Innovations in Exploration & Extraction – results from the Min-Guide project

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What is MIN-Guide?

- Coordination and Support Action (Horizon 2020)
- 3-year project: Feb 2016 - Jan 2019
- Project Coordinator:

  Institute for Managing Sustainability WU

- 10 Partners
- 9 countries
Contribute to an innovation-friendly policy framework for a secure and sustainable supply of minerals.
Innovation-friendly mineral policy
Industry innovation & policy frameworks

- Exploration & Extraction
- Mineral and metallurgical processing
- Waste management & mine-closure

Identify industry innovation challenges and cases

- Legislative framework
- Economic and financial instruments
- Information provision and awareness

Identify EU and EU MS mineral policy frameworks
MIN-Guide activities
Events and information provision

5 Policy Laboratories

1st Policy Lab (WP2)
Vienna, Oct 2016

2nd Policy Lab (WP3)
Leoben, Mar 2017

3rd Policy Lab (WP4)
Luleå, May 2017

4th Policy Lab (WP5)
Athens, Sept 2017

5th Policy Lab (WP6)
Madrid, 2018

Webpage and policy guide

Online Mineral Policy Guide

3 Annual Conferences (EU-Level)

The Closing Conference ‘The future perspective of minerals production in the circular economy’

The Mid-term Conference: ‘Good practice minerals policy transitioning the minerals production value-chain’

The Opening Conference: ‘European minerals policy: Stock-taking and revealing the governance framework’
WP3 “Innovative exploration and extraction”

• Identification of EU MS mineral policies and legislation relevant to innovation in minerals exploration and extraction
• Identification of catalyzing and inhibiting elements for the implementation of innovative mineral exploration and extractive methods (non-technological as well as technological elements) and, following this, an identification of best practice cases
• Assessment of needs and gaps analysis for aligning future policy developments/directions with inclusion of all relevant stakeholders
• Exploration of the feasibility of innovative mining legislation and legal framework for exploitation of sub-surface and deep sea resources.
Innovations in exploration

<table>
<thead>
<tr>
<th>Exploration innovations</th>
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<tbody>
<tr>
<td>New geo-models, i.e. 3D-modelling using multiple geologic, geophysical and geochemical datasets</td>
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<td>Airborne geophysical methods</td>
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<td>Use of commercially available drones and other small aircraft in surveying tenure or high-precision mappings</td>
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<td>In-situ analysis using portable XRF analysers</td>
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<td>In-situ analysis using multispectral core logging</td>
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<td>Trace elements, lithogeochemical &amp; mineral systems mapping</td>
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<td>Use of MMI (mobile metal ion) theory in geochemical explorations</td>
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<td>Advanced field work, including better sample processing and analysis techniques, data analysis and process for environment-friendly exploration</td>
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<td>Advanced geological and geophysical data processing and interpretation, e.g. SOM (self-organising maps) method, prospectivity analysis</td>
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<td>Advanced surficial geochemical and biogeochemical methods based on weak and selective leaching</td>
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<td>Mobile GIS/GNSS applications and improved field mapping workflows, plus availability of cloud-based server storage</td>
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<td>Deep-drilling technologies, including accurate down-hole surveying and directional drilling, downhole geophysical and structural analysis (but NOT yet including down-hole chemical analyses)</td>
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<td>Deep penetrating geophysical technologies, in particular magneto-tellurics and electromagnetics (including SQUID development)</td>
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<td>New drilling technologies</td>
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<td>Improved online access to existing exploration and geological data</td>
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<td>All geological data published</td>
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<td>Faster technology to scan larger areas</td>
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<td>Overarching mining code</td>
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<td>Development of innovative near-mine and deep exploration technologies</td>
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- No breakthrough innovations in exploration in the last 20 years
- “Skills of the geologist”
- Field vs. data
Innovations extraction

**Extraction innovations**

- Autonomous equipment/operations, including use of robotics, smart sensors and 3D-printing
- Process control & (big) data management, (real-time information and mass flows)
- Continuous processes and automation
- Resource characterisation
- New models for financing of mining
- Lower environmental footprint (i.e. biodiversity, ore recovery, energy and CO₂, water, waste)
- New/alternative mining methods (in-situ leaching, mechanical cutting to replace DLB, etc.)
- Digitally enabled worker including remote operation centres, virtual and augmented reality, virtual collaboration
- Transparency and traceability including open platform databases, block chain usage
- Surveying methodology and mine design
- Scale-up of production equipment
- Resource characterisation for better structural controls
- Integrated platforms, enterprise ecosystems incl. IT/OT convergence, asset cybersecurity
- Next generation analytics and decision making including Artificial Intelligence, simulation modellings
- Land use planning governance (site level vs. Cumulative impact at regional level) -- data will allow models/analysis as part of regional development plans
- New business models and customer relations (collaborative business models, customer responsibility)
- Dealing with extreme environments (deep sea mining, extreme depths, arctic...)
- Various safety innovations including cultural changes
- Better skills base
- Better infrastructure, i.e. electricity and “mine-to-market”

- First two considered key
- NGOs: more innovations needed concerning transparency, land use, environmental management
Narrative 1 Impact of policy on exploration & extraction innovations

• Innovations are mainly driven by business opportunity
• Policy is only playing a secondary role, except for areas where innovation can help with meeting legislative requirements
  • Health and safety (e.g. communication and warning systems in underground mines)
  • Environment (e.g. resource efficiency, energy, water, waste management)
• RMI seen as positive since it made minerals a political priority again
• Horizon 2020 and EIT RM programs seen as positive for innovations
Narrative II Innovations and their impact on the SDGs

• No one-size-fits-all single innovation concept that will resolve mining's challenges and contribute positively to all SDGs

• Quite on the contrary, almost all innovation concepts show repercussions on individual SDGs

• The “inside-out” economically driven technological innovations change the societal contract of mining
  • Promise of increased employment opportunities for the local community was always a strong driver for acquiring a social licence to operate
  • “Shared infrastructure” or “New business models and customer relations”

• Many of the innovation concepts analysed have positive impacts on the environmental SDGs

• Innovations do not contribute to SDG 5 on gender equality and empowerment

• The societal innovations are mainly positive for the SDGs, i.e. social and environmental, but often have negative implications on the direct
Conclusions

Is European Mining Smart and Green?

• Innovation is critical for exploration & extraction in the EU
• RMI, EIP, etc seen as positive – will minerals continue to be a political priority?
• National RDI programs (Sweden, Finland, Portugal) seen as positive
• Innovation is mainly driven by business opportunity
• Legislation based on societal challenges drives innovation
• No one-size-fits-all single innovation concept that will resolve mining's challenges and contribute positively to all SDGs

… not yet!
Thank you for your attention

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www.min-guide.eu/