

Drilling Workshop

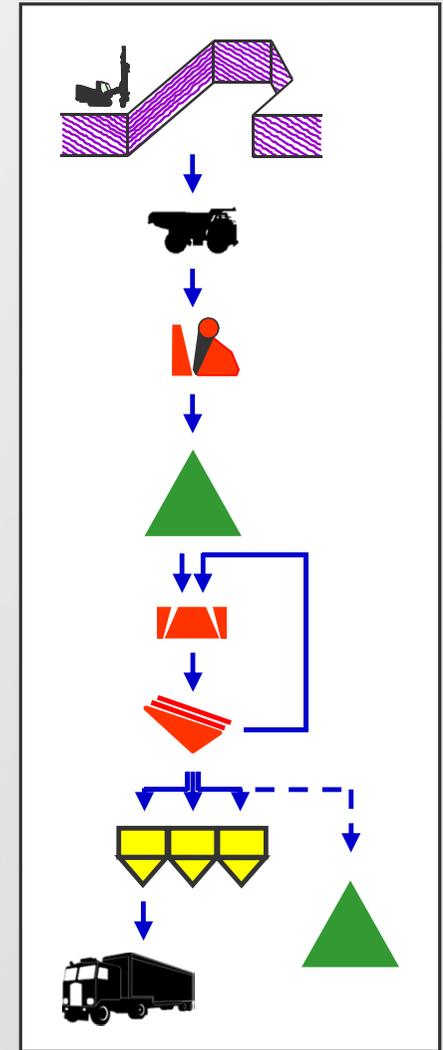
Roy Rathner and Arne Lislrud



Optimisation of quarrying

- Pit-to-Product
- Mine-to-Mill
- Mine-to-Metal

=> requires a overview of operations, technology and markets

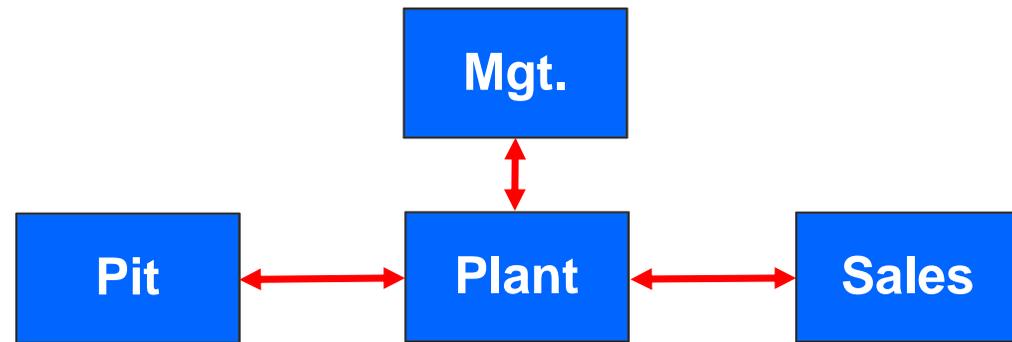


Overview of basic topics

Organisation

Technology

Market
analysis



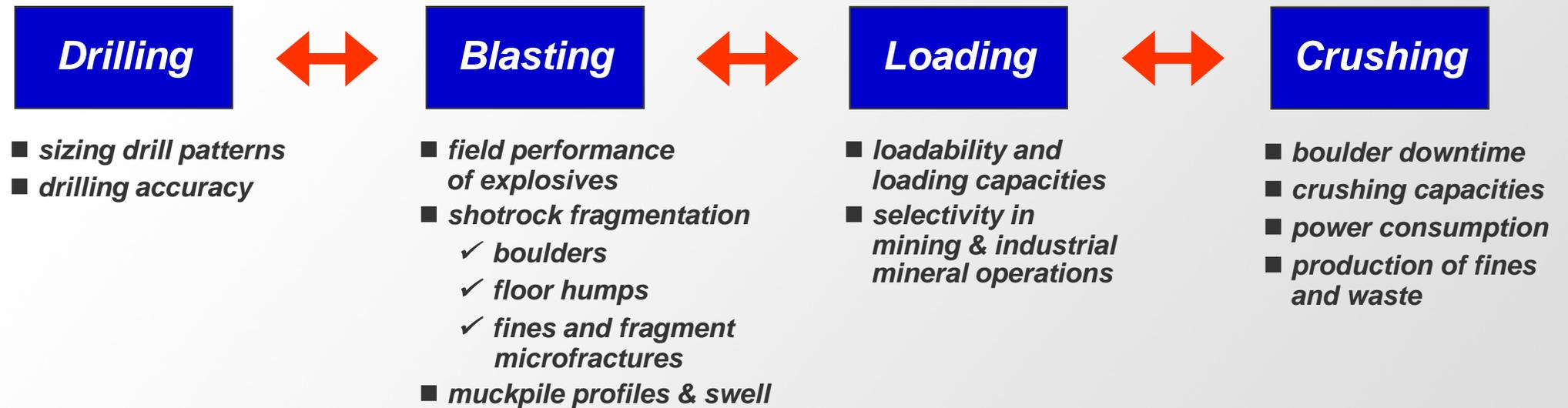
- *end-product volumes*
 - *costs*
 - *pricing*
 - *stockpiling*
- => *right mix of all issues?*

Key quarry performance indicators, KPI's

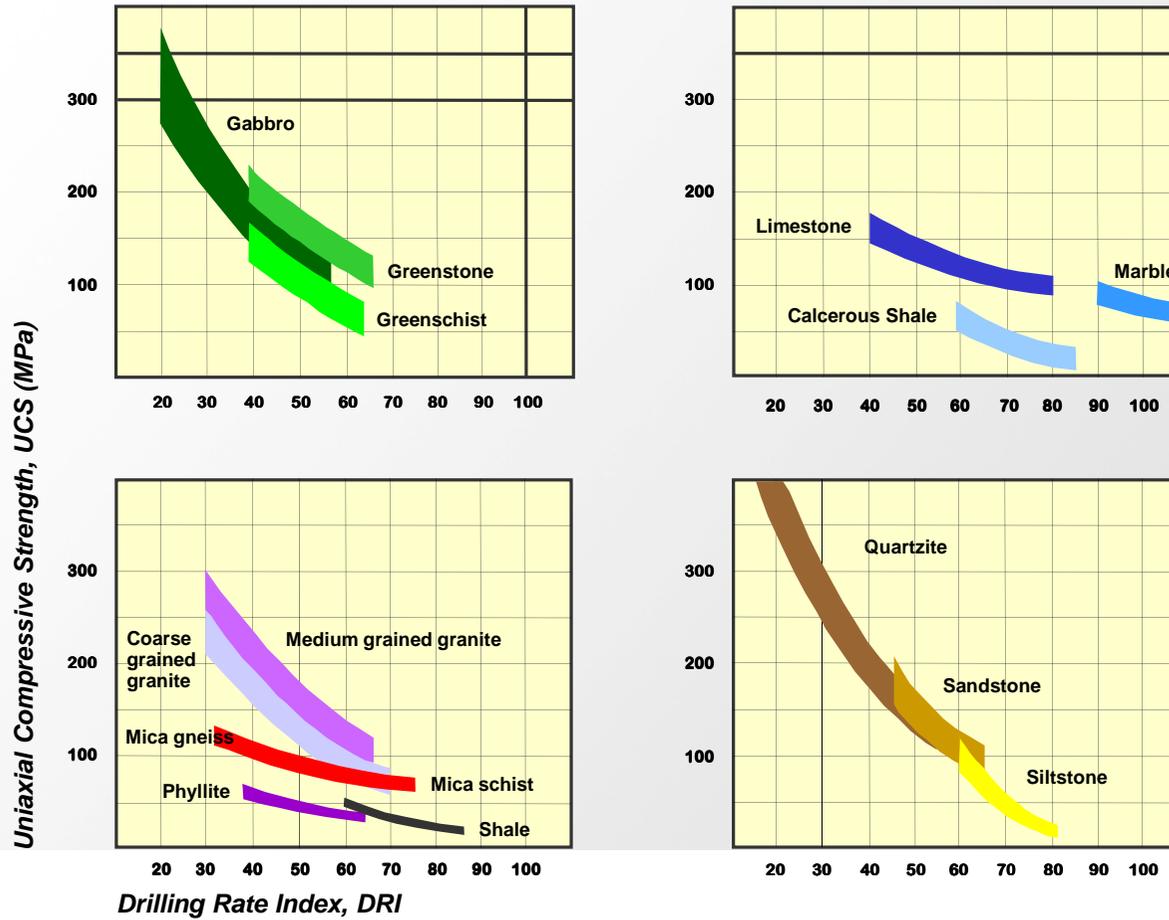
- *key financial performance in a period*
 - ✓ *overall quarry profitability*
 - ✓ *capital employed*
(especially unscheduled stockpiling)
- *key production performance in a period*
 - ✓ *end-product tonnages, costs and margins*
 - ✓ *productivity and cost per machine*
 - ✓ *safety in operations*
 - ✓ *public relations*



How drilling and blasting affect downstream operations



Rock drillability versus strength



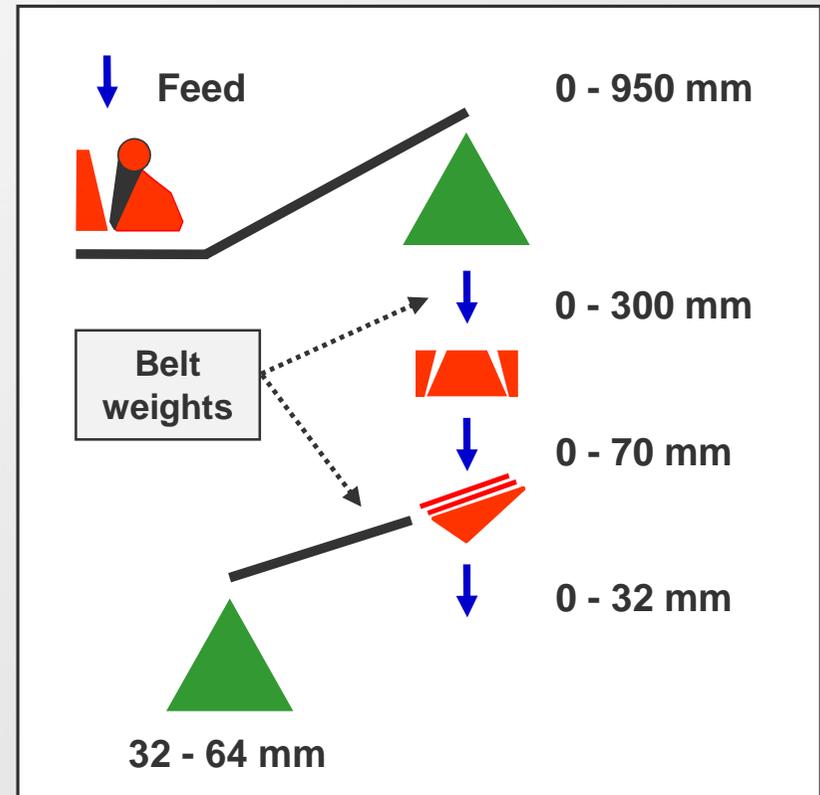
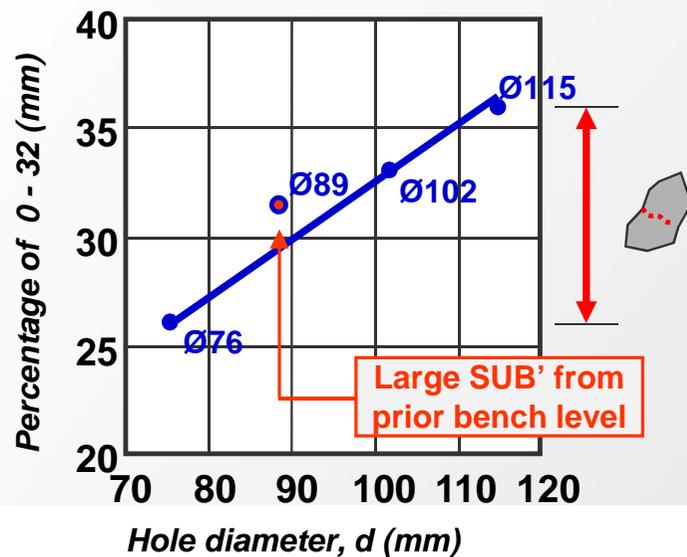
Quality feed – handling boulders

- boulder count dependent on primary crusher opening (and to a lesser extent primary crusher capacity)
- sort boulders from muck pile
- downsize boulders before entering primary crusher
- minimise boulder count using reduced uncharged height and/or tighter drill patterns



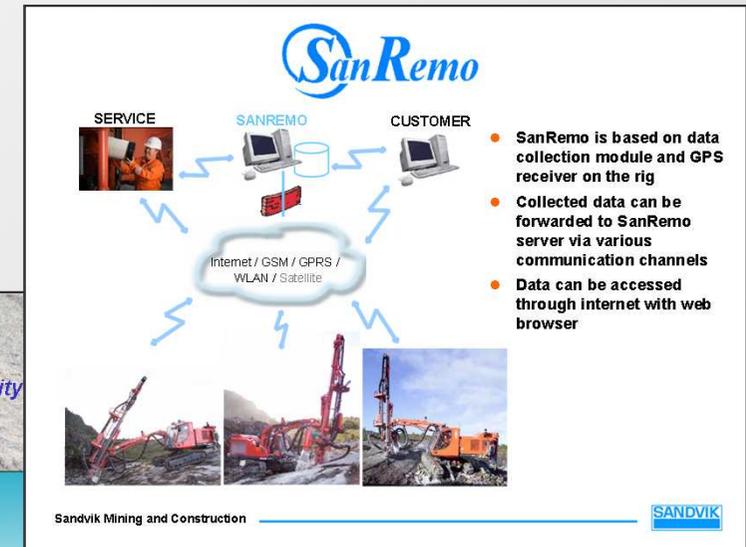
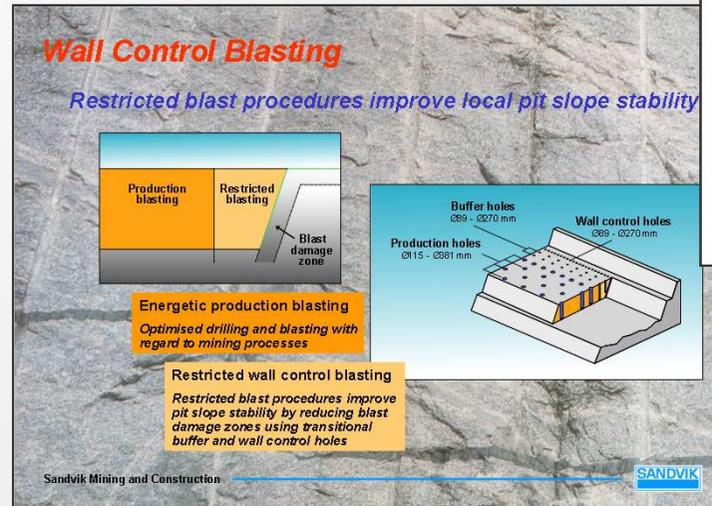
Quality feed – effect of micro-fracturing

Rock type Anorthosite
Explosive Slurrit 50-10
Test blasts 4 x 50 000 tonnes
Bench height 11 m



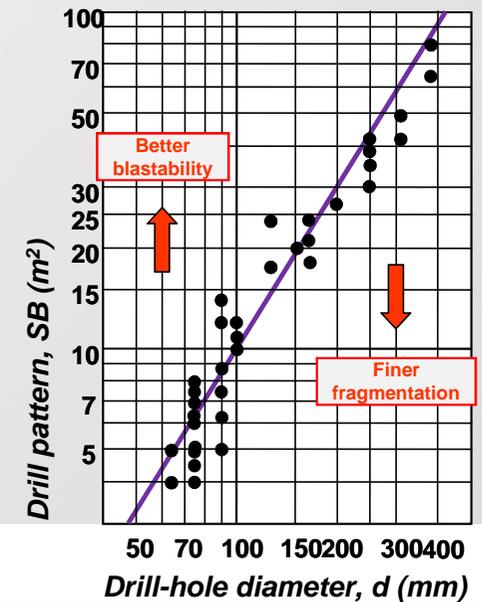
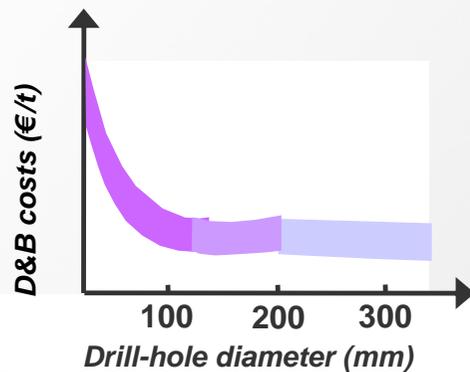
Quarries and D&B contractors

- equipment flexibility and reliability
- D&B as to aggregate production requirements
- ability to handle difficult ground conditions
- availability of local / on-call field service



Criteria for selecting drills

- annual production requirements in bm^3 or t => number of drills
- critical diameter of explosives => hole size big enough?
- flexibility in usage => different types of work
- application costing => D&B costs per t
- operator training and support
- operator comfort and safety
- ease of transport between pits

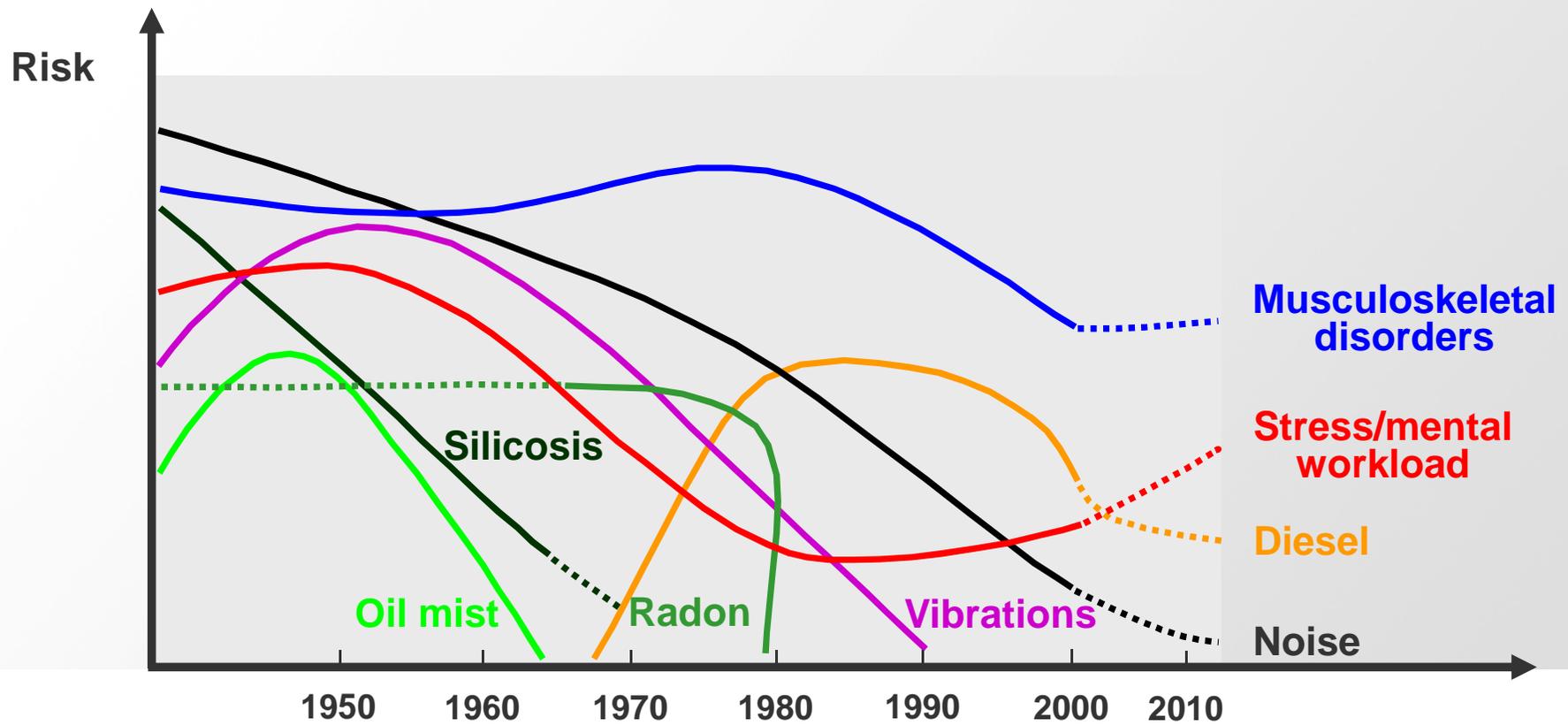


Occupational health and safety

- work related accidents for:
 - ✓ mobile equipment
 - ✓ hazardous work areas
- emissions control
- noise control
- dust control
- flyrock / charging / straight-hole drilling
- falling rocks / wall control
 - => safety is linked as much to equipment as it is to attitudes
 - => health, safety and environmental issues are everyone's concern
 - => the ultimate safety target is zero harm – not just a minimum occurrence of accidents



Assessment of some work related health risks



Safety of inpit operations

- unwanted incidences do not just happen – they have root causes
- actions can be taken so as to reduce frequency and consequences of unwanted occurrences
- the relationship between complexity and knowledge in the workforce is often unbalanced – e.g. operator hazard training is a must!



Premature ignition of electric detonators and blast due to lightning



Pit wall failure burying 3 drill rigs in rubble



Safety of inpit operations

- new equipment requirements for the future?

Rock fall source area

**Mandatory 20m
personnel
exclusion zone
from highwall ?**



**Rollover from terrain
bench - 35m drop**

Mina Alumbraera

Double bench presplitting

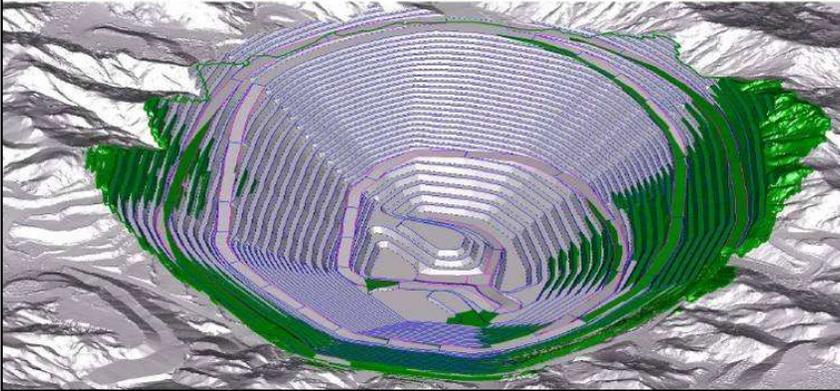


Mina Alumbarrera Pitwall scanlines

Key NPV improvements

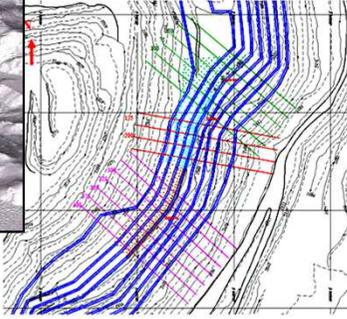
MAA Double Bench and Wall Control program resulting in capital and operational savings over life of mine (>US\$70m NPV benefit)

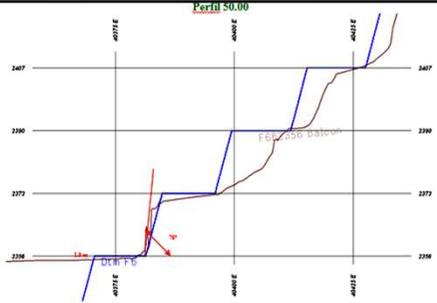


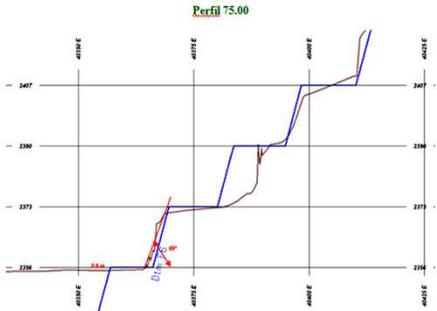


Zona de Estudio		
Fase 6 Banco 2356		
Antena Verde Az 130 Roja Az 100 Magenta Az 132 Norte a Sur - Trazados cada 25 metros		
G130 P 50.0	G100 P 175.00	G132 P 300.00
G130 P 75.0	G100 P 200.00	G132 P 325.00
G130 P 100.00		G132 P 350.00
		G132 P 375.00
		G132 P 400.00

o de Fase final para Fase 6, con ángulos de banqueo de 75° de inclinación.
 dura involucradas 29612, 29614 y 29616.









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