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Identification of Quarries in the Cuzco Valley for the Extraction of Inorganic Pigments to Produce Local Artisanal Paints

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ABSTRACT

This communication is focused on identifying quarries in the Cuzco Valley used to extract inorganic pigments to produce local artisanal paints. The importance of this study is highlighted, which aims to preserve and revive the tradition of Cusco rock art, using local lands and incorporating unskilled labor to promote local development. The approach involves extensive analysis that combines geological methods with traditional knowledge and the experience of local experts. The geology of the Cuzco Valley was mapped and an ethnographic investigation was carried out, which included interviews with local artists, elderly people, and experts in oral tradition, to collect information about the location of the quarries used in pre-Hispanic and colonial times. With these pigments, paintings were produced through a local workshop with students from the professional school of architecture, using motifs from the religious architecture of Cusco as a revaluation of the artisanal production of painting. This feedback places scientific research in the historical-cultural framework of the region, ensuring the authenticity and relevance of the results obtained. The importance of identifying the original quarries used during a particular historical period is emphasized, as this provides a solid basis for producing artisanal paintings that are close to the techniques and colors used by the ancestral cultures of the area.

1. INTRODUCTION

Artisanal painting in Cuzco, a city located in Peru, has a rich and diverse history dating back to pre-Hispanic and colonial influences. Over time, it has experienced an interesting development of local styles that reflect the identity and culture of the region (Flores, 2023).



Figure 1: Location of the city of Cuzco. (Note: The city of Cusco was transformed over time, going from the formation of pre-Inca cultures, the Incas, La Colonia, the republican stage and the present, preserving a rich historical center and expression of traditional architecture rescuing construction techniques and ancestral and artisanal art).

The production of paint with soil pigments in Cusco has a long history dating back to the ancient civilizations that inhabited the region. These traditional paintings are not only an artistic expression, but also a way to preserve and transmit local culture and traditions. The technique of extraction and preparation of pigments has been transmitted from generation to generation, becoming an invaluable cultural heritage for the region (Moreno Ortega & Mutumbajoy Chindoy, 2021). Soil pigments play a crucial role in the Cusco region, not only for their aesthetic value in the production of paintings, but also for their cultural and symbolic

importance. These natural pigments reflect the richness of the Cusco soil and the deep connection that exists between the land and its inhabitants. Furthermore, its use in artistic practices and traditional architecture contributes to the preservation of cultural identity and the strengthening of the historical roots of the region.

Today in Cusco there are communities that preserve the legacy of the use of traditional materials, techniques and technologies for the production of their homes, maintaining the materiality of the spatial and colorimetric physical expression. The application of coatings on adobe walls and walls of heritage buildings are plastered with applications of milk of lime or previously pigmented silicate dyes, through plasters or layers of paint that help to waterproof the masonry by applying two coats in opposite directions that generally They are white. Soil pigments have become essential components in contemporary architecture in Cusco, offering a unique and traditional alternative for the application of artisanal paints. These pigments, obtained from local minerals and soils, provide a deep connection with the territory and culture. Its use highlights the importance of valuing available natural resources and promotes sustainability in the construction of buildings in the region. In contemporary architecture in Cusco, various types of soil pigments are used to make artisanal paints. Some of the most common are ocher, iron oxide, clay, and diatomaceous earth. Each pigment provides unique shades and characteristics that allow a wide range of aesthetic possibilities, adapting to modern architectural designs with a touch of tradition and authenticity.

Artisanal painting in buildings is a manual and traditional process that involves the creation of paintings using ancestral methods and techniques. This type of paint is characterized by its careful and personalized production, where quality and durability are prioritized. The use of natural ingredients and the application of successive layers to achieve unique tones are an integral part of this ancient art (Navarro & Margagliota, 2020). Natural pigments are one of the essential components in the production of artisanal paints, obtained from sources such as minerals, plants or animals. These pigments bring a wide and surprising variety of unique colors and shades to paintings, allowing artists to explore an infinite palette of creative possibilities. On the other hand, oils and resins play a fundamental role as binders to bind the pigments and form a homogeneous mixture. Oils, such as linseed or tung, famous for their versatility and protective properties, add exceptional richness and shine to color, as well as a silky, smooth consistency that makes application easy. Likewise, resins, such as dammar, known for its transparency and durability, help create a flexible and resistant film that ensures that the paint adheres properly to various surfaces. In short, the combination of these natural elements in artisanal painting not only allows for visually impressive results, but also guarantees the longevity and quality of the work of art for many years (Roquez Ramos & Paredes Dugarte, 2014). In the production of artisanal paints for folk architecture, inorganic pigments play an important role. These pigments are composed of inorganic chemical elements that give the paint different colors and desirable physical properties. Some common inorganic pigments are metal oxides such as iron oxide (red, yellow, brown), zinc oxide (white), and titanium oxide (white), and metal sulfides such as cadmium sulfide (yellow, orange, red) and zinc sulfide (yellow) (Marcano, 2018).

The pigment quarries in Cusco have been used throughout history to obtain pigments used in pre-Hispanic mural painting, in local crafts and textiles, among other uses. In addition to their historical and cultural importance, these quarries also present scientific interest due to the geology of the valley and the properties of the inorganic pigments. Through this study, the aim is to obtain greater knowledge about the geological formation of the valley, the types of rocks present and the distribution of the quarries, as well as to analyze the traditional and modern methods of extraction and processing of pigments. Based on these objectives, it is expected to obtain results that contribute to the conservation of cultural heritage and provide recommendations for future research.

2. METHODOLOGY

The location of the quarries responds to the constant search during the last three years, in which, in routine walks guided by geological maps referenced by specialists, as well as by dialogues with residents who live in said areas or who knew of the location of quarries or efflorescences of colored earth. Therefore, we proceeded to create a map of the location of quarries with the presence of earth pigments that are potentially usable for the production of paints. In these quarries, the color tones were verified, as well as the determination or decantation so as not to be confused with colored rocks (difficult in the grinding process), or colorations resulting from weathering or factors external to the soil itself, with which 42 points were recorded.



Figure 2: Process of extraction, crushing, sieving and production of inorganic pigments.

3. RESULTS

Among the most common pigments are iron oxides, which produce shades from red to yellow, and titanium oxides, used to achieve white, opaque colors. In addition, pigments of mineral origin are used such as cinnabar, which offers shades of intense red, and malachite, which provides different shades of green. Pigments of plant origin are also used, such as indigo, which produces blue tones, and cochineal, which is used to obtain red and purple colors. These pigments are obtained through extraction and grinding processes, guaranteeing their quality and durability in paint production see Figure 3.



Figure 3: Georeferencing map of pigments in Cuzco.

The study area is made up of the following geomorphological units:

a) Slope with landslide deposit (VeQ-co): This geoform is located mostly southeast of the work area; They are made up of colluvial deposits. In this geomorphological unit there are the samples (Sample T-4, Sample T-6 and Sample T-10).

b) Alluvial slope (VeQ-al): This geoform is located mostly northeast of the work area; They are made up of alluvial deposits.

c) Mountain in sedimentary rock (MoS): This geoform is located in most of the work area; They are made up of sedimentary rock formations. In this geomorphological unit there are the samples (Sample T-11, Sample T-12, Sample T-13 and Sample 14).

d) Hill in sedimentary rock (CoS): This geoform is located in the central part of the work area; They are made up of sedimentary rock formations. In this geomorphological unit there are the samples (Sample T-1, Sample T-2, Sample T-3, Sample T-5, Sample T-7 and Sample T-9).

e) Hill in intrusive rock (CoI): This geoform is located northwest of the work area; They are made up of intrusive igneous rocks.

f) Sedimentary plateau (AIS): This geoform is located in the central part of the work area; They are made up of sedimentary rock formations. In this geomorphological unit there is Sample T-8.

g) Alluvial terrace (TrQ-al): This geoform is located in the central part of the work area, south of the city of Cuzco; They are made up of alluvial deposits.

h) River channel (CrQ-fl): This geoform is located in the southern part of the work area; Made up of clastic sediments from fluvial deposits, they have a flat or slightly inclined relief.



Figure 4: Paint colors obtained with inorganic pigments from Cuzco.

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