

SEEING BEYOND THE ROCK FACE

Digital Intelligence for Safe Mining

EEMS TARP Day of Learning /
Michelle Pienaar

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science, technology
& innovation

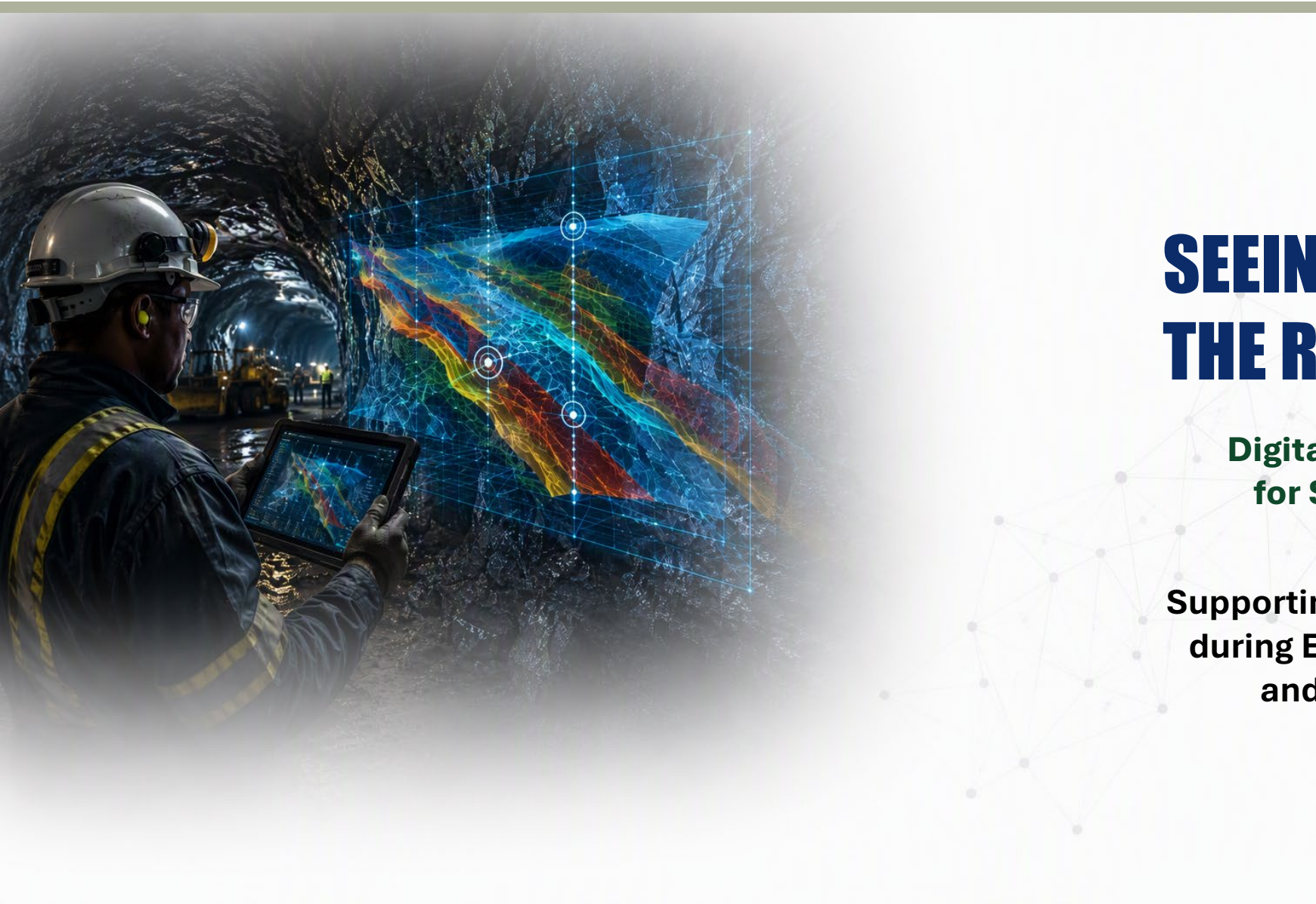
Department:
Science, Technology and Innovation
REPUBLIC OF SOUTH AFRICA



MINERALS COUNCIL
SOUTH AFRICA



SEEING BEYOND THE ROCK FACE



SEEING BEYOND THE ROCK FACE

**Digital Intelligence
for Safer Mining**

**Supporting better decisions
during Entry Examination
and Making Safe**



WHAT WE SEE VS WHAT MAY BE HIDDEN



MANDELA MINING PRECINCT
MINDS FOR MINES

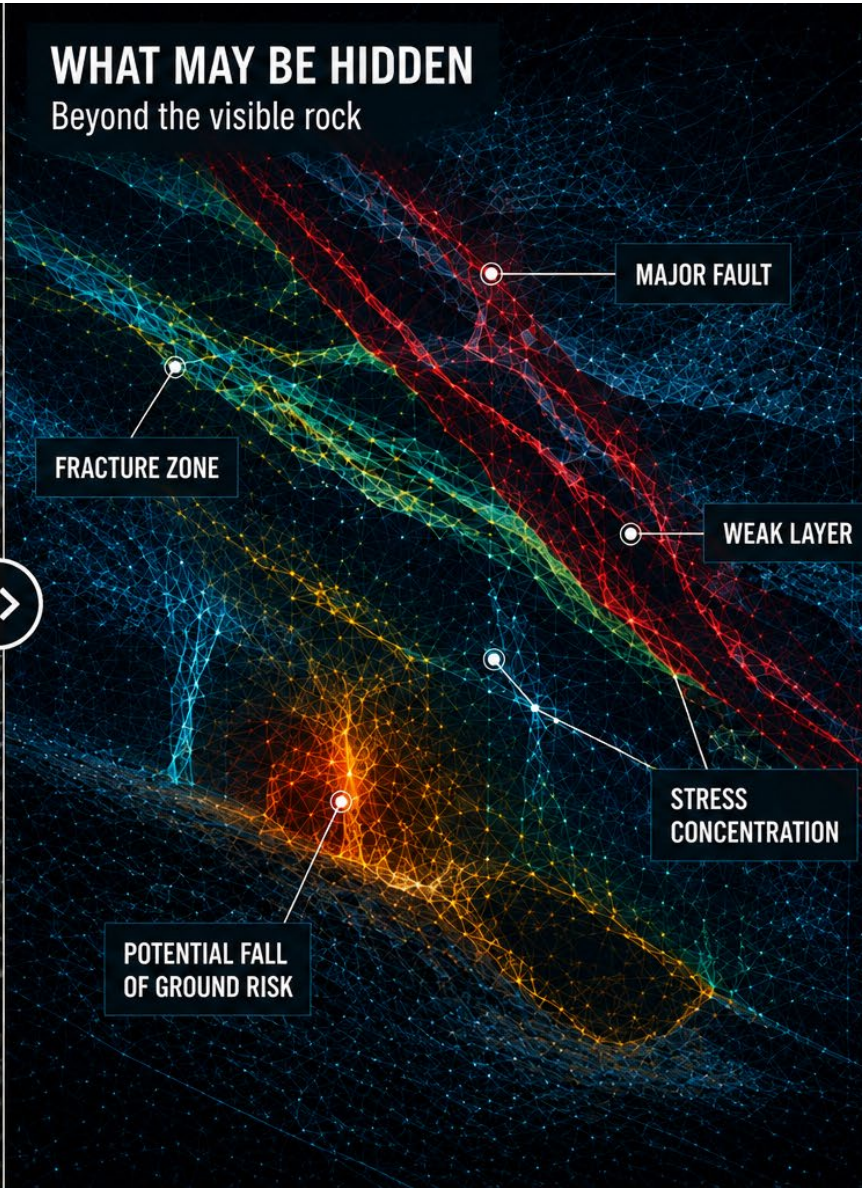
WHAT WE SEE

Visible rock face



WHAT MAY BE HIDDEN

Beyond the visible rock



WHAT MAY BE HIDDEN

-  Fractures
-  Stress
-  Rock Quality
-  Blast damage
-  Geology

WHY ENTRY EXAMINATION MATTER

Before anyone enters a workplace..... How do we know it is safe?



Observe



Listen



Sound



Measure



Experience



Every decision
depends on
the quality of
information
available

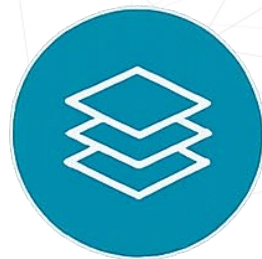
FROM OBSERVATION TO DIGITAL INTELLIGENCE

Our vision is to see beyond the rock face and transform information into safe decisions



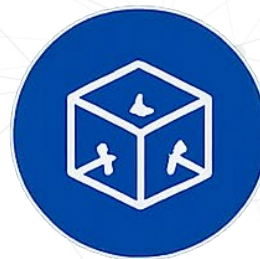
ACQUIRE

Capture data from the orebody



INTERPRET

Transform data into meaning



UNDERSTAND

3D Context and rockmass behaviour



SUPPORT DECISIONS

Timeous, reliable information



IMPROVE SAFETY

Protect people and improve performance

STRATAFY SEEKER



MANDELA MINING PRECINCT
MINDS FOR MINES



PURPOSE

Create high-resolution 3D models of the excavation immediately after blasting



WHAT IT SEES

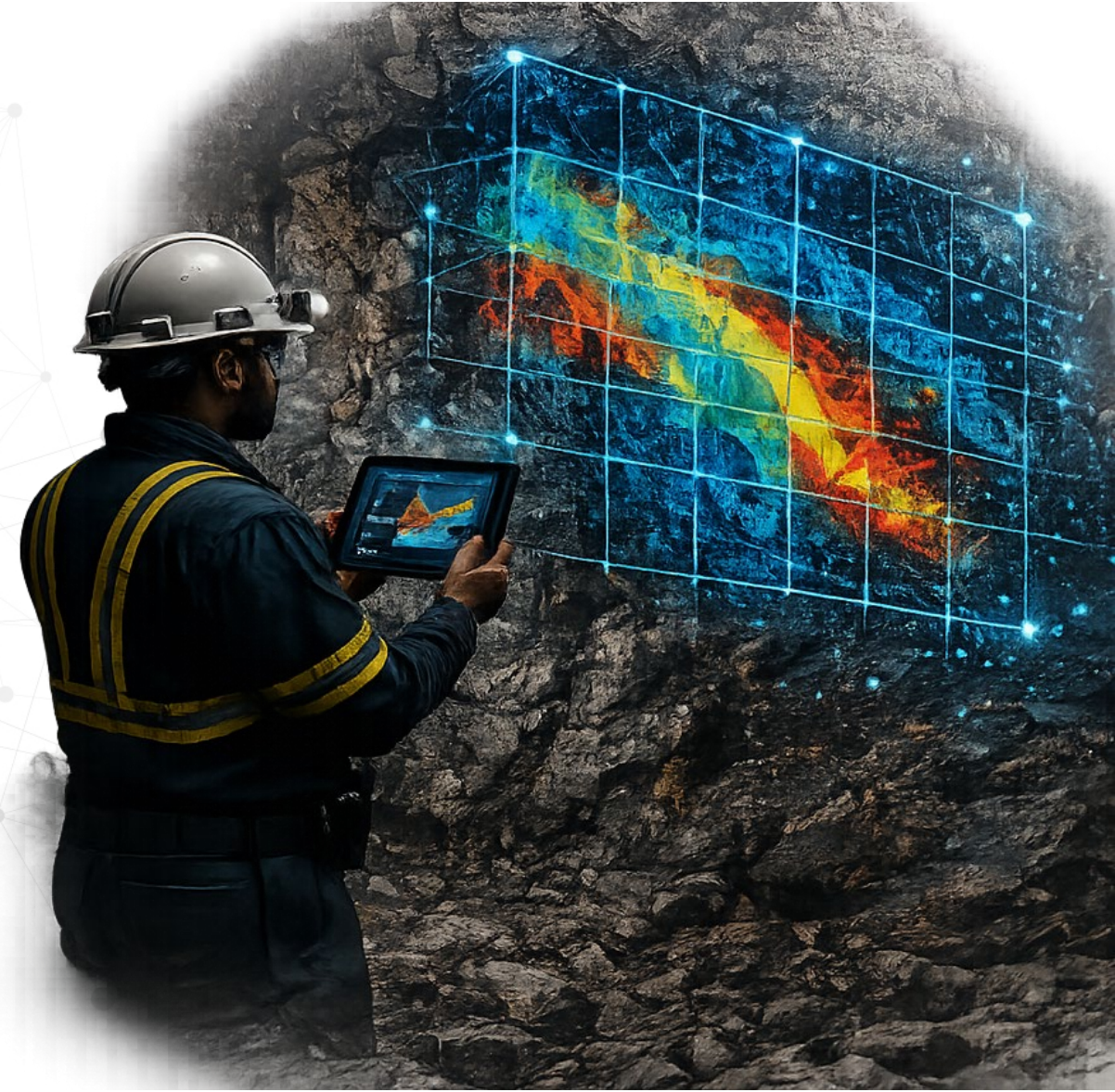
- Geological structures
- Joint sets
- Support
- Excavation geometry



BEMEFOTS

- Digital record of every workplace
- Faster mapping
- Better geological interpretation
- Support making-safe decision

Transforms every workplace into a measurable digital twin



SMART DRILL



PURPOSE

Monitor and optimise drilling operations for safety, efficiency and predictive maintenance



MONITORS

- Torque
- Weight on Bit (WOB)
- RPM
- Penetration Rate
- Vibration
- Equipment Health



BENEFITS

- Real-time drilling feedback
- Predict equipment issues early
- Improve drilling efficiency
- Reduce unplanned downtime
- Enhance safety and productivity

Smarter drilling today for a safe and more productive operations

DIGITAL TOOL FOR ROCK TYPE ASSESMENT



MANDELA MINING PRECINCT
MINDS FOR MINES



PURPOSE

Automatically identify rock types directly at the rock face



WHAT IT PROVIDES

- Lithology identification
- Geological contacts
- Rock-types percentages
- Digital geological records



BENEFITS

- Consistent geological logging
- Immediate geological intelligence
- Reduced subjectivity

Helping miners understand what they are mining



ROCK TYPES (EXAMPLE)

Yellow	Quartzite	45%
Green	Shale	25%
Blue	Carbonate	15%
Purple	Mafic	10%
Grey	Other	5%

CONFIDENCE: 92%

ACOUSTIC ROCK HAZARD DETECTION



PURPOSE

Use sound and artificial intelligence to identify unstable ground



MEASURES

- Rock response to striking
- Sound characteristics
- Hazard signatures
- Stability changes



BENEFITS

- Objective making-safe support
- Consistent hazard assessment
- Early warning of loose rock
- Enhances situational awareness

Turning every strike of the pinch bar into digital intelligence

INTEGRATED ROCK MASS IMAGING

**BOREHOLE
RADAR**



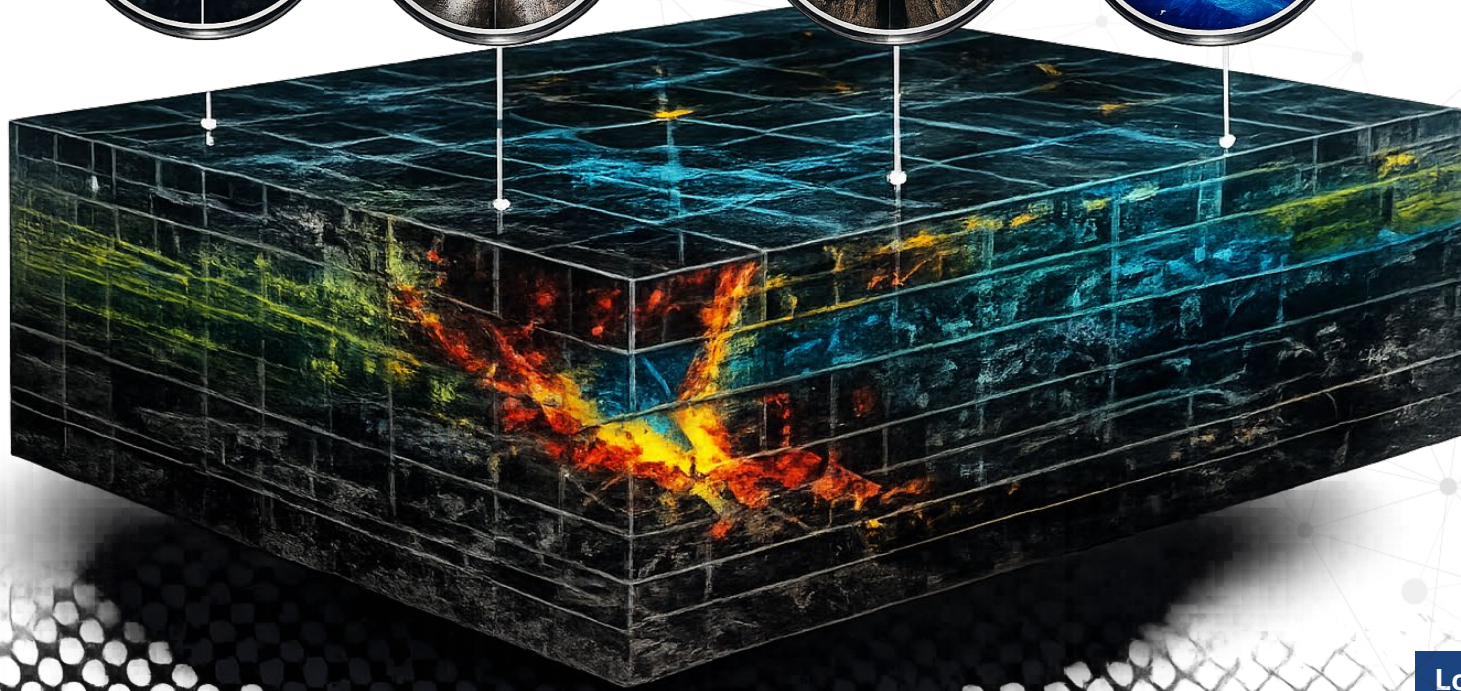
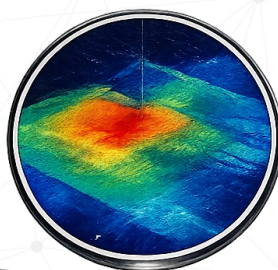
**BOREHOLE
CAMERA**



**OPTICAL
TELEVIEWER**



**SURFACE
SCANNING**



PURPOSE

Combine multiple sensing technologies to understand the rock mass ahead of mining



MEASURES

- Borehole radar
- Borehole cameras
- Optical televiewer
- Surface scanning
- Geological mapping



BENEFITS

- Detect hidden structures
- Validate geological models
- Improve hazard awareness

Looking beyond the rock face before excavation reaches it



PURPOSE

Provide precise underground positioning linked to hazard information



MEASURES

- Accurate workplace locations
- Spatial hazard mapping
- Position linked inspections
- Digital Traceability



BENEFITS

- Know exactly where observations were made
- Integrate information from multiple technologies
- Support risk-based decisions
- Improve accountability and traceability

Every observation has a location. Every location has intelligence

AOK IS **NOT** REPLACING THE MINER

The aim is to give them **DIGITAL INTELLIGENCE** to make better, more informed decisions:

- ✓ Identify hazards earlier
- ✓ Excavation changes
- ✓ Geological features
- ✓ Rockmass changes
- ✓ Ahead-of-face intelligence
- ✓ Digital traceability



TECHNOLOGY DEMONSTRATION

BEFORE (TRADITIONAL)

-  Limited information
-  Manual measurements
-  Paper records
-  Isolated observations
-  Higher uncertainty
-  Reactive actions



AFTER (DIGITALLY ENABLED)



-  Richer Information
-  Automated capture
-  Digital records
-  Integrated insights
-  Lower uncertainty
-  Proactive actions

Technology strengthens judgement. It does not replace it

THE FUTURE OF GROUND RISK



CONTINUOUS MONITORING



CONNECTED WORKPLACE



PREDICTIVE ANALYTICS



REAL-TIME AWARENESS



PROACTIVE ACTIONS



DIGITAL RECORDS



From reactive to proactive. From unknown to understood.

Thank you for attending this presentation



For more information visit our website:
www.mandelaminingprecinct.org.za



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