Geoscientific and geotechnical challenges in post-mining landscapes in Lusatia

Desafíos geocientificos y geotécnicos de las zonas postmineras en Lusacia

Elisabeth Schönfeldt, Olaf Cortés Arroyo, Marcus Fahle, Silvio Janetz, Erik Nixdorf, Mark Gropius, Anne Gädeke, Gundula Erdmann

Federal Institute for Geosciences and Natural Resources
Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)

FEZB – Centre for research and development of post-mining areas

FEZB - Centro de investigación y desarrollo de zonas postmineras

Background

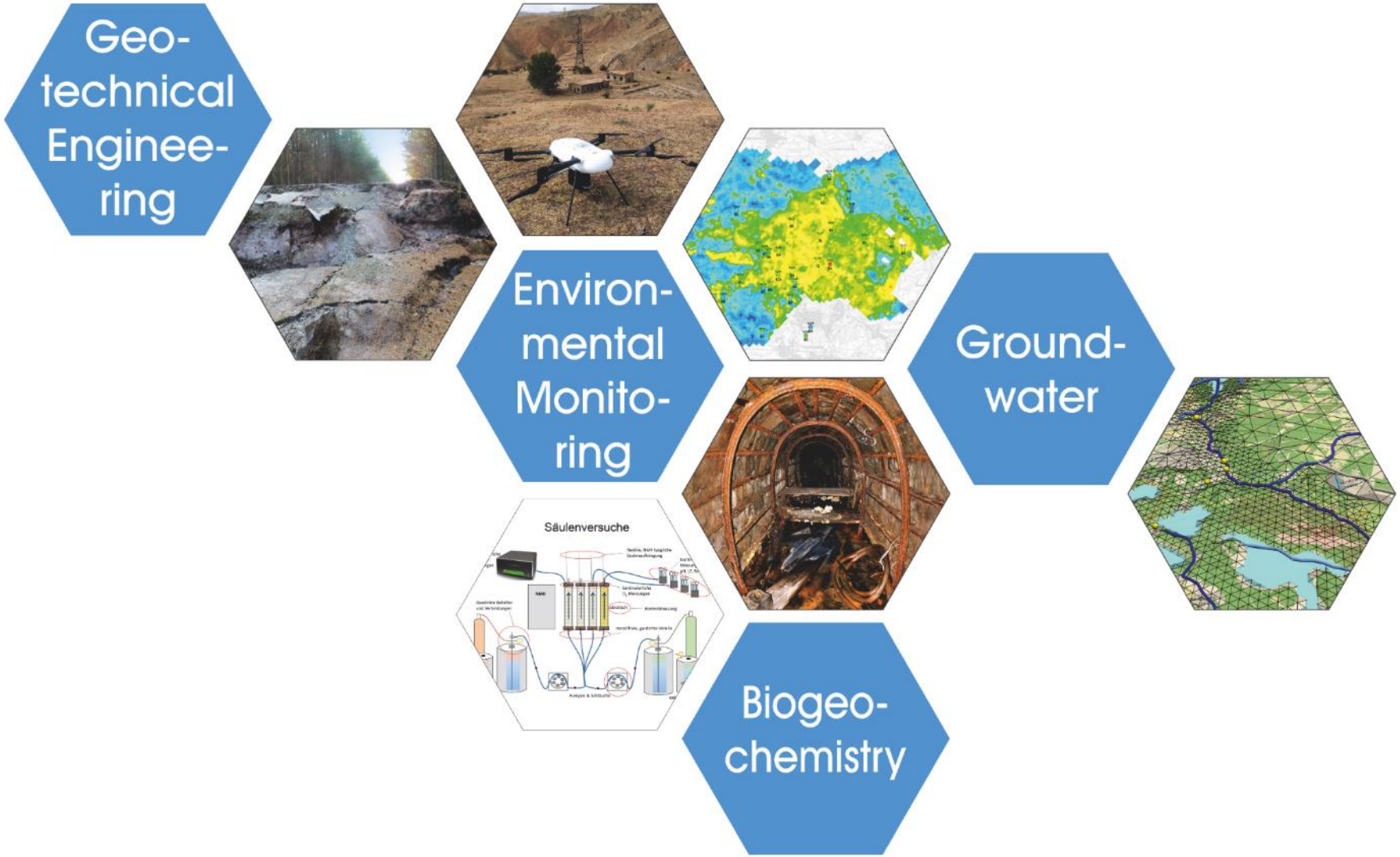
- The German government has decided to end lignite mining by 2038
- Various governmental incentives to foster the structural change in former lignite mining areas
- *One incentive:* Formation of a new centre for research and development focusing on post-mining areas (FEZB) as a department within BGR in Lusatia

Goals of the FEZB

- Support decision making with respect to treatment of post-mining areas
- Develop new monitoring and rehabilitation technologies to describe and improve conditions of post mining areas

FEZB – Fields of Activity

FEZB - Campos de actividad

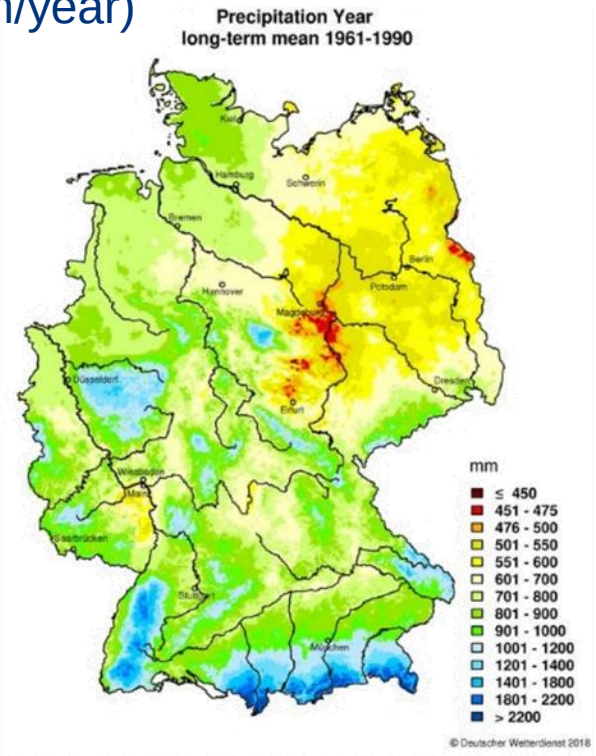


Introduction to Lusatia

Introducción a Lusacia

- Region with an area of around 13 000 km² with around 1.3 mio inhabitants
- Located in Northeast Germany and Western Poland
- Within Germany, Lusatia receives relatively low rainfalls (around 500 to 800 mm/year)

Source: Wikipedia



Source: https://www.dwd.de

Open mining pits in Lusatia

Minas a cielo abierto en Lusacia

Overburden Conveyor Bridge

Bucket-wheel excavator

Topic 2
Stability of dumped material

Topic 1
Mine water management and its impacts

- Huge groundwater deficit and has to be filled up
- In addition:
  Open pit mining created various large lakes, which need water for flooding

In sum:

- Water availability will be strongly reduced until new equilibrium has been reached

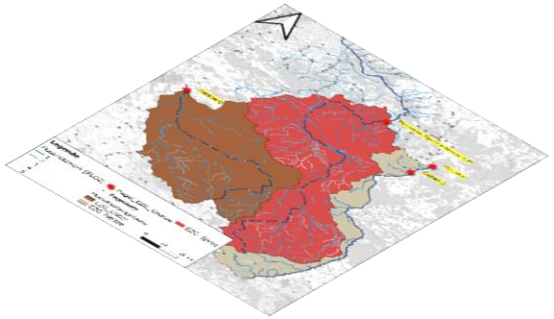
Mine water management – Potential solutions

Gestión del agua de mina – Posibles soluciones

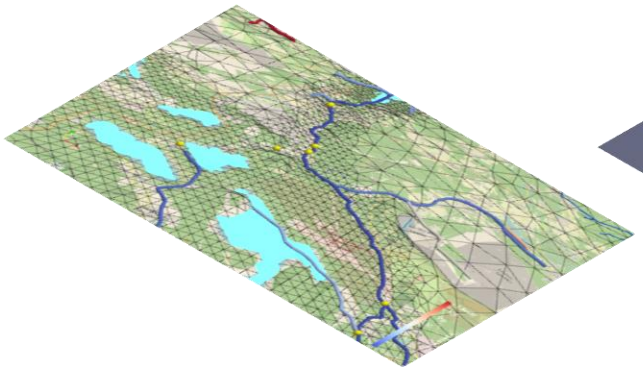
- Different options have been discussed to prevent future water shortages in the region, including an intrabasin water transfer from the Elbe river
- Relevant authorities have agreed to set up a large scale prognostic groundwater model

The FEZB started trials to set up a simplified model covering the particularities of the region

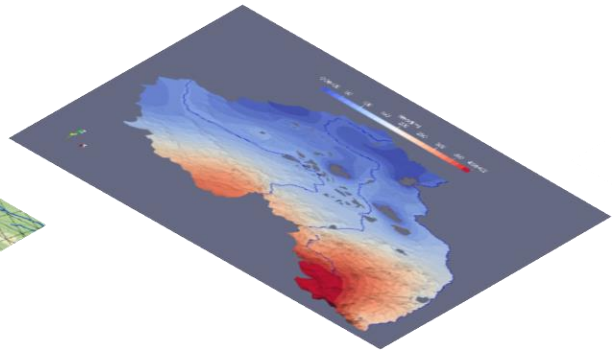
Processing of topographic inputs



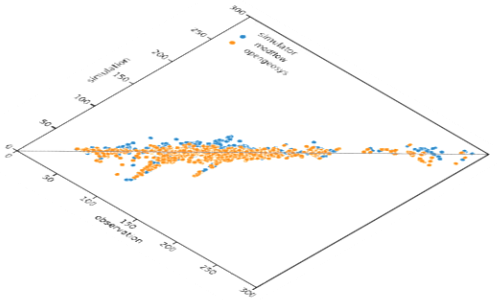
Generation of modelling scheme



Groundwater simulation



Calibration



Automised workflow

Mine water management – Quality impacts

- *Biggest water quality issue:* Oxidation of pyrite (= mineral consisting of iron and sulphur, FeS_2) after groundwater lowering
- Re-rise of groundwater level leads to high concentrations of iron, sulphat and acidity (i.e. acid mine drainage)

Source: https://www.rbb24.de/

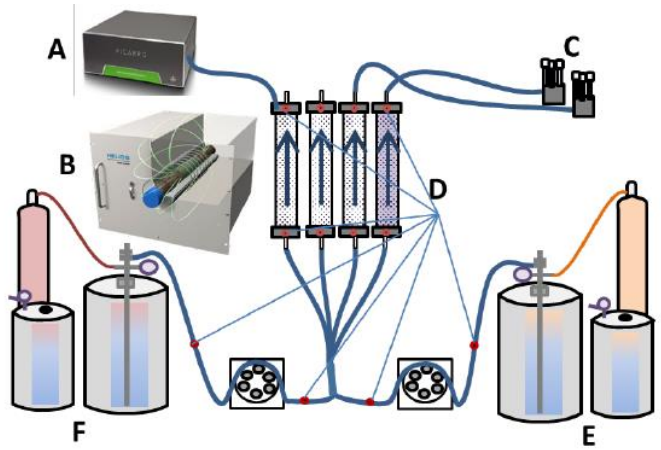
Mine water management – Quality impacts

Approaches to improve water quality:

- In-lake water treatmet by ships or jets to introduce alkaline substances (lime) to neutralise open pit lakes
- Stationary treatment of water from streams and water from dewatering with high iron load
- Treatment of Spree river water in small pre-dam located upstream of dam Spremberg

But still research need for cheaper methods and approaches for balancing of pyrite weathering

- FEZB project on balancing iron sulfide conversion based on Nuclear Magnetic Resonance (NMR)



A regional perspective: Mining related failures in Germany

La perspectiva regional: Fallas relacionadas con la minería en Alemania

Common characteristics

- Flat surface morphology
- Failures located on mining dumps
- Narrow-graded rounded sands, Fine grain content <20%
- Porosity 40 – 50% (loose packing)
- Reconstruction work & groundwater rebound (high water saturation)
- Sometimes no obvious trigger

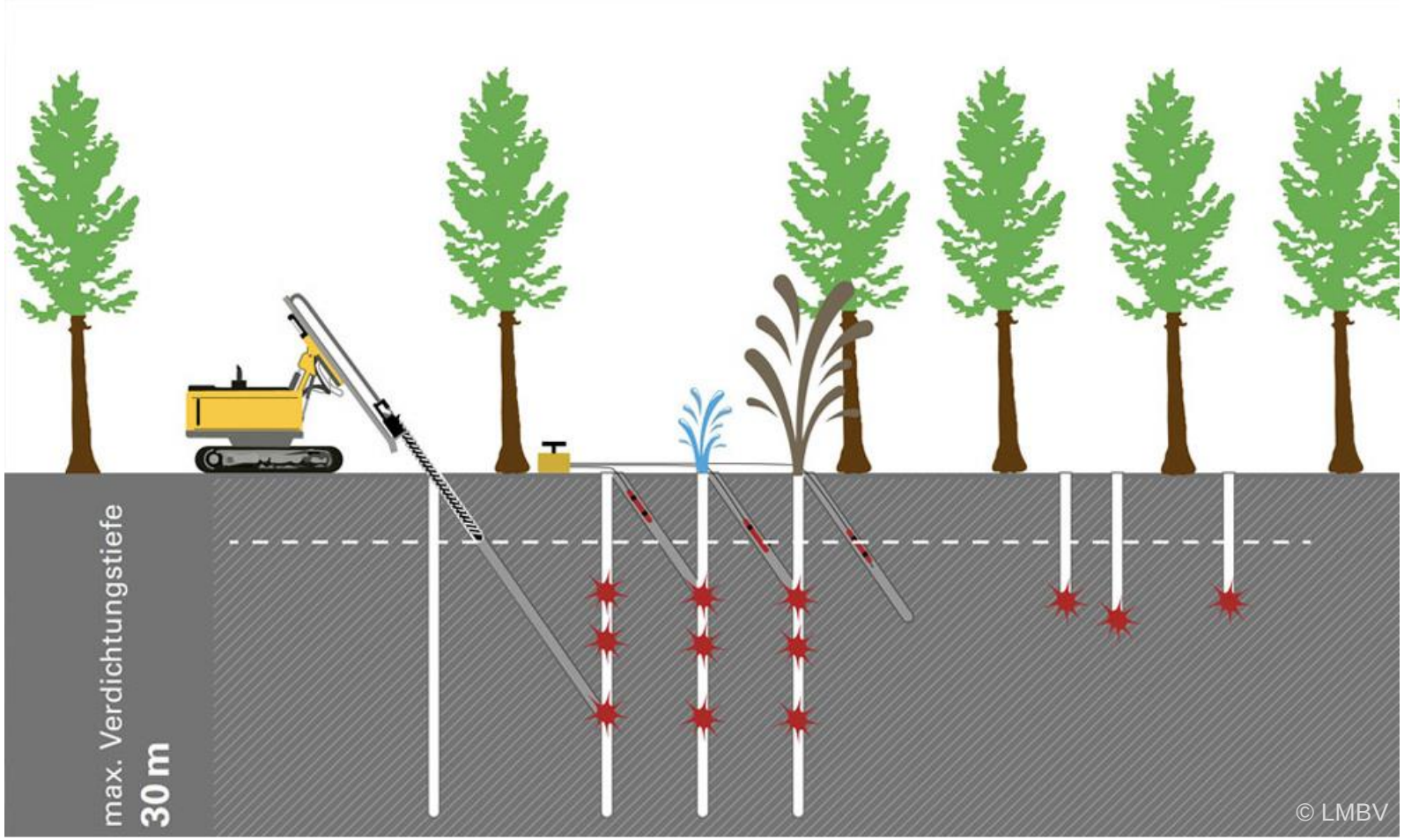
Differences between Peruvian and German tailing dam failures

Diferencias entre los deslizamientos de las presas de jales peruanos y alemanos

Drivers	• Andean topography vs North German lowlands • Groundwater rise vs seismic activity
Initial conditions	• Different lithological components • Different dumping structures
Future	• Monitoring • Renaturalization • Contamination

Mitigation through compaction – Gentle blasting method

Mitigación mediante compactación – Método de voladura suave



Gentle blasting method

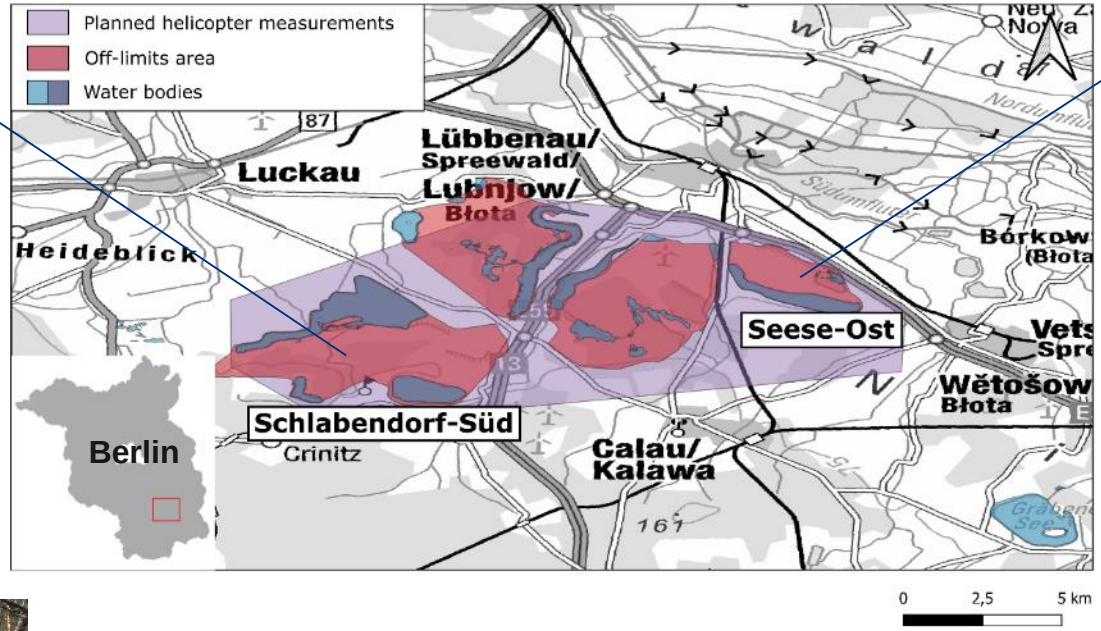
- Explosive charges are drilled into the dump material
- Explosive charges are detonated in a staggered manner
- The ground is lowered within a radius of 10 - 15 m and is refilled with soil

Study area

Área de estudio

Schlabendorf-Süd

- More than 50 liquifaction events on inner burden dumps in the last 15 years
- Off-limits area



Seese-Ost

- Designated area for the gentle blasting method
- Test field in the next ~5 years