Environmental remediation of old mining areas in Centro Region, Portugal

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EDM - Empresa de Desenvolvimento Mineiro

• EDM, a company with more than 50 years – Involved in almost all reference mining projects in Portugal
EDM - Empresa de Desenvolvimento Mineiro

• EDM is a Portuguese State owned company, which operates mainly in two areas:

  – Mineral Resources Exploration:
    • By itself or in Joint-Ventures, develops exploration activities of mineral deposits in world class metallogenic provinces of Portugal aimed at maximizing its mineral resources potential for exploitation

  – Environmental remediation of old mining areas
    • In an exclusive basis, under a concession contract with the Portuguese Government, develops and conducts the environmental remediation and monitoring of abandoned mining sites in Portugal
Environmental remediation of old mines

• Why?

– Mining is a very old activity in Portugal
– During Roman times (from I B.C. to IV A.C.), the territory was extensively explored and exploited for gold;
– 1850 - 1990: main period of mining activity in Portugal;
– Mines of tungsten, tin, uranium, pyrite, copper, lead, gold and silver;
– Environmental impacts from the exploitation and essentially from the abandonment of mining activities
Environmental remediation of old mines

- Mining wastes
Environmental remediation of old mines

- Mine water/Acid Mine Drainage

Covas

Barranco de S. Domingos

Algares - Aljustrel
Environmental remediation of old mines

- Safety risks
- Soil contamination
- Landscape impacts
- Contaminated and degraded infrastructures
- Cultural heritage impacts

Spatial Probability Distribution of As > 219.5
Portuguese approach

Considering:
- Environmental Framework Law (DL 11/87 of 7 April)
- Mining Framework Law (DL 90/90)
- The National Environment Legislation
- European Directives


That aims to:

_ Eliminate the risk factors for public health and safety, resulting from water pollution, soil contamination, heaps and any unprotected areas;

_ Rehabilitate the surrounding landscape and natural conditions of development in accordance with the previous Habitat;

_ Ensure the preservation of significant heritage of old mines, both economic and archaeological and the valorization of archaeological remains related to mining activity;

_ Provide conditions for future use of reclaimed areas such as agricultural or forestry use, tourist and cultural promotion, or another that promotes the community development.
Portuguese approach

- Developed strategy

**Phase 1**
- Inventory Characterization Studies
- Hierarchy Study

**Phase 2**
- Interventional and Master Plans

**Phase 3**
- Detailed Design Project Development
- Environmental Studies

**Phase 4**
- Remediation/Field Works
- Control and Environmental Intervention

**Monitoring**

- Monitoring Maintenance (medium and long term)
Abandoned Mine Inventory

<table>
<thead>
<tr>
<th>MINERAL TYPE GROUPS</th>
<th>NUMBER OF MINES</th>
<th>MOST RELEVANT OLD MINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactive minerals</td>
<td>61</td>
<td>Urgeiriça, Quinta do Bispo, Cunha Baixa e Bica</td>
</tr>
<tr>
<td>Polimetallic Sulphides</td>
<td>10</td>
<td>São Domingos, Aljustrel, Lousal e Caveira</td>
</tr>
<tr>
<td>Tin and Tungsten</td>
<td>40</td>
<td>Argozelo, Covas, Montesinho e Terramonte</td>
</tr>
<tr>
<td>Base Metals</td>
<td>28</td>
<td>Terramonte, Coval da Mó e Miguel Vacas</td>
</tr>
<tr>
<td>Iron and Manganese</td>
<td>16</td>
<td>Orada, Cercal / Rosalgar e Ferragudo</td>
</tr>
<tr>
<td>Coal</td>
<td>3</td>
<td>São Pedro da Cova e Pejão</td>
</tr>
<tr>
<td>Gold</td>
<td>12</td>
<td>Jales, Penedono e Freixeda</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
<td>Gouveia de Baixo e Cortes Pereira</td>
</tr>
<tr>
<td>Asbestos</td>
<td>1</td>
<td>Arado do Castanheiro</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>175</strong></td>
<td><strong>199</strong></td>
</tr>
</tbody>
</table>
Portuguese approach

- Technical objectives
  - Mining Waste Management
  - Mine water and AMD Control and Reduction
  - Mine Water Treatment Systems (Passive, Active and hybrid)
  - Soil decontamination
  - Landscape and habitat integration
  - Heritage preservation
  - Achieve desired End-state conditions according to potential uses
Portuguese approach

- **Results Portugal:**
  - 103 mining areas interventioned until 2018
  - 8 mining areas with ongoing remediation works
  - 56 planned interventions, and 32 with restraints...

<table>
<thead>
<tr>
<th>Mining Areas</th>
<th>Inventory</th>
<th>Concluded 2001-2018</th>
<th>Ongoing</th>
<th>Planned 2018-....</th>
<th>With restraints*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactive</td>
<td>62</td>
<td>40</td>
<td>7</td>
<td>15</td>
<td>0</td>
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<tr>
<td>Polymethalic Sulphides</td>
<td>137</td>
<td>63</td>
<td>1</td>
<td>41</td>
<td>32</td>
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<tr>
<td>Total</td>
<td>199</td>
<td>103</td>
<td>8</td>
<td>56</td>
<td>32</td>
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</table>

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<td></td>
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Portuguese approach

• **Investment:**
  - 98 M€ between 2000-2015
  - 43 M€ approved for 2016-2020
  - 65 M€ estimated for the remaining

• **Main funding sources:**
  – Cohesion Funds
  – Portuguese mining operators royalties
**Centro Region**

- 91 abandoned mines
  - 60 radioactive ores
  - 15 W and Sn
  - 10 Au, Pb, Cu, Ag and Zn
  - 6 Qz, Feldspar and other
Centro Region

• **Results:**
  – 59 mining areas interventioned until 2018
  – 7 mining areas with ongoing remediation works
  – 21 planned interventions, and 4 with restraints...

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</tr>
</thead>
<tbody>
<tr>
<td>Radioactive</td>
<td>60</td>
<td>38</td>
<td>7</td>
<td>15</td>
<td>0</td>
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<tr>
<td>Polymethalic Sulphides</td>
<td>31</td>
<td>21</td>
<td>0</td>
<td>6</td>
<td>4</td>
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<tr>
<td>Total</td>
<td>91</td>
<td>59</td>
<td>7</td>
<td>21</td>
<td>4</td>
</tr>
</tbody>
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|                               |           |                      |         |                  |                 |
|                               |           |                      |         |                  | 4               |

|                               |           |                      |         |                  | 91              |
Centro Region Examples

- Urgeiriça (Nelas)
Centro Region Examples

Urgeiriça Old Tailings Dam

Valinhos area
Urgeiriça Santa Barbara Leisure Park (Old industrial area and ore deposit)
Centro Region Examples

Urgeiriça Santa Barbara Leisure Park (Old industrial area and ore deposit)
Urgeiriça Mine Water Treatment Plant: Active and Passive treatment
Centro Region Examples

- Urgeiriça Old Chemical Treatment Facility
  - Decontamination and requalification for future public uses
Centro Region Examples

- Espinho (Mangualde)
Centro Region Examples

- Barracão Radium Fabric (Guarda)
Centro Region Examples

Barracão Public Park
Challenges in mining remediation

- **New vision/paradigma:**
  
  *“mining waste not only as an environmental issue, but as a secondary source of mineral raw materials”*
  
  - More efficient use of resources, although lagged temporally
  - More efficient environmental remediation
  - Potential economic revenue:
    
    * Business development / profit generation
    * Partially offset remediation, maintenance and monitoring costs
Challenges in mining remediation

• R&D Projects
  – ERAMIN / 7th Framework Program
    ENVIREE - ENVironmentally friendly & efficient methods for extraction of REE from secondary sources
    BIOCRITICAL METALS - Recognition of microbial functional communities and assessment of the mineralizing potential (bioleaching) for high-tech critical metals
  – Life
  – H2020
    UNEXMIN - Autonomous Underwater Explorer for Flooded Mines
Challenges in mining remediation

- **R&D Projects**
  - **UNEXMIN** - Autonomous Underwater Explorer for Flooded Mines
    - use non-invasive methods for autonomous 3D mine mapping for gathering valuable geological, mineralogical and spatial information
    - Pilot test in Urgeiriça Mine, Portugal, 2019

[Project details](https://www.unexmin.eu/)

- **Project starting date:** 1 February 2016
- **Duration:** 45 months
- **Budget:** EUR 4,862,865
- **Output:** 3 working prototypes
Final Considerations

• With the conclusion of the Environmental Remediation of Old Mining Areas Plan, Portugal will correct environmental liabilities and impacts of centuries of mining activity.

• Strong improvements in safety issues, soil, water and air quality, mining heritage preservation and reclamation of these degraded areas for further uses.

• Mining wastes should be seen as potential secondary sources of mineral resources.

• Open to innovative solutions and R&D Programs.

• Contribute to change public perception of mining and promote reopening of old mines, when possible.
Taking care of the past, Challenging the future.

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