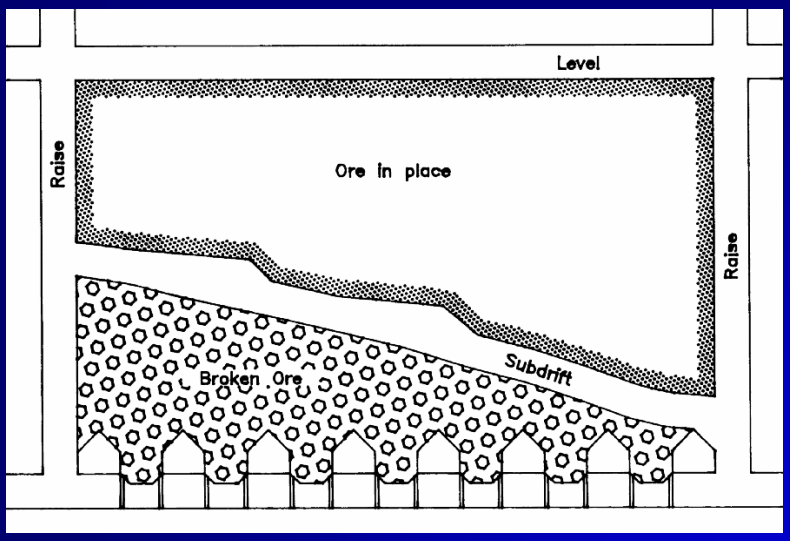
Shrinkage Stoping



Shrinkage Stoping

Basic Facts

Vertical overhand mining method without support

Stopes are mined upwards in horizontal slices

Broken ore partly remains in the stope as a working floor

Used in narrow veins and other steep deposits, for example in gold and metal mining

Requirements

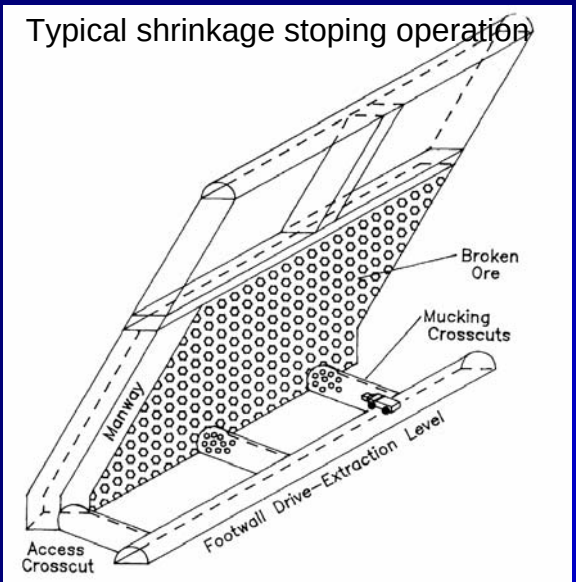
- Ore body should be fairly steep (preferably 60...90°) and narrow to moderately wide (1...30m)
- Ore body should have regular dip and boundaries
- Ore and surrounding rock should be rather strong
- Ore should not pack
- Ore should not oxidise or be subject to spontaneous combustion
- Ore grade should be fairly high and uniformly distributed

Development

- Construction of main haulage levels (vertical distance between levels 60...180m)
- Construction of drifts in the ore body at the desired spacing for the dimension of the stope
- Construction of an extraction drift parallel to the strike of the ore body in the footwall
- Construction of draw points and cross cuts connecting the stope and the extraction drift
- Construction of raises between levels for ventilation

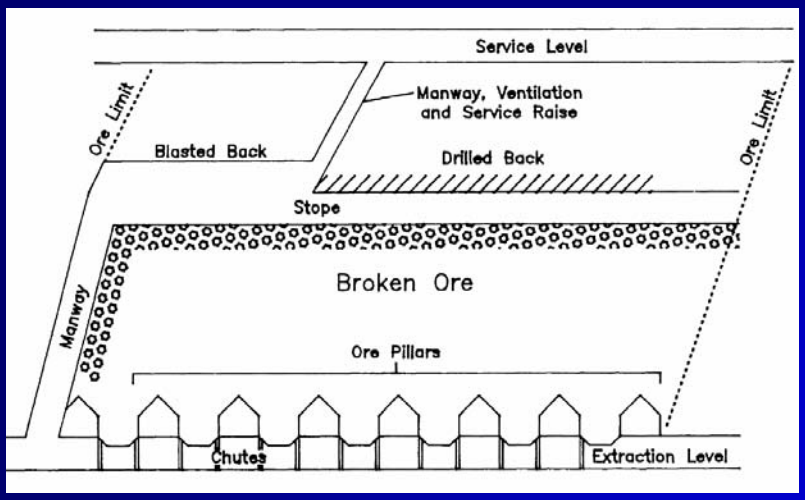
Development

Typical shrinkage stoping operation



Development

Typical shrinkage stoping operation (longitudinal section)



Development

- Drifts are usually driven using conventional drilling and blasting
- Raises can be driven conventionally with drilling and blasting or with raise boring machines

Stoping Operations

Drilling and blasting:

Drill holes are drilled upwards

Drilling is done using hand-held drills, in wider stopes using stope jumbos

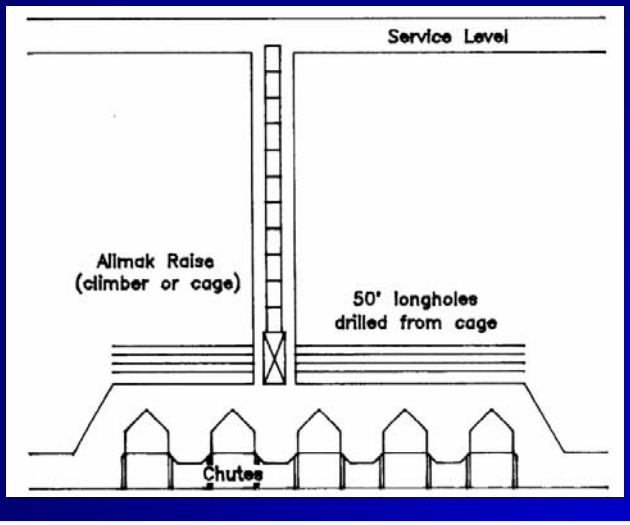
Drill holes are charged with ANFO, gels or slurries

30...40 % of the material can be drawn from the stope due to the swell

60...70 % of the material remains in the stope and is used as a working floor and as support for the walls

Stoping Operations

Variation: longhole shrinkage stoping



Stoping Operations

Alimak Raise Climber

Stoping Operations

Drawing of ore:

Ore freely flows to the draw points because of gravity

Ore is taken from the draw points using LHDs

Ore is hauled to the shaft using LHDs, trucks, trains or conveyor belts

Drawing has to be done in a way to ensure that the level of the ore in the stope is at about 2m below the face

Haulage

LHD Sandvik Tamrock Toro 0010

Stope Drawdown

Drawdown commences when the stope reaches the final dimensions

Drawing must be done evenly to avoid dilution

Hung-up stopes are dangerous and can be washed down with water or broken up using explosives

Advantages/Disadvantages

+ Moderate to small-scale production

+ Ore is drawn by gravity

+ Low capital investment due to little need for equipment

+ No need for ground support

+ Good recovery (75...85 %) and little dilution (< 10 %)

+ Moderate stope development

Disadvantages

- Low to moderate productivity
(5...15 t per employee-shift)

- Labour intensive and difficult to mechanise

- Fairly high mining cost (relative cost 45 %)

- Dangerous working conditions

- Majority of ore tied up in stope, possibility of packing etc.

- Fair selectivity

Example

La Libertad mine, Mexico:

Gold and silver bearing quartz veins

Oreshoot 350m long, 145m high and 6m wide with 70° dip

Gold grade of 400 g/t

Equipment includes LHD, air slushers, stopers, jacklegs and trucks

Productivity about 7 t per employee-shift in the stope

Conclusion

Due to the disadvantages shrinkage stoping is not very popular anymore today

It is used for narrow veins with steep dip and in case other methods cannot be applied