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Exploring uranium minor isotopes (U-233, U-236) as a new tracer to highlight uranium contamination downstream former uranium mine sites

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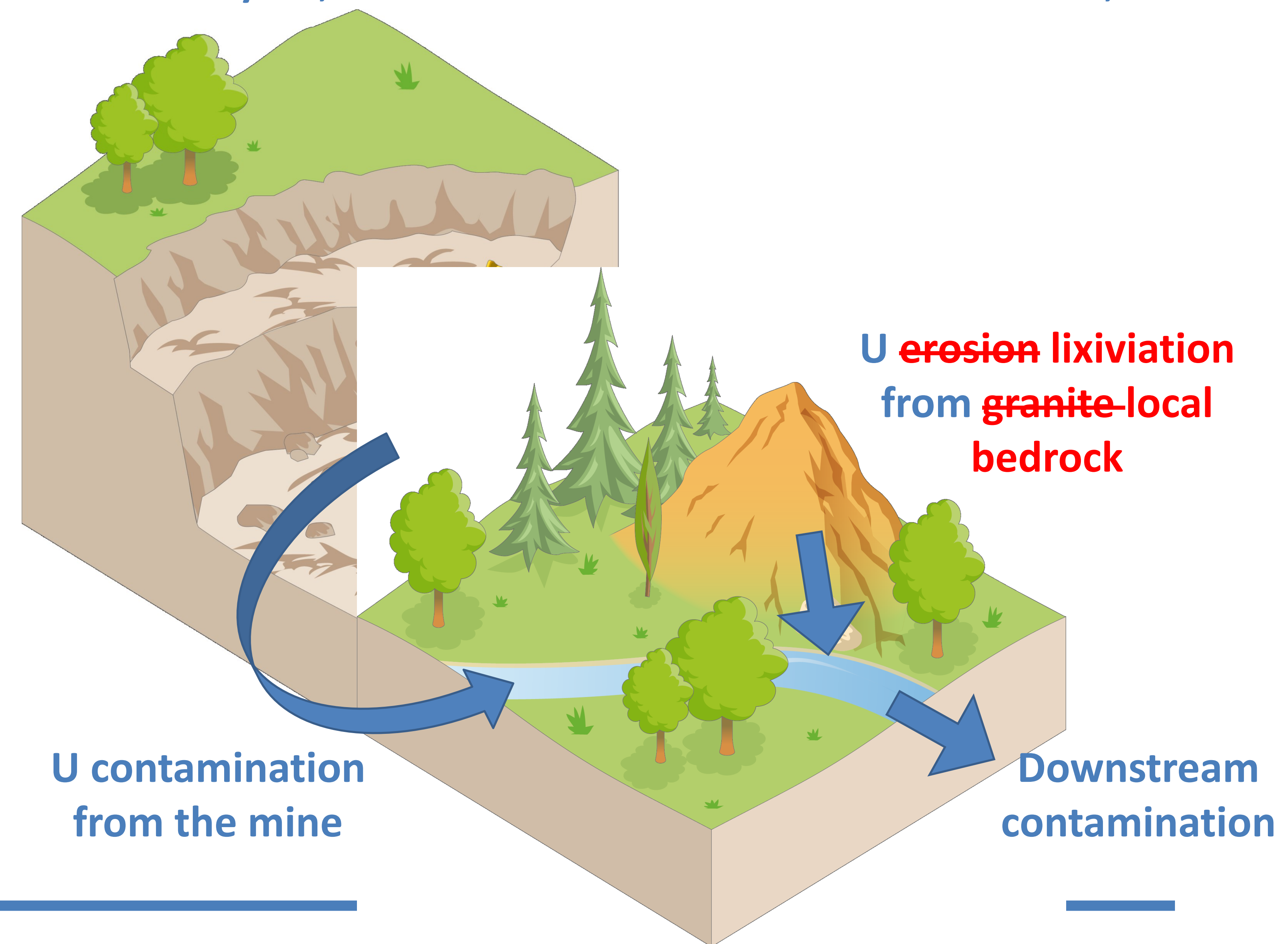
Introduction:

- About 250 former U mines in France.
- Potential **U contamination dissemination** in the vicinity of **U** mines **by due to** extraction processes

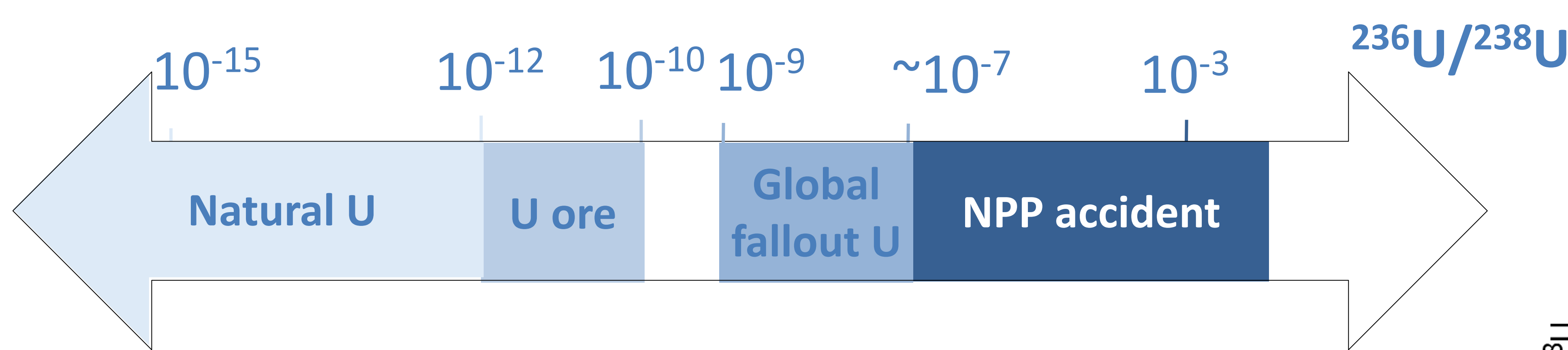
Versus

- Geochemical background of the site containing high concentrations of U

Objective: identifying uranium origin (mine versus geochemical background) in the vicinity of former uranium mines

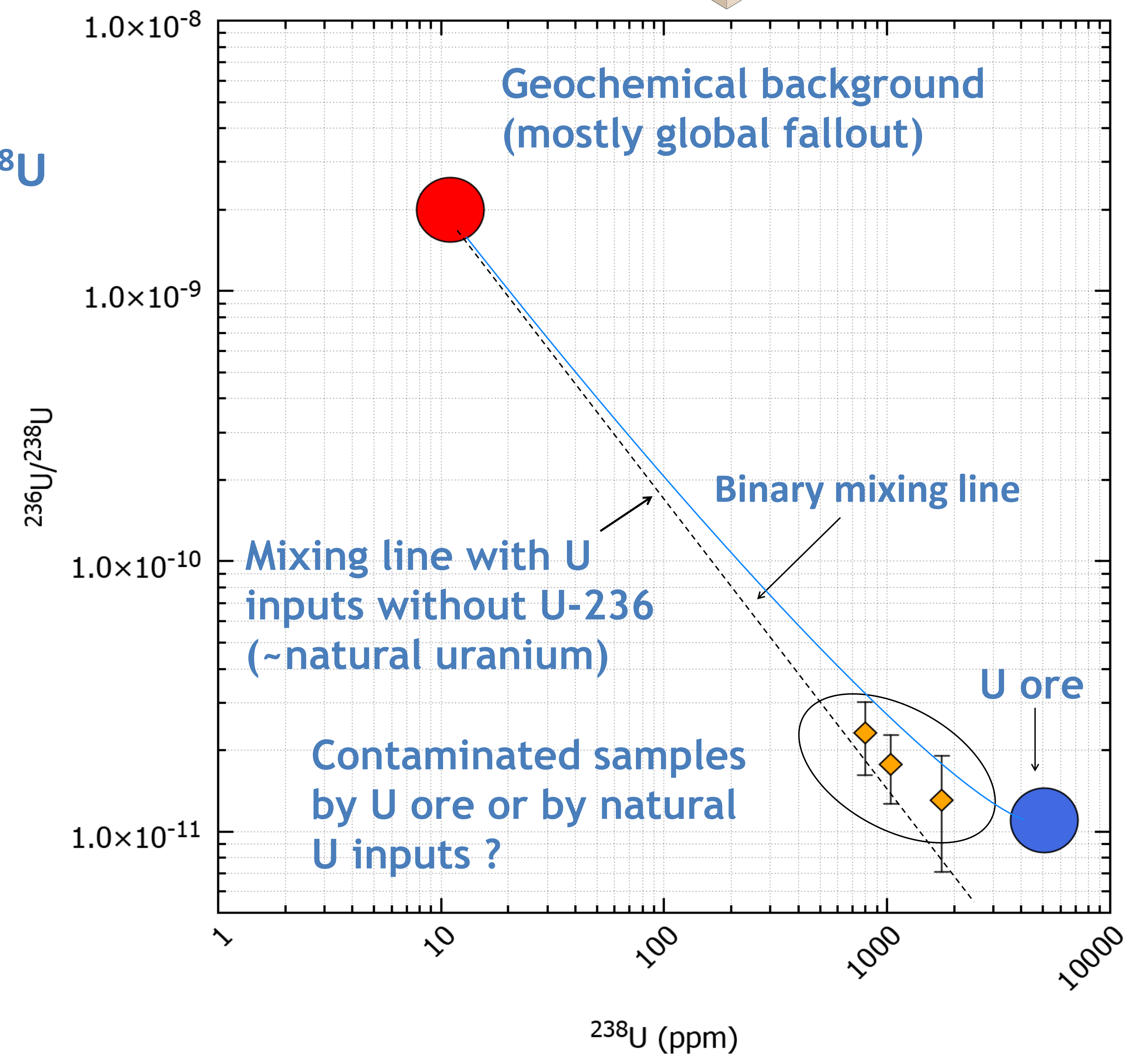


➤ Use of $^{236}\text{U}/^{238}\text{U}$ isotope ratios

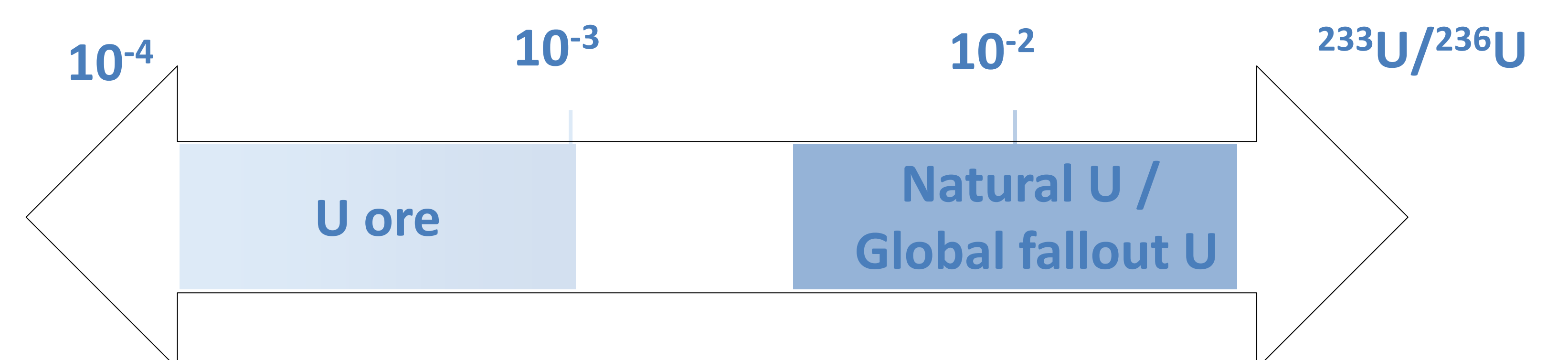
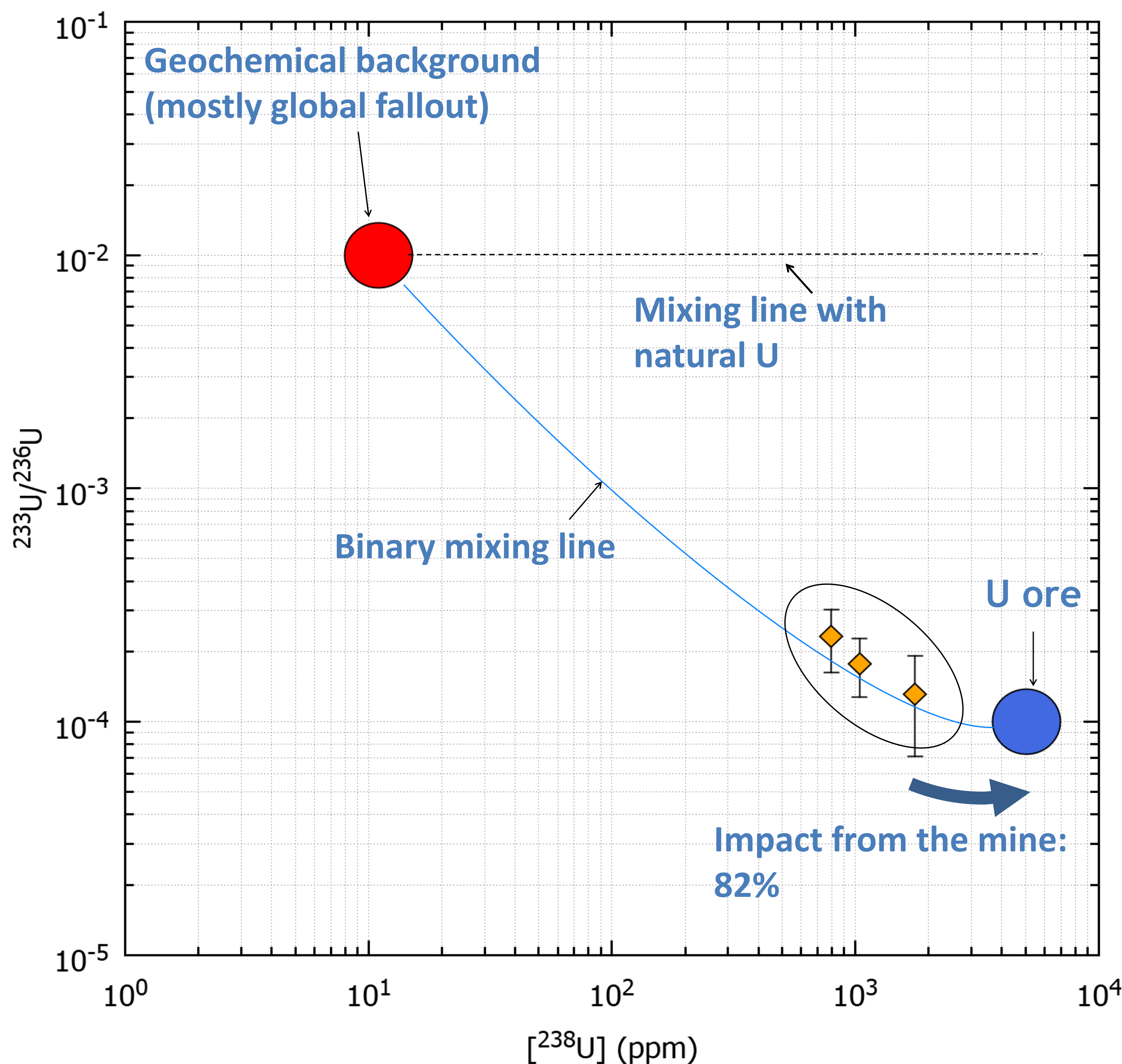


Limitations:

- Anthropogenic inputs increased the $^{236}\text{U}/^{238}\text{U}$ ratio of the geochemical background
- Natural ^{238}U concentration variations can induce a fluctuation of the $^{236}\text{U}/^{238}\text{U}$ isotope ratios.
- **Dilution of the $^{236}\text{U}/^{238}\text{U}$ due to ^{238}U inputs without ^{236}U (or a $^{236}\text{U}/^{238}\text{U}$ close to geochemical background)**



➤ Use of $^{233}\text{U}/^{236}\text{U}$ isotope ratios



Conclusion:

- Natural minor isotopes (^{233}U - ^{236}U , ^{236}U - ^{233}U) were measured in environmental samples,
- Minor isotopes can be used to trace **the origin of uranium contamination** in the environment,
- **The contribution of uranium mining activities in the environment can be quantified.**

However:

- Production of minor isotopes depends on **several parameters** (neutron flux, presence of light elements, thorium concentration),
- **Source term-Endmembers** signatures (Global Fallout and U Ore) are **highly heterogeneous**,
- Further works are needed on other samples to better characterise the **production processes of minor isotopes.**