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Enhance radiation protection with insights into processes and origins

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Obtaining information on the origin and transfer mechanisms of radionuclides in the environment, as well as their fate in the human body in the event of internal contamination, is an important requirement for enhancing radiation protection. To this end, the CAMECA SIMS 7FE7 instrument is used to characterize the elemental and isotopic distribution in environmental and biological matrices.

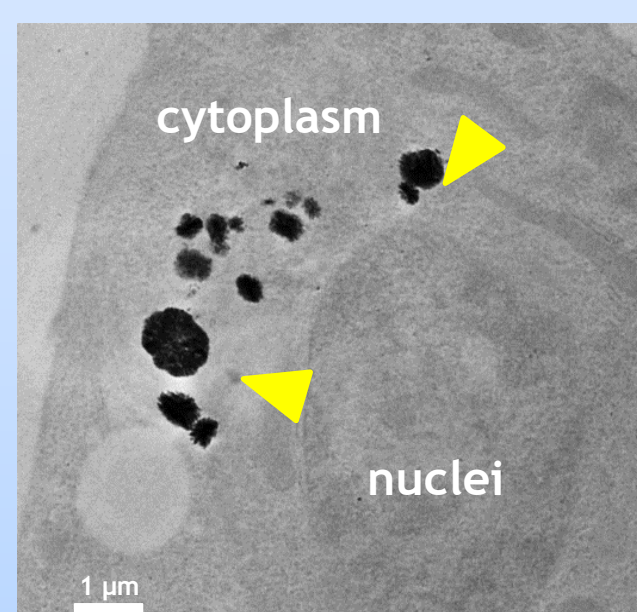
BIOLOGY

- Uranium (heavy metal) has both chemical and radiological toxicities and accumulates preferentially in kidneys (proximal convoluted tubules or PCT) and bones leading nephrotoxicity (after acute exposure)
- Precipitates in the cytoplasm revealed by Transmission Electron Microscopy (TEM) in cells

Objective

Detection and localisation of uranium in various physical forms from tissue to cellular scale

- ➔ Contribute to studies on the incidence of the development of kidney cancer in case of occupational exposure to uranium



Uranium precipitates in cytoplasm (TEM)

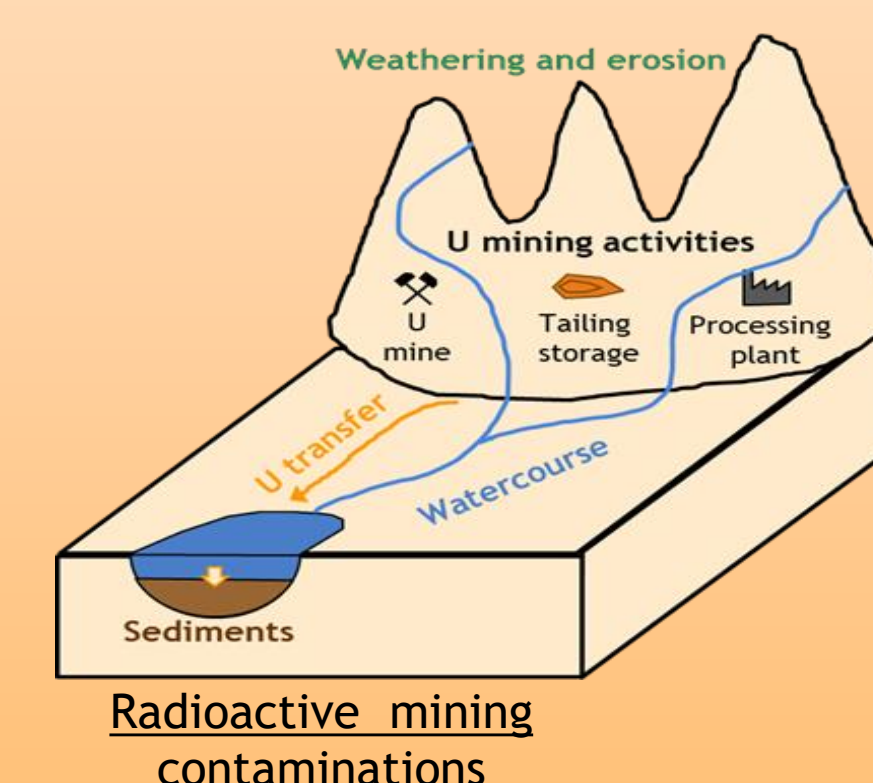
ENVIRONMENT

- Soils and sediments near former uranium mining sites often contain elevated levels of uranium and its decay products compared to the local geochemical background
- High uranium content (and its decay products) in soils and sediments, comparable to mining activities may also result from natural weathering/erosion of the local bedrock

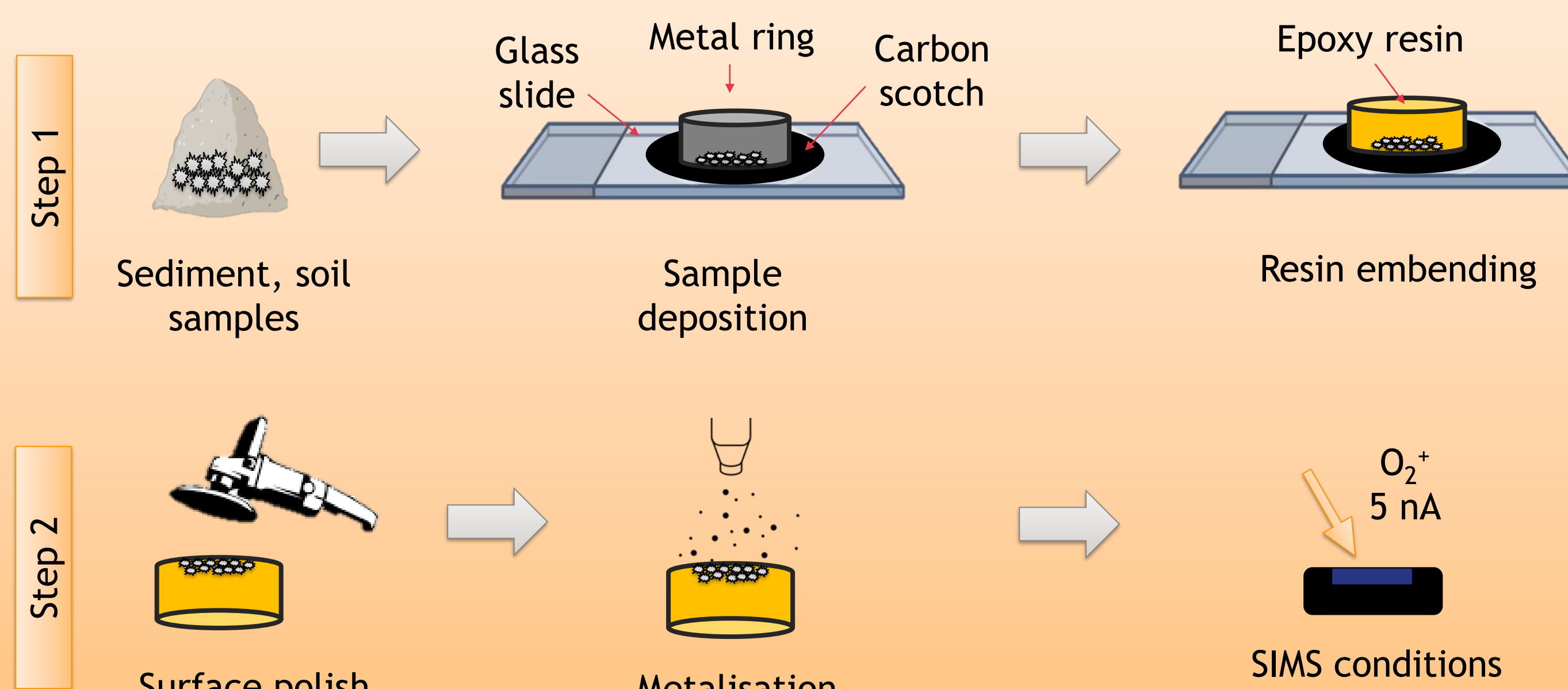
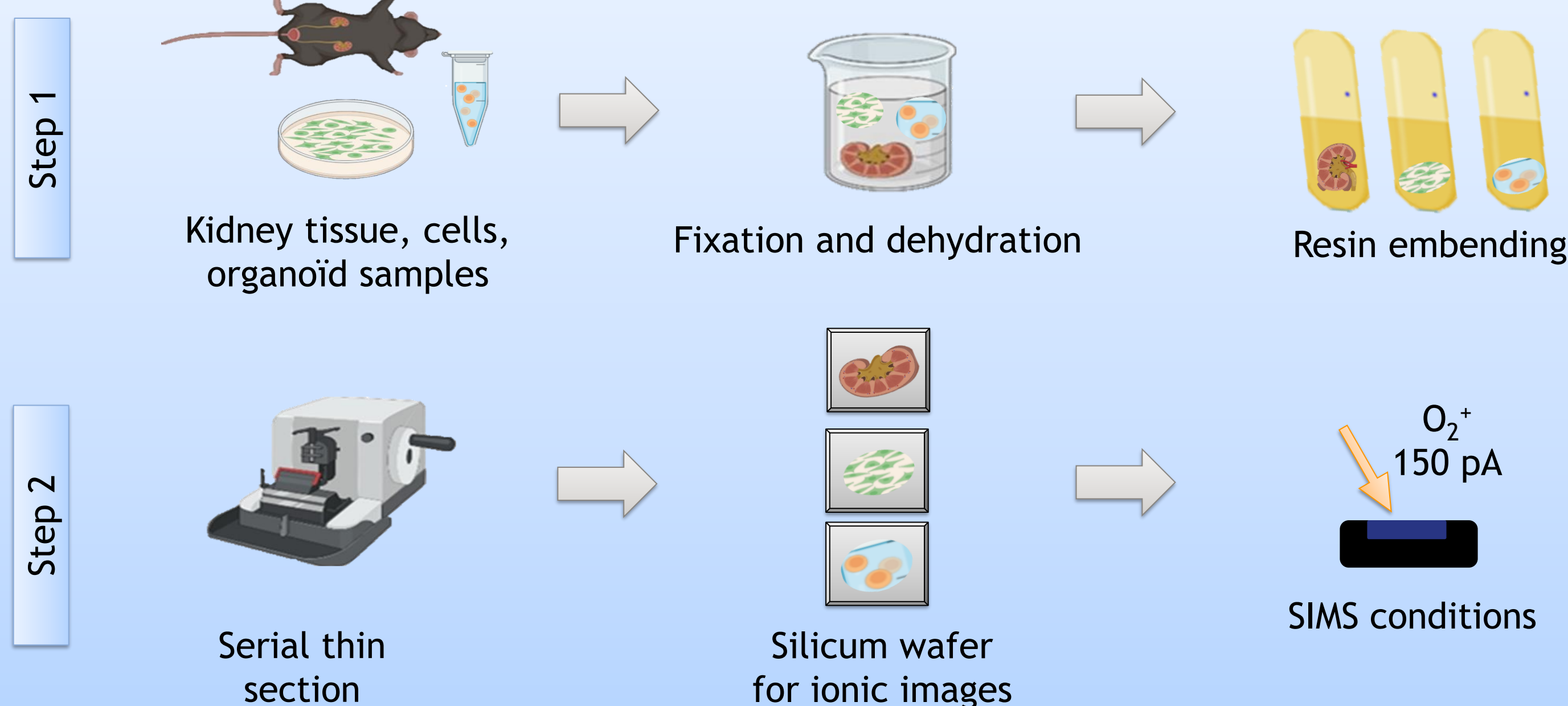
Objective

Identify the sources and transfer/transport mechanisms of radioactive elements

- ➔ Crucial for decision-making, management, and remediation of contaminated areas

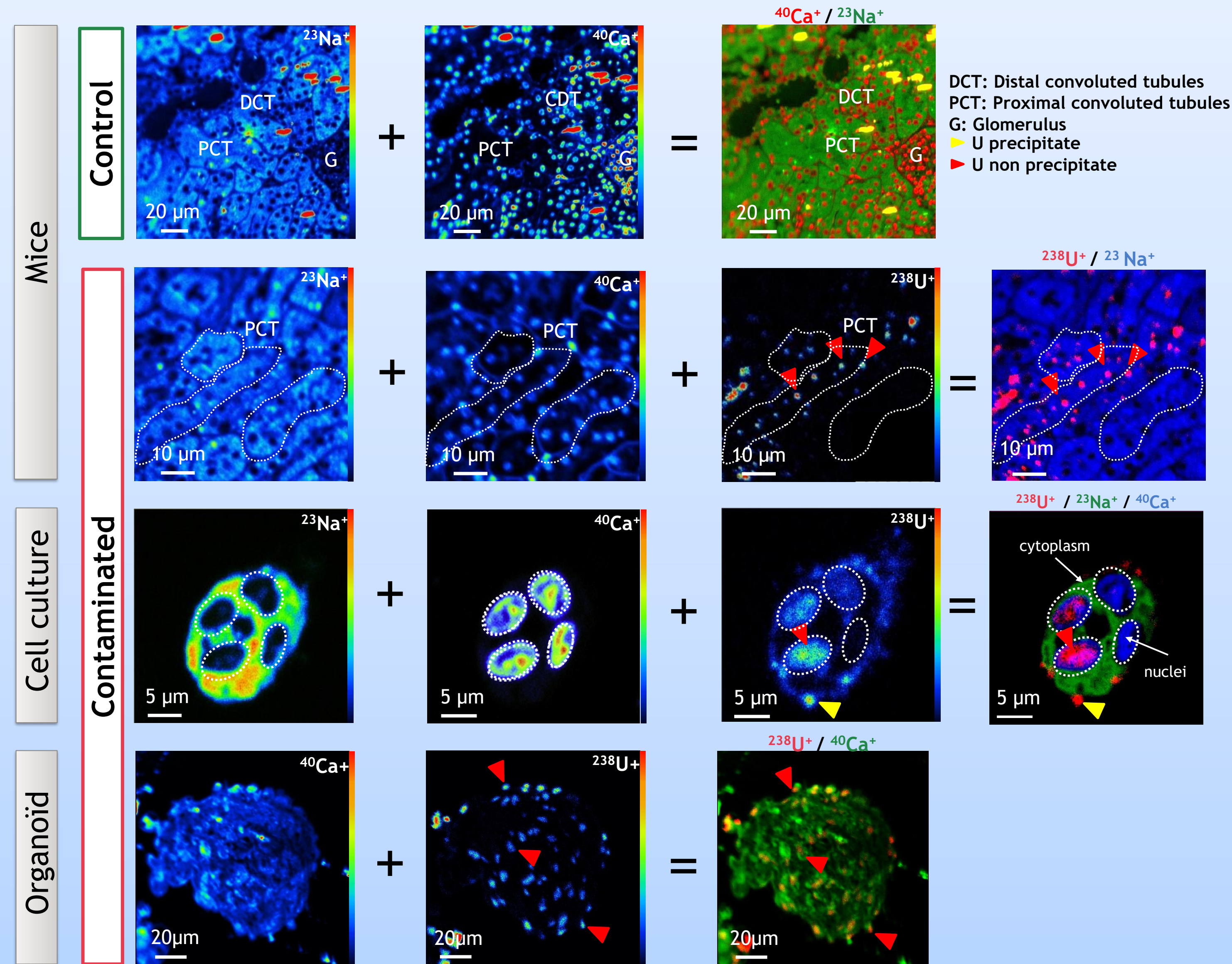


SAMPLES PREPARATION

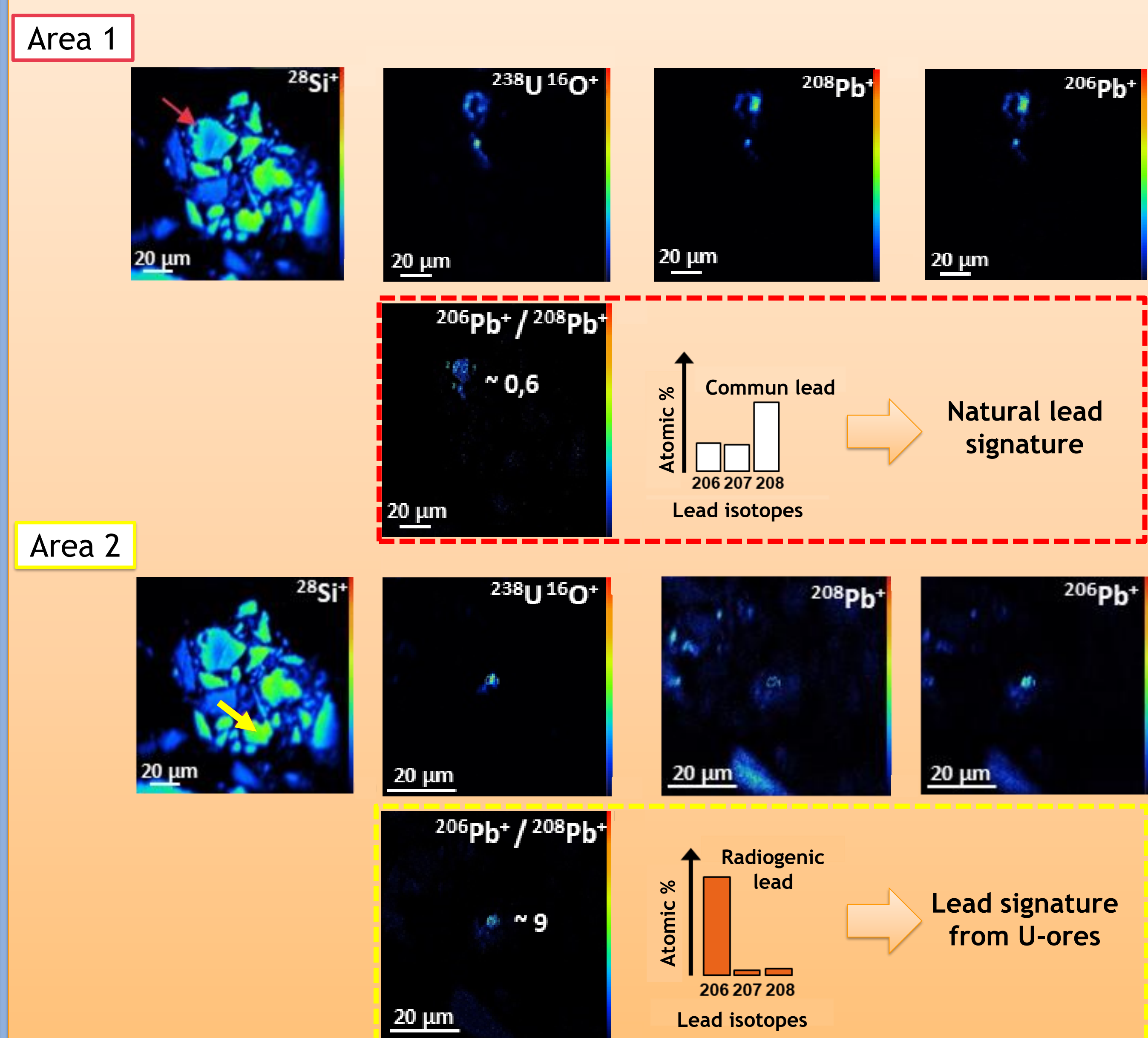


RESULTS

DETECTION AND LOCALISATION OF URANIUM IN KIDNEYS



IDENTIFICATION OF DIFFERENT U-BEARING PHASES IN TWO AREAS OF A SOIL CORE



CONCLUSIONS

- U heterogeneous distribution in rodent renal tissue
- Preferential localisation of U in the PCT nucleus confirmed by studies on cell culture and organoids
- ➔ To provide micro distribution of radionuclides for a better understanding of radionuclides transfer/transport mechanisms

- Confirmation of the presence of a U-rich phase from solid sample
- Identification of two Pb isotope ratios ($^{206}\text{Pb}/^{208}\text{Pb}$)
- ➔ To characterize contamination origin (anthropogenic or natural) based on lead isotope signatures

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SIMS 7F is a valuable tool for radiation protection research in the environmental as well as biological fields