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Development of dendrochemistry applied to polluted sites : Multi-technique approach for the analysis of pollutant tracers and co-tracers on a ring-by-ring basis

HUGO LOUET[1], ANNE-MARIE DESAULTY[2], STEFAN COLOMBANO[2], PHILIPPE LACH[3], CLAIRE AUPART[4] AND MICHEL CHALOT[5]

[1]ADEME/BRGM
[2]BRGM (French Geological Survey)
[3]BRGM
[4]French Geological Survey (BRGM)
[5]Université Marie et Louis Pasteur

Soil contaminated by organic and metallic pollutants from mining and industrial activities needs to be effectively managed for environmental, health and economic reasons. Dendrochemistry is a tool that can be used to date pollution and, potentially, establish its origin in order to identify those responsible. This process is based on the absorption by tree roots of nutrients and, potentially, of certain pollutants present in the soil, and on the absorption of volatile pollutants by the leaves [1].

The main aim of this study is to develop dendrochemistry by adopting a multi-technique approach. To this end, various analysis methods have been developed and used.

Two techniques were developed to analyse changes in the various chemical elements within the rings of the trees sampled: µEDXRF (for Energy Dispersive X-Ray Fluorescence spectrometry) and LA-ICP-MS (for Laser Ablation Inductively Coupled Plasma Mass Spectrometry. These methods make it possible to obtain highly accurate quantitative elemental maps of the levels of major and trace elements present in samples (K, Ca, Zn, Cd, Ni, Cu, As, etc.). In addition, in order to obtain the most accurate dating possible, µtomography analysis has been developed, providing highly accurate images in which the limits of the annual rings can be identified. This dating is also automated using AI.

Finally, a programme developed in Python is used to process, analyse and eventually merge the data obtained using the various analysis techniques. To test and validate the methods developed, two study sites where pollution (metals, organic matter, etc.) is known and referenced have been and will be sampled.

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[1] Binda et al. (2021) The what, how, why, and when of dendrochemistry: (paleo)environmental information from the chemical analysis of tree rings. Science of The Total Environment, Volume 758, 2021,143672,ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2020.143672.