ENTRY EXAMINATION AND MAKING SAFE

MINERAL COUNCIL SOUTH AFRICA: 14 MAY 2021

AGENDA

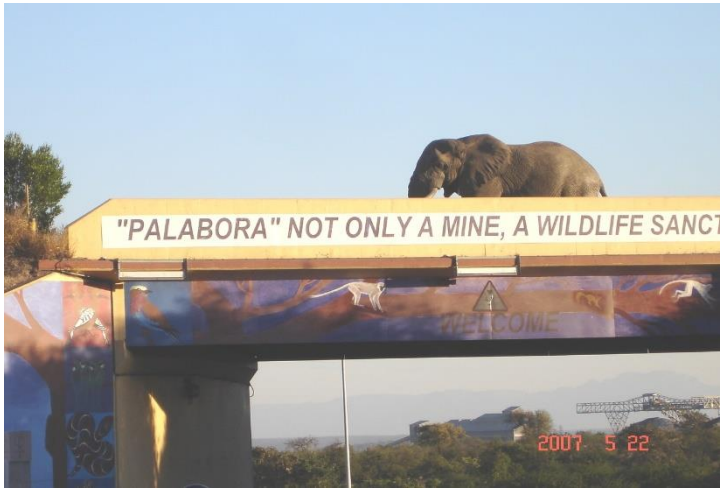
Table of Contents

- Introduction
- PMC Overview
  - ✓ Block Caving Overview
- FOG Stats
- Entry Examination and Making Safe
- Support Methodology
  - ✓ Mark, Drill, & Support
- Sinking Methods
- Seismic System
  - ✓ TARP: Seismic Ratings
- Conclusion: Management Culture

Introduction

Site Location

- Palabora Mining Company is situated in the Ba-Phalaborwa area of Limpopo in South Africa
- The climate is predominantly subtropical, and winters are very mild and frost-free.
- The area is well known for its high summer temperatures experienced from November through to February, which is also the main rain season.
- As Palabora Copper shares common borders with the Kruger National Park as well as private game reserves, the Employer places high value on nature conservation.



Introduction

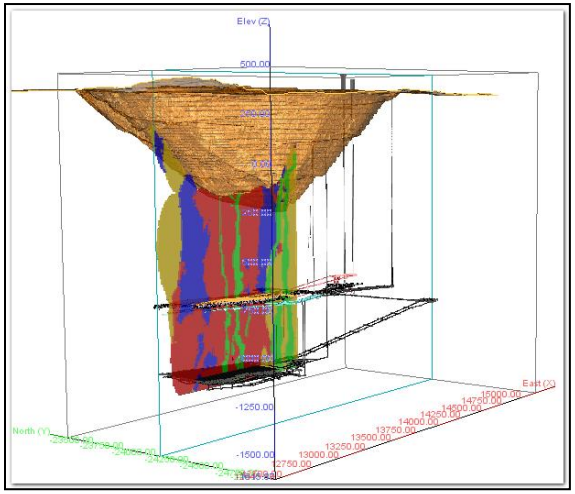
Commodities

- PMC is mining and beneficiation complex
- The mine is a multi commodity complex.
  - Copper
  - Magnetite
  - Vermiculite
  - Gold, Nickel and silver
- Major producer of refined copper in South Africa.
- Produces magnetite of high quality.

PMC Overview

PMC – A Brief History

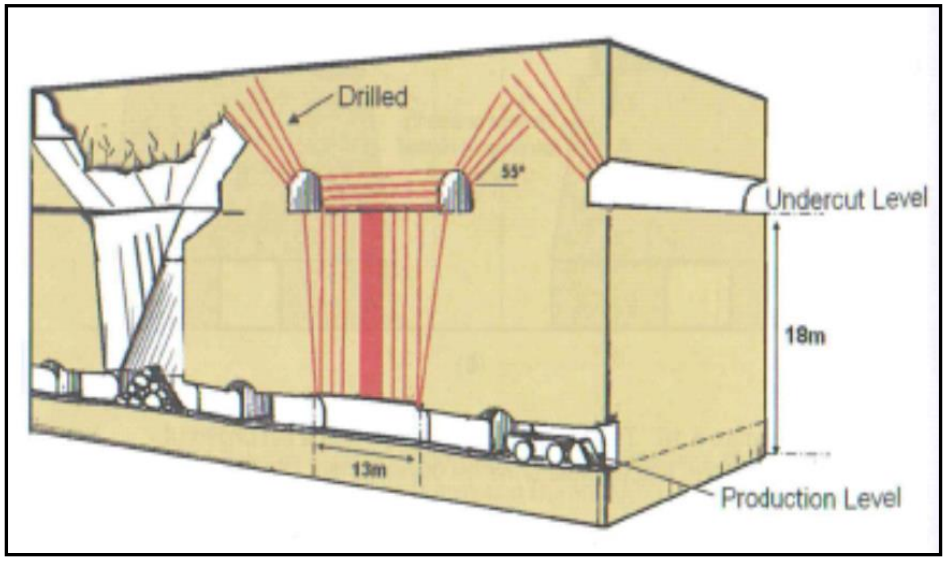
- 1965 - First blast was taken at PMC
- 1996 - Exploration shaft was sunk and resource drilling done from underground exploration drive
- 2002 - April - final blast taken in the pit
- 2004 - Lift I breakthrough and pit wall failure
  - Failure created challenges with resource & nearby Foskor infrastructure
  - Haul road and water pipe line had to be moved – continuous creep
- 2010 - Pre-feasibility study for Lift II
- Dec 2011 – Development commences
- 2014 – Final approval for Lift II Project

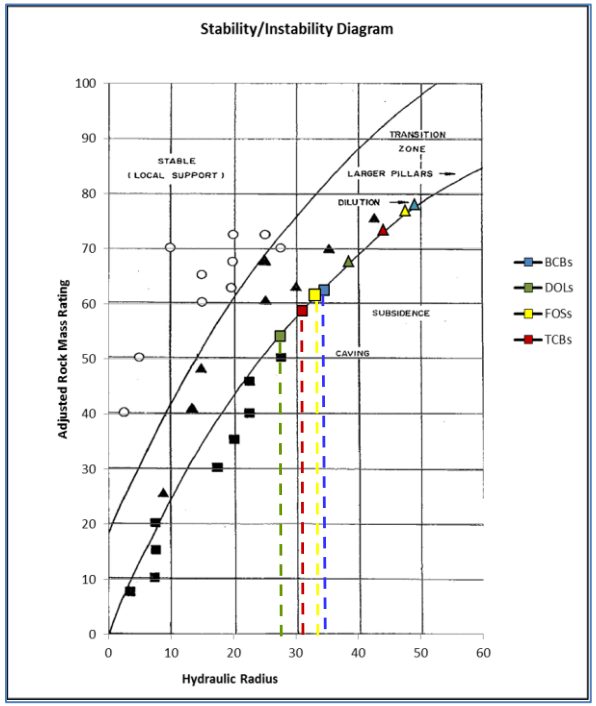


Block Caving Overview

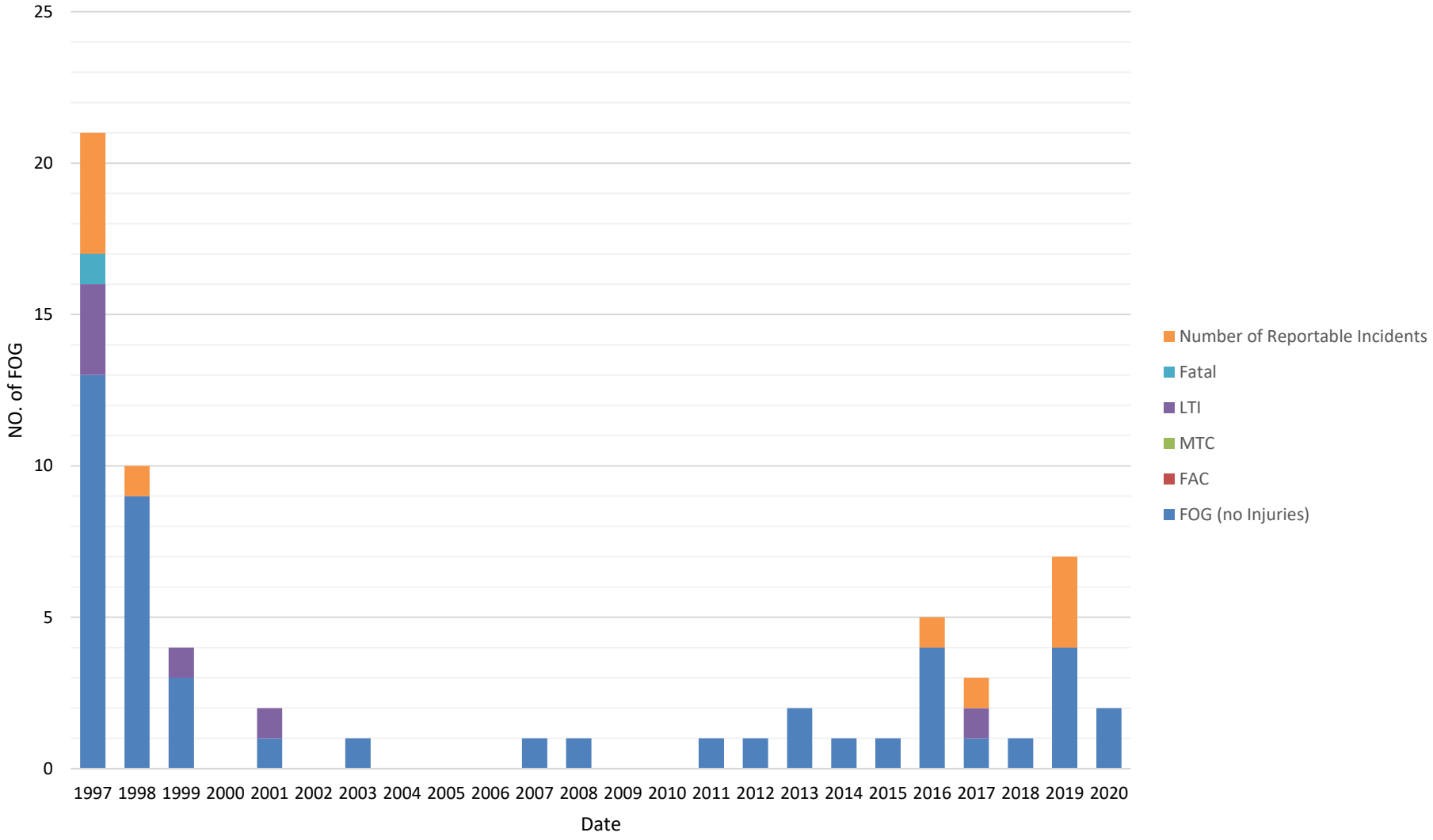
Mining Method - Block Caving

- Block caving is a mass mining method which lends itself to large pipe-like ore bodies which meet the geotechnical criteria for caveability.
- Caveability - Rock mass strength, cave induced stresses and presence of structures
- Void is created in the rock (undercut) which then allows the rock to break under its own weight and stresses.
- At average rock mass conditions, continuous caving predicted at around ~35m – Laubscher's stability chart





FOG Stats


25
20
15
10
5
0
NO. of FOG
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
Date
Number of Reportable Incidents
Fatal
LTI
MTC
FAC
FOG (no Injuries)

Entry Examination and Making Safe

Miner / Geologist / SCO Responsibilities

- Rockfalls are responsible for more than 30% of the fatalities on South African gold and platinum mines, with associated costs and lost productivity.
- One of the most important activities in the mitigation of rockfalls is the entry Examination that occurs before entry to a newly blasted workplace. It is also one of the more dangerous activities that takes place in a workplace.
- The Miner is responsible for all Entry Examinations and making safe on shift.
- The Miner must ensure that all the correct tools are available which are required to safely and effectively examine a development heading as well as making it safe.
- It is the responsibility of the Miner to ensure that no person enters into a workplace, apart from himself and his entry examination team, until such time as the entry examination has been completed and the development heading has been declared safe.
- The working areas not planned or not declared safe shall be barricaded off.
- All roadways used by personnel and vehicles must be inspected that they are supported to the required standard as per Ground Control Management Plan and support quality has not deteriorated.
- A ***geologist maps*** every working that was blasted to provide information on the rock type and current/anticipated geology.
- A ***strata control officer*** assess every workplace after every blast to check the support quality and recommend additional support where necessary

Support Methodology

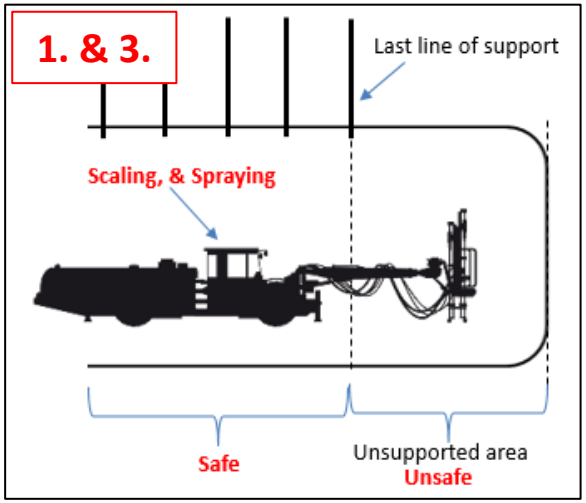
1. **Scaling** – Scaling of rock occurs from a safe side (Supported area), using a drill-rig.

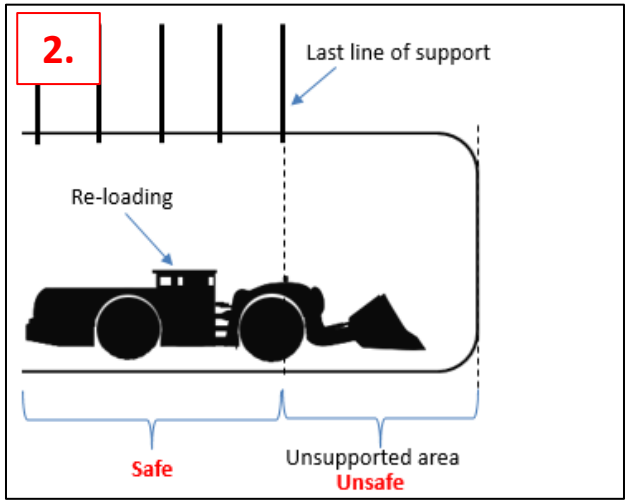
2. **Re-loading** – the scaled material is reloaded using an LHD, whereby the LHD operator remains on the safe side.

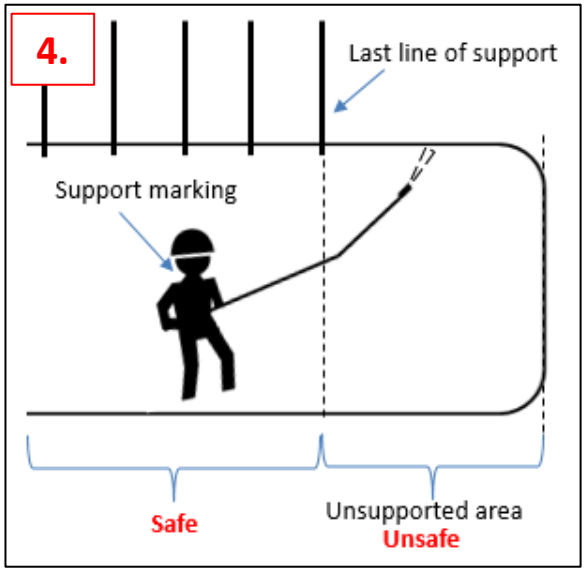
3. **Shotcrete Spraying** – Remote spraying with a spraymec occurs, with the operator remoting from a safe side. Then let it set.

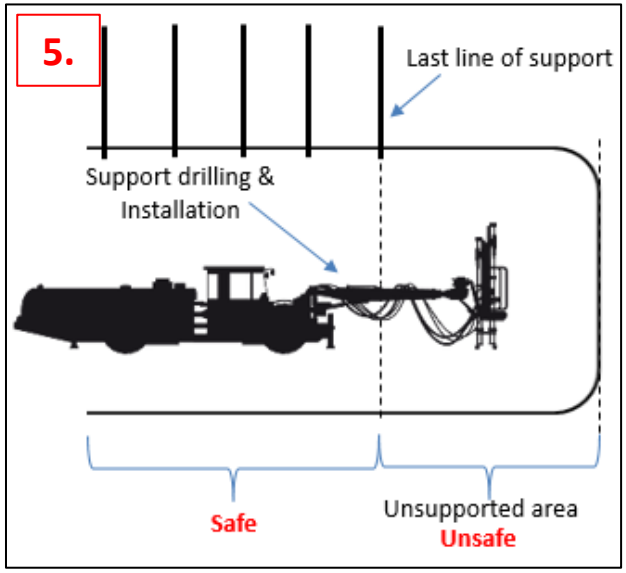
4. **Marking** – Miner marks with a telescopic marking stick from a safe side.

5. **Support Drilling & Installation** – A bolter is then used to drill and support, with the operator remaining on the safe side.









Mark, Drill, & Support

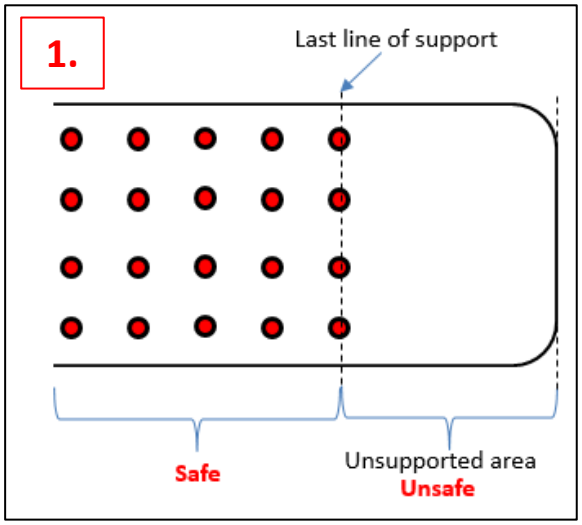
1. **Marking** – 1st row is marked from a safe side by a miner.

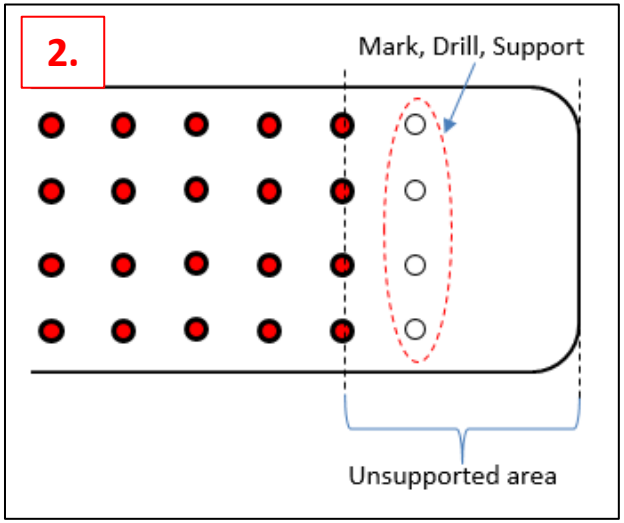
2. **Drilling** – Drilling of the marked row takes place, with the operator remaining on the safe side.

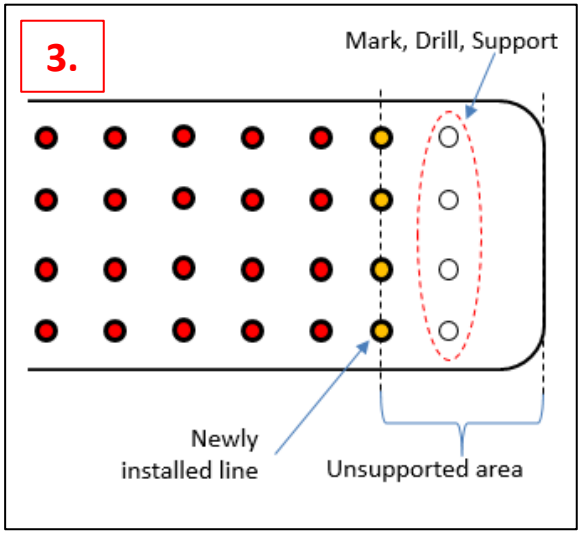
3. **Supporting** – Installation of bolts in the drilled row takes place, again with the operator remaining on the safe side.

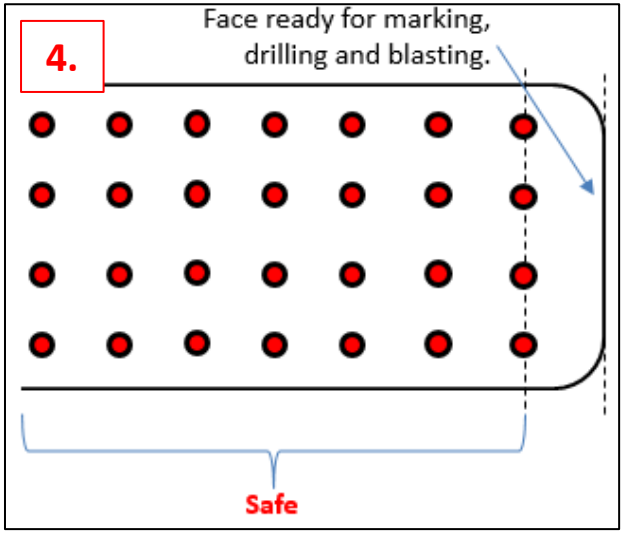
4. **Second Row** – 2nd row is marked, drilled and installed. All from a safe side.

5. **Face** – After support has advanced closer to the face (1.4m from face), then marking and drilling of the face can take place.









Sinking Methods

Comparison

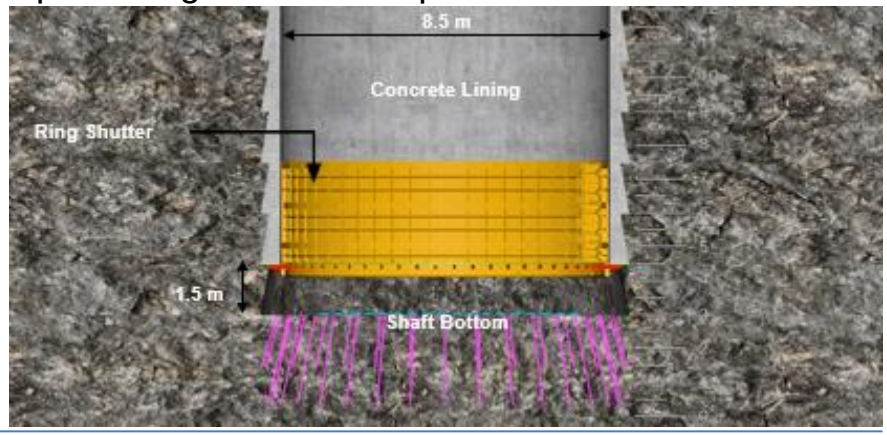
Conventional Method of Sinking

- Traditional Sinking Method requiring numerous support methods and lining to be carried out 12m to 18m from the shaft bottom.
- The blasted rock is mucked out by the cactus grab, people continue to work on the bottom and be exposed to risk. Effective temporary ground support of the newly exposed shaft barrel before the permanent concrete lining has been cast becomes the most important task for the team.

Figure 4—Cactus grab (Douglas and Pfutzenreuter, 1989)

Canadian Method of Sinking

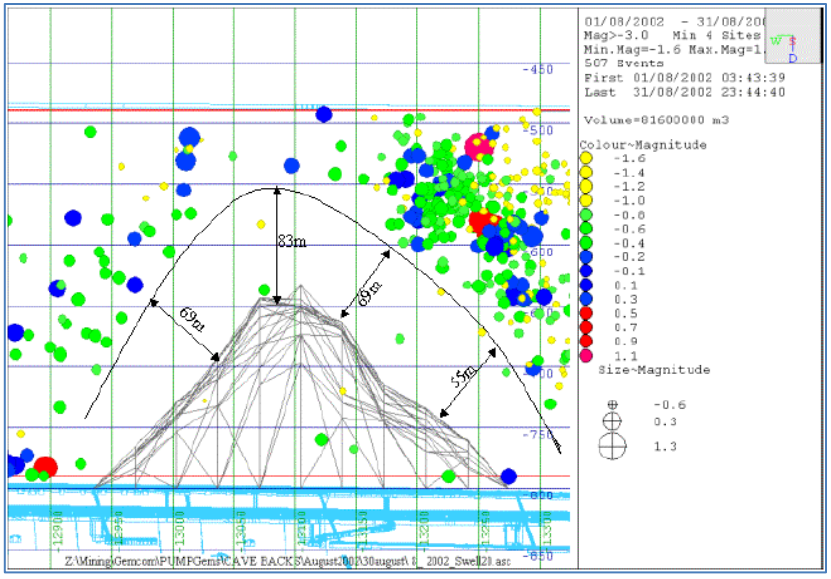
- Shaft Lining Method carried in the shaft bottom with no Temporary Support. Workers are not exposed
- The blasted rock is mucked out by the excavator, this method reduces the number of people on the face, eliminates potentially dangerous equipment such as the Cactus Grab, and places the pouring of concrete in the shaft lining as an in-line activity, not concurrent, greatly reducing risk to personnel working under suspended loads, specifically pertaining to vertical exposure.

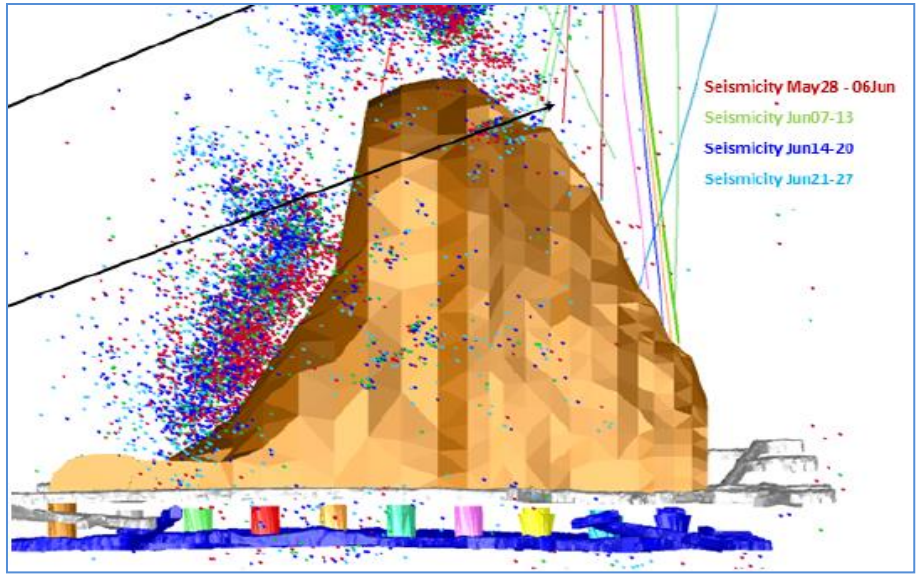


Seismic System

Why the need for a seismic system?

- Tracking of the cave back
  - Cave has actually initiated
  - Minimize risk of personnel exposure to rock bursts
  - Inform on evacuation for breakthrough on Lift I
- Monitor all excavations for potentially hazardous seismic activity, especially larger excavations.





TARP: Seismic Ratings

Short Term Seismic Hazard Ratings

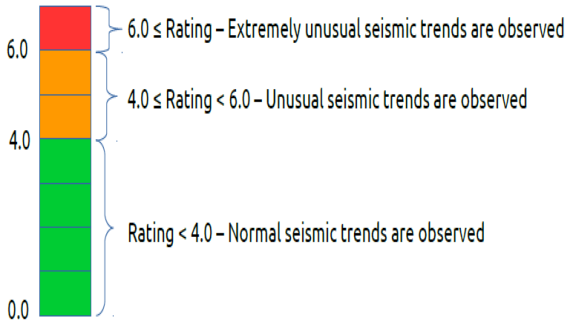
institute of mine seismolo

Example of Ratings Table Entry:

Poly	Event Listing	Last Event Time	New events	Va	Log10 El	Schmidt	Act	Spatial	Rating	Comments
Lift_I		12 Feb 17:27:43	1	0	-	-	0	0	0	
Lift_II		13 Feb 08:12:40	3	0	-	-	1	0	1.5	A few small events located at the so eastern end of Lift II.

Lift_II:
Cumulative Seismic Displacement (Va) = 0
Activity (Act) = 1
Spatial = 0
Total Rating = (0 + 1 + 0) x 1.5 = 1.5

Ratings Colour:



Seismic hazard rating	Miner	Shift Supervisor(2.15.1)	Mine Overseer(2.14.1)	Mine Manager(2.5.2.1)	Rock engineer(14.1(8))/ SCO
0.0 <= r < 4.0	safety declaration must be signed off.	No action.	No action.	No action.	No action.
4.0 <= r < 6.0	safety declaration must be signed off.	Shift Supervisor to accompany the miner.	Should the rating remain at 4.0 <= r < 6.0 for the next 24 hours, The Mine Overseer to overinspect the area.	No action	SCO to accompany the miner. Should the rating remain at 4.0 <= r < 6.0 for the next 24 hours, The Rock Engineer to overinspect the area.
6.0 <= r	Ensure no persons enters the area. This remains in place until the rating drops to 4.0 <= r < 6.0and form part of the response Team for start-up	Attend a Seismic assessment meeting Form part of the response Team for start-up	Attend a Seismic assessment meeting Form part of the response Team for start-up	Hold a Seismic assessment meeting	Verify the rating with a seismologist (IMS). Attend the seismic assessment meeting. Form part of the response team for start up

Conclusion: Management Culture

Systems (Safety, Geology, Rock Engineering, Planning, Survey)

- Monthly risk assessment is carried out on Workings planned for the month.
- The risk assessment is conducted by safety, geology, rock engineering, planning, survey and production departments based on information at hand.
- Where a workplace has been standing, the superintendents/Mine Overseer of the above mentioned departments goes underground and do visual inspections and risk assessment.
- Risk assessment is distributed to everyone involved especially shift bosses and miners.
- **A geologist maps every workplace that was blasted to provide information on the rock type and current/anticipated geological features.**
- **A strata control officer asses every workplace after every cut to check support quality and to recommend additional support where necessary.**