Impact assessment of human activities, the EO-MINERS showcase

EO contribution in monitoring environmental and societal impact of mining activities
• Securing EC raw material supply
• ETP – SMR and Strategic Research Agenda
• GMES : integrating spaceborne and subsurface information component, EU Raw Material Initiative
• GEO - GEOSS
International initiatives and raw materials

**EU**
- EU’s 2001 Sustainable Development Strategy (SDS) (renewed in 2006)
- 2005 Thematic Strategy for the Sustainable Use of Natural Resources
- 2008 EGS proposals for the implementation of a coherent EU non-energy raw materials policy
- Flagship initiative "Resource Efficient Europe"
- European Innovation Partnership (EIP) on raw materials
- Africa-EU High Level Conference on Raw Materials

**International**
- ICMM Sustainable Development Framework
- SDMI, an international forum for the Sustainable Development indicators in the Mineral Industry
- African Mining Vision 2050
- African Mining Partnership (AMP)
The aim of EO-MINERS is to bring into play EO-based methods and tools to facilitate and improve interaction between the mineral extractive industry and the society in view of its sustainable development while improving its societal acceptability.
OBJECTIVES - 1

Assess **policy requirements** at macro (public) and micro (mining companies) levels

Define environmental, socio-economic, societal and sustainable development criteria and **indicators** to be possibly dealt using EO
Demonstrate the capabilities of integrated EO-based methods and tools in:

- monitoring,
- managing
- contributing to reduce the environmental and societal footprints of all phases of a mining project
Contribute making reliable and objective information about affected ecosystems, populations and societies, basis for a sound “trialogue” between industrialists, regulatory bodies and stakeholders.

The project will initiate and develop a sound "trialogue" between **the three main groups** involved, based on reliable and objective information about ecosystems, populations and societies affected by mining activities.
EO-MINERS Consortium

3 demonstration sites (CZ, ZA, KG)
## Who we are?

<table>
<thead>
<tr>
<th>Beneficiary name</th>
<th>Country</th>
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<th>Country</th>
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</thead>
<tbody>
<tr>
<td>(BRGM) Bureau de Recherches Géologiques et Minières</td>
<td>France Coordination</td>
<td>Council for Geoscience</td>
<td>South Africa</td>
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<tr>
<td>British Geological Survey</td>
<td>UK</td>
<td>Anglo Operations Limited, Anglo Technical Division</td>
<td>South Africa</td>
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<tr>
<td>Tel-Aviv University</td>
<td>Israel</td>
<td>Université de Versailles – St Quentin</td>
<td>France</td>
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<tr>
<td>Deutsches Zentrum für Luft - und Raumfahrt e.V.</td>
<td>Germany</td>
<td>Česká Geologická Služba</td>
<td>Czech Republic</td>
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<tr>
<td>Wuppertal Institut für Klima, Umwelt, Energie GmbH</td>
<td>Germany</td>
<td>Sokolovská Uhelná a.s.</td>
<td>Czech Republic</td>
</tr>
<tr>
<td>Geoloski Zavod Slovenije</td>
<td>Slovenia</td>
<td>Central Asian Institute for Applied Geoscience</td>
<td>Kyrgyzstan</td>
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<td>Mineral Industry Research Organisation</td>
<td>UK</td>
<td>KyrgyzAltyn</td>
<td>Kyrgyzstan</td>
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EO and GIS in societal acceptability – a simplified conceptual model
EO and GIS in societal acceptability – a simplified conceptual model
Sokolov lignite open pit demo site (CZ)

- AMD (Acid Mine Drainage)
- Impact on vegetation
- Coal fires
- Sediment (coal) Dust
- Landscape degradation
Emalahleni (Witbank) coal field demo site (South Africa)

- The largest coal field in ZA
  - More than 60 x 60 km
- AMD (Acid Mine Drainage) affecting
  - Drainage system and wetlands
  - Urban areas
- Coal fires
- Dust
- Subsidence
- Landvalue degradation
- Uncontrolled urban sprawling
EO-MINERS Makmal – Kazarman gold mine demo site (KG)

- Cyanide contamination
  - Surface waters
  - Groundwater?
- Radioactive contamination
- Health
- Employment 70% depending on mine activity
EO tools and methods

• **Satellite data**
  – Conventional optical sensors: Landsat Thematic Mapper, ASTER
  – Very high resolution optical sensors, such as Ikonos, Quickbird, WorldView_II, SPOT 5
  – Radar sensors, in particular for INSAR applications

• **Airborne data**
  – Airborne imaging spectroscopy (hyperspectral) survey
  – Airborne geophysics: radiometric, electromagnetic, aeromagnetic
  – Thermal infrared (multi and broad band)

• **In situ monitoring methods**
  – Time-lapse electrical resistivity tomography (ALERT)
  – Ground monitoring networks
  – In situ point measurements (temperature, pH,…)
  – Field spectroradiometry campaigns (VNIR, SWIR, TIR)
  – Information and/or measurements about vegetation, soil, groundwater and dust
  – Chemical Model and 3D characterization of the contaminated soils
EO-MINERS and GEO - GEOSS

- Securing the inclusion of minerals in GEO work plan 2012 – 2015 (with AEGOS)

- Two SBAs now address minerals
  - EN-01: Energy and Geo-resources Management
  - SB-05: Impact Assessment of Human Activities
EO-MINERS contribution to GEO 2012 – 2015 work plan management

• SB-05 three components:
  – Component C2: Impact Monitoring Systems for Geo-resource Exploration and Exploitation
    • EC FP7 (EO-MINERS, ImpactMin), BRGM (France, s.chevrel@brgm.fr), DLR (Germany), BGS (UK)
  • EN-01
  – Component C1: Tools and Information for the Resource Assessment, Monitoring and Forecasting of Energy Sources (including solar, wind, ocean, hydropower, and biomass) and Geological Resources (including mineral and fossil resources, raw material and groundwater)
    • EC FP7 (EO-MINERS), Mines ParisTech (thierry.ranchin@ensmp.fr), DLR (Germany), BGS (UK)
      CEOS, EuroGeoSurveys, IEEE, IRENA, IUGS
WP 2012 – 2015
EN-01-C1 priority actions

- Develop and promote the use of integrated Earth observations for each stage of the mineral lifecycle (exploration, extraction, transportation, waste disposal, mine remediation and aftercare) to provide the basis for informed decision-making and improved geo-resources management. Develop a sustainable “trialogue” between the mining industry, regulators and civil society.
- Encourage training of decision-makers at all relevant levels for interpreting relevant data and products.
WP 2012 – 2015
SB-05- C2 priority actions

• Develop new tools for impact monitoring of mining operations using Earth observations
• Integrate information from in-situ, airborne and satellite observation (through data assimilation) to provide impact diagnostics
• Identify and implement strategic measures for the competitive, reliable and sustainable management of geo-resources exploitation and treatment of re-usable materials, based on innovative monitoring and accounting methodologies (see also EN-01)
• Integrate often-sectoral monitoring approaches (and corresponding impact analysis) into a coherent approach, based on innovative Earth observation techniques (related to space-borne, airborne and ground-based sensor systems
SB-05-C2
Expected Achievements by 2015

- Integration of spaceborne, airborne and ground-based EO datasets into mature stakeholder-oriented EO products
  - Integrated EO-based products and tools to monitor the societal and environmental impact of the extractive industry over all phases of a project, from exploration to closure
SB-05-C2 progress and key outputs for 2012

- better addressing minerals within GEO
- towards services in mineral exploration, impact assessment, closure and reclamation
SB-05-C2 progress and key outputs for 2012

• Indicators for assessing and monitoring environmental and societal impact of extractive industry
• Proceedings of GEO and Minerals workshop
• Qal/val for hyperspectral data acquisition and processing
• Mineral and vegetation mapping from VNIR – SWIR – TIR imaging spectroscopy
• Starting on-site triologue (industry, regulators, local communities) activities
Mining-related indicator development strategy

WP2

Expert elucidation

Indicator A
Indicator B
... Indicator X

Technology assessment

Feasibility evaluation

Technology Development

Indicator A
Indicator C
Indicator G

Technology testing

Merge indicators

Indicator C
Indicator 7
Indicator λ

WP1, WP5

Stakeholder elucidation

Indicator 1
Indicator 2
... Indicator n

Technology assessment

Feasibility evaluation

Technology Development

Indicator 2
Indicator 7
Indicator 9

WP3

Conceptual Site model

Indicator α
Indicator β
... Indicator μ

Feasibility evaluation

Technology Development

Indicator α
Indicator δ
Indicator λ

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Exploitation of TIR imaging spectroscopy

- Lake Medard (CZ) former open pit
- Enhancement of geotechnical engineered banks and trails for site rehabilitation

Quartz: yellow
Clay rich: blue
Exploitation of SWIR imaging spectroscopy

• Mapping areas of high acidity in lignite mine area
SB-05-C2
key impediments and gaps

• Lack of spaceborne high resolution hyperspectral sensors
  ⇒ rely on airborne on-demand data acquisition at high cost
  ⇒ local scale assessments

• Reluctance of industrialists to provide, share and disseminate data on impact of their activity
Linkage with other GEO Tasks

- Earth Observing Systems
  - C1: coordination hyperspectral spaceborne, airborne (EUFAR), in situ
  - C3: responsible use of arctic mineral resources (CEARC, at UVSQ)

- Document user requirements for environmental, geological core set
- Earth Data Sets
  - QA4EO In situ observations
- GEOSS Design and Interoperability
  - INSPIRE compliance
- Advancing GEOSS
  - Data Sharing Principles
    - Data sharing
    - Developing Institutional and Individual Capacity
- S&T in GEOSS
- Integration observation systems
  - RTD => operations
- Building a user-driven GEOSS
  - Trialogue issues
  - Stakeholder involvement
- Global Urban Observation and Information
  - Tools and Information for Health
    - Monitoring air quality
    - Contaminants in water
    - Tracking pollutants
  - Small-scale and illegal mining activities (Hg)
- Energy and Geo-Resources Management
  - Information for resource assessment
  - Integrated EO for each cycle of mineral life
  - Participative approach
- Capacity building institutional
- Monitoring air quality
- Information for resource assessment
- Integrated EO for each cycle of mineral life
- Participative approach
• **Field measurements** - reflectance and emissivity QA (*new protocol + standards*)
Generation of dedicated spectral libraries for ASTER and hyperspectral image calibration and processing.
ZA: TM series change detection
1989 – 2002 - 2010

- Evolution of mining and urbanisation along time
- Employment and urbanisation strongly dependant on mining
"Trialogue" approach

EO-MINERS Trialogue

European Trialogue
- MFA Workshop
- GMES / RMI
- SDIMI (??)

Site-specific Trialogues
- One individual workshop per test site
- Workshop in South Africa
- Workshop in Czech Republic
- Workshop in Kyrgyzstan

Raise awareness about possible contribution of EO methods and EO-MINERS products to impact assessment, influence related policy developments

Get stakeholders to talk to each other about impact assessment and suitable (joint) actions
Recommandations for accelerating WP implementation

- Lobbying industry community and associations (EuroMines, ETP-SMR…) for a better engagement in participative actions
  - Involve industry and industrialists in GEO – GEOSS (role of GEO Sec?)
- Promote EO-based integrated tools in user oriented conferences and events (rather than in EO oriented events…) = tackling the right audience
Thanks for your attention!

Contact: s.chevrel@brgm.fr