

Notre-Dame-de-Paris and historic monuments: Tracing their current and past contribution to lead pollution of the Paris environment

Keywords: Notre-Dame de Paris, environment, lead, isotopy, trajectories, pollution, Historic Monuments, restoration

PhD supervision and hosting teams:

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- Sandrine Baron, CNRS HDR Researcher at the TRACES laboratory (UMR 5608 CNRS) and co-leader of the METAL team "Metals: Economics and Techniques through Archaeology and the Laboratory"; <https://univ-toulouse.academia.edu/SandrineBaron/>; ORCID: 0000-0003-1910-8903

Doctoral school: ED Mechanical and energetic sciences, materials and geosciences - SMEMAG (University of Paris Saclay) <https://www.universite-paris-saclay.fr/ecoles-doctorales/sciences-mecaniques-et-energetiques-materiaux-et-geosciences-smemag>

Proposal description.

This PhD aims to produce an original study of the contribution of Historic Monuments (HM), notably Notre-Dame de Paris, to the global lead contamination of the Paris (France) environment. The project will contribute to the knowledge of the multiple sources of lead pollution in the Paris area by isotopic tracing. Indeed, the fire of the roof and the spire of Notre -Dame de Paris (April 2019) highlighted the question of pollution caused by lead used massively in the construction of HM since the Middle Ages. Our previous works have demonstrated the ability of the stable lead isotopes tool to discriminate between these different sources of lead. The respective contribution of some major sources to contamination of the Seine over the last century was deduced. The potential contribution of the HM which contains hundred tons of lead remains undisclosed. The PhD will establish the chemical signature of each HM site, to move towards a historical retrospective of the impacts of lead from HM, based on natural archives of environmental contamination and on the knowledge acquired on the Seine River basin, in particular on the historic trajectories of lead (uses, imports, recycling, etc.). Ultimately, this thesis will help define HM-dedicated guidelines for restoration works involving lead.

Methodology.

The adequate sampling of leaded artefacts in HM requires a necessary contextualization of the samples, integrating the knowledge of historical trajectories of uses and therefore the potential evolution of provenances through time. The extent of recycling should also be taken into account. These samplings will be carried out in collaboration with historians and archaeologists experts in building materials. In a second step, the PhD will have to perform the sampling of environmental matrixes (water, air, soil, runoff) in and around HM. The doctoral student will carry out elementary and isotopic analyzes at LSCE and TRACES laboratories. The environmental samples will first be analyzed at LSCE (elementary and isotopic analyzes). Then the PhD will synthesize the results in order to identify the samples requiring a finer isotopic analysis in order to specify the origin of the lead used. Thus, the isotopic analysis of selected lead specimens will be carried out mainly at TRACES, to benefit from the contribution of Pb-204 measurements. In parallel with the field and laboratory work, the PhD will have started a bibliographic research both centered in the environmental field but also in historical and archaeometrical (in particular on the non-ferrous tracing metals in ancient

periods), in order to synthesize and interpret the data corpus to draw up an environmental assessment tightly linked to the history of HM.

Collaborations.

This interdisciplinary project will involve historians, archaeologists, geochemists and heritage specialists, in particular Aurélia Azéma and Véronique Vergès-Belmin (LRMH) and Maxime L'Héritier (ArScAn), Marie-Hélène Didier (DRAC–CRMH), Laurence Lestel (METIS), Gaël Leroux (TRACE), Matthieu Roy-Barman and Louise Bordier (LSCE)

Required skills.

- MSc degree in geochemistry; environmental geochemistry
- Field and laboratory experience (work in a clean room context in particular)
- Knowledge in mass spectrometry, elementary and isotopic chemistry but also on the main general principles of source tracing using isotopic tools.
- Knowledge of mining geology and / or contaminant transfer would be appreciated
- Ability to take initiative, curiosity and adaptability are prerequisites for this interdisciplinary subject requiring the mobilization of different types of media and data.
- Driving license B (light-duty vehicle)

Contacts.

Send a CV, a cover letter, as well as the names and contact details of referees to Dr Sophie Ayrault and Dr Sandrine Baron : sophie.ayrault@lsce.ipsl.fr AND sandrine.baron@univ-tlse2.fr

Deadline for application: September 10, 2020.