

<b>NUMBER OF PARTNER:</b>	P3 Cesmar7, P4 An.t.a.res srl
<b>TYPE OF WORK:</b>	Mural painting
<b>COUNTRY:</b>	Italy
<b>CITY:</b>	Reggio Emilia
<b>ADDRESS:</b>	Community Centre ARCI PIGAL Via Petrella
<b>OWNER / CUSTODIAN:</b>	Municipality of Reggio Emilia
<b>ARTIST:</b>	Göla Hundun
<b>TITLE OF THE WORK:</b>	Two dragons carrying a new creature OBJ_8
<b>YEAR OF EXECUTION:</b>	2012
<b>MATERIALS:</b>	Housepaint and spray

	Name of the sample	Original materials	No original materials	Pigments / dyes		Organic binders		Type of support*		Other**	
				Identification methods	Results	Identification methods	Results	Identification methods	Results	Identification methods	Results
1	GP1	X		μ- Raman on the cross-section sample	Bluish paint layer (Hostopen Violet) is on a violet layer based on phtalocyanine pigment	-	-	-		-	
2	GP2	X				FTIR-ATR	Acrylic polymer			Imaging analyses:	State of conservation and fluorescence response of the

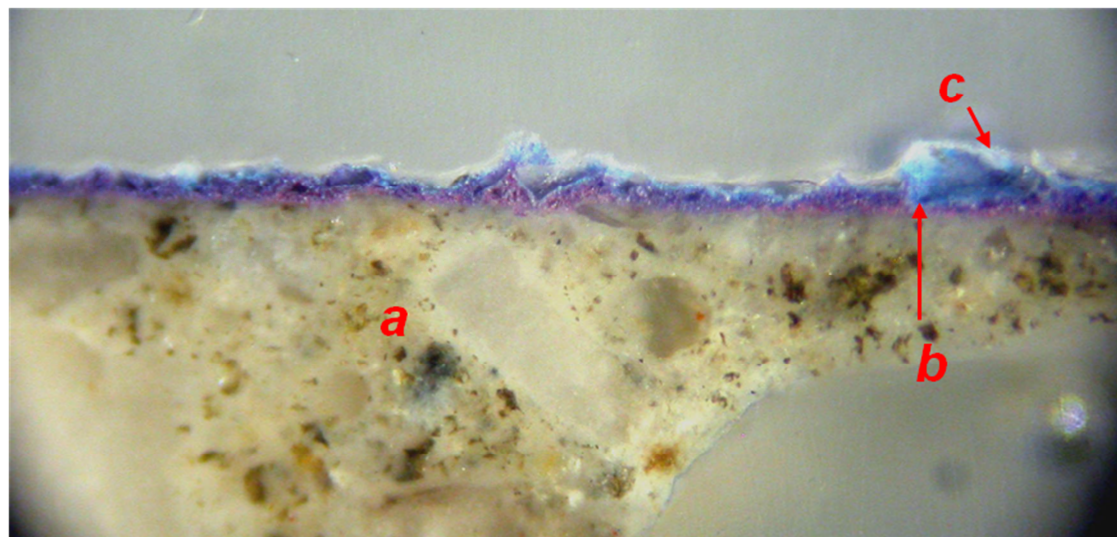
							based coating			digital photography with raking light and Ultraviolet fluorescence photography	coating	
						Py-GC/MS	Acrylic resin alkyd resin resin (paint layer?)					
3	GP3	X				FTIR-ATR	Acrylic + alkyd-containing resin			Stereomicroscopy on sample fragments		
						Py-GC-MS	Alkyd resin, Styrene-acrylic resin (traces)					
4	GP4	X			Calcite and silicates	FTIR-ATR	Acrylic resin + ?					
5	GP5		X?							Optical microscopy and cultural techniques	Co- dominant organism	CF U %
											Aureobasidium sp.	17
											Penicillium sp.	19
											Dematiaceous moulds	19



												(Cladosporium/Alterna ria)	
												Rhodotorula (red yeast)	17
												Epicoccum	5

\* mortars, stone, metal ect.

\*\* Additional research or analyzes, for example: aging tests, colorimetry, pH...



**Fig. 1** “Two dragons carrying an egg (new creature)” – sample GP1 – cross section – reflected Visible light – magnification 150 x

GP1 sample was collected from a blue area painted by brush (**fig.1**), that hue was originally deeper.

The study of the GP1 sample has shown the following structure and composition:

- a)** Concrete support > 500  $\mu\text{m}$  thick;
- b)** Violet paint layer based on phtalocyanine pigment, average thickness of 20  $\mu\text{m}$ ;
- c)** Bluish paint layer composed of Hostopen Violet, average thickness of 20  $\mu\text{m}$ ;
- d)** Whitish thin layer (coating) is hypothesized, it is too thin to be measured but its application has been reported by Pigal.

GP2 was collected from the coating applied by brush/roller on unpainted/painted surface (i.e. *d* layer of the GP1 sample), this whitish and fragile coating is flaking off (**fig.2**). FTIR-ATR spectrum has shown the characteristic absorption of an acrylic emulsion (probably p(*n*BA-MMA) confirmed by Py-GC-MS, with likely chalk and imaging analyses have allowed to highlight its presence and the bad state of conservation (flaking, cracking) (**fig. 3-4**).

GP3 was collected from a fragile and flaked pale yellow (yellow-orange former) spray paint layer; it is detaching, together with the coating GP2 (**fig. 5**), from the pink paint layer applied below by brush (**fig. 6**). FTIR-ATR spectra have shown pattern of an acrylic resin for the yellow layer and alkyd-containing resin for the pink layer. Py-GC/Ms confirmed and better defines the two natures of the layers (styrene-acrylic for yellow layer and alkye alyer for the pink layer)

GP4 was collected from a drop of silver paint (gold former) on a violet area paint applied by brush made off an acrylic resin, Calcite and silicates. The composition of Silver paint is not clear.

GP5 was taken several times during the 2019<sup>th</sup> year from a thin dark grey and compact patina that is spread on not pigmented areas of concrete support following a sort of grid and it is associated with cracks (**fig.3**). Analysis has shown a significant presence of filamentous fungi and yeast, being the black mould *Aureobasidium* the most dominant organism (**fig. 7-10**)

The presence of fungal species indicates the availability of organic substances on the surface of the cement wall.

It is not clear if the black patina has only a biotic origin.

An investigation on concrete preparation techniques has highlighted the use of mineral oil for the detachment of concrete from molds. This procedure leaves in some surface areas dark patinas that could get harder and darker with aging. Probably this organic patina could be subsequently colonised by microorganisms, which enhance the surfaces darkening. In particular some fungal species such as *Aureobasidium*, *Epicoccum*, *Penicillium* and yeast such as *Rhodotorula* are known to effectively degrade mineral or vegetable oil. <sup>1,2,3,4</sup>

The presence of a biofilm on the surface might contribute to the degradation of the substrate by progressive darkening, water accumulation (and subsequent frost weathering), acidification and leaching.

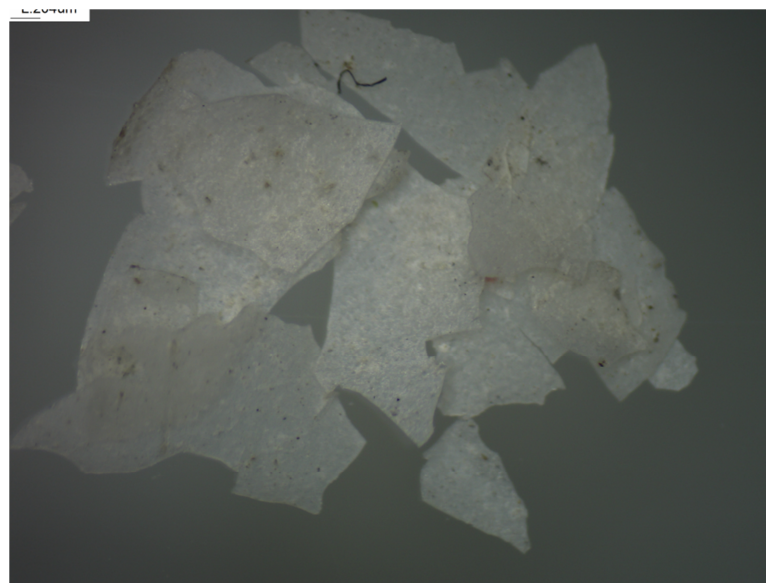
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<sup>1</sup> Van Nieuwenhuijzen EJ, Sailer MF, van den Heuvel ER, Rensink S, Adan OCG, Samson RA. (2019) Vegetable oils as carbon and energy source for *Aureobasidium melanogenum* in batch cultivation. *Microbiology Open.*; 8(6): e00764. doi:10.1002/mbo3.764

<sup>2</sup> Yemashova, Natalia & Murygina, Valentina & Zhukov, Dmitry & Zakharyantz, Arpenik & Gladchenko, Marina & Appanna, Vasu & Kalyuzhnyi, Sergey. (2007) Biodeterioration of Crude Oil and Oil Derived Products: A Review. *Reviews in Environmental Science and Biotechnology.* 6. 315-337. 10.1007/s11157-006-9118-8.

<sup>3</sup> Gupta Aman, Gupta Deepak and Vaidya Vinit (2015) *Epicoccum nigrum* link. As a potential source of Mycoremediation against oil spill, *Int. J. of Life Sciences*, Special Issue, A5: 32-36

<sup>4</sup> Das N, Chandran P. (2011) Microbial degradation of petroleum hydrocarbon contaminants: an overview. *Biotechnol Res Int.* doi:10.4061/2011/941810



**Fig. 2** “Two dragons carrying an egg (new creature)” –GP2 – SM –  
magnification 20 x



Fig. 3 "Two dragons carrying an egg (new creature)" – particular – digital photo under raking light

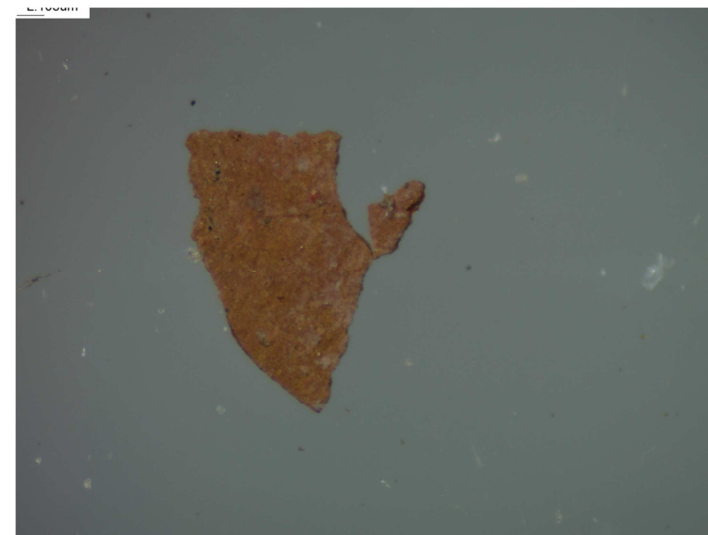


**Fig. 4** "Two dragons carrying an egg (new creature)" – particular – ultraviolet fluorescence photo





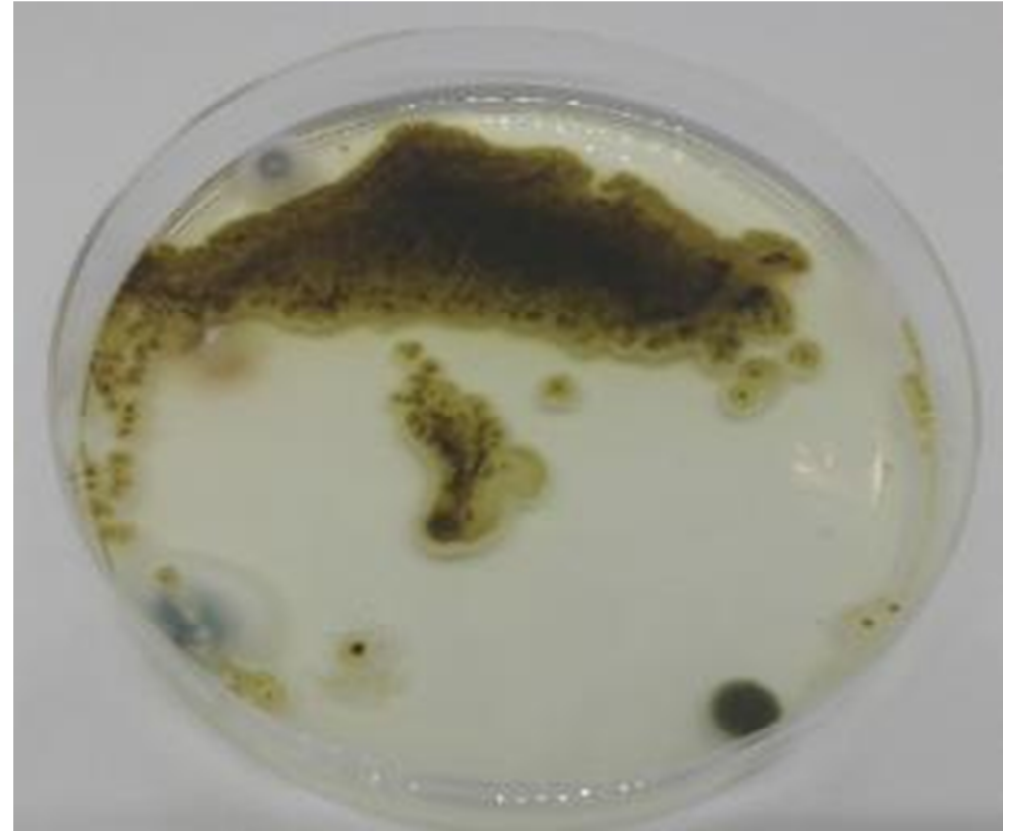
**Fig. 5** “Two dragons carrying an egg (new creature)” – sample GP3 – SM – magnification 40 x



**Fig. 6** “Two dragons carrying an egg (new creature)” – sample GP3 – SM – magnification 40 x



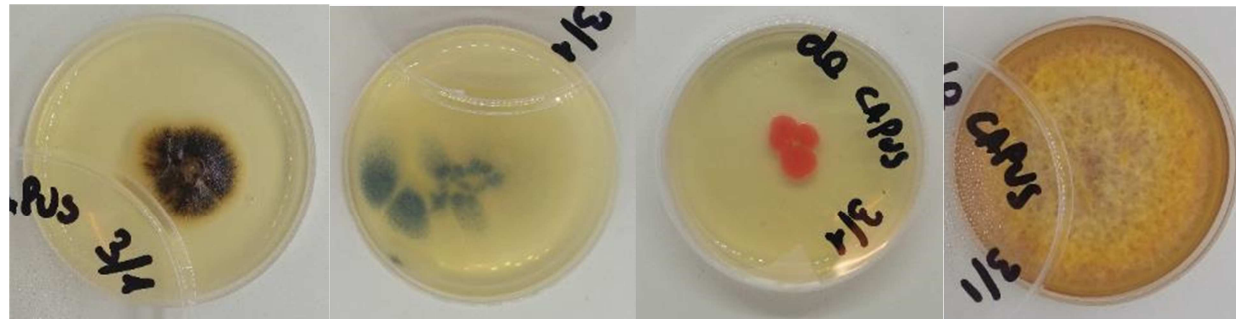
**Fig.7** "Two dragons carrying an egg (new creature)" – sample GP5 – transmitted Visible light – magnification 400x : erratic and motile spherical cells, sometimes present in 2-3 cells chain



**Fig. 8:** *Aureobasidium* colonies on agar plate from samples collected in July 2019



**Fig. 9.** Total CFU obtained on agar plates from samples collected in December 2019



**Fig. 9** Co-dominant fungal species isolates (*Aureobasidium*, *Penicillium*, *Rhodotorula*, *Epicoccum*) from samples collected in December 2019



This document was produced within the project *Conservation of Art in Public Spaces (CAPuS)*.

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**Education, Audiovisual and  
Culture Executive Agency**

Erasmus+: Higher Education-Knowledge  
Alliances, Bologna Support, Jean Monnet

CAPuS project has received funding from the  
European Commission, Programme Erasmus+  
Knowledge Alliances 2017, Project N°  
588082-EPP-A-2017-1-IT-EPPKA2-KA

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