Applied Research Partnerships with Developing and Transition Countries Swiss Universities of Applied Sciences and Universities of Teacher Education

Project title

Geology, mineralogy and geochemistry of ochers in Rajasthan (India)

Year

2008

Thematic focus

Painting raw materials, colouring earths

Project location

Jaipur, Chittourgarh, Bhilwara, Udaipur - Rajasthan, India

Swiss Institution

Giovanni Cavallo, geologist, giovanni.cavallo@supsi.ch Institute of Materials and Constructions, DACD-SUPSI -CH-6952 Canobbio (TI, Switzerland) www.imc.supsi.ch

Description

A precise and systematic knowledge of the materials used in the ancient and modern artistic objects represents the first step before projecting any conservation work.

Earth sciences provide several analytical techniques for a better understanding of the origin, composition and even provenance of the raw materials used as pigments and for determining physical and chemical properties as durability, stability, compatibility; all these properties depend on the purity of the raw material.

Earthy pigments and particularly ochres have been widely used from ancient times to date for decorating bodies, caves, religious temples and architectural surfaces.

Development relevance

The cooperation between Indian and Swiss partners is principally developed on the basis of a mutual enrichment of competencies and applied oriented horizons. The experience of the Indian partner on geology and of the Swiss partner on materials used for decorating architectural surfaces found a common interchange and the basis for



Mine of clay-rich hematite (red ochers) at Sawa (Rajasthan)

a long-term cooperation is grown up.

The study will be very useful for people working in the field of conservation and restoration of cultural heritage both in India and Switzerland. The information acquired will be used as teaching material during the lectures held at BA and MA courses.



People working in a mine of white clay (kaolinitic clay) at Sawa (Rajasthan)



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Partner Institution

Manoj Pandit, geologist, manoj.pandit@gmail.com University of Rajasthan, Dept. of Geology, 302004 Jaipur (India) http:// www.uniraj.ernet.in/Departments/Geology/bottom.html

The use of these materials is primarily related to their easy availability in all the countries and in different geological contexts being products of weathering of host rocks. Rajasthan State in the NW of India is one of the most important locales in the production and export of ochres and clay pigments.

The project provided a well-needed fill up in the knowledge and in identifying and selecting appropriate type for restoration works in terms of stability and compatibility. In addition, the study would also open new fields for Indian researchers, being the application of geological sciences to cultural heritage conservation a new opportunity.

Main features of the project

The painting raw materials studied in the districts of Bhilwara, Chittourgarh and Udaipur in Rajasthan State (India) show a strong connection between the host rocks and the deposits; the microstructure and the texture of the original rock are sometimes very well preserved. In many cases the reconstruction of the entire profile could be possible and the deposits can be described as an in-situ alteration profile.

The common character in the Bhilwara and Chittaurgarh districts is the association between white clays and yellow ochres; this is controlled by the geology where feldspar alteration (the intrusive granitoids may become extensively altered during a long sequence of igneous and geothermal activity; rocks dominated by feldspars and quartz, at low temperatures <150 •C may be changed to kaolinite group clays) is responsible for kaolinite formation sometimes in association with illite, and biotite alteration for yellow ochres (goethite).

Distinctive characteristics are the association kaolinite and kaolinite/illite with goethite and hematite. This is very useful for establishing the provenance of the raw materials, also in connection with the trace element anylisis.

Indian clay-rich ochers are similar to French ones where ochers are pigmented by goethite always containing well-ordered kaolinite and some illite.

The studied areas show a large availability of earthy pigments (white, yellow and red) generally of good quality usable as source for natural pigments. These materials should be used for the conservation and restoration of architectural surfaces instead of synthetic pigments for a lot of reasons: the compatibility with the support and the other pigments, the stability in terms of time-resisting and in relationship to the climatic conditions, the respect with the traditional art of painting.

In many cases the use of modern pigments leads to a complete transformation of the original surface becoming flat, cold and extraneous to the environment.

As comparison it is possible to understand this difference looking at the colour used in villages where traditional materials have been used and not.

All the paintings raw materials collected need a preliminary treatment before their use in order to separate the colouring fraction from the other minerals, generally quartz and calcite. The raw materials have to be grinded in a mortar using a pestle. In the Indian tradition this is a symbolic operation where the male and female principles get together. After this preliminary treatment, the material has to be washed in order to separate the non-colouring and colouring minerals: the non-colouring minerals remain on the bottom of the basin and the remaining in suspension. The tinged water is then decanted and left to evaporate. The final product corresponds to the pigment.

Another aspect is the conservation of the deposit. During our sampling at Iswal in Udaipur district, the only deposit of red ocher was almost covered by waste and in a few months it will not be visible anymore.

Regarding the diagnostic techniques adopted, petrography revealed many interesting aspects otherwise non detectable using ancillary techniques as XRD (X-Ray Diffraction) and XRF (X-Ray Fluorescence). The use of FTIR (Infrared Spectroscopy) was very useful for the fast analysis of clay minerals such us kaolinite and illite. Kaolinite-rich goethite samples didn't show the goethite diagnostic bands because masked by the kaolinite absorption bands.





Clay-rich goethite (yellow ochers)

Use of red colouring earths for decorating architectural surfaces in Shekhawati region (NE Rajasthan)