

The Largest Stone Labyrinth in India: Geological, Archaeological and Archaeoastronomical Investigations of the 15 Circuit Labyrinth of Khadaki, Deccan Plateau, Maharashtra

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Abstract—This research paper presents a comprehensive geological and archaeological analysis of the recently discovered 15-circle stone labyrinth (chakravayuha) in Khadaki village, Tuljapur tehsil, Dharashiv district of Maharashtra, India. The structure represents India's largest known stone labyrinth, dating approximately 2,000 years before present, situated within the protected grassland region at coordinates approximately 17°45'57.11"N 76°2'43.79"E. This megalithic monument exhibits unique architectural complexity with fifteen concentric circular stone arrangements, unprecedented in the Indian subcontinent. The study integrates geological analysis of the Deccan Trap basalt substrate, petrological characterization of the construction materials, archaeological contextualization within the Iron Age-Early Historic period, and comparative analysis with global labyrinth traditions. Findings suggest the structure served multifunctional purposes including ritual, astronomical observation, and possible connections to ancient trade networks linking the Indian subcontinent with Mediterranean civilizations.

Index Terms—Chakravayuha, Deccan basalt, Dharashiv, Iron Age India, Labyrinth, Megalithic architecture.

I. INTRODUCTION

In May 2024, researchers identified a significant megalithic structure within the Khadaki grassland conservation area, situated approximately 20.5 kms North East of Solapur, and 59.4 kms South East of Dharashiv district, Maharashtra. This discovery, as confirmed by first Geologist later Archaeologist constitutes a remarkable 15-circle stone labyrinth, now recognized as the largest and most

architecturally complex structure of its type documented in India. Its sophistication, defined by fifteen concentric circular stone arrangements, markedly exceeds the scale of previously known Indian labyrinths, which are typically characterized by seven or fewer circuits.

This monument elevates the Khadaki site into an elite global category of megalithic constructions, inviting comparison with the seven-circuit labyrinths of Scandinavia, traditions associated with Cretan mazes, and various circular stone monuments distributed across Eurasia. The discovery holds substantial significance for archaeology, offering unprecedented potential to illuminate the technological proficiency, cosmological frameworks, and extensive cultural networks of Iron Age communities inhabiting the Deccan region [1].

The objectives of this comprehensive study are multifocal and interdisciplinary. Primarily, it seeks to characterize the geological substrate and origin of construction materials, while conducting detailed documentation of the monument's architectural and structural features. A core aim is to establish a firm chronological context by situating the labyrinth within regional megalithic traditions. Further analytical goals include investigating its potential functional purposes, which may encompass astronomical, ritual, and commemorative uses. The research will also probe the structure's connections to ancient trade routes and broader cultural exchange networks, undertaking systematic comparisons with labyrinth traditions globally. Finally, the study

includes a critical assessment of current conservation requirements and anthropogenic or environmental threats to the integrity of the monument.

II. GEOGRAPHICAL AND GEOLOGICAL SETTING

Khadaki village (Census 2011 location code: 561580) is situated in Tuljapur tehsil, Dharashiv district,

Maharashtra, at an elevation of approximately 546.20 meters above sea level. The village encompasses 1458 hectares (14.58 km²) with a population of 1326 (2011 Census). The labyrinth is located within the designated Khadaki Grassland Protected Area, a conservation zone spanning the southeastern outskirts of the settlement.

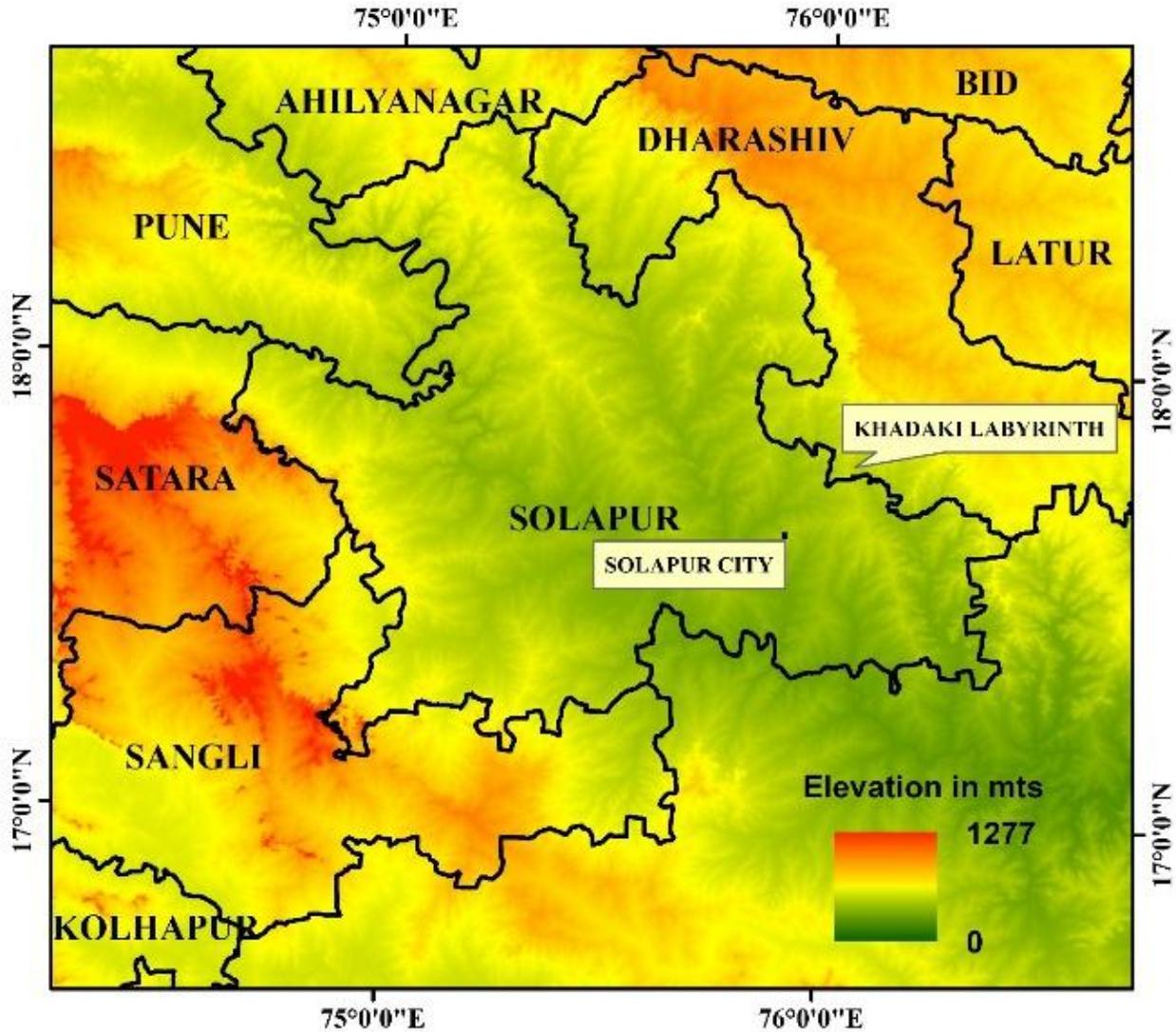


FIG. 1 LOCATION MAP OF THE KHADAKI LABYRINTH, DHARASHIV (OSMANABAD) DISTRICT, MAHARASHTRA, INDIA

The local topography is characterized by gently undulating terrain typical of the Deccan Plateau, with relatively flat-topped hills and gradual slopes. The region falls within the rain shadow of the Western Ghats, resulting in semi-arid climatic conditions with

average annual rainfall of approximately 500-600 mm, concentrated during the southwest monsoon (June-September) [2] [27].

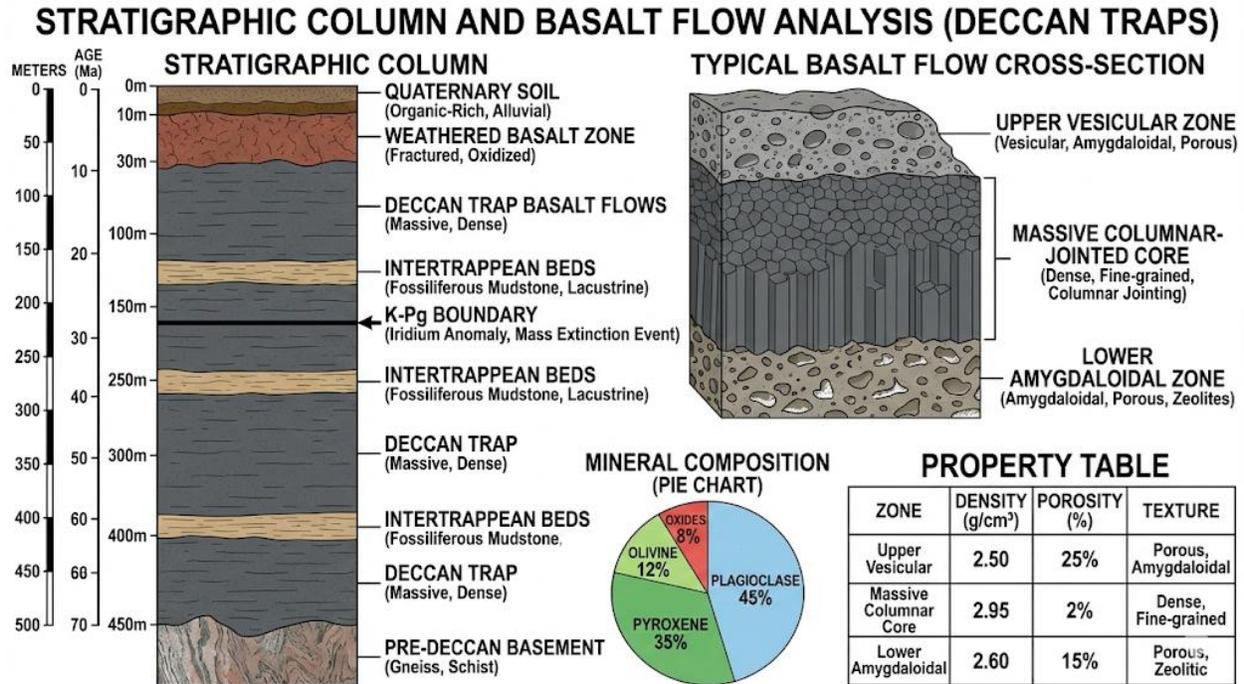


FIG. 2 GEOLOGICAL SETTING OF THE STUDY AREA

The Dharashiv / Solapur district is located entirely within the Deccan Trap geological province, a continental flood basalt province of exceptional size. This igneous formation originated from a major volcanic event approximately 66 to 65 million years ago, a period corresponding to the Late Cretaceous-Early Paleocene transition and coinciding with the Cretaceous-Paleogene boundary [3]. With an original estimated extent of approximately 1.5 million square kms and a current coverage of roughly 500,000 square kms, the province features basalt accumulations that exceed 2,000 meters in thickness in certain areas. The volcanism is attributed to the Indian tectonic plate's passage over the Réunion hotspot during its northward drift after the fragmentation of Gondwana. Eruptions occurred through extensive fissure systems, generating successive lava flows separated by sedimentary intertrappean beds that denote intervals of volcanic inactivity [4].

The petrology of the Deccan basalts in the Dharashiv /Solapur region is predominantly tholeiitic, constituting over 95% of the flows [28]. This composition is characterized by a primary mineral assemblage consisting of plagioclase feldspar (35–50%, with a labradorite-bytownite composition),

pyroxene (30–45%, including augite and pigeonite), olivine (5–15%, typically forsterite-rich in the lower flows), and opaque oxides such as magnetite and ilmenite (5–10%). The basalts display a range of textural varieties, including massive, fine to medium-grained dark grey to black types; vesicular forms containing gas cavities often infilled with secondary minerals (amygdales); and porphyritic textures featuring phenocrysts of feldspar or pyroxene within a finer-grained groundmass. Distinct structural features result from cooling and surficial processes, including the development of vertical prismatic columnar jointing during solidification, the concentric exfoliation of spheroidal weathering, and flow banding marked by the parallel alignment of minerals indicating lava flow direction [5].

A tropical to semi-arid weathering regime has acted upon these surface basalts to produce characteristic soil profiles. The dominant soil type is Regur, commonly known as Black Cotton Soil, formed through the chemical weathering of basalt [30]. This soil is rich in montmorillonite clay minerals, iron oxides, calcium, and magnesium, and possesses a high shrink-swell capacity that generates distinctive cracking patterns during seasonal desiccation [6]. Its thickness is variable, ranging from minimal cover on

elevated topography to several meters in valley floors.

Groundwater resources in the Dharashiv / Solapur district are primarily hosted within several geological units. These include the fractured and jointed zones of massive basalt flows, vesicular and amygdaloidal horizons that provide secondary porosity, weathered basalt zones typically extending to depths of 10–20 meters, permeable intertrappean sedimentary beds, and alluvial deposits along major river valleys [7] [29]. The region exhibits seasonal fluctuations in groundwater levels, with pre-monsoon water table depths typically ranging from 6 to 10 meters. Following the monsoon season, this level rises significantly, with the water table reaching depths of 1.5 to 3 meters below the surface [8].

III. ARCHAEOLOGICAL CONTEXT

The megalithic tradition in peninsular India constitutes a widespread Iron Age cultural phenomenon, dating approximately from 1500 to 300 BCE, with some structural origins extending into the preceding Chalcolithic period. Communities of this era constructed a diverse range of monuments, which can be categorized broadly as sepulchral and non-sepulchral. Burial structures include dolmens, characterized by a capstone supported by vertical slabs; cists, or box-like stone slab chambers; cairns, which are stone mounds covering burials; stone circles marking burial areas; and urn burials utilizing large pottery vessels for cremated remains. Non-sepulchral structures encompass menhirs, or standing stones likely serving as memorial or astronomical markers; linear stone alignments; hero stones commemorating warriors; and stone labyrinths, interpreted as ritual or ceremonial pathway structures [9].

In Maharashtra, numerous megalithic sites are documented, with particular concentrations in the Vidarbha region, including Junapani, Khapa, Mahurjhari, and Naikund near Nagpur; in Western Maharashtra, particularly within Pune district; and in a more scattered distribution across the Marathwada region, including Sambhajinagar, Dharashiv, and Beed. The stone circles at Junapani, located approximately 602 kms northeast of Khadaki, are of notable significance, as they feature cupule markings that suggest potential astronomical alignments related to solstice sunrise positions [10].

Prior to the Khadaki discovery, the corpus of documented stone labyrinths in India was limited. The Gedimedu labyrinth in Tamil Nadu, a square seven-circuit design measuring 17 by 17 meters and dated to approximately 2,000 years before present, was the second-largest known example and shows pattern similarities to the 1200 BCE Pylos tablets from Greece. The Bannerghatta labyrinth in Karnataka is a circular, seven-tiered structure locally known as "yeLu sutthina kote," with an uncertain date estimated between 2000 and 100 BCE. The earliest documented example is the Usgalimal labyrinth in Goa, which is a rock engraving rather than a constructed stone arrangement, associated with an Upper Paleolithic to Mesolithic rock art complex. A later tradition is represented by a circular cave labyrinth in Andhra Pradesh dated to the 6th century CE. The Khadaki structure, with its fifteen circuits, represents more than double the complexity of these previously known examples, suggesting either exceptional ritual significance or advanced astronomical and calendrical functions [11].

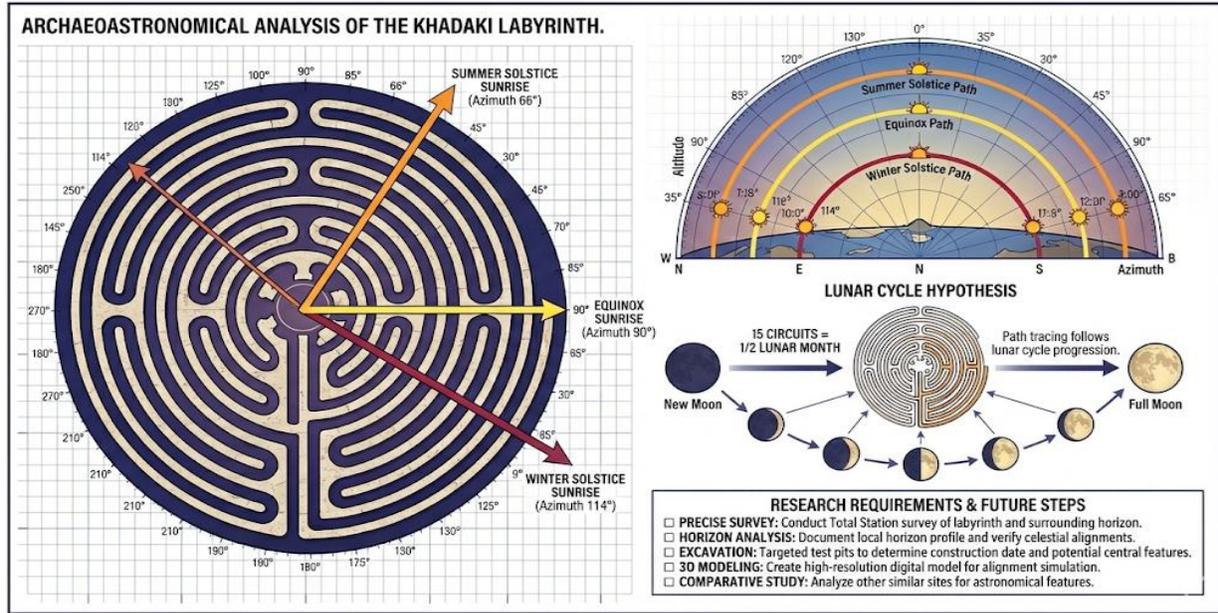


FIG. 3 ARCHAEOASTRONOMICAL ANALYSIS OF KHADAKI LABYRINTH

Establishing a precise chronology for megalithic structures presents significant challenges, primarily due to the absence of organic materials suitable for radiocarbon dating, a lack of stratigraphic context in many surface monuments, and the difficulty in distinguishing the date of construction from subsequent periods of use. The preliminary age estimate of approximately 2,000 years for the Khadaki labyrinth is therefore based on relative dating through archaeological associations. This estimation is supported by its alignment with known Iron Age to Early Historic period megalithic traditions in the Deccan region, roughly 300 BCE to 300 CE. Further contextual evidence includes material culture recovered from the Khadaki vicinity, such as Roman coins from the 1st century CE, terracotta lamps typical of the Early Historic period, semi-precious stone beads indicating trade connections, and iron implements associated with megalithic contexts [12]. The site's strategic position along an ancient trade corridor connecting the Deccan interior to coastal ports provides additional chronological and cultural context.

IV. STRUCTURAL DESCRIPTION AND ARCHITECTURE

The Khadaki labyrinth is configured as fifteen concentric circular stone walls arranged in a complex, radial pattern extending from a central focal point. Unlike maze structures with multiple branches and dead ends, this configuration follows a continuous, non-branching pathway that spirals from the entrance to the center, which is characteristic of classical labyrinth design. From the field study it is observed that the outer diameter of the structure is 15.40 meters with 15 circular rings.

The construction materials for the labyrinth were sourced locally from the Deccan basalt formations within a 1-to-5-kilometer radius. Geological analysis indicates the predominant use of massive basalt from weathered outcrops, supplemented by some vesicular basalt pieces. The builders selectively utilized naturally fractured basalt blocks, including pieces defined by columnar joints and spheroidally weathered rounded blocks, typically ranging from 20 to 80 cms in diameter. The transportation of these stones, with individual masses estimated between 50 and 300 kilograms, was likely achieved using methods such as wooden rollers, sledges, and organized human labor, a feasible undertaking given the relatively short transport distances [13].



FIG.4 GEOLOGICAL SOURCE MATERIAL (BASALT) OF THE KHADAKI STONE LABYRINTH

The construction technique involved several sophisticated stages. Foundation preparation likely included the partial excavation of the surface regur soil to reach the weathered basalt substrate, creating a leveled base possibly stabilized with smaller stone fragments. The walls themselves were constructed using a dry-stone masonry method without mortar, with blocks placed with their long axis horizontal and carefully fitted to minimize gaps. The original wall height is estimated to have been between 0.5 and 1.0 meters, though current degradation makes this uncertain. Establishing the circular layout would have required setting a central pivot point and using cordage or reed measuring rods to mark consistent radii, with sequential construction of the circuits proceeding either from the center outward or from the periphery inward [14].

The fifteen-circuit design reflects a high degree of architectural sophistication, demonstrating advanced mathematical understanding through the maintenance of precise circular geometry, consistent spacing of approximately 0.40 meters between concentric walls, and accurate alignment to a central point. The engineering capabilities implied by the construction are considerable, involving an estimated 5,000 to 15,000 individual stones and a coordinated labor force potentially numbering between 50 and 200 individuals, suggesting a construction timeline ranging from several months to years. The structure also possesses significant symbolic complexity [15]. The number fifteen may encode cosmological, astronomical, or ritual significance, while the single, continuous pathway from entrance to center embodies a potent metaphorical journey. Furthermore, the structure's orientation may incorporate specific solar or stellar alignments, a hypothesis requiring detailed archaeo astronomical analysis for confirmation.

V. FUNCTIONAL INTERPRETATIONS

The ritual and ceremonial functions of the Khadaki labyrinth can be examined through several interpretive frameworks. One significant association is with the "chakravayuha" (Sanskrit: चक्रव्यूह) tradition, a term translating to "wheel formation" or "circular array," most famously referenced in the Mahabharata epic. This mythological connection suggests the labyrinth's pathway may have served ritualized movement, such as walking as a spiritual practice for meditation and mindfulness, symbolizing a journey representing cycles of life, death, and rebirth, or functioning as a site for purification or transformation rituals [16]. The design may also embody defensive symbolism, intended to protect a sacred central space, ward off malevolent forces, or mark a territorial boundary.

Given the strong association of megalithic traditions in Peninsular India with burial practices and ancestor veneration, a mortuary function is a plausible hypothesis. The central chamber, if confirmed through excavation, may contain a cist burial or cremation deposit, with the circular walls defining a sacred mortuary precinct. The monument could thus serve a commemorative purpose, potentially representing an architectural-scale elevation of the hero stone tradition, marking a community burial ground, or signifying the genealogical importance of a specific lineage for clan identity [17].

Astronomical and calendrical functions are strongly suggested by the structure's geometry and potential alignments. Preliminary observations indicate potential solar orientations, where the entrance may align with sunrise or sunset positions at the solstices, and multiple sight lines between entry, center, and peripheral stones could mark key solar dates. East-

west alignments for equinox observations may have integrated the structure with an agricultural calendar. The fifteen circuits may further encode lunar cycles, corresponding to half of a synodic lunar month (approximately 29.5 days), mapping the progression from new to full moon, or even relating to the 18.6-year lunar nodal cycle used for eclipse prediction.

The circuits could also represent a mapping of nakshatra (lunar mansion) systems or the tracking of specific stellar asterisms important in Vedic astronomy, alongside observations of the pole star for establishing cardinal directions [18].

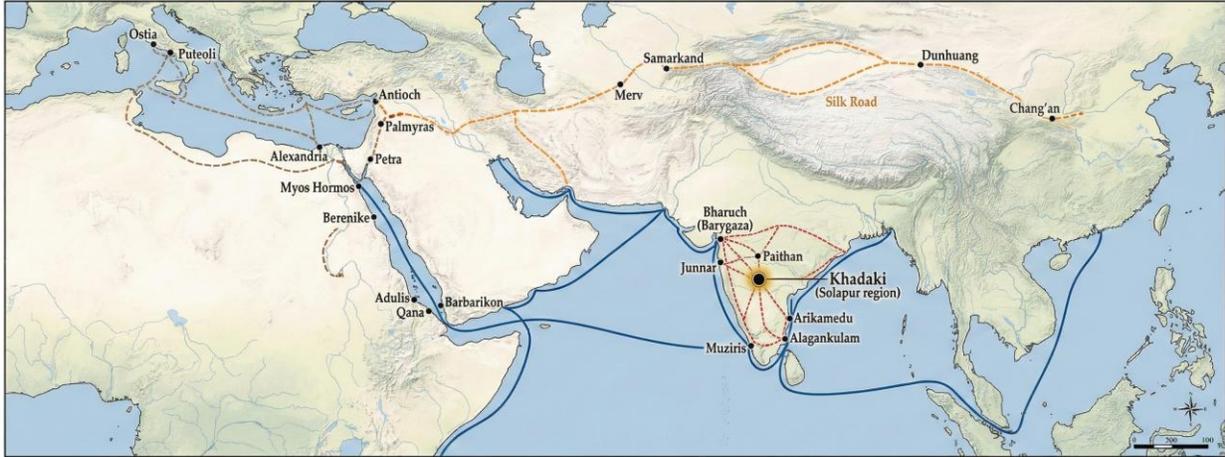


FIG. 5 TRADE NETWORK ASSOCIATED WITH THE KHADAKI LABYRINTH

The labyrinth's location provides significant context for understanding its potential role within ancient trade networks. The Khadaki region is situated along ancient trade corridors connecting the interior Deccan to coastal entrepôts, suggesting it may have functioned as a trade-route marker or caravanserai. Archaeological evidence supports active connections, including the recovery of 1st century CE Roman coins in the Dharashiv / Solapur district, fragments of Mediterranean amphorae at coastal sites indicating imports, and the export of semi-precious stones like carnelian and agate from the Deccan region westward [19]. The presence of similar labyrinth patterns documented across the Mediterranean, Northern Europe, and West Asia raises a cultural diffusion hypothesis, where design concepts may have been transmitted via these trade networks, resulting in a local adaptation and synthesis of external architectural traditions with indigenous megalithic practices.

During the Early Historic period (300 BCE - 300 CE), the region was integrated into flourishing maritime trade along the Silk Route, connecting Roman Egypt and Red Sea ports with South Asia and Southeast Asia. Key commodities exported from India included spices, textiles, precious stones, and

ivory, while imports comprised gold, silver, wine, olive oil, glassware, and coral. Overland routes connected interior production centers like those on the Deccan Plateau to coastal ports, with Dharashiv / Solapur positioned along these major trade arteries. Within this network, the labyrinth may have served multiple functions: as a waypoint marker for caravans, a site offering ritual protection for travelers, a meeting place for trade negotiations, or an indicator of cultural boundaries [20].

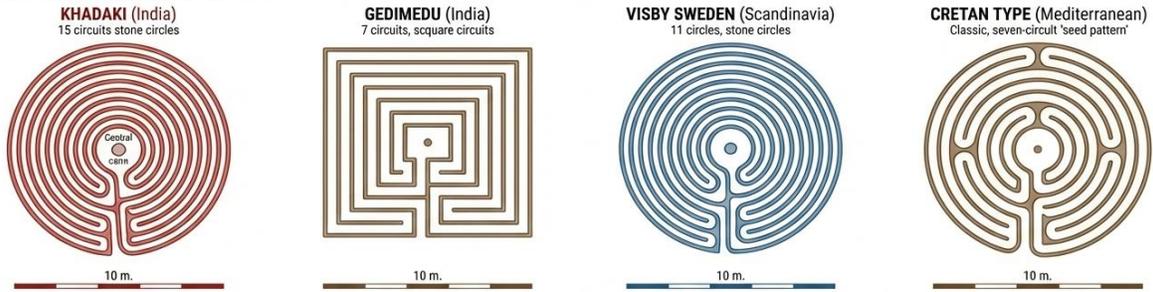
VI. COMPARATIVE ANALYSIS: GLOBAL LABYRINTH TRADITIONS

Of the over 600 documented stone labyrinths in Scandinavia, more than 300 are located in Sweden, with concentrations in Swedish Lapland and coastal regions. These structures are characterized by predominantly 7, 11, or 15-circuit designs, circular or kidney-shaped plans, and typical diameters ranging from 5 to 20 meters. Their frequent coastal locations suggest strong maritime cultural associations. Interpreted functions include fishing magic rituals to ensure favorable catches, protective magic against storms, seasonal ceremonial activities, and possible use as astronomical calendar markers. Their

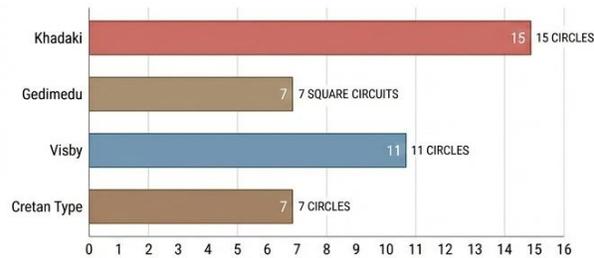
chronology remains problematic, with estimates ranging widely from 200 to 1500 CE, though some may be older. In comparison, the Khadaki labyrinth's 15-circuit design matches the more complex Scandinavian examples, suggesting either convergent cultural development or distant transmission of

concepts. However, its inland location contrasts sharply with the coastal distribution in Scandinavia, indicating likely differences in its primary functional and cultural context [21].

LABYRINTH PLAN COMPARISON



COMPARATIVE CIRCUIT COUNT (Number of Concentric Walls/Paths)



GLOBAL DISTRIBUTION OF STONE LABYRINTHS



FIG. 6 CROSS-CULTURAL COMPARISON OF LABYRINTH TRADITIONS WORLDWIDE

Within the Cretan and Mediterranean traditions, the labyrinth holds significant mythological context, most famously associated with the Knossos labyrinth housing the Minotaur and the architect Daedalus, with the symbol appearing on Cretan coins from the 5th to 4th centuries BCE. Archaeological evidence includes clay tablets from Pylos dating to 1200 BCE depicting seven-circuit labyrinth designs, labyrinth symbols in Roman mosaics throughout the Mediterranean, and various petroglyphs and architectural elements at other sites [22]. These

Mediterranean labyrinths most commonly feature a seven-circuit design with either square or circular variants, following a single pathway with four-fold symmetry. Compared to the Khadaki structure, while the fundamental design principles of a single, concentric pathway are similar, the 15-circuit complexity of the Indian example exceeds the typical seven-circuit Mediterranean models. This significant difference suggests either an independent regional development or a substantial local elaboration of an imported conceptual template.

TABLE 1 COMPARATIVE CHARACTERISTICS OF SELECTED LABYRINTH SITES WORLDWIDE

Site Name	Location	Circuits	Diameter (m)	Date (approx.)	Form
Khadaki	India	15	15.4	2000 BP	Circular
Gedimedu	India	7	17	2000 BP	Square
Bannerghatta	India	7	15	2000-100 BCE	Circular
Visby	Sweden	11	12	Medieval	Circular
Saffron Walden	England	17	40	1699 CE	Circular
Chartres	France	11	13	1205 CE	Circular

Megalithic henges and stone circles in Britain and Ireland, such as Stonehenge, Avebury, and Newgrange, while not labyrinths in the strict definition, provide relevant points of structural and functional comparison. These sites, constructed between 3000 and 2000 BCE, are characterized by concentric arrangements of standing stones and earthworks, precise solar and astronomical alignments, and clear ceremonial and ritual functions. They represent massive investments of communal labor within a sacred landscape context [23].

The Khadaki labyrinth shares several of these broad characteristics, including circular planning, potential astronomical integration, presumed ceremonial functions, significant labor investment, and a likely sacred landscape context, placing it within a similar category of large-scale communal monument-building, albeit with a distinct architectural form.

A synthesis of global traditions reveals that labyrinth symbolism embodies several universal themes across diverse cultures and periods. These include potent journey metaphors, representing the life path from birth to death, a spiritual pilgrimage toward enlightenment, or a physical representation of inner transformation. The form also frequently reflects concepts of cosmic order, where the circular shape mirrors celestial movements, numerical symbolism encodes cosmological structures, and the design integrates earthly and heavenly realms. Furthermore, labyrinths often serve boundary functions, demarcating sacred from profane space, protecting a central core, and acting as a testing ground for initiates [24]. The Khadaki labyrinth participates in this extensive global tradition, simultaneously exhibiting the unique architectural features and specific cultural context of the Deccan region.

VII. GEOLOGICAL CONSIDERATIONS FOR CONSTRUCTION

The site selection for the Khadaki labyrinth appears to have been guided by a confluence of practical geological and environmental factors. Geologically, the primary criteria included the availability of suitable basalt source material within a practical transport distance, a relatively level terrain to minimize extensive earth-moving, a well-drained substrate to prevent waterlogging, and a stable

foundation, where the weathered basalt surface was superior to deeper, less stable soil layers [31]. Environmentally, the location was likely chosen for its visibility on a subtle elevation or plateau surface, its accessibility via established pathways or proximity to settlements, the availability of water from seasonal streams to support the construction workforce, and the presence of semi-arid grassland vegetation that could be easily cleared for construction [25].

The long-term preservation of the structure is significantly attributed to the inherent durability of the Deccan basalt used in its construction. This durability stems from the rock's dense, interlocking crystalline texture, which provides high resistance to mechanical weathering and moderate resistance to chemical weathering in the prevailing semi-arid climate. Despite these favorable properties, the site remains subject to various degradation factors. These include biological weathering from lichen and algal growth that can accelerate chemical breakdown, physical weathering driven by temperature fluctuations causing thermal expansion and contraction, anthropogenic disturbance from agricultural activities or stone removal for construction, and vegetation growth where root penetration can destabilize the stone arrangements [26].

The current reportedly well-preserved condition of the labyrinth is likely due to a combination of its location within a protected grassland area and nearby forest area that has prevented agricultural plowing, the semi-arid climate limiting biological activity, the inherent durability of the basalt itself, and its recent discovery, which has historically limited extensive human disturbance.

VIII. RESEARCH METHODOLOGIES AND FUTURE INVESTIGATIONS

A preliminary assessment of the Khadaki labyrinth has been completed, encompassing visual documentation through aerial drone photography and ground-level photogrammetry, along with sketch mapping of the overall configuration. The initial archaeological survey included surface artifact collection, a condition assessment, and a preliminary chronological evaluation based on regional context.

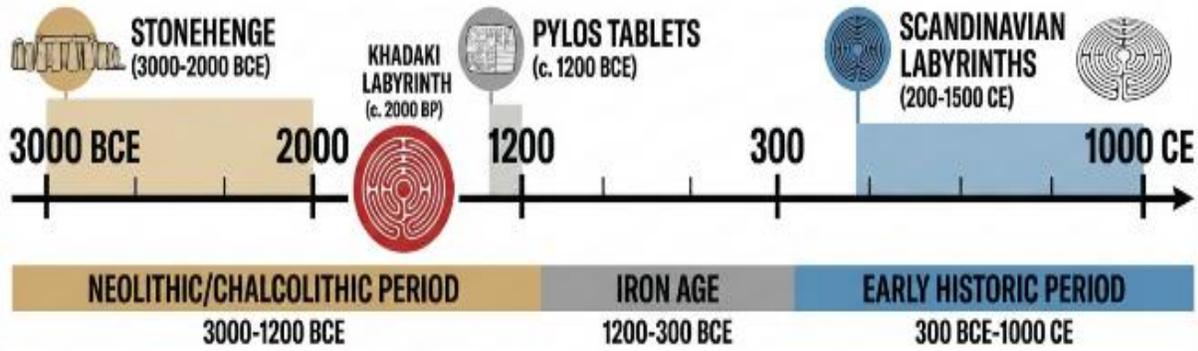


FIG. 7. CHRONOLOGY OF STONE STRUCTURES AND CULTURAL CONTEXT

Future research recommendations are structured across several interdisciplinary methodologies. High-resolution surveying is essential, utilizing a Total Station Theodolite for precise coordinate mapping of all stone positions and three-dimensional modeling, complemented by LiDAR (Light Detection and Ranging) to generate a centimeter-scale digital elevation model for detecting subtle landscape modifications. Ground-Penetrating Radar (GPR) is recommended for non-invasive subsurface investigation to identify potential buried features such as a central chamber or foundation trenches and to characterize soil stratigraphy.

Geoarchaeological analysis should involve detailed petrographic studies through thin-section microscopy to determine mineralogical composition and characterize source rocks. Geochemical analysis, including X-ray fluorescence (XRF) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS), would aid in stone source provenancing through elemental and trace element analysis. Comprehensive soil analysis is also necessary, involving pedological profiling, micromorphology of construction layers, and geochronological dating using techniques like Optically Stimulated Luminescence where suitable sediments are present.

Archaeological excavation should proceed with strategically placed units targeting the central area to test for a burial chamber or ritual deposits, the periphery to investigate construction sequence, and the entry/exit zones to examine usage patterns. Systematic artifact recovery would focus on pottery for chronotyping, lithic tool identification, biological

remains such as charcoal for radiocarbon dating, and metallurgical artifacts.

A dedicated archaeo astronomical investigation is warranted to test for potential alignments. This includes precision surveying of the entry/exit axis azimuth for comparison with solar declinations at solstices and equinoxes, and photographic documentation of sunrise/sunset alignments at key dates. Stellar alignment analysis requires identifying potential sight lines, applying precessional corrections to reconstruct the sky configuration of 2,000 years ago, and comparing findings with Vedic nakshatra systems. The potential lunar observation function of the fifteen-circuit design should also be analyzed, investigating its symbolism relative to lunar phases and potential alignments with the 18.6-year lunar standstill cycle.

Finally, comprehensive comparative studies are needed to situate the labyrinth within its broader context. Regionally, this involves systematic surveys for additional labyrinths in the Dharashiv district, integration with existing megalithic site distribution maps, and paleo demographic modeling of Iron Age settlement patterns. On an interregional scale, detailed formal comparisons with other labyrinths such as Gedimedu and Bannerghatta, as well as global forms, are crucial. This should be integrated with trade route archaeology along Deccan-coastal corridors and a thorough examination of evidence for Roman-Indian contact.

IX. CONSERVATION AND HERITAGE MANAGEMENT

The Khadaki labyrinth currently benefits from its location within the Khadaki Grassland Protected Area and near the forest area, which affords a degree of legal protection against agricultural encroachment, controlled access to limit unregulated foot traffic, and vegetation management that preserves the structure's visibility.

Several natural and anthropogenic factors pose ongoing threats to the site's preservation. Natural degradation processes include the progressive weathering of the basalt stones, biological colonization by lichen and vegetation. Anthropogenic impacts present significant risks, such as unmanaged tourism leading to stone displacement, the potential for stone theft for use as construction material, agricultural expansion should its protected status lapse, and urban development pressures associated with the growth of Dharashiv or Solapur. Furthermore, climate change introduces long-term vulnerabilities, including altered precipitation patterns that may accelerate weathering rates, increased frequency of extreme weather events like intense rainfall and drought, and shifts in vegetation communities that could destabilize the structure.

A comprehensive conservation strategy is recommended, beginning with immediate actions. These include completing a thorough photographic archive and detailed baseline condition assessment to document the site prior to any further degradation, and establishing permanent survey benchmarks. Stabilization efforts should focus on identifying and carefully repositioning displaced or unstable stones using minimal intervention techniques that avoid intrusive restoration and preserve the site's authenticity. Access management is critical and should involve designating a specific visitor pathway to minimize contact with the structure, installing interpretive signage to educate the public about its significance and fragility, and establishing clear carrying capacity limits for daily visitors.

For long-term management, the implementation of a systematic monitoring program is essential, including annual condition assessments, photographic monitoring from fixed positions, and controlled vegetation management. To foster public

understanding and support, site interpretation should be developed through a visitor center with exhibits on the geological and archaeological context, the creation of educational materials for schools and tourists, and integration of the site into regional cultural heritage tourism circuits. Establishing an on-site research facility would support ongoing investigations and facilitate international collaborative research, with findings published in peer-reviewed journals to ensure global scholarly access. Finally, enhancing the site's legal protection is paramount. This should involve nominating it for State Protected Monument status under the Maharashtra Ancient Monuments and Archaeological Sites and Remains Act, pursuing potential inclusion as part of a serial nomination for UNESCO World Heritage status with other South Asian megalithic sites, and developing a comprehensive, stakeholder-involved site-specific management plan.

X. CONCLUSIONS

The 15-circle stone labyrinth of Khadaki represents an extraordinary convergence of geological opportunism, technological sophistication, and cultural complexity in Iron Age Deccan society. Constructed from locally sourced Deccan basalt approximately 2,000 years ago, the monument stands as India's largest and most architecturally complex stone labyrinth, surpassing all previously documented examples in circuit number and spatial extent.

The structure is profoundly embedded in its geological context, exploiting the abundant Deccan Trap basalt substrate and demonstrating an intimate understanding of local lithological properties. Its builders selected naturally fractured basalt blocks from nearby outcrops, minimizing transport requirements while ensuring the structural durability that has facilitated exceptional preservation over two millennia. This architectural achievement, manifesting as fifteen concentric circuits, required sophisticated geometric planning, coordinated communal labor, and considerable time investment. The precision of the circular geometry and consistency of spacing across all circuits indicate the use of either direct measurement from a central pivot or cumulative expertise derived from prior construction experience.

Culturally, the labyrinth embodies multiple interpretive possibilities, functioning potentially as a ritual circumambulation pathway, an astronomical observatory, a burial monument, a trade route marker, or a synthesis of these roles. The indigenous chakravayuha tradition documented in Sanskrit literature provides a relevant cultural context, while material evidence of Roman-period trade suggests the possibility of Mediterranean influence or, conversely, an independent parallel development. Within a comparative global context, the Khadaki structure participates in a widespread labyrinth tradition spanning from Scandinavia to South Asia, yet exhibits distinctive characteristics, most notably its exceptional circuit complexity and inland, rather than coastal, positioning. Determining whether it represents an indigenous elaboration of universal symbolic forms or the result of cultural transmission along ancient trade networks remains an open question for investigation.

This discovery necessitates a reassessment of several key areas, including the complexity and sophistication of Deccan Iron Age societies, the extent of interregional cultural connections during the Early Historic period, the distribution and diversity of megalithic traditions in Peninsular India, indigenous astronomical knowledge and calendar systems, and the role of monumental architecture in prehistoric social organization. The structure provides tangible evidence for advanced engineering capabilities, mathematical understanding, cosmological sophistication, and social coordination that were previously underappreciated in studies of Iron Age Deccan communities.

Priority future research directions must include high-resolution surveying and three-dimensional modeling, strategic archaeological excavation of central and peripheral zones, archaeo astronomical analysis of solar and stellar alignments, comprehensive petrological and geochemical characterization, regional surveys for associated sites, absolute chronological dating through multiple methodologies, and comparative analysis with a global labyrinth dataset.

The heritage value of the Khadaki labyrinth is multifaceted. It possesses significant scientific value as a unique dataset for understanding Iron Age

technology, cosmology, and trade. Its educational value lies in being an accessible example of prehistoric engineering and astronomy. The structure holds cultural value through its connection to living traditions of ritual circumambulation in Indian religions, and economic value through its potential for sustainable cultural tourism development that benefits local communities. Its well-preserved state underscores its high conservation value, warranting international recognition and protection.

The discovery of this remarkable monument in May 2024 opens a new chapter in understanding the prehistoric heritage of Maharashtra and broader South Asian megalithic traditions. As systematic investigation continues to yield insights, it stands as a testament to the ingenuity, cultural sophistication, and cosmological awareness of its anonymous builders. The fifteen circuits spiral inward, mirroring the way archaeological and geological inquiry spirals progressively deeper into the mysteries of the human past. The Khadaki labyrinth invites not only scholarly investigation but also contemplation of the universal human drive to create meaning through monumental architecture, celestial observation, and sacred landscape modification—themes that transcend time, culture, and geography, connecting us to our ancient ancestors through the timeless medium of stone.

ACKNOWLEDGMENT

The author expresses sincere gratitude to the Honorable Deputy Director and the Honorable Commissioner, Groundwater Surveys and Development Agency (GSDA), Pune, for their invaluable guidance, encouragement, and institutional support throughout the course of this research. Their continuous motivation and administrative support have greatly facilitated the successful completion of this study. The author also acknowledges GSDA, Pune, for providing a conducive research environment and access to necessary technical and organizational resources. The encouragement and support extended by the senior authorities of GSDA have been instrumental in carrying out this research work effectively.

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