Rare earth elements in mushrooms

ANJA GRAWUNDER[1]* AND MATTHIAS GUBE[23]

[1]Friedrich Schiller University Jena, Institute of Geosciences, Jena, (correspondence: *anja.grawunder@uni-jena.de)

[2]Friedrich Schiller University Jena, Microbial Communication, Jena

[3]Georg August University Göttingen, Soil Science of Temperate Ecosystems, Göttingen

Fungi are important organisms in ecosystems, acting as destruents, parasites or symbionts. Their fruiting bodies (=mushrooms) can accumulate metals including radionuclides [1]. However, for mushrooms rather limited knowledge is available on contents and distribution of rare earth elements (REE), a group of f-block metals with growing importance in biogeochemical cycles.

In the former U mining area Ronneburg/Germany, for which high REE concentrations in groundwater and soil solution have been reported [2], 32 fruiting bodies of *Lactarius pubescens* were sampled in autumn 2011 and 2012. This fungus is common in obligate ectomycorrhizal relationship with *Betula* sp., a pioneer plant in the location. The associated soil had pH_{CaCl2} 4.0; its bulk ∑REE content was 141.3 $\mu g\ g^{-1}$ from which 9.0 $\mu g\ g^{-1}$ were bioavailable (extraction with NH_4NO_3 and CH_3COONH_4).

Fruiting bodies were separated into stipes, lamellae, pileus and pileipellis, dried and digested with HNO_3. The highest REE contents were found in the pileipelles and lamellae (e.g. for La: <2.58 and <0.34 $\mu g\ g^{-1}$). Stipes and pilei had lower contents (La: <0.14 and <0.04 $\mu g\ g^{-1}$), which is consistent with their function as transport, rather than storage systems. In older fruiting bodies, the lamellae and pileipelles were characterized by slightly higher contents of REE and Al, while contents of Ca, Cd, Co, (Cu), Mn, S, and Zn were decreased. For the pileipelles also P was higher and Fe was lower for older mushrooms. After normalizing REE contents to Post Archean Australian Shale [3], the resulting REE patterns showed that the positive Ce anomaly present in the bioavailable soil fraction is missing in biomass. Light REE (La-Nd) were stronger enriched in lamellae and pileipelles. Middle REE (Sm-Dy) enrichment was found both in soil and fungal biomass. This indicates that the fungus is able to mobilise stronger bound REE from other soil fractions than the biovailable one, redistributing them in the fruiting bodies.

[1] Falandysz & Borovička (2013), *Appl. Microbiol. Biotechnol.* **97**, 477-501.

[2] Grawunder et al. (2015), *Appl. Geochem.* **54**, 100-110.

[3] McLennan (1989), *Rev. Min. Geochem.* **21**, 169-200.