ISM Commission II meeting
29th May 2025

Matching mining sequence and process design to both deposit and market environment – case study from a rock salt mine

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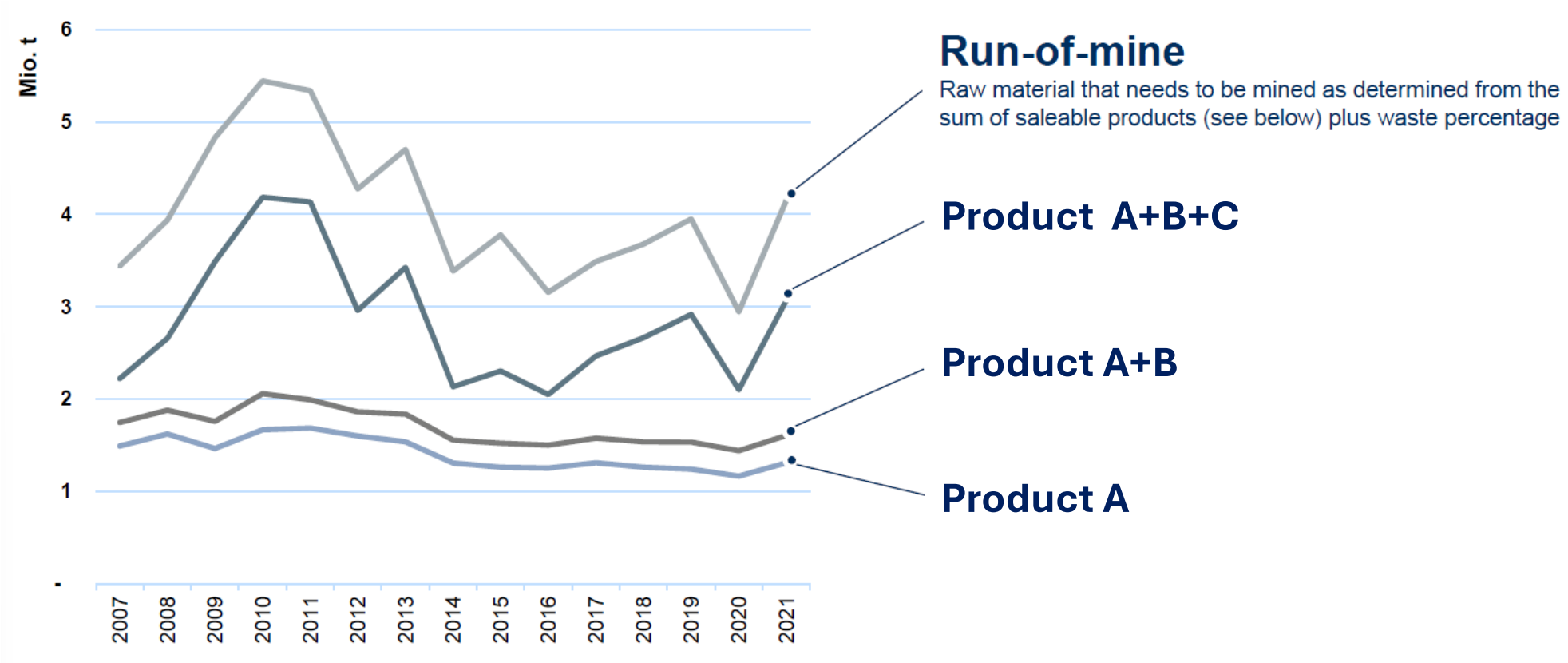
Production requirements (market volatility)



Deposit and geotechnical boundary conditions

Sedimentary strata

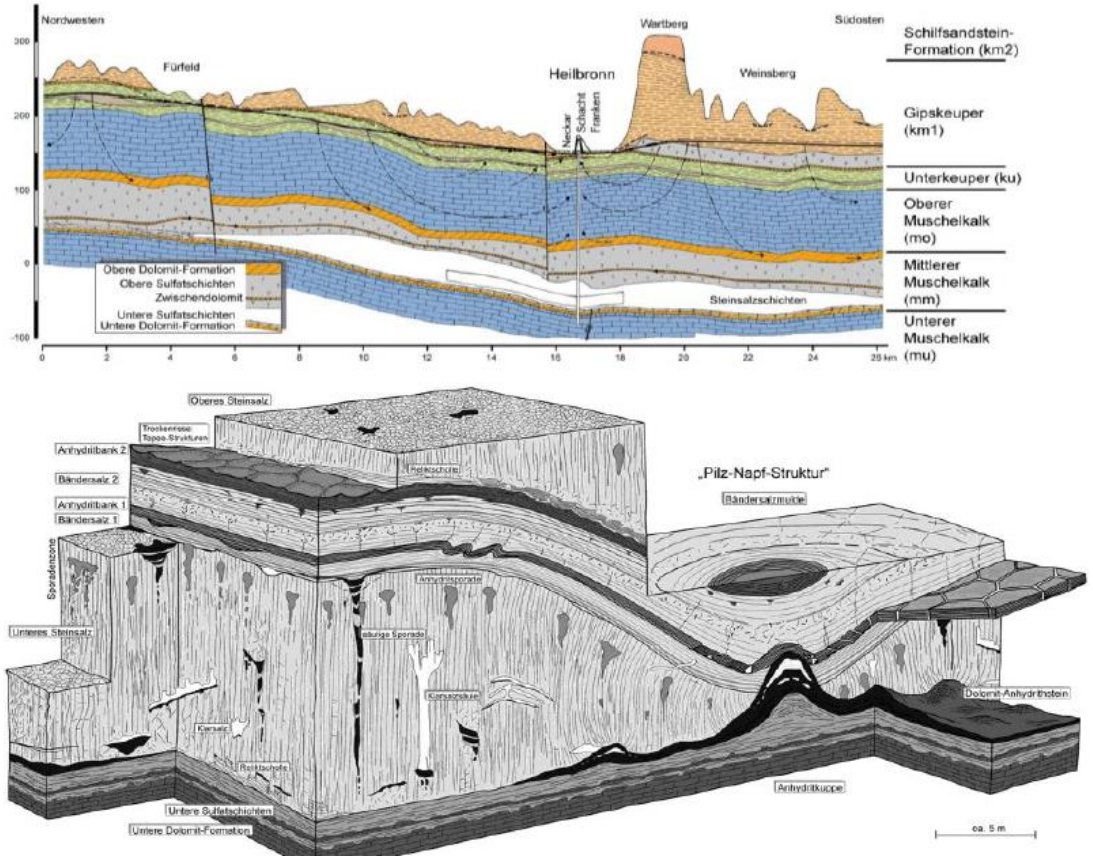
Flat lying deposit in 200 m depth, surrounded by competent strata with minimum roof support requirements, sheltered from any water ingress through geological barriers, with 95% salt purity, no explosible gases.

Massive mining

Target zone allows for excavation of rooms at least 10 m high and 15 m wide (room-and-pillar method). Comfortable for infrastructure development, material storage and fast workforce transport u/g.

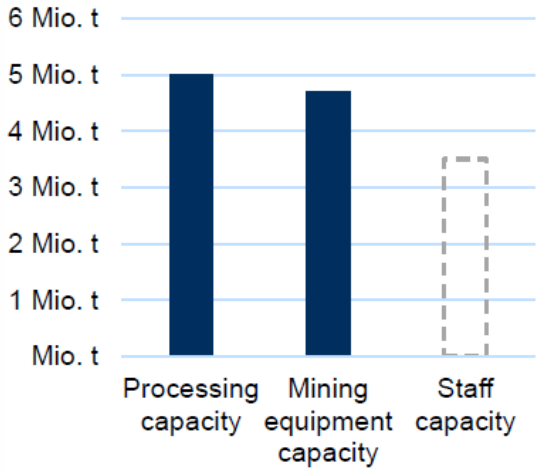
Technology friendly

Soft rock environment (< 25 MPa) that can be cutted or blasted. However, closure of the deposit or intrusions of massive anhydrite cones (> 80 MPa) may occur at random.

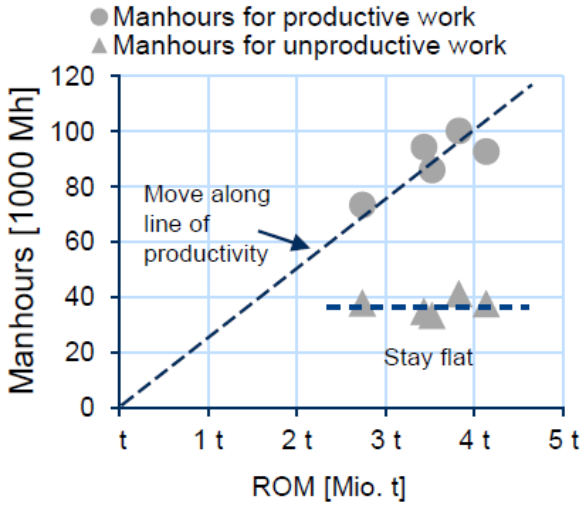


Mining strategy

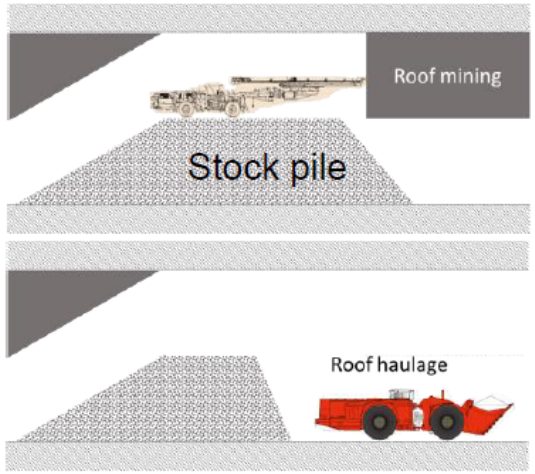
1. Install an equipment capacity which can just service the maximum ROM you want to deliver at maximum utilization.



2. Employ a workforce capacity for lower than average expected ROM to stay financially „lean“ in times of little demand and add temporary workers and/or overtime to realise full potential when opportunity arises. Also, make maximum use of workforce time balance.



3. Implement a process of mining that allows for stockpiling of semi-finished products (at no additional cost) to react quickly on market opportunities

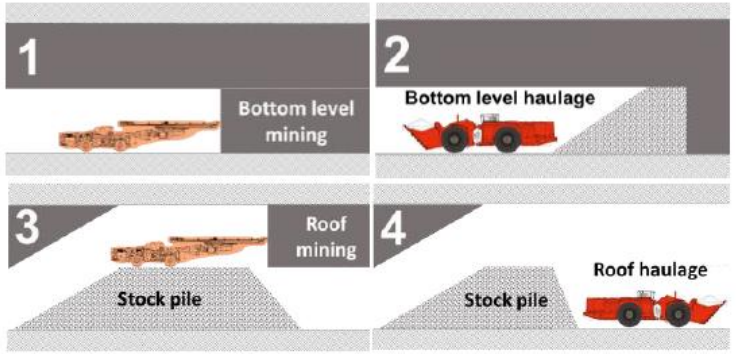


Conventional and mechanized mining

Drill & Blast

Drilling: 7 m blast holes
Explosive: ANFO
Approx. 1,000 t salt per blast
Mechanized scaling
Loading: 21t- LHD

Directly accessible salt (step 1+2) and
option for stock-piling (step 3+4)

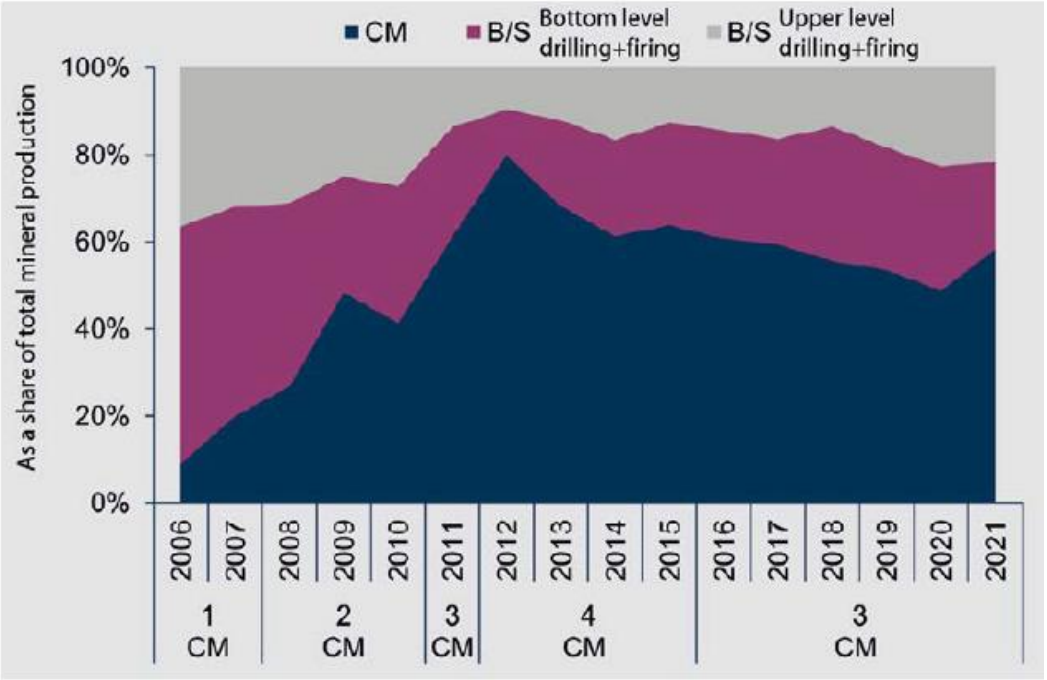


Mechanical cutting

CM: Sandvik MB770
7 m cutting boom width, 5 m height
Rooms 10 m high and 14 m wide in 4 cuts
Truck transport to section conveyor

Directly accessible salt (no significant
option for stock-piling)

CM vs D&B – history on site



Process evaluation

Criteria	Assessment*				
	Continuous miner	Drilling and firing			
	winning haulage	bottom level winning	upper level winning	bottom level haulage	top level haulage
Cost Specific outlay expenditure on volume production and work safety	/	–	+	/	/
Quality Saleability of the raw material in end product	–	/	+	/	/
Flexibility Adaptation to fluctuating volume requirements	/	/	+	/	+
Integration Information flow, communication and coordination expenditure	+	–	/	/	+
Complexity Potential for standardisation and automation	+	–	/	/	+
Emissions Ground surface perceptible noise and vibration	+	–	–	/	/
Balance sheet	++	––––	++	/	+++

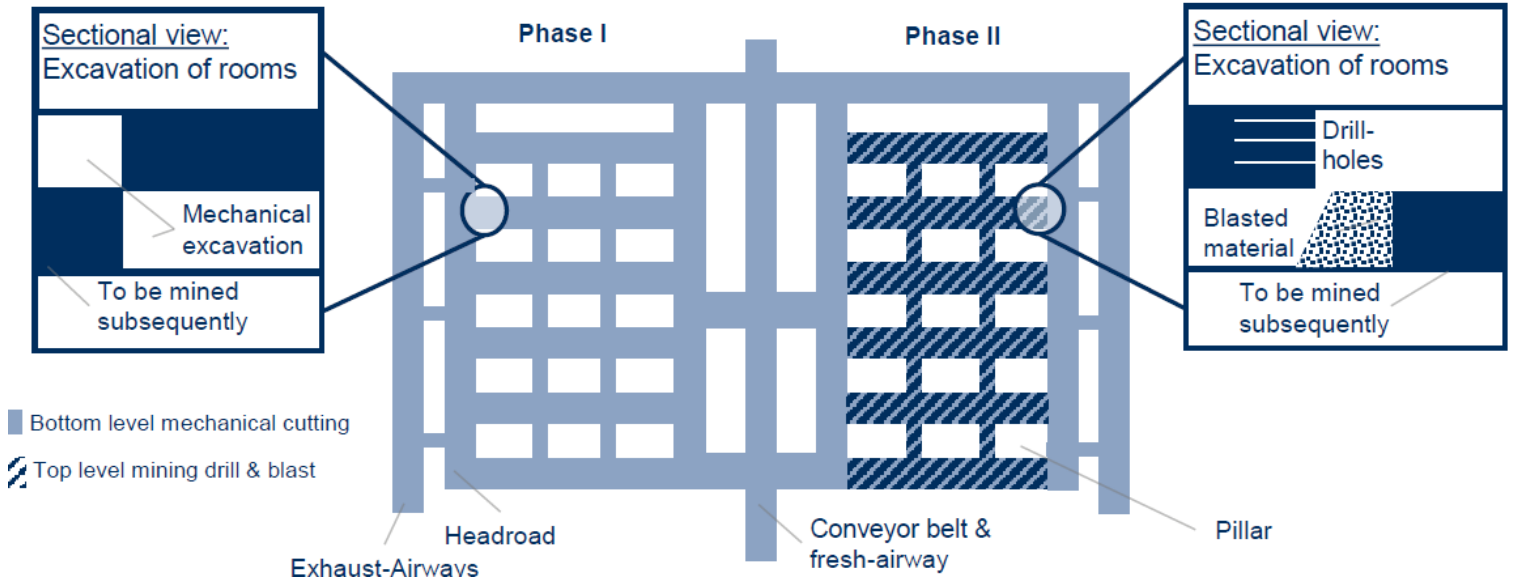
* + beneficial / neutral – adverse

Optimization: combination of CM with D&B

„Best of two worlds“: Lower overall cost of production and increase optional stock-piling capacity, through…

- Exchanging the most expensive process „bottom level drill & blast“ with cheaper „bottom level cutting“
- Exchanging „top level cutting“ with cheapest process „top level drill&blast“

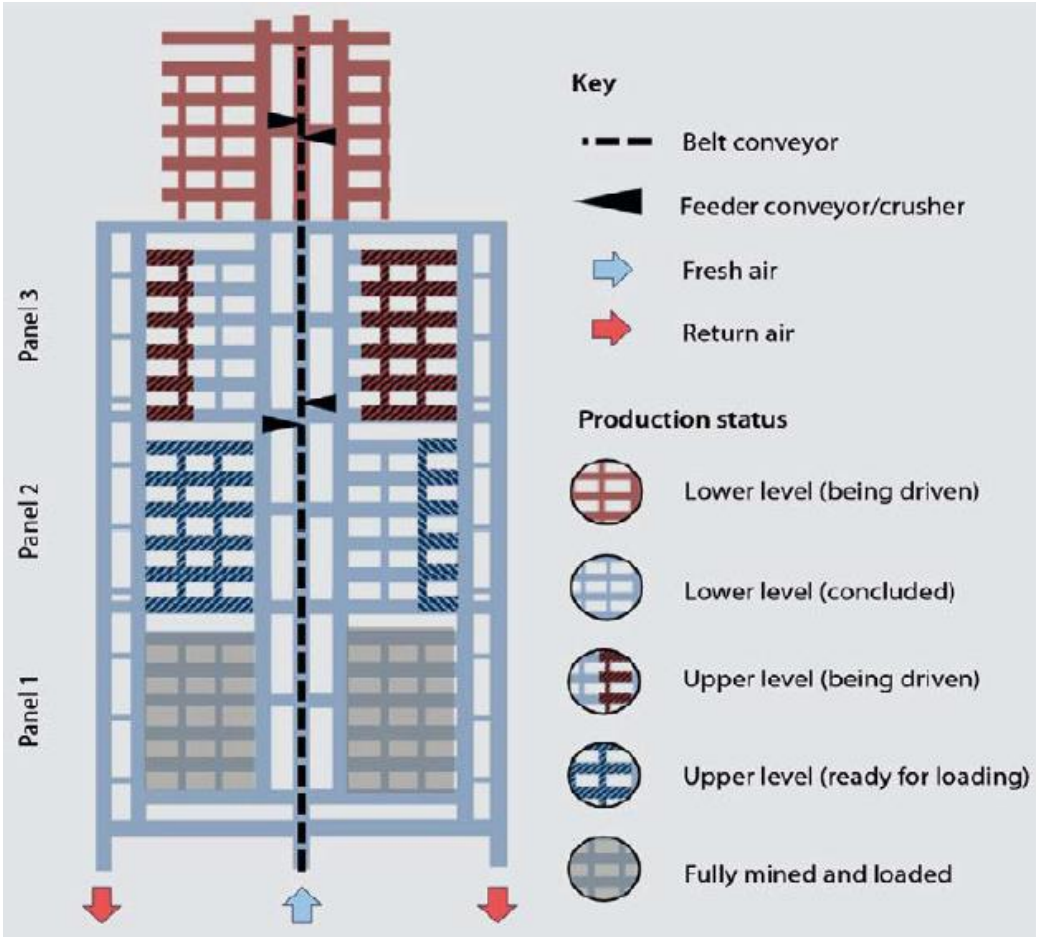
Schematic section layout and mining method



Explanation

- Tonnage ratio 60 % CM 40 % top level D&B
- 20 % of top level blasting requires immediate haulage, rest may be stockpiled

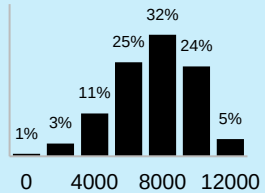
Development and operating status



Process simulation (example)

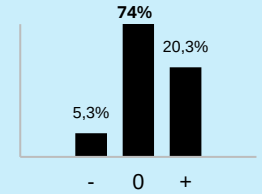
Approach:

- Simulation based on number of workforce, equipments, availabilties, productivities und individual process logic (Monte-Carlo-Method)
- Boundary conditions: no restricition from side of processing unit; no restrictions between lower bench cutting and upper bench blasting (simplified!)



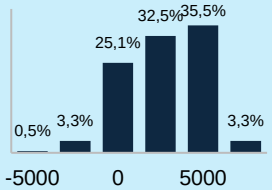
Mining capacity per shift

- 71% of shifts with high capacity >6.000 t
- Only 1 % of shifts without any mining capacity



Haulage and processing per shift
-: shortfall 0: coverage +: excess capacity

- Example: Utilization processing unit at 80 % (of capacity)
- Needs-based haulage on 74 % of shifts
- Excess haulage on 20 % of shifts (up to + 1.500 t)
- Haulage falls short on 5 % of shifts (up to -5.000 t)
- Requirement of intermediate storage (process buffer)



Stockpile development (upper bench) per shift (potential)

- On 71 % of shifts, upper bench stock can develop positively (avg. 1650 t/shift)
- Attention: possibly throttled by continuous miner capacity upper bench blastring > CM lower bench cutting

Ongoing improvement (in test stage)