

PhD Fellowship:

4-year PhD Fellowship as part of the project HISTORIC GYPSUM PLASTERWORK – LEARNING FROM THE PAST (GYPS) (Reference PID2023-149367NA-I00) financed by the Spanish Ministry of Science, Innovation and Universities/European Union. The candidate will be expected to enroll in the PhD program Ciencias de la Tierra at the University of Granada and will be working within a multidisciplinary team, supervised by Dr. K. Elert and Dr. G. Cultrone.

Candidate's profile: Master's degree or equivalent in Biology, Chemistry, Physics, Engineering, Geology, Heritage Conservation, Materials and Conservation Science, Architecture or related fields. Previous experience with the analysis and testing of heritage materials, publication of scientific results, research stays in national/international institutions, and good English skills will be valued. Spanish knowledge of advantage.

Funding (total): 125.200 EUR (includes salary, travel grant, and compensation)

Anticipated starting date: Spring 2025

Further information: K. Elert (kerstin.elert@eea.csic.es)

Project title: Proyecto de I+D+i YESERÍAS HISTÓRICAS – APRENDIENDO DEL PASADO (GYPS)/HISTORIC GYPSUM PLASTERWORK – LEARNING FROM THE PAST (GYPS)

Reference: PID2023-149367NA-I00

Funding agency: Agencia Estatal de Investigación (Ministerio de Ciencia, Innovación y Universidades) con cofinanciación FEDER

Call: Proyectos de Generación de Conocimiento 2023 (Plan Estatal de Investigación Científica y Técnica y de Innovación 2021-2023)

Project duration: 1 septiembre 2024 – 1 septiembre 2027

Members of the investigation team:

Dr. Kerstin Elert (IP), Escuela de Estudios Árabes, CSIC; Dr. Giuseppe Cultrone, Universidad de Granada (UGR), Departamento de Mineralogía y Petrología; Dr. María Rosario Blanc García, UGR, Departamento de Química Analítica; Dr. Fátima Linares Ordóñez, UGR, Centro de Instrumentación Científica; Dr. Rosario Villegas Sánchez, Universidad de Sevilla, Departamento de Ingeniería Química y Ambiental; Dr. Esther Ontiveros Ortega, Instituto Andaluz del Patrimonio Histórico, Junta de Andalucía; Ms. Elena Correa Gómez, Patronato de la Alhambra y Generalife, Departamento de Restauración; Dr. Ramón Rubio Domene, Patronato de la Alhambra y Generalife, Departamento de Restauración

Members of the working team:

Dr. Davide Gulotta, The Getty Conservation Institute (Los Angeles), Built Heritage Research Initiative; Dr. Pedro Bel-Anzué, Arquitecto y Arquitecto Técnico (Aragón); Dr. Rosa Espinosa-Marzal, Universidad de Illinois, Departamento de Ingeniería Ambiental

Project summary:

The main objective of this project is the study of historic gypsum plasterwork, its mineralogical composition, textural and physico-mechanical properties and their relation with ancient plaster making technology. This project investigates the underlying technological influence on performance, durability, and alteration processes undergone by historic plasterwork in order to establish adequate future conservation treatments and design compatible gypsum-based materials for heritage conservation and sustainable new construction. The idea of this research is driven by historical evidence that shows the wide-ranging constructive possibilities of traditional gypsum for exterior and structural applications in rural and monumental architecture in many countries of the Mediterranean Basin, and in particular in the gypsiferous Spain. This stands in stark contrast with modern, industrial gypsum (fired at $\sim 200^{\circ}\text{C}$ and mainly containing bassanite), which is limited to interior and finishing applications. Several factors have been considered responsible for the superior mechanical strength and weathering resistance of traditional gypsum as compared to its industrial counterpart, such as its multiphase composition (fired at $\leq 1000^{\circ}\text{C}$ and containing bassanite, anhydrite, and uncalcined gypsum), possible pozzolanic reactions due to the presence of accessory minerals (carbonates and clays), low water/solid ratios, and special application techniques (application of organics, polishing and compaction). So far no systematic study has been performed, which relates the aforementioned factors alone or in combination with the ultimate performance of gypsum plasters, thereby unveiling the secret of ancient traditional gypsum plaster making. Therefore, a comprehensive analysis of historic gypsum plasters and mock-ups prepared mimicking ancient traditional techniques will be carried out. A twofold approach will be applied: i) an in situ investigation of exterior gypsum plaster at the Alhambra fortress using nondestructive techniques (including the Duetto, a unique portable X-ray diffraction and X-ray fluorescence instrument designed for heritage applications) combined with laboratory analyses and tests of original gypsum samples from the Alhambra fortress and various Aragonese monuments to determine their composition mineralogy, texture, porosity and strength, and ii) a study of mock-ups prepared with multiphase products and varying water/solid ratios, pozzolanic or organic additives, and subjected to different traditional surface treatments. Mock-ups will be exposed to different accelerated aging tests and compared to historic plaster samples to further the understanding of gypsum alteration. Compared to other historic binders such as lime, studies involving gypsum are limited and there is still a lot to learn from ancient gypsum technology. This research will not only assist in the selection of adequate conservation treatments, but will also have implications for the design of optimized gypsum-based materials for new constructions with reduced carbon footprint. It is envisioned that the outcome will not only be of local importance but also have national and international impact, especially since the project will be performed in collaboration with various researchers from national and international institutions and partners (Universidad de Granada, Universidad de Sevilla, Instituto Andaluz de Patrimonio Histórico, Patronato de la Alhambra y Generalife, University of Illinois, and the Getty Conservation Institute).