Morphology of ore deposits

ORE MORPHOLOGY
According to
Situation relative
to lithological banding
of host rocks

1- Discordant orebodies

2- Concordant orebodies

Discordant orebodies

- **A-Regularly shaped bodies:**
- **B- Irregularly shaped bodies:**

2- Concordant orebodies
Classified according to host-rock type

- **A-Stratiform deposits**
- **B- Concordant bodies in igneous rocks**
- **C- Concordant Orebodies of residual deposits:**

1- Discordant orebodies:

- These comprise **two types:** a- *regularly shaped* bodies and b- *irregularly shaped* bodies:

A- Regularly shaped bodies

- ***i- Tabular orebodies*** are extensive in two dimensions, but have a restricted development in the third dimension: (e.g., quartz veins & lodes).

- Veins are developed along fissures or fractures and often inclined with a footwall and hanging wall, and are characterized by ***"pinch- and swell"*** structure.

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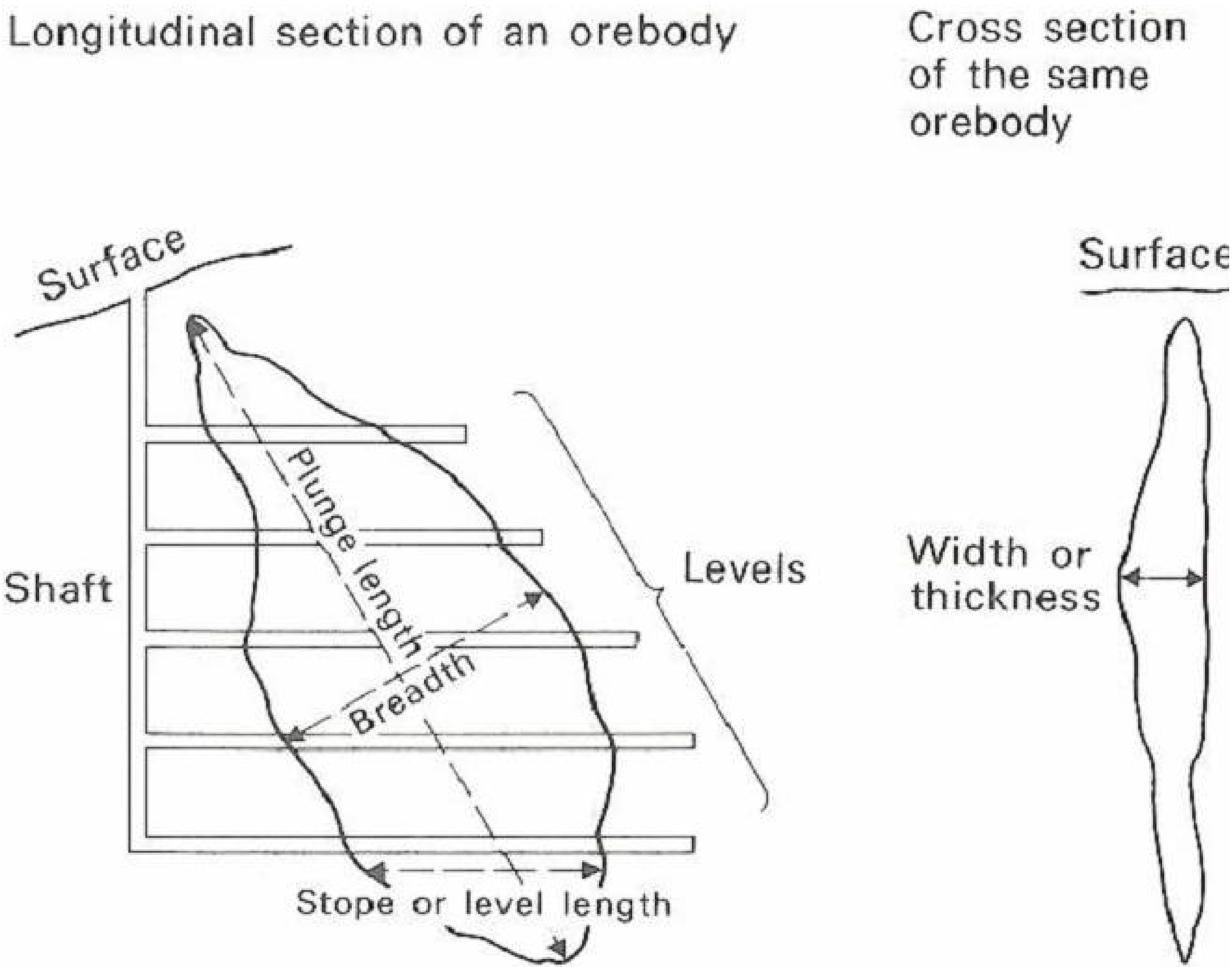
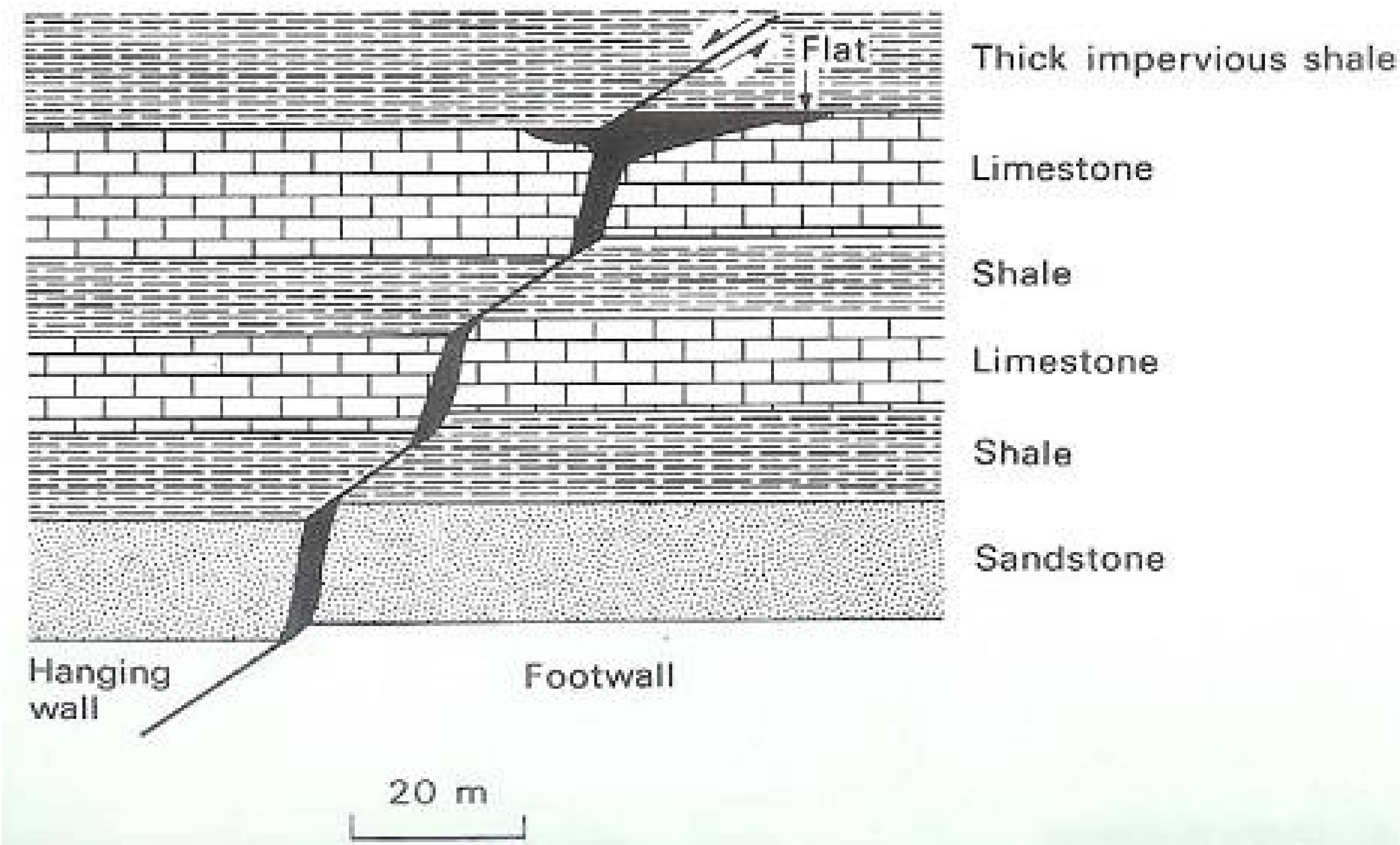


Longitudinal section of an orebody
Cross section of the same orebody
Surface
Surface
Plunge length
Breadth
Levels
Shaft
Width or thickness
Stope or level length

Tabular orebodies (e.g. qz veins)) are often inclined with a footwall and hanging wall, and are characterized by ***"pinch- and swell"*** structure**.**

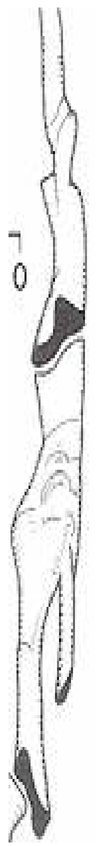


Origin of "pinch- and swell" structure:

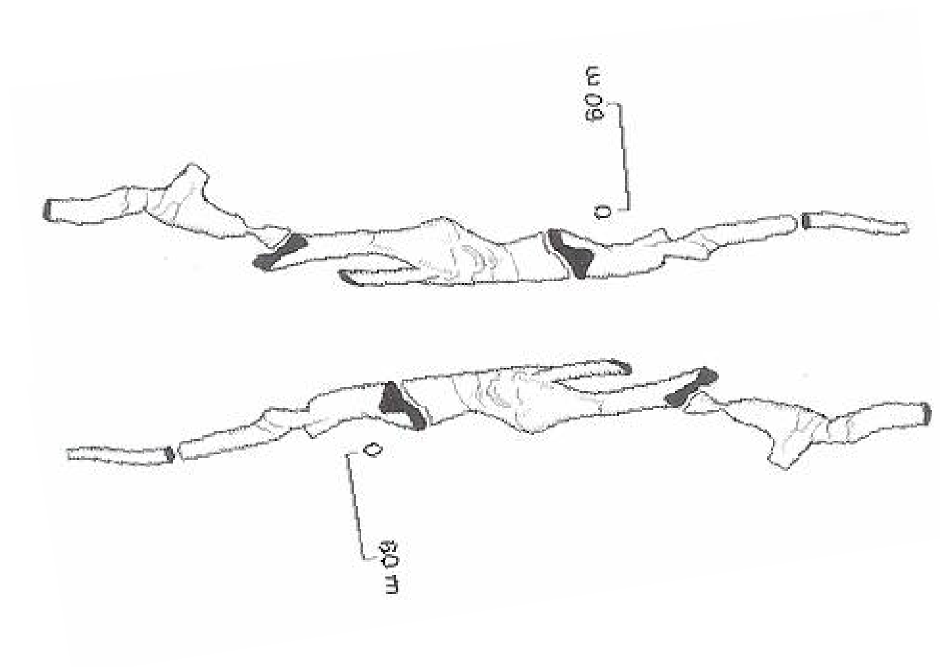
- Movement along fractures (commonly normal faulting) produces open spaces and cavities (dilatant zones) in the more steeply dipping parts of the fracture with narrow channelways in the less steeply dipping parts (this is due to the different nature of rocks). So when minerals are deposited along the fracture, they would be swelled in the open space cavities and pinched along the narrow channelways.

- **ii-*Tubular orebodies***
- These bodies are extensive in one dimension, but have a restricted development in the other two dimensions, e.g., Pipes and mantos.
- **Pipes** (also known as "**chimneys**") are Vertical to subvertical tubular orebodies.
- **Mantos** (also known as "flat-laying bodies") are horizontal to subhorizontal tubular orebodies.
- Pipes and mantos are commonly *branching, anastomosing* and associated to each other, where pipes acting as feeders to mantos.
- Pipes and mantos with quartz fillings are sometimes mineralized with Bi, Mo, W, and Sb particularly near granitic intrusions.

Pipes (Chimneys)



Mantos (Flat laying bodies)



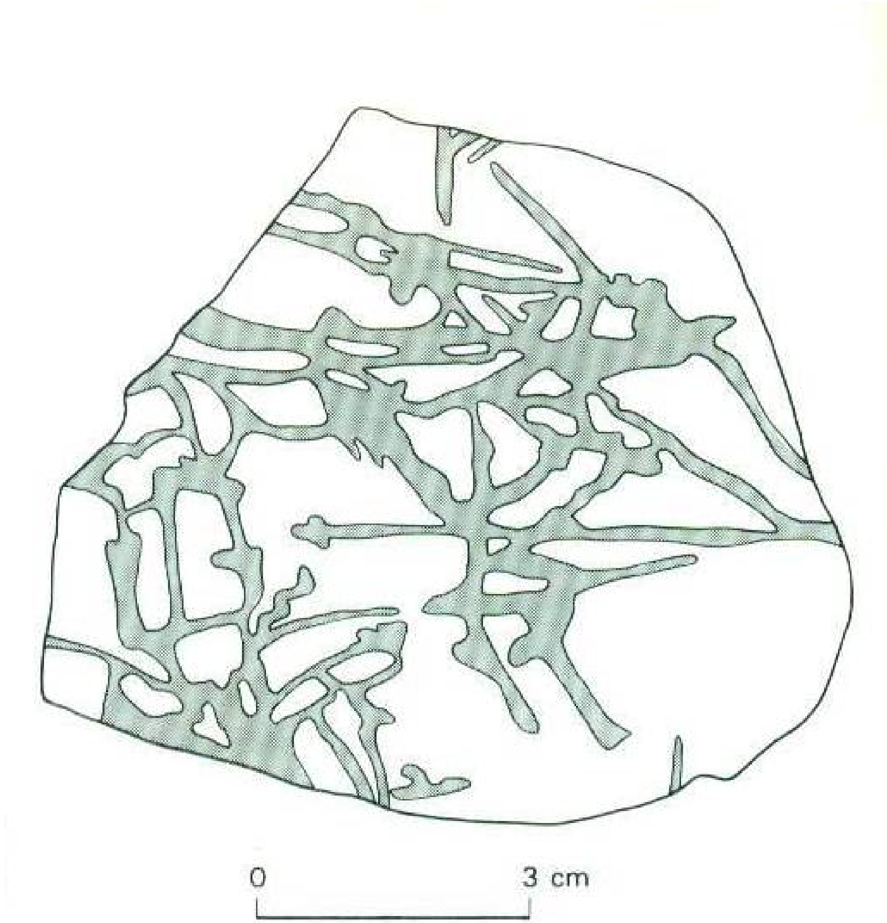
B- Irregularly shaped bodies

- **i- *Disseminated deposits*** in which ore minerals are peppered throughout the host rocks.
- e.g., diamond in kimberlite & orthomagmatic Ni-Cu deposits in gabbros.

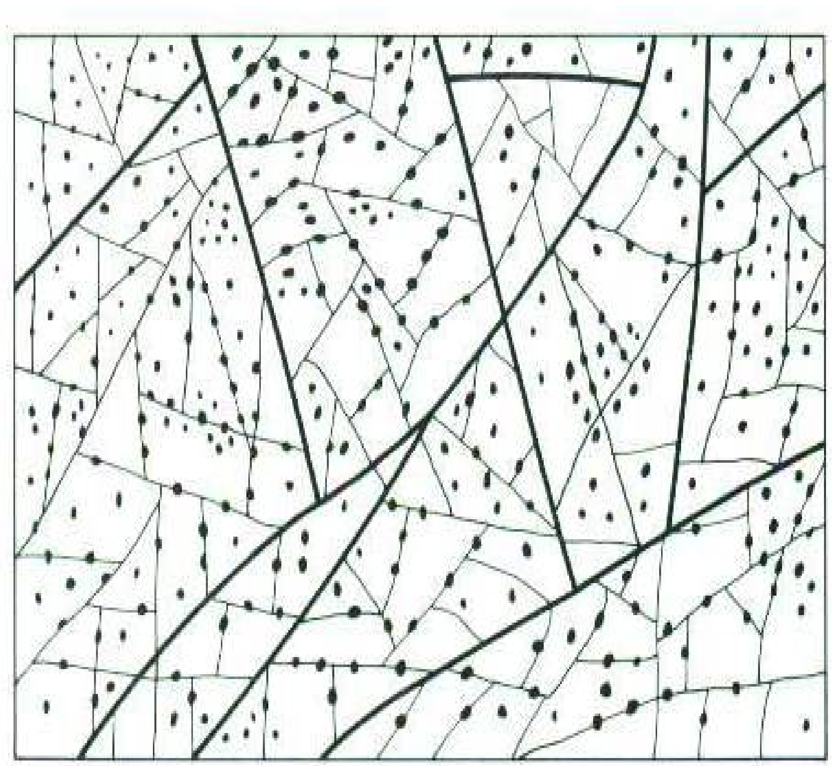
- ***Stockwork*** is a type of disseminated deposits in which ore minerals are disseminated in a network of closely-spaced and intercalating veinlets in the host rock, or disseminated in both the veinlets and the host rock.

Stockworks

In a net of veins &veinlets



In both veins & country rocks

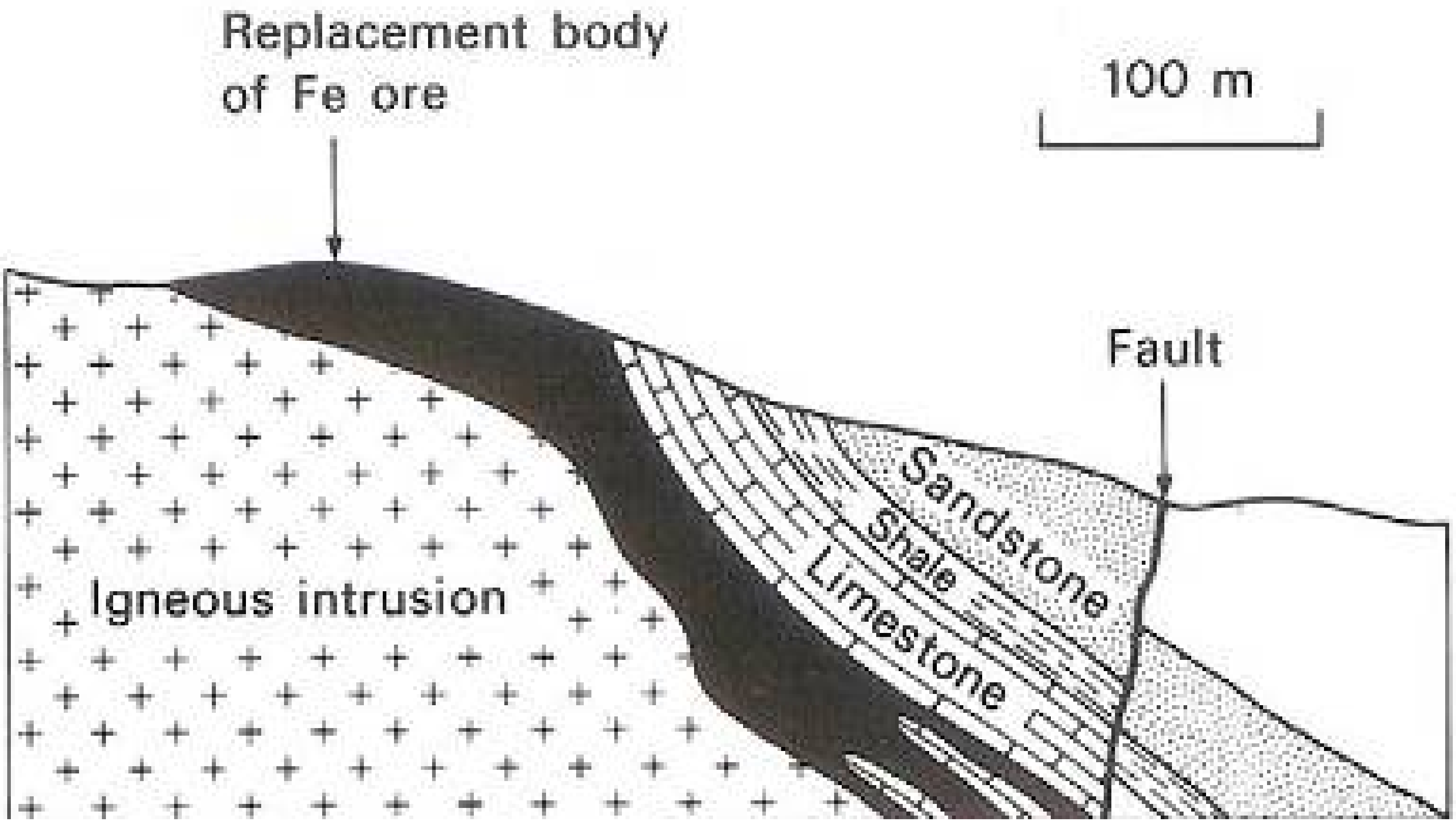


- Stockworks most commonly occur in acid to intermediate plutonic igneous intrusions, but sometimes they cut across the contact into the country rocks, and in a few cases the whole deposit occurs in the country rocks.

- In disseminated deposits, the mineralization generally decreases outwards, so their outer boundaries are often irregular, with however overall shapes of cylindrical, cap-like or pear-like.

- **ii- *Replacement deposits:*** in which the ore deposit is formed by replacement of pre-existing rocks with extremely irregular shape.
- Best example is Skarn deposits, also known as pyrometasomatic or contact metamorphic deposits.
- Skarn deposits are formed by replacement of carbonate rich sediments at contact with igneous intrusions with development of calc-silicate minerals such as diopside Ca(Mg,Fe)Si2O6, wollastonite CaSiO3, andradite garnet Ca3Fe2Si3O12, and actinolite Ca2(Mg, Fe)5Si8O22(OH,F)2.
- These deposits are rich in variable ore minerals of Fe, Cu, W, C, Zn, Pb, Mo, Sb and U.

Skarn deposits



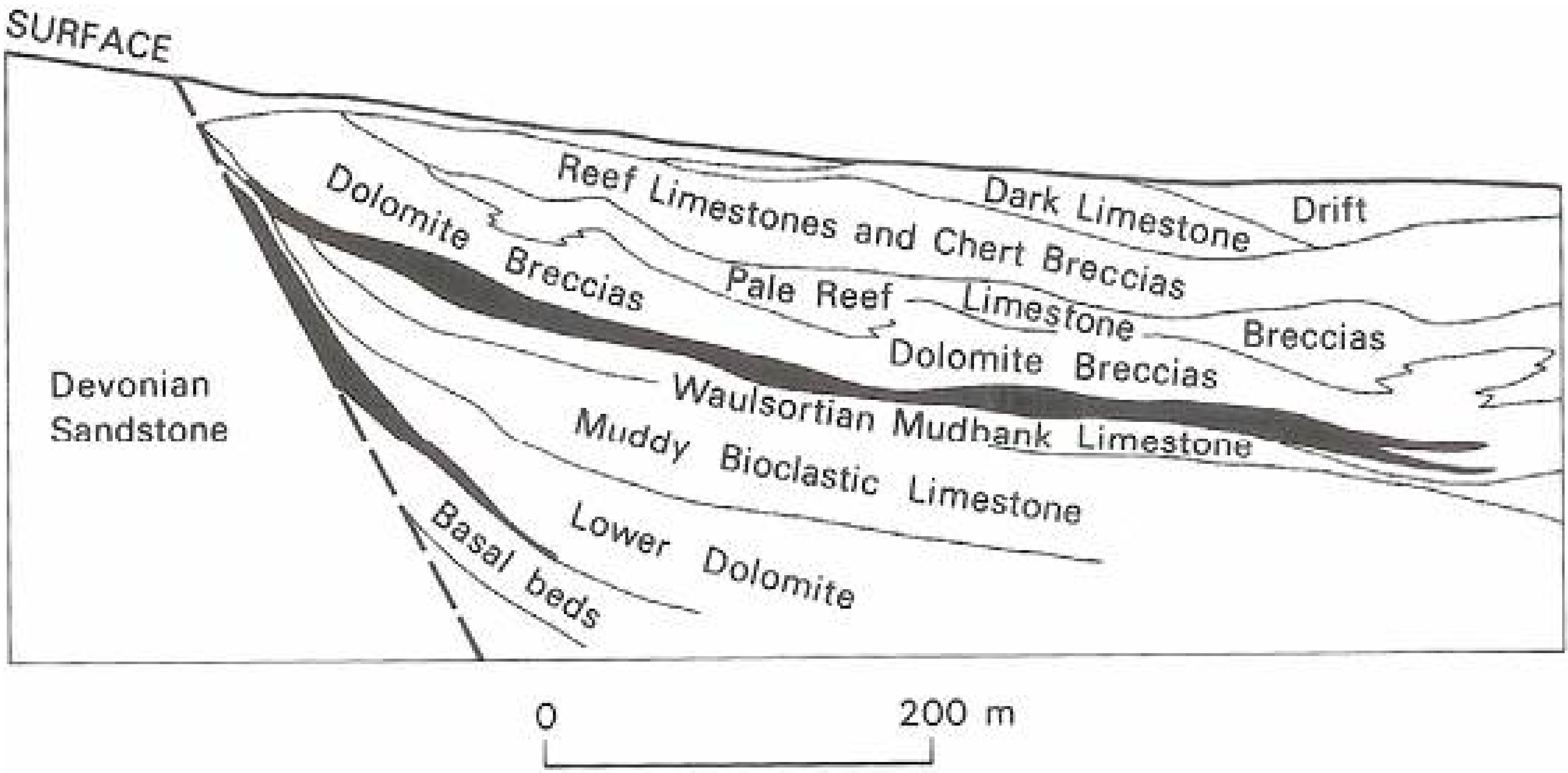
- **2- Concordant orebodies:**
- Morphology of these orebodies is classified according to their host rocks as follows:
- A- Concordant orebodies in sedimentary host rocks (Stratiform ore deposits):
- B- Concordant orebodies in igneous host rocks:
- C- Concordant orebodies of residual deposits:These

- **A- Concordant Orebodies in sedimentary host rocks (Stratiform ore deposits):**
- These orebodies show a considerable development parallel to bedding and a limited development perpendicular to it. They may be syngenetic* and represent an integral part of the stratigraphic sequence, or epigenetic* as infillings of pore spaces or replacement orebodies.

Stratabound deposit:

- Any type of orebodies that is restricted to a particular part of the stratigraphic column, regardless whether it is concordant or discordant.Examples

A syngenetic stratiform Pb-Zn orebody in a limestone succession

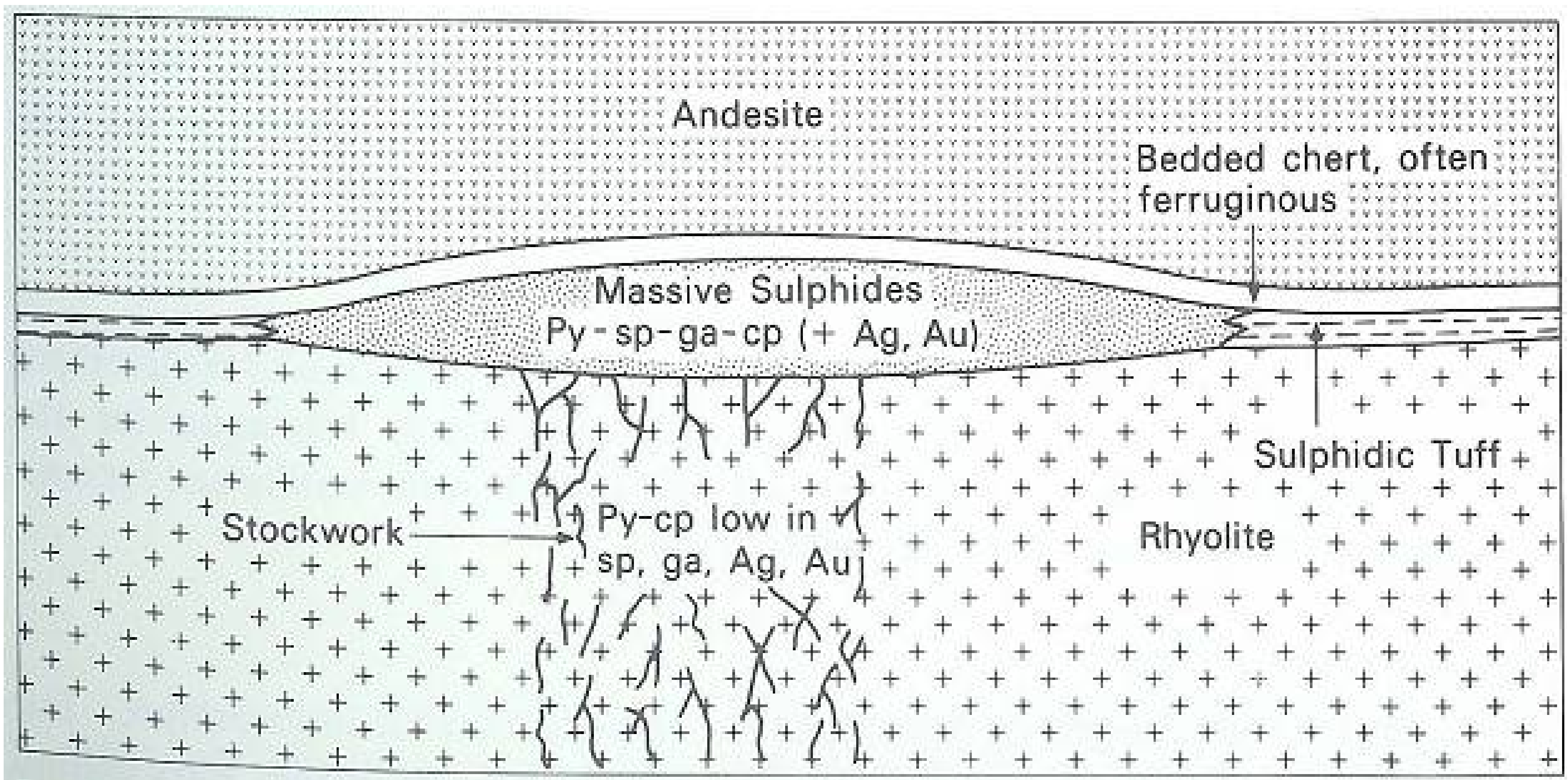


Examples of Concordant Orebodies in sedimentary host rocks:

- 1- Limestone hosts of Pb-Zn deposits, where the orebodies are commonly found in particular beds of higher permeability increased by dolomitization or fracturing.
- 2- Marine argillaceous hosts of exhalative oxide-sulfide deposits where magnetite, pyrite, pyrrhotite galena, sphalerite, chalcopyrite, and cassiterite are syngenitically formed among the accumulating marine sediments.
- 3- Arenaceous hosts, Such as copper deposits of chalcopyrite $CuFeS_2$ and bornite Cu_5FeS_4 are concentrated along the cross-bedding and in the hollows of the ripple marks and desiccation cracks in some altered feldspathic sandstones. Chalcocite Cu_2S in some places occurs as pore-filling copper deposit in aeolian sandstones red beds. Also beach sands (black sands) and placers contain considerable amounts of Ti, Zr, Th, Ce, aand Y.
- 4- Rudaceous (gravels & conglomerates) hosts: These rocks represent important source of gold and uranium (e.g., Witwatersrand deposit in South Africa). They are large-scale deposits (Km's) and characterized by "white runs" of vein quartz pebbles (conglomerates) arranged in fan-shaped distribution in quartzite suggesting formation in alluvial distributary channels. Uranium is a by-product.

- **B- Concordant Orebodies in igneous host rocks:**
- **1- In volcanic rocks:**
- **i-** ***Vesicular filling Copper deposits:***
- These deposits of native Cu commonly form in the permeable vesicular tops of basic lava flows whose permeability may have been increased by autobrecciation.
- **ii-** ***Volcanogenic massive sulfides VMS:***
- VMS deposits are generally stratiform lenticular or sheetlike orebodies developed at the interfaces between volcanic units or at volcanic-sedimentary interfaces; these interfaces or horizons may represent a change from volcanism to sedimentation or simply pauses in volcanism.
- These deposits are composed mainly of Fe-sulfides (pyrite & pyrrhotite), commonly associated with Pb-Zn deposits in rhyolitic rocks while are rich in Cu deposits in mafic volcanic rocks.

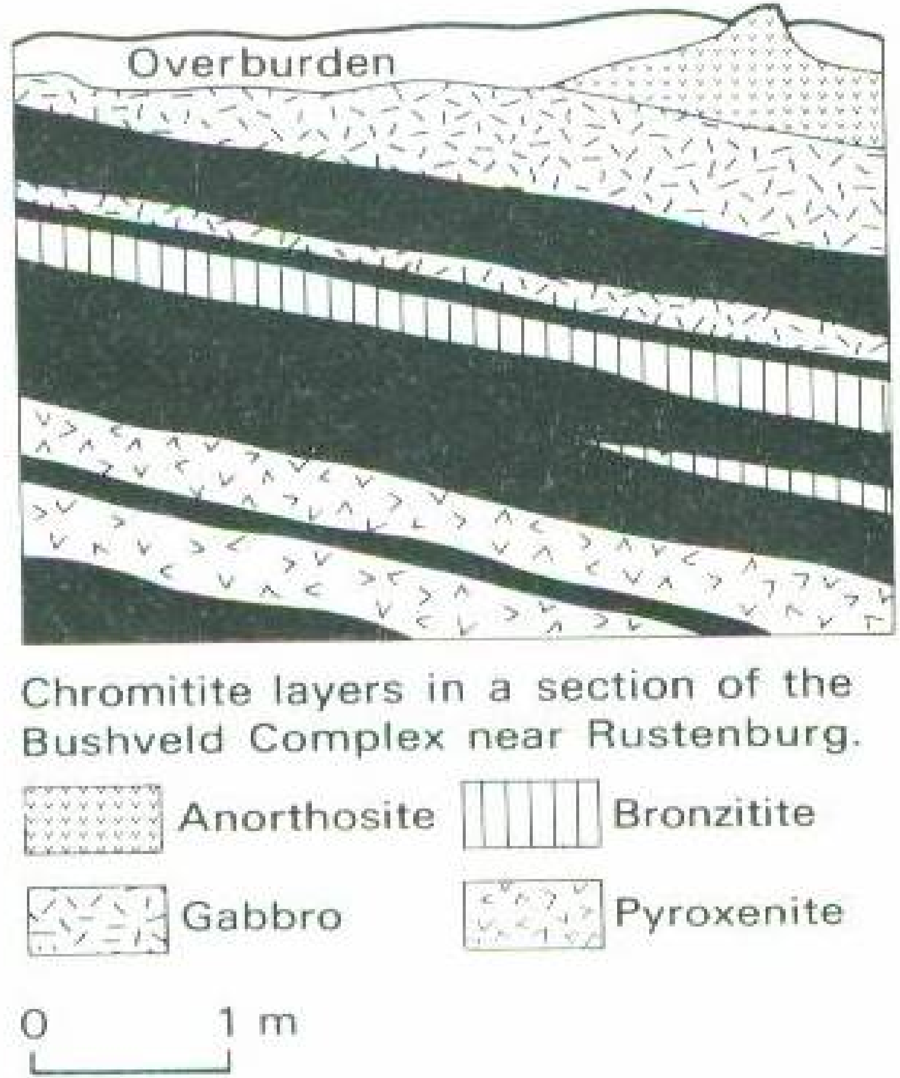
A cross section through a volcanic massive sulfide deposit (VMS).



- **<u>2- In plutonic rocks:</u>**

i- Chromite, ilmenite & magnetite layers basic igneous intrusions.

- The normal rhythmic layering in the basic igneous rocks occurs normally between felsic and mafic minerals (differentiation), however, discrete layers of chromite, ilmenite and magnetite can develop in these rocks and extend for many km's.



Chromitite layers in a section of the Bushveld Complex near Rustenburg.

- **ii- Conformable Ni-Cu sulfides beds and lenses formed by liquid immiscibility.**

These orebodies also develop among the normal rhythmic layering in basic igneous rocks again as discrete layers or lenses of pyrrhotite, chalcopyrite, pyrite, sphalerite and pentlandite.

- **C- Concordant Orebodies of residual deposits:**
- Removal of silica and alkalis from nepheline-syenite leaves a cap of bauxite that is later buried as conformable deposit with the associated sediments.
- Again conformable nicheliferous laterite deposits results originally from weathering of peridotite rocks.

A profile of peridotite showing development of a concordant layer of residual laterite