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# Implementation of the TRIAD approach for the ecological risk assessment of an old lead mine

Nicolas Pucheux<sup>1</sup>, Sandrine Andres<sup>1</sup>, Pascal Pandard<sup>1</sup>, Cécile Grand<sup>2</sup>

<sup>1</sup>INERIS, Rue Jacques Taffanel, 60550 Verneuil-en-Halatte

<sup>2</sup>ADEME, 20 avenue du Grésillé BP 90406 49004 ANGERS CEDEX 01

E-mail contact: [nicolas.pucheux@ineris.fr](mailto:nicolas.pucheux@ineris.fr)

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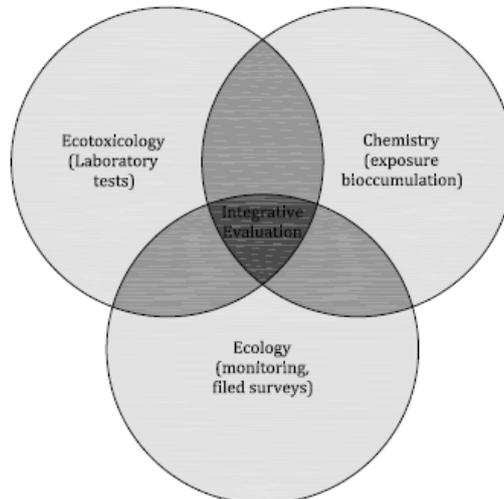
## 1. Introduction

Site specific ecological risk assessment of soil contamination goes with intrinsic difficulties. Obvious ones are heterogeneity of soil properties, landscape, local communities, diversity and ecosystem structure, and contamination nature and pressure.

Different tools are suitable to perform an ecological risk assessment. Most often, a pragmatic combination of these tools will allow the risk to be assessed in an appropriate way. In this context, the International Standard ISO/DIS 19204 “Soil quality – Procedure for site specific ecological risk assessment of soil contamination (Soil quality TRIAD approach)” describes in a general way the application of three combined lines of evidence (chemistry, ecotoxicology and ecology). The TRIAD includes different tiers in which each consecutive tier is increasingly fine-tuned according to the site-specific situation.

## 2. Materials and methods

The TRIAD method is designed to use three different environmental risk assessment approaches (chemistry, ecotoxicology and ecology) at once in order to compensate uncertainties from one with strength of the other two.



**Figure 1: Schematic view of the three lines of evidences (LoEs) of the soil quality TRIAD [1].**

The method allows for a proportionated and step-wise evaluation based on a tiered approach, depending of site-specific situations. The first tier of the method is composed of tests requiring few resources (time and money). A complex study as the one selected for the applied case (see below) may require the need to use more elaborated assessment tools in further tiers.

The selected site for the applied case is an open pit mine operated during 60 years and which the activities stopped about 100 years ago. The ground still contains high levels of metallic pollution (mainly Pb, Cd, Zn).

Five contaminated areas were selected out of the 15 that were identified. Selection criteria were typology, presence or absence of vegetation, indication of presence of organic matter in soil:

- Residues and mining products containing high levels of metallic pollutant combined with a high bioavailability potential (F, I1 and I2 on Figure 2).

- Areas containing high level of an old contamination naturally re-colonized by scattered vegetation (K on Figure 2).
- Vegetable garden, enriched in organic matter ground, containing high level of contaminants with a low bioavailability (G on Figure 2).

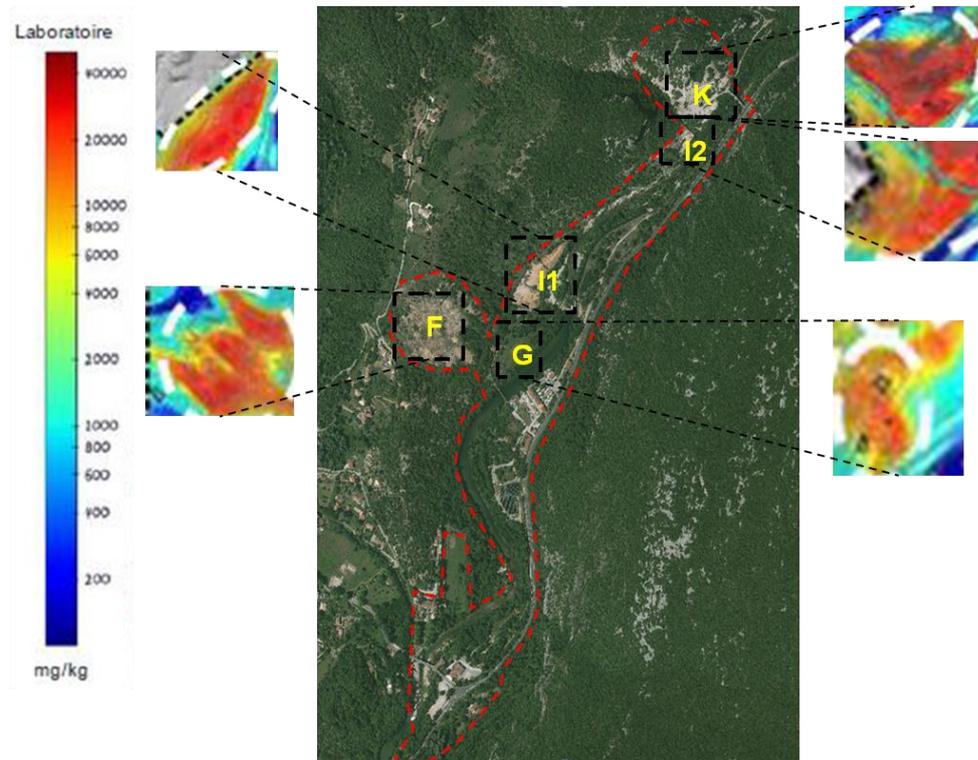


Figure 2 Lead concentration in soil [2]

### 3. Results and discussion

Datas collected consist of already available chemical concentrations in soil, quantification of bioavailability (animal and plant models), abundance and diversity of plants and nematods in soil obtained during past years. They were enough datas to use early tiers of the TRIAD approach on selected sites and their immediate surroundings. When necessary, ecotoxicological test were carried out to obtain missing datas. It was possible to apply the tier one tools on every selected locations. The combined use of chemical concentration in soil (Chemistry), plant screening test (Toxicology) and simple vegetation survey (Ecology) were sufficient to assess the risk on some of the 5 areas (F, G, I1, I2 and K). In consequence, some of the expensive and time consuming datas collected in these locations were not needed to assess the risk. On other locations, uncertainties were still too great and the implementation of higher tiers was needed.

### 4. Conclusions

The study allowed to experience the ease and the efficiency in using the different tiers of this decision-helping method that is TRIAD. The focus had been done on the outcome of it in order to obtain practicable results according to the complexity of the study. It reveals that for some locations, the use of TRIAD method could have saved financial and time resources. The use of the highest tier on particularly complex zones will need additional datas, future investigations are planned for the year 2016.

### 5. References

- [1] ISO/DIS 19204 "Soil quality – Procedure for site specific ecological risk assessment of soil contamination (Soil quality TRIAD approach)".
- [2] ELISOL Environment. 2012. Rapport d'étude sur la nématofaune du sol [...] sur d'anciens sites d'activités minières.