University of Genova

Department of Earth, Environmental and Life Sciences

Doctorate Course in Earth and Environmental Science and Technology

Università degli Studi di Genova

STAT

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

Earth Science Curriculum

Research Theme n. 6

Titolo: Studio sperimentale sulla produzione di pigmento blu da minerali di Co
Title: Experimental investigation on natural Co-based blue pigment

Tutor and co-tutor
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Program description including the formation program abroad

The program is aimed at experimental research on pigments, with particular focus on the cobalt blue pigment, one of the oldest and most used in the history of art. The pigment shows significant compositional variability, linked to raw materials and production technologies. Cobalt blue pigments applied to enamels and glass produced between the 15th and 16th centuries are characterized by the presence of arsenic exclusively in the group of artefacts produced after 1520.

For both pigments the production starting from erythrite, smaltite and skutterudite from the Erzgebirge mining district is inferred, the differences deriving from production processes. The removal of arsenic could be due to the roasting of the minerals, with which saffron was produced, or to the use of different fluxes used to make the glaze; these are two cobalt by-products produced in the Erzgebirge region from 1520 and between 1540-60 respectively.

Preliminary experiments starting from 3 raw materials based on erythrite and clinosaphorite have demonstrated the possibility of producing a cobalt blue pigment with no As or low As content. Many historical recipes seem to describe the use of erythrite, a red mineral also called flower of cobalt, in the production of cobalt blue. Roasting experiments on erythrite + CaO + borax mixtures yielded an oxide of Co-Fe-Ni and an arsenate phase of Ca-Co-Na-Ni; roasting of clinosafflorite yields Co-rich phases and As-Co-Fe-Ca phases. Then the arsenic is not completely removed, but cobalt phases with a low arsenic content are obtained; moreover, Ca, Na and Pb favor the formation of arsenates within the enamel. Experimental runs on several starting materials will be associated with microcompositional and microstructural characterization of the reactants and products.

The PhD program will be developed in co-supervision with Vic University (Spain) and will encompass i) a specific formation on methods for the mineralogical and compositional characterization of geomaterials and derived pigment with fundamental and advanced spectroscopic techniques;
ii) the project requires the development of experiment design skills and of data elaboration; iii) experimental results will be interpreted in the light of definition of a representative chemical system and verified through chemographic contraints.

The candidate will be committed to spend up to 1 year in research activities at the co-supervisor laboratory and at other facilities abroad.

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Tutor's publications MAXIMUM 3

1. Elena Castagnotto, Federico Locardi, Sawssen Slimani, Davide Peddis, Laura Gaggero, Maurizio Ferrett 2021. Characterization of the Caput Mortuum purple pigment and synthesis of a modern analogue. Dyes and Pigments, Volume 185, February 2021 Article number 10888, 10.1016/j.dyepig.2020.108881

2. Simona Scrivano, Laura Gaggero, Elisa Volpe, 2019 Paint relics on Middle Age building stones as proxies o commercial routes and artistic exchanges: a multi-analytical investigation, Special Issue Archaeometri Implications of Minerals. Minerals 2019, 9, 663; doi:10.3390/min9110663
3. Scrivano S., Gaggero L., Gisbert Aguilar J. 2019. An experimental investigation of the effects of grain size and pore network on the durability of Vicenza Stone, Rock Mechanics and Rock Engineering, 52/9, 2935-2948, doi.org/10.1007/s00603-019-01768-x