

## Germanium and Rare Earth Element accumulation in woody bioenergy crops

Werner Hentschel

Technische Universität Bergakademie Freiberg, Germany (werner.hentschel@student.tu-freiberg.de)

Germanium and REEs are strategic elements that are used for high tech devices and engineered systems, however these elements are hardly concentrated into mineable ore deposits. Since these elements occur widely dispersed in the earth crust with concentrations of several  $\text{mg}\cdot\text{kg}^{-1}$  (Ge  $1.6\text{ mg}\cdot\text{kg}^{-1}$ , Nd  $25\text{ mg}\cdot\text{kg}^{-1}$ ) a new possibility to gain these elements could be phytomining, a technique that uses plants to extract elements from soils via their roots. Since knowledge about accumulating plant species is quite limited we conducted research on the concentrations of strategic elements in wood and leaves of fast growing tree species (*Salix spec.*, *Populus spec.*, *Betula pendula*, *Alnus glutinosa*, *Fraxinus excelsior*, *Acer pseudoplatanus*).

In total 35 study sites were selected in the mining affected area around Freiberg (Saxony, Germany), differing in their species composition and degree of contamination with toxic trace metals (Pb, As, Cd). On each site plant tissues (wood and leaves, respectively) of different species were sampled. In addition soil samples were taken from a soil depth of 0 - 30 cm and 30 - 60 cm.

The aim of our work was to investigate correlations between the concentrations of the target elements in plant tissues and soil characteristics like pH, texture, nutrients and concentrations in six operationally defined soil fractions (mobile, acid soluble, oxidizable, amorphous oxides, crystalline oxides, residual or siliceous). Concentrations of elements in soil extracts and plant tissues were measured with ICP-MS. The element Nd was selected as representative for the group of REEs, since this element showed a high correlation with the concentrations of the other REE

We found that the concentration of Nd in the leaves ( $0.31\text{ mg}\cdot\text{kg}^{-1}\text{Nd}$ ) were several times higher than in herbaceous species ( $0.05\text{ mg}\cdot\text{kg}^{-1}\text{Nd}$ ). The concentration of Ge in leaves were ten times lower than that of Nd whereas in herbaceous species Nd and Ge were in equal magnitude.

Within the tree species *Populus spec.* ( $0.77\text{ mg}\cdot\text{kg}^{-1}$ ) and *Salix spec.* ( $0.36\text{ mg}\cdot\text{kg}^{-1}$ ) showed by far the highest concentrations of Nd in leaves. *Fraxinus excelsior* ( $0.10\text{ mg}\cdot\text{kg}^{-1}$ ) and *Betula pendula* ( $0.06\text{ mg}\cdot\text{kg}^{-1}$ ) feature the lowest concentrations of Nd in leaves.

We found significant correlations between the concentration of the target elements in the plant tissue and the concentration of these elements in the first steps of the sequential extraction of the soil samples.

These studies have been carried out in the framework of the PhytoGerm project financed by the Federal Ministry of Education and Research, Germany.