Toxic Mining Waste in the pre-Accession Countries

*the pecomines project*

Concepts to Link Inventory, Impact Assessment and Legislation Development

Marco D’Alessandro, Giovanni Bidoglio, Tamás Hámor, Győző Jordán, Erik Puura, Panos Panagos, Stefan Sommer, Marc Van Liedekerke, Anca Marina Vijdea

European Commission, Joint Research Centre
Institute of Environment and Sustainability
Soil and Waste Unit

NATO/CCMS STUDY PILOT MEETING
Baia Mare, România, September 8 -11, 2003.
Rationale: Why Mining?

Potential environmental risks

- Safety of waste facilities (in particular dam stability)
- Operational waste management (acid mine drainage, possible contamination of the environment)

Commitment of the European Commission for a Directive on Mining Waste
A Research Project Focusing on Inventory, Regulations and Environmental Impacts of Toxic Mining Wastes

Objective 1: Contribute to the assessment of consequences of mining accidents in a perspective of ecosystem protection, by comparing approaches to site monitoring and restoration.

Objective 2: Develop a methodology for inventory of toxic waste sites from mineral mining in relation to “_sensitive” catchment areas, by combining an indicator approach and an analysis of satellite remote sensing.

Objective 3: Comparison of existing legislation on mining and mining waste to support the environmental approximation process.
Inventory

European Environment Agency
TC Wastes

New Initiative on Mining Waste

Regulations

National Experts

collaboration with National and Regional Authorities

Environmental Impact

workshop

workshop

workshop
Guidance through a Steering Committee:
- Reference in each country to assure scientific quality and relevance of the project in the light of needs of Candidate Countries.
- Organisation of Meetings and Workshops (October 2001, May 2002, autumn 2003) involving also UNEP, Euromines, WWF, MS, DG ENV, EEA.

Spin-off Project:
- Joint field campaign MAFI, VITUKI, ITC, JRC-IES and DLR for data acquisition at two Hungarian mining areas in conjunction with HySense flight (August 2002).
Work Packages in the DPSIR Framework

**DRIVING FORCES**
- human demand for mineral resources

**PRESSURES**
- emission sources as the result of exploitation of mineral resources and abandoned mining areas

**STATE**
- the quality of environment threatened by emissions originating from mining

**IMPACTS**
- degradation of ecosystems, quality of life, including human health, cultural resources, recreational value

**RESPONSE**
- actions of communities and policy makers to reduce impacts and risks to an acceptable level

**inventory**

**assessment**
THE INVENTORY APPROACH

Develop and test a methodology to gather data on potentially hazardous mining waste sites on a country basis. The approach combines site-specific information harmonised through a questionnaire and put into a relational database, with geo-referenced spatial information also derived from remote sensing data.

- Expert network, communication with national experts responsible for data supply which ensures efficiency and quality control.
- Digital interface, web application for data presentation, dissemination and inquiry through Internet was developed. All questionnaire data, spatial data (maps, etc.), other information e.g. text, graphs and photos.
- Detailed guide, glossary and Questionnaire.
- Data need kept to the minimum necessary for site screening.
- Hierarchical data structure from basic (location, status, commodity) to more complex and uncertain information (waste quantities, emissions). In this way the Questionnaire is suitable for both regional screening and detailed local inventory of mine waste source characterisation.
Inventory Example: Slovakia

Selected “hot spots” in the Slovak Republic
### Areas of intensive mining and processing waste (“hot spots”) in Poland

<table>
<thead>
<tr>
<th>MINING BRANCH</th>
<th>AREA</th>
<th>NUMBER OF MINES</th>
<th>Extracted matter</th>
<th>Number of disposals</th>
<th>DISPOSAL AREA</th>
<th>Waste quantity</th>
<th>Annual Extraction</th>
<th>Hazardous component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard coal</td>
<td>Upper Silesian Coal Basin</td>
<td>27</td>
<td>102 490.0</td>
<td>49</td>
<td>20 551.0</td>
<td>481 441</td>
<td>80 881.7</td>
<td>NaCl - 1.76 %; FeS2</td>
</tr>
<tr>
<td></td>
<td>Lower Silesian Coal Basin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2 730.0</td>
<td>14</td>
<td>248.5</td>
<td>Fe2+</td>
</tr>
<tr>
<td></td>
<td>Upper Silesian Coal Basin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2 488.5</td>
<td>-</td>
<td>Fe2+</td>
</tr>
<tr>
<td>Lignite</td>
<td>Kleszczów Trough</td>
<td>2</td>
<td>34 694.0</td>
<td>2</td>
<td>3 080.0</td>
<td>14 000.0</td>
<td>4 108.0</td>
<td>Na-; SS-; Pb, Cr, La</td>
</tr>
<tr>
<td></td>
<td>Krotosław</td>
<td>1</td>
<td>877.5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Cr, V, Co, Ni</td>
</tr>
<tr>
<td></td>
<td>Krotosław</td>
<td>9</td>
<td>16 700.0</td>
<td>9</td>
<td>4 320.0</td>
<td>29 600.0</td>
<td>1 308.0</td>
<td>Na-; Pb; Cr; La; Cu; Ni</td>
</tr>
<tr>
<td>Radioactive elements</td>
<td>Krotosław</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>168.5</td>
<td>4 710.0</td>
<td>-</td>
<td>Na2+, SO4-; Sr, Cr</td>
</tr>
<tr>
<td>Lignite</td>
<td>Krotosław</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>200.0</td>
<td>-</td>
<td>-</td>
<td>Na2+, SO4-; Sr, Cr</td>
</tr>
<tr>
<td>Radioactive elements</td>
<td>Złotoryja</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Na2+, SO4-; Sr, Cr</td>
</tr>
<tr>
<td>Copper ore</td>
<td>Upper Silesian Coal Basin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>FeS2</td>
</tr>
<tr>
<td></td>
<td>Lower Silesian Coal Basin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>FeS2</td>
</tr>
<tr>
<td>Copper ore</td>
<td>Rybnik Coal District</td>
<td>15</td>
<td>102 480.0</td>
<td>14</td>
<td>6 202.0</td>
<td>292 623.0</td>
<td>50 750.7</td>
<td>NaCl - 1.76 %; FeS2</td>
</tr>
<tr>
<td></td>
<td>Kleszczów Trough</td>
<td>2</td>
<td>34 694.0</td>
<td>2</td>
<td>3 080.0</td>
<td>14 000.0</td>
<td>4 108.0</td>
<td>Na-; SS-; Pb, Cr, La</td>
</tr>
<tr>
<td></td>
<td>Krotosław</td>
<td>1</td>
<td>877.5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Cr, V, Co, Ni</td>
</tr>
<tr>
<td></td>
<td>Krotosław</td>
<td>9</td>
<td>16 700.0</td>
<td>9</td>
<td>4 320.0</td>
<td>29 600.0</td>
<td>1 308.0</td>
<td>Na-; Pb; Cr; La; Cu; Ni</td>
</tr>
<tr>
<td>Zinc/lead ore</td>
<td>Szymanowice</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Krotosław</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Złotoryja</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Zinc/lead ore</td>
<td>Szymanowice</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Złotoryja</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nickel ore</td>
<td>Konin District</td>
<td>9</td>
<td>15 700.0</td>
<td>9</td>
<td>4 320.0</td>
<td>29 600.0</td>
<td>1 308.0</td>
<td>Na-; Pb; Cr; La; Cu; Ni</td>
</tr>
<tr>
<td></td>
<td>Złotoryja</td>
<td>2</td>
<td>34 694.0</td>
<td>2</td>
<td>3 080.0</td>
<td>14 000.0</td>
<td>4 108.0</td>
<td>Na-; Pb; Cr; La; Cu; Ni</td>
</tr>
<tr>
<td></td>
<td>Krotosław</td>
<td>1</td>
<td>877.5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Cr, V, Co, Ni</td>
</tr>
<tr>
<td></td>
<td>Krotosław</td>
<td>9</td>
<td>16 700.0</td>
<td>9</td>
<td>4 320.0</td>
<td>29 600.0</td>
<td>1 308.0</td>
<td>Na-; Pb; Cr; La; Cu; Ni</td>
</tr>
<tr>
<td>Arsenic ore</td>
<td>Bytom Area</td>
<td>23</td>
<td>5 492.0</td>
<td>23</td>
<td>742.0</td>
<td>15 661.0</td>
<td>1 054.0</td>
<td>Zn - 2.47 %; Pb - 0.33 %</td>
</tr>
<tr>
<td></td>
<td>Złotoryja</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Złotoryja</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Bytom Area</td>
<td>23</td>
<td>5 492.0</td>
<td>23</td>
<td>742.0</td>
<td>15 661.0</td>
<td>1 054.0</td>
<td>Zn - 2.47 %; Pb - 0.33 %</td>
</tr>
<tr>
<td></td>
<td>Złotoryja</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Złotoryja</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

PL-Geological Survey
Inventory Example: Hungary

Landscape Wounds (incl. mining sites)

H-Ministry of Environment
**pecomines database: Web application**

<table>
<thead>
<tr>
<th>Mining Site</th>
<th>Unit</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*mining site in the database*
I. Identification and Location
II. Status and Production
III. Geological Characterisation of Mineral Deposit
IV. Mineral Processing and Waste Management
V. Emissions and Environmental Impacts
Support compilation of the inventory by improving spatial details and differentiation of potentially hazardous mining waste materials from other sites in the CORINE LC system. A geo-referenced mapping of surface mining waste deposits at local and national scale, based on spectral discrimination of mineralogical components. Demonstration of the method applied to Landsat-TM data for rapid screening.

Multi-temporal satellite scenes at time intervals covering the period 1985 – 2000. Total area covered is ca. 120 000 km².
SPECTRALLY BASED METHODOLOGY FOR RAPID SCREENING OF MINING WASTES BY USE OF LANDSAT-TM IMAGES

Exposed rock surface: Andesite quarry-RO

Strong weathering of iron oxides and hydroxides

Processed remote sensing image pointing out ferric/ferrous minerals

Secondary minerals in sulfide bearing deposits: Porphyry copper open-pit

Oxidation of sulfides with release of acid water and heavy metals

Processed remote sensing image pointing out co-occurrence of both OH and Fe bearing minerals
Output: large-area maps of spatial distribution of mining wastes

Landsat-TM image (07.10.1991)

Discrimination between weathered materials and others prone to acidification

Detection of changes over time

Map of mineral fuels and metals

Processed image showing the zones with iron oxides and OH-bearing minerals

Novoveska Huta – Rudnany (Slovakia)
REMOTE SENSING ANOMALIES DETECTED AND MAPPED IN SLOVAKIA
Change detection in Smolnik – Smolnicka Huta area, Slovak Republic

25.08.1987 06.08.1992 20.08.2000

Active mine  Closed mine  Remediated tailing pond
Actions on multi-country level require harmonised criteria and procedures to classify environmental impacts.

A comparative assessment and ranking of different mining sites for 37 hot-spots focusing on initial steps of the overall risk assessment. The hot-spot (metal, uranium, fossil fuel, industrial minerals) categories are:

1. Sites emitting hazardous, polluted water
2. Large contaminated lands, waste heaps and/or tailing ponds
3. Tailing ponds with large volumes of polluted water or heaps with unstable slopes, at risk of accidental release of pollutants
... and application to other sites, which are compared on log-log scale plotting emission flow-rates and the number of times environmental quality standards are exceeded.
Possible classification of hazardous sites with respect to the emissions potential.

A parameter IH (isohazard) is defined as $\log(\text{times standard exceeded}) + \log(\text{emission rate, m}^3/\text{day})$, and its value has a meaning of a potential to pollute equal amount of good quality water per day.
The approach addressed and clarified:

- Ownership (land, minerals, waste)
- Authority framework, licensing procedures
- Control, sanctions, liability
- Financial aspects and public acceptance
- National policies, programmes
- Data management and access
- Original regulatory ideas
TYPICAL REGULATORY FRAMEWORK OF MINING IN CANDIDATE COUNTRIES

- Council of Ministers (Government)
- Ministry of Economy
- Ministry of Environment
- Mining Authority
- Geological Survey
- Env. Authority
- Water Authority
- Regional or Local Professional Authorities
- Local Governments
- Constitutional Court
- Supreme Court
- County Courts
- Local Courts

Legend
- Jurisdiction
- Supervising Authorities
- First-instance Authorities
LEGAL CLASSIFICATION OF MINES IN CANDIDATE COUNTRIES

MINES AND QUARRIES

- Illegal (not licensed)
- Legal (licensed)
- Pre-operational (licensed mining plot)
- In operation (licensed technical operation plan)
- Not in operation
  - Temporarily suspended
  - Closed
  - Not remediated
  - Remediated

LEGEND

- Potentially high environmental risk
- Medium environmental risk
- Low environmental risk
Conclusions of the regulatory report

- Adoption of EU waste legislation is advanced.
- Mining legislation shows differences among Candidate Countries (e.g. ownership and scope).
- Opening and operation of mines are well regulated, closure and aftercare are less prescribed. Regulatory enforcement requires improvement.
- Geological data (including mineral resources) are well recorded, mining operation and waste data are less accurately managed.
- Mining regulations focus mainly on safety and not on environmental impacts.
- Limited use of royalty incomes for mitigating and remediating mining-related environmental impacts.
available on request
from
tamas.hamor@jrc.it
Article 19 ... drawing-up inventories of closed waste facilities … identification ...and their classification according to the degree of their impact on human health and the environment

Article 20 Within three years… the Commission shall adopt ... definition of the criteria for the classification of waste facilities, … including threshold concentrations for hazardous waste and dangerous substances
Contaminated Sites in Accession Countries

Community Actions on Soil

- Towards a Thematic Strategy on Soil Protection (COM(2002)179 final)
- Proposal for a Directive on Soil Monitoring (mid 2004)
- Proposal for a Commission Communication on contamination, erosion and organic matter content of soil and related research and legislative needs

Workshop in Budapest – end of October

- Develop and test a large-scale approach to the inventory and assessment of environmental impacts associated to contaminated sites
- Benchmarking historical heritage and national actions of 13 Accession and Candidate Countries
- Agree on methodologies and establish a platform for information exchange to collect, use and deliver back data