

## **Environmental magnetism and effective radium concentration: the case study of the painted cave of Pech Merle, France**

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Painted caves, showing testimony of prehistoric art, are nowadays subject to intense attention to understand the conditions of stability and avoid degradation. The preservation of cultural sequences and archaeological artefacts represents especially a crucial issue in the case of caves opened to visitors. For this purpose, a better knowledge of these preserved environments that imprint paleoenvironmental conditions at the time of deposition is needed. In this context, different environmental parameters of the Pech Merle cave, in France, are currently actively monitored including temperature, hygrometry, and gas measurements such as CO<sub>2</sub> and radon-222 (decay product of radium-226). This temporal monitoring needs to be complemented by a detailed characterisation of the site, including petrophysical and mineralogical properties. To better constrain the environmental and paleoenvironmental context, more than 100 samples including soils, sediments, rocks and speleothems were collected inside and outside the cave area. We report here magnetic properties of powdered samples (low-field susceptibility, hysteresis parameters, and saturation magnetization) coupled with effective radium concentration (ECRa) measurements. We observe that magnetic susceptibility, which ranges over 5 orders of magnitude from calcareous rocks to topsoils and argillaceous filling deposits, correlates well with ECRa values. This correlation, previously observed (Girault et al., 2016) in very different geological contexts, could be interpreted as a common concentration of sources, also indicating a signature of natural samples to the contrary of anthropic environments disturbed by human activities, in which case the association is blurred. This study demonstrates the general interest of combining two different parameters – here low-field magnetic susceptibility and effective radium concentration determined using non-destructive techniques in the field and in the laboratory – to physically characterize geosystems and to propose a novel approach to discriminate naturally preserved and human-impacted or polluted sites.

Girault, F., Perrier, F., Poitou, C., Isambert, A., Th  veniaut, H., Laperche, V., ... & Douay, F. (2016). Effective radium concentration in topsoils contaminated by lead and zinc smelters. *Science of The Total Environment*, 566, 865-876.