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Case Study - Developing an Ecotoxicological Soil Screening Standard for Metals/Metalloids

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Problem Statement: Metals occur naturally in the environment and the bioavailability of metals and metalloids varies according to soil physico-chemical conditions. Furthermore, soil-dwelling organisms and microbial processes vary in their sensitivity to metals/metalloids. Developing an ecotoxicological soil screening level for a metal/metalloid is therefore challenging as it needs to recognize these various issues.

Scientific Issues: The standard needs to consider background concentrations of metals/metalloids in soils as these vary widely across soils in different jurisdictions. There are various definitions of "background" that also need to be considered. The reaction of metals/metalloids with the soil solid phase generally reduces their bioavailability (compared to soluble metals/metalloids in solution) and this also varies as a function of various soil properties, such as pH, clay content, organic matter content, etc. The basis of how the soil standard will be measured also needs to be considered – will it be a standard based on total concentrations in soil or one based on a fractional measure of the metal/metalloid in soil? Biological issues such as adaptation to metals/metalloids, species sensitivity and protection of species *versus* functions also needs to be considered. The role of the screening standard in the risk assessment process also needs to be defined.

Current risk assessment: Several jurisdictions have soil screening standards based on total concentrations in soils and find these problematic for implementation. Recent advances in the science of metals/metalloid behaviour in soils has been incorporated into standards for soils in Europe and in Australia, and these try to address the issues raised above and provide a "best practice" given current scientific understanding. These approaches will be reviewed and the rationale for the choice of various options explained.

Discussion questions:

1. What is the best way to incorporate background concentrations into a risk assessment process?
2. How do we determine background concentrations of metals/metalloids in soils?
3. Should soil standards be based on total concentrations or on a partial extraction of soils to recognize differences in metal/metalloid bioavailability across soils?
4. What is the best way to recognize different sensitivities of soil organisms or soil processes to metals/metalloids?

Key reading

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