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Design and layout of Sublevel, VCR, Open and Long blast hole Stoping

u/g Metalliferous mining practical

Introduction

Sublevel Stoping

VCR Stopes

Open Stopes

Long blasthole stope

Sublevel Stoping

VCR Stoping

Open Stoping

- Underhand
- Overhand
- Shrinkage
- Breast
- Combined

Long blasthole Stoping

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Sublevel Stoping

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Long blasthole stope

Mine development normally starts from a shaft sunk in the footwall to avoid any subsequent caving effects from the stopes

The ore body is divided vertically by driving crosscuts and haulage levels every 150 to 400 ft (45 to 120 m). Access raises driven in the ore body are used to further subdivide the ore body into blocks for stoping.

A collection system is constructed, during which time the stope block is all or partially undercut. Sublevels are driven through the proposed stope block every 30 to 180 ft (10 to 55 m), and more than one sublevel may be used on each level, depending on the width of the ore body.

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- Stoping is carried out by blasting vertical slices into an expansion slot the height and width of the proposed stope, usually by enlarging a slotting raise with longhole drilling and blasting. Shrinkage stoping has also been used to form the starting slot that may be developed at the end or middle of the stope.

- Slotting has been shown to be a very expensive part of the stoping operation, accounting for 20 to 30% of total stoping costs.

- Stopes are typically contained by a crown pillar, which protects the level above, rib pillars, and a sill pillar through which the ore collection system is cut. Substituting filled stopes for rib pillars has been achieved successfully under some conditions.

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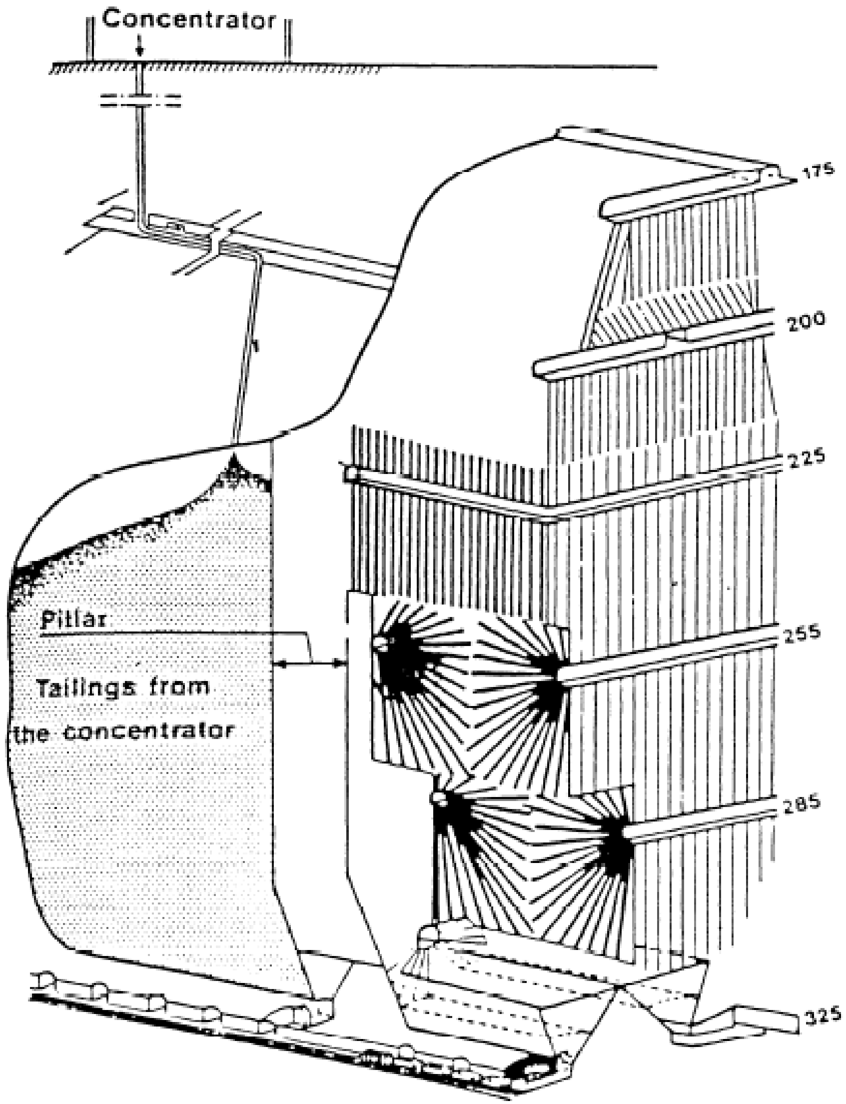

Sublevel stoping showing the relationship between development and production

Introduction

Sublevel Stoping

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Long blasthole stope

Mine	Ore Body	Stope Dimensions, ft				Pillars, ft	Haulage, Interval, ft
		Width	Length	Height	Sublevel		
Kidd Creek (Belford, 1981)	Massive base metal sulfide	79	98	299	98	70–98	397
Torman (Matikainen, 1981)	Massive limestone	148–164	328–492	328	49–164	148–164	—
Rio Tinto (Botin and Singh, 1981)	Massive sulfide	66	66–164	131–236	131–236	41	174–276
Mt. Isa (Goddard, 1981)	Bedded sulfide	82–164	98	410–820	66	82	574–984
Burra Burra (McNaughton, 1929)	Massive sulfide	39	328	164	43	43	197
Luanshya (Mabson and Russell, 1981)	Bedded sulfide	39	39	115	36	16–32	164–230

Conversion factor: 1 ft = 0.3048 m.

Sublevel Stoping Basic Dimensions

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Sublevel Stoping

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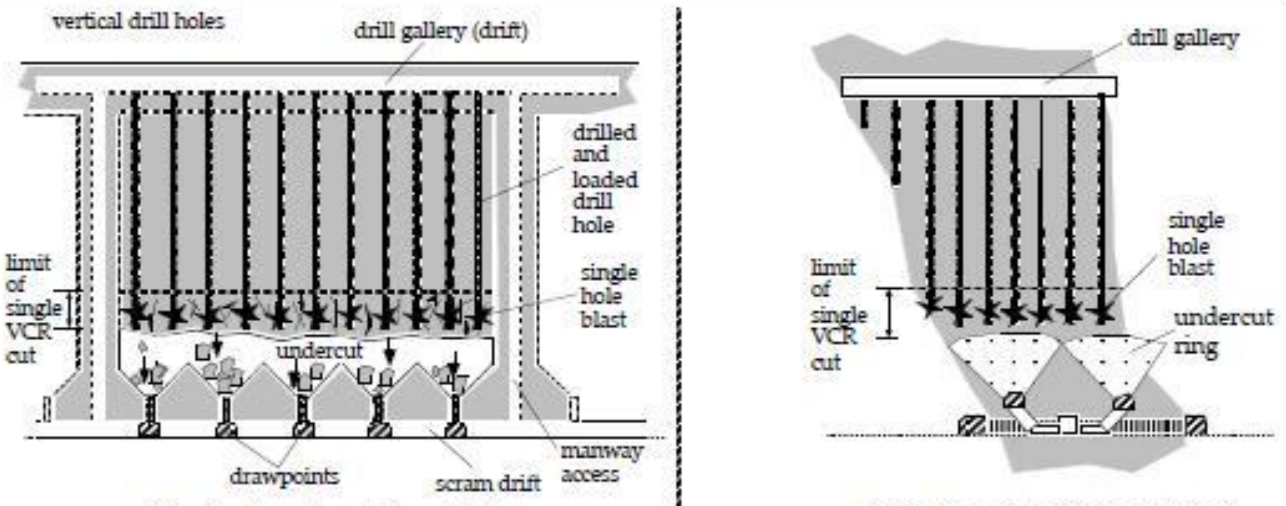

Vertical section (along dip) showing multiple hole arrays

Vertical section (along strike) showing single array of holes

- ❑ Large parallel holes drilled similar to parallel drilling method
- ❑ Horizontal slices are blasted with near spherical charges into the undercut
- ❑ Spherical charge – length to diameter ratio 6:1 to simulate spherical charge
- ❑ Distance between consecutive slices is nearly 4.6 – 5m
- ❑ Drilling is completed prior to blasting, therefore, this method has high productivity and efficiency

Open Stopes

- Underhand Stoping
- Overhand Stoping
- Shrinkage Stoping
- Breast Stoping
- Combined Stoping

Underhand Stoping

Undercut and fill mining is a method of extracting a block of ore by mining successive slices (cuts) 6 to 15 ft (1.8 to 4.6 m) in height from the top down, and filling each successive cut with cemented sand fill.

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Underhand Stoping

A vertical or steeply dipping vein is developed on levels 150 to 200 ft (46 to 61 m) apart with a system of lateral drifts on each level.

Extraction crosscuts are driven through the vein on 100- to 300-ft (30- to 91-m) intervals. Orepass raises are driven or bored between the upper and lower crosscuts

In mechanized mines, ramps are driven for access to the stopes and ore passes.

The initial floor is established on the upper level. It is mined by driving a conventional drift round, and the opening is supported by square sets or by rock bolts and mats

Contd.

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Underhand Stoping Contd.

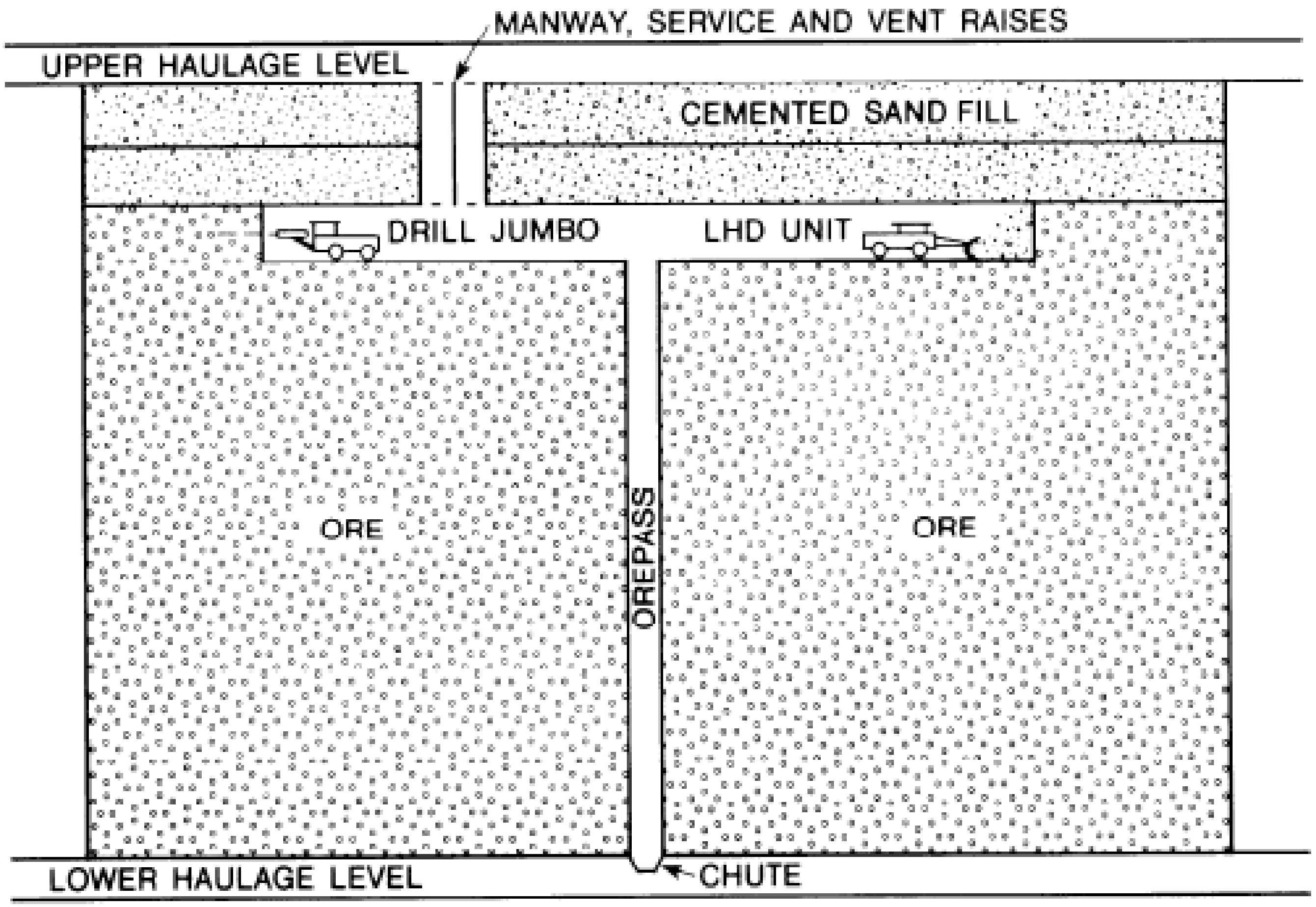
The ore is removed by use of slushers, or LHD equipment in mechanized stopes, through orepasses to the level below.

When the initial cut is completed, a timber and/or wire fabric mat is placed on the floor of the cut, and the opening is filled tightly with cemented sand fill.

Access to the mining area on the next cut is achieved by carrying the manway and timber slide openings, or the access ramps, downward

Mining is then resumed on the next cut below the mat. As the cut is advanced, the mat/sand fill covering issupported, if necessary, by round timber posts.

Underhand Stoping
Contd.



Longitudinal section of an undercut and fill stope.

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Overhand Stoping

One common method of developing narrow veins is to drive crosscuts from a lateral in the wall rock when poor ground conditions exist, or when the vein is crooked or has poor continuity.

The crosscuts are driven through the vein, and the raises are driven on the vein from the crosscuts. An initial drift is driven in the ore for the length of the stope, and it may be driven on the level or 20 to 25 ft (6 to 8 m) above the level. This serves as the undercut.

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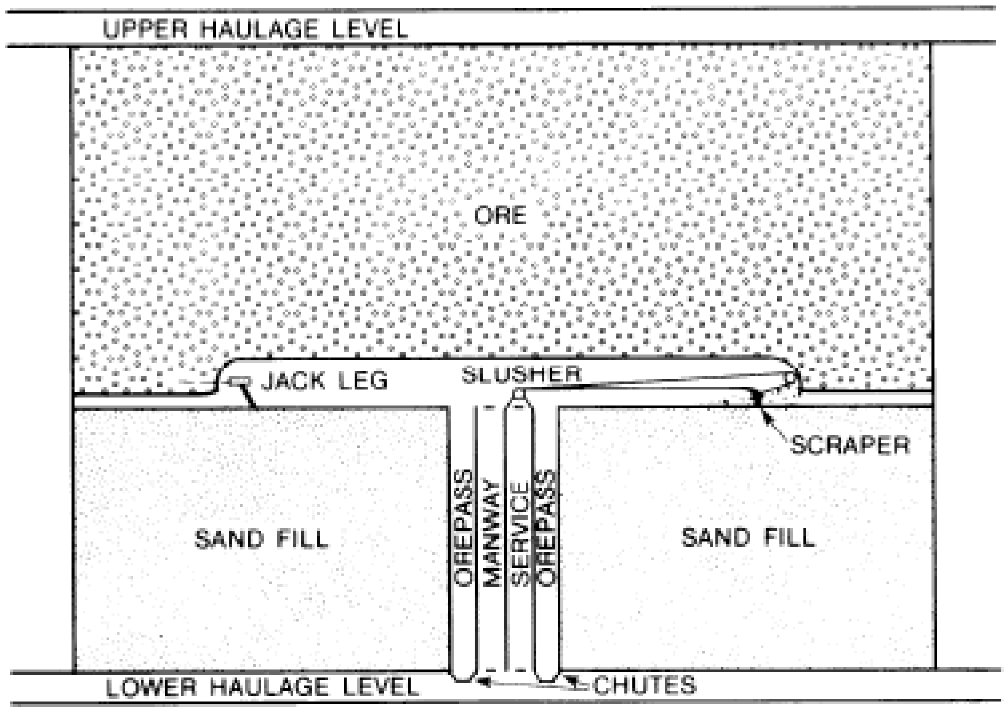
Overhand Stoping



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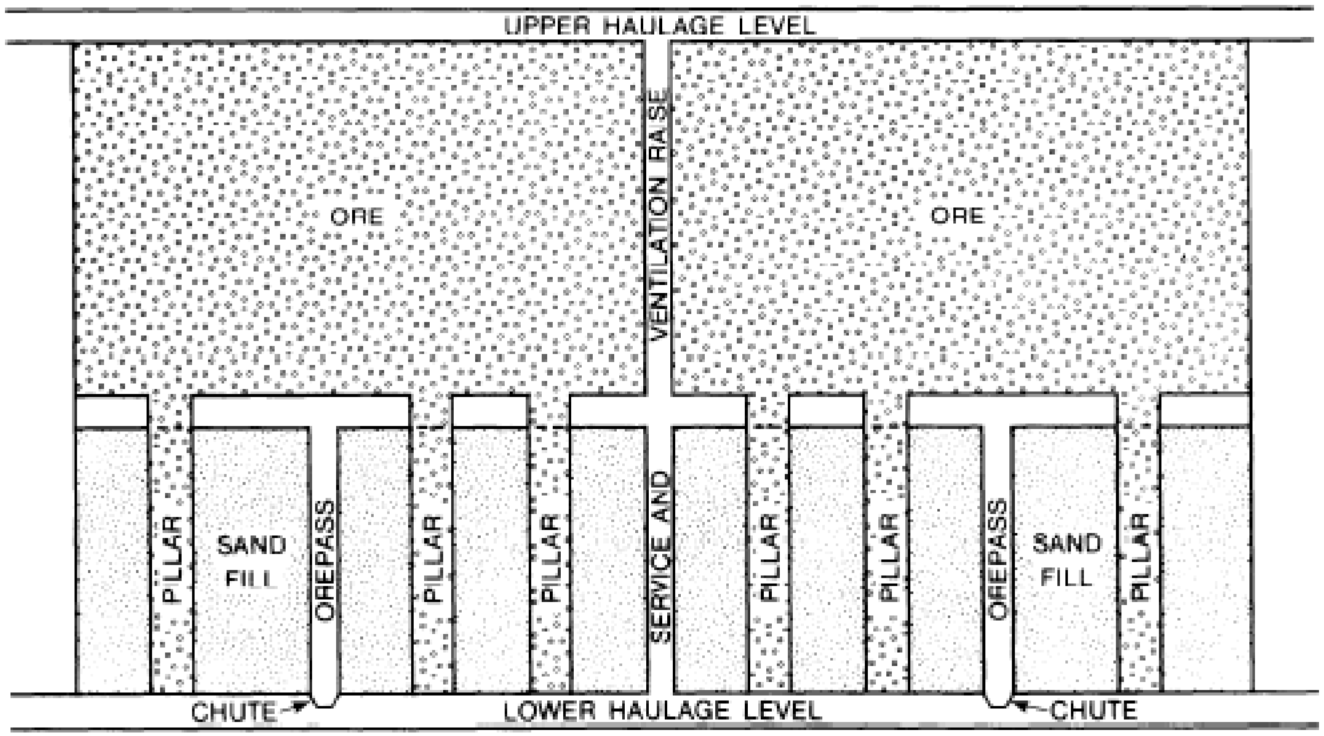

LONGITUDINAL SECTION

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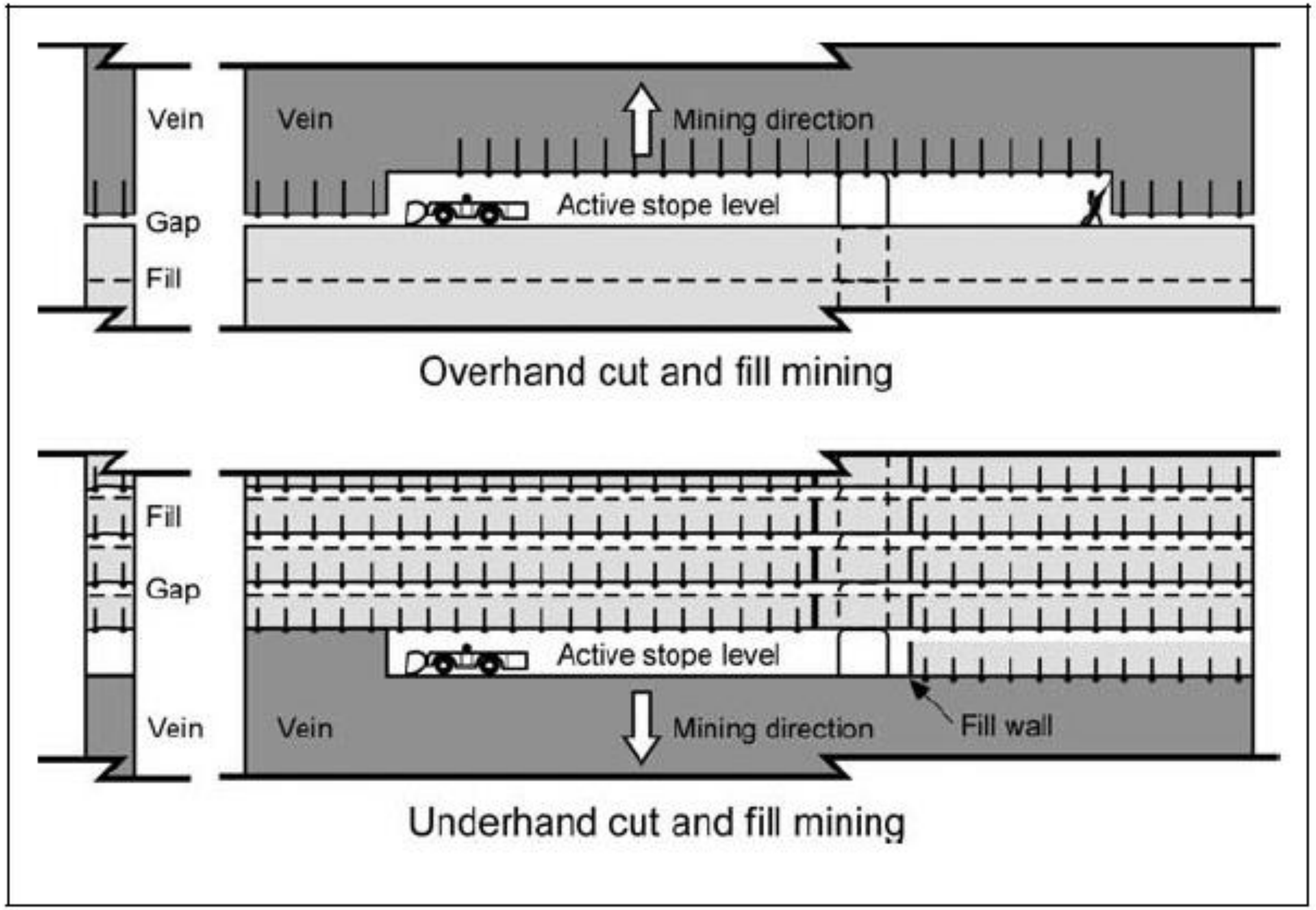
Comparison of Underhand and Overhand Stoping



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Shrinkage Stoping

- Sites for shrinkage stoping are generally developed by **drifting in the vein or ore zone on two levels**, spaced vertically 100 to 600 ft (30 to 180 m) apart. After a viable ore body has been established, the next phase consists of driving one or more raises to establish vertical ore continuity and also to provide ventilation and access to the stope.

- Stopes may be prepared with extraction raises on 25 to 30 ft (7.5- to 9-m) centers over the length of the ore shoot; each raise is fitted with a chute, normally of timber construction. Extraction raises are belled out and “hogged over” as the undercut for the start of the first stope cut. This type of preparation is still used but on a very limited basis.

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Shrinkage Stoping

A common method

Step 1

Drive an extraction drift parallel to the ore body development drift about 25-50 ft in the footwall of the ore body

Step 2

Drawhole extraction crosscuts are driven from the footwall drift into the ore drift on 25-50 ft centers

Step 3

The back of ore body is then blasted down and the swell is extracted through downholes, either with rail mounted mucking machines or LHDs

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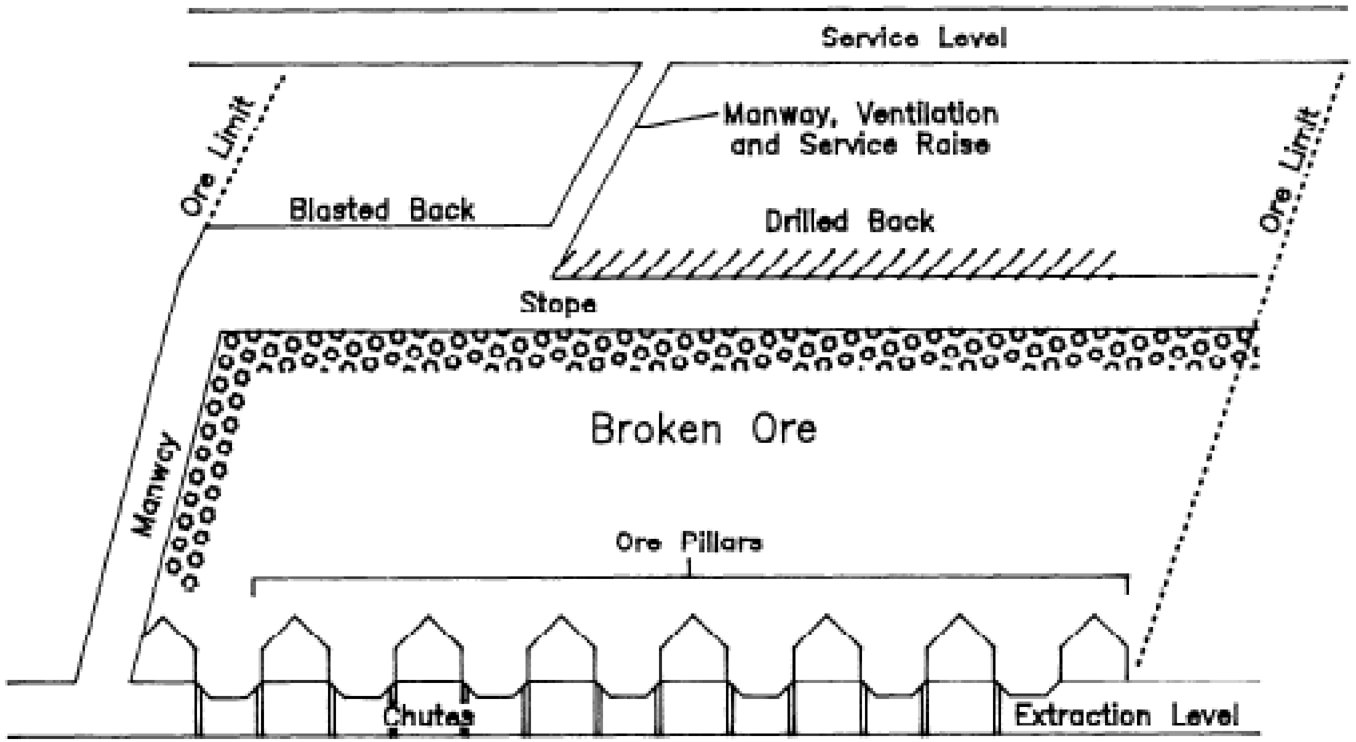
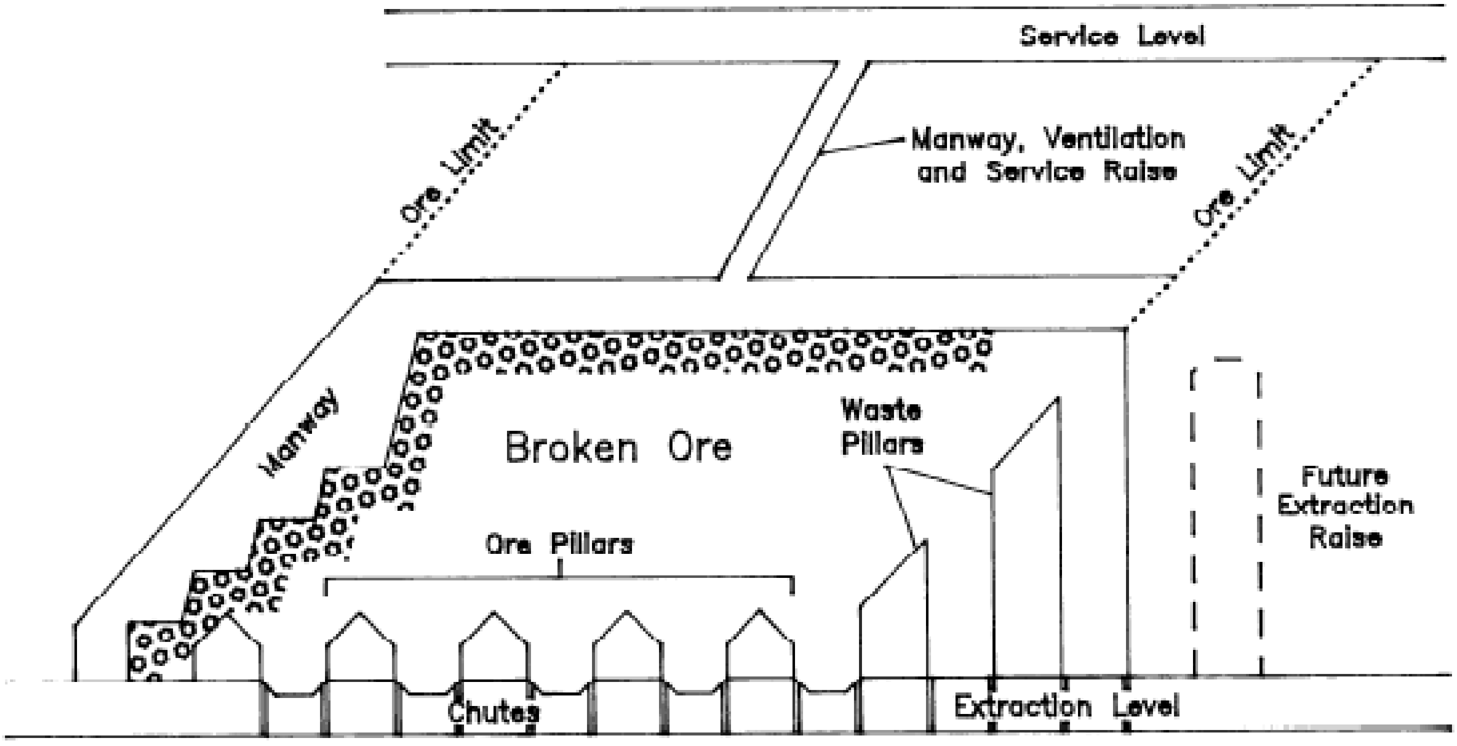
Shrinkage Stoping



Longitudinal section–typical shrinkage stope.

Shrinkage Stoping



Longitudinal section—shrinkage on shallow-raking ore body

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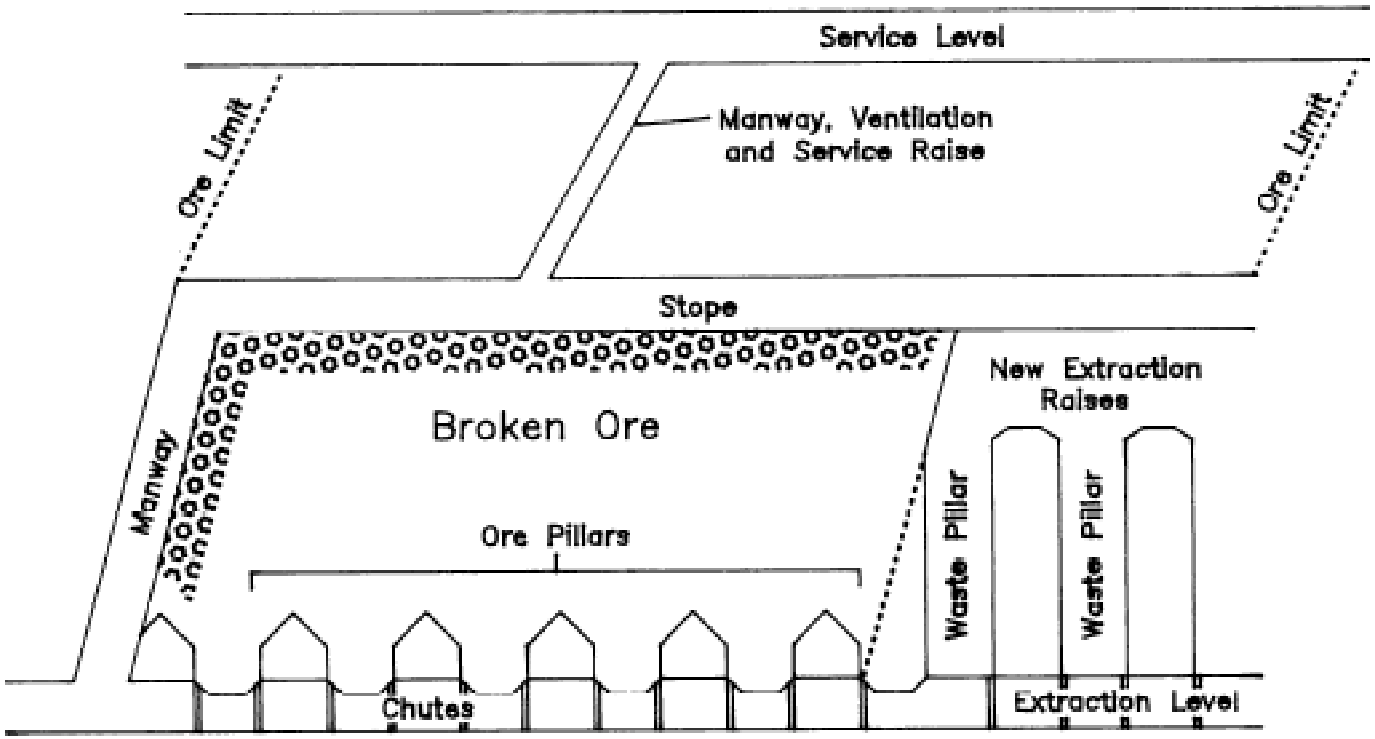
Shrinkage Stoping



Longitudinal section—shrinkage on irregular ore body

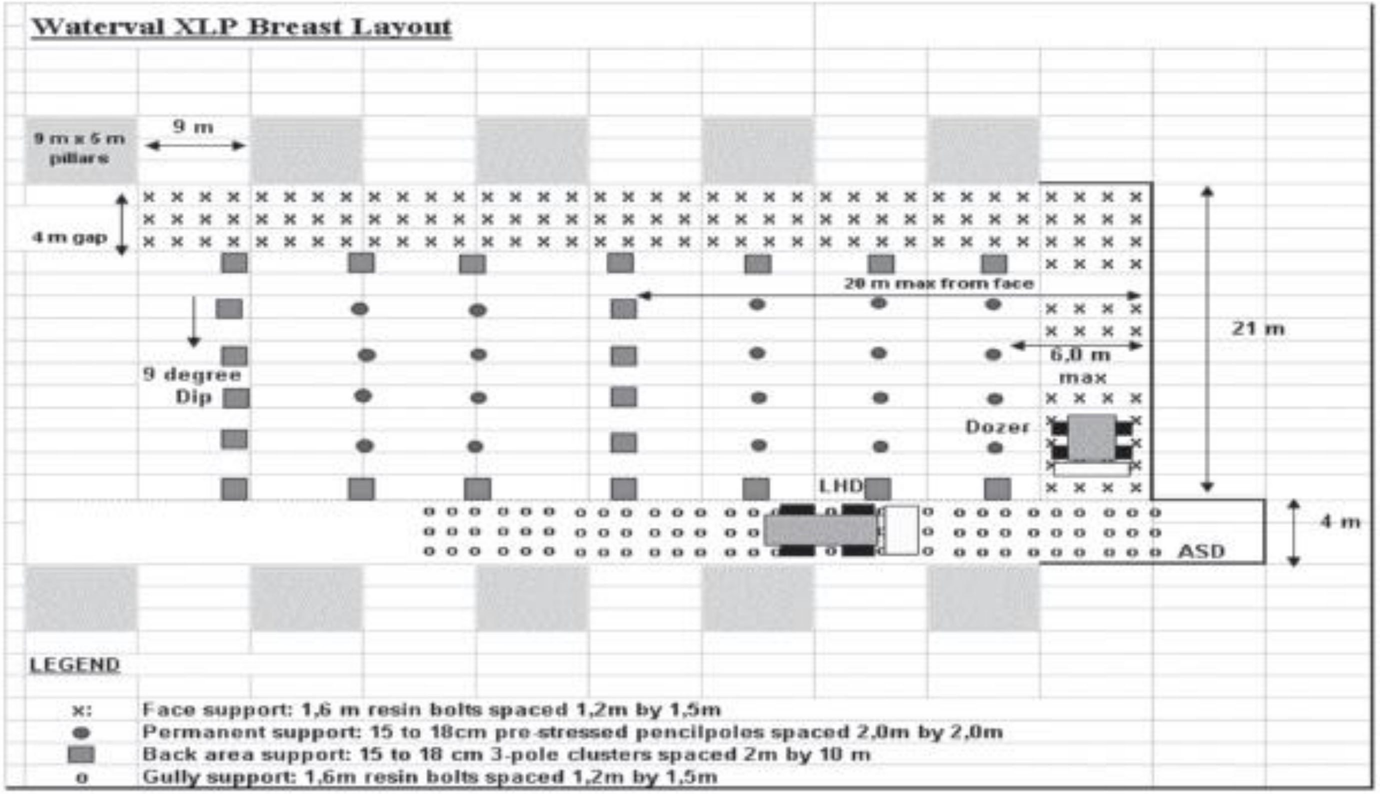
Breast Stoping

Explanation w.r.t Anglo Platinum mine

- The major constraint in this layout is the skin to skin spacing of 25 metres that result in a panel length of only 21 metres.
- However, this fits in well with the three shifts per 24 hours practiced at Waterval.
- Good aspects of the layout are the wide clearances at the face supported with roof bolts that permit the bottom eight metres of rock to be blasted into the gully and the balance of the blasted rock to be distributed over the roofbolted area such that the dozer has easy access and easily cleans the face.
- The gully is carried as an advance strike gully and that does lead to some congestion as gully advance and face advance have to interact continuously.

Breast Stoping

Explanation w.r.t Anglo Platinum mine



Mechanized Breast layout at Waterval

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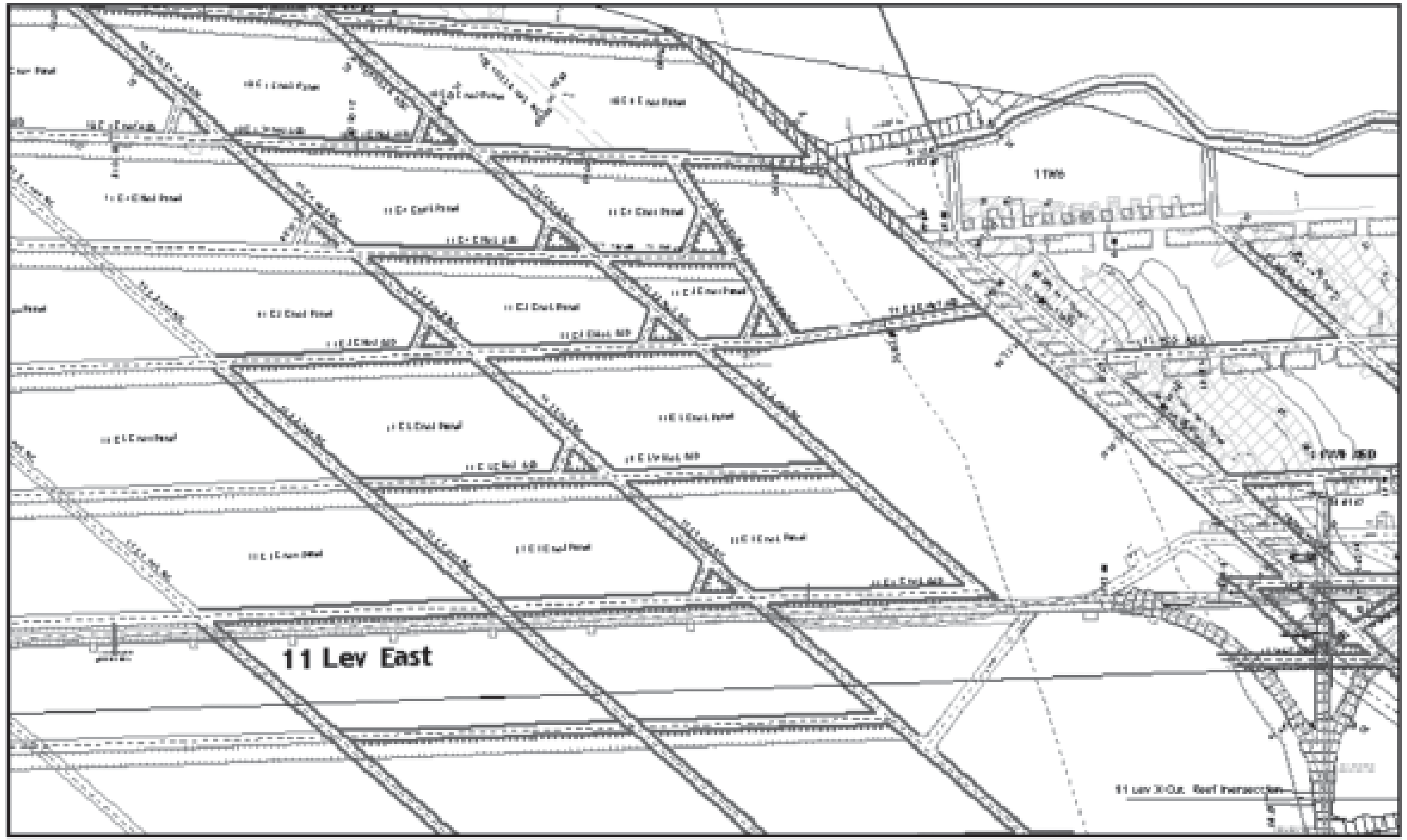
Breast Stoping

Explanation w.r.t Anglo Platinum mine



Mechanized Breast layout at Lonmin

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1. In blasthole stoping, from the drilling level at the top of the block, rows of radial blast holes are drilled down to the top of the extraction trough

2. A raise is driven at one end of the block and slashed to full stoping width to form a slot. The rows of blast holes are now blasted as one row or as several rows at a time toward the open slot. Hole diameter vary widely, but typically lie in the range of 76 -165 mm for wide blocks, 165mm in diameter holes are often used.

3. Hole straightness is an important design consideration that affects ragmentation, ore loss, and dilution. In general, one would select the largest hole diameter possible for the stope geometry since straight hole length is strongly dependent on hole diameter.

4. The specific development (amount of development required to exploit a certain volume of ore) is inversely proportional to block height. Since the cost of development is significantly higher than costs for stoping, one wants to have the highest possible number of extraction blocks associated with given extraction and a given drilling level.

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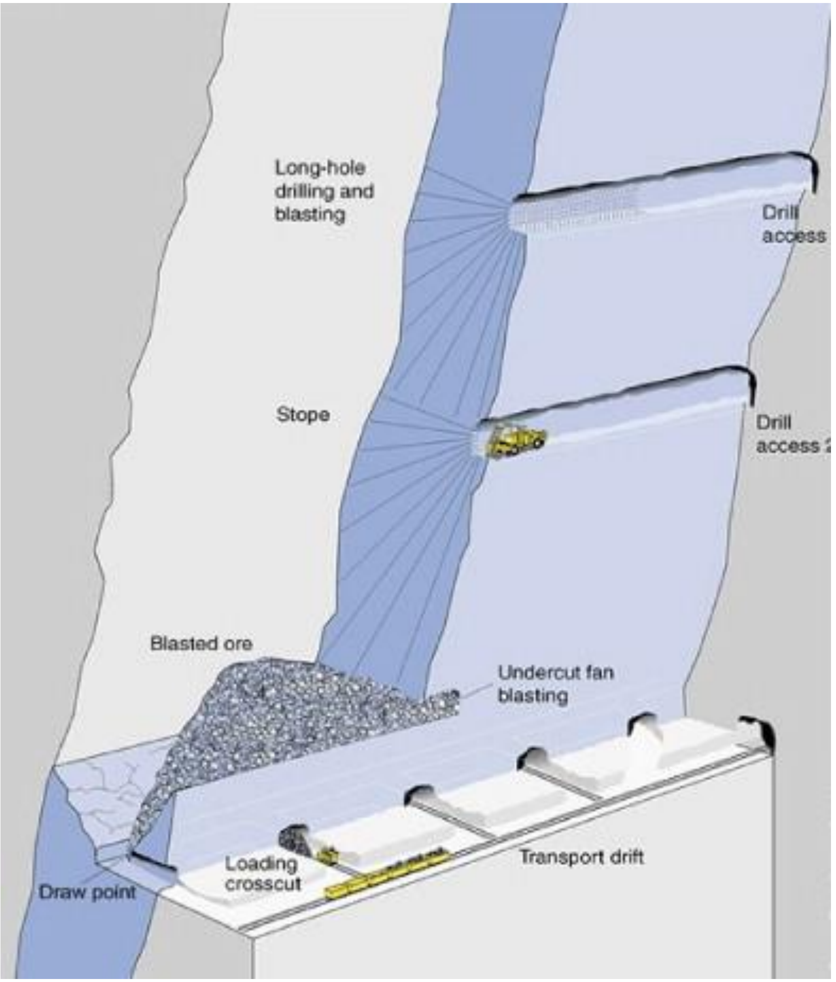

Blasthole stoping

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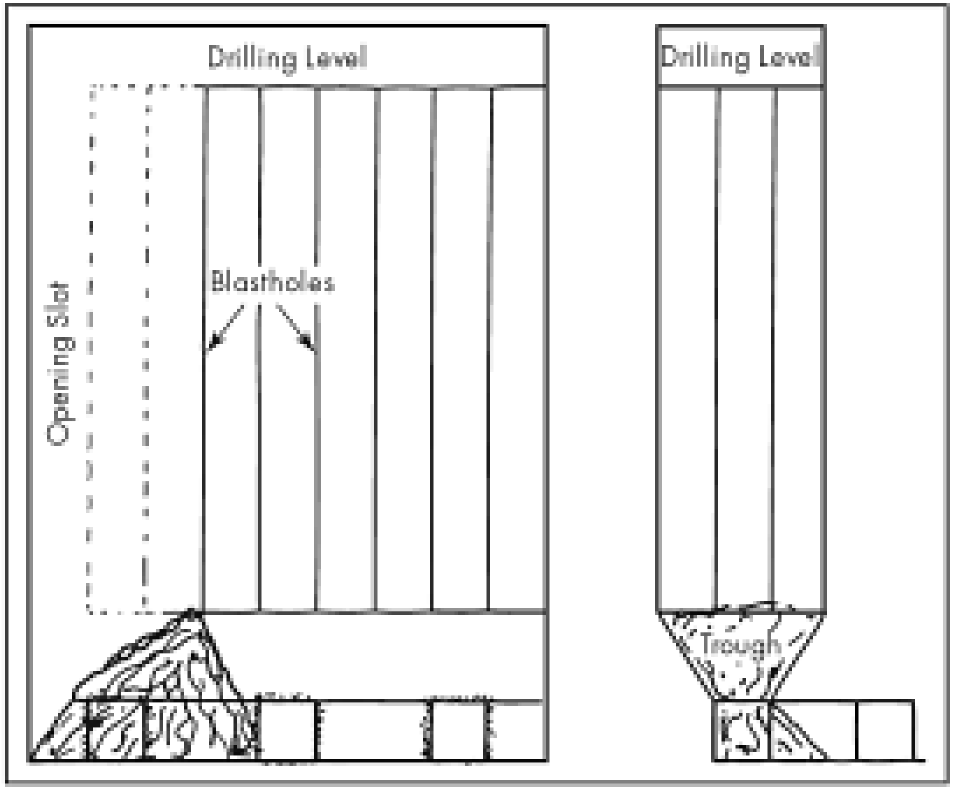

Blasthole stoping method starting with a slot opening