POTENTIAL ENVIRONMENTAL IMPACTS OF MINING

A SHORT ILLUSTRATED REVIEW

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POTENTIAL ENVIRONMENTAL IMPACTS OF MINING

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nature of mining sources & mining life cycle

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- CONCENTRATING METALS
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socio-economic impacts & public safety
positive impacts

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INTRODUCTION

Some facts on the nature of mining sources

- Mining has been an integral part of the development of civilization
- Early mining operations have left a ***historical legacy*** of negative environmental impacts that affect our perception of mining
- ***A mine is a waste management project*** = A new paradigm to meet the global objectives for sustainable development in the 21st century
  - 95% of the material excavated from a mine are waste materials generally left at the surface
  - Some large operations handle more material and generate more waste than many entire industries
- ***Major impacts*** are resulting of ***negative changes in geochemistry over time,*** when a material 's environment changes (e.g.: from a reducing environment to an oxidizing one…)

INTRODUCTION (2)

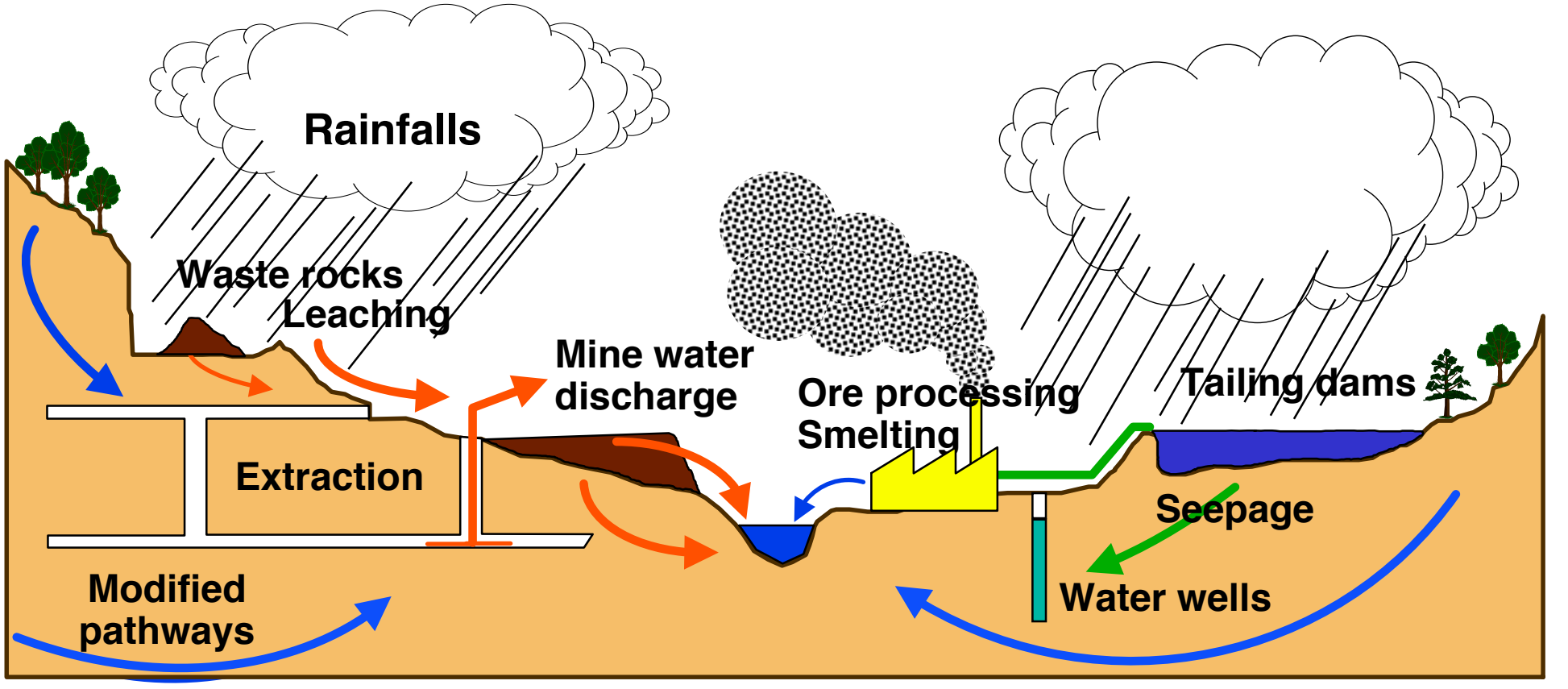
Some facts on the nature of mining sources

- ***This long- term nature of mining impacts*** **requires that predictive tools, design performance, monitoring, be effective for** ***many decades.***

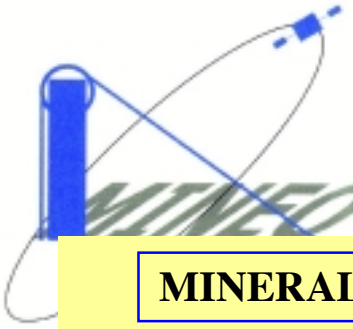
- ***Potential Environmental Impacts*** **are greatly influenced by geological factors :**

  - deposit size
  - host rocks lithology & wall rock alteration
  - nature of ore & trace element geochemistry
  - ore & gangue mineralogy and zonation
  - secondary mineralogy
  - topography, physiography & climate
  - hydrology
  - mining & milling methods employed
  - ...

Simplified Mining process and global Impacts on water



Mining Life Cycle



PROCESS

WASTE

MEDIA AND HAZARD

MINERAL DEPOSIT

NATURAL LEACHING

Open pit or underground mining

DISUSED MINES

WASTE ROCKS

ORE

Mining metals

Leaching

Milling

DUSTS

EFFLUENTS

METALS IN SOLUTION

CONCENTRATES

TAILINGS LEACHATE PONDS SLAGS

Concentrating metals

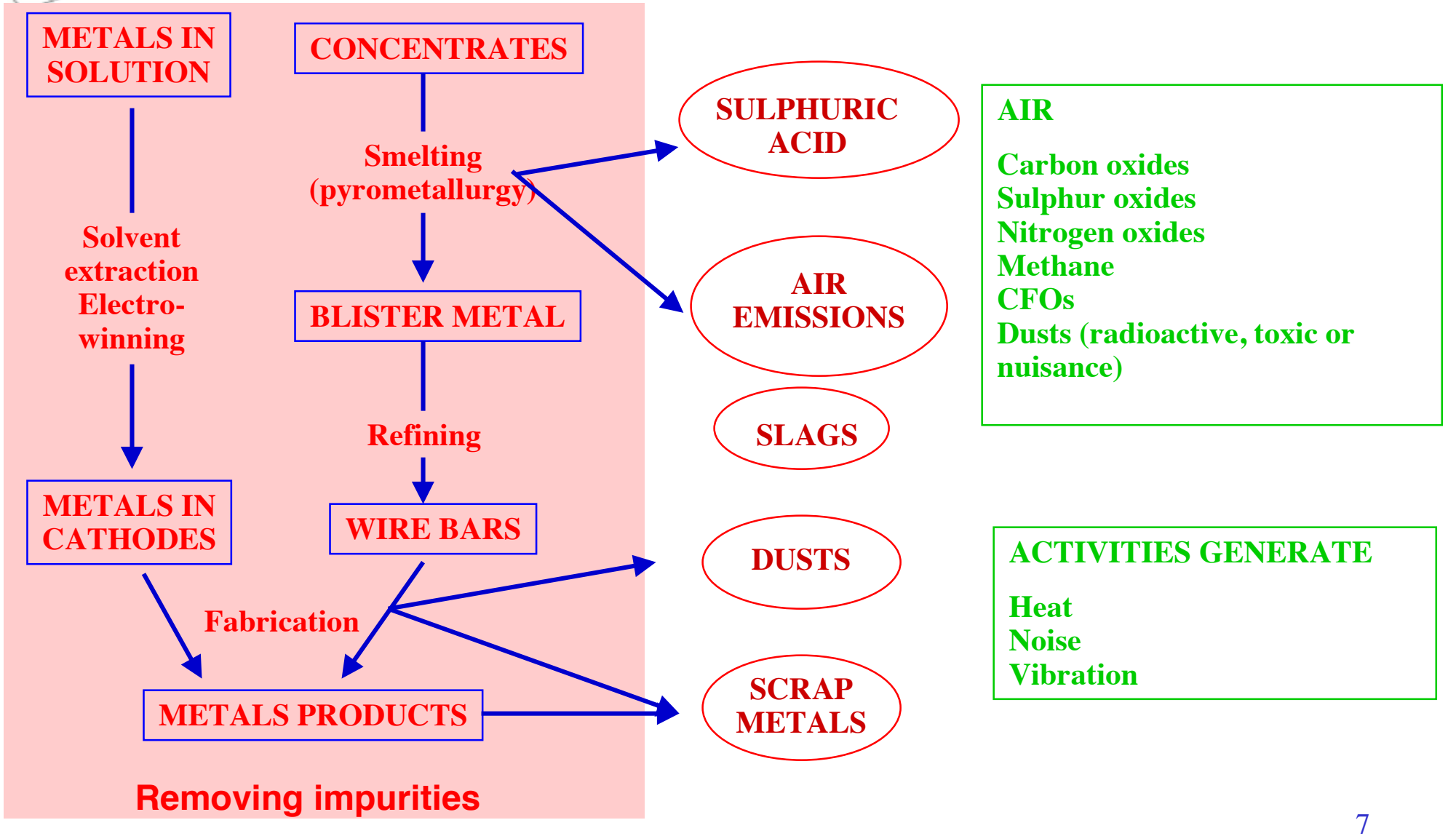
LAND

Land degradation
Land fragmentation
Soil disruption
Soil contamination
Erosion

WATER

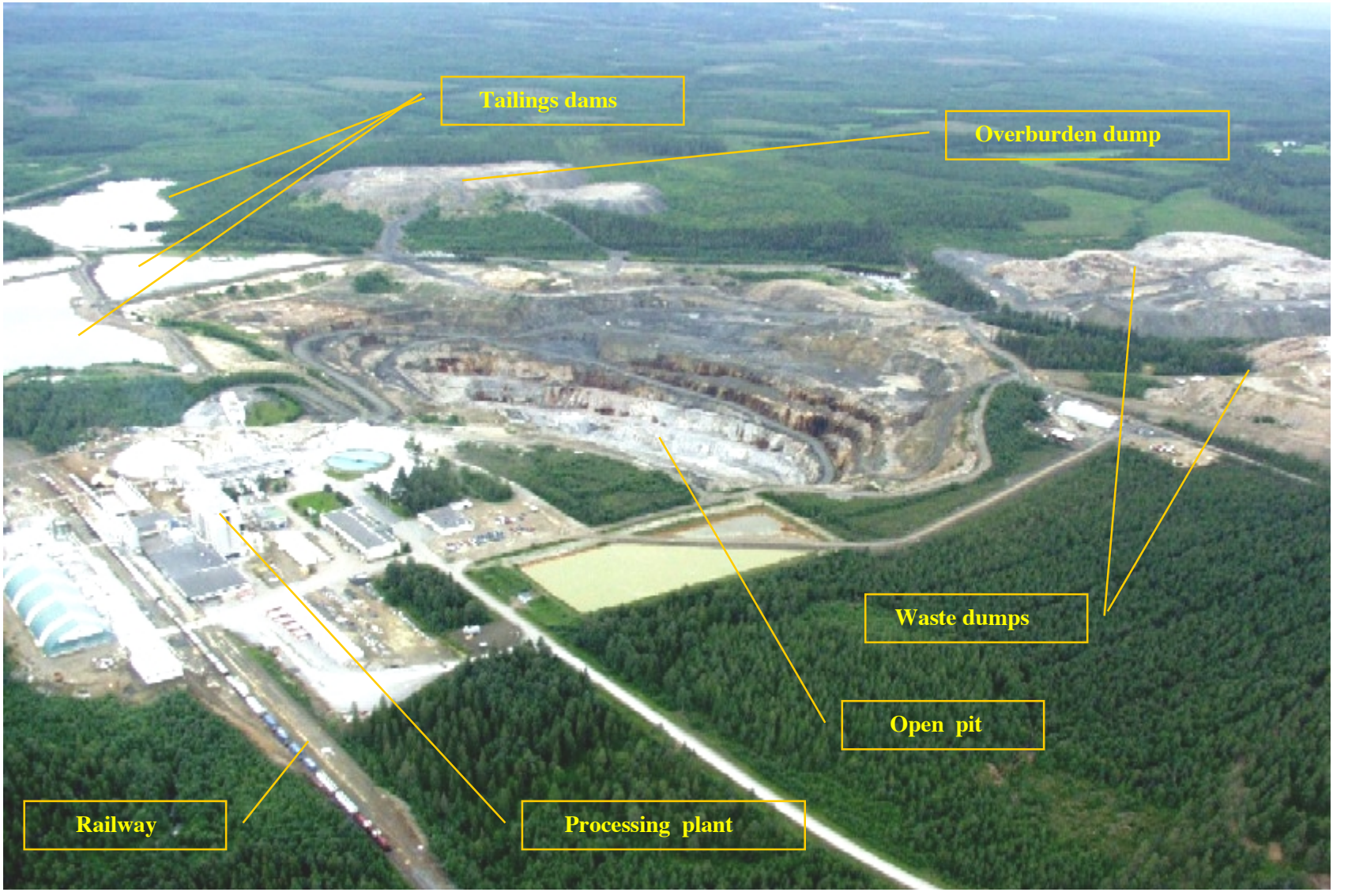
Groundwater table alteration
Spring and borehole yield
River or surface water diversion
Turbidity
Contamination of rivers
Acid Rock Drainage (ARD)
Tailings

Mining Life Cycle (2)



Modified from warhurst 1999

Main Surface Components of a Mine Site in Activity



Mining metals (1)

Physical disturbance to the landscape

Sibai copper mine (Russia)

Mining metals (2)

Waste Rock disposal

Uchaly copper mine (Urals / Russia)

Mining metals (3)

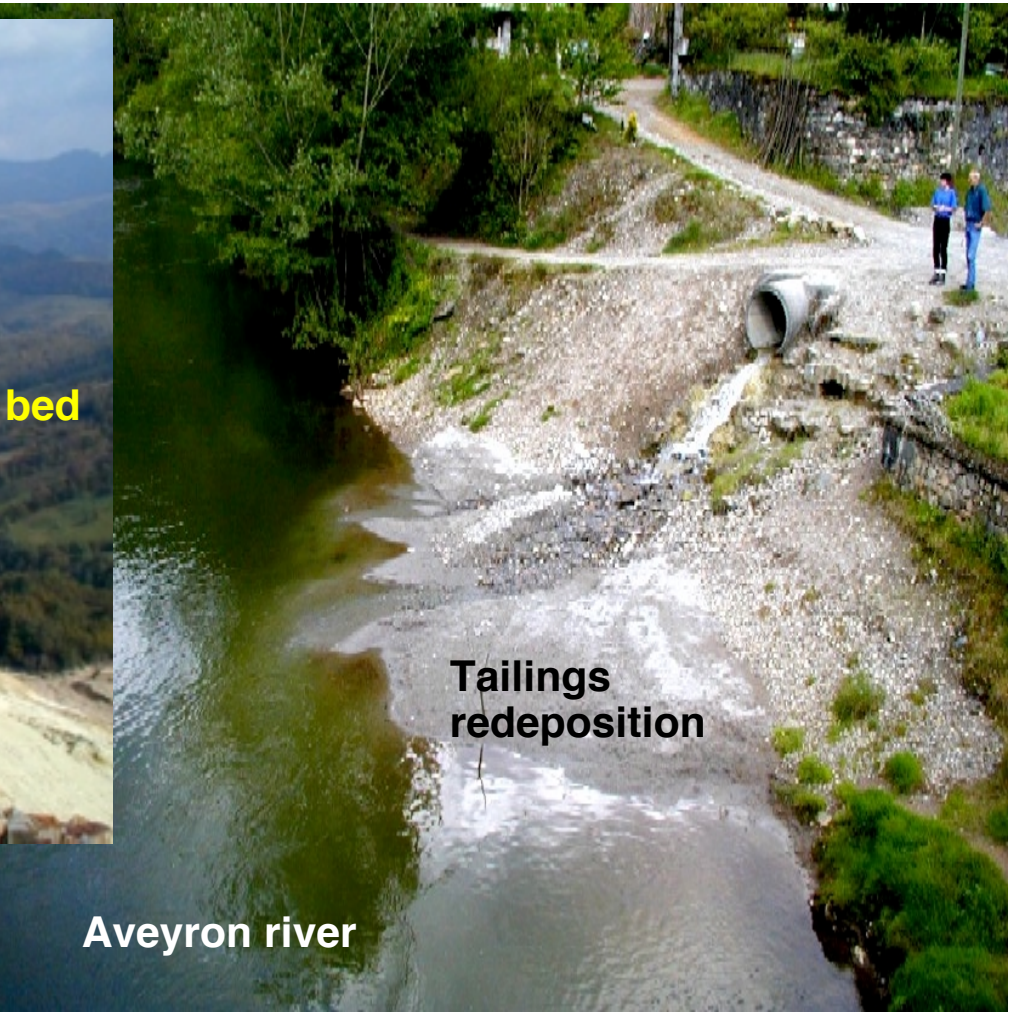
Erosion of waste rocks dumps

Sibai copper mine (Russia)

Mining metals (4)

Erosion and sedimentation process

Rosia Poieni mine (Rumania)



La Baume Pb / Zn ancient mine (France)

Mining metals (5)

Acidic and metals-bearing soils and water

Assarel copper mine (Bulgaria)

Rosia Montana gold mine (Rumania)

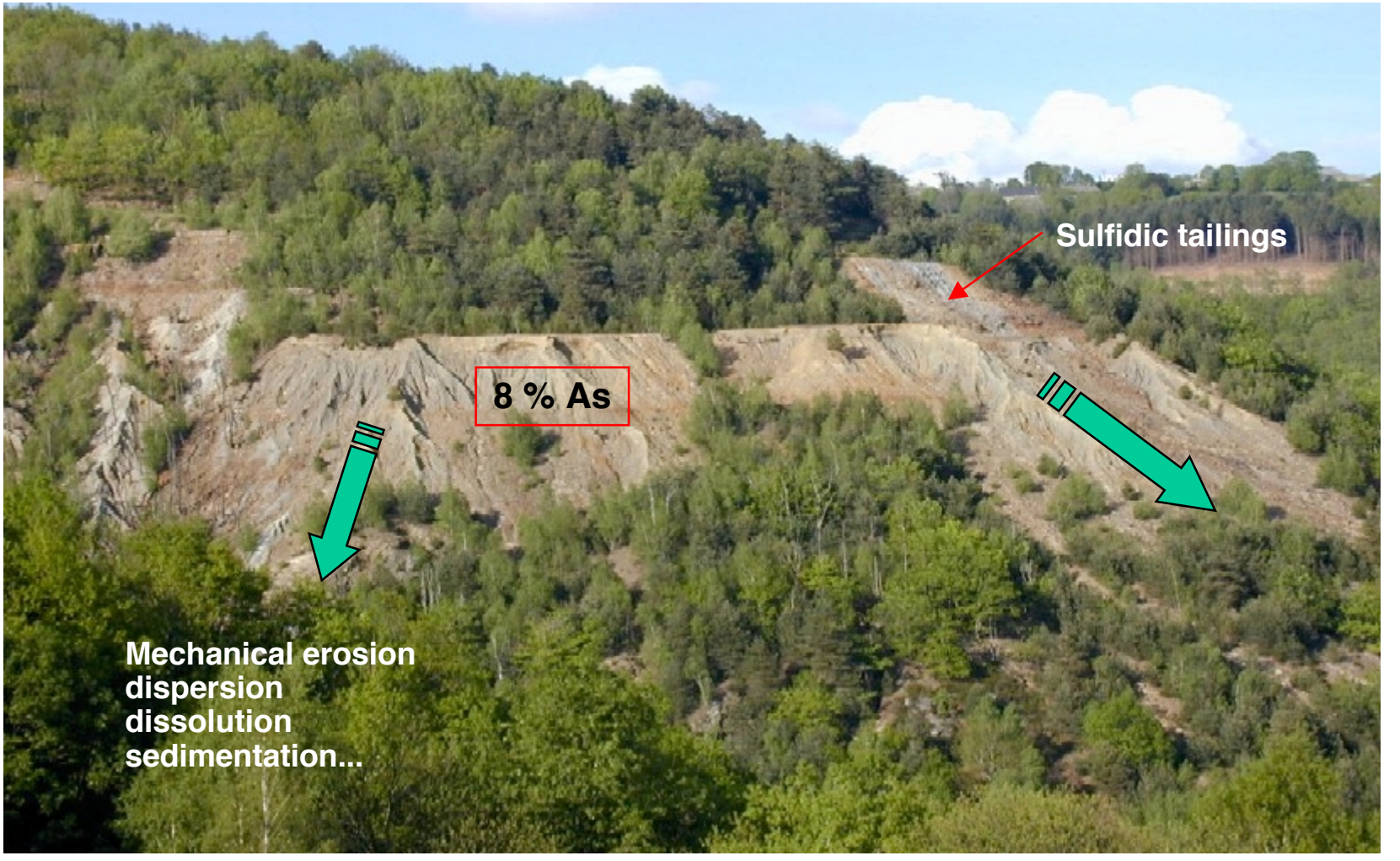
Concentrating Metals (1)

Accumulation of Tailings containing residual chemicals

Pyrite-rich tailings impoundment in Russia

Concentrating Metals (2)

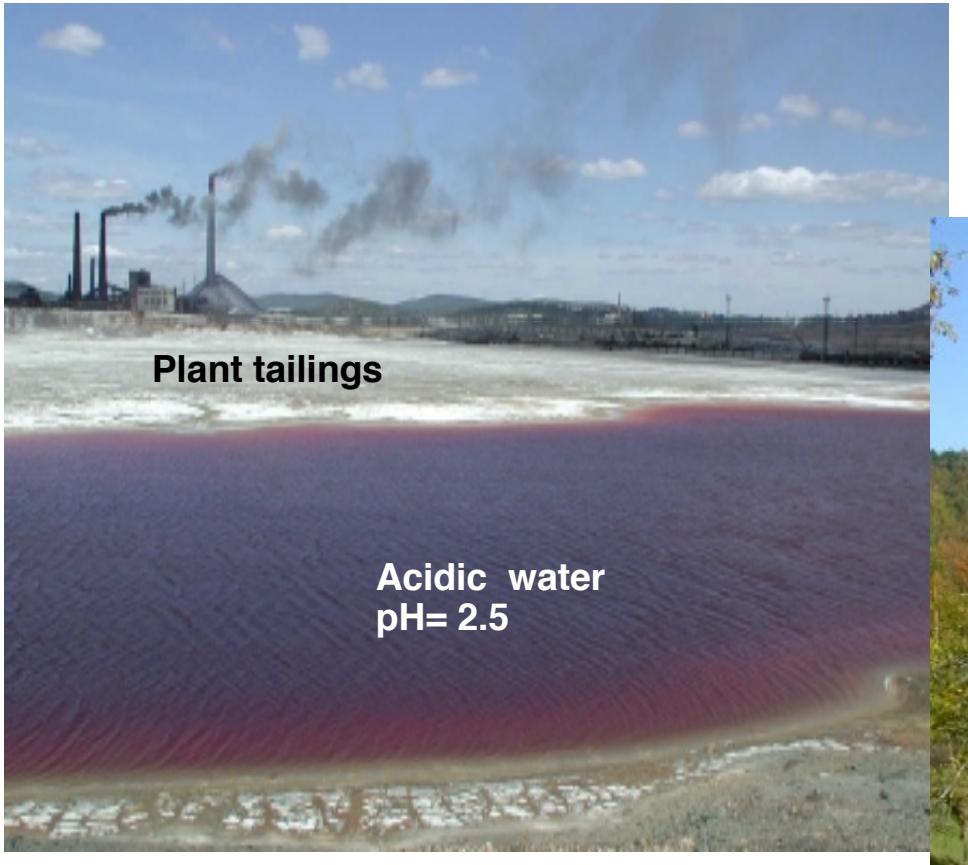
Erosion of Tailing Dumps by Wind and Water



ENGUIALES Tungsten mine (France)

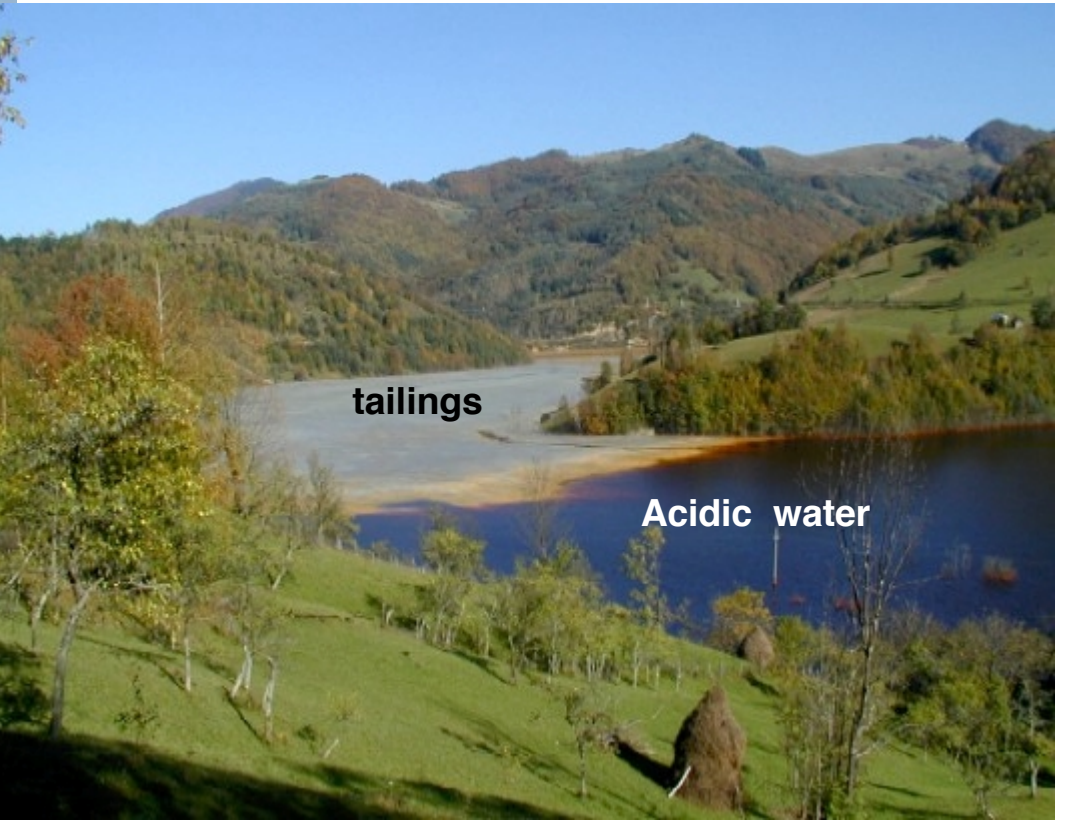
Concentrating Metals (3)

Production of Acid Mine Drainage



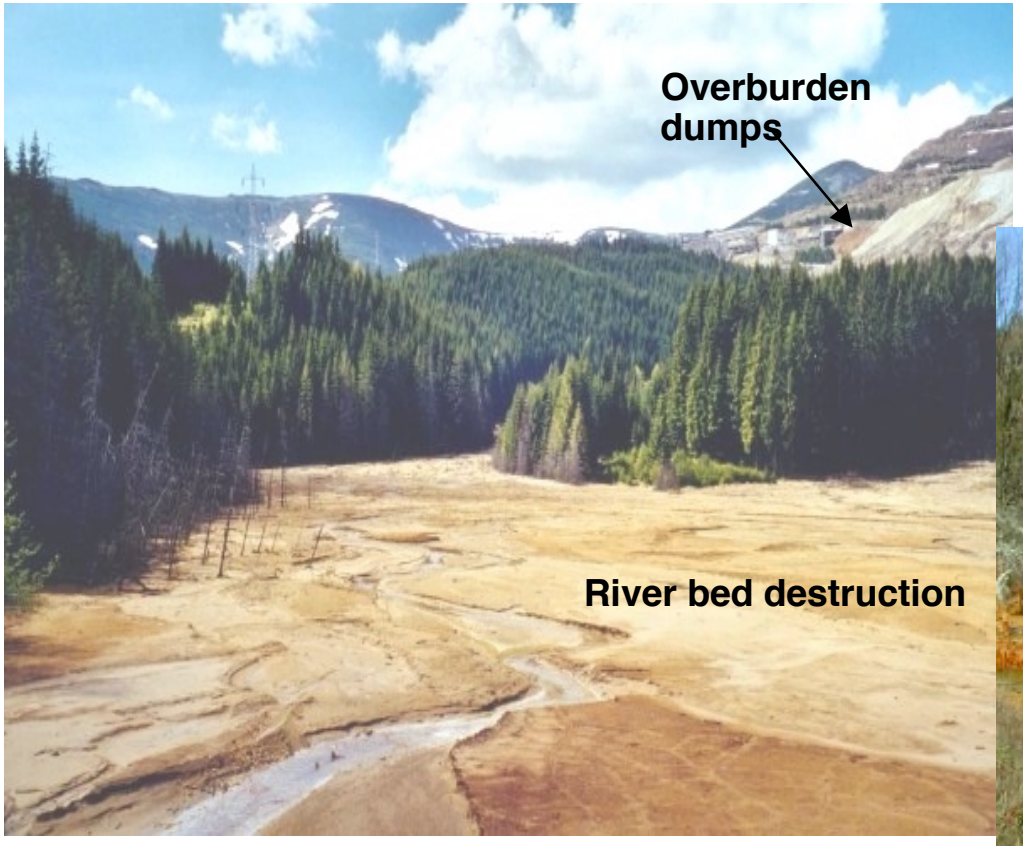
Karabash area (Russia)

Rosia Poieni (Rumania)



Concentrating Metals (4)

Effects of Acid Drainage



Calimani Mine (Rumania)

Rosia Poieni (Rumania)

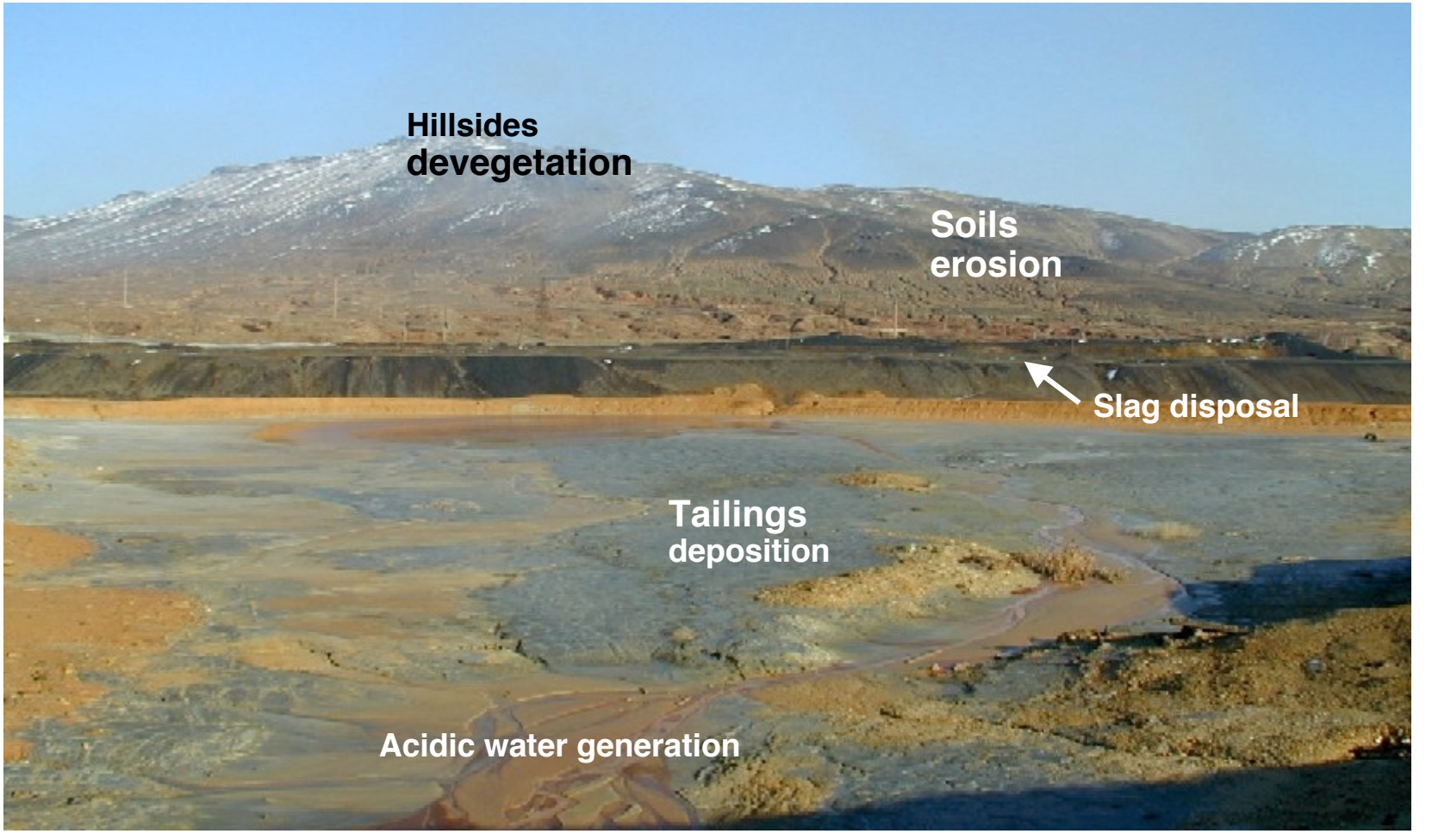
Concentrating Metals (5)

Gold Cyanide Heap Leaching

Gold heap leaching Pilot test

Mining and Concentrating Metals (6)

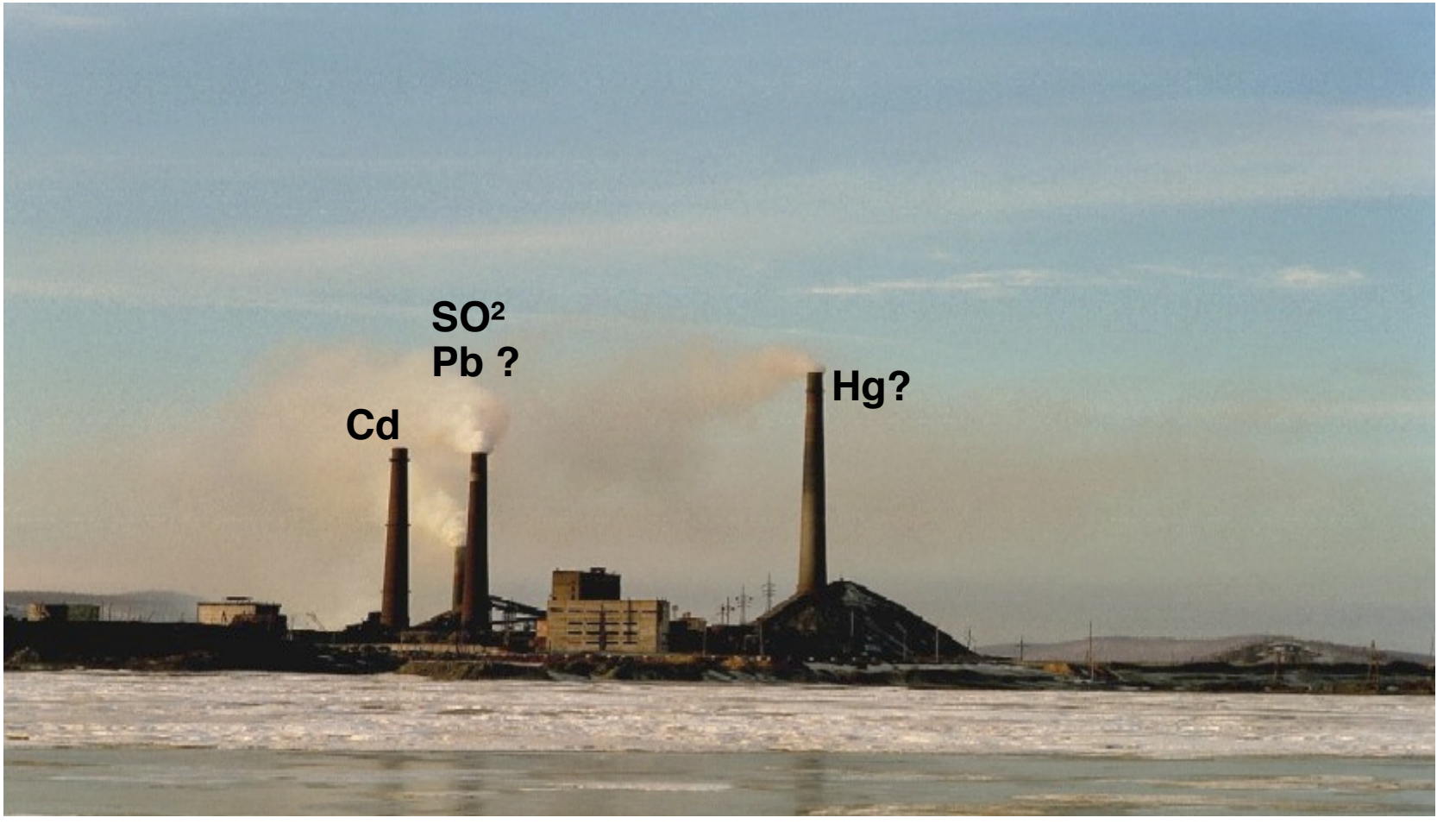
Cumulative Impacts



Karabash mining area (Russia)

Removing impurities (1)

Smelter stack emissions and release to air

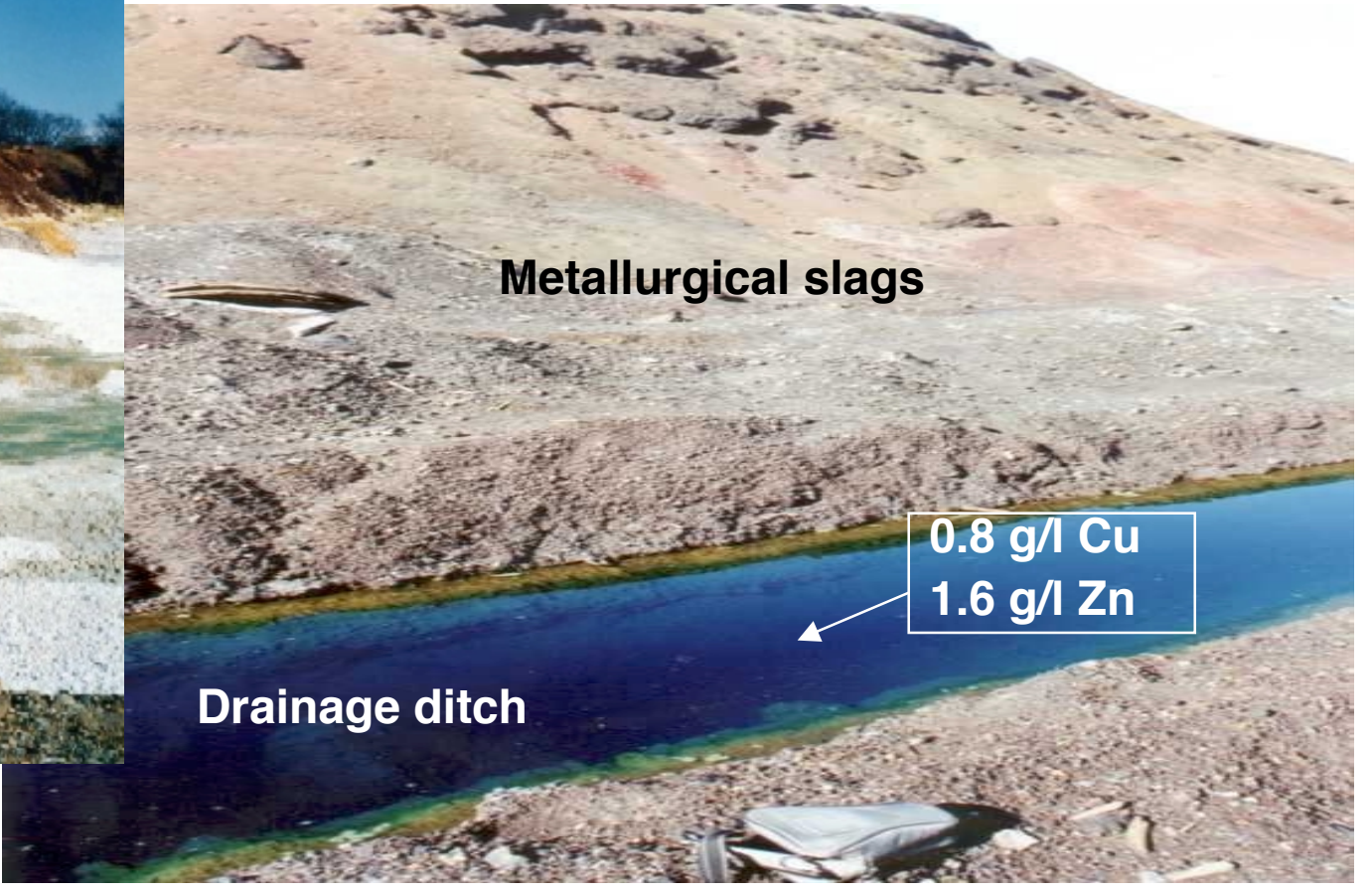


Karabash copper smelter (Russia)

Removing impurities (2)

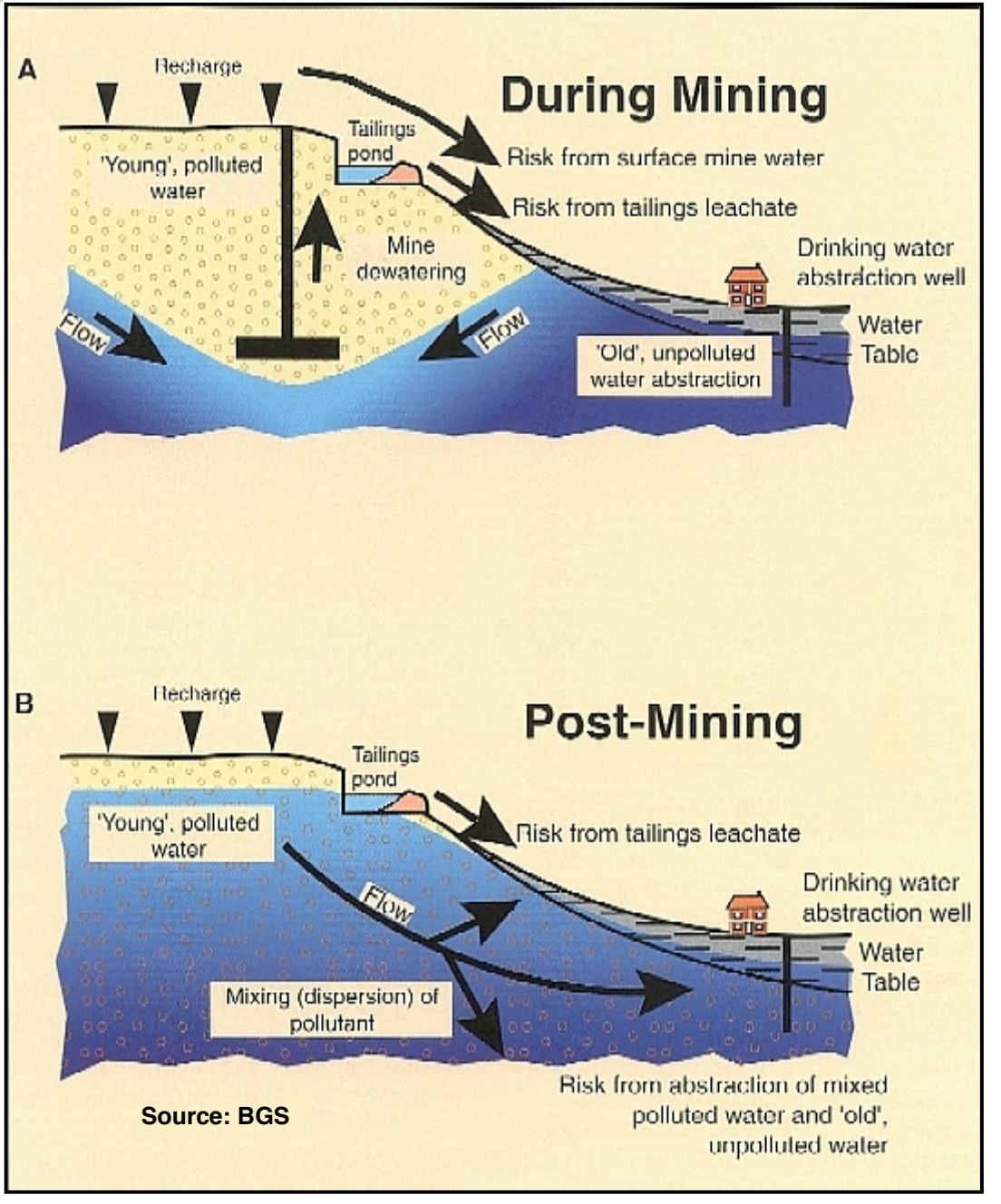
Metals and dissolved pollutants from slags disposal and release to water

La Lucette Sb smelter (France)



Zn smelting plant (Russia)

Potential variations of impacts
after a mine closure



Potential variations in impacts from hazardous mine waste after a metal mine is closed

Socio-economic impacts and ancient mining

Abandoned facilities at the surface

Sentein Pb,Zn, Ag ancient mine (France)

Socio-economic impacts and old mining sites

Physical stability

Lorraine (France)

Socio-economic impacts and public safety

bioaccumulation in the food chain

Carnoulés (France)

Uchaly (Russia)

Positive impacts: metals empower us

Conclusions (1)

Providing metals and raw materials for the future

The demands for both minerals and metals are expected to increase in the decades ahead (world population growth and rising standards of living…)

New challenges and balanced approaches for mineral supply and environmental protection needed

Society 's expectations and the future of the mining industry require that *the long-term environmental impacts* of mining be adequately addressed

Conclusions (2)

Protecting the environment and human health

PREVENTION is the key

- dumping sites and tailing dams management and reclamation
- water management and treatment
- reduction of acid rock drainage
- control of dust and gaseous emissions
- recycling
- ...

Conclusions (3)

How Science and technology can help ?

The example of **MINEO PROJECT**

Developping more efficient and cost-effective tools based on Earth Observation Methods for handling mining-related environmental impacts and risks at regional scales

- ***identification***, ***characterization*** and ***mapping*** of surface physical and chemical disturbances:
  landscape patterns = surficial indicators of processes

- ***detailed mapping*** in a risk assessment perspective of sources of pollution, migration pathways, endpoints and population / ecosystems potentially at risk

- ***definition*** of contamination model and monitoring programme ...