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**HydroSciences
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**SUBMISSION TITLE: DISCRIMINATION OF THE NATURAL GEOCHEMICAL
BACKGROUND OF ANTHROPOGENIC GEOCHEMICAL INPUTS: CONCEPTUAL
ANALYSIS APPLIED TO THE CHARACTERIZATION OF GROUNDWATER MASSES.**



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Inspiring Groundwater



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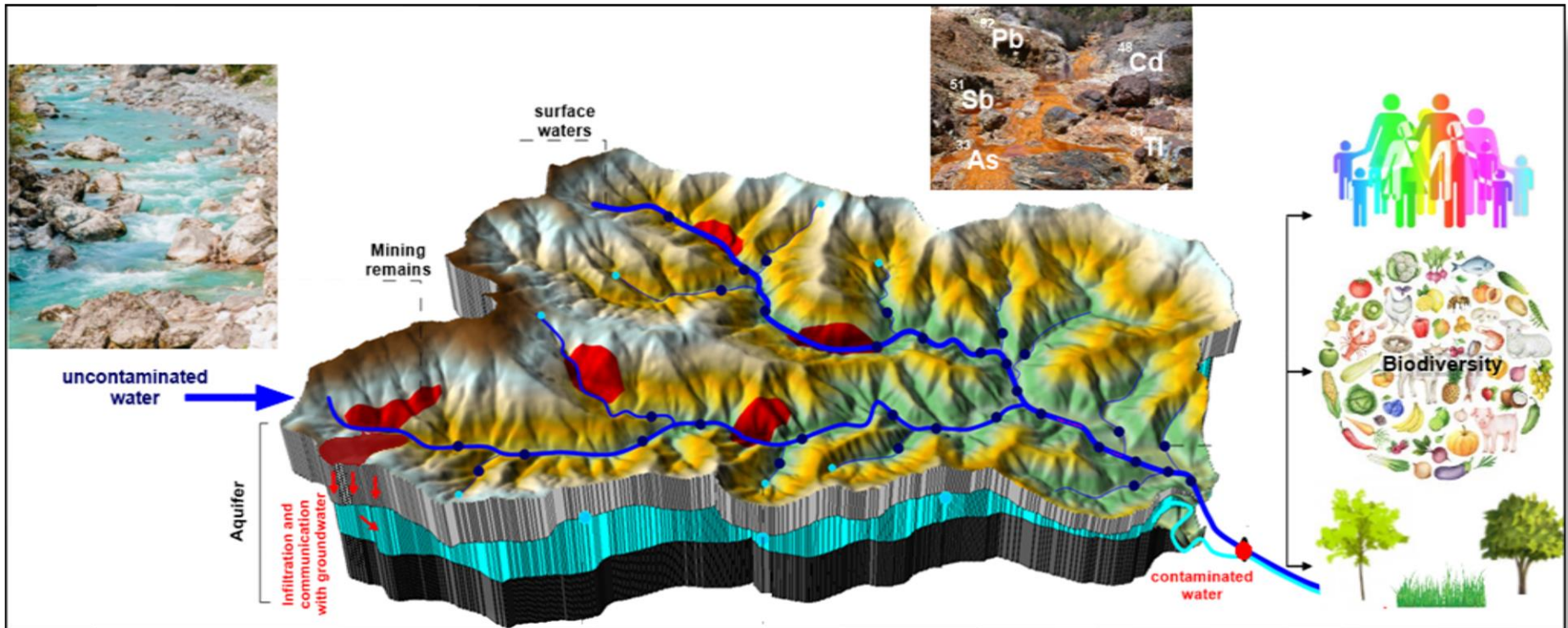
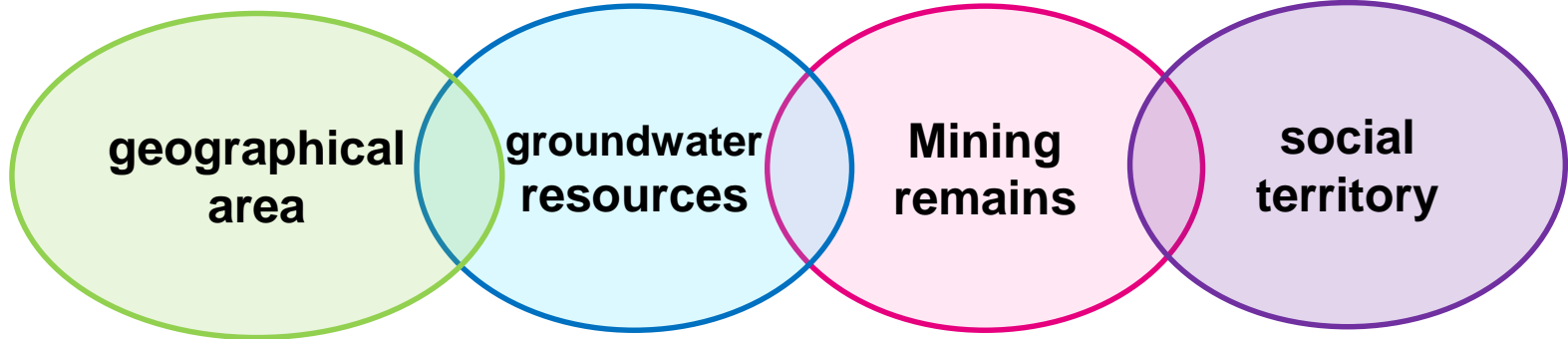
1.INTRODUCTION

2.THE EXISTING

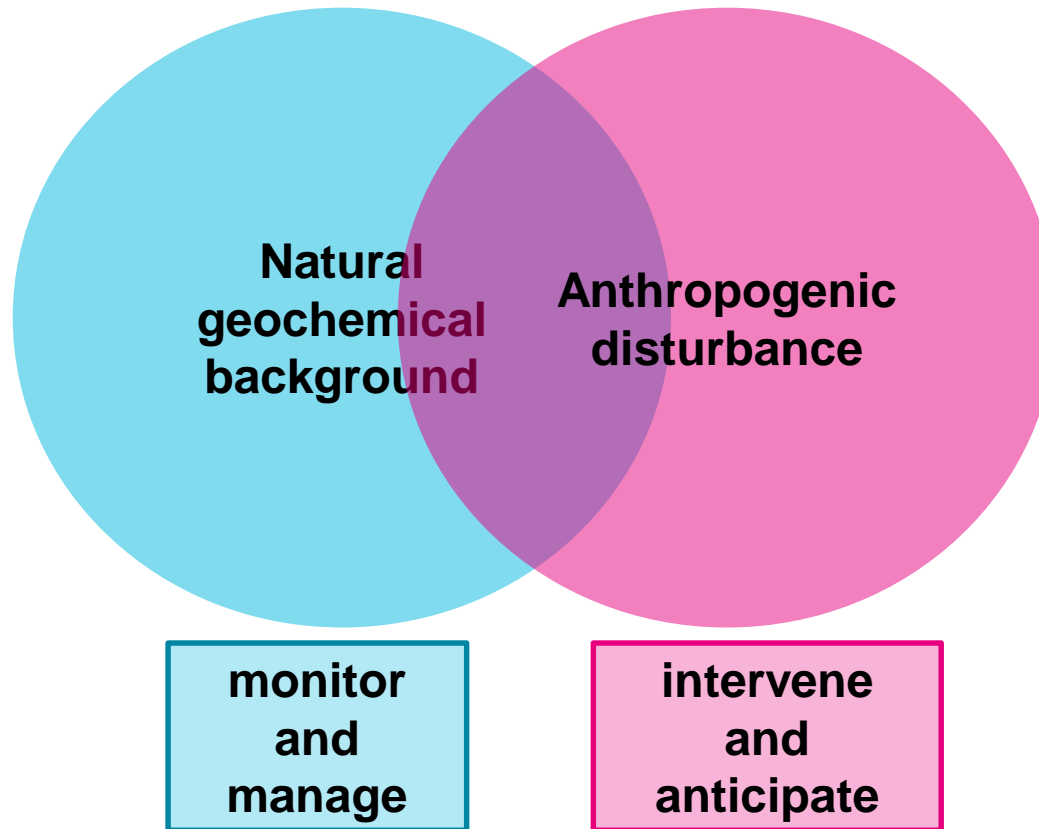
3.SCIENTIFIC CONTRIBUTION

4.DISCUSSION AND CONCLUSION

1.1 Contextual framework



1.2 Scientific question



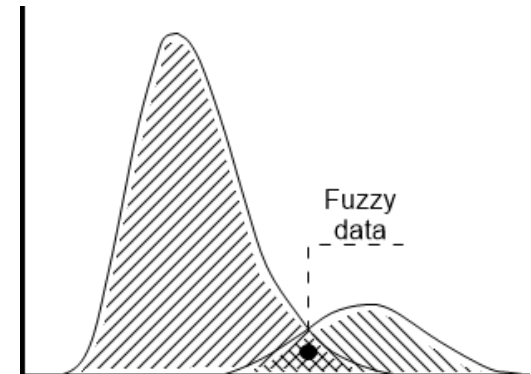
How to distinguish anthropogenic contributions to groundwater trace metal(loid)s enrichment from the natural geochemical background in an area that has experienced past mining activity ?

2.1 How previous work has answered the question?

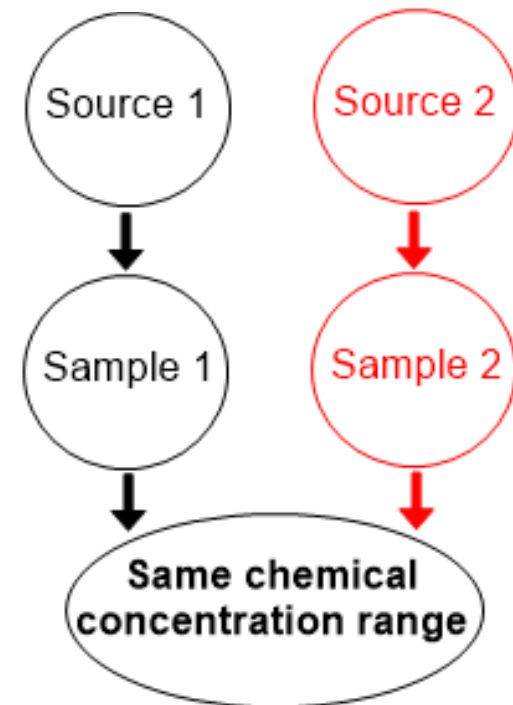
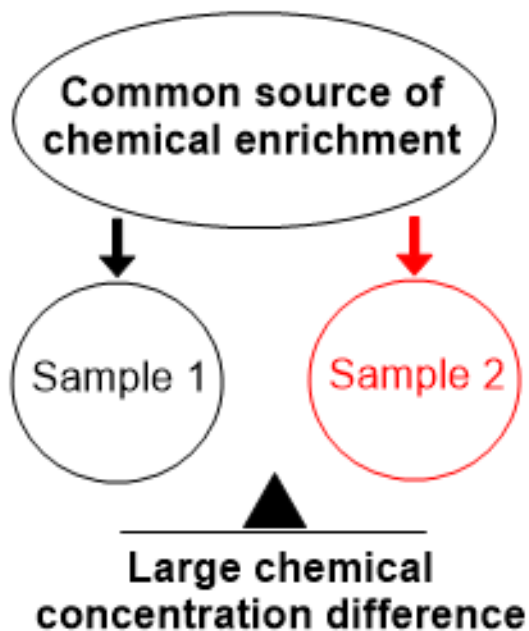
- **statistical techniques, probability plots, screening methods** (Preziosi and al. 2014), or **a combination of these methods and tools** (Parrone, Ghergo, and Preziosi 2019).
- **geochemical techniques based on geochemical foresight** (Edmunds and Shand 2009; A. Blum and al. 2001)
- **spatial and geostatistical techniques** (Dalla Libera et al. 2017; Molinari et al. 2019; Gaus et al. 2003)

2.2 Limits of the existing

- **Uncertainties of existing numerical approaches:**
fuzzy data



- **Uncertainties of existing geochemical approaches:**



3.1 Method development

Combining relevant factors (statistical, hydrogeochemical and geomorphological) in the same approach to account for the enrichment contributions of a groundwater sample

- **Factor a: statistical distribution**

- Lepeltier distribution
- Gauss distribution

- **Factor b: hydro geochemical conditions**

- mineralogical composition of the aquifer (ore deposit genesis)
- hydrogeochemical conditions for rock-water exchange

- **Factor c: Anthropogenic context**

- geomorphic gradient to describe the proximity of the mine remains to the measurement point

Favourable = 1 ; unfavourable = 0

3.2 The aggregation operator

Multi-criteria aggregation function

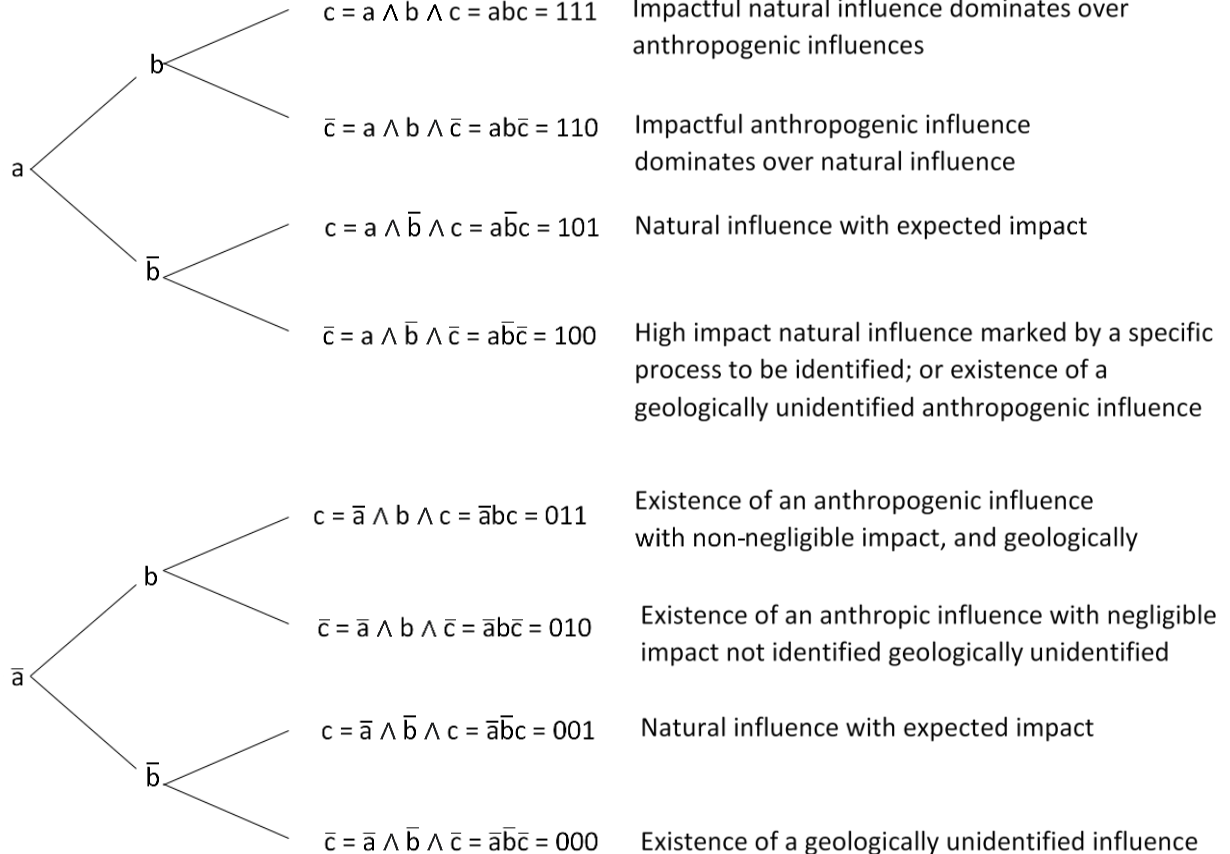
$$\varphi_{a,b,c}(S)$$



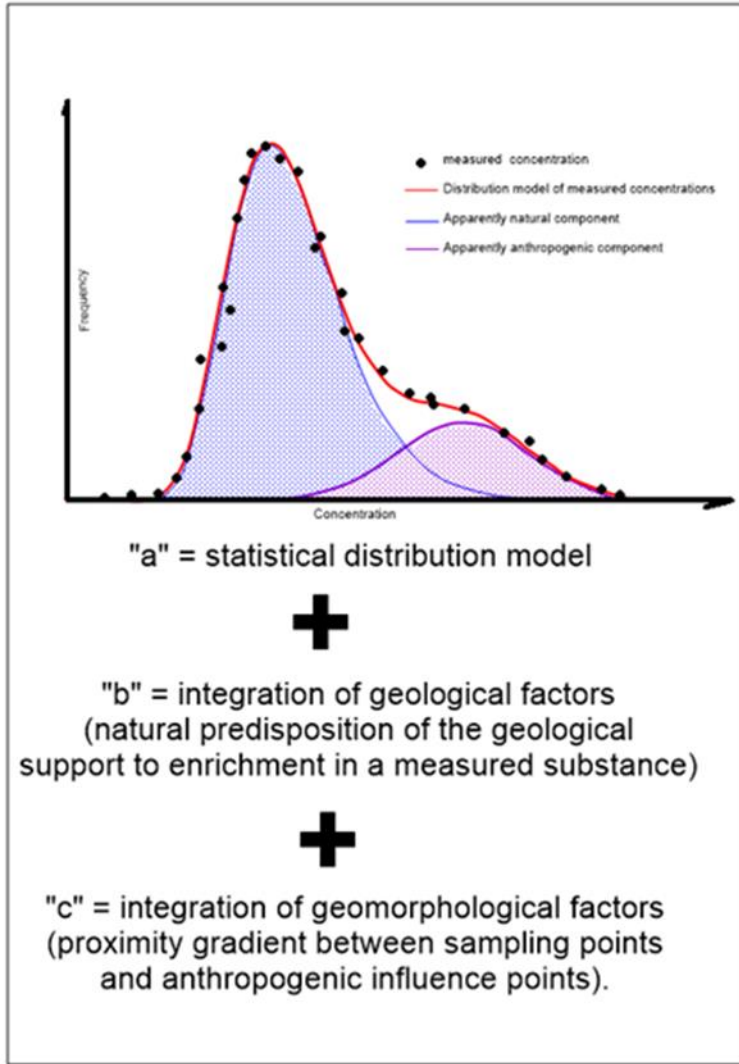
Natural geochemical background

$$NGB(S) =$$

function of $\varphi_{a,b,c}(S)$



$$= \begin{cases} NGB_i = "Mi", & \text{if } \varphi_{\kappa}(S) = \{111; 101; 011; 001; 100\}, \text{ with } M_i \text{ the measurement of the concentration of the sample } S \text{ of the fixed parameter.} \\ NGB_i = "med + 1.65 \sigma", & \text{if } \varphi_{\kappa}(S) = \{110; 010; 000\}, \text{ med the median and } \sigma \text{ the standard deviation of the main population, separate from the residual secondary population for 95\% test power} \end{cases}$$



$$\varphi_{a,b,c}(S)$$

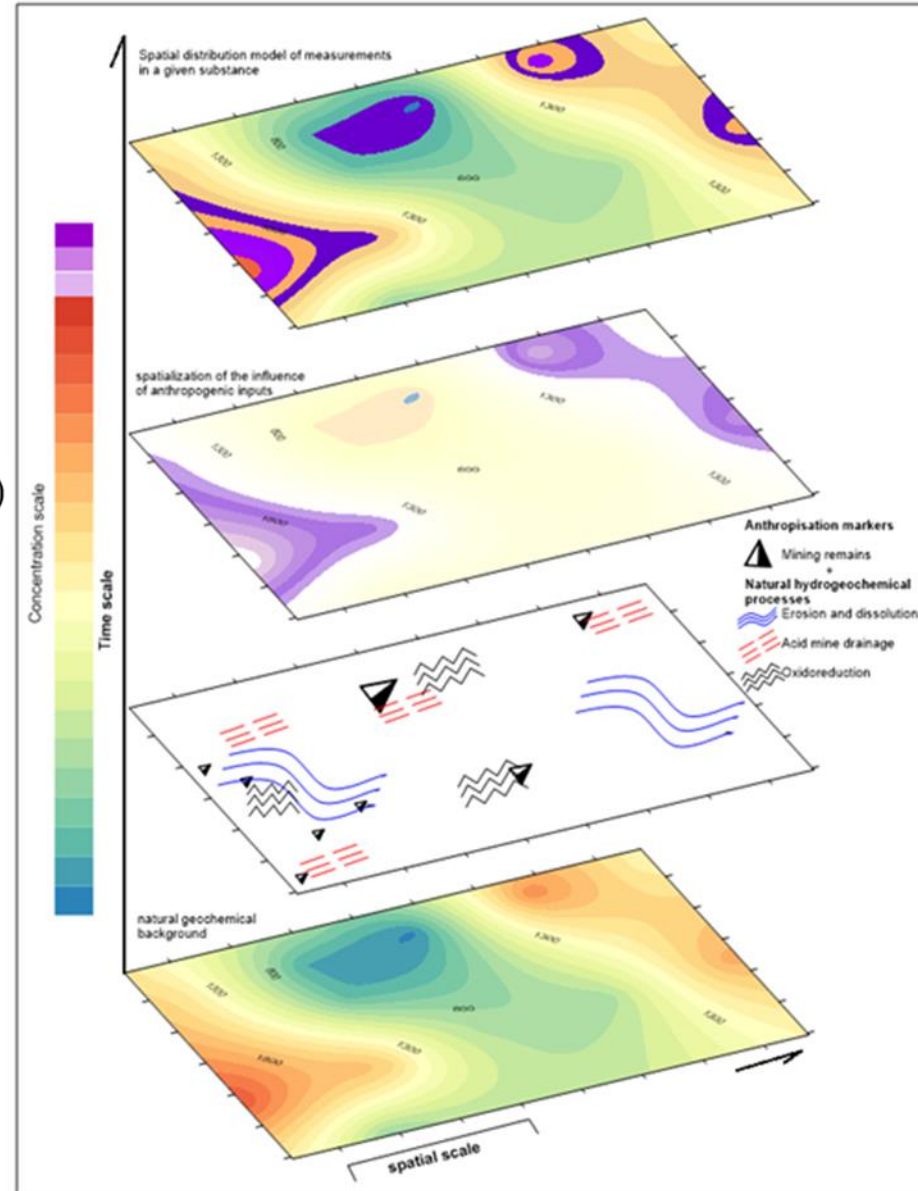


Figure 1 : Conceptual model of discrimination of the natural geochemical background of anthropogenic inputs in a groundwater body