



University of Genova

Department of Earth, Environmental and  
Life Sciences

Doctorate Course in Earth and  
Environmental Science and Technology

Università degli Studi di Genova



Dottorato in Scienze e Tecnologie  
per l'Ambiente e il Territorio

### Curriculum in Earth science

#### Research Theme 3

<b>Titolo <i>Metodi innovativi a basso impatto ambientale nella conservazione dei beni culturali</i></b> <b>Title <i>Innovative methods with low environmental impact in the conservation of cultural heritage</i></b>
Tutor and co-tutor Laura Gaggero <a href="mailto:laura.gaggero@unige.it">laura.gaggero@unige.it</a> , Paola Letardi (CNR)
<p>Program description, including the formation program in private company</p> <p>The process of subaerial alteration of metal pieces disperses bioavailable metal elements into the environment but above all is mitigated with chemical protective agents that are not friendly for the environment and the operators.</p> <p>The progressive and irreversible deterioration of copper alloys is caused by nantokite, copper chloride CuCl, which accumulates near the metal until it reacts with the humidity present in the external environment. The expansive hydration reaction produces basic copper trihydroxychlorides, which induce mechanical fragmentation or cracking of the material. As weathering progresses, erosion and material loss occurs. In extreme cases, the deterioration reaches the partial or total pulverization of the find, compromising the reading or causing the loss of the artistic object.</p> <p>To date, inhibitors and protectants based on benzotriazole and its derivatives are applied in the preservation of copper alloys. This organic corrosion inhibitor presents unacceptable criticalities including high toxicity for the environment and the operator.</p> <p>The PhD project plans to develop a low toxicity inhibitory treatment that addresses the two main problems arising from the corrosive process of chlorides: the impossibility of mechanically removing the nantokite from the natural patina of the bronze and the need to balance the acid environment of spotty corrosion by modifying the conditions that favor the weathering cycle.</p> <p>The project aims at experimentally verifying, through mineralogical studies and chemical and physical investigations, the efficacy, aesthetic impact, durability and safety of green corrosion inhibitors, which are not harmful to the environment or to health. The field of cross disciplinary investigation includes the study of passivation through inorganic products possibly coupled with microbial action.</p>
PON research line: Green
Company hosting the PhD: CST s.r.l.
Financial support: 100022-2012-GL-ALTRIPRIVN_02 Laboratorio Analisi microstrutturali, chimiche e fisiche di materiali inorganici, naturali e litici
<p>Tutor's publications (max 3)</p> <p>Castagnotto, E., Locardi, F., Slimani, S., Peddis, D., Gaggero, L., Ferretti, M. Characterization of the Caput Mortuum purple hematite pigment and synthesis of a modern analogue (2021) <i>Dyes and Pigments</i>, 185, art. no. 108881, DOI: 10.1016/j.dyepig.2020.108881</p> <p>Scrivano, S., Gaggero, L. An experimental investigation into the salt-weathering susceptibility of building limestones(2020) <i>Rock Mechanics and Rock Engineering</i>, 53 (12), pp. 5329-5343. DOI: 10.1007/s00603-020-02208-x</p> <p>Scrivano, S., Gaggero, L., Gisbert Aguilar, J. An Experimental Investigation of the Effects of Grain Size and Pore Network on the Durability of Vicenza Stone (2019) <i>Rock Mechanics and Rock Engineering</i>, 52 (9), pp. 2935-2948. DOI: 10.1007/s00603-019-01768-x</p>