



The role of science in developing (recovery) concepts for mining waste
German - Peruvian Raw Materials Forum

Agenda

Introduction

- People
- **recomine**-alliance
- HIF

Concepts

- Analyses
- Avoidance
- Transformation
- Re-Mining

Examples

- Case Study: Tiefenbachhalde
- Project: Re-Mining^{PLUS}
- Project: DYNOSORT
- HIF Spinoffs



Introduction: People and Institutions



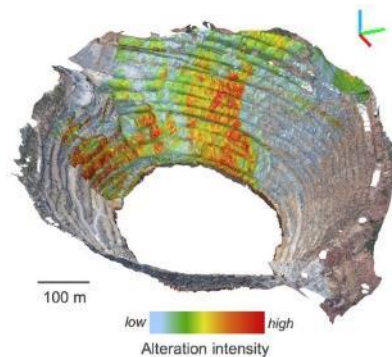
Philipp Büttner
recomine-coordinator



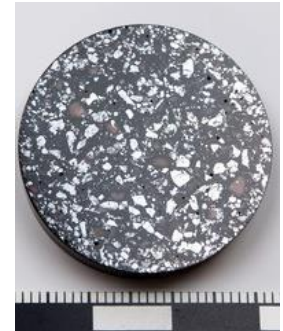
Dr. Jonathan Engelhardt
Tech transfer in recomine



HELMHOLTZ INSTITUTE FREIBERG
FOR **RESOURCE TECHNOLOGY**

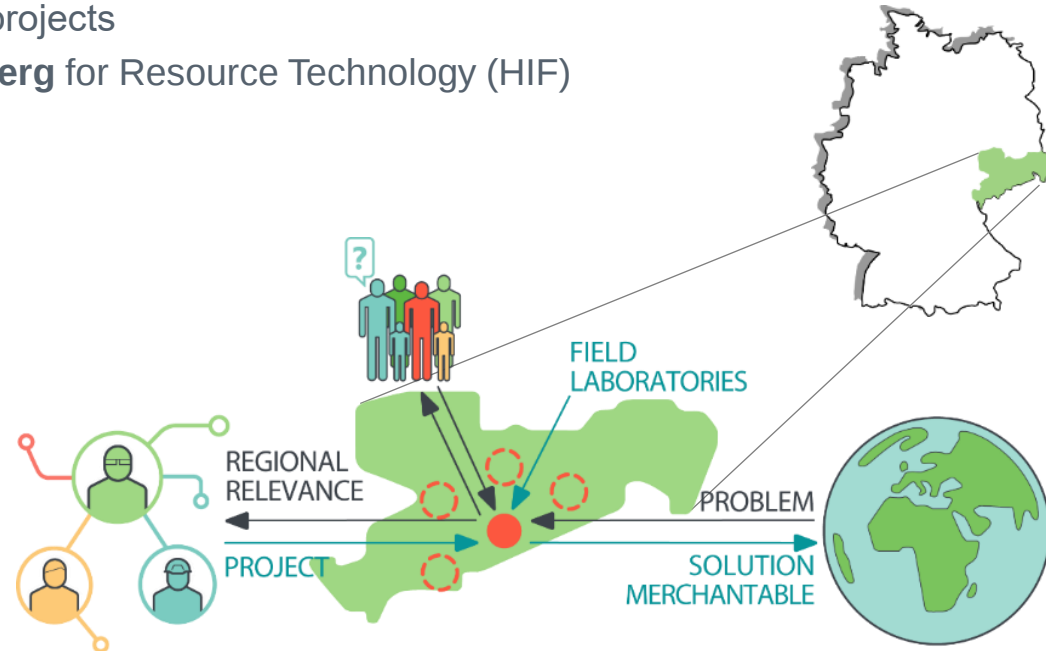
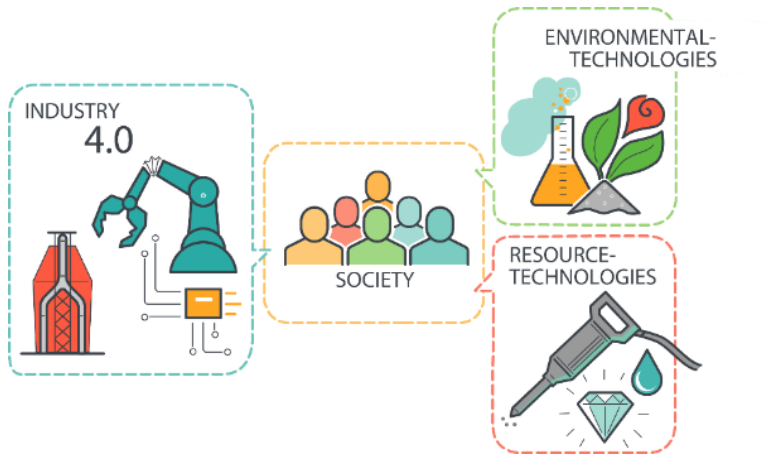


prepare | analyze | embrace

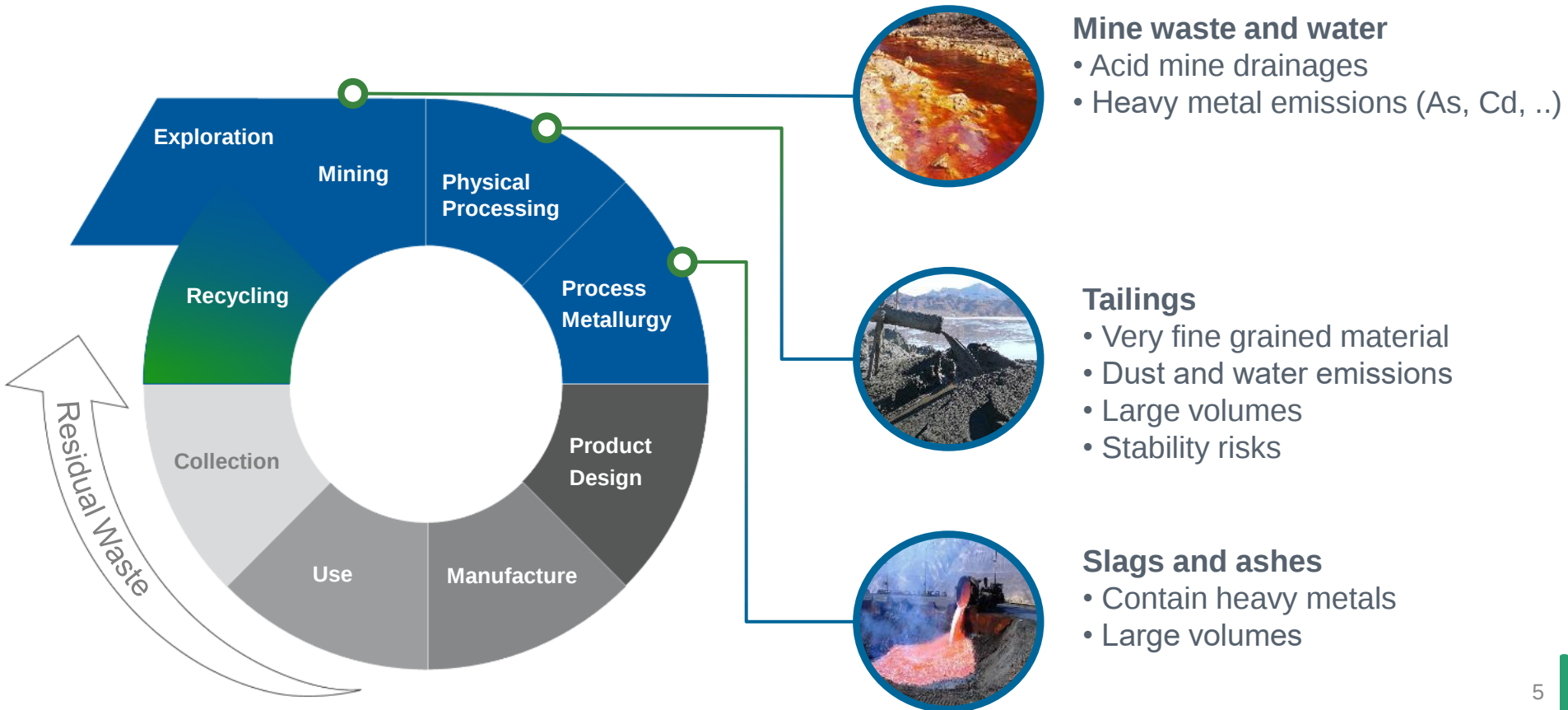


The recomine-alliance

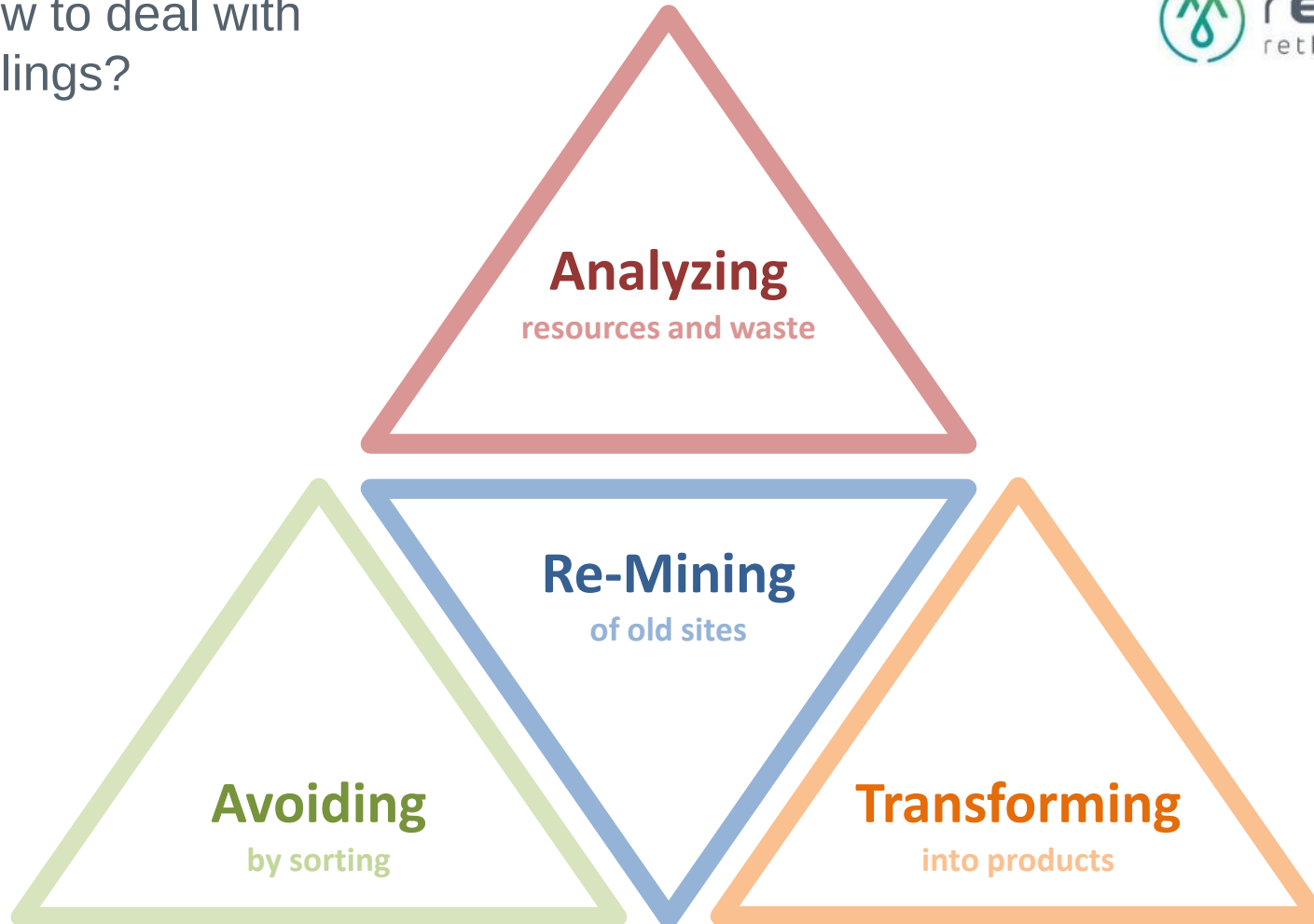
- 70 institutions (industry/research/NGO/politics/education)
- Holistic mine waste solutions
- 5 field laboratories (3 tailing sites), 8 R&D projects
- Coordination by **Helmholtz-Institute Freiberg** for Resource Technology (HIF)
- Visit us: www.recomine.net/en



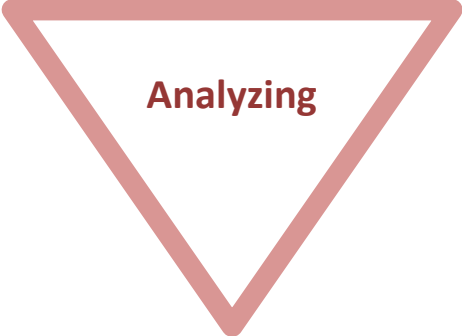
Mining, processing, metallurgy – a waste problem



How to deal with Tailings?



Research focus at HIF (and in **recomine**)



Analyzing

Analyses

- Geochemistry, mineralogy
- Sampling strategies
- Modelling algorithms
- Geometallurgical modelling
- Realistic resource potential



Re-Mining

Reprocessing

- Bioleaching
- Fine particle flotation
- Bioflotation
- Solvent extraction



Transforming

Atypical usage

- Construction industry
- Colour pigments
- Adsorbents
- Abrasives



Avoiding

Ore sorting

- Avoiding tailings
- Ideal backfilling
- Machine learning
- Optimal sensor settings

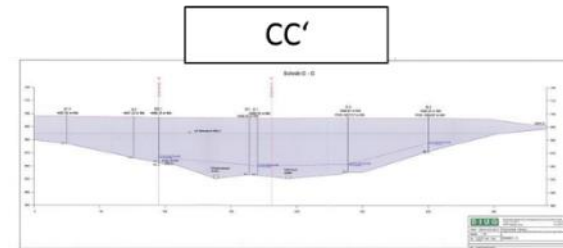
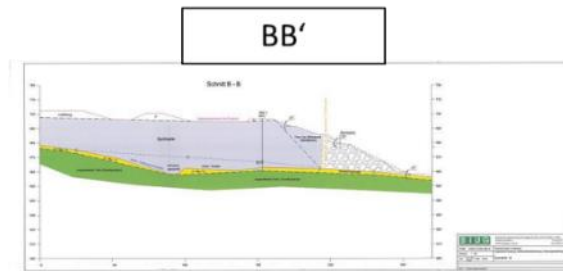
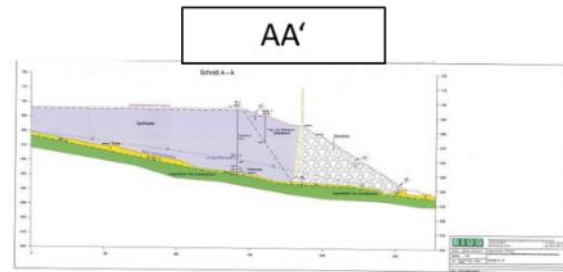
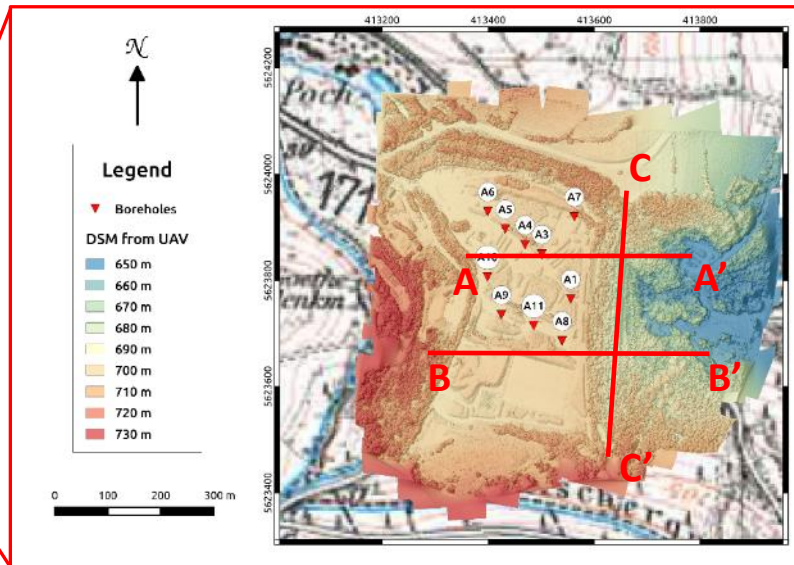
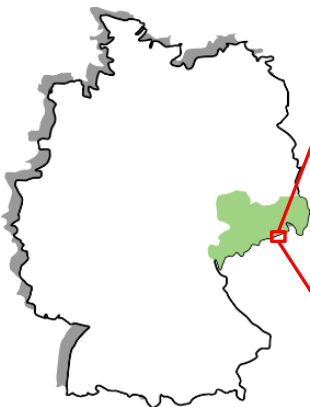


Analyzing tailings: Tiefenbachhalde



Data collection

- Historical data and maps
- Remote sensing data
- Sampling grid
- Drill campaign





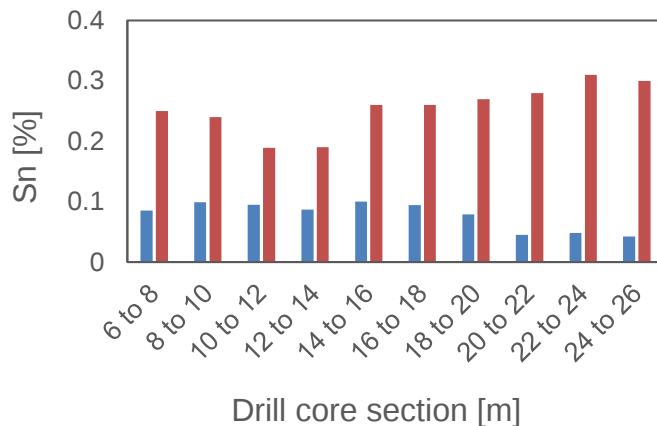
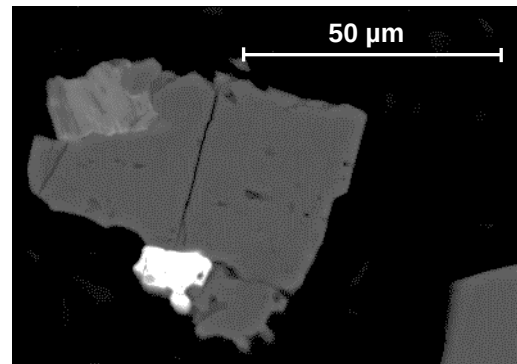
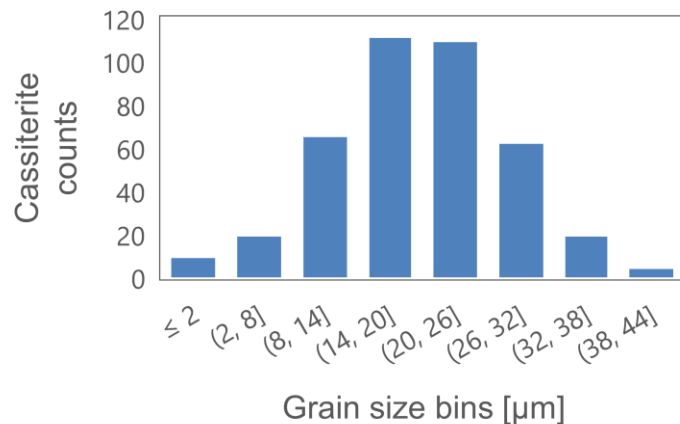
Analyzing: Tiefenbachhalde

Detailed Analysis

- Mineral liberation analyzer
- X-Ray fluorescence
- Laser granulometry

Theoretical resource potential
 $\approx$
volume x concentration of Sn

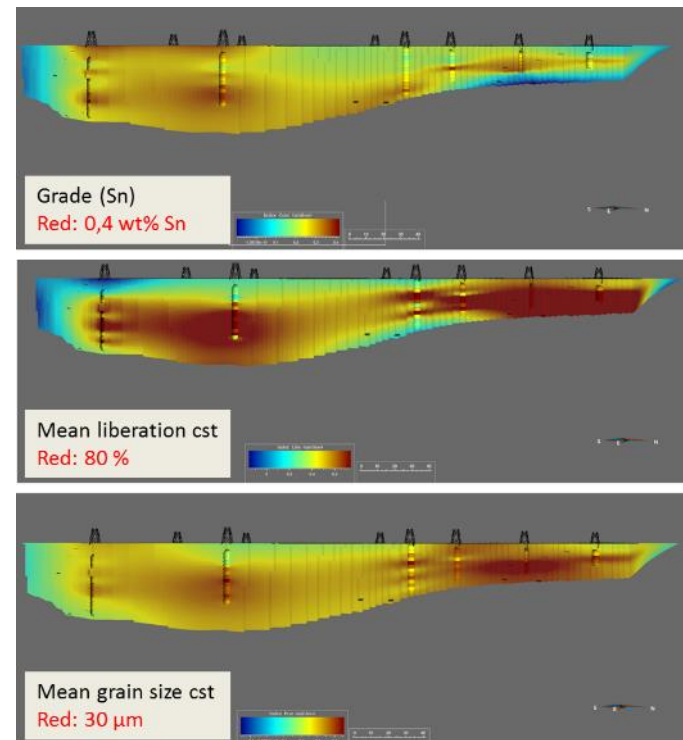
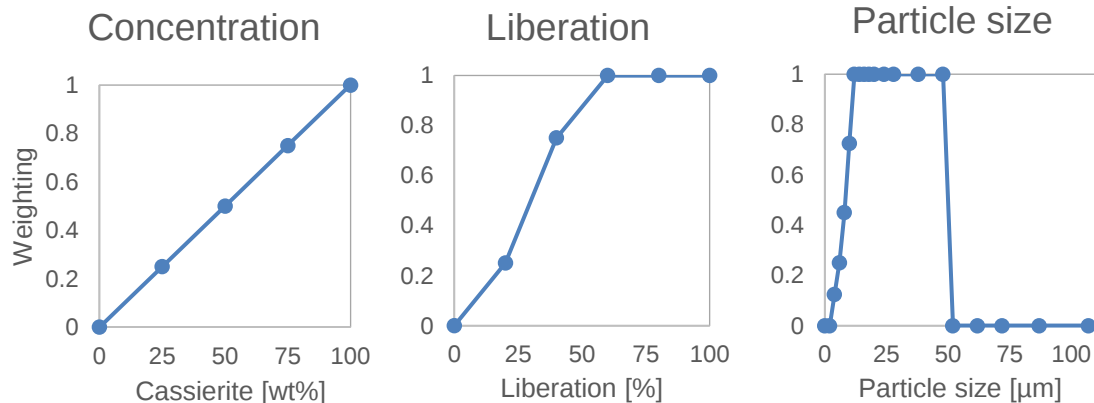
... not realistic!

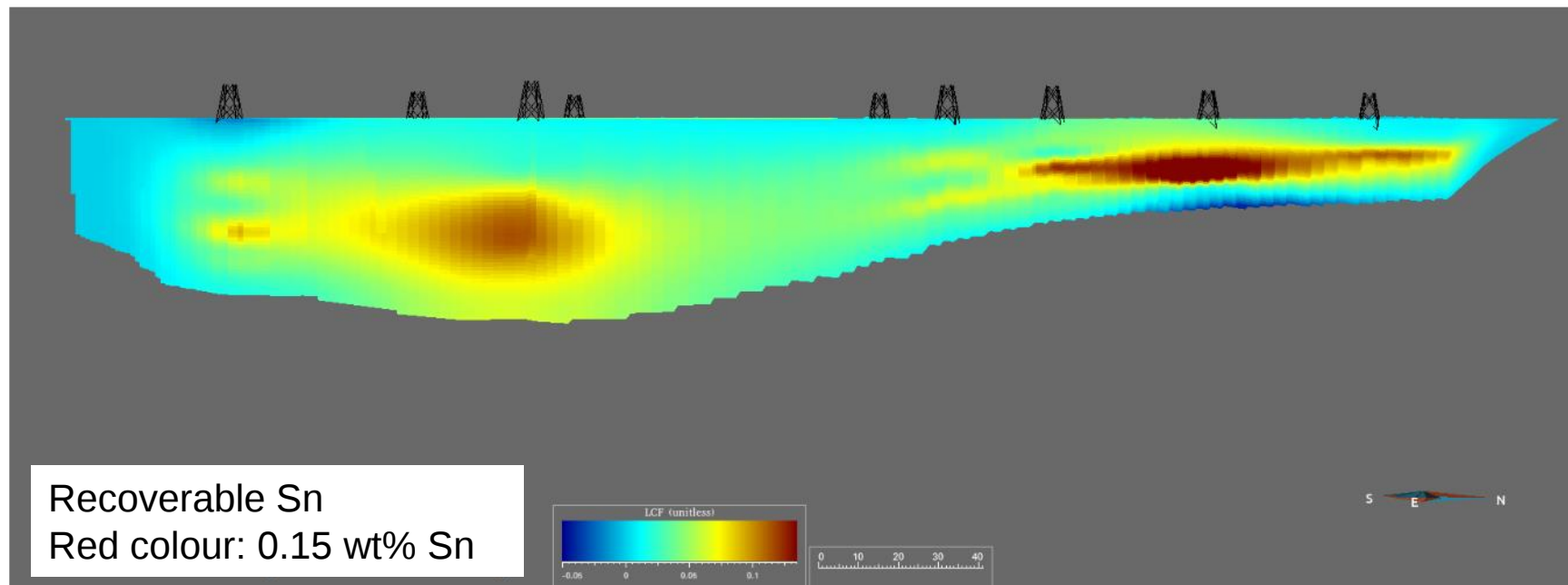




Creation of a realistic resource potential model

- Geo-metallurgical approach
- Respecting particle behaviour in processing
 - (e.g. cassiterite-flotation)
- Weighting functions for material characteristics
- 3-D model using geo-statistical optimized algorithms





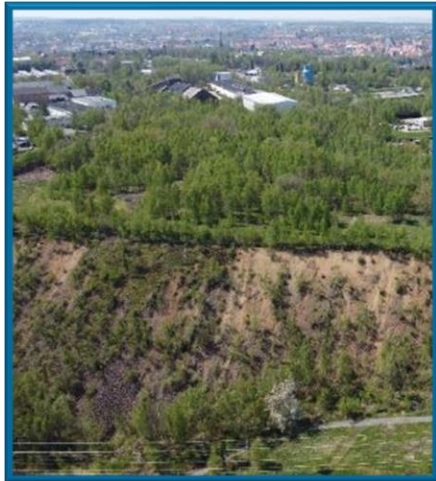
Realistic resource potential = recoverable Sn within the volume

... respects processing limits!



Remining^{Plus}: Semi-mobile pilot in mine waste treatment

Tailings material



Bioleaching reactor



Liquid - liquid extraction

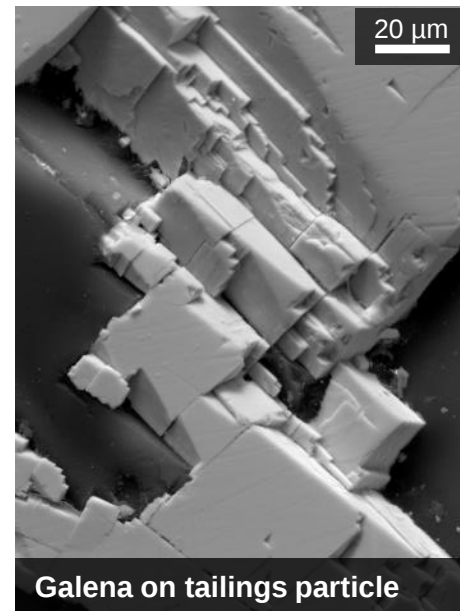
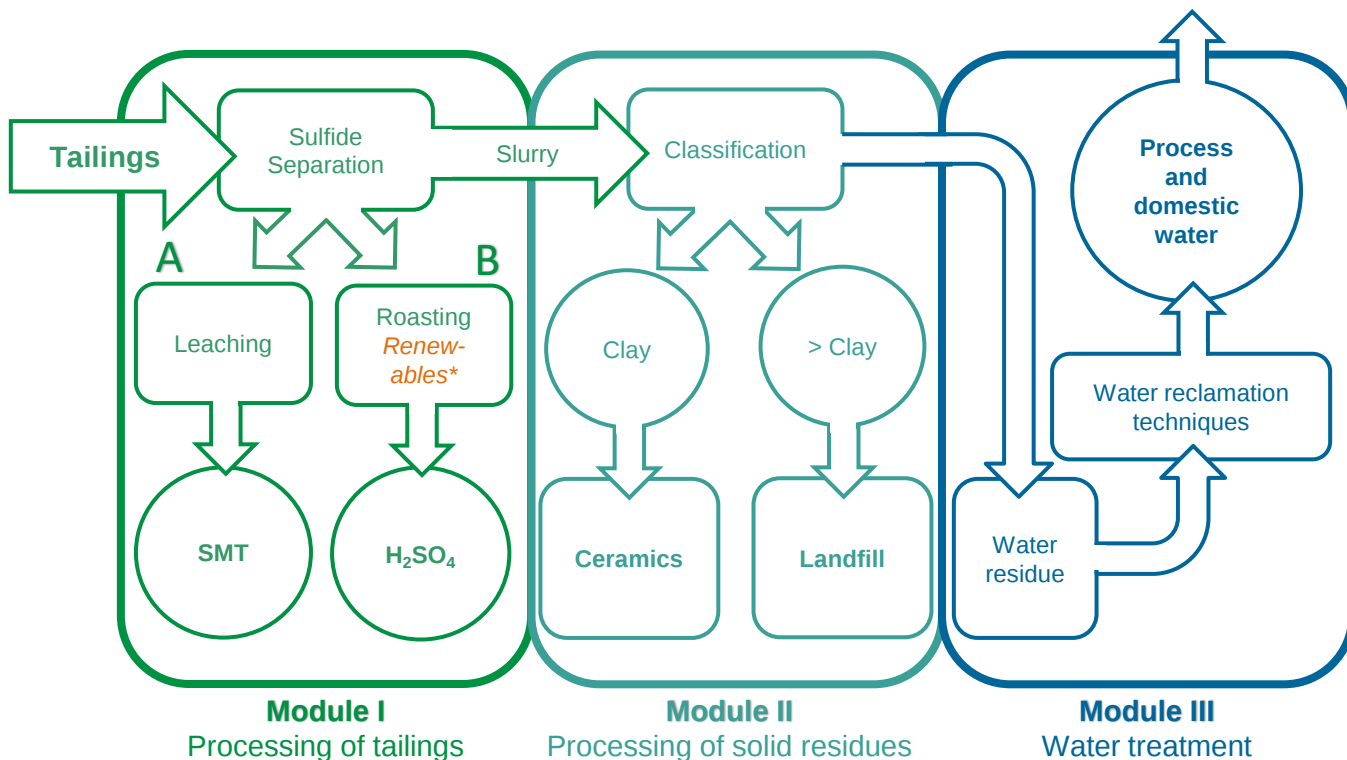


Electrolysis cell





Transforming: **recomine** at the BHP Challenge

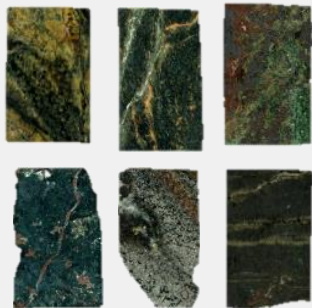




Avoiding: improving ore-sorting DYNOSORT

1. Data acquisition

Samples

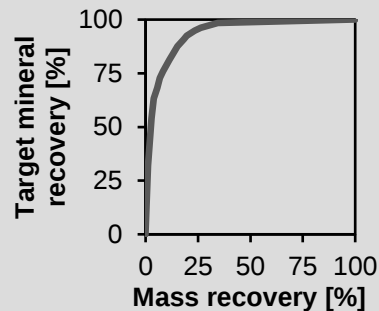


Analysis

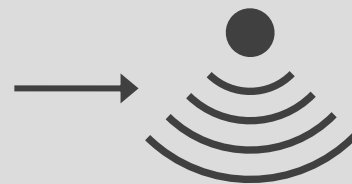


2. Simulation

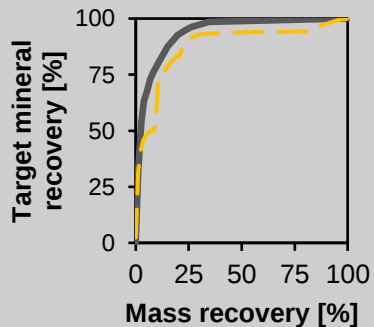
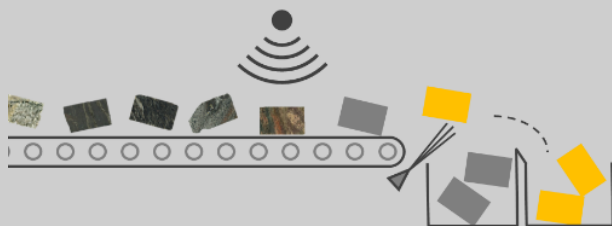
Simulations



Optimal sensor



3. Validation



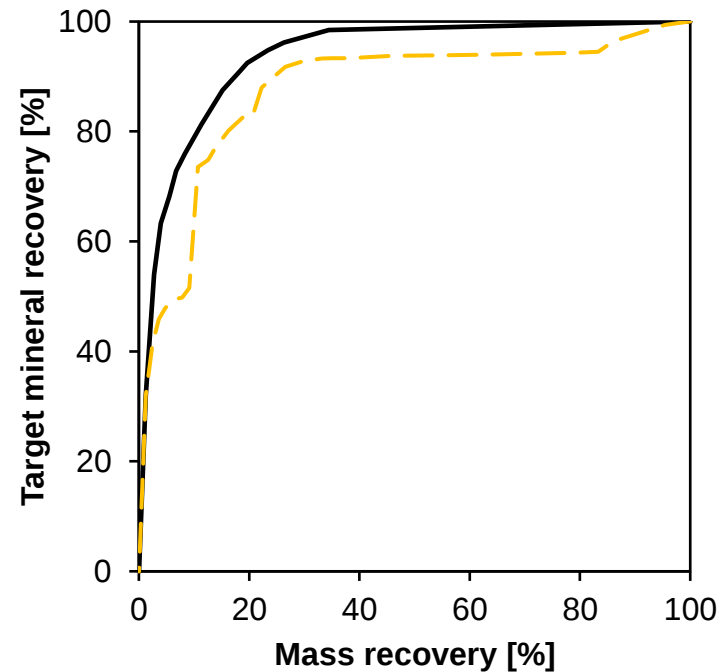
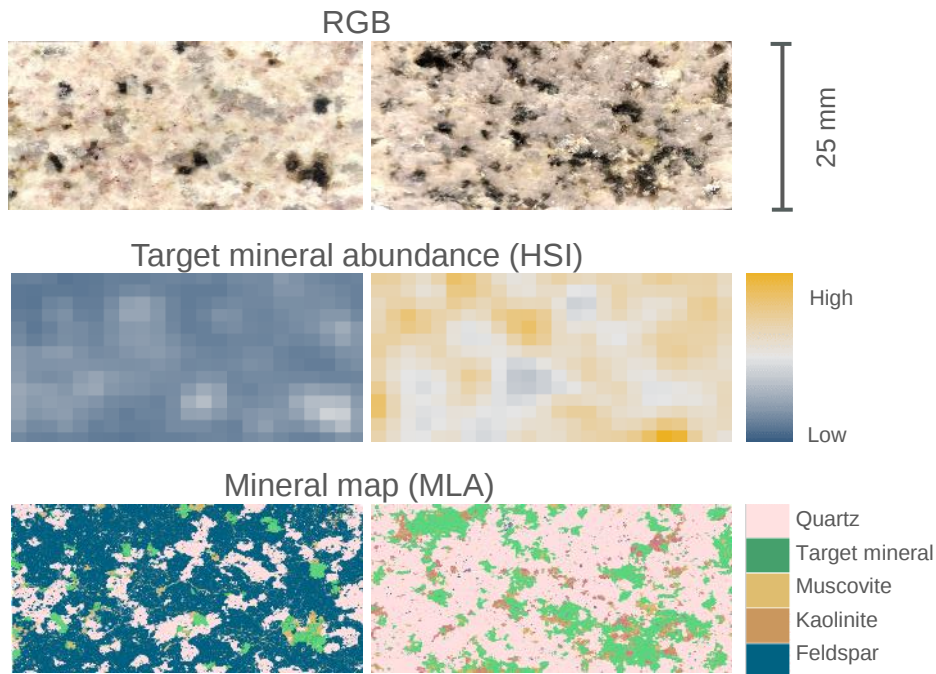
4. Pilot Plant



Source: Steinert GmbH



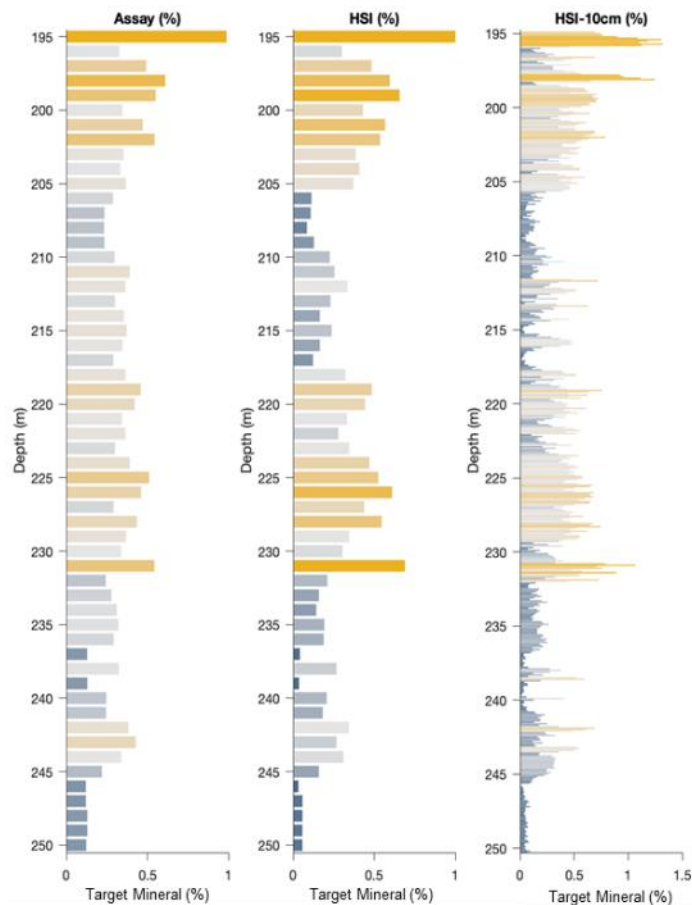
Avoiding: MLA and HSI



- Preliminary results based on MLA
- About 93 % target mineral recovery at 27 % mass recovery
- Comparison to implementation through HSI spectral analysis



Spinoffs at HIF



- Transportable drill core scanner
- 1500 meters scanned
- Data can be used to model sorting
- Efficiency for the entire deposit

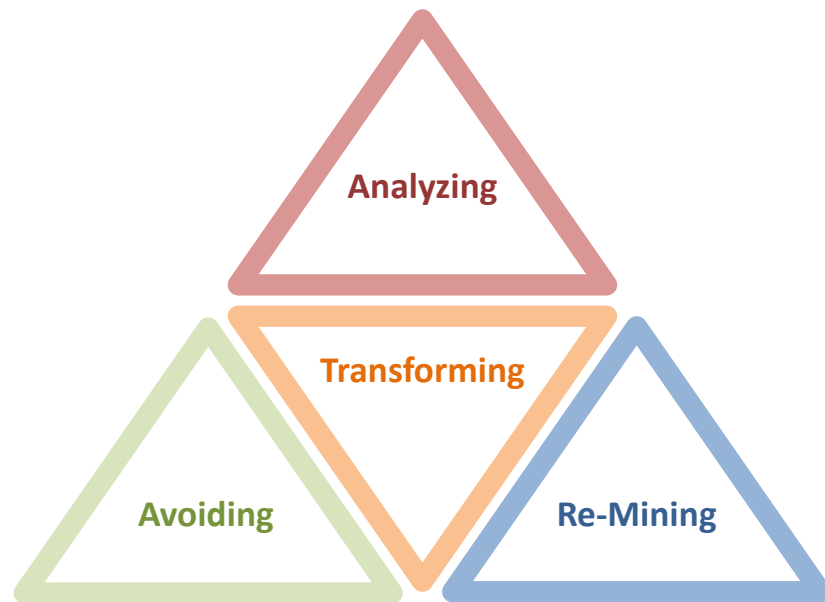


Our Approach

- Thorough mineralogical knowledge of mining waste
- Thorough spatial legacy models
- Machine learning based sorting model
- Geo-metallurgical research design

Competences in HIF and in recomine

- HQ mineral analytics
- Remote sensing
- Geo-statistical modelling
- Geo-metallurgical interpretation
- Interdisciplinary research teams
- > 9 yrs experience with projects on tailings
- 3 tailing test sites (field laboratories)
- Strong regional, national & international network





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