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► To cite this version:

Hugo Jaegler, Alkiviadis Gourgiotis, Arnaud Mangeret, Pascale Blanchart, Guillaume Morin, et al.. Exploring uranium minor isotopes (U-233, U-236) as a new tracer to highlight uranium contamination downstream former uranium mine sites. 7ème Congrès de la Société Française des Isotopes Stables, SFIS, Nov 2019, ORSAY, France. 2019. hal-02460190

HAL Id: hal-02460190

<https://hal.science/hal-02460190>

Submitted on 29 Jan 2020

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Exploring uranium minor isotopes (^{233}U , ^{236}U) 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** U-mines **by** due to extraction processes

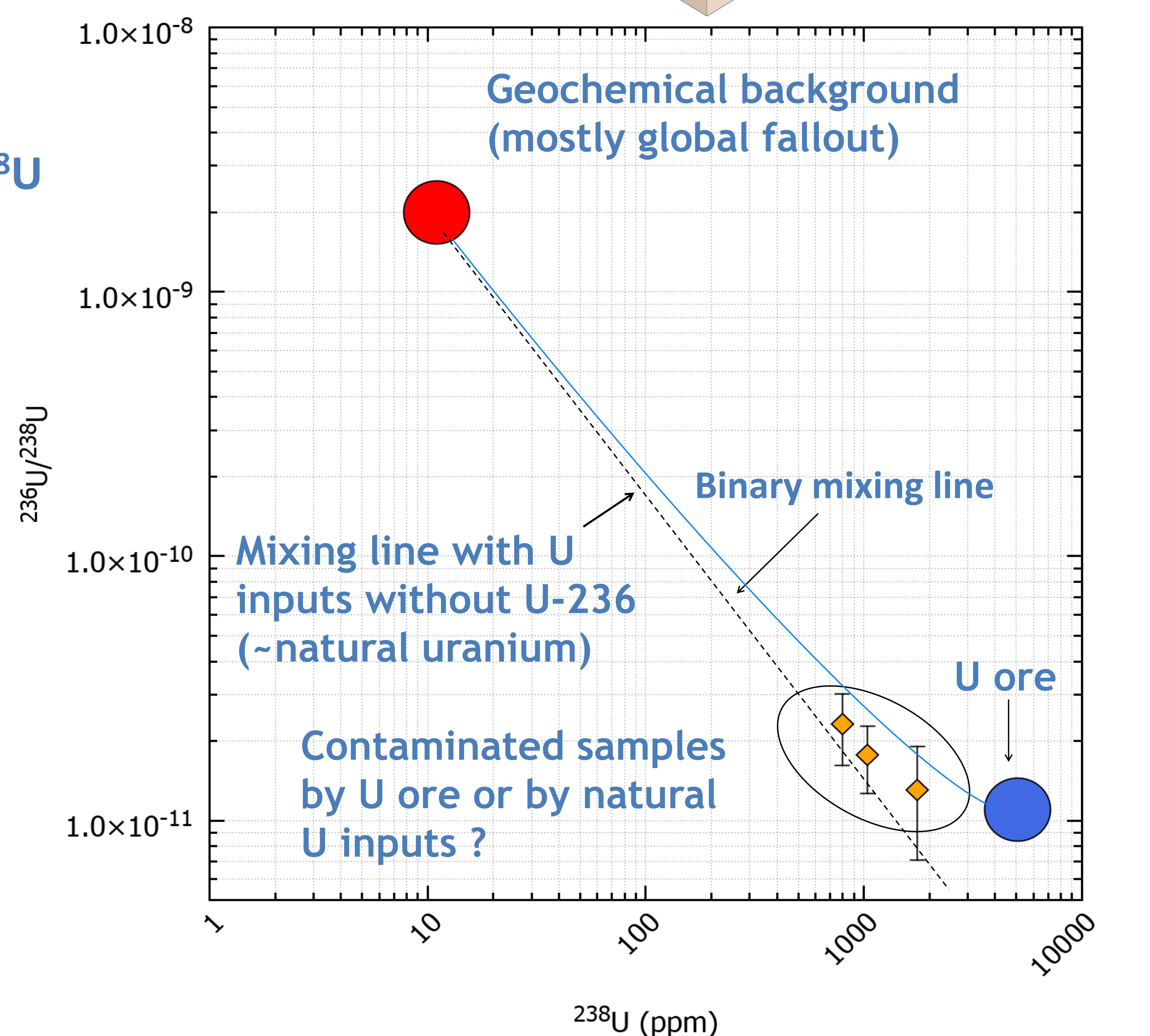
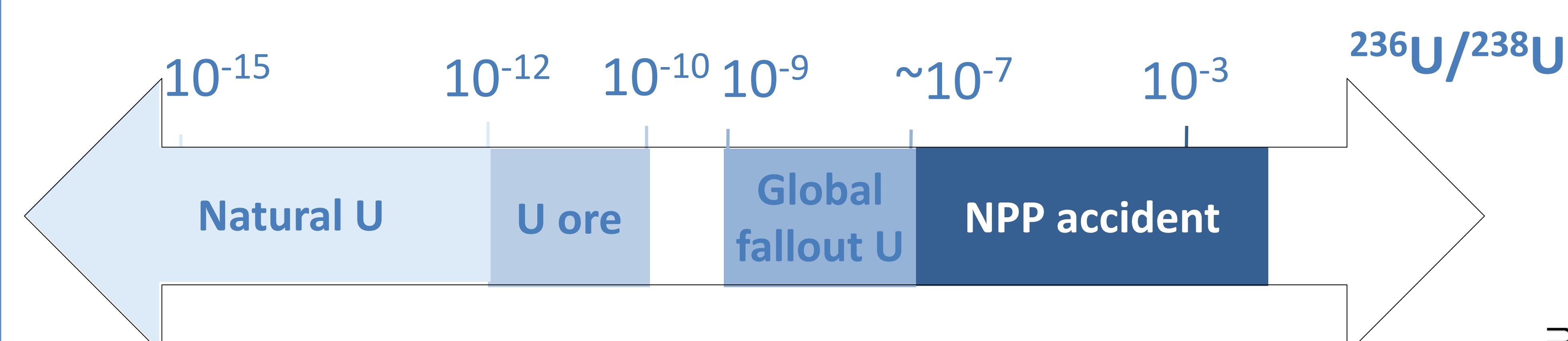
Versus

- 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



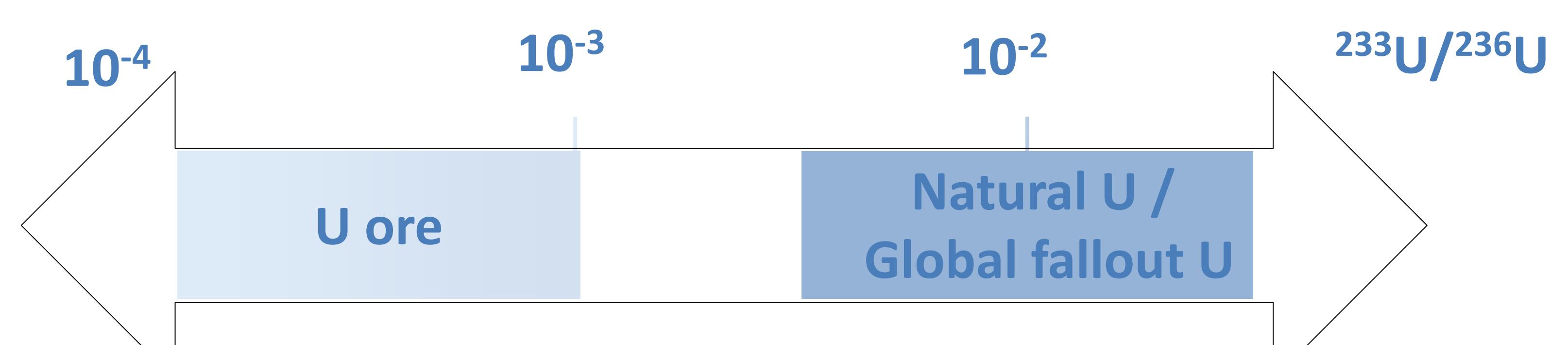
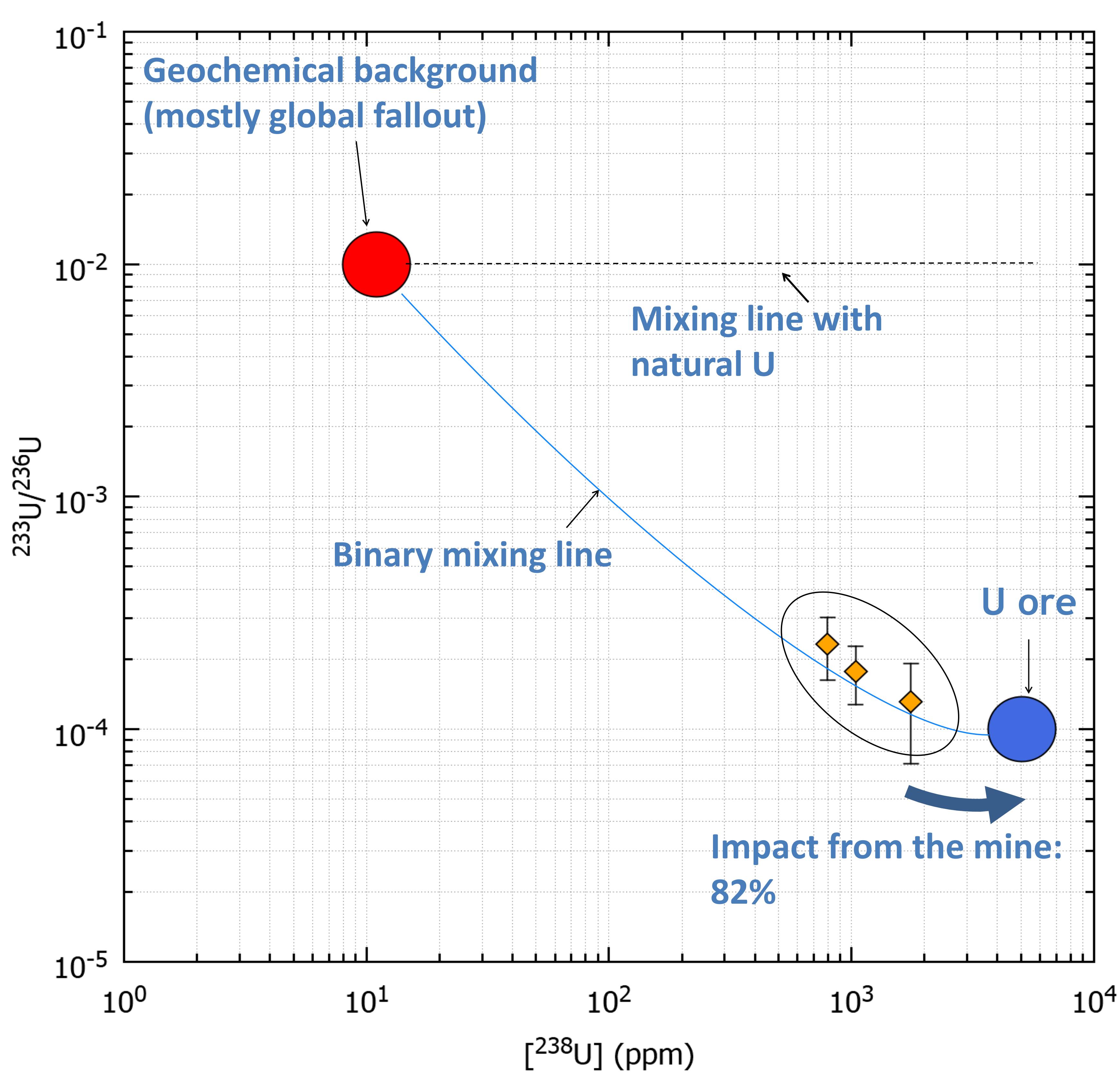
➤ Use of $^{236}\text{U}/^{238}\text{U}$ isotope ratios



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 ($^{233}\text{U}-^{236}$, $^{236}\text{U}-^{233}$) 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.