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***Geology 12***  
***Igneous Rocks:***  
***Part #2-***  
***INTRUSIVE STRUCTURES***

Lecture Notes, Figures, and Images

# REMEMBER!

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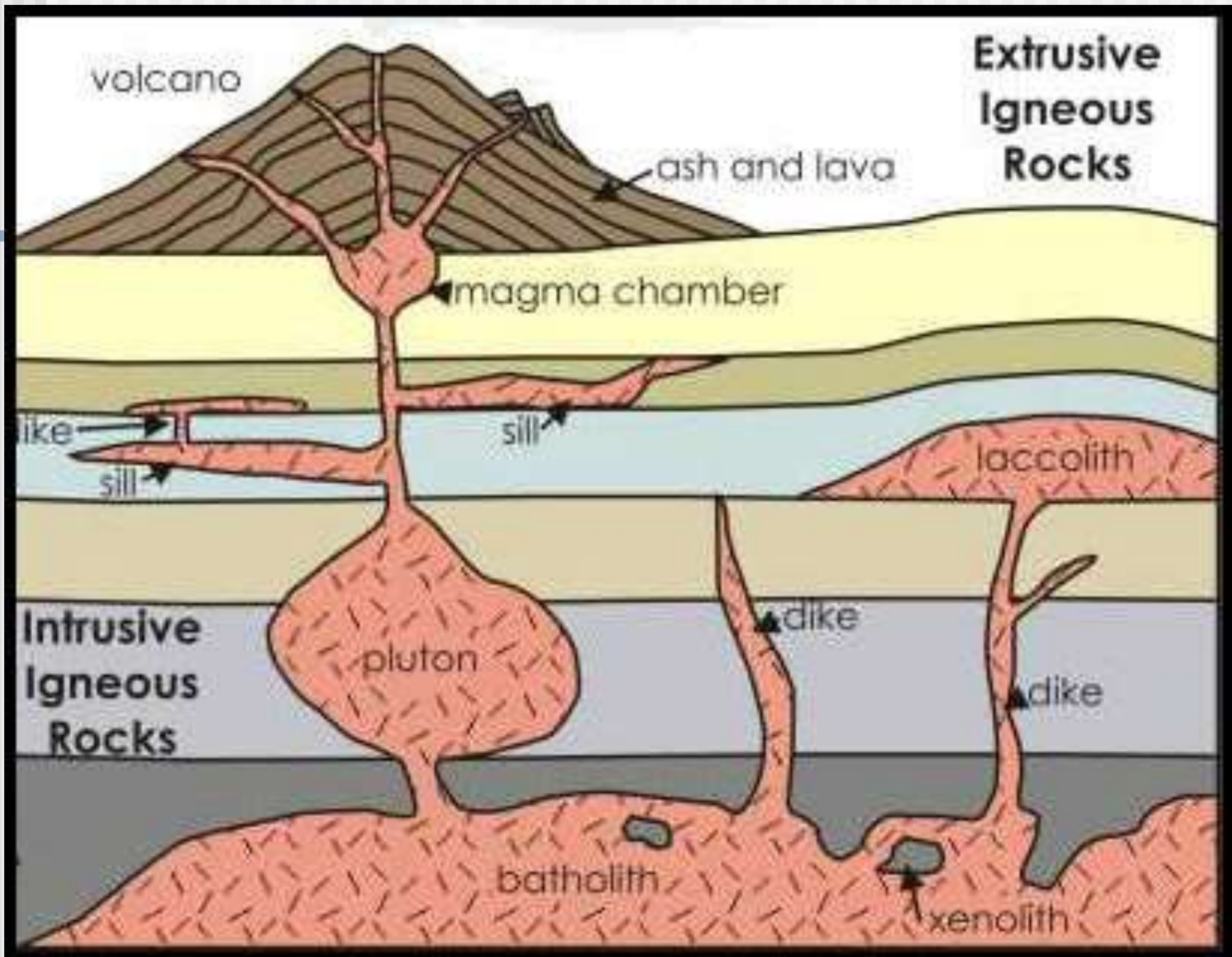
- Molten rock **underground** is called **MAGMA**.
- Molten rock **above ground** is called **LAVA**.
- We will now deal with materials that form **underground** (intrusive) from **MAGMA!**

# Plutonic = Igneous Intrusive Structures:

Formed from **Magma**.

Rises through “**Country Rock**” in two ways:

1. If magma is less dense than surrounding country rock, then it will be buoyant and rise on its own.
- n If magma is more dense than surrounding country rock, then it must be under pressure in order to rise.



# Type of “Intrusion” is determined by:

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1. Properties of the **Magma**.
2. Composition of the **Country Rock**.
3. Structure of the **Country rock**.

**Any Intrusion or Plutonic Rock structure, regardless of shape or size can be referred to as a **PLUTON**.**

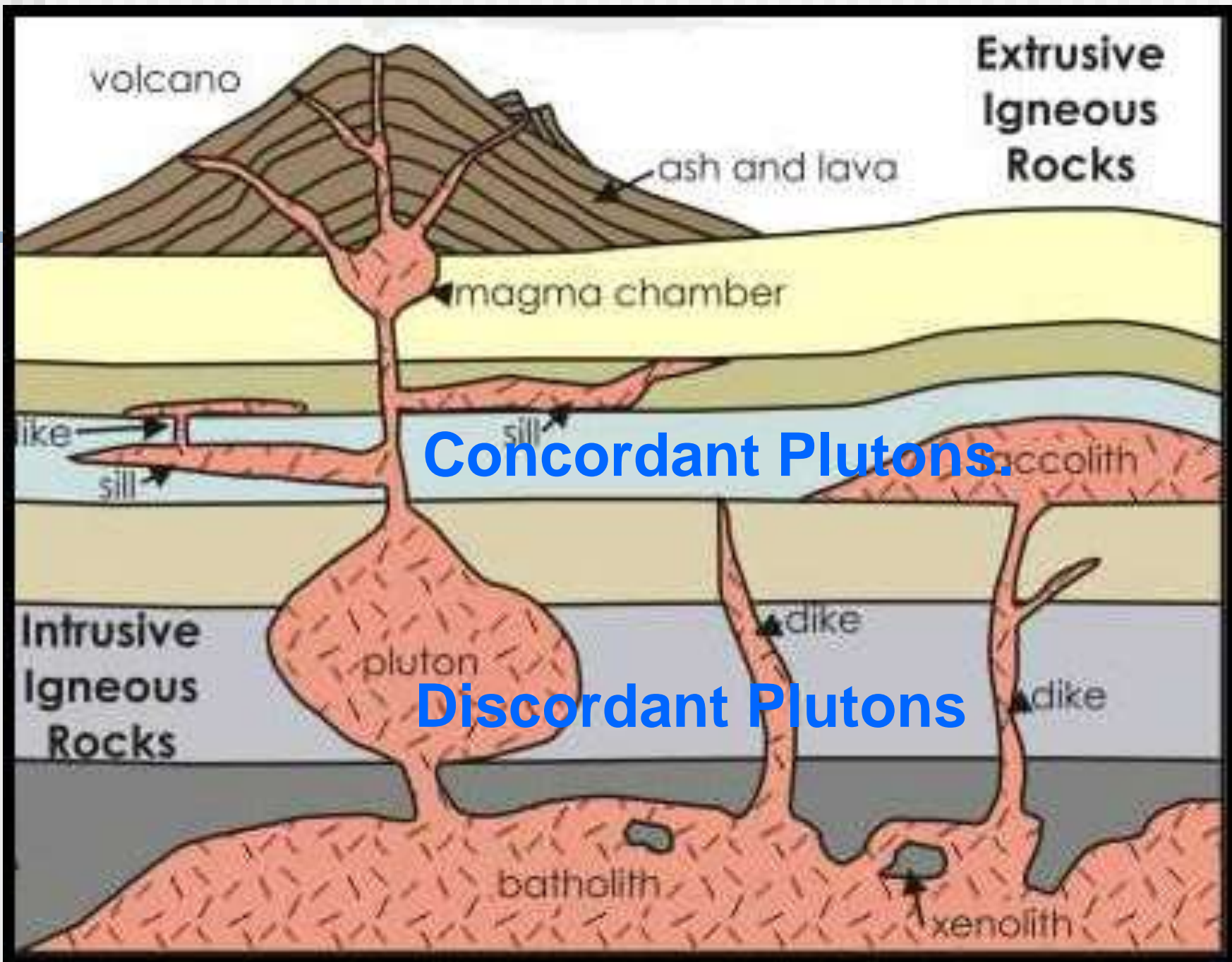
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**i. Concordant Plutons.**

**Tend to be **parallel** to country rock.**

**ii. Discordant Plutons.**

**Tend to **cut across** country rock.**



# You are responsible for the following Seven Plutonic (Igneous Intrusive) Rock Structures:

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1. **Batholiths**
2. **Stocks**
3. **Sills**
4. **Dykes**
5. **Xenoliths**
6. **Pipes / Diatremes**
7. **Laccoliths / Lopoliths**
8. **Chilled Margin**



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**Batholith:**

# Bath-O-Lith!

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**Lith** = Rock

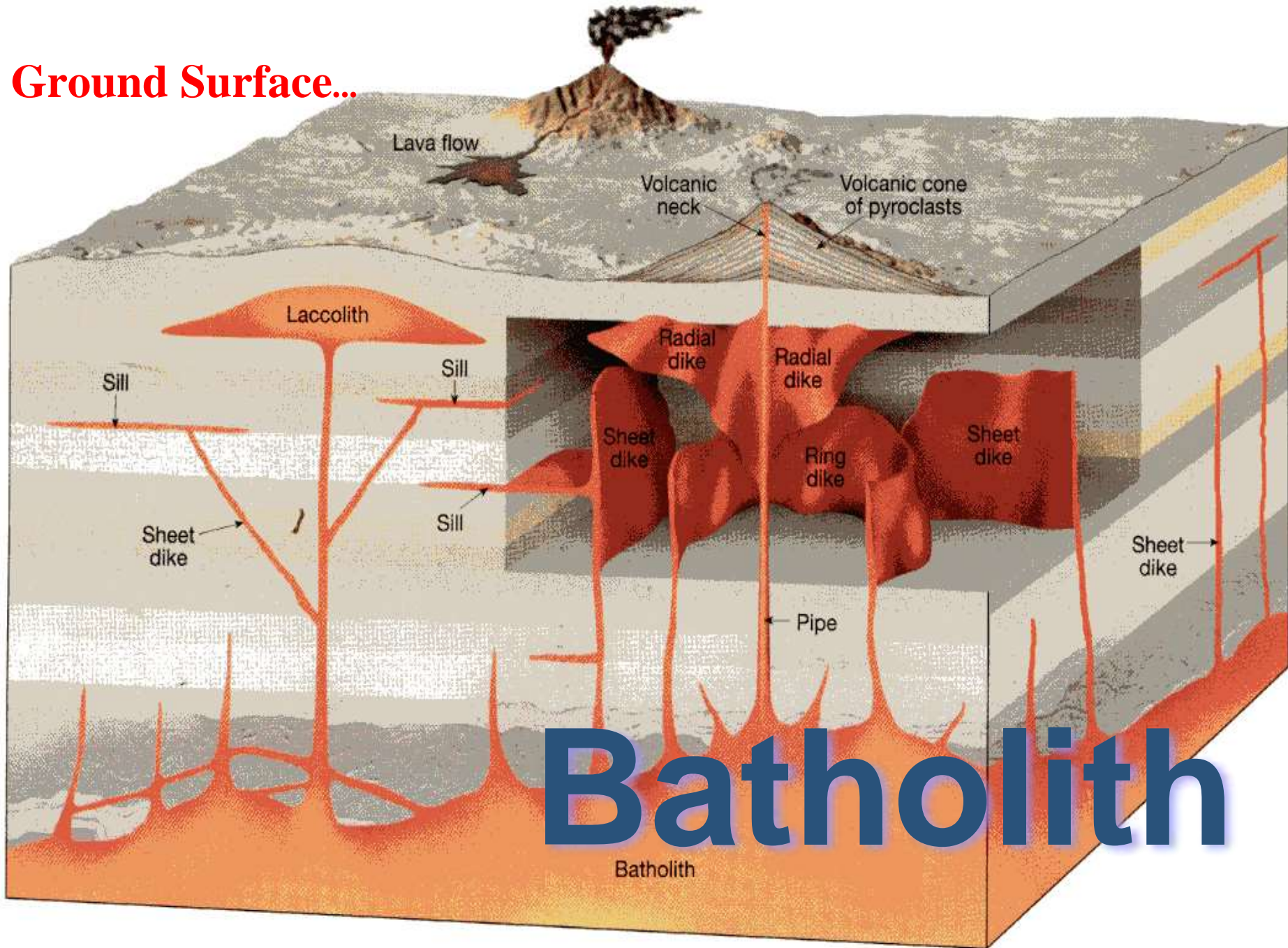
**Bath** = large liquid body...

you know...like the TUB!

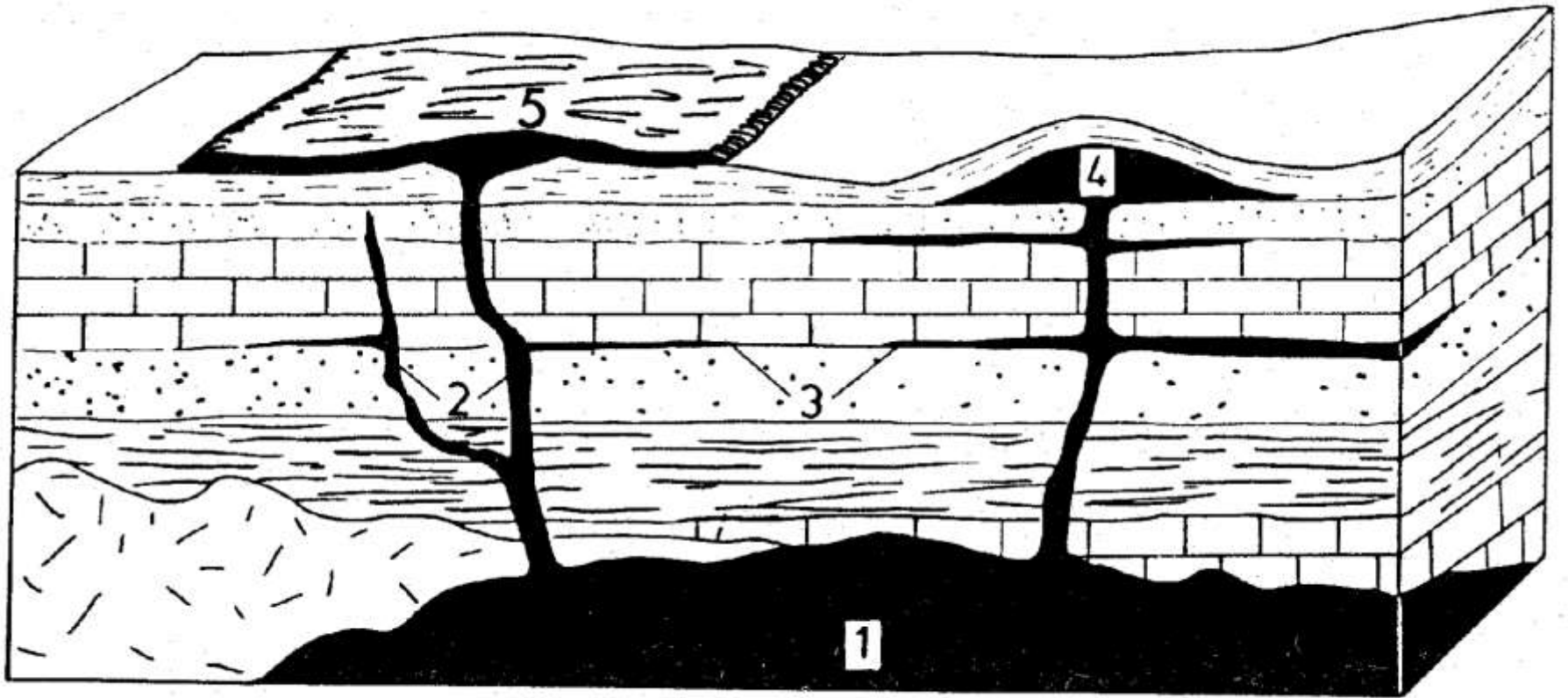
Therefore...

**BATHOLITH** = Rock formed from large liquid body

# Ground Surface...

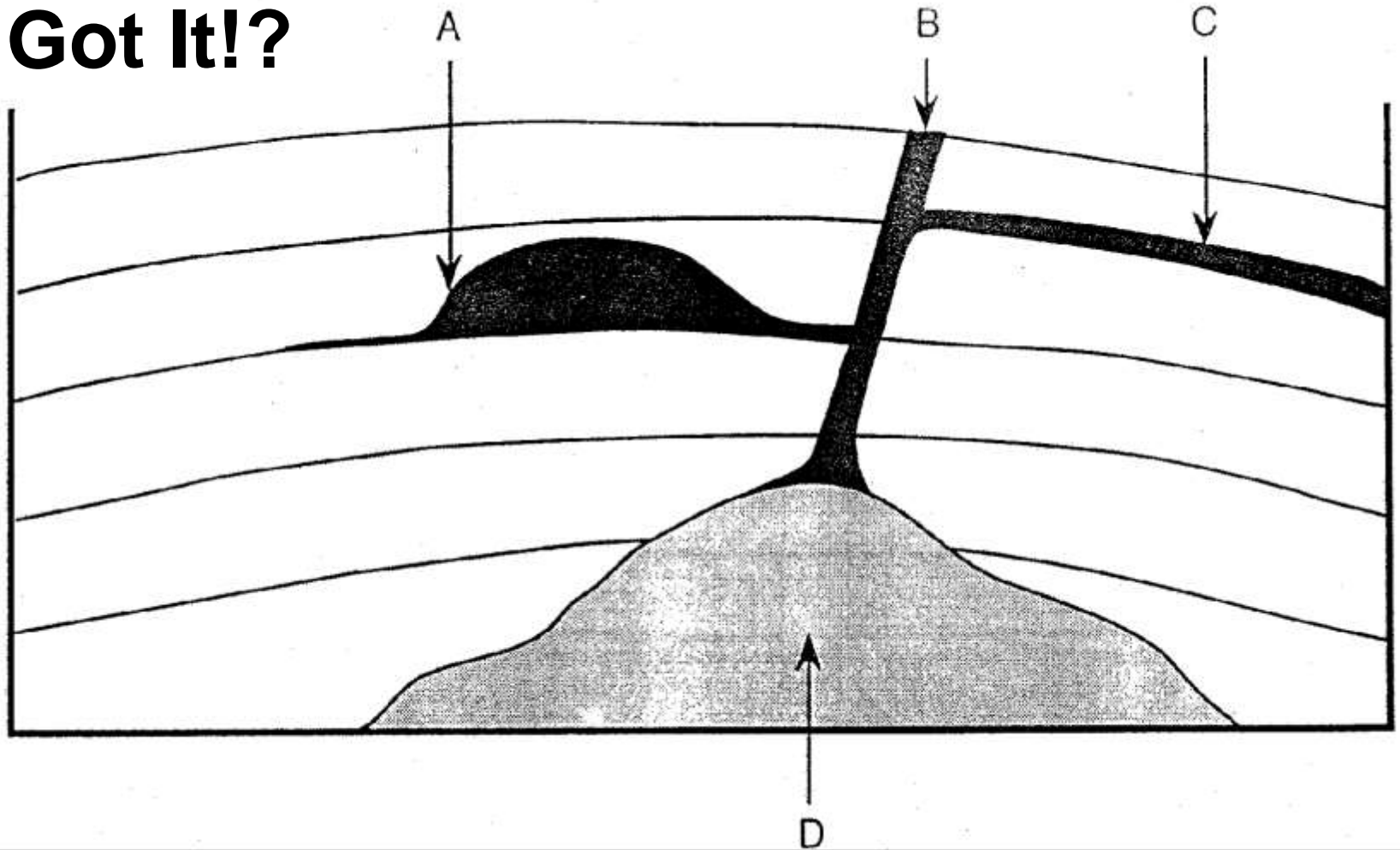


# Batholith



**Batholith**

**Got It!?**



**Batholith**

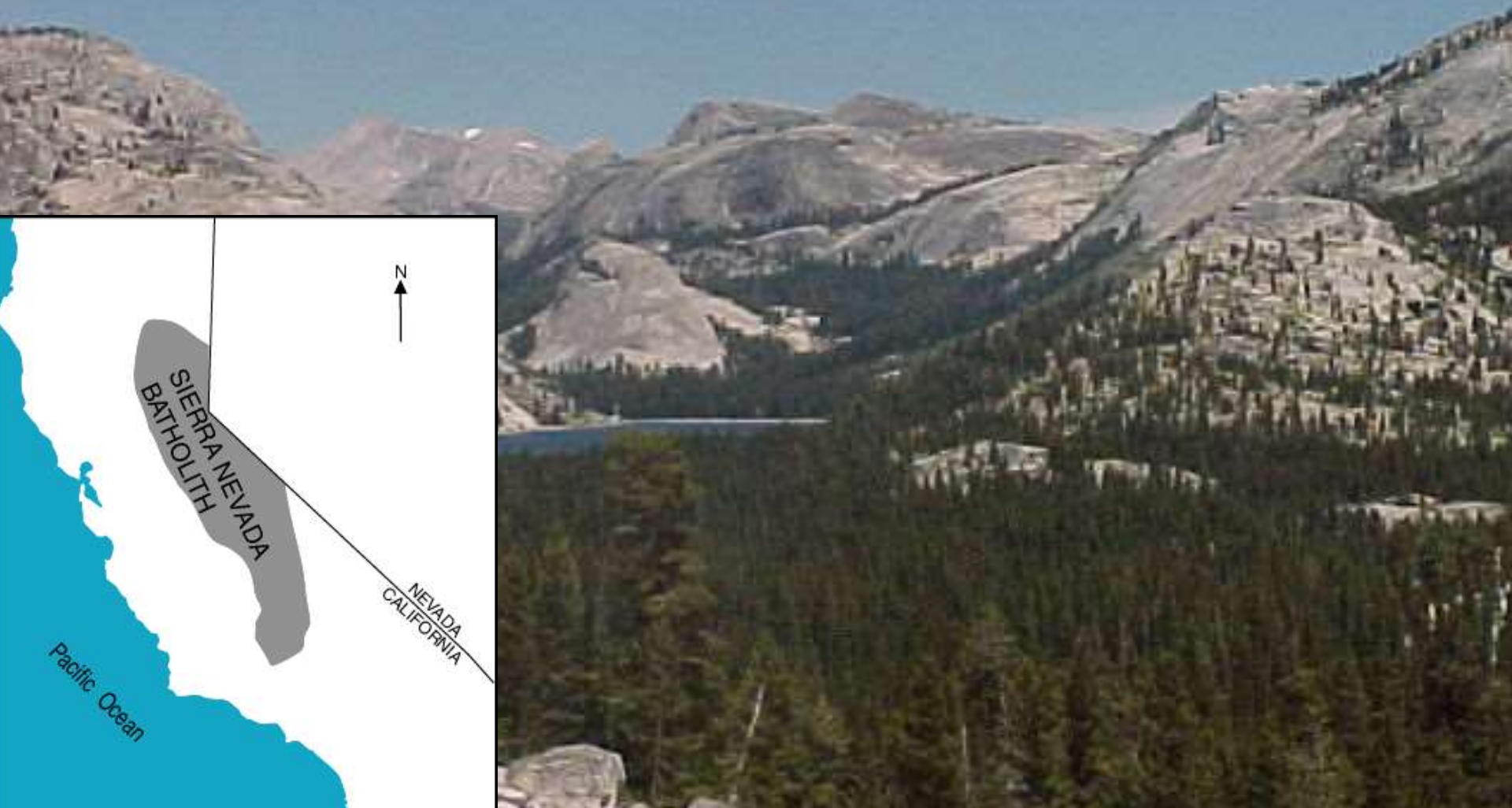
# Half-Dome in Yosemite Valley, California



**Same Thing  
Different View!**



# Half-Dome and El Capitan in Yosemite Valley are part of the Sierra Nevada Batholith



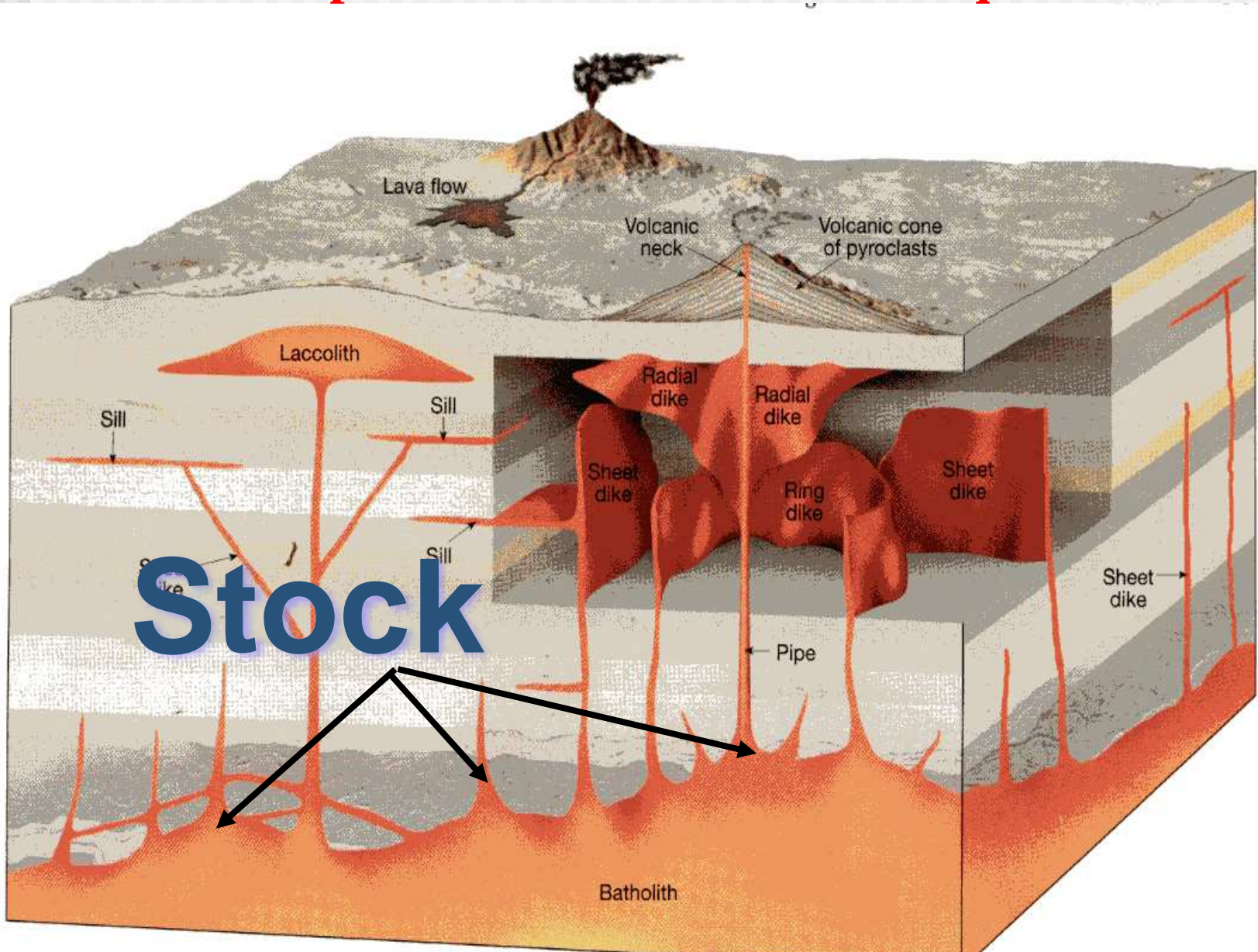


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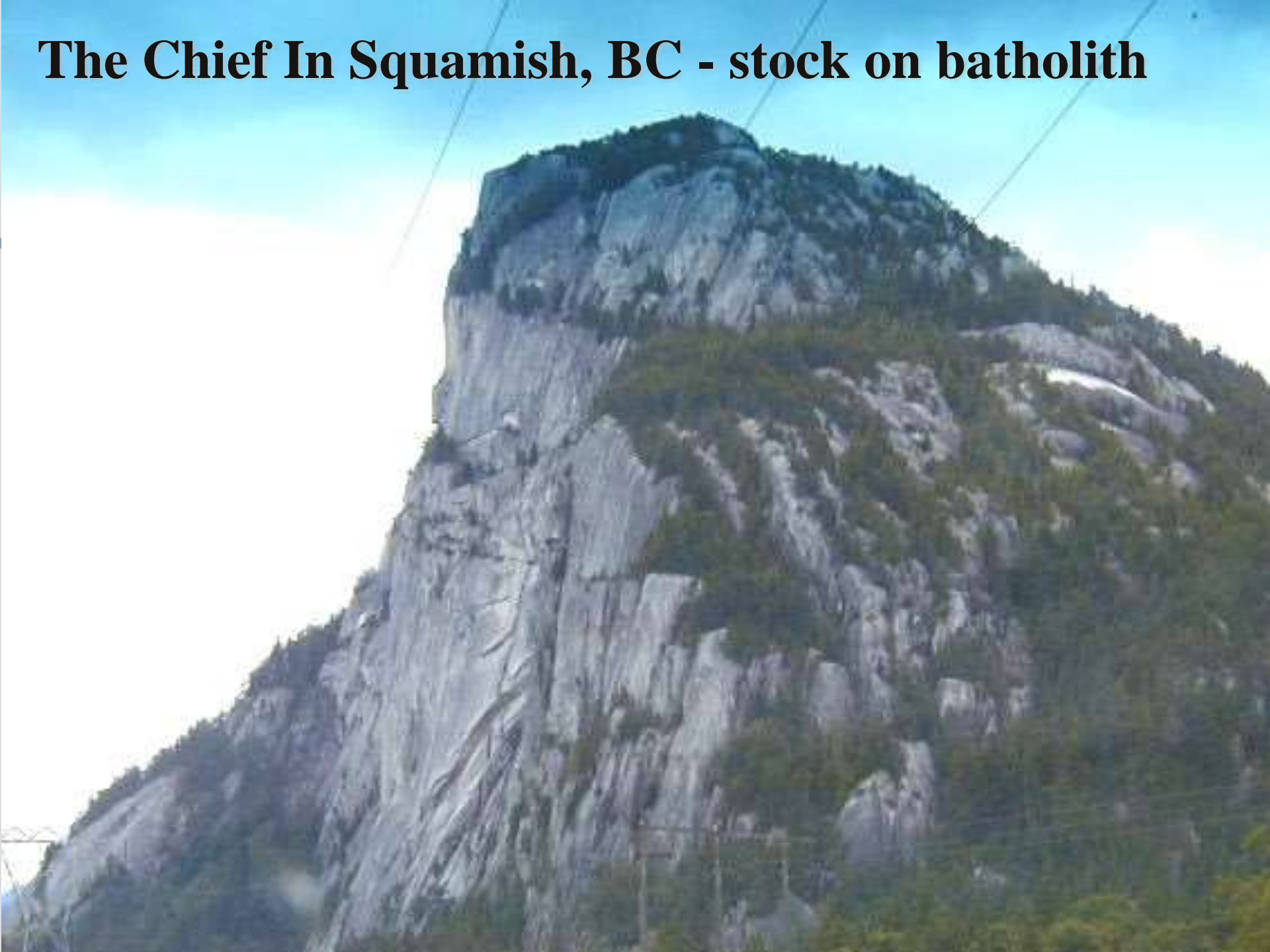
**Stock:**

Stocks are often the top bulges of batholiths.

Stocks have an exposed surface area of <100 square kilometres



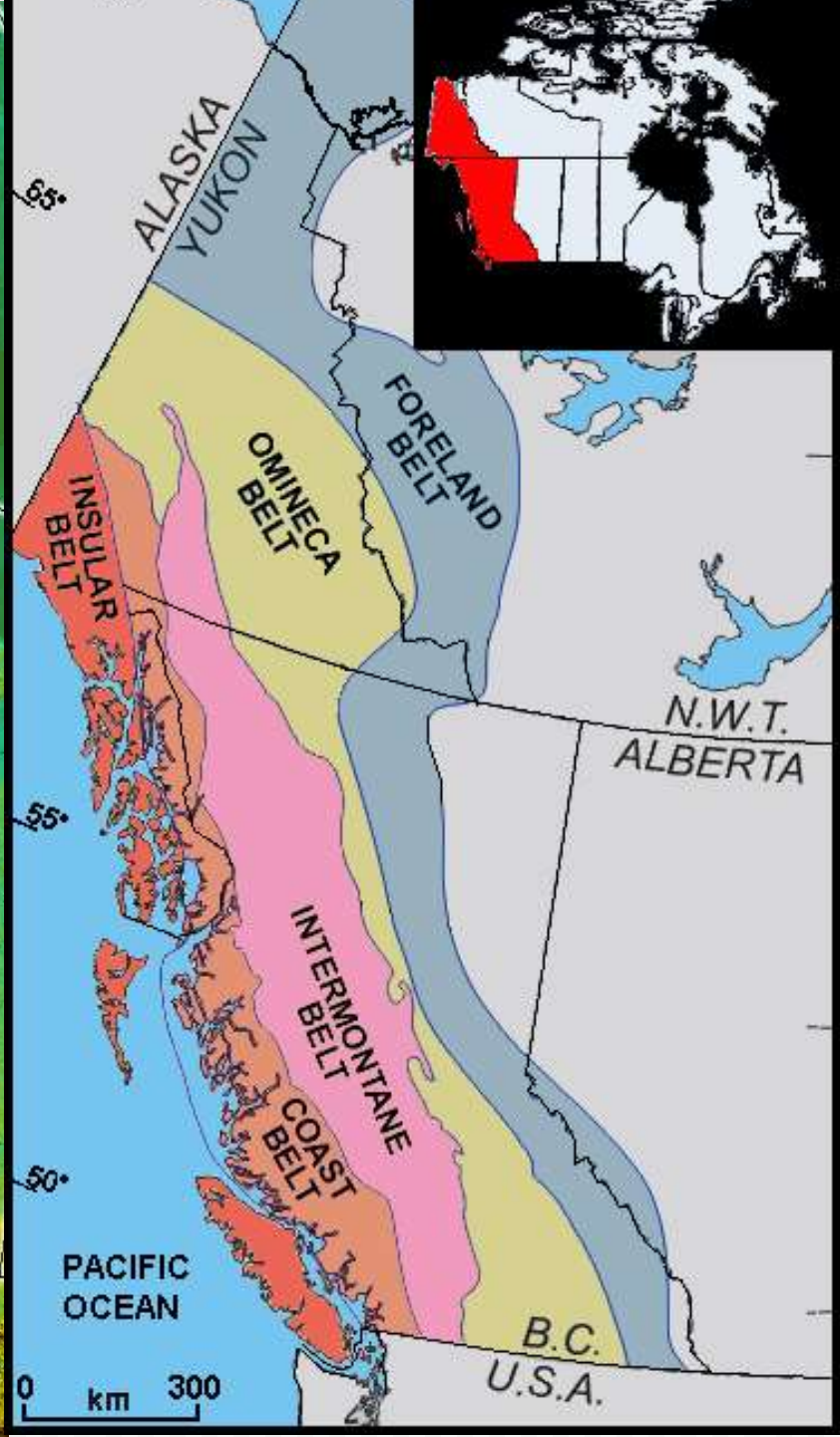
# **The Chief In Squamish, BC - stock on batholith**



Same Thing  
Different View!

- Part of the Coast Range Plutonic Complex

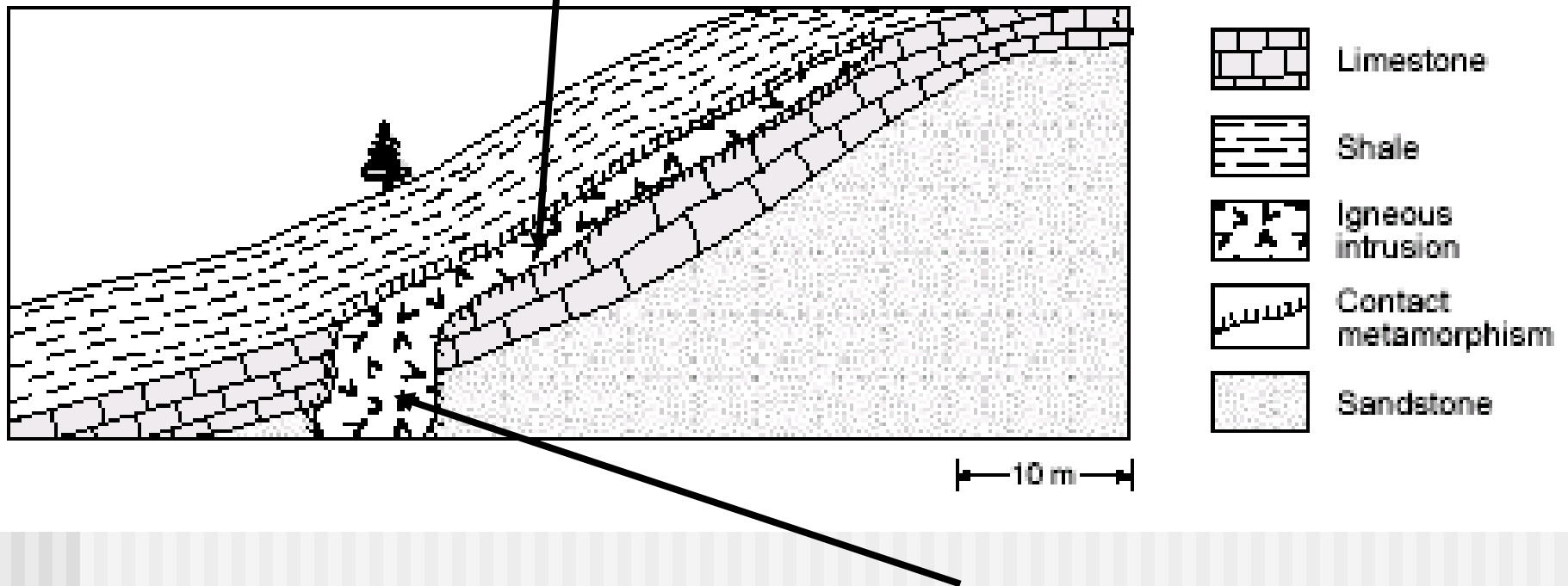




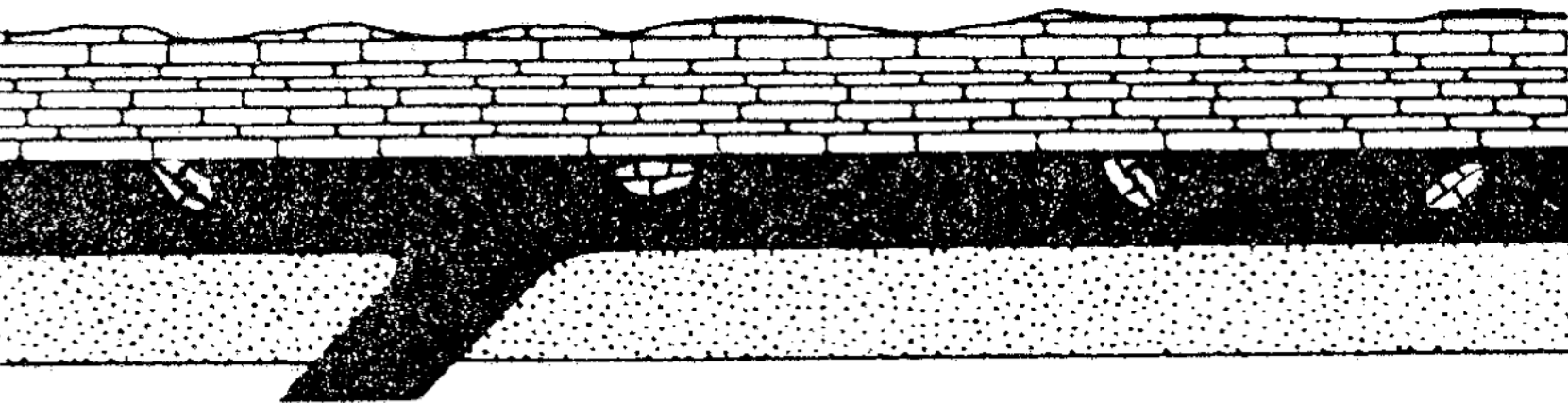
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**Sill:**

## A Sill = Horizontal to bedding plane

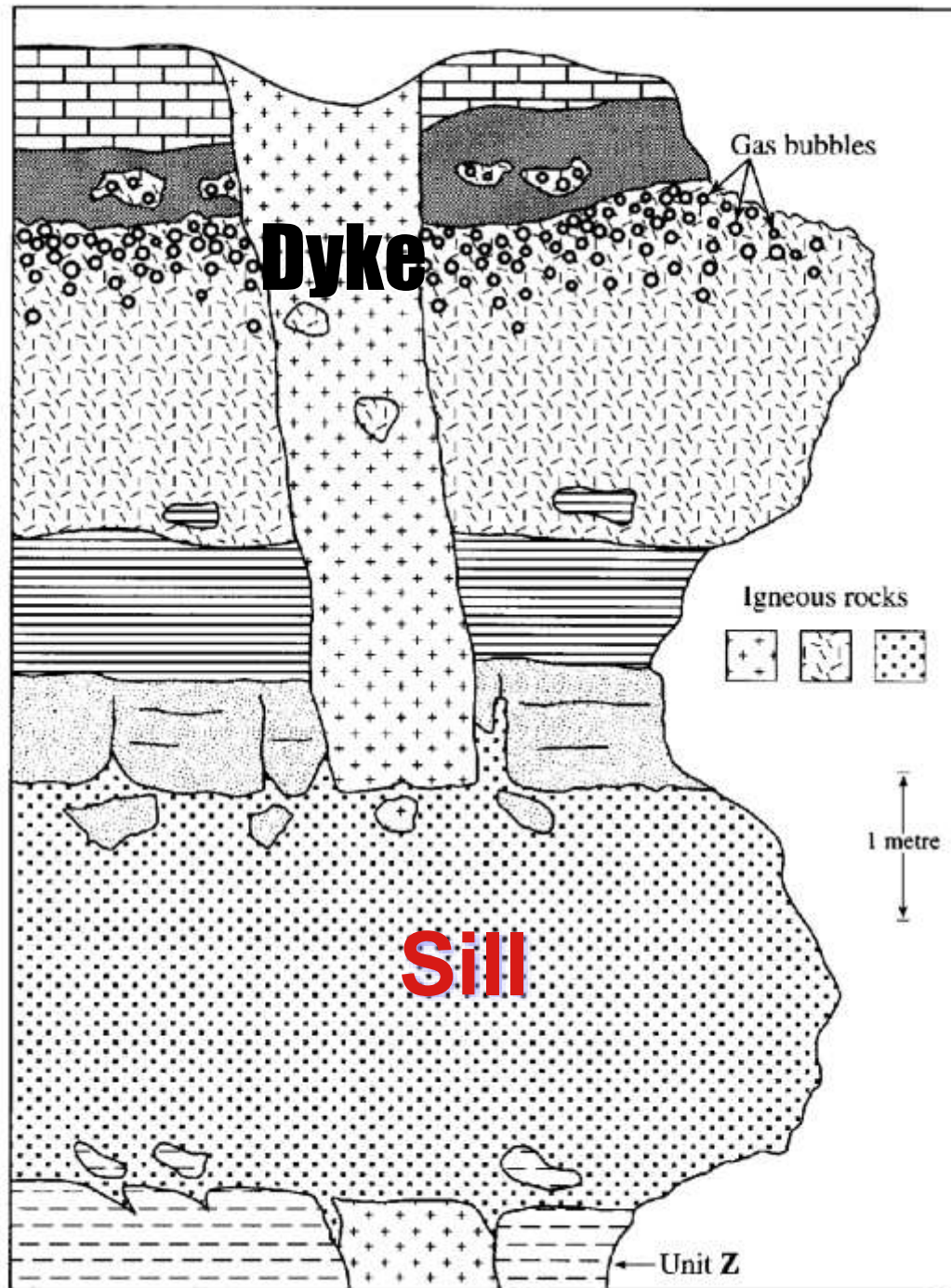


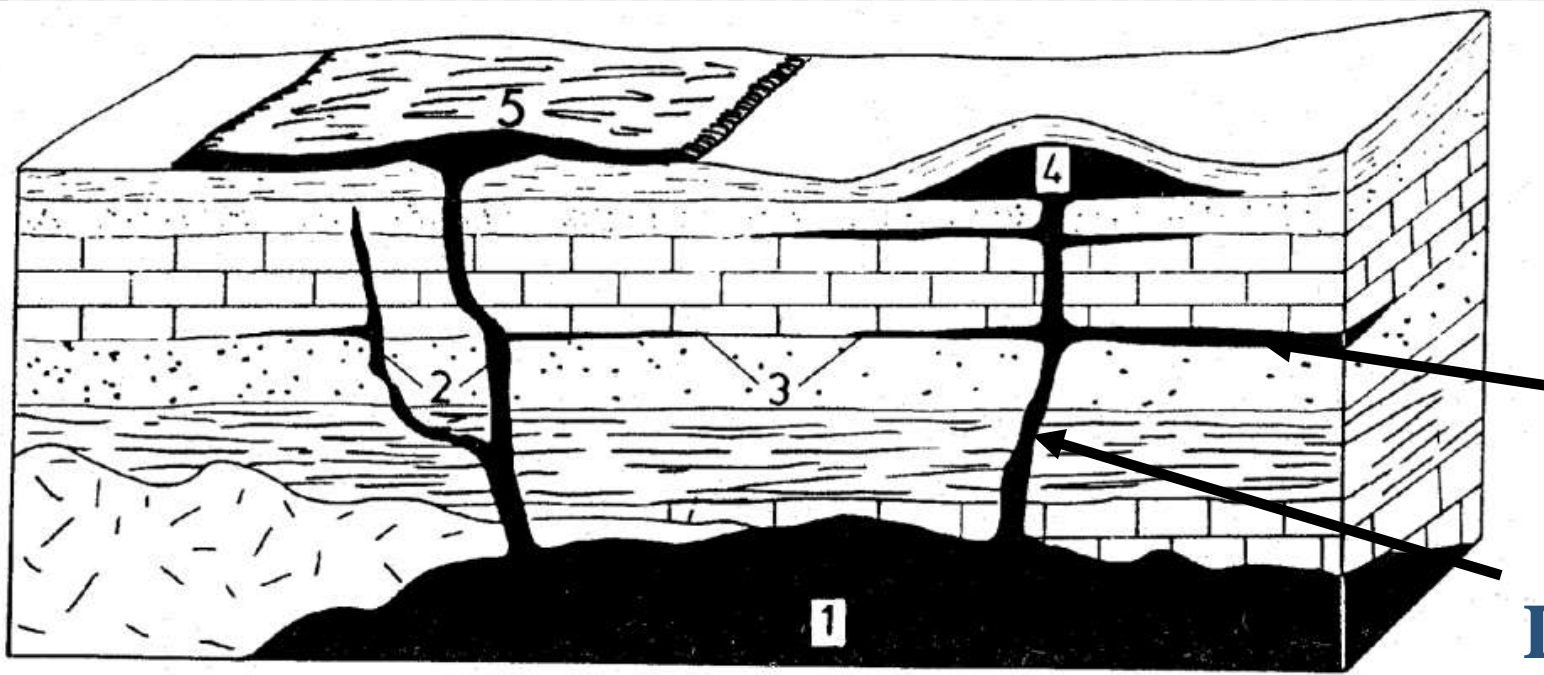
**\*\*Sills are between layers, while Dykes cut across layers!**



Sill



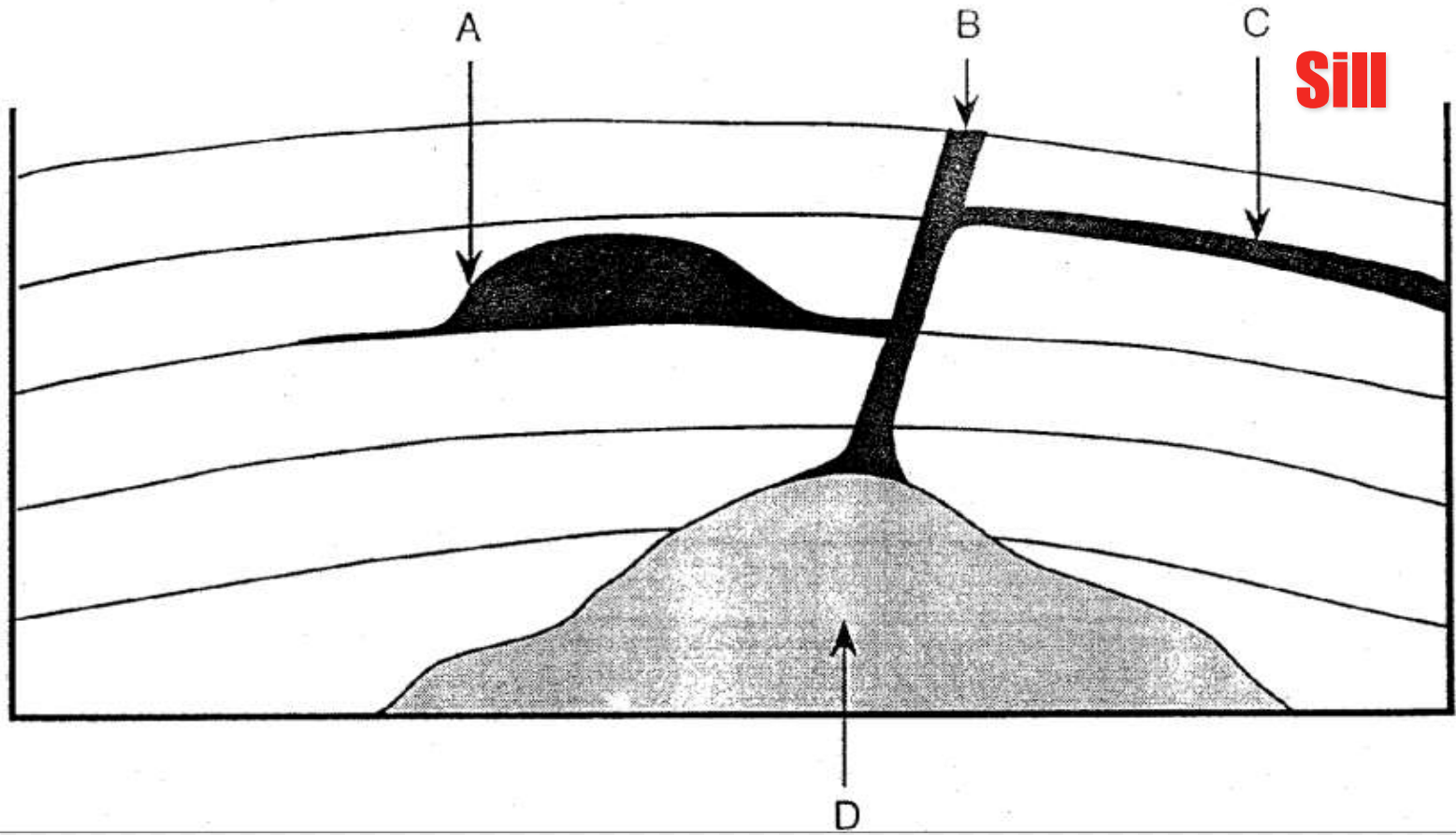




Sill

Dyke

Batholith

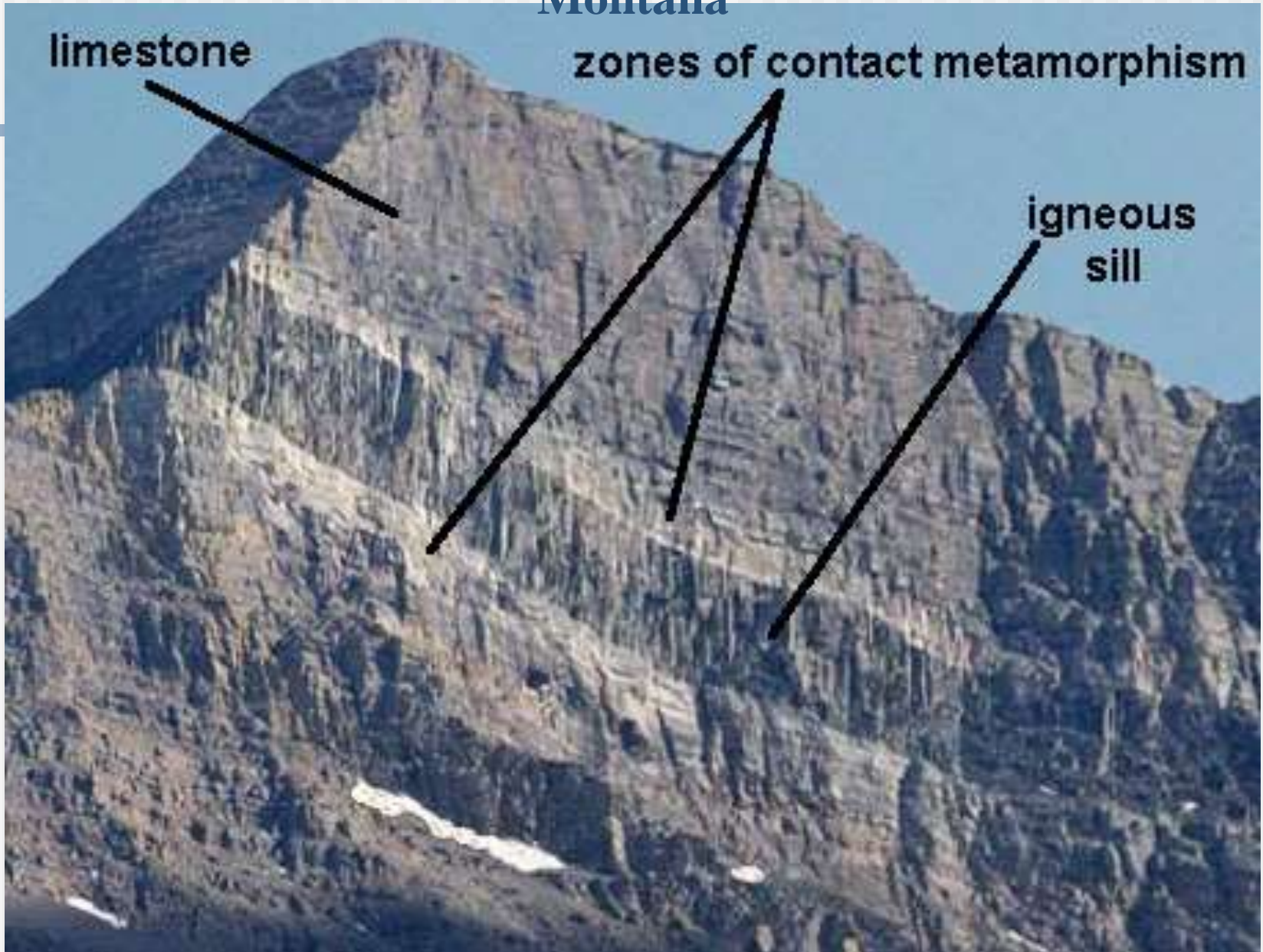


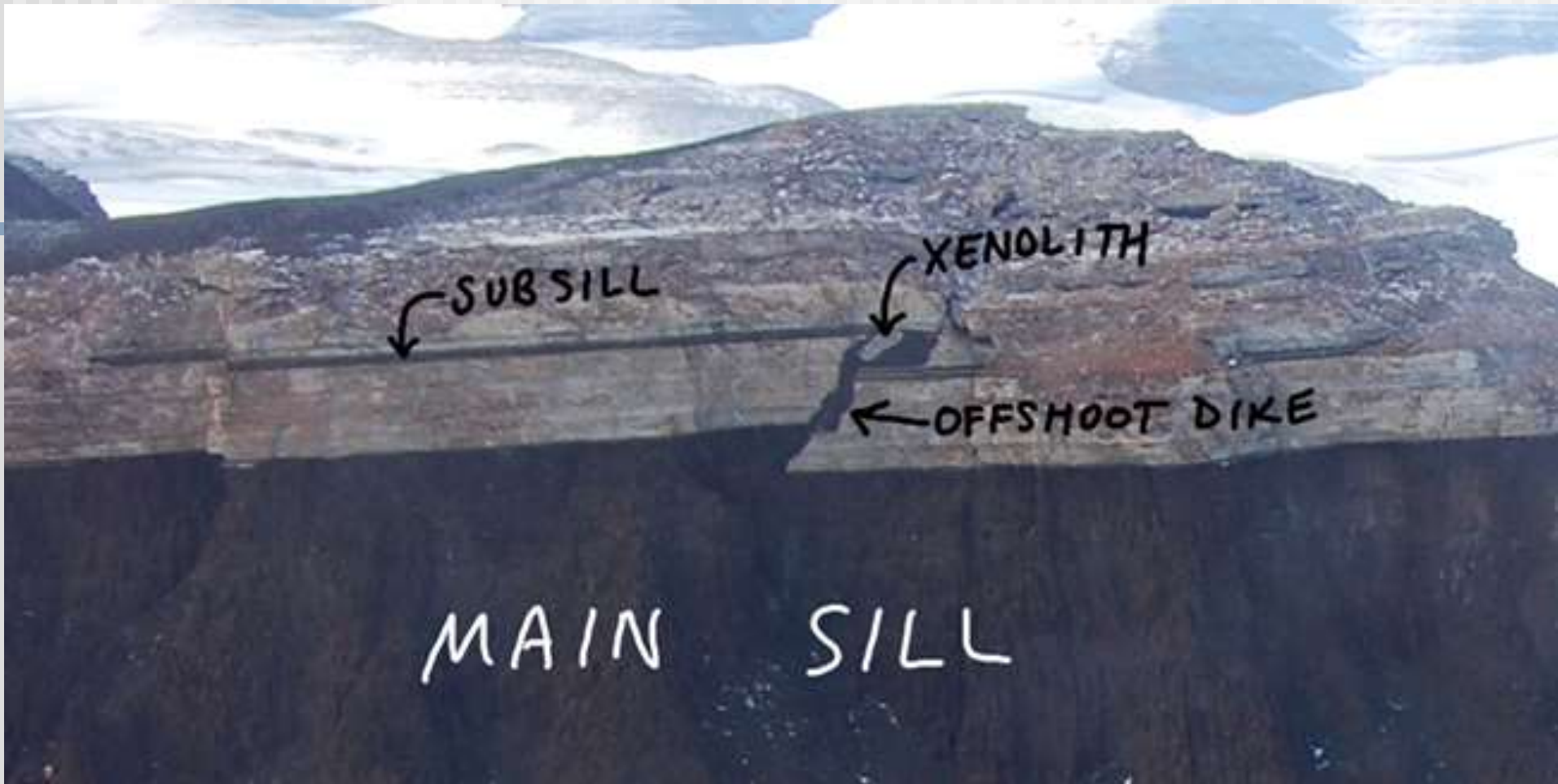
Batholith



**Sill**

# Glacier National Park, Montana





Sill in Antarctica

**Got It!?**

**Sill**

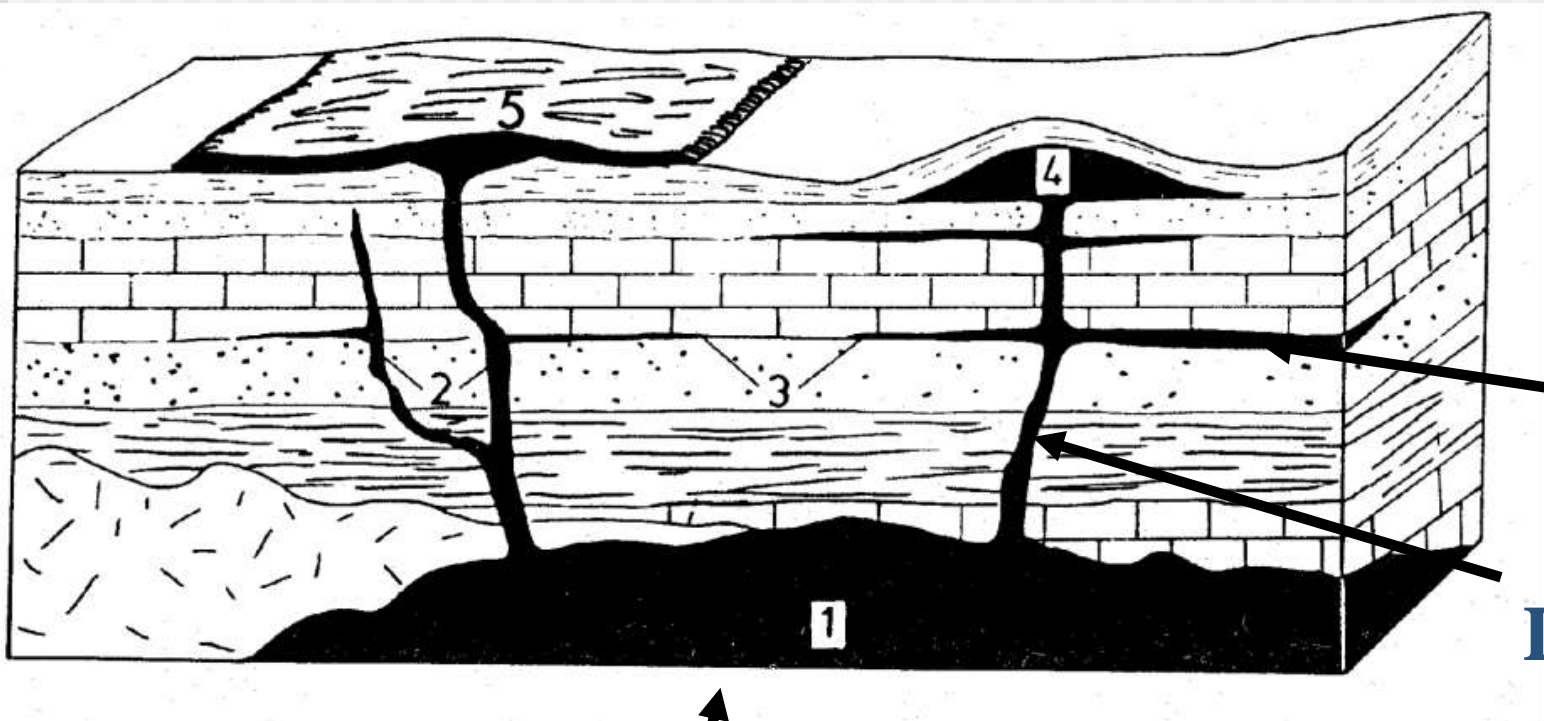


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**Dyke:**



**A dyke = crosses bedding planes**

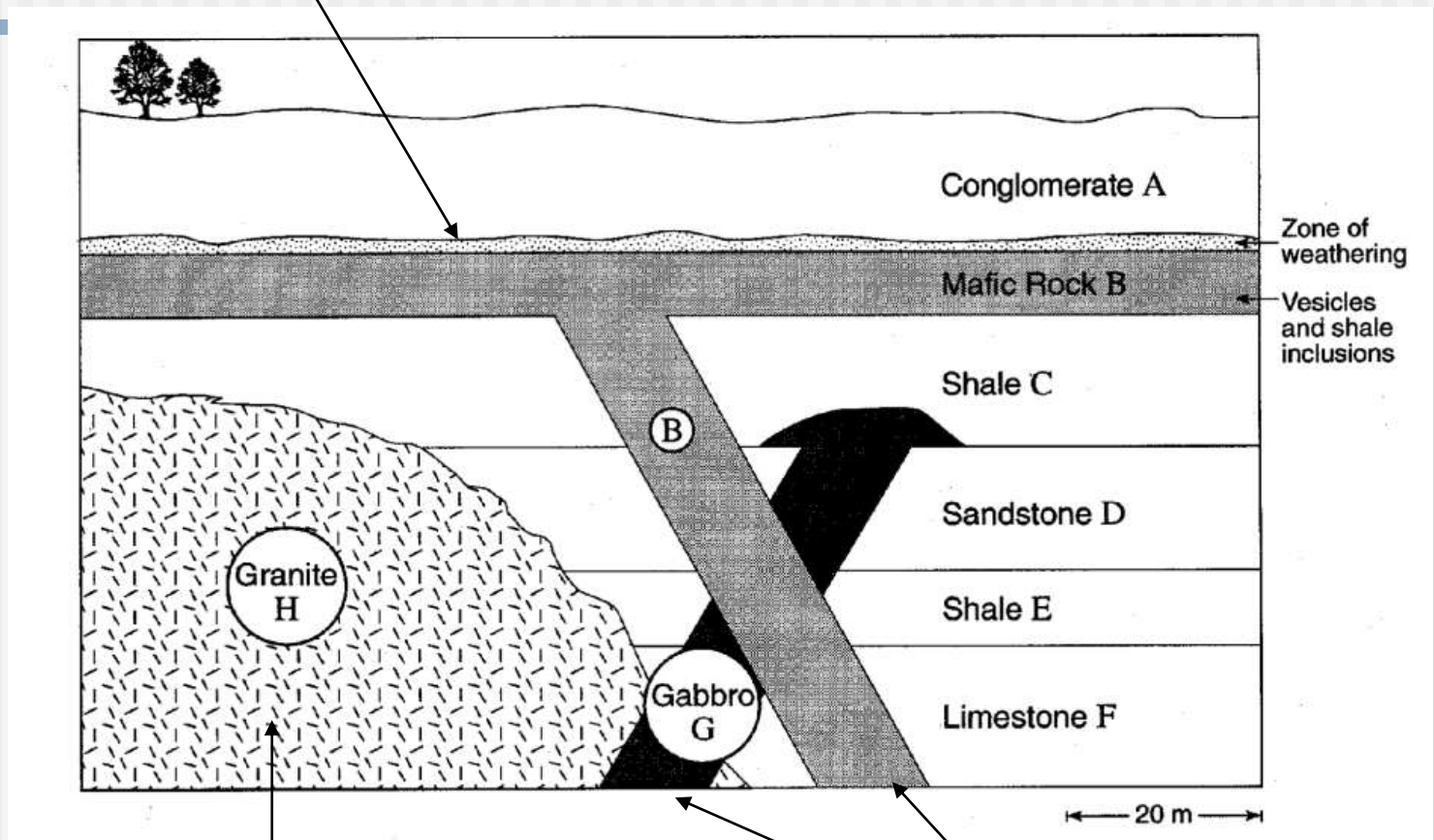


**Sill**

**Dyke**

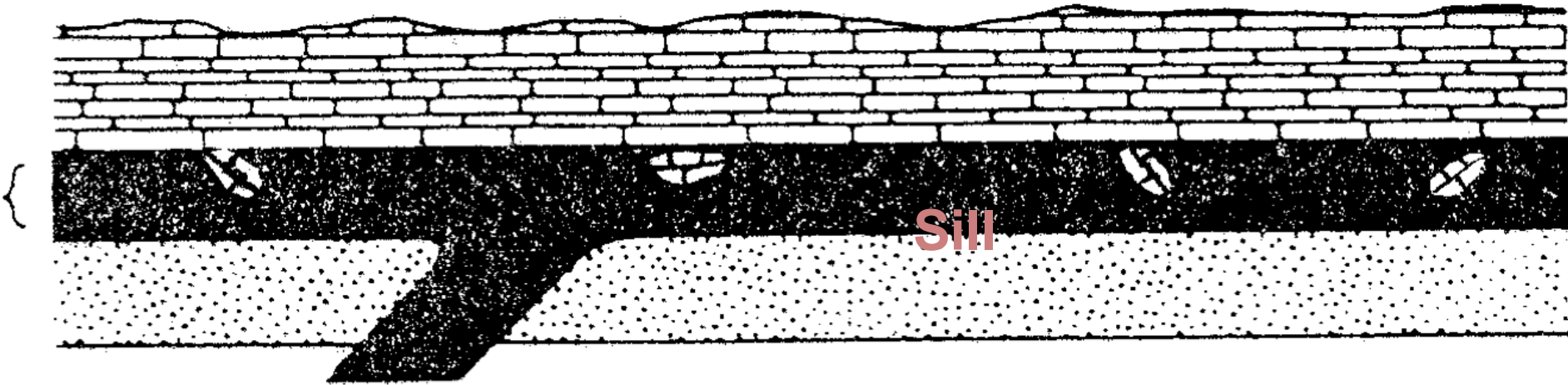
**Batholith**

# Sill



Batholith

Dykes



Sill

Dyke  
Dyke

# Basaltic / Mafic Dyke





**felsic dike**

1Y. 8M.  
DEC. 2 1994

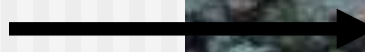
"Mafic" Dyke  
"Mafic" Dyke



mafic  
dyke

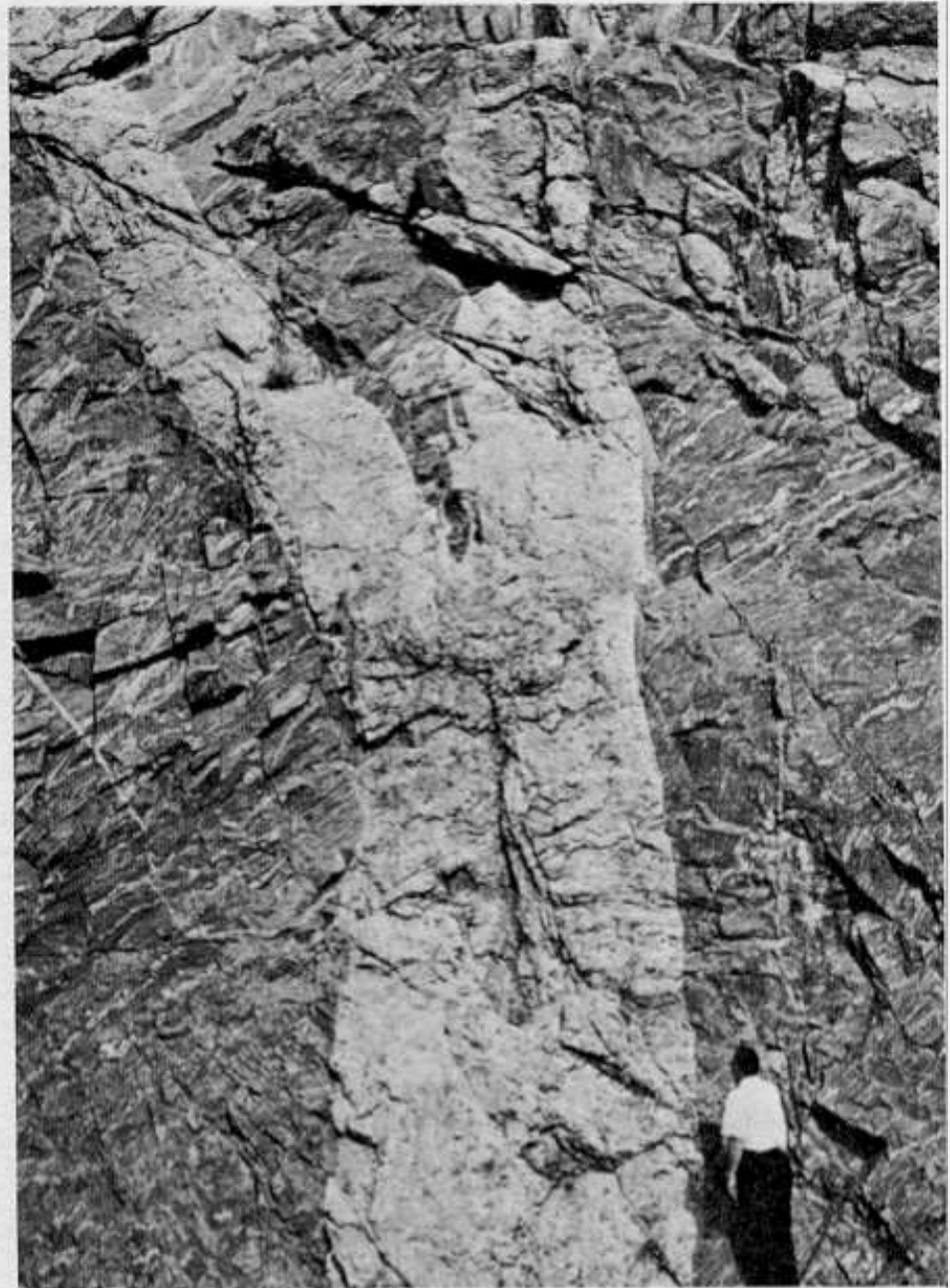


Nice Hat!



**Dyke or Sill?**

**Why?**





**Felsic  
Dykes/Sills**

**Mafic  
Country Rock**



**Also note how this small dyke stands higher than the rock surrounding it!**



**Why might this be so??**

If you look closely you will notice that the dyke is finer grained than the country rock.

This is because it cooled very quickly as it was surrounded by COOL country rock.

This means it is more dense than the surrounding country rock.

Because it is more dense...it is more resistant to weathering...

Therefore it weathers more slowly, and stands out higher than the surrounding rock which is weathering more quickly!

We call this phenomena “Differential Weathering”

Very Dense



Not So Dense!





Dyke



**Vertical ~40 mya  
cross-cutting  
mafic dyke**

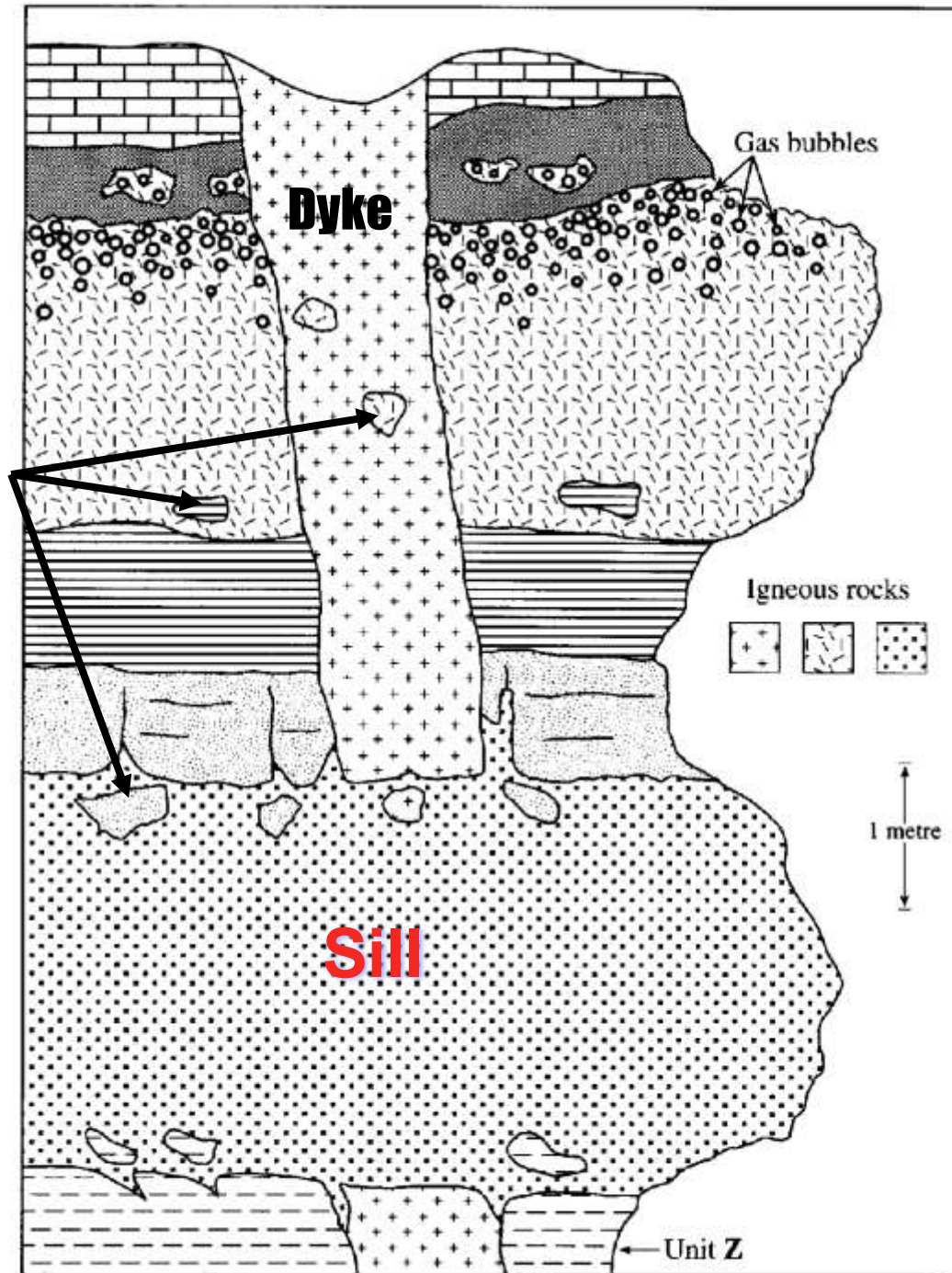
**Got It!?**



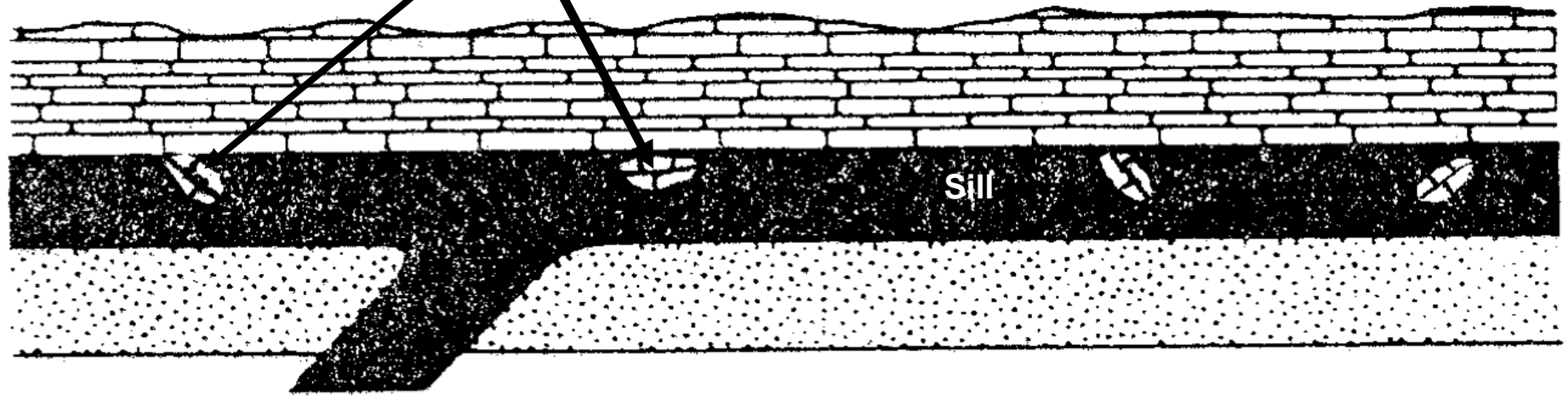
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# Xenoliths:

# Xenoliths



Xenolith



Sill

Dyke



A photograph of a rock sample showing a xenolith within an igneous intrusion. The top portion of the image is a light-colored, speckled rock labeled "Country Rock". Below it is a dark, fine-grained rock labeled "Igneous Intrusion". Within the intrusion is a lighter-colored, speckled rock labeled "Xenolith". A ruler is placed vertically next to the xenolith for scale, showing it is approximately 10 cm high. A black arrow points from the text "Xenolith" to the xenolith. A blue horizontal line is positioned above the "Igneous Intrusion" label.

**Country Rock**

**Igneous Intrusion**

**Xenolith**

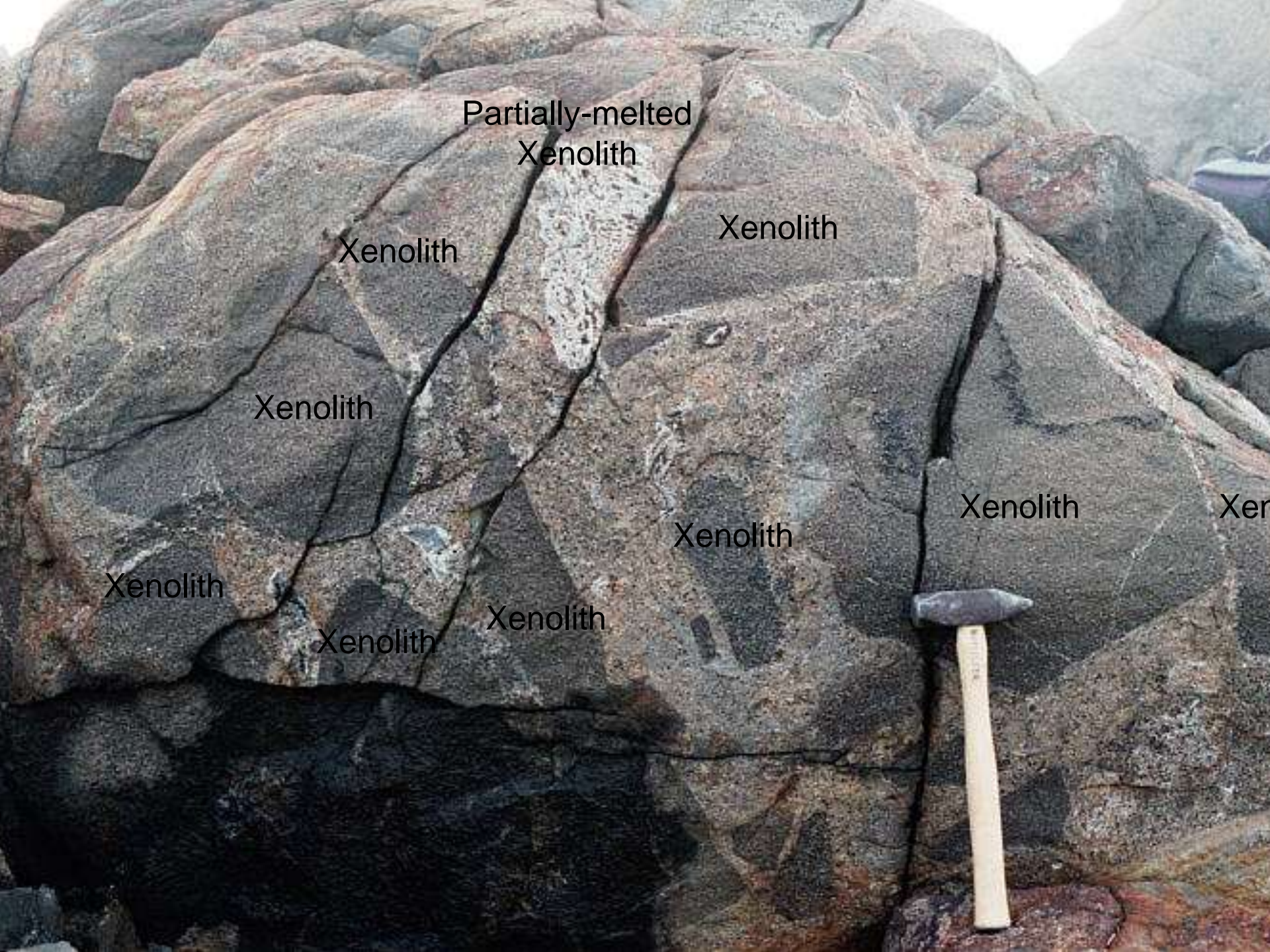
The result of incomplete  
Wall Rock Assimilation

This xenolith is from West Vancouver!





Xenolith



Partially-melted  
Xenolith

Xenolith

Xenolith

Xenolith

Xenolith

Xenolith

Xenolith

Xenolith

Xenolith

Xenolith

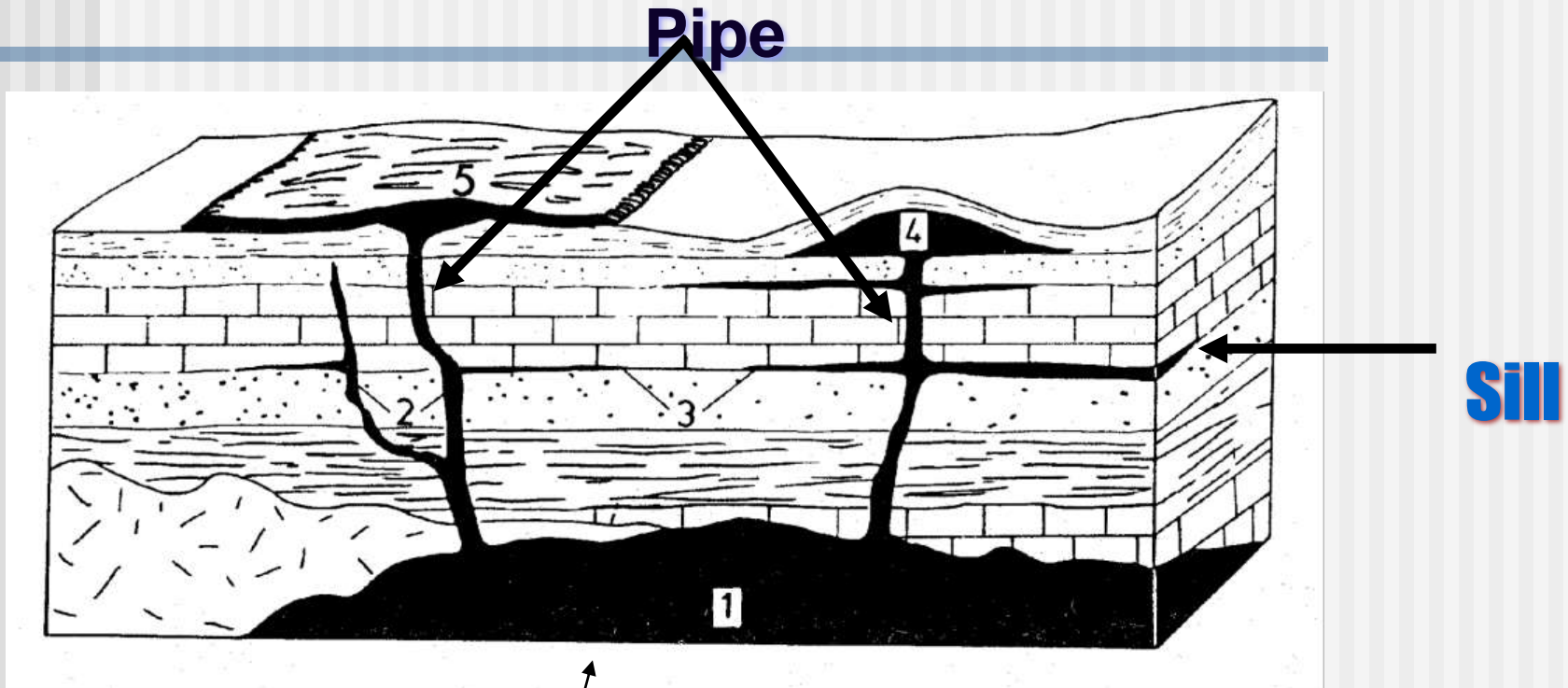


**Xenoliths**

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# Pipe or Diatreme:

Pipes are usually feeder conduits to volcanoes or other intensive igneous bodies

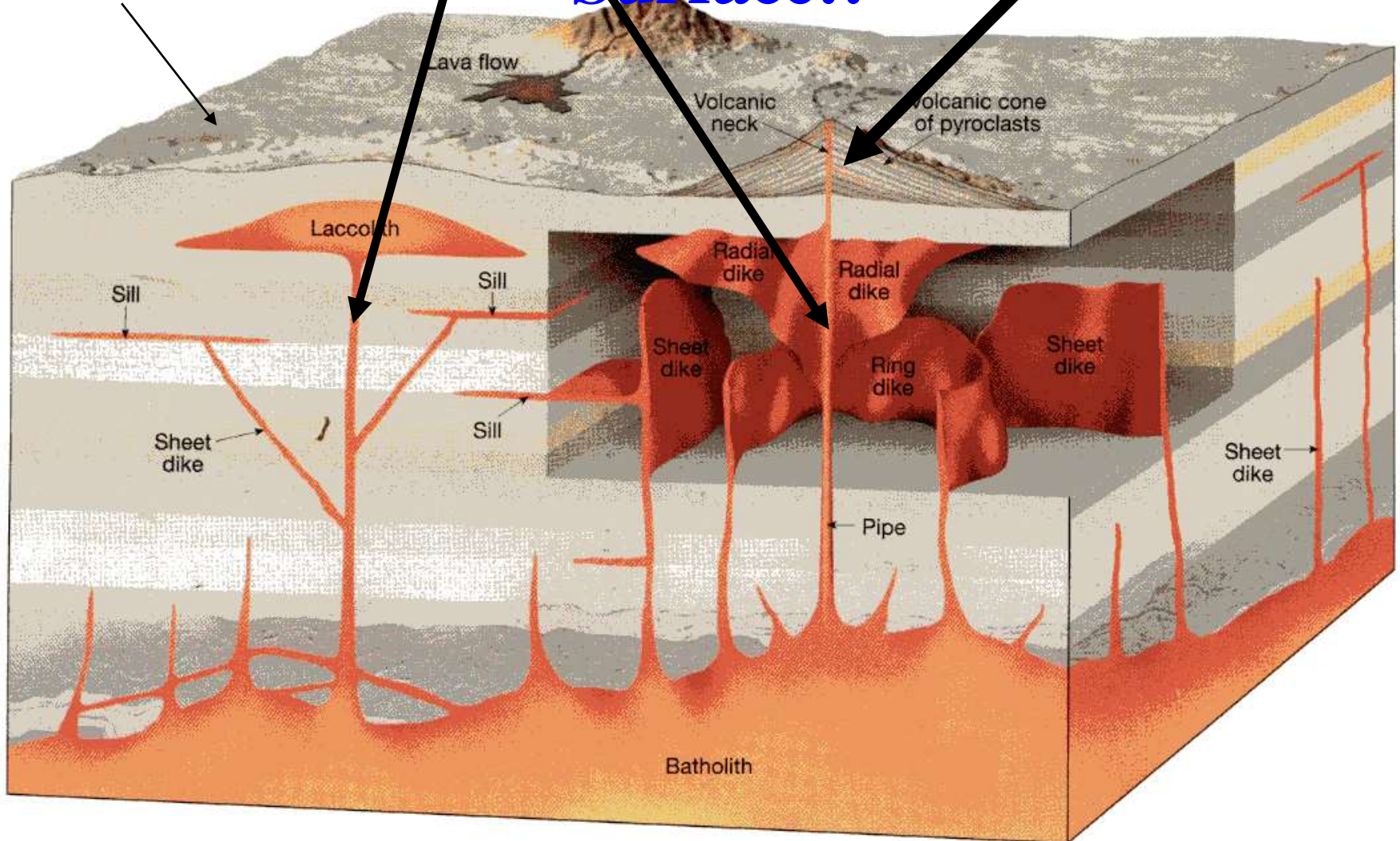


**Batholith**

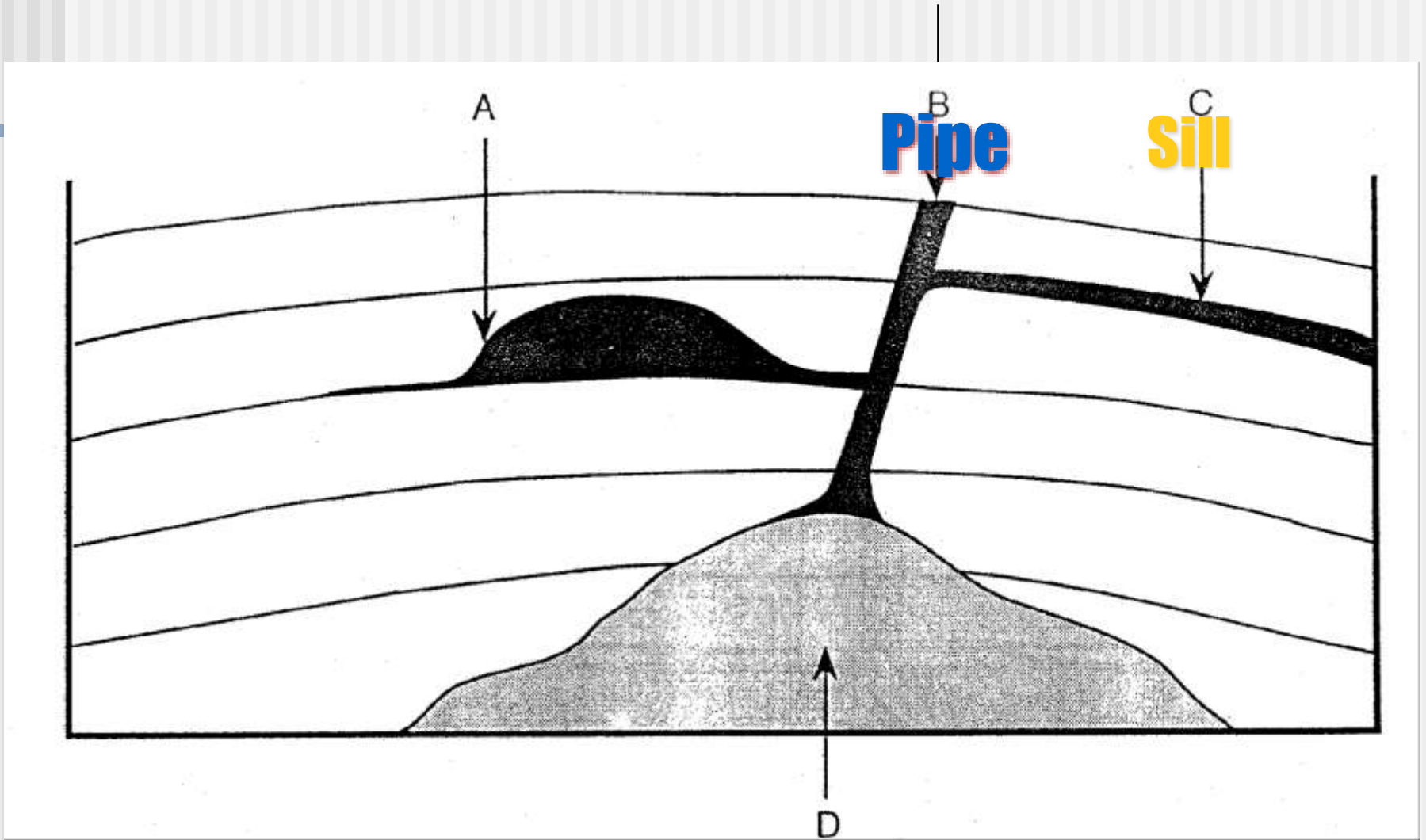
# Pipe or Diatreme when **below** ground surface!!

Neck When Above Ground Surface!!

Ground Surface...





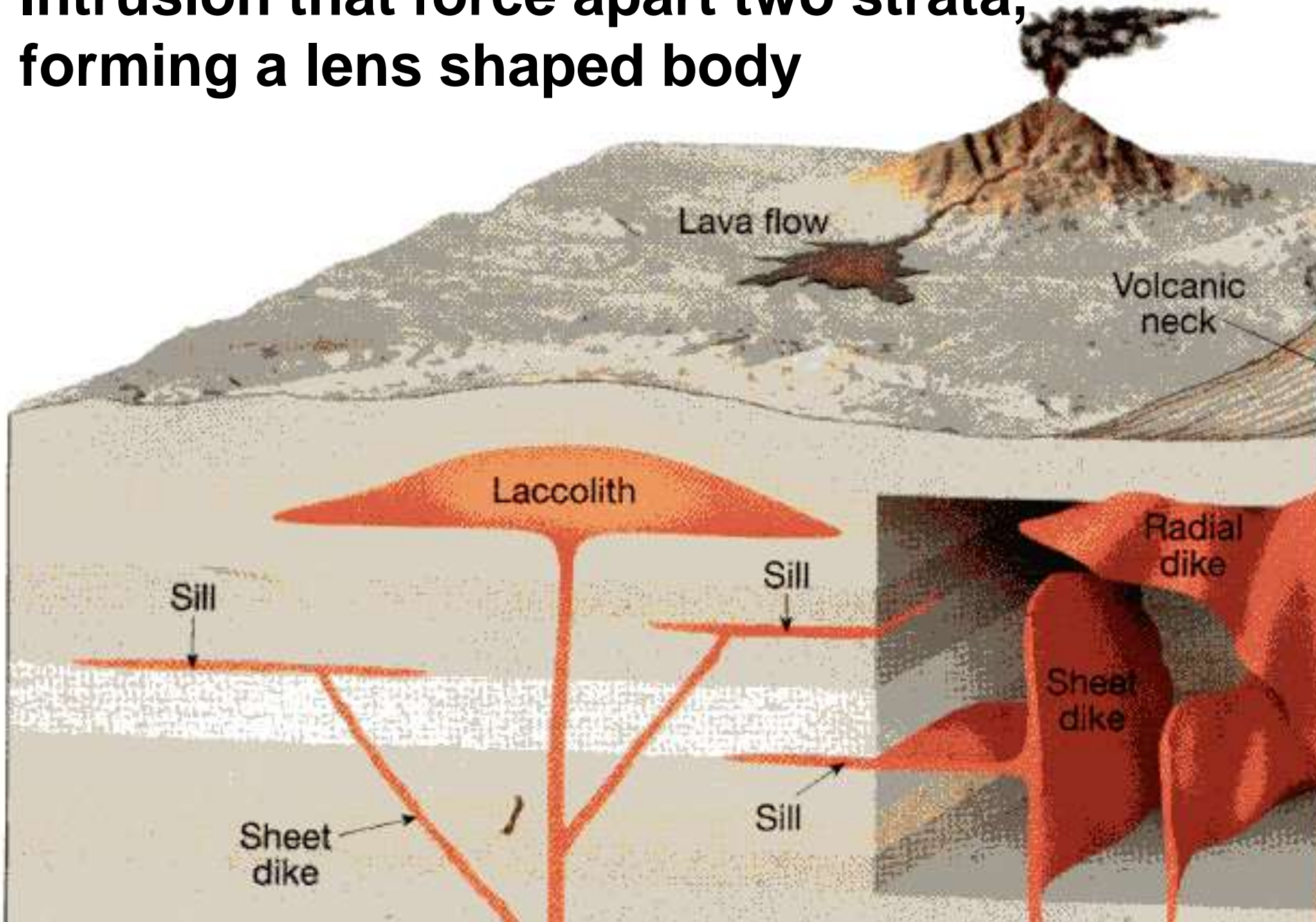


Batholith

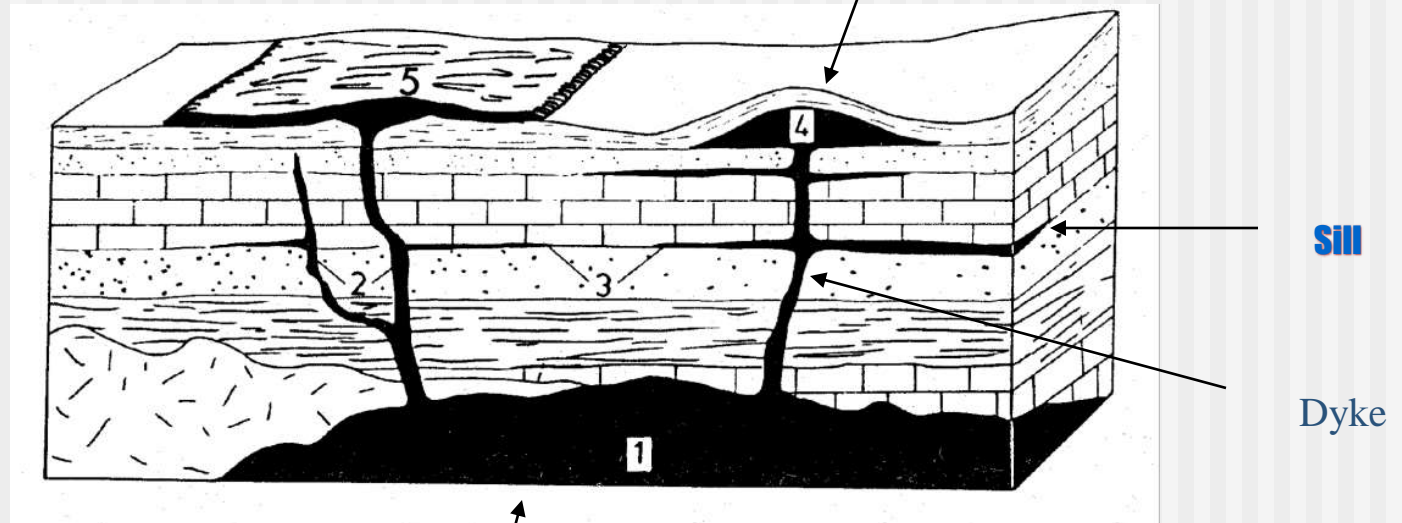
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# **Laccolith or Lopolith:**

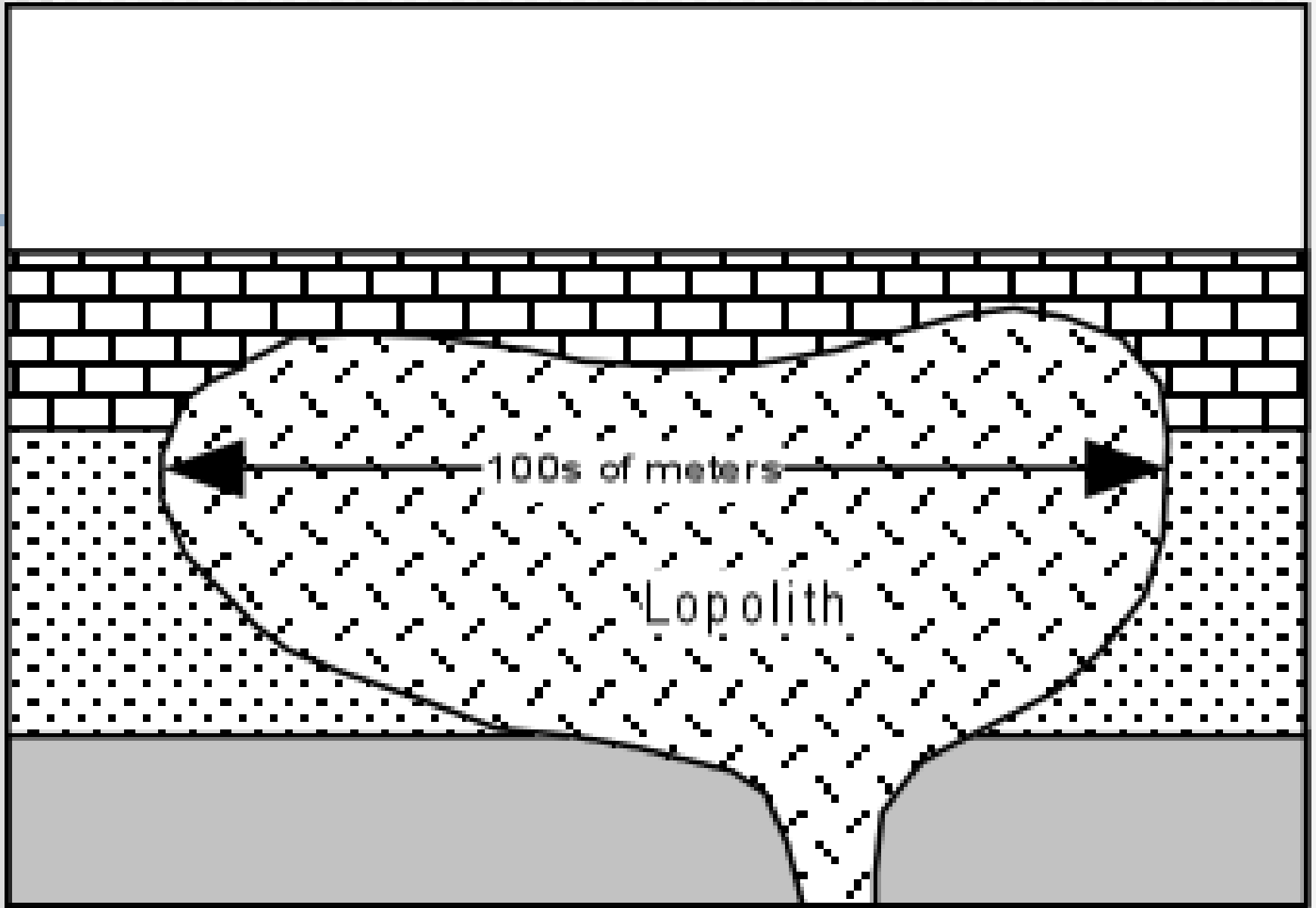
# Intrusion that force apart two strata, forming a lens shaped body

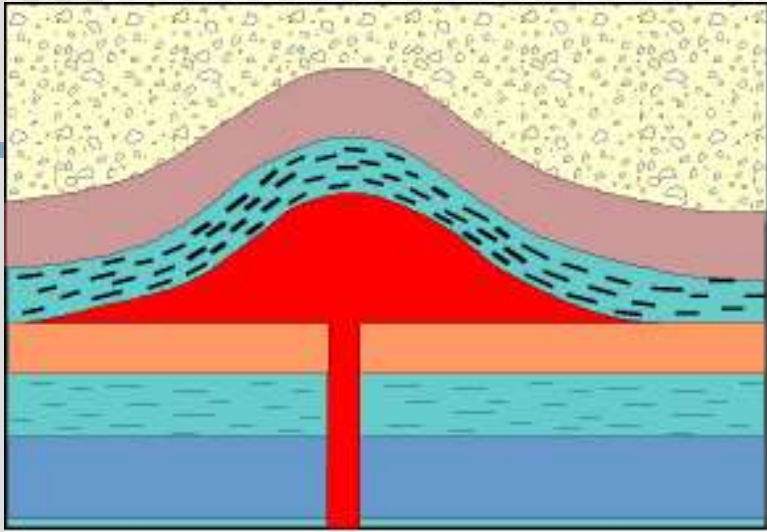


# Laccolith

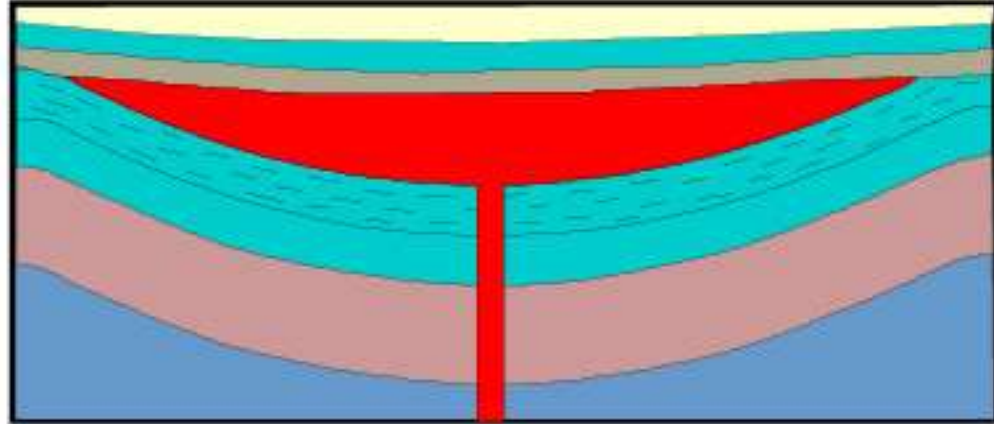


# Batholith





a



b

Which is Which?

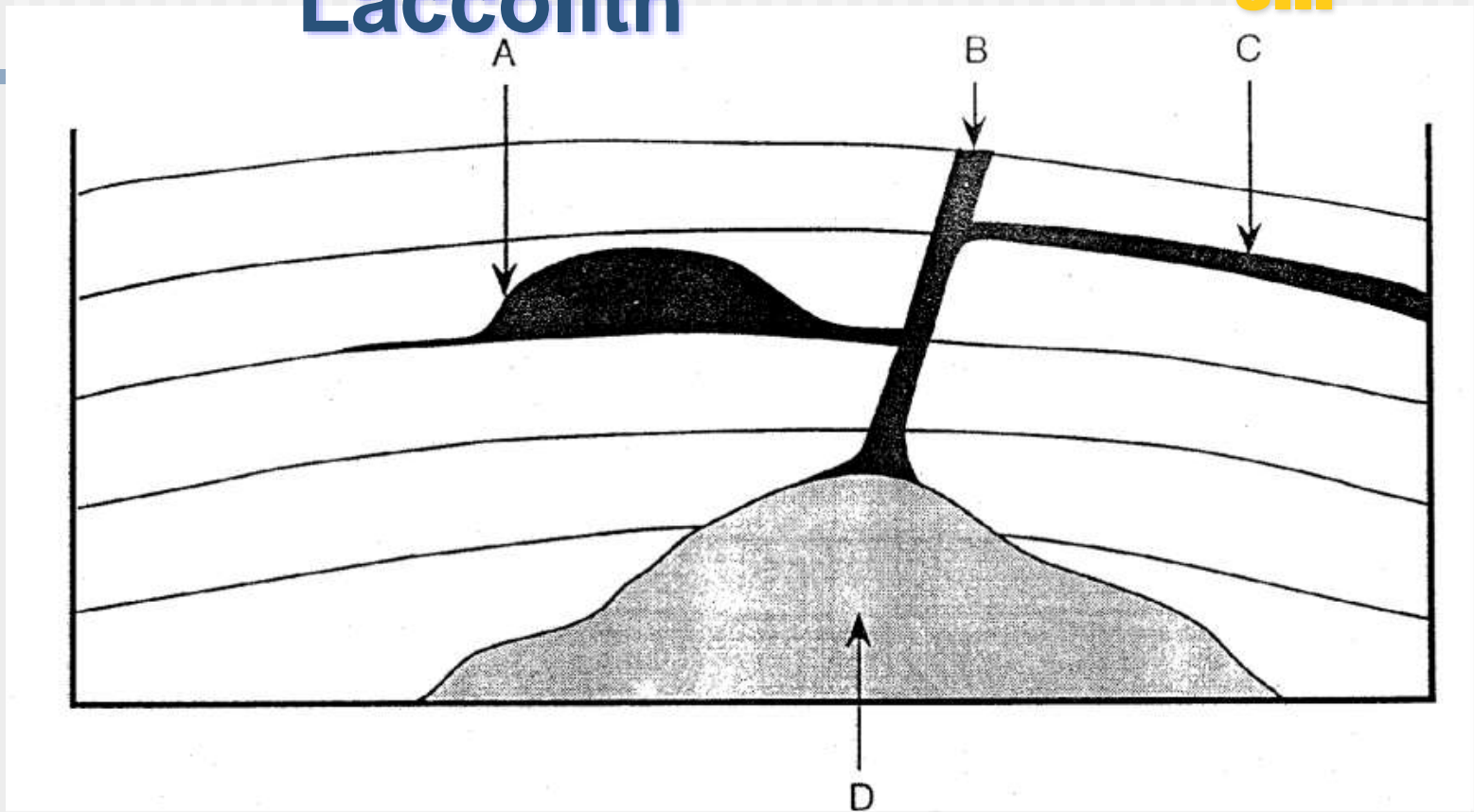
**Laccolith**

**Lopolith**

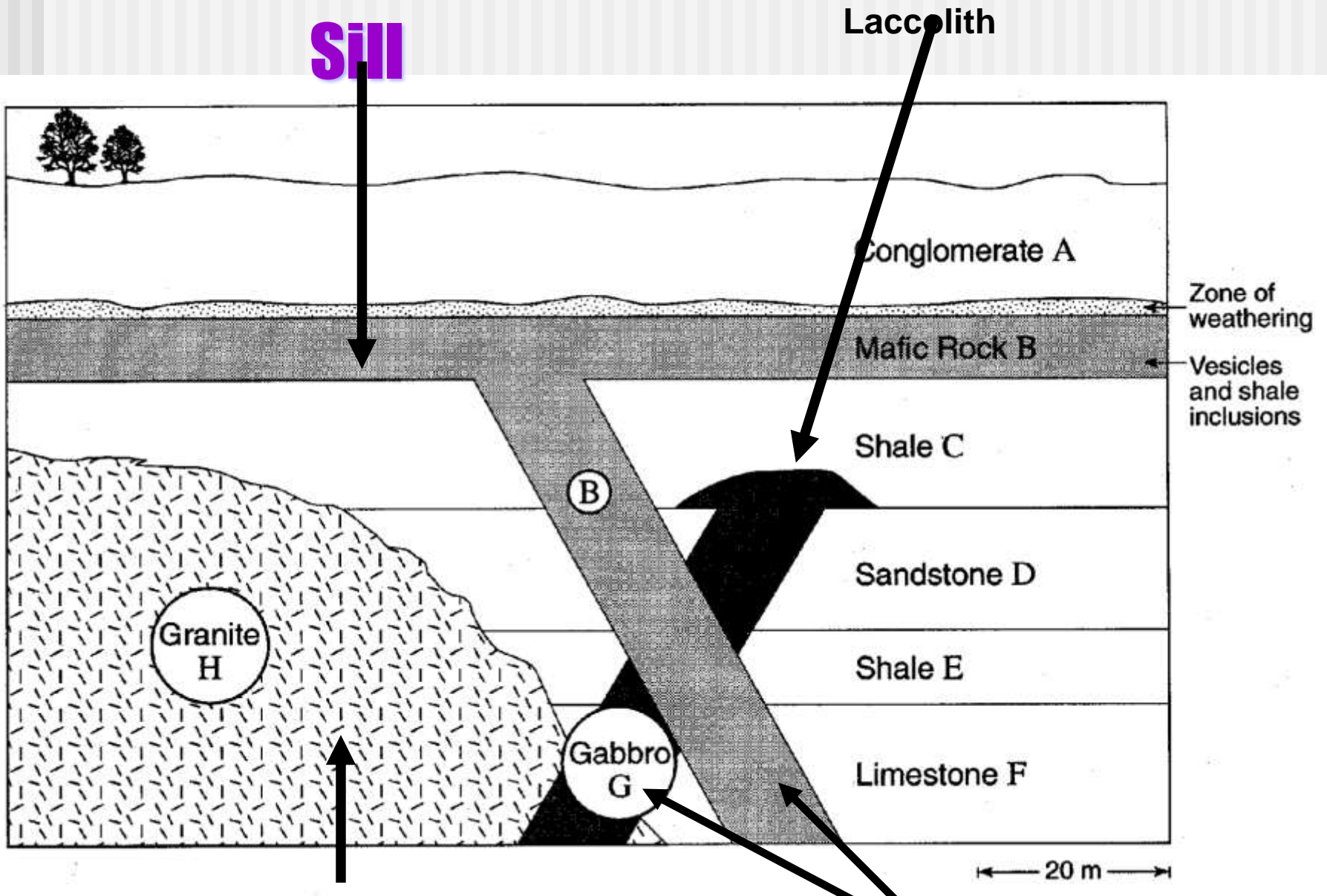
**Laccolith**

**Pipe**

**Sill**



**Batholith**



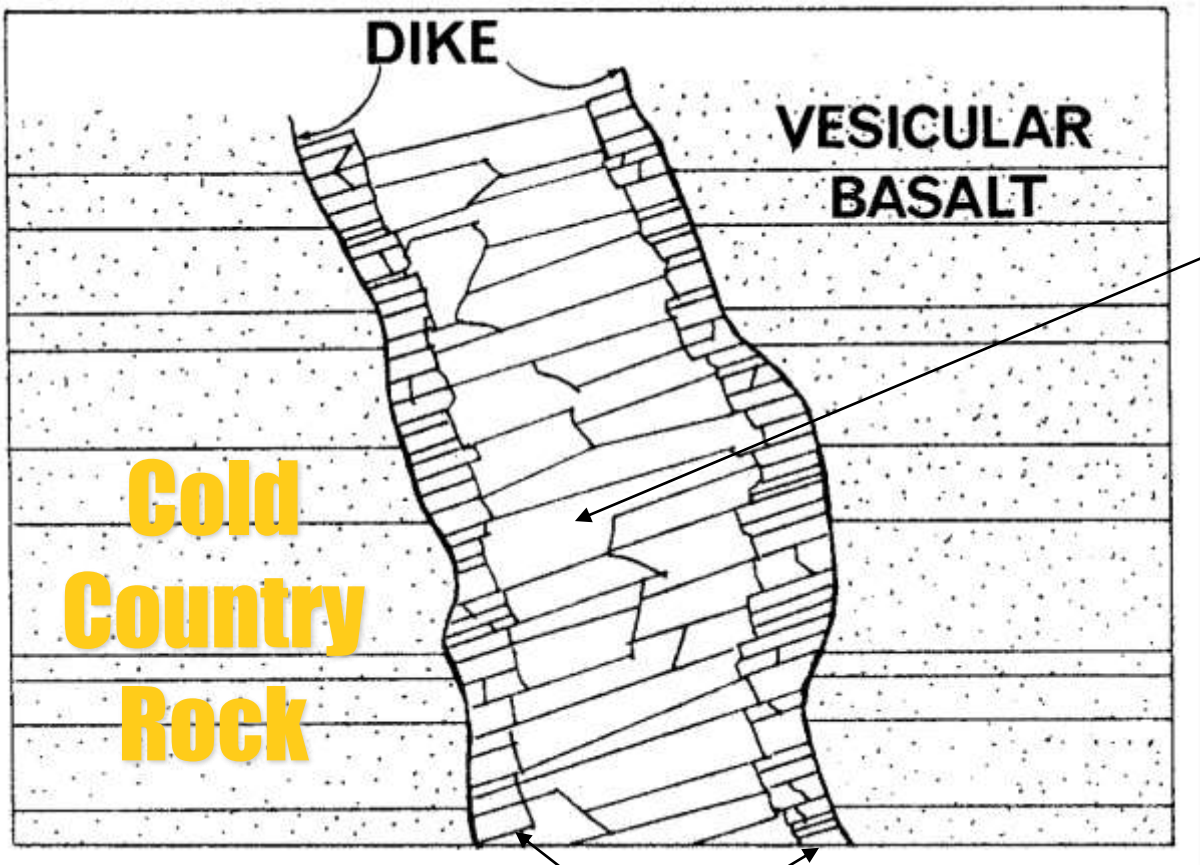
**Batholith**

**Dykes**



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# Chilled Margin:



**Middle Cools  
more slowly =  
(Insulated +  
Further from  
cold country  
rock) therefore  
it is Coarser  
Grained!**

**Chilled Margins  
=FineGrained  
=Rapid Cooling**



**Chilled margin**

**Chilled margin**



Chilled margin



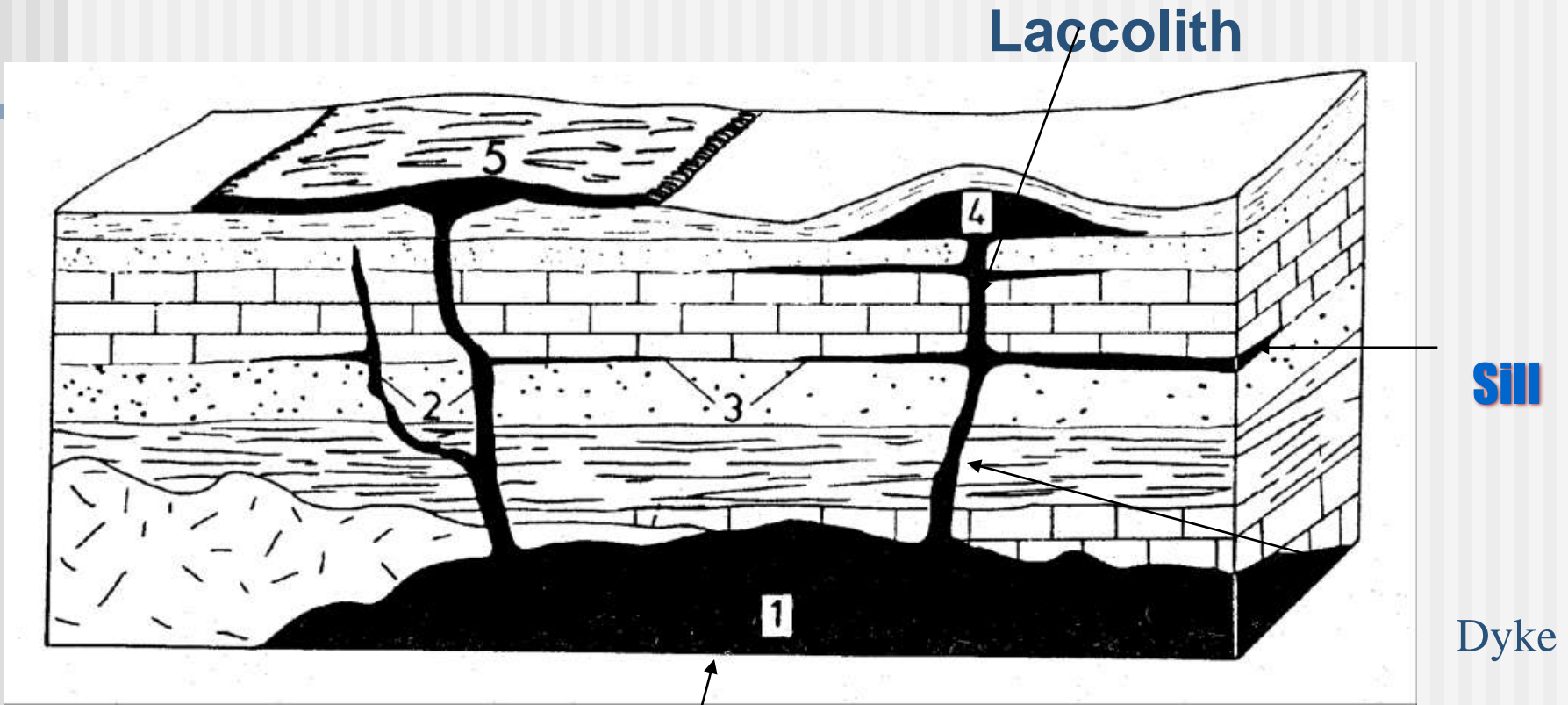
Chilled margin

**Chilled margin**



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# **A Quick Review!**



Laccolith

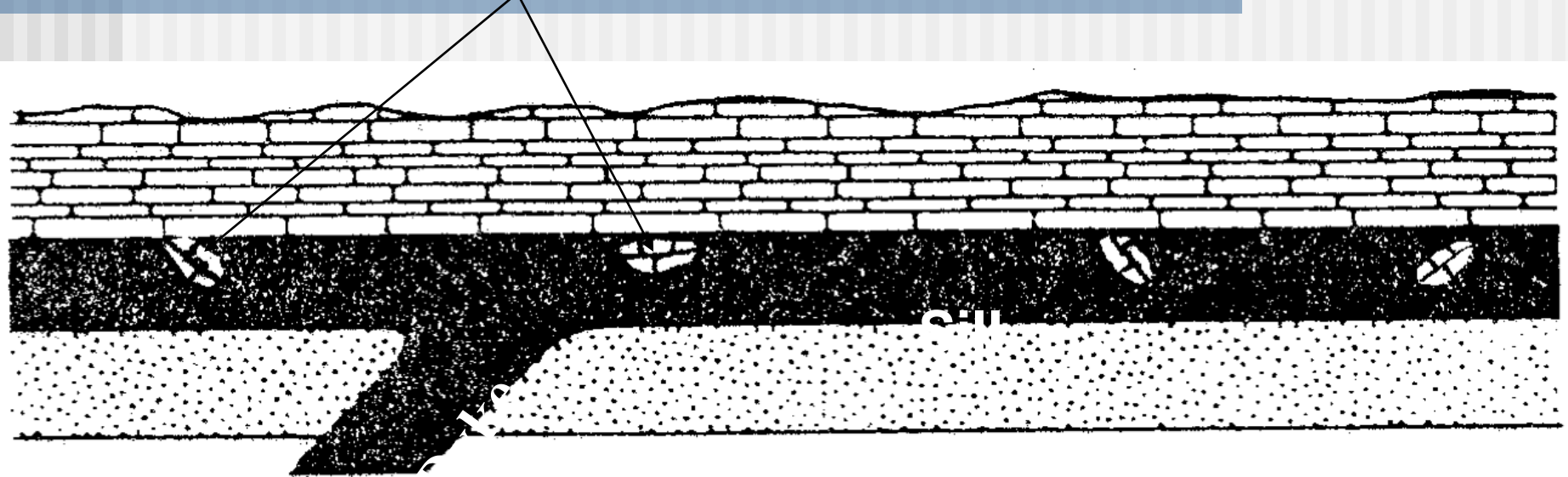
Sill

Dyke

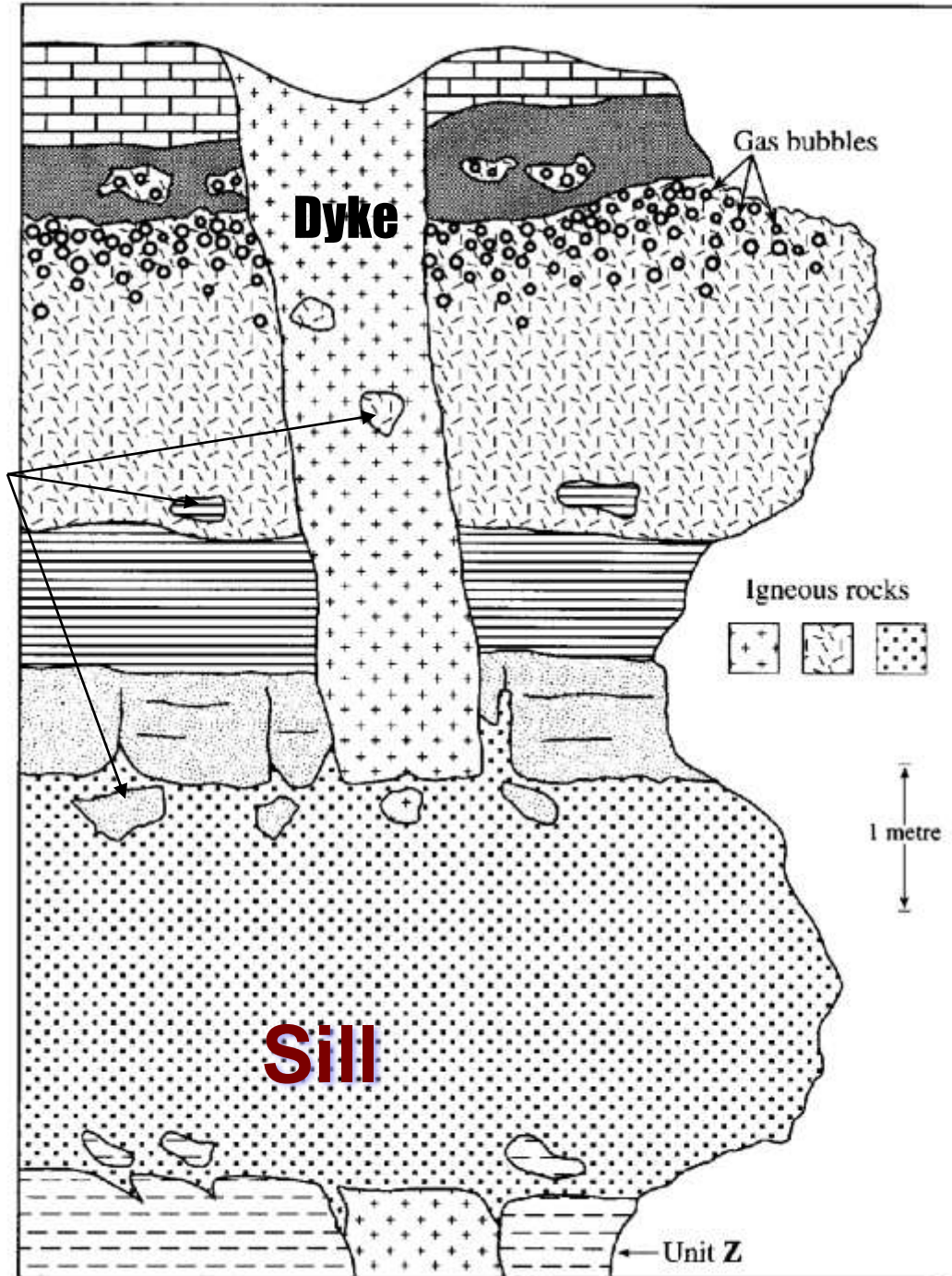
Batholith



Xenolith



# Xenoliths

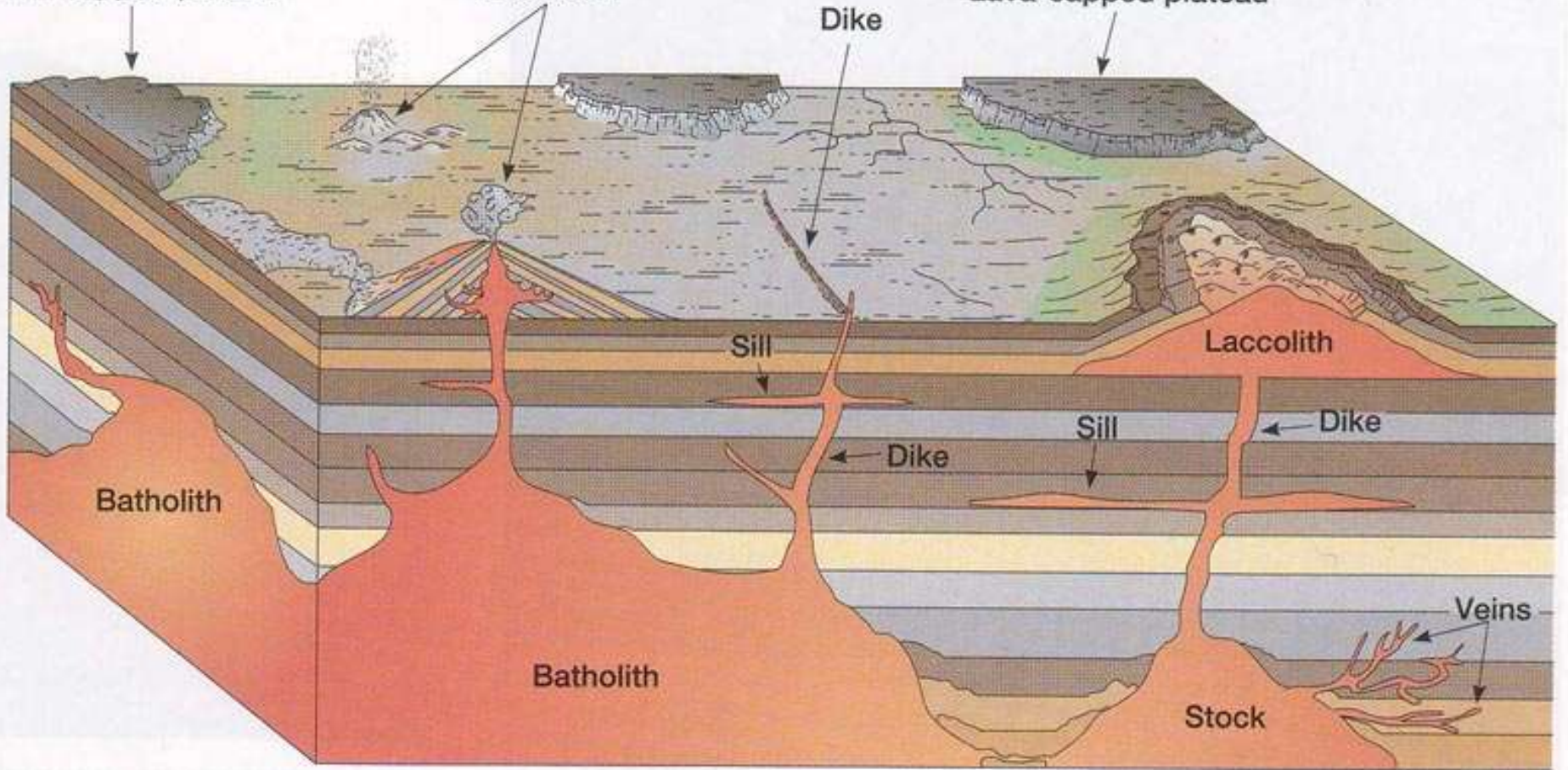


Lava-capped plateau

Volcanoes

Lava-capped plateau

Dike



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# INTRUSIVE and EXTRUSIVE IGNEOUS BODIES DIAGRAM

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## INTRUSIVE:

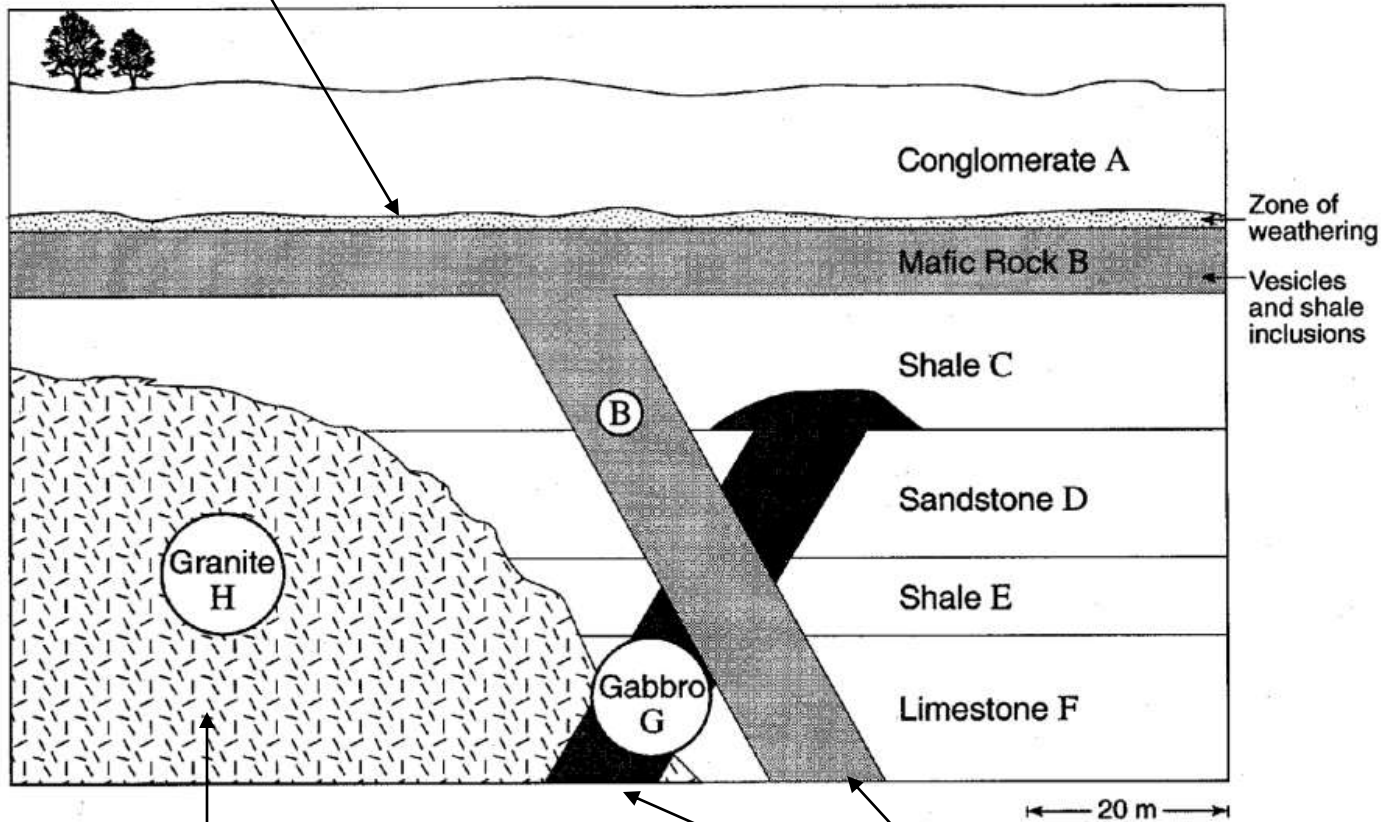
**Draw all structures on bottom half of page.  
2D or 3D - use p.142**

(Batholith, Sill, Dyke, Xenolith, Stock/Pipe,  
Laccolith, Loppolith, Chilled Margin)

*Earn easy marks!! Make it look good!*

**20 marks**

# Sill



Batholith

Dykes

