Greener and leaner soil and sediment remediation: an overview of *in-situ*

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Abstract

Over the past decade there has been heightened interest in using in-situ remediation for contaminated sediments and in-situ technologies for soils have been underway for the past few decades. Such technologies include methods for degrading the contaminants in place or arresting or blocking exposures through the use of various barriers and amendments. These approaches appeal to common sense as they can be less costly to implement, can be less disturbing to the environment, and may pose lower risks to humans. But often the arguments regarding pros and cons of in-situ vs. removal technologies focus on specific aspects of the remedial process. What can be lost in narrow arguments is the fuller understanding of the life cycle of the various technologies with respect to overall economic, environmental, and human health benfits.

The economic benefits aspects are often the easiest to grasp and to compare among removal and in-situ remedial technologies. Less obvious are overall ecological benefits. Understanding relative ecological benefits typically requires a broad understanding of the ecological risks/impacts that contaminants are having within the system, the degree to which these risks will be reduced in the short and long-term by the remedial technologies, and the short and long-term impacts of the remediation.

A variety of methodologies have arisen to capture the relative environmental risks and benefits of alternative technologies. These include Net Environmental Benefits Analysis (NEBA), Integrated Environmental Benefits Analysis (IEBA), and Relative Risk Methods (RRM). Implementation of these methods requires knowledge of the various ecological systems and associated ecological srvices.

Relative human health risks and benefits involve a comparison of technologies in the short and long-term for the full range of remedial elements. Particular attention has been given to the life-cycle aspects that influence site-related risk reduction, potential risks associated with remediation, and even risks to remedial workers. While the last has gotten much discussion, it is important to note that "risk acceptability" is itself a variable that is not constant over all populations.

This talk will weave together the above aspects into a consideration of the "greener" and "leaner" nature of in-situ remediation and the efforts that are needed to make that case.

Origin of uranium deposits revealed by their rare earth element signature

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Uranium deposits have formed in a wide range of geological settings including deep metamorphic/magmatic to surficial conditions and range in age from Archean to recent time. These temporal and spatial variations have given rise to an extreme diversity of deposits [1]. However, understanding their genesis and exploring for uranium deposits have remained challenging. In particular, very limited link between trace element or isotopic composition of uranium oxide and the conditions for their accumulation to economic grades have been clearly established.

Here we report REE abundances in uranium oxides, measured by microbeam methods (SIMS and LA-ICP-MS), for a series of 20 worldwide uranium occurrences from six of the major uranium deposit types. This study demonstrates that the REE contents of uranium oxides are very specific to each deposit type, regardless of the age or variations in local geological settings. Thus, REE abundances reflect directly the mineralising processes specific to each deposit type. We propose an evaluation of the first order parameters (T, REE sources and fluid composition) controlling the REE behaviour in each mineralized system. When applied to giant unconformity-related deposits, REE abundances enable to better understand their formation. Our results demonstrate that the REE patterns of uranium oxides are powerful tools for refining metallogenic models, and a key for the definition of the genetic model of new uranium discoveries [2].

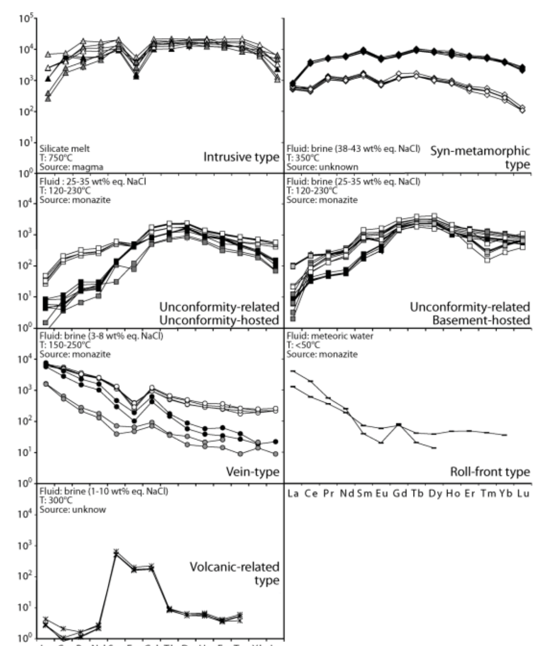

Figure 1:chondrite-normalized REE patterns of uranium oxides for six different types of worldwide U deposits. Source : source of REE

[1] Cuney (2009) *Mineralium Deposita* **44**, 3-9. [2] Mercadier et al. (2011) *Terra Nova* **23**, 264-269.