Microbially stimulated recovery of precious metals from household waste incineration slag

E. MARIE MUEHE[12], JING HE[1], DOMINIK WIMMER[1]*, ALEXANDER BETZ[1], CAROLINE SCHMIDT[1], KURT KONHAUSER[3] AND ANDREAS KAPPLER[1]

[1]Geomicrobiology, University of Tuebingen, Germany
[2]Soil and Environmental Biogeochemistry, Stanford University, USA
[3]University of Alberta, Edmonton, Canada
*correspondence/presenting author: evna@gmx.net

The use of precious metals and Rare Earth Elements (REE) in the production of electronic products continues to increase. To meet this demand, the recovery of REE from industrial waste has become a focul point of recent research. However, it remains unclear whether abiotic extraction procedures can be stimulated and optimized by using microorganisms capable of dissolving minerals and other solid phases in the waste. The goal of this project, therefore, is to evaluate combined abiotic and biotic extraction procedures for an increase in metal extraction efficiency from household waste incineration slag.

Our research has demonstrated that the application of extracting solutions with pH values <4 leads to an economically feasible recovery of industrially precious metals (e.g., Co, Cr, Ag, Pt) and REE (e.g., La, Nd, Tm). We show that microbial cultures capable of oxidizing and reducing Fe minerals and S compounds optimize the geochemical leaching of these elements. More specifically, a variety of known microorganisms are evaluated for efficient metal extraction.

Additionally, microbial communities are enriched from various acidic and metal-rich environments and are tested for increasing the efficiency of precious metal extraction from incineration slag. These enrichments were cultivated in the presence of the slag to increase the likelihood of enriching microbial consortia optimally adapted to each specific slag. A combination of known laboratory microbial cultures and newly enriched microbial consortia will ultimately be applied in precious metal extraction from household waste incineration slag.