

An Archaeological Study on the Use of Raw Materials for Beads at the Deegavapi Monastic Complex

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Introduction

Beads represent one of the most analytically rich categories of small finds in archaeology, offering insight into ancient technological practices, exchange systems, and the symbolic dimensions of material culture. Their raw materials, manufacturing techniques, and contexts of use reflect deliberate choices embedded in specific economic, social, and ideological settings, making bead assemblages sensitive indicators of technological specialization and patterns of interaction. Within the wider Indian Ocean world, beads circulated through long-distance trade networks and were commonly fashioned from durable solid materials, serving as enduring markers of connectivity among diverse communities.

The Deegavapi Rajamaha Viharaya, located in the Deegavapi Grama Niladhari division of the Ampara District in Sri Lanka's Eastern Province, preserves a monastic complex with evidence dating at least to the Anuradhapura period. Excavations at the southern wahalkada in 2020 revealed a stone reliquary containing a varied bead assemblage, gold reliquaries, a gold foil sannasa inscription, and limestone reliquaries, underscoring the ritual and symbolic significance of beads in Buddhist devotional practice. Despite this importance, the raw materials and production technologies of the Deegavapi beads have not been systematically studied. This research undertakes a combined morphological and archaeometric analysis to investigate raw material selection, manufacturing sequences, and resource procurement, thereby elucidating technological organization and broader networks of connectivity within the eastern Sri Lankan monastic landscape.

Objective

The primary objective of this research paper is to study the archaeological potential concerning the use of raw materials in the beads discovered at the Deegawapi monastic complex. Archaeological evidence has revealed that alongside the evolution of human behavior and culture, beads were utilized for various purposes, incorporating a diverse range of raw materials. Focusing on these factors, the research has been further developed to address the following

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sub-objectives. In particular, attention was directed toward secondary objectives such as analyzing the beads through morphological and scientific methodologies with a focus on their physical characteristics; studying the rituals and bead deposition practices associated with the raw materials of the beads found in the vicinity of the Deegawapi Stupa(Vahalkada) identifying the cultural processes of bead deposition along with the corresponding state patronage and historical periods; and exploring local and foreign relations.

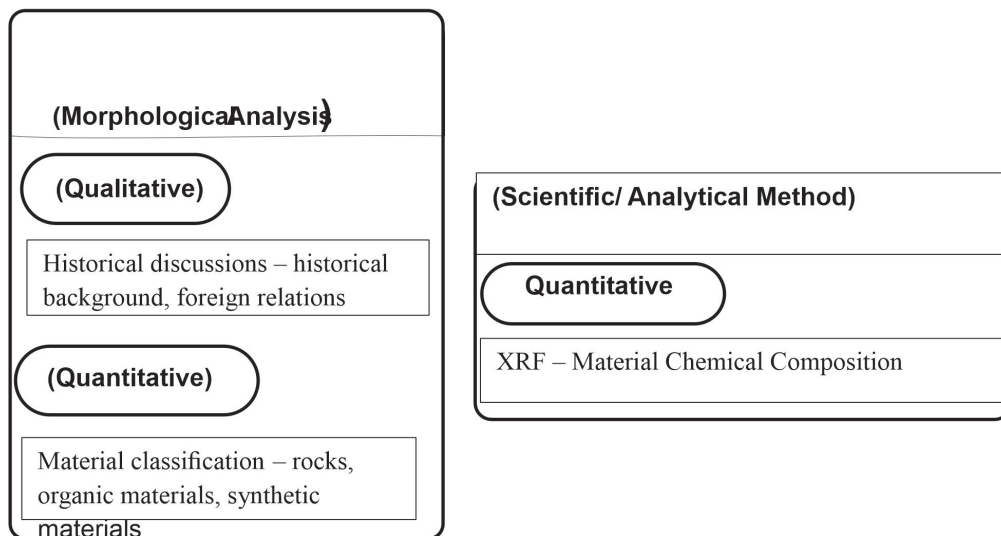
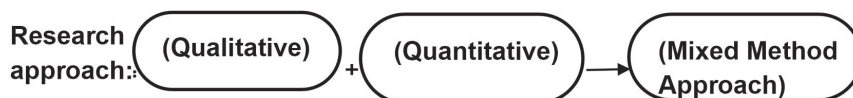
Methodology

Beads have been discovered in abundance within archaeological sites representing the historical period of Sri Lanka. According to research conducted to date, beads have been recovered from more than sixty percent of archaeological sites belonging to this historical context. Despite this prevalence, the absence of a standardized, systematic analytical framework has significantly constrained the scholarly understanding of their manufacturing technology, raw material sourcing, foreign relations, and chronological development.

A substantial body of evidence comprising bead artifacts, raw materials used for bead production, and glass bead furnaces has been documented across numerous locations. Key sites where bead evidence has been identified include Mantai (Carsell 2013), Kirinda (Wijeratne 2018; Somadeva 2004), Godawaya (Roth 2001), Anuradhapura Inner City (Coningham 2006), Jetavanaramaya (Gamloth 2016), Abhayagiriya (Wickramagama 1992; Kulatunga 2018), Akurugoda (Deraniyagala 2001), Tissamaharama (Madhusanka 2022), Ridiyagama (Bopearachchi 1999), Kaudagala Stupa (Buddikasiri 2023), Deegawapi Stupa (Buddikasiri 2023), Veheragala (Rev. chanaloka 2007), Anula Stupa (Unpublished 2022), Giribawa (Katugampola 2022 Katugampola 2024), Neelagiri Stupa (Buddhikasiri 2023), Kelaniya Pilapitiya (Bopearachchi 1999), Rajagala (Weerasinghe 2021), the Building with the Yatala Seat (CCF Reports 2017), Polonnaruwa Shiva Devalaya No. 02 (Coningham 2019), Kuchchaveli (Sanchi 2023), Ruwanwelisaya (Kulatunga 2018), and Sandagiriya (CCF Reports 2016). But they lack a unified methodological framework enabling inter-site synthesis. Internationally, scholars working on Indian Ocean trade archaeology have demonstrated that bead assemblages particularly glass beads serve as critical indicators of production centers, trade networks, and cultural exchange when subjected to systematic typological, technological, and archaeometric analysis. The absence of such an integrated approach in Sri Lankan bead studies constitutes a significant methodological gap in the existing literature.

This study employed a phased, mixed-method research design to investigate the raw-material basis of the Deegavapi bead assemblage. First, a

comprehensive review of historical sources and prior archaeological research established the contextual framework for glass and stone bead production and exchange. Subsequently, 430 beads recovered from excavations within the Deegavapi monastic complex in 2011 and 2021 were subjected to macroscopic morphological analysis and X-ray fluorescence (XRF) compositional study, allowing detailed characterization of raw materials and technological attributes. Quantitative and qualitative assessment of these data supported an integrated examination of technological, social, economic, and cultural relationships embedded in the raw material choices and physical properties of the Deegavapi beads.



Results

The bead assemblage recovered from the Deegavapi (Deegavapi) monastery complex comprises 430 specimens, classified into nine distinct raw material categories: shell, glass, carnelian, clear quartz, amethyst, grey smoky quartz, unidentified stone/rock, lapis lazuli, and chank (conch) shell. This distribution is presented quantitatively in Chart 1.3 and proportionally in Chart 1.4, providing a comparative basis for evaluating raw material selection patterns within this monastic context.

Distribution of Raw Materials

Quantitative analysis reveals that shell constitutes the dominant raw material, with 189 specimens representing 44% of the total assemblage. Glass beads occupy the second-largest category, numbering 95 specimens and accounting for 22.1% of the total. Carnelian follows as the third most frequent material, with 87 beads (20.2%), while clear quartz comprises 31 specimens (7.2%). Amethyst accounts for 16 beads (3.7%), and the remaining categories, grey smoky quartz (5 beads, 1.2%), unidentified stone/rock (4 beads, 0.9%), lapis lazuli (2 beads, 0.5%), and chank shell (1 bead, 0.2%) represent minor constituents of the collection. This hierarchical distribution indicates a pronounced reliance on locally available organic material (shell), supplemented by both technologically produced (glass) and imported semi-precious

stone (carnelian, amethyst, lapis lazuli) categories.

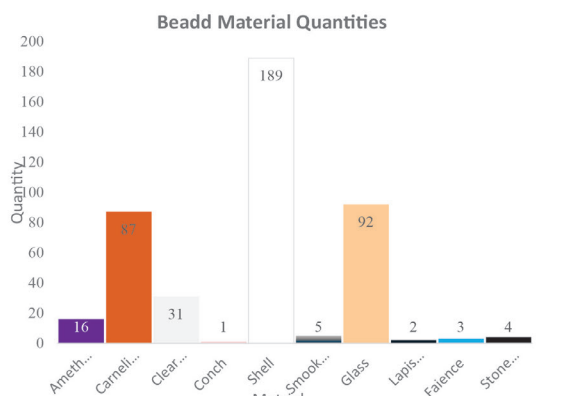


Figure 1.3. Deegavapi Beads: Quantitative data on raw material analysis

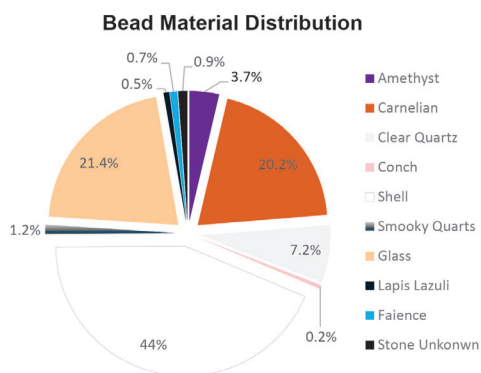


Chart 1.4. Deegavapi Beads: Percentage analysis of raw materials

Shell and Glass Predominance

The predominance of shell as a raw material, comprising nearly half of the total assemblage, is consistent with local availability and suggests probable local manufacture. The high frequency of shell beads corresponds with their established association with purity, fertility, and religious symbolism within Buddhist and broader South Asian traditions.

Glass beads, representing approximately one-quarter of the assemblage, indicate that this material required advanced production techniques unavailable through purely local means, reflecting the technological capacity and material value attributed to glass during the period under study. The scale of glass bead representation is consistent with associations between glass and elite or luxury use within contemporaneous social hierarchies.

Stone Bead Categories

Among stone-derived beads, carnelian is the most abundant, at 20.2% of the total assemblage. Variation in size and coloration, ranging from deep red to orange, is observed across the carnelian sample. The recovery of carnelian beads from the excavation of the southern gateway (Vahalkada) of the Deegavapi monastery premises is documented, situating this material within the broader trade context associated with Gujarat, India, as a probable source region.

Clear transparent quartz beads represent 7.2% of the total assemblage, constituting the smallest of the semi-precious stone categories identified. This category is characterized by distinct transparency and the application of specific geometric shapes to a subset of specimens, indicating deliberate selection and processing distinct from other bead types in the collection.

Amethyst beads account for 3.7% of the total assemblage (16 specimens), representing a comparatively rare stone type within the Deegavapi collection relative to other Sri Lankan sites, including Salgahawatta, Jetavana, and Abhayagiri in Anuradhapura, where amethyst beads have also been documented.

Minor raw material categories identified include grey smoky quartz (1.2%, 5 beads), lapis lazuli (0.5%, 2 beads), unidentified stone (0.9%, 4 beads), and chank shell (0.2%, 1 bead). The grey quartz specimen (bead sample-5) exhibits a distinctive appearance not commonly observed within the broader assemblage. Lapis lazuli (bead sample-2), a non-local mineral, is represented by only two specimens; this material is documented as originating from the Badakhshan region of Afghanistan. Comparative data indicate that Peter Francis recorded two lapis lazuli beads from Anuradhapura Gedige and four from Mantai, while Coningham

reported five lapis lazuli beads from Salgahawatta, Anuradhapura. The single chank shell specimen, though statistically minimal, is noted in association with documented ritualistic and religious significance of conch shell material within South Asian Buddhist and Hindu traditions.

Compositional Analysis of Unidentified Specimens

A subset of beads with indeterminate raw material composition was subjected to X-ray Fluorescence (XRF) analysis conducted by the Sri Lanka Atomic Energy Board using a Niton XL 3t GOLD handheld instrument. This analysis identified the presence of silicon (Si), aluminium (Al), potassium (K), calcium (Ca), iron (Fe), copper (Cu), and trace elements within the analyzed sample. It is noted that the instrument's sensitivity limitations preclude reliable detection of light elements such as sodium (Na), magnesium (Mg), and oxygen (O), and the absence of these elements in the dataset therefore does not indicate their true absence within the material composition.

For the black glass bead sample specifically, the elemental weight composition obtained via XRF was as follows: aluminium (2.3%), silicon (8.4%), phosphorus (0.5% and 0.06%), potassium (1.5%), calcium (1.3%), titanium (0.5%), chromium (0.01%), manganese (0.2%), iron (6.5%), nickel (0.1%), copper (1.3%), zirconium (0.02%), with the remaining 76.5% recorded as balance. The moderate aluminium content combined with low calcium content observed in this profile is consistent with the mineral soda alumina (m-Na-Al) glass category, characterized by alumina levels typically exceeding 2% and calcium oxide levels below 3-4%. This compositional profile differs from the plant ash soda-lime (v-Na-Ca) glass category, which is typically associated with higher calcium and magnesium content linked to Western Asian and Islamic glassmaking traditions.

The elevated iron (6.5%) and copper (1.3%) content identified within the black glass bead sample corresponds with the observed blackish coloration of the specimen, with iron functioning as the primary colorant contributing to black or deep blue hues, and copper contributing to blue-green tonal properties. The compositional data collectively confirm the classification of this specimen within the m-Na-Al mineral-soda glass tradition, distinguished by the use of mineral soda flux, locally sourced silica, and alumina-rich raw materials, and distinct from plant-ash-based glass compositions on the basis of its low calcium content.

Discussion

The Deegavapi bead assemblage reflects broad participation in the craft and exchange networks of ancient Sri Lanka and the wider Indo-Pacific region. The glass beads exhibit chemical and typological characteristics consistent with

mineral soda alumina (m-Na-Al) glass, a technological tradition well documented across South and Southeast Asia. Their reliance on mineral fluxes, rather than plant-ash recipes, firmly situates this assemblage within the Indo-Pacific glass bead industry. XRF analysis of the black glass bead confirms a siliceous m-Na-Al matrix with deliberate manipulation of iron and copper colorants, consistent with established Indo-Pacific compositional classifications. The stone beads correspond to recognized production traditions involving clear quartz, amethyst, and carnelian, processed through multi-stage chaînes opératoires. The identification of non-local materials, including lapis lazuli, points to integration within long-distance trans-regional supply chains. Collectively, the raw material, typological, and compositional evidence indicates that Deegavapi was embedded in interconnected technological and commercial regimes, providing a reliable foundation for future provenance studies.

Conclusion

This study demonstrates that an integrated morphological and compositional analysis of the Deegavapi assemblage effectively illuminates ancient material practices and exchange relationships. Combining macroscopic observation with XRF elemental analysis clarifies the technological choices and manufacturing strategies of bead producers at the monastery. The evidence reveals distinct technological trends, non-local raw material incorporation, and structured distributional patterns linked to production, trade, and ritual deployment. The research establishes a replicable analytical platform for future regional comparative studies of Sri Lanka's historical bead industries.

Keywords - Deegwapi stupa, Beads Material, Technology, scientific analysis, Glass & stone

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