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Study of Coloring Pigments in Sri Lanka: Late Pleistocene to Holocene from Wet Zone rock shelters

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Abstract

Sri Lankan wet zone rock shelters plays a unique role in the investigation of the global expansion of human activities and particularly microlithic phase adaptation to tropical environments. Rock shelters in the low-land wet zone rainforest of Sri Lanka, has yielded some of the evidence of Homo sapiens in South Asia. Archaeologists contend that it was our aptitude for symbolic, technological, and social behaviors that was central to Homo sapiens rapidly expanding across the majority of Earth's continents during the Late Pleistocene. This expansion included movement into extreme environments and appears to have resulted in the displacement of numerous archaic human populations across the Old World. Our foragers were present at wet zone rockshelters from 48,000 cal. BP to the Holocene. My Data (red ochre, yellow ochre, graphite and mica) from the recent excavation of the sites show that modern humans in tropical rainforests interacted with a diverse tropical setting from the Late Pleistocene to the Holocene.

Key words: wet zone, rockshelter, coloring pigments, Sri Lanka, Holocene, Pleistocene

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Introduction

Ochre-colored artifacts in Sri Lanka are often associated with prehistoric and early historic periods, where natural iron oxide pigments (ochre) were used for symbolic, decorative, or functional purposes (Deraniyagala, 1992). The discovery of ochre artifacts in prehistoric Sri Lankan archaeological contexts has significantly deepened my understanding of symbolic behavior, cultural complexity, and technological adaptation among early Homo sapiens in South Asia. Ochre—an iron-rich, earth-derived pigment in shades of red, yellow, and brown—has been widely recognized across the prehistoric world as one of the earliest materials used for symbolic and artistic purposes. Its appearance in Sri Lanka, particularly at the Fahien-lena cave site, provides critical evidence that complex symbolic behavior was present in tropical regions much earlier than previously assumed.

At more evidences of rockshelters, located in the rainforests of southwestern Sri Lanka, ochre use has been dated to nearly 48,000 years ago, making it the earliest known instance of such behavior in South Asia and one of the oldest in the world outside Africa (Langley et al., 2020; Perera et al., 2011). Excavations at the site have uncovered both worked ochre nodules—some ground or scraped to produce pigment—and pierced ochre beads, which likely served decorative or social signaling functions. The co-occurrence of marine shell beads, finely crafted bone tools, and microlithic stone technologies within the same stratigraphic layers highlights the sophisticated and symbolic culture of these early rainforest foragers. Unlike many other prehistoric sites where coloring pigments appears primarily as a utilitarian material, such as for hide processing or hafting tools, the Sri Lankan assemblages strongly suggest symbolic usage. The aesthetic and non-functional qualities of the beads—often drilled and smoothed without evidence of grinding for pigment—point toward their role in ornamentation, identity expression, or ritual activity.

The study of ochre artifacts in Sri Lanka challenges earlier models that placed the emergence of symbolic behavior primarily in African or European contexts. It instead supports a more geographically diverse and simultaneous development of symbolic culture across early human populations. The Sri Lankan rockshelters evidence also demonstrates how such behaviors emerged and thrived in tropical rainforest environments, previously thought to be marginal zones for early human occupation (Langley et al., 2020).

Here, I describe evidence for coloring artifacts from 48,000 years before present at the Sri Lankan sites of Low-land rockshelters—the earliest coloring artifacts outside of Africa. According to analysis data, coloring pigments are more abundant in Early Holocene phase and the microlithic phase had also persisted to at least the Mid Holocene in Sri Lanka. The findings of current study showed the continuation of the various attributes of the prehistoric culture from the Late Pleistocene to Mid Holocene.

Methodology

In this research, I have followed the primary and secondary sources. Primary sources are included such as field excavation (Kebella-lena and Fahien-lena – 2023) and also referred the research excavation reports in Kebella-lena (2022), Batadomba-lena (1980, 2005), Kithulgala Beli-lena (1983, 2017), Fahien-lena (1988, 2009 – 2012, 2023). The reported of coloring artifacts from these sites, have been reveled more shaping of coloring artifacts and ritual activities.

Results

The use of pigments by prehistoric peoples in Sri Lanka provides a fascinating glimpse into ancient human culture and creativity. Archaeological evidence suggests that early inhabitants of Sri Lanka, particularly during the microlithic periods, utilized various pigments for various purposes.

The presence of pigments at Kebella-lena was noted from the 2022 excavation. Also, Table 1 summarizes the evidence from Kebella-lena for the use of pigments based on the excavations in 2022. Limited excavations at Kebella-lena have yielded a very large quantity of excellently preserved ochre from the Terminal Pleistocene to Holocene but few colorant pigments of Fahien-lena have been reported in the 2023 season. The 8 ochres from the Terminal Pleistocene, 184 ochres from the Early Holocene and 146 ochres from other cultural phases have been documented at the Kebella-lena. Furthermore, 10 graphite from Terminal Pleistocene, 69 from the Early Holocene and 50 from other cultural phases have been documented at the Kebella-lena and mica is very few pigments were noted. However, few coloring pigments were documented from Fahien-lena, which noted 2 pigments from Terminal Pleistocene, 15 pigments from Early Holocene, 9 pigments from Mid Holocene and 3 pigments from the Late Holocene phase. These data show that symbolic practices persisted at the Terminal Pleistocene to the Late Holocene in Sri Lanka. Coloring pigments of Kebella-lena were only included in the typology (Sumangala et al., 2025).

Few grindstones with signs of use, and often these used surfaces reveal smears of red ochre, graphite or mica. One dimple-pitted hammerstones, some of which display surfaces smoothed by grinding and traces of red ochre. Fractured specimens are few. dimple-pitted nut stones connote, which are large and multiple pitted and with signs of having been used for a grindstone. Table 1 represents used red ochre, used yellow ochre, red and yellow ochre without signs of use, used graphite, graphite fragments without sign of use and mica fragments without sign of use. The frequencies of these pigments seem to rise and fall steadily with stones that have been used or had the potential to be used, for grinding pigment.

Table 2 summarize the evidence from Fahien-lena for the use of pigments based on the excavations in 2023. Fragments of red ochre, graphite and mica were recorded from the cultural

phases of Fahien-lena. Some specimen was the largest colorant piece recovered and display significant grinding and rubbing facets. The surfaces of some ochre and graphite exhibit extensive polish, indicating that they have rubbed against a soft surface such as skin (Figure 3). Ochre was very occasionally used in coloring the remains of the deceased, coloration of human bones was not reported in Kebella-lena (2022) and Fahien-lena (2023), but according to the Wijeyapala (1997; 381) reported the red-ochre coloration of the postcranial bones of the Mid Holocene (female skeleton) from Fahien-lena (1997) and also coloration human bones was reported from Fahien-lena in 2012 excavation season. In the 2012 excavation in Fahien-lena, 139 pieces of utilized colorant were identified by the excavation team (Stock et al., 2022). These are most prevalent in the Late Pleistocene through to Early Holocene, though a small amount was also recovered from the latest context.

In Kebella-lena, the presence of a considerable quantity of red and yellow ochre is documented through the cultural sequences, occurring as discrete pieces as well as smears presented on grindstones, anvils, and hammerstones (Figure 2). A considerable number of mica and graphite were also reported. As these do not naturally occur in the local lithology and no sources have been identified, it is more likely that the ochre was intentionally introduced, possibly through trade or transport by hominins. However, I cannot entirely rule out alternative processes, such as secondary natural transport (Table 1, 2). These findings lend support to the hypothesis that the widespread use of ochre, mica, and graphite may not have been solely functional—their use may have included a symbolic element. Some of the earliest known use of ochre has been reported from Late Pleistocene rock shelter at Batadomba-lena (Perera, 2010). In their 1989 study, Kennedy and Deraniyagala observed yellow ochre staining on a human vertebra from layer 7c, the earliest occupation phase, which they dated to approximately 38,000 years BP (Perera, 2010). The site exhibits a paucity of evidence pertaining to the production and utilization of ornaments. The Kebella-lena and Fahien-lena specimens are paralleled by the use of red ochre to coat the Pothana and Alawala Pothgul-lena rock shelter, which is currently dated to over 14,000 to 5,000 years ago. A piece of yellow ochres were found in reported association with the burial of a child from Layer III-a-2 (26,425 cal. BP) at Kitulgala Beli-lena (Wijeyapala, 1997). Although red ochre (from Layer III-a-1) is the oldest recognized ochre at Kitulgala Beli-lena, the layers dated older than 26 ka show a strong preponderance of yellow ochre. Furthermore, ochre was also used to coat the Ravana-ella human frontal (Ravana-ella Rock sheler). Moreover, a considerable number of used red and yellow ochre pieces have reportedly been found in the Mid Holocene habitation deposits of the Warana and Pilikuttuwa rock shelters, in the low-land wet zone.

The correlation analysis of the distribution of graphite, ochre,

and mica across cultural phases at Kebella-lena reveals strong positive correlations among all three materials. Graphite and Ochre exhibit a very strong positive correlation ($r = 0.963$, $p = 0.000$), indicating that they tend to appear together in the same cultural phases. Graphite and Mica also show a strong positive correlation ($r = 0.902$, $p = 0.006$), suggesting a significant association between these two materials. Additionally, Ochre and Mica demonstrate a strong positive correlation ($r = 0.941$, $p = 0.002$), highlighting a close relationship between them. These findings suggest a consistent co-occurrence of graphite, ochre, and mica across the cultural phases at Kebella-lena.

The correlation analysis of graphite, ochre, and mica distribution across cultural phases at Fahien-lena shows weak to no significant associations among the materials. Graphite1 and Ochre1 have a weak positive correlation ($r = 0.275$, $p = 0.551$), indicating a minimal relationship between these two materials in the cultural phases. The correlation between Graphite1 and Mica1 is negative ($r = -0.222$, $p = 0.632$), suggesting no meaningful relationship between these materials. Similarly, Ochre1 and Mica1 also show a weak positive correlation ($r = 0.206$, $p = 0.657$), further indicating that there is no strong association between these materials across the cultural phases. Overall, the results suggest that graphite, ochre, and mica are not significantly related in the Fahien-lena cultural phases.

Table 1. Distribution of Kebella-lena ochre, graphite and mica classification on cultural phases

Phase	Context	Function	Material	No. of Pigments
VII	1	Pigment	Graphite	31
			Ochre	61
	3	Pigment	Ochre	3
	14	Pigment	Graphite	7
			Mica	1
			Ochre	3
VI	4=7	Pigment	Graphite	19
			Ochre	58
V	15	Pigment	Ochre	24
IV	9	Pigment	Graphite	69
			Mica	7
			Ochre	184
III	10	Pigment	Graphite	10
			Ochre	8

Table 2. Distribution of Fahien-lena ochre, graphite and mica classification on cultural phases

Phase	Context	Function	Material	No. Pigments
VII	1, 2, 3, 4, 29, 22, 23, 33	Pigment	Ocher	-
VI	5	Pigment	Graphite	1
			Ocher	2
V	6, 8, 34, 21, 32, 14, 15	Pigment	Ocher	9
IV	16, 10, 31, 30, 11	Pigment	Mica	1
			Ocher	5
III	12=17=25, 9, 36, 35, 18, 19, 27	Pigment	Graphite	3
			Ocher	6
II	20		Ocher	2
Total				29

In Fahien-lena 2012 excavation season, completely unique to the site are three large beads made entirely of red ochre nodules, one found in Early Holocene and two with missing provenance (from excavations before 2010). Unlike the

136 other fragments of yellow, red, and mica colorants that exhibit striations from grinding and scraping to produce powdered pigment—only one of the beads shows any sign of grinding or scraping of its surface (Figure. 4) (Langley et al., 2020). Instead, all three have been perforated with c. 3-mm holes, the edges of which show signs of stringing. The higher surfaces of each ochre bead exhibit extensive rounding and polish, indicating that they have rubbed against a soft surface such as skin or hide (Langley et al., 2020). As far as we are aware, no other ochre beads have been reported for any other Pleistocene or Early Holocene–aged contexts anywhere in the world—instead, more durable beads (such as those made in shell or bone) have been found colored with pigment, either incidentally (transfer from the body/clothing) or deliberately (F. d'Errico et al., 2005). At Fahien-lena, no traces of colorants were observed on the shell beads, possibly owing to the fact that they were recovered during wet sieving and later washed. Silver (mica) pigments are the dominant colorant in the assemblage, followed by dark-to-bright reds, and then bright yellow (Langley et al., 2020). Mica nodules are exceptionally small in most cases, averaging just over 1 cm in maximum dimension. The 31.5-g specimen shown in Figure. 4 (D) was the largest colorant piece recovered and displays significant grinding and rubbing facets (Langley et al., 2020). If mica was available in large nodules, as this example indicates, the small finds then suggest that this type of pigment was regularly reduced to near exhaustion.

Fragments of red and yellow ochre occur from the earliest cultural layers up, and ochre smears are present on a number of grindstones and hammerstones throughout the cultural layers. Small quantities of graphite and lumps of mica, alien to the lithology of the rockshelter walls, may have also been introduced by humans as pigments. A human vertebra from layer 7c bears yellow ochre staining (Kennedy and Deraniyagala,1989), suggesting that, other possible uses notwithstanding, ochre was also used in a ritual context.

Coloring pigments were very occasionally used in coloring the remains of the deceased, as in the cases of the thoracic vertebra with yellow ochre coloration dated to ca. 30,000 years ago at Batadomba-lena (Perera, 2010; Perera et al., 2011)), and the red-ochre coloration of the postcranial bones of the middle Holocene female from Fahien-lena. The Batadomba-lena specimen is paralleled by the use of red ochre to coat the Willandra Lakes 3 burial, at Lake Mungo in Australia, which is currently dated to over 40,000 years ago (Bowler et al., 2003). There is considerable evidence for the use of pigments at Batadomba-lena in contexts other than mortuary rituals, as revealed by fragments of red ochre, yellow ochre, graphite, and mica from the earliest prehistoric occupation onwards, often smeared on stone artefacts that had been used to grind the pigment (Perera, 2010). Marks connote a grindstone with signs of use such as one or more large depressions, one or more small depressions, or a deep groove. Often these used surfaces reveal smears of red

ochre, graphite or chalk. In Kithulgala Beli-lena, varites coloring pigments have been utilized for fashioning artifacts, there are pieces of red and yellow ochre, graphite and mica reported, all very small and small in size. These may have been brought from out side possibly as source material for preparing pigments for ritualistic painting or other domestic purposes. The use of red and yellow ochre is clearly evident by the presence of ochre smeared grindstones, mullers, grinding stones found in habitation levels from IIIa onwards (Wijeyapala, 1997). Some well worn pieces of ochre and graphite with rubbing marks at one or several sides were also found in the assemblage.

Figure 1: Rubbed ochre artifacts (1, 2, 3); these ochres may have been used for ritual activities. The higher surfaces of each ochre exhibit extensive rounding and polish, indicating that they have rubbed against a soft surface such as skin or hide and skeleton (Sumangala et al., 2025).

Figure 2: Color material of Kebena-lena; Graphite and (01), ochre bead (2)

Figure 3: Coloring artefacts from Fahien-lena: Red ochre (1, 2) and Graphite (3)

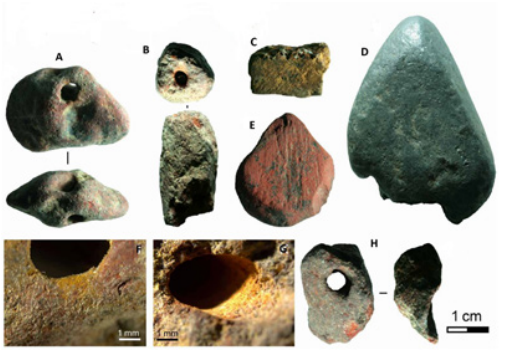

Figure 4. Coloring pigments culture of Fahien-lena. Ochre beads (A, B, F, G and H) and used (C) yellow, (E) red, and (D) mica colorants (Langley et al., 2020)

Discussion

The cultural phases at wet zone rockshelters contain red and yellow ochre, mica and graphite. As these do not naturally occur in the local lithology and no sources have been identified, it is more likely that the ochre was intentionally introduced, possibly through trade or transport by hominins. However, I cannot entirely rule out alternative processes, such as secondary natural transport. Abraded pieces of the ochres, this evidence by used ochre and ochre smeared grindstones, they have had knowledge on preparation of different colors. Red ochre, yellow ochre, graphite and mica were possibly in use for the purpose. Langley and colleagues have demonstrated the based on previous excavations, coloring pigment beads (polishing and rounding) and grinding and rubbing mica from Fahien-lena (Langley et al., 2020). While the collection and use of mica and ochre pigments are noted for other early Homo sapiens sites in Batadomba-lena, Kithulgala Beli-lena and Kuragala for smeared or other purpose (Perera et al., 2011; Wedage et al., 2020; Eregama, 2022).

Abraded pieces of red and yellow ochre and graphite were found in Terminal Pleistocene layers of Fahien-lena. The graphite nodules had invariably been utilized to exhaustion, probably reflecting its scarce availability. It is noteworthy that some human remains, dated to 45ca 4ca, were found coated with red ochre at Fahien-lena. Beads made of red ochre were found at Fahien-lena at layers dated to 8,700-8,000 cal. years BP. These red ochre beads show signs of anthropogenic perforation and polish suggesting that they transformed as pendant. These artifacts, common as Homo sapiens's personal coloring pigments, show one perforation and groove to facilitate suspension, and they are not colored with ochre.

Conclusion

The coloring artifacts of Sri Lanka—particularly those unearthed at wet zone rockshelters—offer invaluable evidence of the early emergence of symbolic thought, artistic expression, and social complexity among modern humans in tropical South Asia. Dating back nearly 45,000 years, these finds include both pigment-bearing ochre nodules and intentionally crafted ochre beads. Such associations underline that these prehistoric communities engaged in symbolic behaviors comparable to those observed in contemporaneous societies across Africa, Europe, and Southeast Asia.

Far from being peripheral to the broader story of human evolution, Sri Lanka's ochre record reveals that early humans in rainforest environments developed equally sophisticated cultural traditions. The selective production of pigment, the crafting of ornamental items, and their possible role in identity, ritual, or social signaling point to a fully modern cognitive capacity expressed through material culture. These discoveries not only expand the geographic scope of early symbolic practices but also challenge the idea that tropical rainforest settings were cultural backwaters in

prehistory. Instead, Sri Lanka stands out as a key location for understanding the diversity, adaptability, and creativity of early Homo sapiens.

The understanding and manipulation of coloring pigments indicate a significant level of technological advancement, with prehistoric people demonstrating knowledge of mineral composition and chemical processes. Coloring pigments in prehistoric times were more than mere aesthetics; they played essential roles in communication, expression, and spiritual beliefs. The study of these pigments offers a window into our ancestors' cognitive and social complexities, highlighting their creativity and connection to the world around them.

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