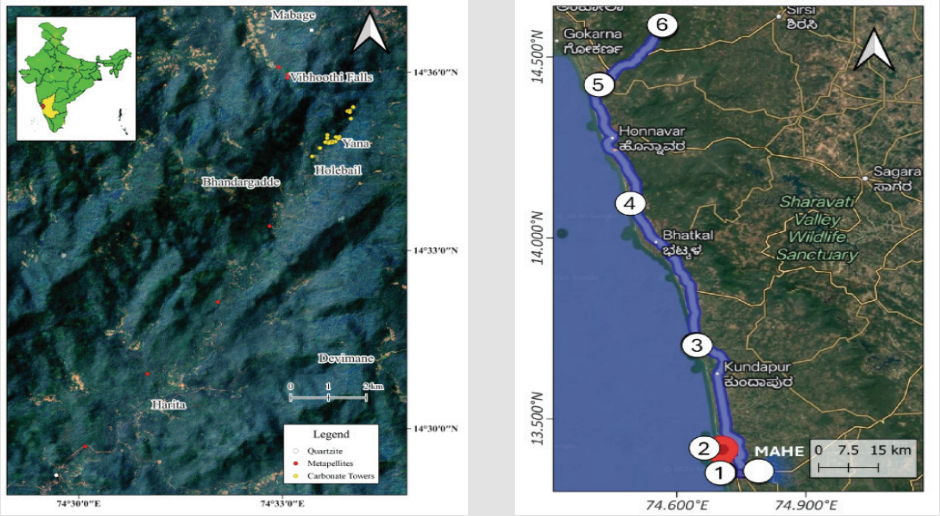


Figure 4 - Field locations for the study from the Yana Caves and the surrounding region.

Location Description including Geomorphology, Sedimentology, Chronology, Geochemistry

The field excursion encompasses two geologically distinct yet complementary localities—St. Mary's Island and Yana—which together illustrate the interplay between tectonics, volcanism, sedimentation, weathering, and landscape evolution across western Karnataka.

St. Mary's Island

The first component of the excursion focuses on Coconut Island, the principal island within the St. Mary's archipelago. Geomorphologically, the island is characterized by spectacular columnar-jointed felsic volcanic rocks that have been sculpted by active marine erosion. Wave action acting on resistant volcanic bedrock has produced steep coastal cliffs, extensive wave-cut platforms, and numerous rock pools developed along joint-controlled surfaces. The eastern margin of the island experiences high-energy marine conditions, whereas the western side is comparatively sheltered and characterized by the accumulation of shell-rich beach sediments.

Sedimentologically, the coastal deposits consist predominantly of unconsolidated biogenic carbonate material derived from fragmented marine shells, intermixed with aeolian quartz sands and coarse detrital fragments produced through weathering of the volcanic bedrock. These deposits provide valuable insights into contemporary coastal sedimentary processes and shoreline evolution along the western Indian margin.

Chronologically, high precision 40Ar/39Ar geochronology indicates crystallization ages between approximately 88 and 90 Ma, linking the volcanism directly to tectono-magmatic events associated with the separation of India and Madagascar during the Late Cretaceous. These ages demonstrate that the St. Mary's volcanic rocks pre-date the Deccan Traps and form part of the broader Madagascar Cretaceous Igneous Province.

Geochemically, the volcanic succession comprises subalkaline felsic volcanic rocks, predominantly rhyolites and rhyodacites, with silica contents ranging from approximately 68–74 wt.%. The rocks are enriched in Large-Ion Lithophile Elements (LILEs), display pronounced negative europium anomalies and exhibit isotopic signatures consistent with sub-continental lithospheric mantle-derived magmas that underwent fractional crystallization with limited crustal contamination. These characteristics provide important constraints on magma generation and tectonic processes during Gondwana fragmentation.

Yana Karst Complex

The second component of the excursion focuses on the Yana karst system, one of the most remarkable tropical karst landscapes of the Western Ghats. Geomorphologically, the area is dominated by the towering Bhairaveshwara and Mohini monoliths, which rise dramatically above the surrounding evergreen forest. The carbonate towers exhibit extensive karst

solution features, including dissolution grooves, cavities, overhangs, and cave systems that record prolonged interaction between groundwater and carbonate bedrock under humid tropical conditions.

Sedimentologically, the carbonate succession originated within a shallow-marine depositional environment during the Archean and was subsequently affected by deformation, metamorphism, uplift, and prolonged subaerial exposure. The present landscape reflects the cumulative effects of tropical weathering, groundwater circulation, and differential dissolution acting over geological timescales.

Chronologically, the host dolomitic carbonate rocks are assigned an age of approximately 2.7 Ga and form part of the Precambrian geological framework of the Dharwar Craton and the Kumta Suture Zone. In contrast, the modern karst landforms represent a much younger geomorphic system that has evolved primarily through Quaternary weathering and dissolution processes.

Geochemically, monoliths are composed predominantly of calcite and dolomite with variable silica enrichment. Their distinctive dark grey to black coloration is attributed to the presence of carbonaceous material together with oxidation products of trace manganese and iron. The mineralogical composition and structural fabric of the carbonate rocks exert a strong control on groundwater movement, dissolution patterns, and the development of the spectacular karst landforms observed today.

Geological Significance

Together, St. Mary's Island and Yana provide a rare opportunity to examine geological processes operating across vastly different timescales and tectonic settings. While St. Mary's Island records Late Cretaceous volcanism associated with the breakup of Gondwana and the opening of the Indian Ocean, Yana preserves evidence of Archean carbonate deposition, Precambrian tectonic evolution, and ongoing tropical karstification. The two localities collectively illustrate how ancient tectonic and magmatic events continue to influence modern geomorphic and sedimentary systems, making the western Karnataka transect an outstanding natural laboratory for investigating Earth-surface processes, landscape evolution, and geoheritage conservation.

Geoheritage, UNESCO Heritage, Archaeological Sites in the Vicinity, Customs and Culture

The excursion incorporates two of the most significant geoheritage localities in southern India. St. Mary's Island is recognized as a National Geological Monument because of its globally important columnar volcanic structures and its significance in understanding the breakup of Gondwana. Yana is recognized as a National Geo-Heritage Site and represents one of the finest examples of tropical karst geomorphology preserved within the Western Ghats landscape. Although included on India's tentative list for future consideration, it does not currently possess UNESCO World Heritage status. Yana is recognized as a National Geo-Heritage Site by the Geological Survey of India and lies within the broader Western Ghats UNESCO World Heritage landscape, representing one of the finest examples of tropical karst geomorphology preserved in the region. The surrounding areas of both localities also encompass important archaeological, historical, and cultural landmarks, including Darya Bahadurgarh Fort, Barkur, Mirjan Fort, and the Udupi Sri Krishna Matha, while Yana itself remains an important pilgrimage centre centred on the Bhairaveshwara cave temple. The cultural landscape is further enriched by traditional practices such as Yakshagana, Bhootada Kola, and Kambala, which reflect the enduring relationship between local communities, their religious traditions, and the natural environment.

Both sites are vulnerable to increasing tourism pressure, infrastructure development, littering, and unauthorized collection of geological materials. Conservation of these localities requires an integrated approach that combines scientific research, public education, sustainable geotourism, and community participation. The excursion emphasizes responsible field practices and highlights the importance of preserving geological heritage for future generations. By integrating internationally significant geological features with rich archaeological, cultural, and religious heritage, these localities serve not only as important geoconservation sites but also as outstanding outdoor laboratories for advancing research in tectonics, geomorphology, volcanology, karst science, Quaternary landscape evolution, and geoheritage management.

Images from St. Mary's Island (also known as Coconut Island)



Figure 6 - Columnar-jointed rhyodacites at St. Mary's Island



Figure 7 - Rock pool in the columnar-jointed rhyodacites at St. Mary's Island



Figure 8 - Wave-cut columnar structures seen at St. Mary's Island



Figure 9 - A close-up of columnar jointing at St. Mary's Island



Figure 10 - Mohini Shikar of Yana Caves



Figure 11 - Dissolution grooves at Yana Caves



Figure 12 - Sigma-type porphyroclast at Yana Caves



Figure 13 - The insides of Yana Caves

Conclusion

This excursion traverses an exceptional geological archive spanning nearly 2.7 billion years of Earth history, from the Archean evolution of the Dharwar Craton and Precambrian carbonate successions of the Western Ghats to the Late Cretaceous volcanic rocks associated with the breakup of India and Madagascar and the actively evolving Quaternary landscapes of coastal Karnataka. Through an integrated examination of tectonics, magmatism, geomorphology, coastal dynamics, tropical weathering, and karstification, participants gain a comprehensive understanding of the processes that have shaped the western margin of Peninsular India.

The combination of St. Mary's Island and Yana within a single field programme highlights the remarkable geological diversity of Karnataka and demonstrates the enduring influence of ancient geological events on modern landscapes. Beyond their scientific importance, both localities represent nationally significant geoheritage resources whose conservation is essential for future research, education, and sustainable geotourism. The excursion therefore provides not only a journey through deep geological time but also an opportunity to appreciate the importance of preserving Earth's geological heritage for future generations.

Acknowledgements

The organizers gratefully acknowledge the contributions of all institutions, researchers, students, and support personnel involved in the planning and preparation of this field excursion. We extend our sincere appreciation to the scientific community whose research has significantly advanced our understanding of the geological evolution, geomorphology, and geoheritage significance of St. Mary's Island, the Kumta Suture Zone, and the Yana karst system.

We also acknowledge the support and cooperation of local communities, government agencies, and administrative authorities whose continued efforts contribute to the conservation and accessibility of these important geoheritage sites. Special thanks are due to the Geological Survey of India for its leadership in promoting geological heritage conservation, scientific research, and public awareness.

The organizers are particularly grateful to the Manipal Academy of Higher Education (MAHE) for providing institutional support and fostering field-based teaching, research, and outreach activities. We further express our sincere gratitude to the organizers of the XXII INQUA Congress 2027 for providing the opportunity to develop and host this field excursion as part of the Congress programme. Their commitment to promoting international scientific exchange and field-based learning has enabled the presentation of Karnataka's exceptional geological heritage to the global Quaternary science community.

We look forward to welcoming participants in January 2027 and hope that this excursion will stimulate new scientific collaborations, research initiatives, and discussions on geoheritage conservation, landscape evolution, and Earth-system processes along the western margin of India.

Annexure

Field Excursion Guidelines: Do's and Don'ts

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

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

Do's	Don'ts
1. Follow the instructions of the excursion leaders, coordinators, and local authorities at all times. 2. Remain with the group and inform the excursion leader before leaving the designated route. 3. Wear appropriate field attire, including sturdy closed-toe footwear, full-length trousers, a hat or cap, and weather-appropriate clothing. 4. Carry sufficient drinking water, personal medications, sunscreen, insect repellent, and other essential field supplies. 5. Keep a valid photo identification and your excursion registration details with you during travel.	1. Do not collect rocks, fossils, archaeological artefacts, biological specimens, or any other materials without prior authorization. 2. Do not damage, deface, or remove material from geological outcrops, caves, monuments, heritage structures, or other natural features. 3. Do not wander alone or separate from the excursion group without informing the field leaders. 4. Do not climb unstable slopes, cliffs, rock formations, or enter hazardous areas unless specifically instructed or supervised. 5. Do not swim or enter rivers, lakes, lagoons, or coastal waters unless expressly authorized by the excursion leaders.

6. Respect local customs, religious sites, cultural heritage, and private property.

7. Follow the Leave No Trace principles by carrying back all waste and helping to keep field sites clean.

8. Use designated trails and approved observation areas to minimise environmental disturbance.

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

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

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

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

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

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

6. Do not consume alcohol, recreational drugs, or engage in unsafe or irresponsible behaviour during the excursion.

7. Do not operate drones or other restricted equipment without obtaining the necessary permissions.

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

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

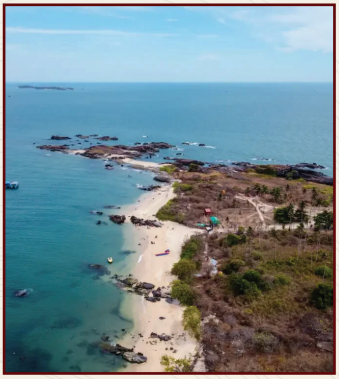
10. Do not leave valuables unattended or rely solely on mobile phone connectivity in remote areas.

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

Disclaimer

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













Scan for
Field Guide Book

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