Challenges in Deep Mine Rescue within the European I²Mine Project

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Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future

- European Mining at Great Depths
- 4 Year Project, 26 Million Euro Budget
- 26 Partners from 10 EU-Countries e.g.
Work Package 6: “Health and safety and environmental aspects in future deep mining”
Task 6.6: “Deep Mine Rescue”
Scenario: „Miners trapped underground“

→ Increase Preparedness!
→ Concepts & Guidelines
→ Technological Studies
→ …
European Mine Rescue today

- Private vs. Governmental Structures
- Company-owned Mine Rescue Teams vs. civil Fire-Fighters
- Database of central Mine Rescue Stations
- Bilateral Cooperation instead of International Networks
- European Directives vs. National Mining Laws and Standards

- more collaborative Approach
- European Mine Rescue Platform
Major Hazards in UG Mining

A Literature Review:

- Fire
- Roof Fall
- Explosion
- Inundation
- Haz. Gases
- Outbursts

Bar chart showing the percentage of each hazard type.
Major Hazards in UG Mining

An International Survey:

- 36 Mines
- 8 Commodities
- 4 Continents

![Graph showing major hazards in underground mining]

- Ammonia
- CO2
- CO
- H2S
- CH4
- N2O
- O2
- Seam Gas
- Inundation
- Rock Fall
- Fire
- Vent. Breakdown
- Others
Integrated Selection:

- Fire
- Haz. Gas
- Inundation
- Rock Fall
- Explosions & Outbursts
Classification System

Classification of major Mine Emergencies

- Dead Ends
  - Water Inundation
  - Major Rock Fall
  - Long-lasting "sealed off Area"
- 2 Escape-Ways (Main Air Flow)
  - Fire
  - Hazardous Gas
- Fire
  - Water Inundation
  - Major Rock Fall
  - Hazardous Gas
- Temporary "sealed off Area"
- (Self-)Rescue
- Partly "sealed off Area"
- 2nd Escapeway (Self Rescue)
- New Challenge at Great Depths
- Adapt Standard Procedures

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Transfer to Great Depths

- Length of Escape-Ways
  - Self-Rescuer Application
  - Refuge Chambers
- Travel Time for Mine Rescue Teams
- Use (second) Escape-Ways whenever possible!
- Scenario: „Miners trapped underground“
- Rescue Drilling Time
  - San Jose, Chile 2010: 700 m → 3 Months
  - Europe’s Future Mining: 2000 m → ???
Example 1: Room & Pillar

Top View:

- Cave-in
- Trapped Miners

Lateral view:

>1,500 m

Cave-In
Example 2a: Single Road Heading
Example 2b: Single Road Heading

Water Inundation

👤 = Trapped Miners
Example 3: Sublevel Stoping

- Level A (Production)
- Level B (Production)
- Level C (Haulage)
- Stope
- Cave-In
- Blasted Rock
- Trapped Miners
Example 4: Cut & Fill

- **Ore**
- **Backfill**
- **Ramp**

- **= Cave-In**
- **= Trapped Miners**
Example 5: Sublevel Caving

Level A

Level B

Level C

Caved Ore

Cave-In

Trapped Miners
Outlook

- I²Mine‘s Vision of fully automated, un-manned Mines
  - But: at least small number of UG Workers in foreseeable Future

- Possible Rescue Missions at Great Depths
  - of increasing Scope and Extent with increasing Depths

- Need for Research, I²Mine: Deep Mine Rescue
  - Fully equipped Rescue Chambers
  - Integrated Escape-Way Concepts
  - Communication, Tagging & Tracking
  - Emergency Management, Guidelines
  - Concept for a European Mine Rescue Platform
Conclusion

- I²Mine developing „Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future“
- Variety of Mine Rescue Concepts and Philosophies in Europe
- Fire, Rock Fall, Inundations and haz. Gases as major Hazards
- Challenge of long-lasting Entrapments at Great Depths
- Ongoing I²Mine Research for „Deep Mine Rescue“

Collaborative and sustainable future European Mine Rescue
Thank you and Glückauf!

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