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Go Your Own Way: Bronze Age Mobility in the Seine Valley with the input of strontium isotope variability mapping

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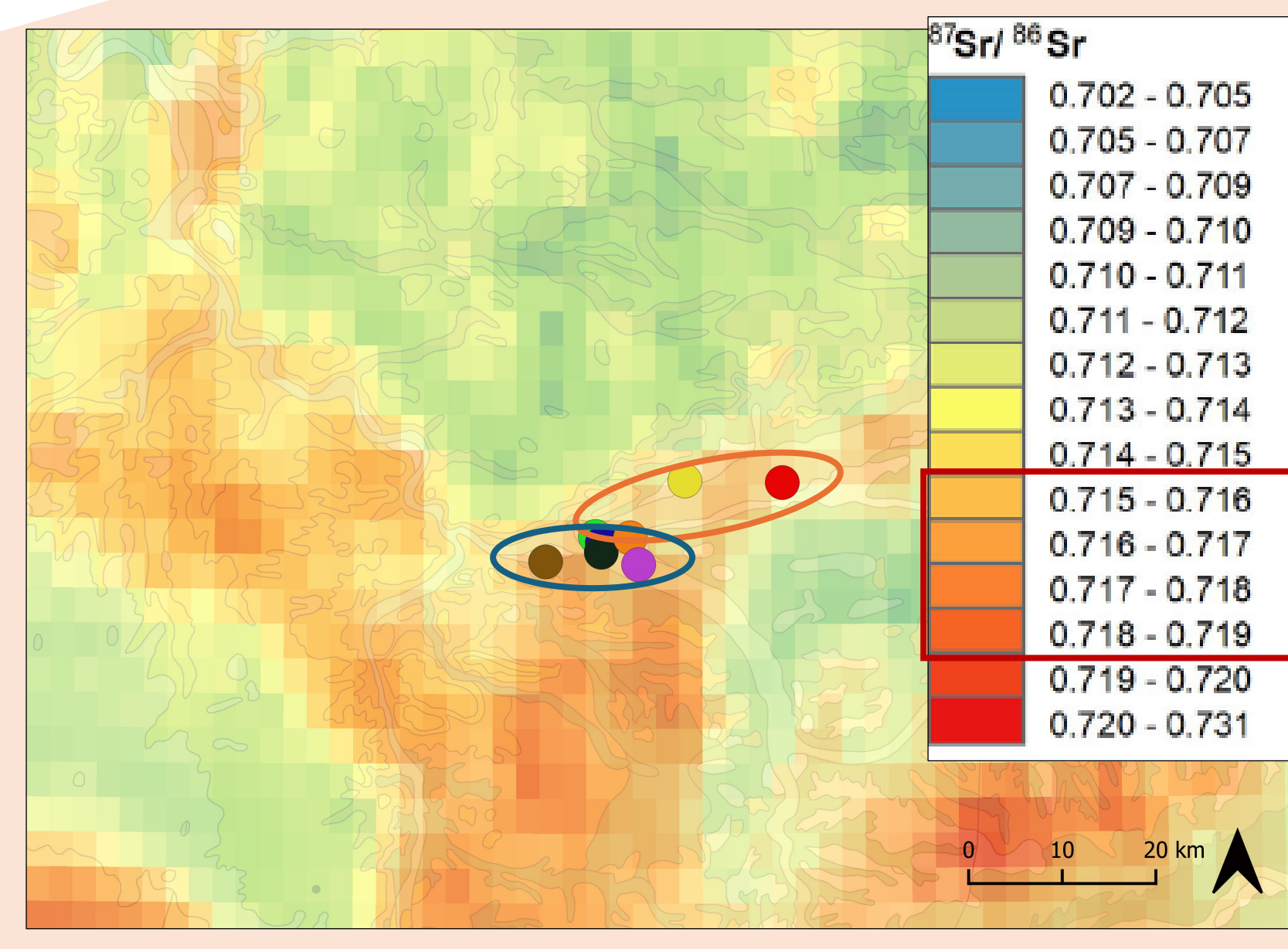
Go Your Own Way : Bronze Age mobility in the Upper Seine Valley with the input of strontium isotope variability mapping



Measuring strontium isotope ratio ($^{87}\text{Sr}/^{86}\text{Sr}$) in archaeological samples is a key tool for tracking past human mobility and is now widely applied in archaeological studies. However, this method needs an in-depth **knowledge of the bioavailable strontium variability** in the studied area. The development of a **mapping** of the local bioavailable Sr is necessary to characterize human mobility pattern and landscape management.

This study focuses on 8 Bronze Age sites located in the Seine-Yonne confluence region, in the Upper Seine Valley (France). During the Bronze Age, this area is marked by new cultural influences and significant changes in population dynamics, that could be explained by population mobility. In this context, 103 human cremated bones were analysed and the strontium isotope ratio were compared, firstly, to a **large-scale reference dataset** (isoscape of France) and secondly to a **local high-density map**, based on local plant samples (n=99).

Large scale isoscape used as a baseline for bioavailable strontium variability

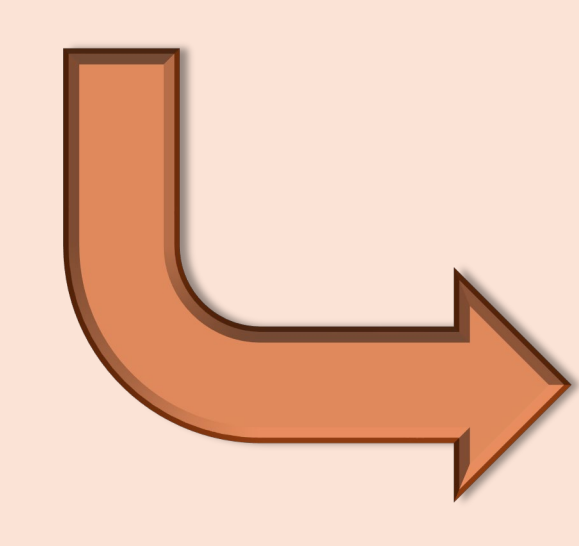


- First large scale bioavailable $^{87}\text{Sr}/^{86}\text{Sr}$ baseline for France, based on combined soil and plant samples, using a novel geostatistical framework (kriging), Willmes *et al.*, 2018.
- Considering that this map covers the entire territory of France, the sample density is relatively low (n= 610 sample locations)

According to the large scale isoscape:
 $0.715 > \text{local } ^{87}\text{Sr}/^{86}\text{Sr} > 0.719$

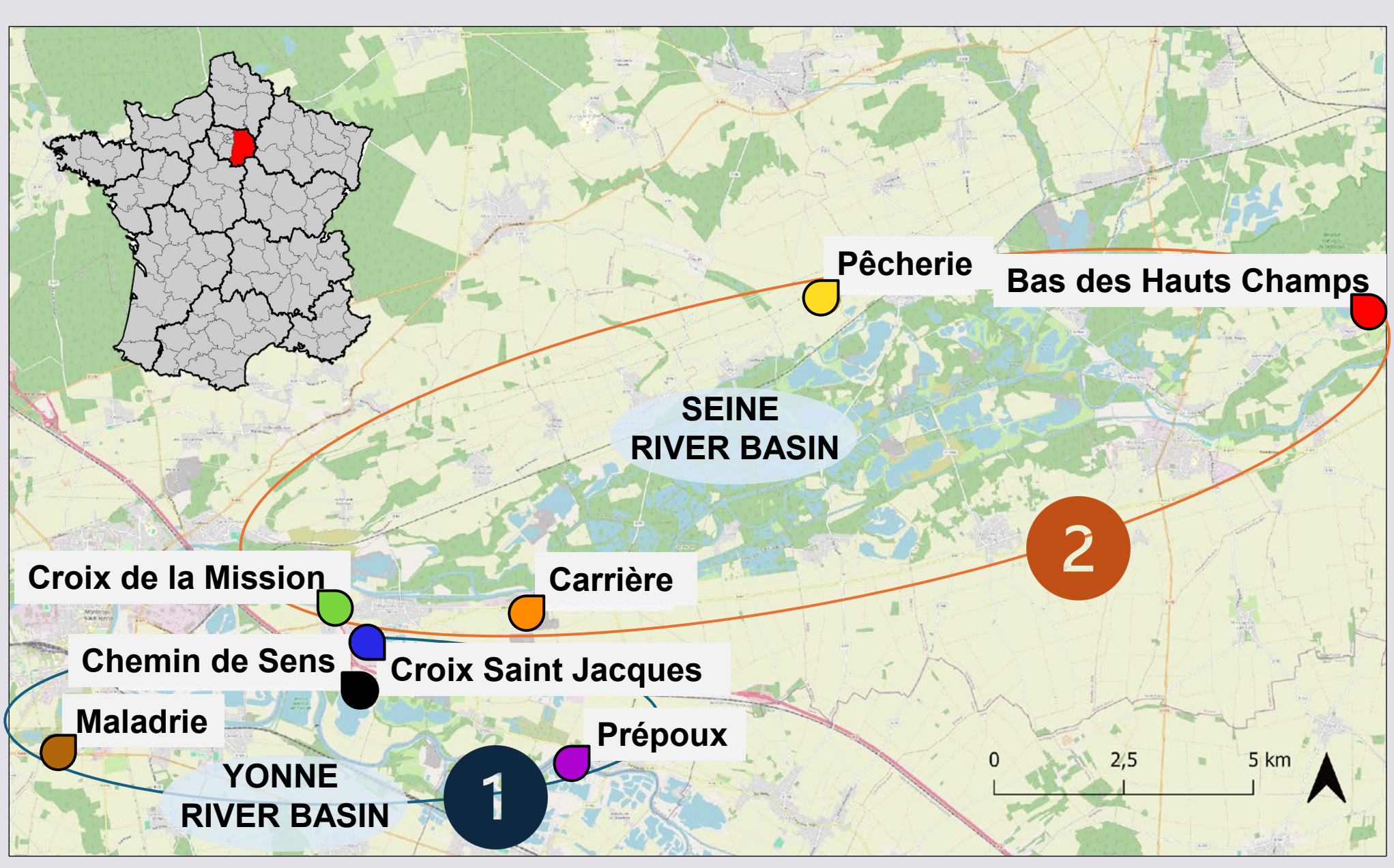
The local bioavailable strontium have **higher values** than the one measured in the human samples

Mapping of bioavailable strontium isotope ratios in France (Willmes *et al.*, 2018) and archaeological sites (points)



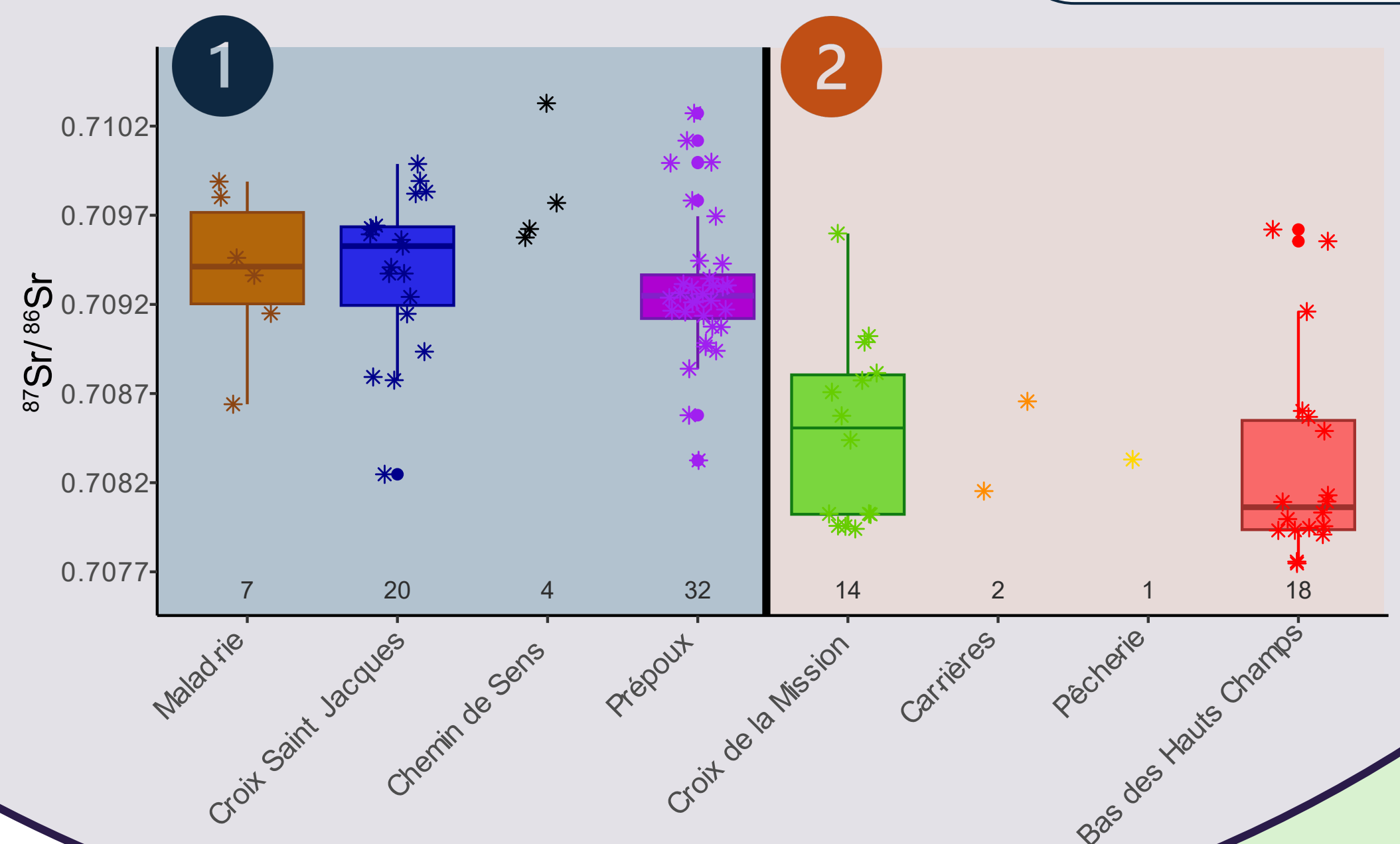
The local bioavailable strontium variability **doesn't match** the human $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratio, which means that **none of the individuals are considered as locals**

The Upper Seine Valley population



The $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratio of 103 cremated human bones were analysed

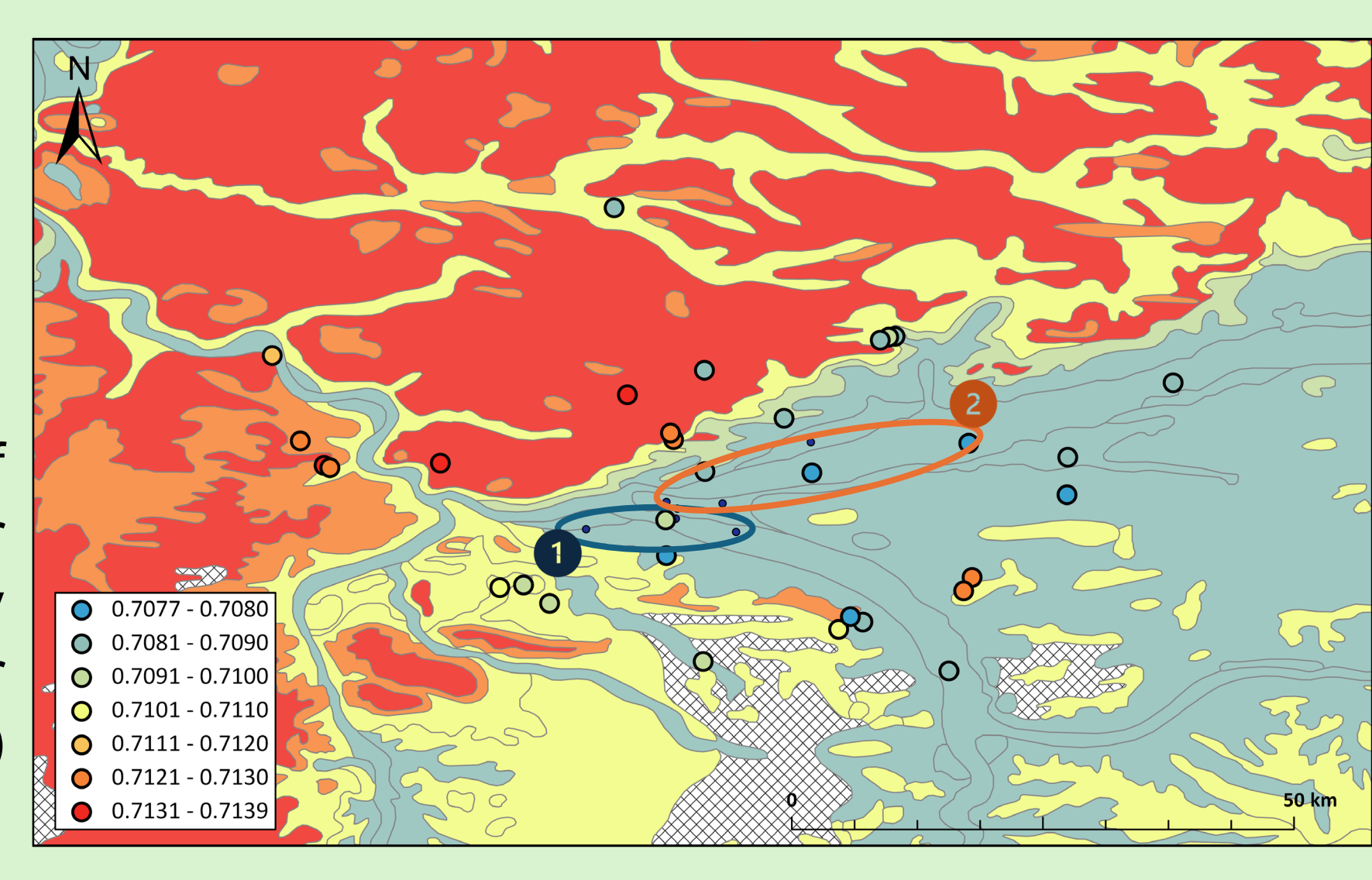
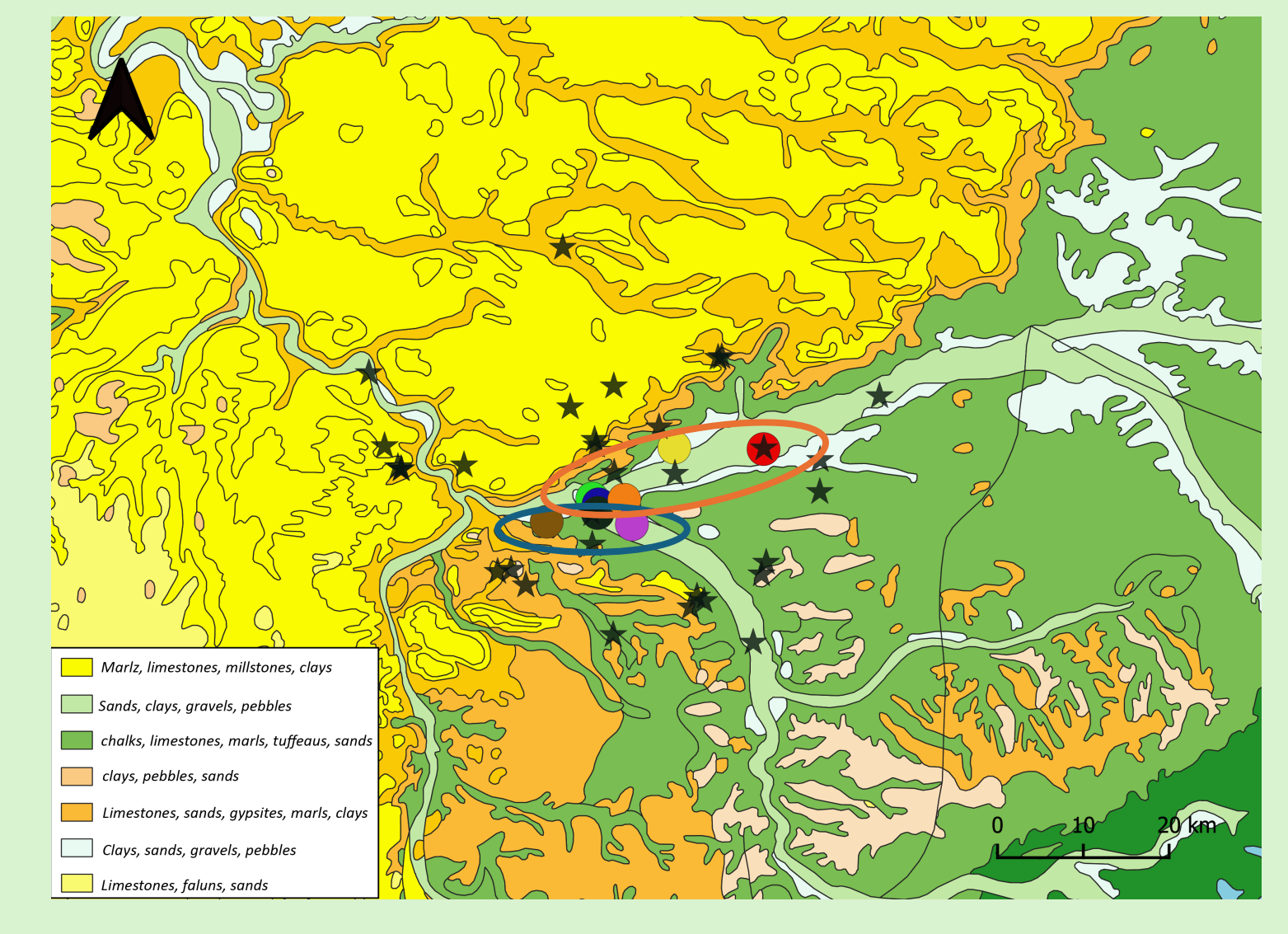
- 2 groups identified**
- $0.7082 > ^{87}\text{Sr}/^{86}\text{Sr} > 0.7102$
 - $0.7077 > ^{87}\text{Sr}/^{86}\text{Sr} > 0.7092$



Local high-density map used as a baseline for bioavailable strontium variability

Development of a high-density bioavailable $^{87}\text{Sr}/^{86}\text{Sr}$ baseline for the Upper Seine Valley:
33 locations sampled within a 60 km radius
99 plants collected and analysed

Sampling locations (stars) and archaeological sites on a geological map



Mapping of the bioavailable $^{87}\text{Sr}/^{86}\text{Sr}$ in the Upper Seine Valley (based on median per geology)

We can identify 3 main areas:
 to the east, between the Seine and Yonne rivers: $0.7077 > ^{87}\text{Sr}/^{86}\text{Sr} > 0.7090$
 to the south, below the Yonne: $0.7091 > ^{87}\text{Sr}/^{86}\text{Sr} > 0.7110$
 to the north-west : $0.7111 > ^{87}\text{Sr}/^{86}\text{Sr} > 0.7139$



The isoscape distribution matches the human $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratio:
 group 1 with values below the **Yonne**
 group 2 with values in the east, near the **Seine**

CONCLUSION

Within the humans, two clusters are identified based on $^{87}\text{Sr}/^{86}\text{Sr}$, which could suggest a distinct difference in land-use.

The human Sr values were compared to a **reference dataset** to better understand this distribution. The bioavailable strontium variability shown by the **large scale mapping** didn't match the human values, identifying the whole group as **non-local**. However, by developing an **extensive mapping of the local bioavailable Sr**, we were able to show that the **two river basins**, the Seine and Yonne, have distinct bioavailable Sr values that match with the human values. This reinforces the hypothesis that the distribution is linked to a **distinct land management**: the first group consumed resources near the Yonne and the second near the Seine, despite the geographical proximity of the archaeological sites.

Extensive mapping of the bioavailable strontium is a crucial tool, in addition to large scale mapping and modelling, to identify past mobility patterns.