



# The composition and technology of the 3–4<sup>th</sup> century CE decorative earthen plaster of Pithalkhora caves, India



M. Singh <sup>\*</sup>, S. Vinodh Kumar, Sujata A. Waghmare

Archaeological Survey of India, Science Branch, Bibi-ka-Maqbara, Aurangabad 431 004, India

## ARTICLE INFO

### Article history:

Received 9 October 2015

Received in revised form 23 March 2016

Accepted 26 April 2016

Available online xxxx

### Keywords:

Earthen plaster

Particle size

Aggregate

Illite

Calcite

Quartz

## ABSTRACT

This research focuses on the characterization of ancient decorative earthen plaster of India's Pithalkhora group of caves. The restoration strategies being planned for the earthen plaster demand detailed scientific investigation to understand technology and composition so as to prepare matching plaster. The mineralogical, micro-structural and chemical characterization of the earthen plasters have been investigated by analytical tools like petrological microscope, XRF, CHN analysis, laser scattering particle size analyzer, FTIR, XRD, Scanning Electron Microscopy, thermal analyzer (DGA/DTA) as well as on-site observations. A comparative study with nearby sites portrays the earthen plaster of Pithalkhora coarser (silt: 62–100%, sand: 2–2.2%) with traces of clay (0–2%); hence it may be prone to damage by grain breakages. The chemical composition confirms that the aggregates mixed with the earthen plaster belong to that of locally available basaltic origin. SEM studies show addition of quartz and traces of clay (illite and montmorillonite) to augment the flexibility and performance of the plaster. The restoration plaster should be synthesized with aggregates of locally available basaltic rock mixed with slaked lime in addition with rice husk and other vegetal fibres as vegetal additive to overcome the shrinkage of the plaster.

© 2016 Elsevier Ltd. All rights reserved.

## 1. Introduction

The analyses and characterization of ancient earthen plaster in India is still in primitive stage despite notable progress in last decade worldwide (Sharma et al., 1995; Singh and Arbad, 2014, 2015). A critical understanding of earthen support layer is very essential as many problems associated with conservation of ancient decorative surface originate from structural or support layers. Due to vulnerability of earthen support layers, the literature in decorative layers on earthen support is very limited (Warran, 1990; Mora et al., 1984; Houben and Guillard, 1984; Griffin, 1999). Another major restriction is the availability of samples as research cannot be completed at the cost of damage to the historic surfaces. To tailor appropriate conservation strategies, the art conservators are required to be well versed about the problems of earthen architecture. Identification and characterization of original materials is a vital step for proper understanding of the deterioration process of the original fabric on earthen support layer. Such characterization allows development and synthesis of novel materials whose composition can be matched with the original materials. The materials used for conservation of earthen supports should be chosen in accordance with accepted conservation criteria (compatibility with original materials: equivalent or weaker strength, similar porosity and density etc.). The appropriate knowledge about composition and characteristics of original materials is an essential requirement for identifying the repair materials which fulfil the criteria.

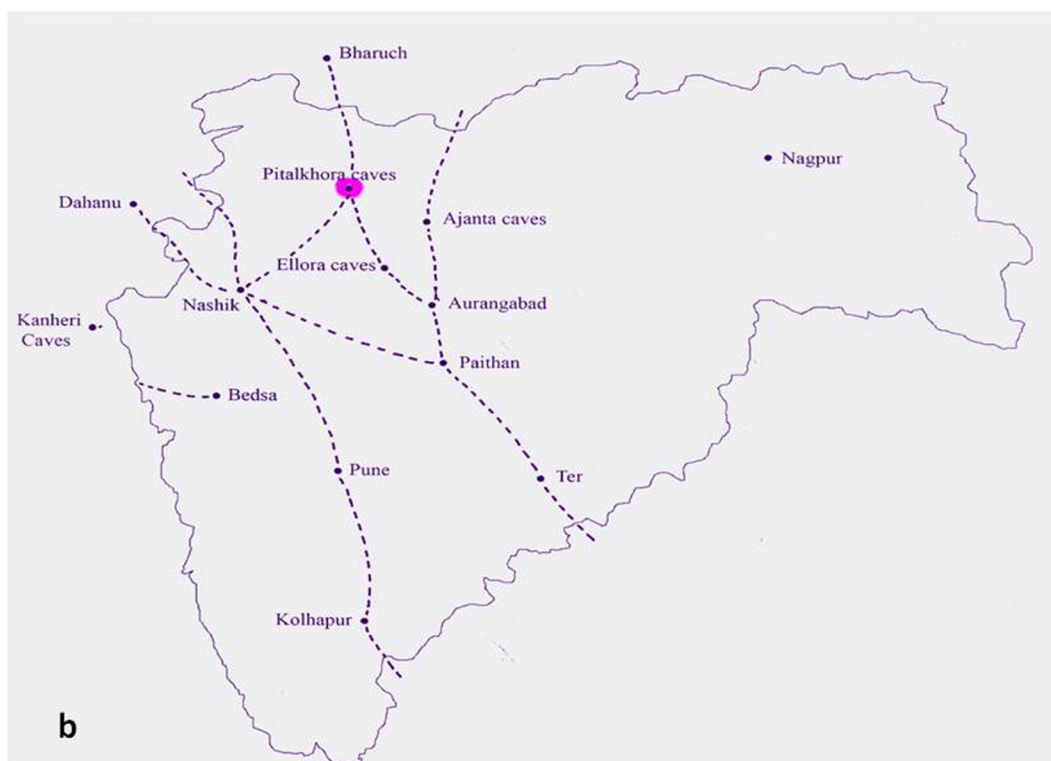
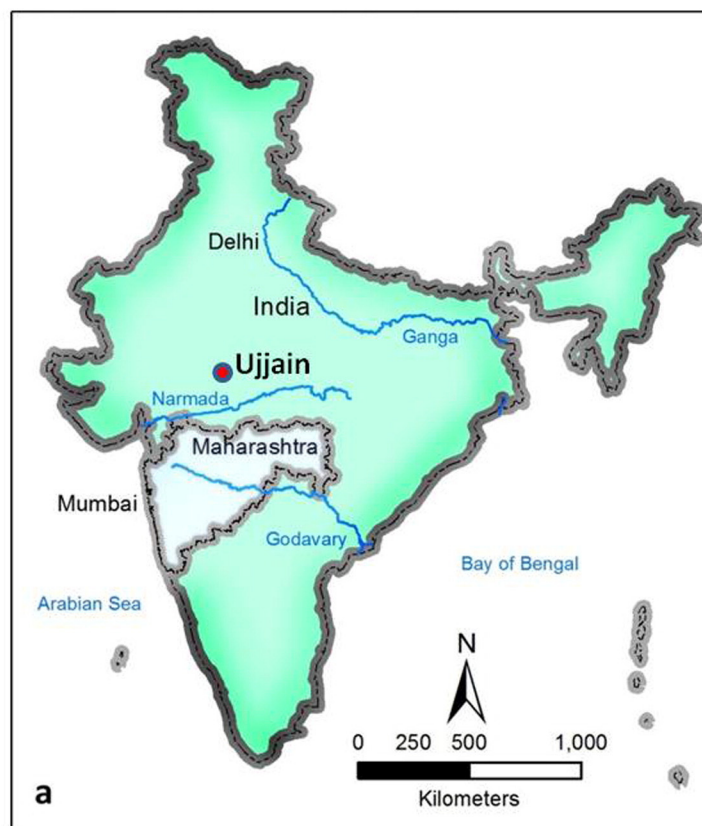
Pithalkhora Caves (20° 15' N; 75° 15' E) located in remotely wildlife valley in the Satamala range of western Ghats of Maharashtra, India consists of 14 Buddhist Caves and forms one of the earliest centres of the rock-cut architecture. The Pithalkhora caves represent an early Hinaya rock cut architecture but the earthen plaster and its painting are of Mahayana period as per inscription found dating back from 250 BCE to 3–4th century CE (Fergussons and Burgess, 2000; Nagaraju, 1981). This place was along an ancient trade route (Fig. 1) that connected the Deccan tableland with the port of Bharuch on the west coast and the ancient city of Ujjain to the north. Fig. 2 shows the general view of Pithalkhora caves. The Chaitya and Monastery Caves in this group have traces of very beautiful paintings of which some are surviving in the former. Fig. 3 show the beautiful painting on the earthen plaster of main Chaityagriha.

In contrast to other rock cut caves of western India, the Pithalkhora caves were excavated from variety of basalt stone which weathers fast. As the caves are carved in somewhat softer, fragile basaltic rock marked by thick clayey veins, here one can also see examples of 'ancient conservation'. A feature need special mention is ingenious arrangement diverting rain water from its way into the caves through cracks by making long tunnel like opening in the ceiling and allowing the concealed drain to lead the water outside.

Based on the ancient Indian painting recipe and recipe for the preparation of earthen plaster written in Sanskrit language in 6th century CE (Sivaramamurti, 1978), just after the painting works of Pithalkhora/Ajanta caves, it will be interesting to explore any addition of proteinaceous materials in to the earthen plaster of Pithalkhora, documented

<sup>\*</sup> Corresponding author.

E-mail address: [m\\_singh\\_asi@yahoo.com](mailto:m_singh_asi@yahoo.com) (M. Singh).



**Fig. 1.** (a) The map showing the location of Pithalkhora caves. (b) The map shows the location of Pithalkhora caves along with Buddhist caves of Maharashtra.

in ancient text to enhance the binding properties of the mortar. This will give additional data on the nature and characteristic of Pithalkhora plaster and help us in synthesis of compatible materials for restoration work. Adding vegetal additives is the common feature of all earthen plasterworks to enhance its performance (Miller, 1934, Orazi, 1994).

The types of vegetal additives incorporated in the plaster vary according to the place and availability of local materials surrounding the site (Singh and Arbad, 2014). It is essential to investigate and characterize vegetal remains in the original plaster to synthesize a matching plaster mix.

Download English Version:

<https://daneshyari.com/en/article/7446498>

Download Persian Version:

<https://daneshyari.com/article/7446498>

[Daneshyari.com](https://daneshyari.com)