Exploring radionuclide contamination using new ^{226}Ra standards and high-resolution NanoSIMS analysis

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Introduction

- **Radionuclide contamination:** Human activities, such as nuclear operations and mining, release radionuclides into the environment, posing risks to ecosystems and populations.
- **Limitations of traditional analyses:** Bulk sample analyses often fail to identify contamination sources due to isotopic mixing and concentration dilution.
- **High-resolution imaging technique:** NanoSIMS enables grain-scale isotopic mapping, offering detailed insights into radionuclide-bearing phases.

Analytical protocol

- CAMECA **NanoSIMS 50** instrument at MNHN, Paris
- Validation of synthetized **^{226}Ra-bearing barite standard,** (absence of interferences impact).
- Creation of a **calibration curve** for ^{226}Ra content in barite
- **Validation of the feasibility** of analyzing multiple radionuclides and stable isotopes in small mineral phases from environmental samples: ^{238}U, ^{232}Th, ^{230}Th, ^{226}Ra, ^{208}Pb, ^{207}Pb, ^{206}Pb
- This analytical development enables a more in-depth interpretation of the **origin of radionuclides**

Conclusions

Case study – Rophin wetland contamination

- $^{206}Pb/^{207}Pb$ vs $^{208}Pb/^{207}Pb$ are in accordance with bulk results from Geng et al. 2024
- Analyses at the grain scale permit to highlight potentially primary phase and secondary one

Data treatment

- The use of geostatistical tools could enable the treatment of NanoSIMS images for low-count isotopes and the identification of potential structural features
- Ongoing work!

QUICK TIPS

Key Takeways!

NanoSIMS high-resolution imaging analysis: Application to contaminated wetland soils reveals distinct U and Pb-bearing phases, multiple contamination sources, and heterogeneous radionuclide distributions.

Implications for Remediation: Findings support improved models of contamination evolution and inform more effective site remediation strategies.

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