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Stabilization of the Tlaltecuhtli monolith pigments

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ABSTRACT

A painted monolith, as important as the Aztec Calendar or the Coyolxauhqui, has been discovered in the ritual Aztec center of Mexico City. It represents Tlaltecuhtli, the bisexual manifestation of the Earth from whom all life comes. Still, pigments, which have lost their conglomerating resins, have to be retained. In this study, the consolidation of ochre pigment on original fragments from the Aztec sculpture is presented. Several compounds were tested as consolidants, on the one hand natural polysaccharides, Funori and Slobber of *Nopal* exudate, on the other derivatives of cellulose, Methocel® and Klucel®, and also commercial consolidants as KSE 300® and Paraloid B72®. To simulate the ageing of consolidated samples, they were treated in an Accelerated Weathering Tester. Then, both sets of samples, fresh and aged, were characterized structural, morphological and texturally by using X-ray diffraction, electronic microscopy and nitrogen adsorption, respectively. A leaching test was performed on consolidated samples to evaluate the consolidant efficiency.

1. Introduction

The monolith, discovered in October 2006, in the main religious Aztec site of Mexico City, represents the Earth god, Tlaltecuhtli. The piece corresponds to the sixth step of the Templo Mayor construction, from 1502 to 1521. This period corresponds to the Ahuízotl government period, previous to the arrival of Spaniards. The piece is a carved sculpture of 3.57 m in North–South direction, 4 m in East–West direction, and a maximum thickness of 38 cm (Matos Moctezuma and López Luján, 2007).

It is a monolith as important as the Aztec calendar or the Coyolxauhqui (Matos Moctezuma and López Luján, 2009). Tlaltecuhtli is the bisexual manifestation of Earth from whom all life comes. Tlaltecuhtli with her open-jawed toothsome face is represented in a childbearing squatting position. Her open mouth is the passage to the underworld located inside earth. Her lower jaw is missing as it was torn from her by Tezcatlipoca to prevent her from sinking beneath the waters. Thus, Tlaltecuhtli is the surface of the earth, but she is angry about her position. She was the first to demand the hearts and blood of humans, for her unwilling sacrifice. She represents both life and death.

Several painted zones have remained, the preserved colors are mainly ochre, blue, two different types of red, black and white. The mineral pigments have lost the original binder that stuck them to the monolith surface, and they may disappear. Several solutions may be proposed to retain the original colors to the rock surface.

In a previous work (Barajas et al., 2009), we discussed the monolith composition and the interaction between its constitutive material, andesite, and *Nopal* mucilage (Cárdenas et al., 2008) whose main advantage is that it is a natural material used by local populations. However, *Nopal* mucilage is a complex mixture which is difficult to reproduce (Majdoub et al., 2001). The results were compared with those obtained in the same conditions impregnating the mineral with a commercial consolidant, KSE which is a derivative ethyl ester of silicic acid. It was shown that each fixation agent presents different advantages.

In this work, small samples of the original andesite stone were painted in ochre and several binding agents were used. These are model samples which should provide a criterion to choose the binding agent to be used to preserve the prehispanic pigments. The samples were also treated in an accelerated ageing chamber to simulate the deterioration of materials with time under specific conditions of humidity and solar irradiation. The purpose of such study is to determine how much the various fixation agents modify the pigments and/or resist the action of time.

2. Experimental

2.1. Samples

Original fragments of the stone were found, right beneath the center of the sculpture. We assume that these fragments belong to

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Table 1
Comparison of the consolidants used to fix the ochre pigment of this work.

Consolidant label	Consolidant	Chemical composition	Solution applied on the monolith sample
P B72	Paraloid B72	Copolymer methyl ethyl methacrylate	Solution 2.5% P B72 in xylol
NS	*Nopal* Slobber	Polysaccharide containing Arabinose, galactose, rhamnose and xylose (Cai et al., 2008)	Aqueous solution
FUN	Funori	Polysaccharide extracted from Japanese algae	Aqueous solution 1.25%
KSE 300	KSE 300	Derivative ethyl ester of silicic acid	Solution 1:1 in ethanol
KLU	Klucel	Hydroxypropyl cellulose	Aqueous solution 1%
METH	Methocel	Methyl cellulose	Aqueous solution 1%

the missing central part of the monolith. Small pieces with an area of approximately 5 cm^2 were selected. These pieces were painted with an iron hydroxide pigment (dust) using a brush. The painted pieces were covered three times with a consolidant applied with a dropper.

Six consolidants were used both natural or synthetic: Funori, *Nopal* exudate Slobber, Methocel®, Klucel®, KSE 300® and Paraloid B72®. Table 1 summarizes the main features of the consolidants and the conditions of application on monolith fragments.

Note that the solvent and the consolidant concentration vary as they have different physicochemical properties.

2.2. Accelerated ageing

Samples with pigment and consolidant were treated to simulate ageing. A painted monolith fragment, without consolidant, was also studied for comparison purposes. Samples were placed in an Accelerated Weathering Tester from The Q Panel Company Q.U.V. Temperature was maintained at 45–50 °C for 16 h under UV exposition and a relative humidity of 20–30% and then 8 h at 45–50 °C under 80–100% of relative humidity without UV exposure. This cycle was repeated for 75 days which are equivalent to 3 years in real time.

2.3. Characterization

2.3.1. X-ray diffraction (XRD)

The samples were studied by powder X-ray diffraction (XRD) with a Bruker-axs D8-advance diffractometer coupled to an X-ray diffraction copper anode tube. The X-ray diffraction patterns were recorded with a scintillation counter. A nickel filter selected the CuKα radiation. The identification of compounds was performed conventionally comparing with the JCPDS files. Although samples are usually grinded to be studied by X-ray diffraction, in this work we managed to put the full sample in the sample holder in such a way that the painted surface fulfilled the Bragg condition. Note that the samples are very rough and hence a flat zone has to be found. The contribution of the sample surface to the diffractogram is then optimized.

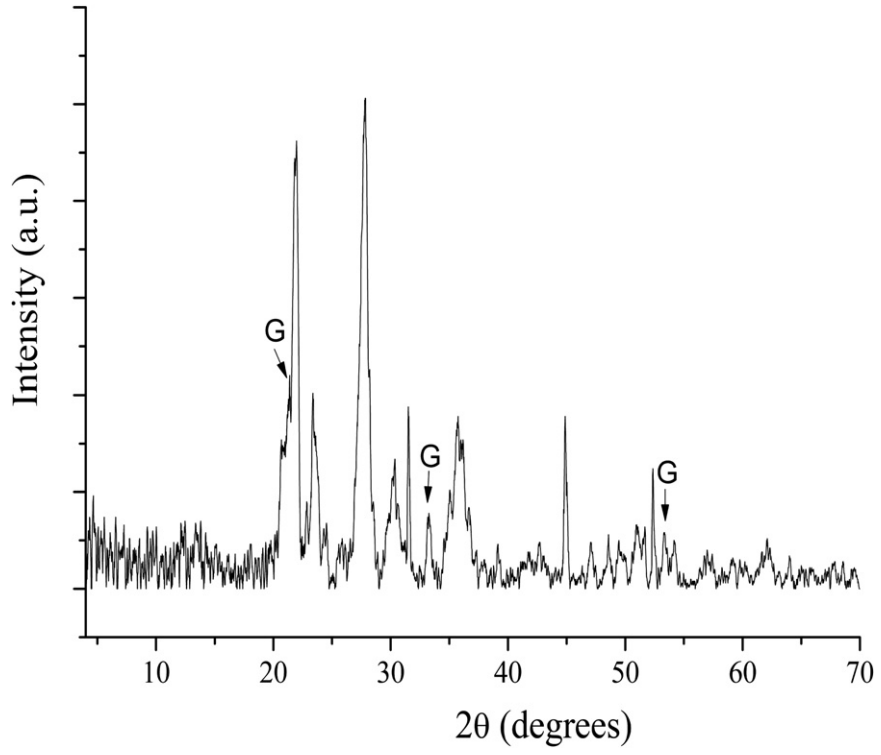

Fig. 1. X-ray diffraction pattern of andesine rock painted with iron oxide. Peaks labelled with a G correspond to goethite phase.