

# VOLCANOLOGY

1. Eruption Processes & Products
2. Volcanoes
3. Volcanic Hazards and Resources



Mayon Volcano, Philippines, 1984

# 1. Eruption Processes and Products

# Volcano.....

....structure where magma is erupted  
....includes the erupted products

## ERUPTION STYLE

**EXPLOSIVE**



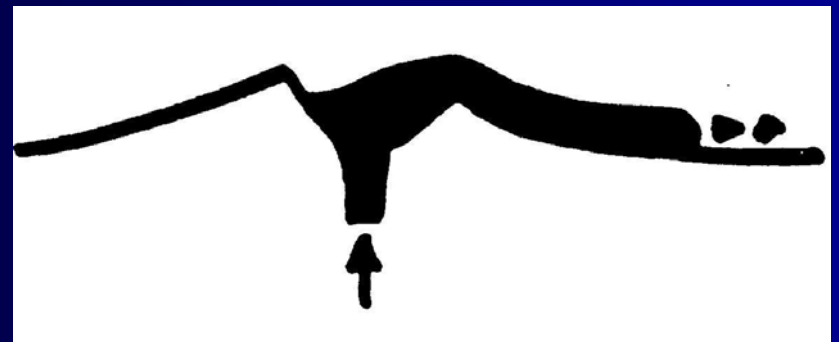
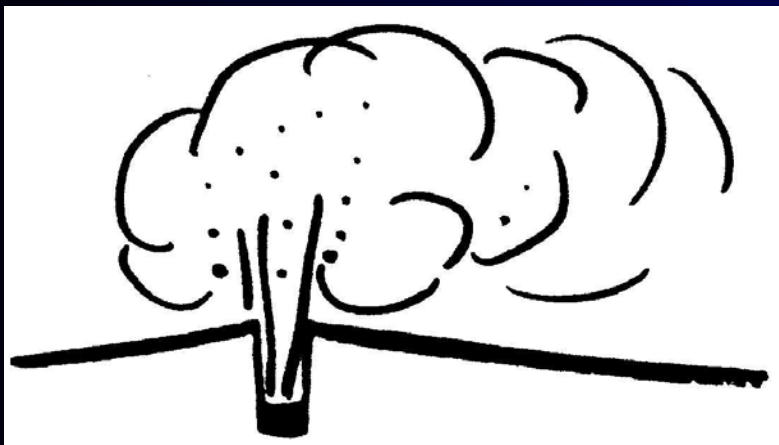
**EFFUSIVE**



**pyroclastic deposits**

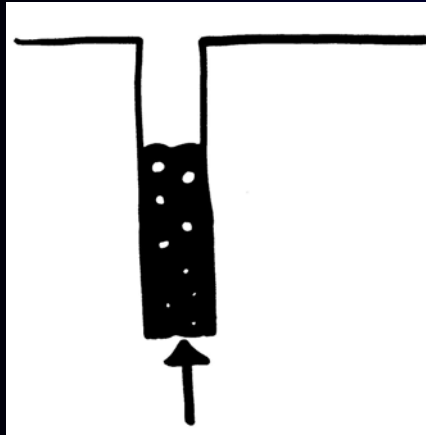


**lavas**



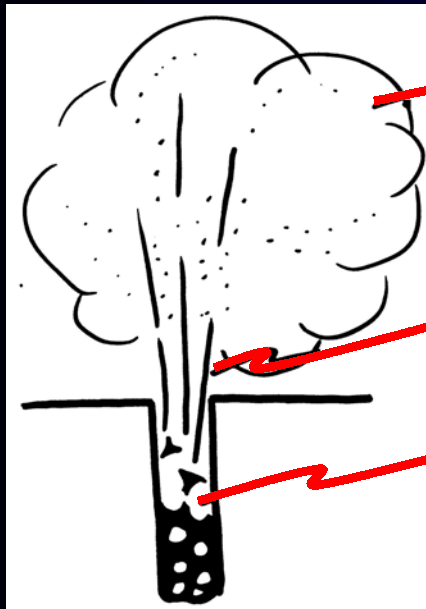
# Explosive

- Magma with high gas content
- Magma with high viscosity



- gas forms bubbles
- bubbles are trapped
- P build-up

→ explosive eruption

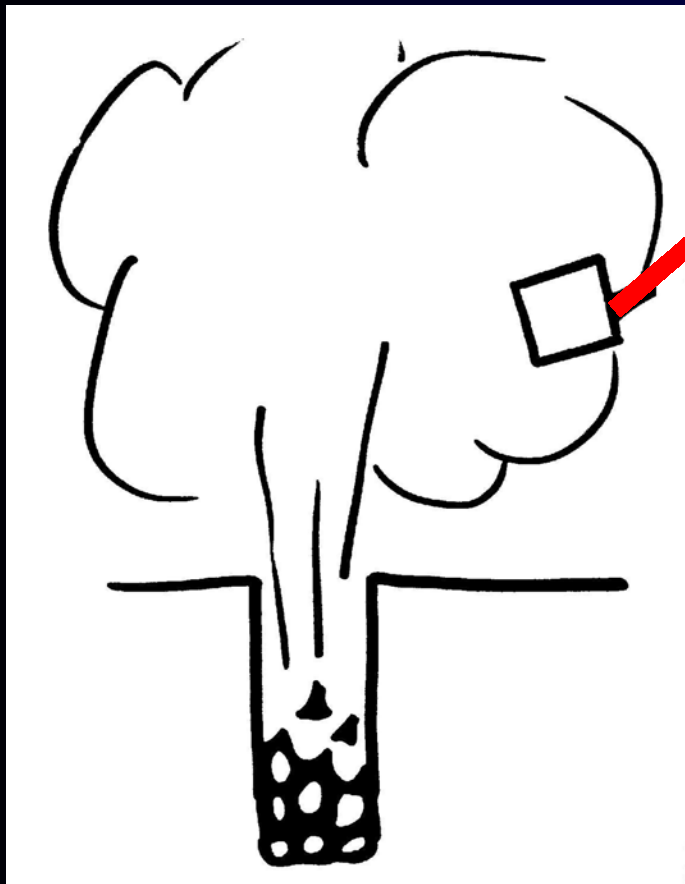


rapidly expanding  
cloud of gas +  
particles

jet

magma is torn apart  
by explosions

- rapidly expanding cloud of gas + particles (buoyant)
- jet (driven by decompression)
- magma is torn apart by explosions

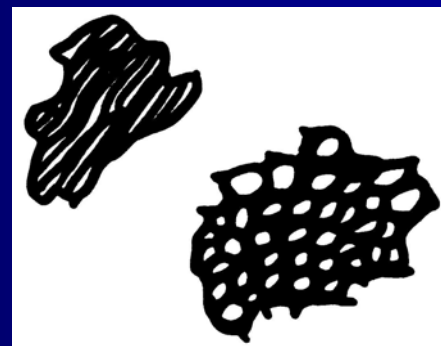


particles  
"PYROCLASTS"

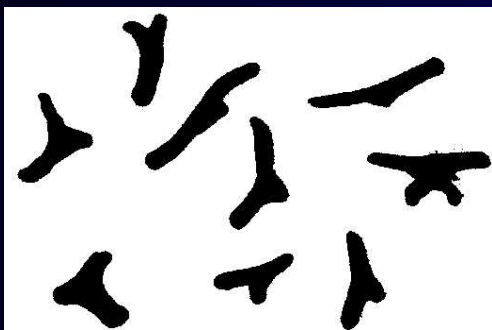
crystals &  
broken crystals



pumice or scoria



glass  
shards  
(walls of  
bubbles)

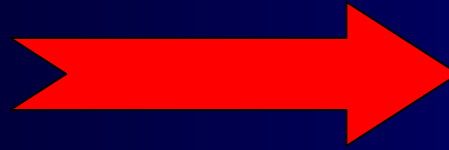


1 mm

wallrock fragments  
("lithic clasts")

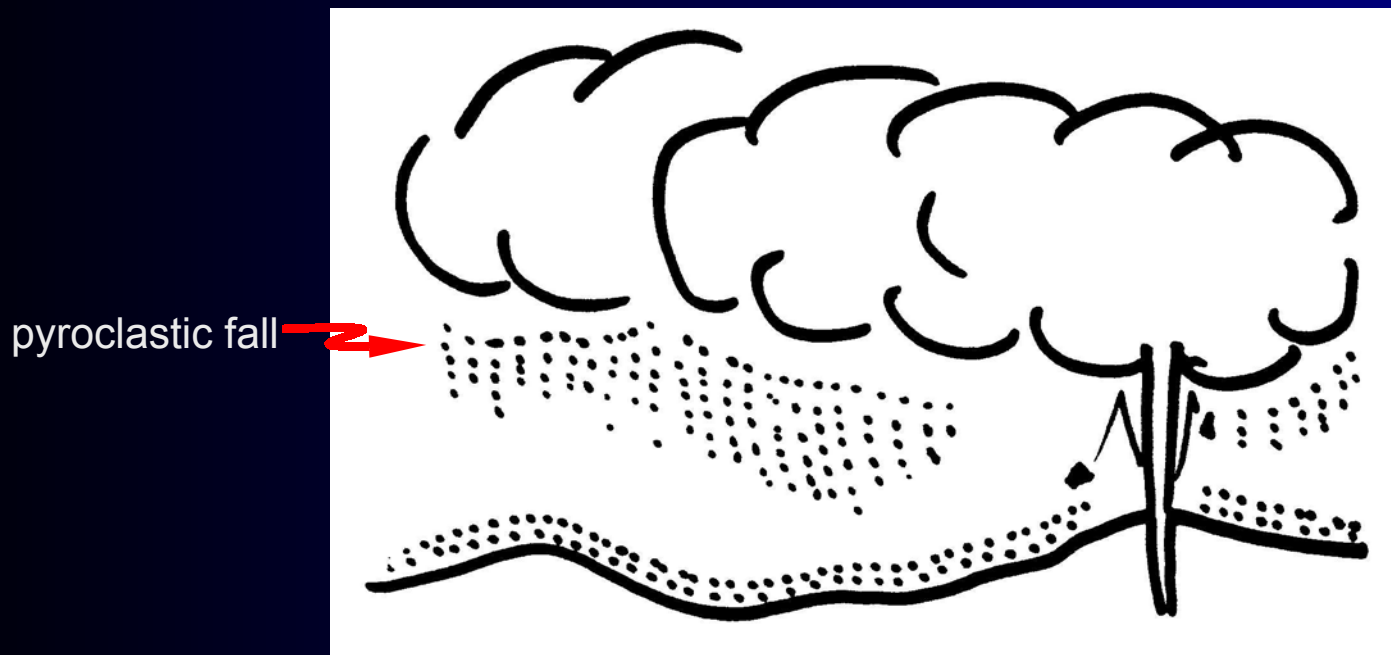


**EXPLOSIVE  
ERUPTION**



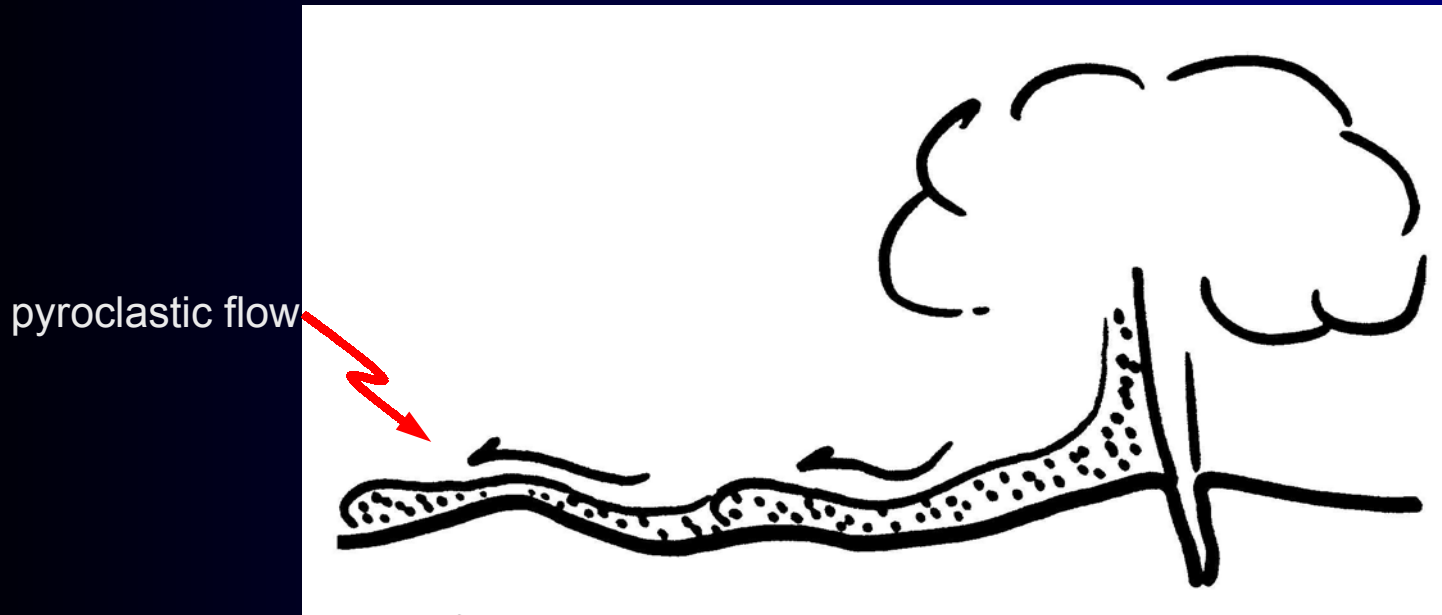
**pyroclastic  
deposits**

## **Pyroclastic fall**



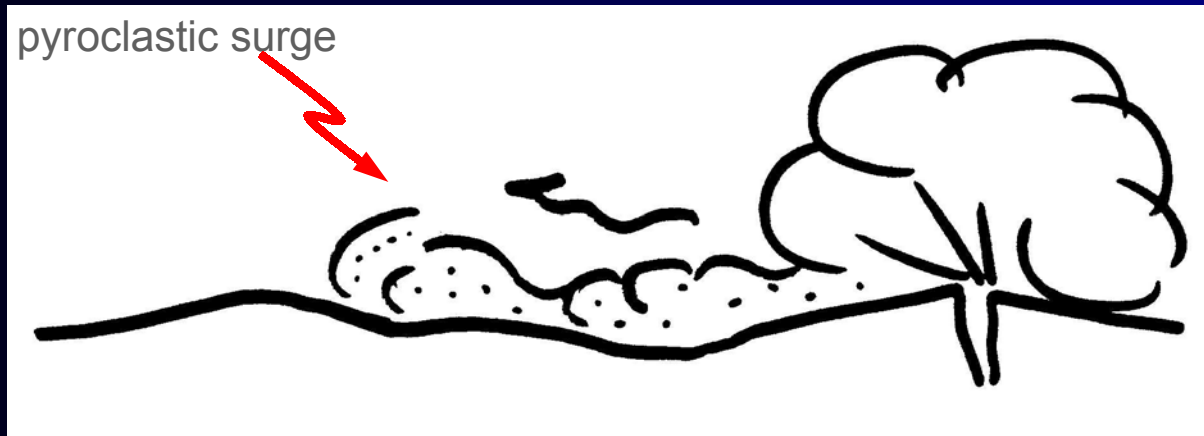
# Pyroclastic flow

- hot, laterally moving, gas-particle dispersion
- high particle concentration



# Pyroclastic surge

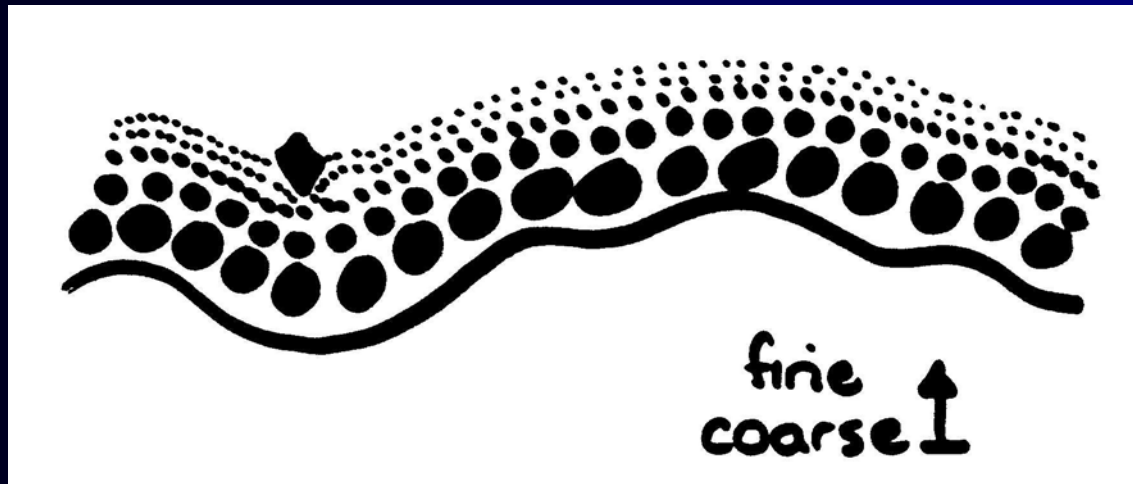
- warm-hot, laterally moving, gas-particle dispersion
- low particle concentration
- turbulent





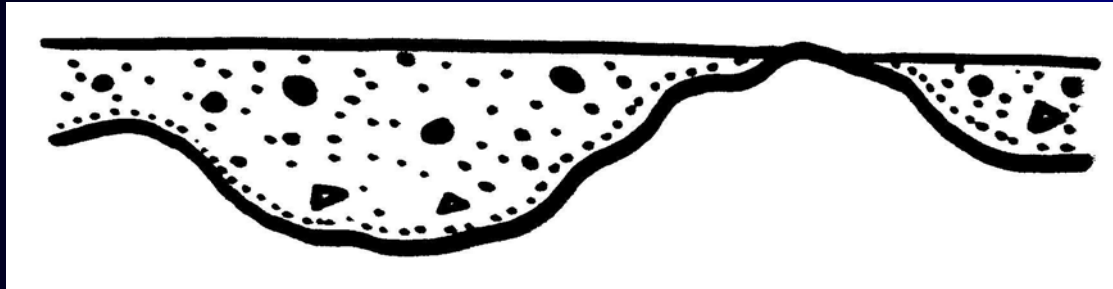
# Fall deposits

- good layering, often graded (coarse to fine)
- mantle uneven surfaces (uniform thickness)
- smaller grain size & thinner with distance from source



# Flow deposits

- massive
- infill topography, flat top surface
- poorly sorted
- may be very thick (100's m)
- aka "ignimbrite"



# Ignimbrite

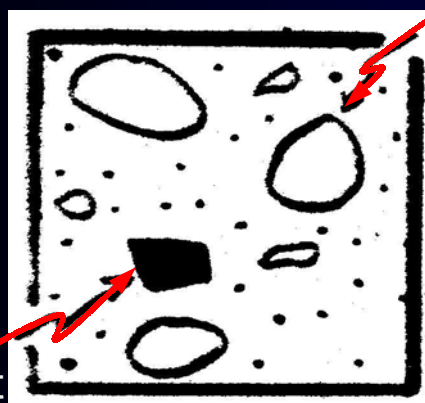
..... pumice-rich pyroclastic flow deposit

..... may be welded

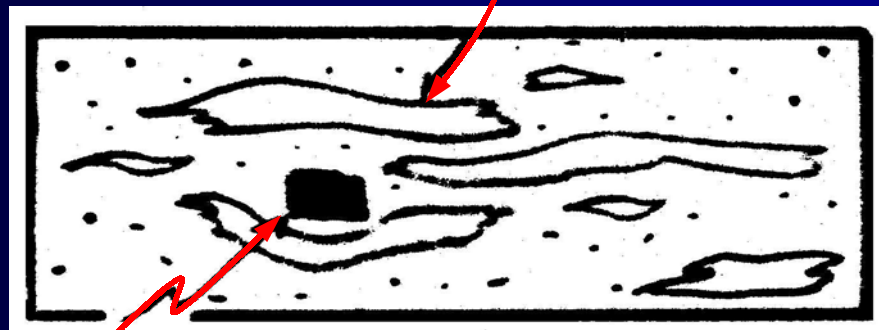
- particles still v.hot (= 500°C) when deposited
- load pressure causes hot, sticky particles to weld together
- pore spaces between particles, and vesicles in pumice are eliminated

“instant” hard, solid rock called “**welded ignimbrite**”

➔ e.g. Battleship Rock ignimbrite, New Mexico



pumice

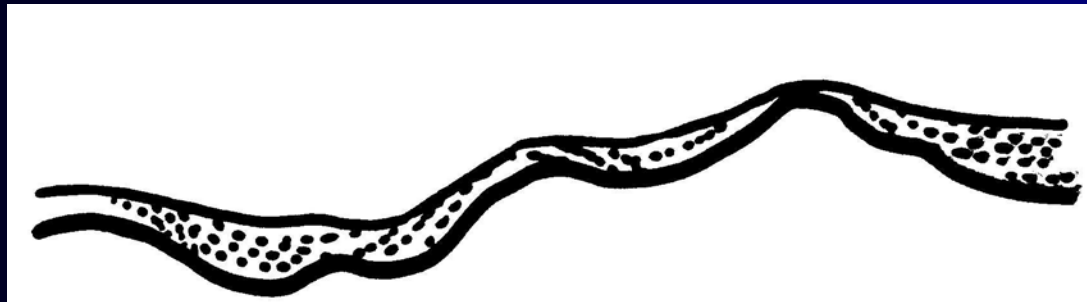


flattened pumice

lithic clast still the same

# Surge deposits

- good layering, cross bedding
- partly mantle, partly infill topography
- usually only small volume & close to source



P'c fall, flow and surge deposits  
may be lithified to form **pyroclastic rock**

# Grainsize

## PYROCLASTS

> 64 mm	block (angular), bomb (fluidal)
2 - 64 mm	lapilli
< 2 mm	ash

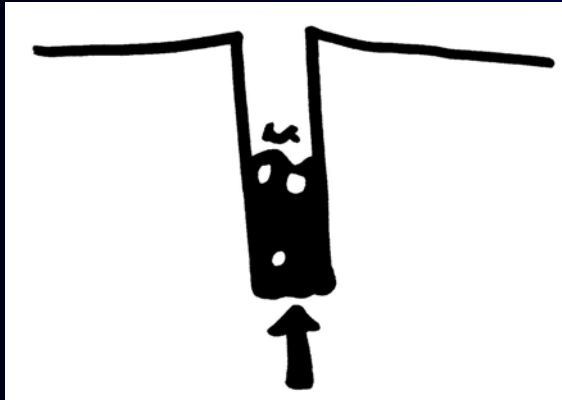
## PYROCLASTIC ROCKS

> 64 mm	pyroclastic breccia, agglomerate
2 - 64 mm	lapillistone, lapilli tuff
< 2 mm	tuff

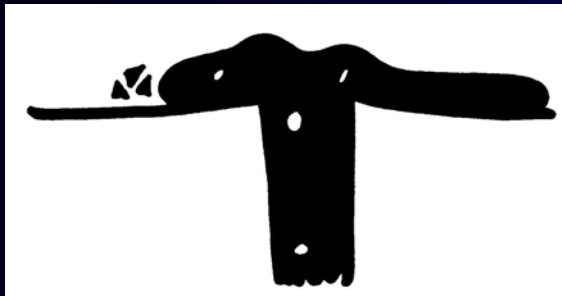
these terms should be reserved for proven  
pyroclasts and pyroclastic rocks  
i.e. generated by **EXPLOSIVE ERUPTIONS**

# Effusive

- Magma with low gas content
- Magma with low viscosity



- gas forms few bubbles
- these grow and rise
- bubbles break easily
- magma continues to rise and eventually erupts



➔ effusive eruption

(generally only minor, mild accompanying explosive activity)

➔ Lavas: coherent + autoclastic

# Lavas

..... surface flows of molten rock

..... behaviour & features controlled by

- composition, especially  $\text{SiO}_2$
- temperature
- volatile content
- shape of vent
- gradient of substrate
- discharge rate

# Lavas

**Low SiO<sub>2</sub> lava**      e.g. basalt

- two common types:      pahoehoe - fluidal surface  
   a'a - lots of fragments, "clinker"
- sheets, tubes, channels; thin but extensive

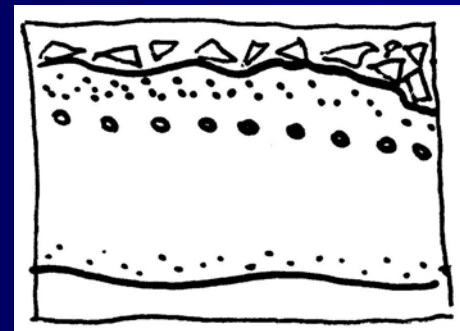
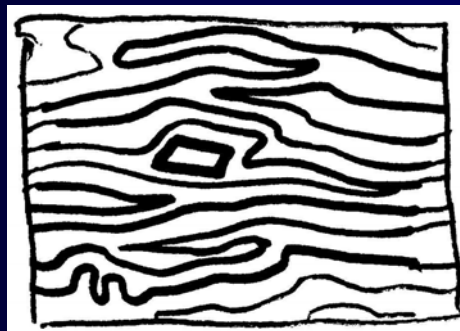
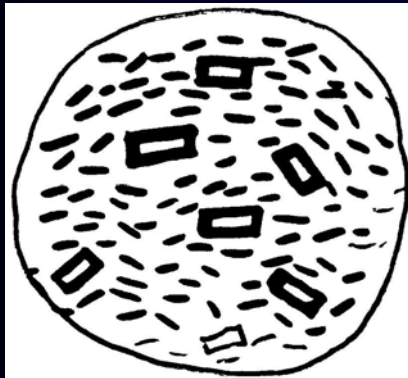
**High SiO<sub>2</sub> lava**      e.g. rhyolite

- thick, short flows; domes
- abundant loose blocks of pasty, congealed lava



# Characteristic features of lavas

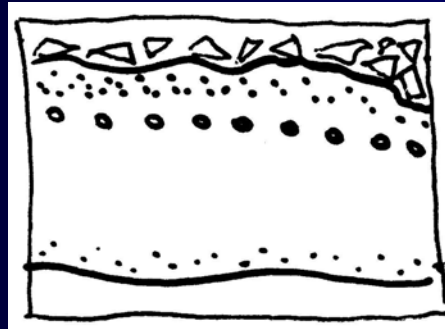
- ..... once cooled  $\neq$  “instant”, solid rock
- ..... may be flow banded
- ..... may contain euhedral crystals (“phenocrysts”)
- ..... may be vesicular
- ..... may contain volcanic glass if rapidly cooled
- ..... may have columnar jointing
- ..... foreign rock fragments are uncommon
- ..... typically include both coherent & clastic textures  
(cf. clastic texture of pyroclastic rocks)



} lava

# Autobreccia

- broken fragments of lava
- formed during active flow of hot lava when cooler brittle parts of the lava are torn apart and break up
- fragments may be flow banded and vesicular
- typically tabular, slabby and twisted shapes



} autobreccia  
} coherent lava  
}