**Dynamic extraction using rotating coiled columns for studies
on the fractionation and bioaccessibility of trace metals/metalloids
in environmental solids**

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The exposure of trace metals/metalloids in the environment cannot be correctly assessed by measuring merely the total concentration of individual trace metal/metalloid species, because the mobility, bioaccessibility and, consequently, toxicity strongly depend on their chemical forms and type of binding. Traditionally, the identification and quantification of metals/metalloids associated with predefined phases or soil compartments are performed by using batch sequential extraction procedures. This approach is accompanied by secondary adsorption and fractions overlapping phenomena, which could be minimized using the dynamic extraction systems. Alternative methodologies, which are being developed in recent years, are based on dynamic (flow-through) fractionation of elements in large-sized columns, stirred flow cells, microcolumns (MC), and rotating coiled columns (RCC). Each system has advantages and limitations which are depended on the column design and operational parameters. MC and RCC look most promising, besides, they allow one to determine elements in the effluent in on-line mode (Rosende 2009). Resemblances and discrepancies of the dynamic extraction in RCC and MC were evaluated by the fractionation of Cu, Pb, Zn, As, Sb, and Se according to their physicochemical mobility and bioaccessibility in soil, sludge, and sediment samples. The eluents (leachants) were applied in correspondence with three different four- and five-step sequential extraction schemes for partitioning trace metals, arsenic/antimony, and selenium, correspondingly. The data obtained were correlated with the properties of samples under investigation and operational principles of RCC and MC. In general, similar trends were found for the distribution of trace metals (metalloids) between extractable and residual fractions. However, some evident deviations were observed. The content of organic matter (organic carbon) in a sample can be regarded as an important physicochemical parameter affecting the leaching efficiency.

The evaluation of soil extraction methods within a biouptake framework has only recently drawn attention. For the assessment of bioaccessibility of trace metals/metalloids, aqueous salt solutions, buffered salt solutions, weak acids, reductive, oxidising, and complexing reagents are commonly used. Correlations between results obtained by chemical (in vitro) and biological (in vivo) methods have been critically evaluated (Fedotov 2014). In general, the extraction of environmental solids with diluted salt solutions, namely, 0.01 M CaCl2, 0.1 M Ca(NO3)2, 1 M NH4OAc or 1 M (NH4)2SO4 is currently regarded as a suitable method for predicting the plant uptake of trace metals. CaCl2 and Ca(NO3)2 extractions seem to be the most suitable technique for the assessment of metal availability to plants. As compared to the batch extraction, the dynamic methods may result in more correct assessment of the plant uptake of trace metals.

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*References*

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