



## Determination of the pseudo total metal content of environmental matrices by different extraction methods

Sezin Oeztan and Rolf-Alexander Duering

Justus von Liebig-Giessen, Institut für Bodenkunde und Bodenerhaltung, Giessen, Germany  
(sezin.oeztan@umwelt.uni-giessen.de)

In the determination of metals in solid samples, extraction stage is a consequential but also in general mightily time-consuming period. During the last decades, new extraction techniques for extractable metals in environmental matrices have been developed that will substitute the conventional procedures in the future. The aim of this study is to proffer a simple digestion procedure for solid samples with microwave technology for classically determined metals and elements seldomly determined such as Be, Tl, etc. in environmental matrices.

Soil samples have been taken from different locations in Hesse, Central Germany and from contaminated sites in Tbilisi, Georgia. Closed vessel microwave assisted extraction (MAE) with aqua regia as extraction agent and EDTA-microwave extraction (EDTA in closed vessel MAE) are compared with conventional aqua regia extraction method for the determination of metals (As, Ba, Be, Cd, Co, Cr, Cu, Li, Mn, Mo, Ni, Pb, Tl, V, Zn). Furthermore, mobile and potentially available fractions were identified by EDTA and NH<sub>4</sub>NO<sub>3</sub> extractions. In addition to the pseudo total metal contents of soils, chemical and physical properties of the investigated soils were also identified. Ascertainment of the metals in soils was done by ICP-OES methodology.

Results of the study adduce that the MAE procedure with aqua regia as extraction agent shows approximately the same concentrations as the conventional aqua regia digestion in the determination of pseudo total content of As, Ba, Be, Cd, Co, Cr, Cu, Li, Mn, Mo, Ni, Pb, V, Zn. The EDTA-microwave extraction gives approximate values in the ascertainment of pseudo total Cd, Co, Mn, Cu, and Pb amounts as the conventional aqua regia digestion. Furthermore, the results from the MAE (aqua regia) and EDTA-microwave extraction are evaluated with two reference standard soils (CRM 7001 and CRM 7004) to ascertain the accuracy of the MAE and EDTA-microwave extractions.

Using minimal reagent chemicals is a strategic characteristic of MAE (aqua regia) and EDTA-microwave extraction procedures. Consequently for both processes only 0.3 g of sample and 8 ml of extraction solution is used. The tenacy of EDTA in microwave methodology as the extracting medium instead of using concentrated acids is decent, thus resulting in a clean and less hazardous metal dissolution.

This study demonstrates that MAE (aqua regia) and EDTA-microwave extraction in closed-pressurized vessels are good alternatives to the conventional aqua regia digestion. Several advantages of EDTA-microwave extraction can be compassed which include higher safety, accuracy and reduced contamination and also requires significantly less time for metal dissolution. By the use of feeble acids as EDTA, the sample material is not corrupted during the extraction procedure.