# Technological Questions of Mining and Environmental Protection

**Author: Petra Schneider**

**Contact: Klaus-Dieter Oswald**

Head of Department, Authorised Officer

C&E Consulting und Engineering GmbH, Germany

Jagdschänkenstr. 52, D-09117 Chemnitz

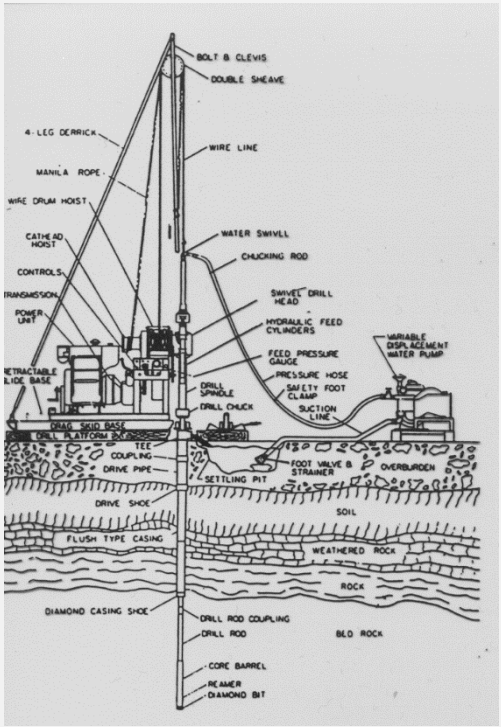
www.cue-chemnitz.de

# Mining

Mining projects vary according to the type of metals or materials to be extracted from the earth.

There are **phases of a mining project**, beginning with mineral ore exploration and ending with the post-closure period:

- Exploration, project development, design
- Site preparation and clearing
- Active mining
- Disposal of overburden and waste rock
- Extraction
- Tailings disposal
- Site reclamation and closure



# Processing of Mineral Resources

**Ore mineral**: part of ore containing the desired metal

**Gangue**: part of ore containing waste material

**Tailings**: piles of gangue removed from ores

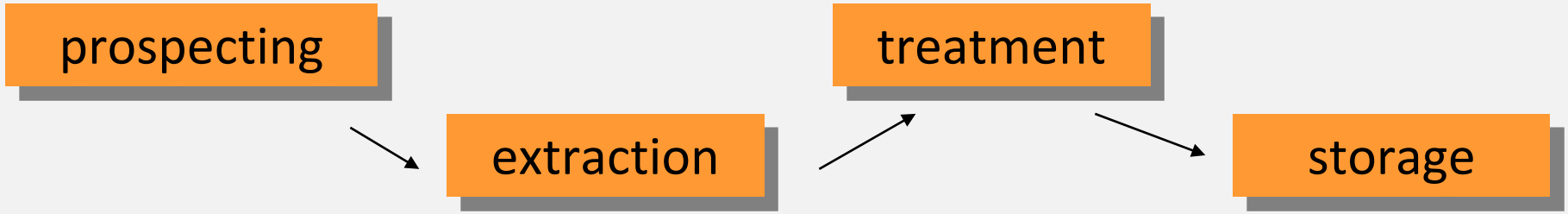
**Smelting**: separates the metal from other elements in the ore mineral

**Products**: metal; solid wastes; radioactive material; air, water, and soil pollution; noise; safety and health hazards; ugliness; heat

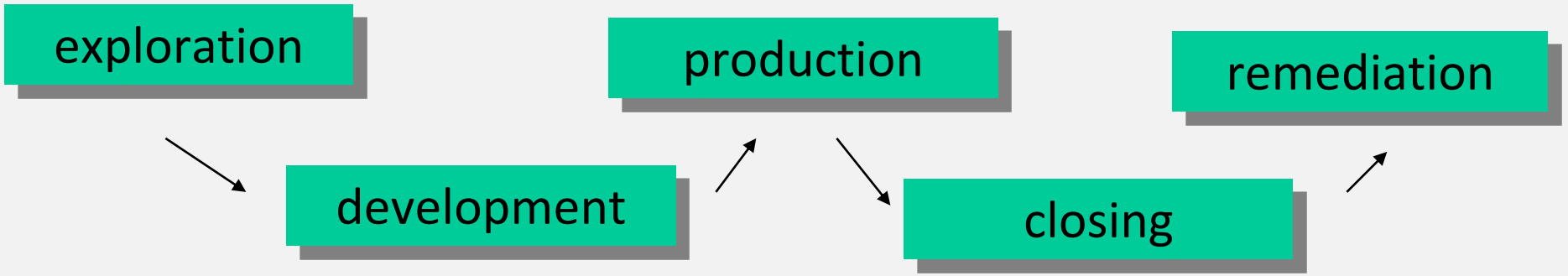
**Disposal or recycling**

# Planning: Life Cycle Analysis

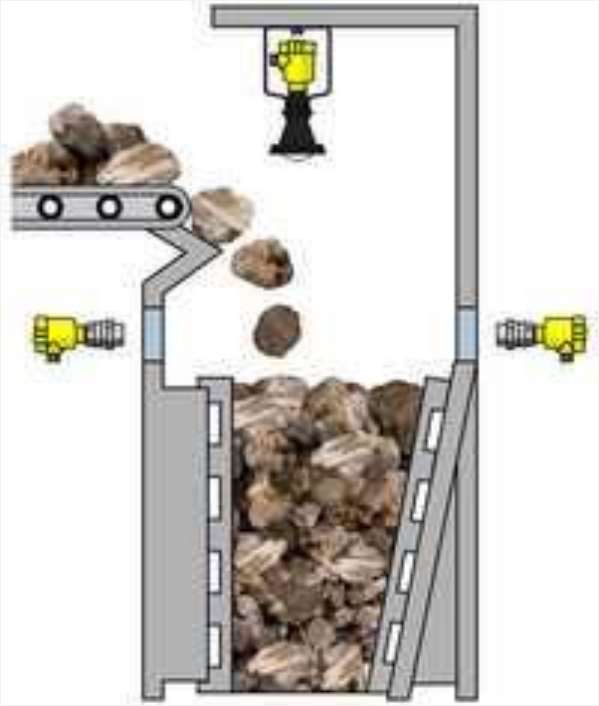
## Life cycle of mineral commodity (on-site)



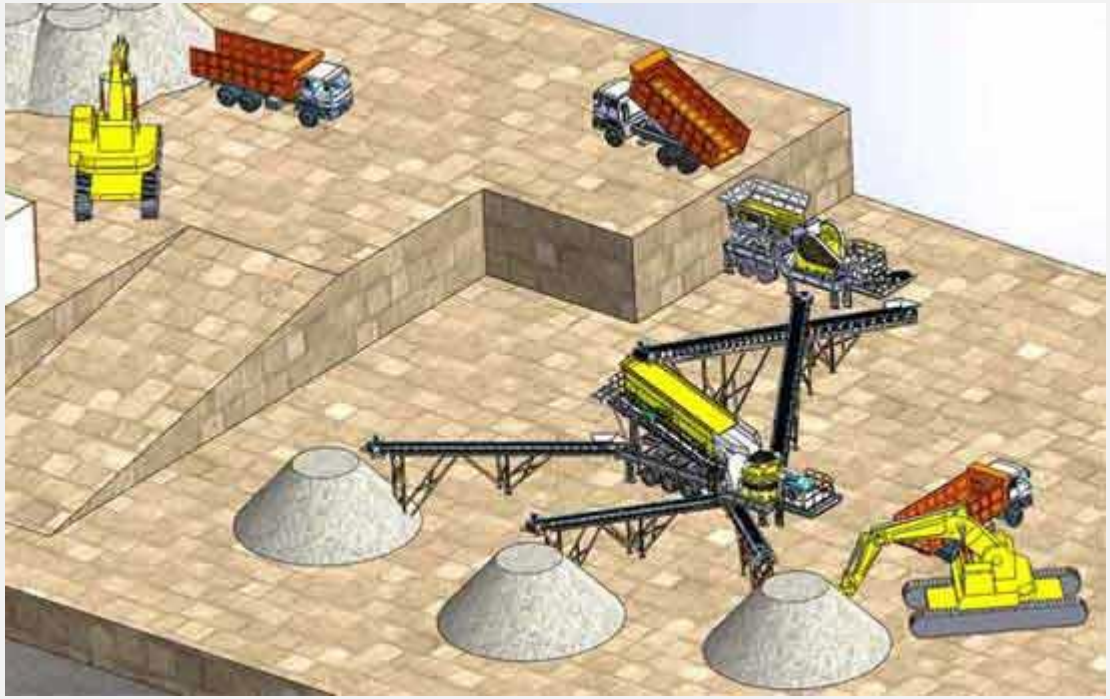

## Life cycle of mine project



# Mineral Processing: Construction Material



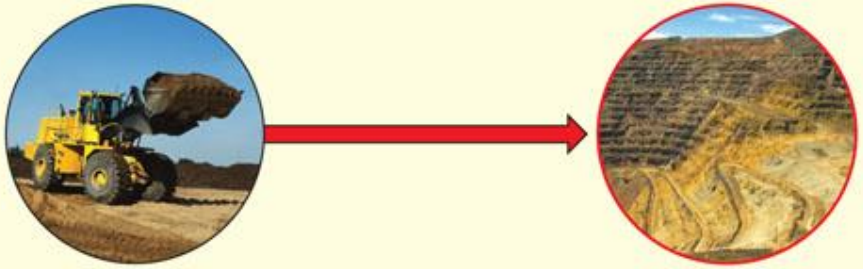
Crushing of minerals for construction material



# Environmental Effects of Mineral Use

## Natural Capital Degradation

### Extracting, Processing, and Using Nonrenewable Mineral and Energy Resources

| Steps | | Environmental Effects |
|---|---|---|
| Mining<br>Exploration, extraction |  | Disturbed land; mining accidents; health hazards; mine waste dumping; spills and blowouts; noise; heat |
| Processing<br>Transportation, purification, manufacturing |  | Solid wastes; radioactive material; air, water, and soil pollution; noise; safety and health hazards; heat |
| Use<br>transportation or transmission to individual user, eventual use, and discarding |  | Noise; water pollution; pollution of air, water, and soil; solid and radioactive wastes; safety and health hazards; heat |

# Environmental Impacts of Mining Residues

**Devastation of the land surface**

- surface-mining, land/soil erosion, loss of biodiversity

**Subsidence**

- Collapse of land above underground mines, sinkholes

**Toxic mining waste**

- Waste dumps, dust

**Acid mine drainage**

- Rainwater seeping through a mine or mine wastes

**Air pollution**

- Toxic chemicals emitted into atmosphere

**Toxic tailings ponds**

- Toxic mining wastes (sludge) can leak into ecosystems

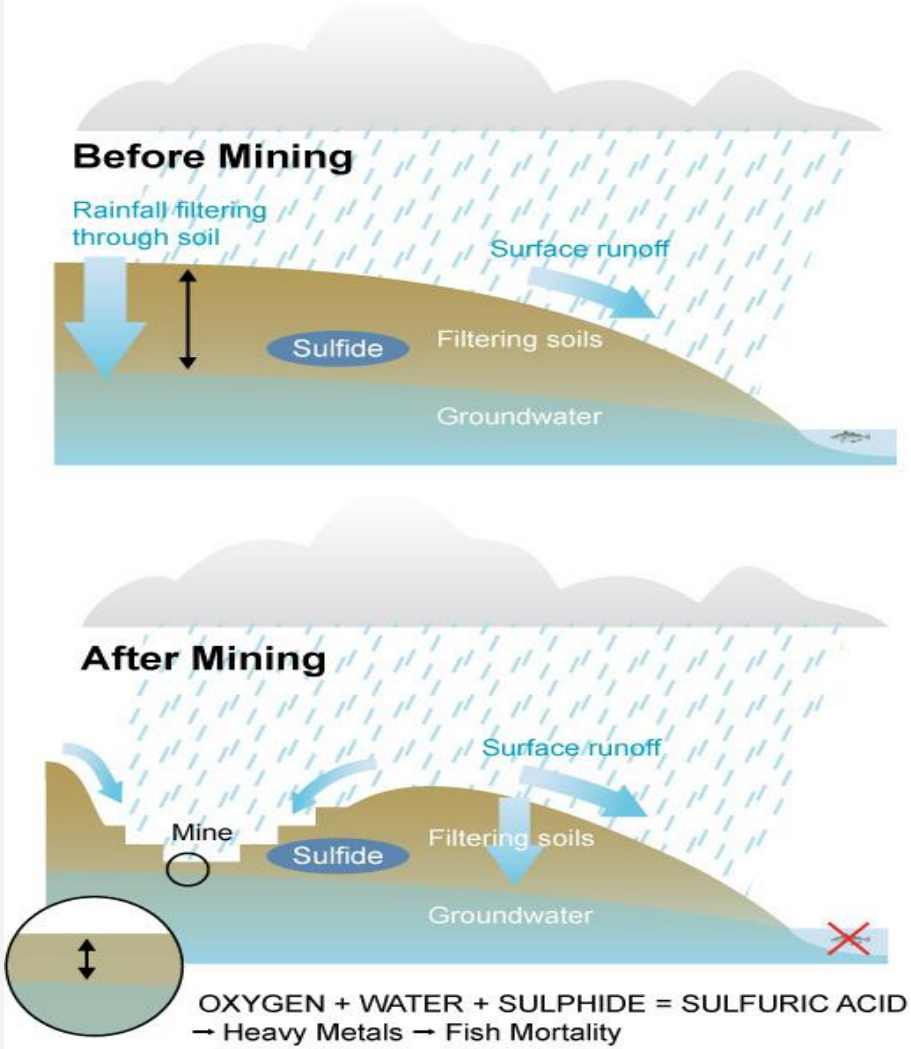
# Harmful Environmental Effects of Mining

Acid Mine Drainage (AMD)

Heavy Metal Contamination

Processing chemical pollution

Erosion and Sedimentation




Extraction decreases groundwater depth and natural filtration, and increases the groundwater contamination.

# Heavy Metal Contamination and Leaching

- Heavy metal pollution is caused when such metals as arsenic, cobalt, copper, cadmium, lead, silver and zinc contained in excavated rock or exposed in an underground mine come in contact with water.
- Metals are leached out and carried downstream as water washes over the rock surface.
- leaching is particularly accelerated in the low pH conditions such as are created by Acid Mine Drainage.

# Environmental Protection in Mining

- Implementation of Environmental Management Systems
- Reduction of emissions to air, water and soil
- Reduction of land devastation and land reclamation after mining
- Underground can never be fully restored → flooding or backfilling
- Huge amount of waste → recycling and / or landscape remediation
- leaching is particularly accelerated in the low pH conditions such as are created by Acid Mine Drainage → mine water treatment

# Cleaner Production Technologies

"…the continuous application of measures for design improvement, utilization of clean energy and raw materials, the implementation of advanced processes, technologies and equipment, improvement of management and comprehensive utilization of resources to reduce pollution at source, enhance the rates of resource utilization efficiency, reduce or avoid pollution generation and discharge in the course of production, provision of services and product use, so as to decrease harm to the health of human beings and the environment." (UNEP, 2006)

# Subjects of Protection via CPT in mining

- Air → Minimization and Avoiding of emissions (dust, aerosols, steam, odours, exhausts etc.)
- Water → Minimization of water usage
  → Minimization of discharge of contaminated water
  → Minimization of conatmination / treatment of contaminated water
- Soil → Minimization of contamination
- Wildlife → Protection of Fauna / Flora
  → Renaturation /Rehabilitation of excavated sited
- Health / Safety → prevention of health impacts
  → prevention of accidents

# Examples of CP during Mining processes

- Exploration, project development, design
  → Design including a cradle to grave design at the beginning (rehabilitation of the site after use should be included in the planning stage)
- Active mining
  → BAT for extraction machinery, dedusting, water treatment
  → OHSAS Management
- Disposal of overburden and waste rock
  → reduction of contamination / reduction of amounts / storage in compliance with international legal directives
- Extraction
  → BAT for extraction machinery, dedusting, water treatment
  → OHSAS Management Processing of materials
- Tailings disposal
  → Reduction of amounts / Reduction of contamination / storage in compliance with international legal directives
- Processing → Dedusting / OHSAS / Clean energy / BAT for Machinery
- Site reclamation and closure → As planned

# Thank you for your Attention!

# Contact:

**C&E Consulting und Engineering GmbH**

**Jagdschänkenstraße 52**
**D-09117 Chemnitz**
**Telefon: 0371/8814270**
**Telefax: 0371/8814311**
**E-mail: klaus-dieter.oswald@cue-chemnitz.de**