

## **Germanium and rare earth elements in soils under different land use types in the area of Freiberg (Saxony, Germany)**

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A geochemical mapping study was conducted to investigate the spatial distribution and chemical fractionation of germanium (Ge) and selected rare earth elements (REEs) in topsoils and soil-grown plants under different land use types (moist grassland, mesic grassland, arable land) in the area of Freiberg (Saxony, Germany). The area of Freiberg is characterized by the mining of polymetallic sulphide deposits (Pb, As, Zn, Cd) which led to the pollution of top soils with metals and metalloids due to local emissions from metal smelting plants that occur widespread in the area. Since Ge often appears to be associated to sulphide ores like sphalerite, galenite and argyrodite, (post-)mining areas such as the Freiberg region are paradigmatic for phytomining research. The study area covers approximately 1,000 km<sup>2</sup> in the south of Central Saxony, and 138 samples from 46 sampling sites were examined. Additionally, at each sampling site plant samples were collected. On arable soils the plant samples represented the cultivated crop species. On sites in mesic and moist grassland, samples from the most dominant plant species were taken and measured with ICP-MS. Ge and REEs in soils were partitioned by a sequential extraction procedure into mobile/exchangeable (Fraction 1), acid soluble (Fraction 2), bound to organic matter (Fraction 3), amorphous Fe/Mn-oxides (Fraction 4), crystalline Fe/Mn-oxides (Fraction 5) and residual fractions (Fraction 6). Total concentrations of Ge and REEs in soil varied considerably ranging from 1.0 µg g<sup>-1</sup> to 4.3 µg g<sup>-1</sup> for Ge and 97 µg g<sup>-1</sup> to 402 µg g<sup>-1</sup> for total REE concentrations. Elements in potentially plant available fractions (sums of Fraction 1 – Fraction 4) represented 8% of total Ge and 30% of total REEs, respectively. Soils on moist grasslands contained significantly higher total concentrations of Ge and REEs and higher concentrations of Ge and REEs in potentially plant available soil fractions compared to soils of mesic grasslands and arable land. Highest concentrations of Ge could be measured in plant species growing on moist grassland. The results of this study indicate that moist grasslands may act as sinks for Ge and REEs. In these soils high amounts of soil organic matter may foster the formation of labile element pools, increasing the availability of Ge and REEs.

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