

# LAVAS



# COMPOSITION OF LAVAS

	SiO <sub>2</sub> %	phenocrysts*
<b>rhyolite</b>	> 69	kspar, qtz, plag, bi (h'e, px, fa)
<b>dacite</b>	63 - 69	plag, h'e, px, bi (qtz)
<b>andesite</b>	52 - 63	plag, h'e, px (ol)
<b>basalt</b>	45 - 52	px, plag, ol

\* approximate guide only

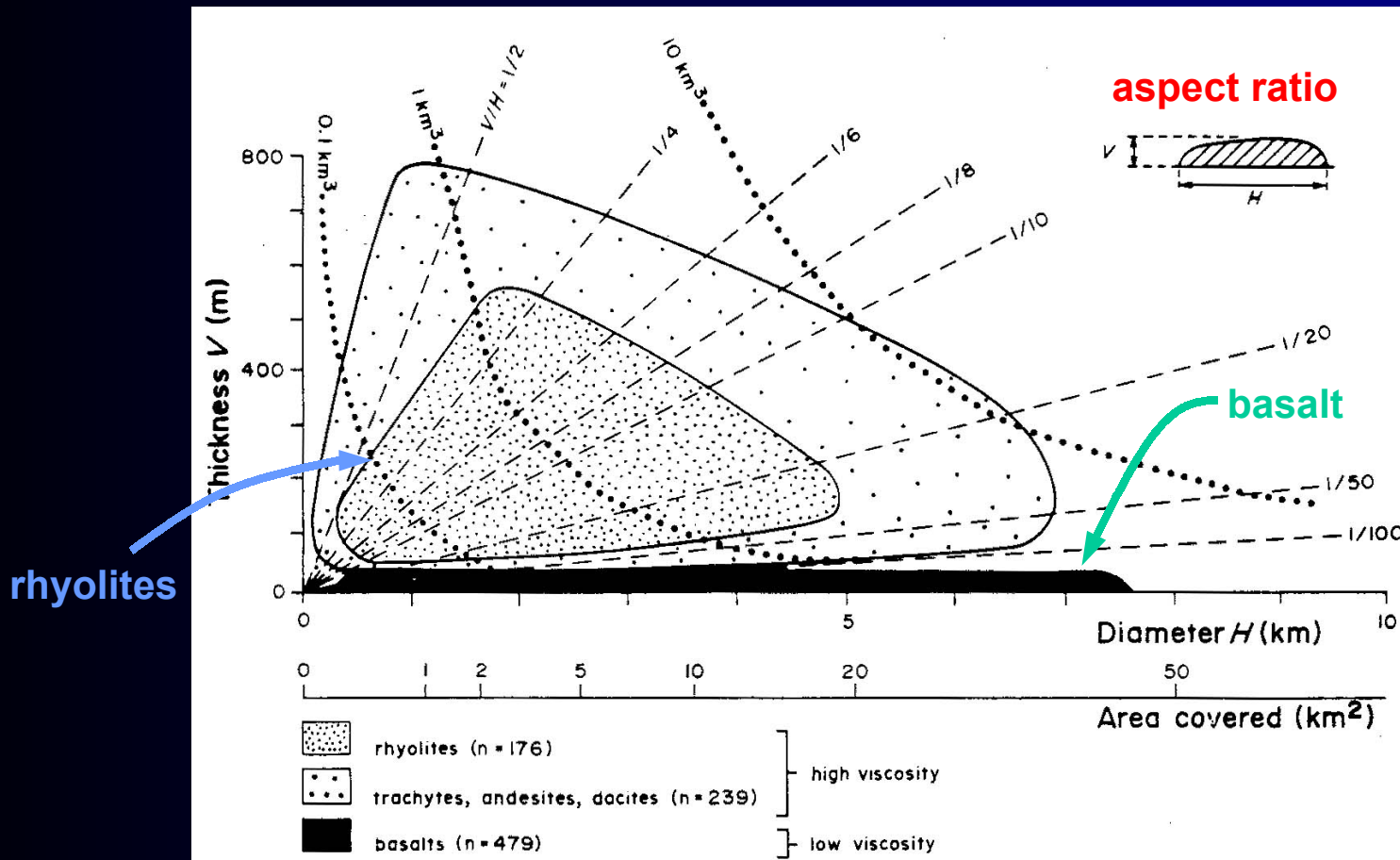


silicic, felsic..... rhyolite, dacite

intermediate..... andesite

basic, mafic..... basalt

# DIMENSIONS OF LAVAS



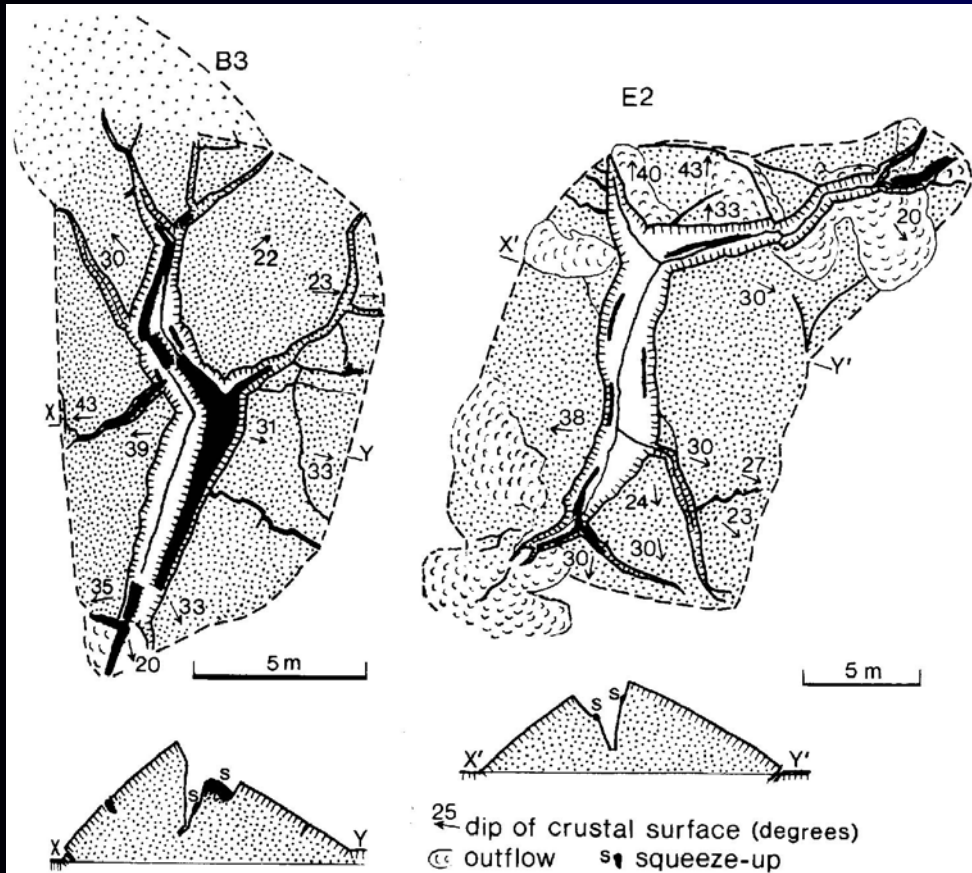
Dimensions of lavas of different compositions. The two scales along the x-axis give the area and the lateral extent (Walker 1973).

# BASALTIC LAVAS

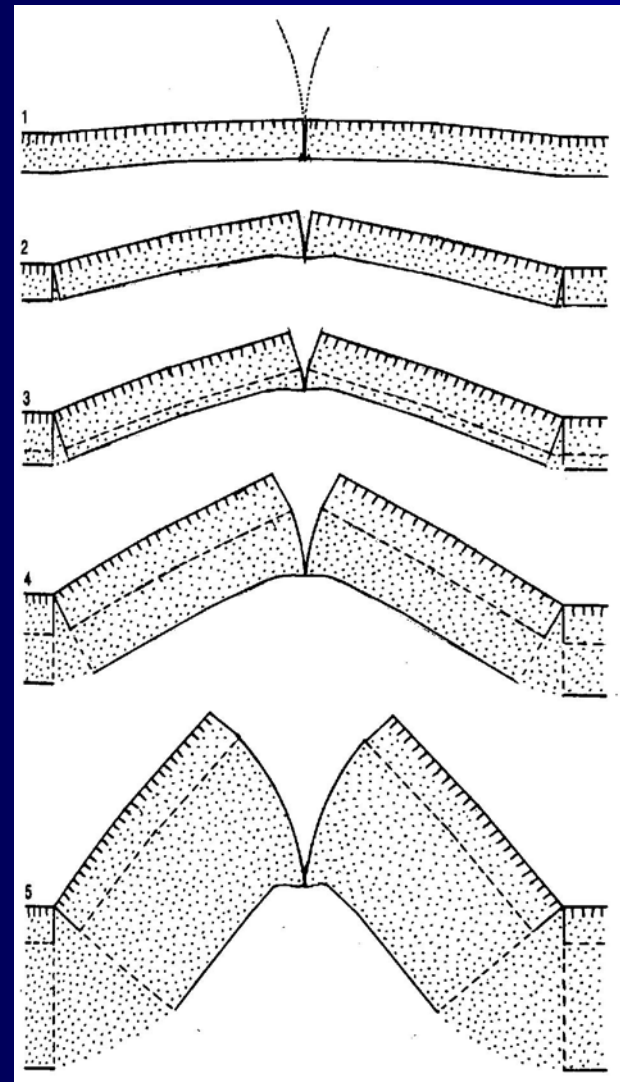


- **a'a vs. pahoehoe** (viscosity, rate of shear) ...
- **tubes, channels, levees** ...
- **columnar joints**: cooling  $\Rightarrow$  contraction  $\Rightarrow$  joints;  
~ perpendicular to isothermal surfaces ..
- **tumuli**: mounds, 1 to 10 m high; up-tilting of solid  
crust by molten lava beneath .

# TUMULI

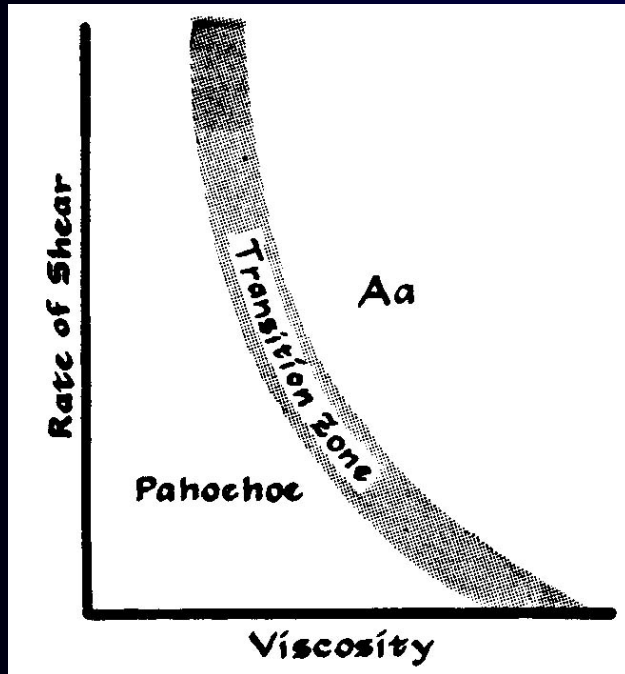


Tumuli in plan view and profile  
(Walker 1991).



Stages in the growth of a tumulus  
(Walker 1991).

# BASALTS



Rates of shear and viscosity for pahoehoe and a'a lavas (Peterson & Tilling 1978).

Effusion rates of some basaltic lavas

Eruption	Effusion rate ( $\text{m}^3\text{s}^{-1}$ )
Laki 1783	$5 \times 10$
Etna 1865-1975 ( $n = 17$ )	1545
Etna 1975	0.3-0.5
Mauna Loa 1851-1950 ( $n = 101$ )	100
Askja 1961	33 (800)
Paricutin 1943-52	0.7

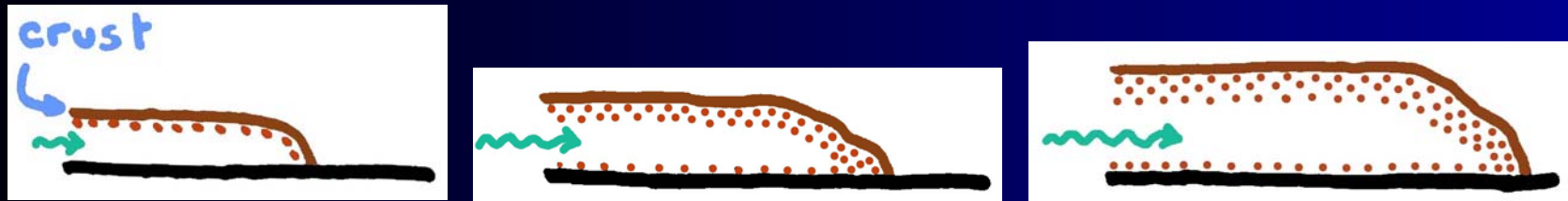
# BASALTIC LAVAS



- **dimensions**

**thickness:** <1m to a few tens of m;

stagnant lavas thicken by inflation

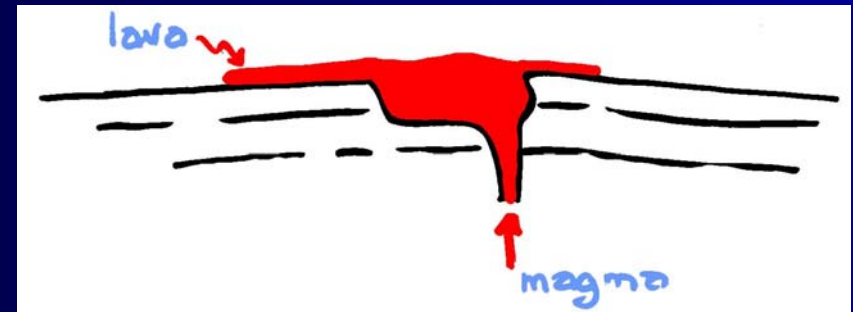


**extent:** commonly several km; longest are >hundred km (tube-fed) eg. Undara, Qld  
(low viscosity, well insulated)

**volume:** generally  $\ll 15\text{km}^3$  but the largest (flood basalts) are hundreds  $\text{km}^3$  in volume

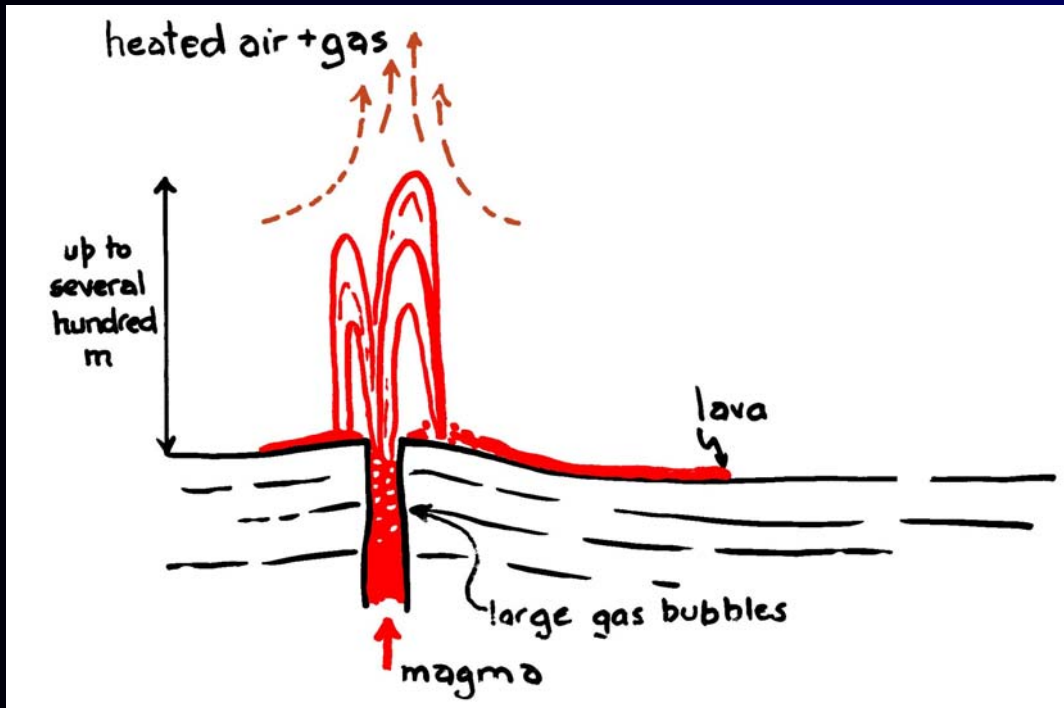
# BASALTIC LAVAS

- eruption styles:



upwelling & overflow

“fire fountain”  
driven by high discharge  
& volatile exsolution



- central vent  
↳ shield volcano

vs.

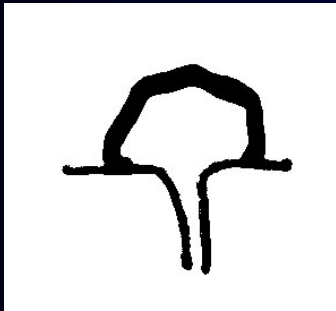
- fissure vent  
↳ flood basalt provinces

# RHYOLITIC LAVAS

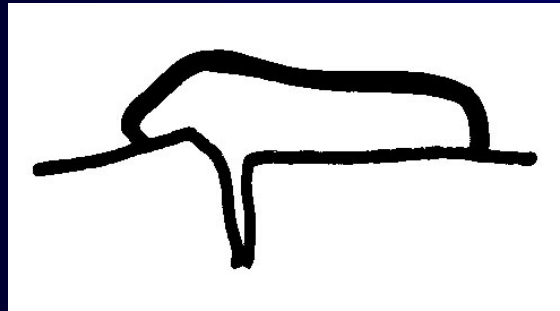
small

...

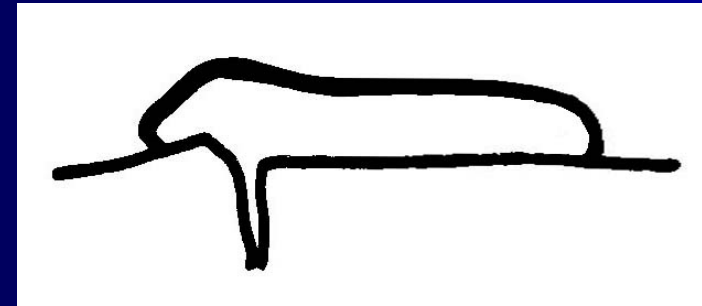
dome



coulée



flow



cross section

## dimensions

thickness

tens to a few hundred m

extent

< 5 km

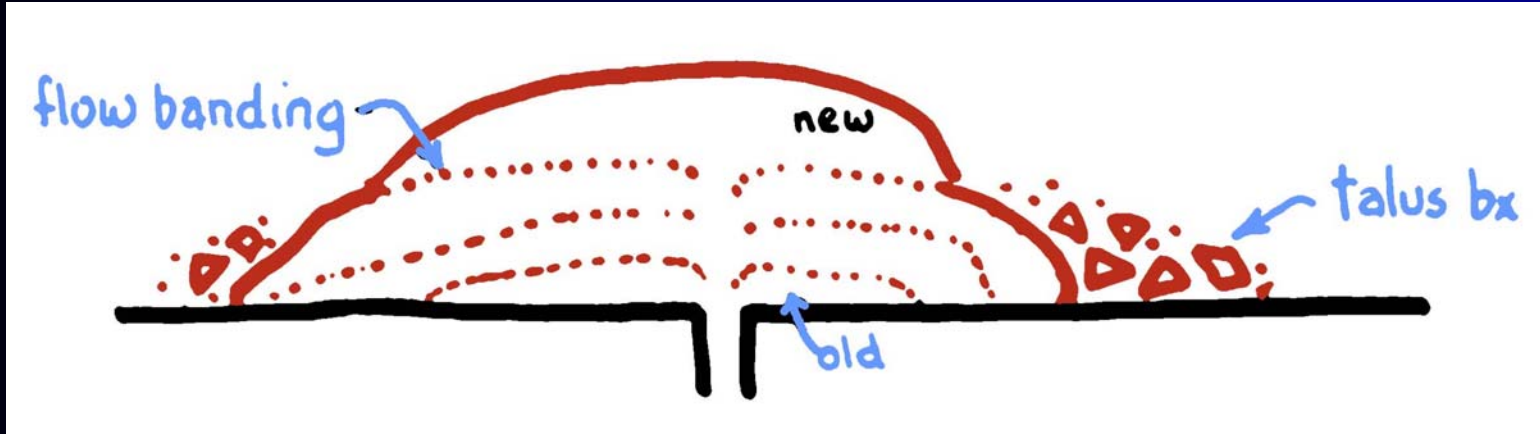
volume

< 5 km<sup>3</sup>, most < 1 km<sup>3</sup>

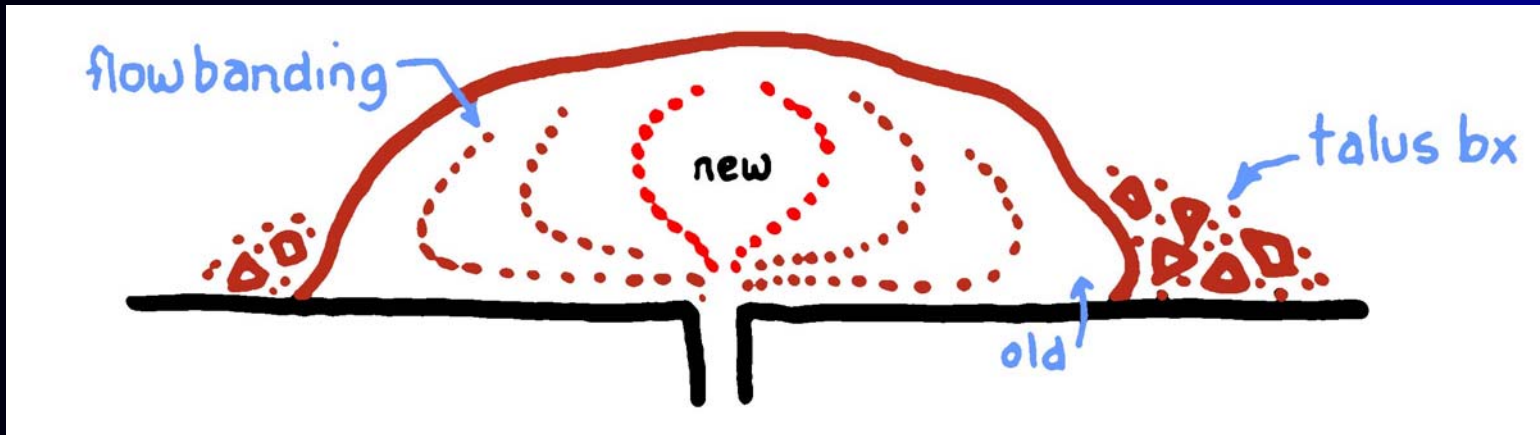
# RHYOLITIC LAVAS

growth mechanism

EXOGENOUS - addition to the outside



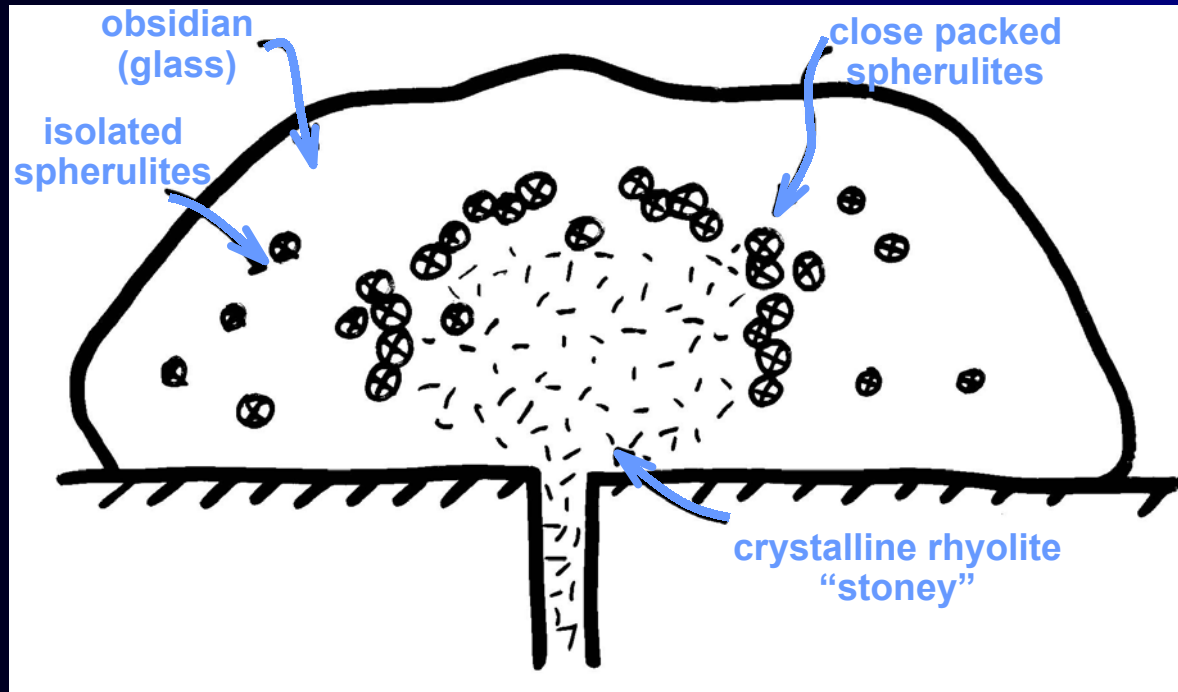
ENDOGENOUS - addition to the inside



# RHYOLITIC LAVAS

## crystallisation

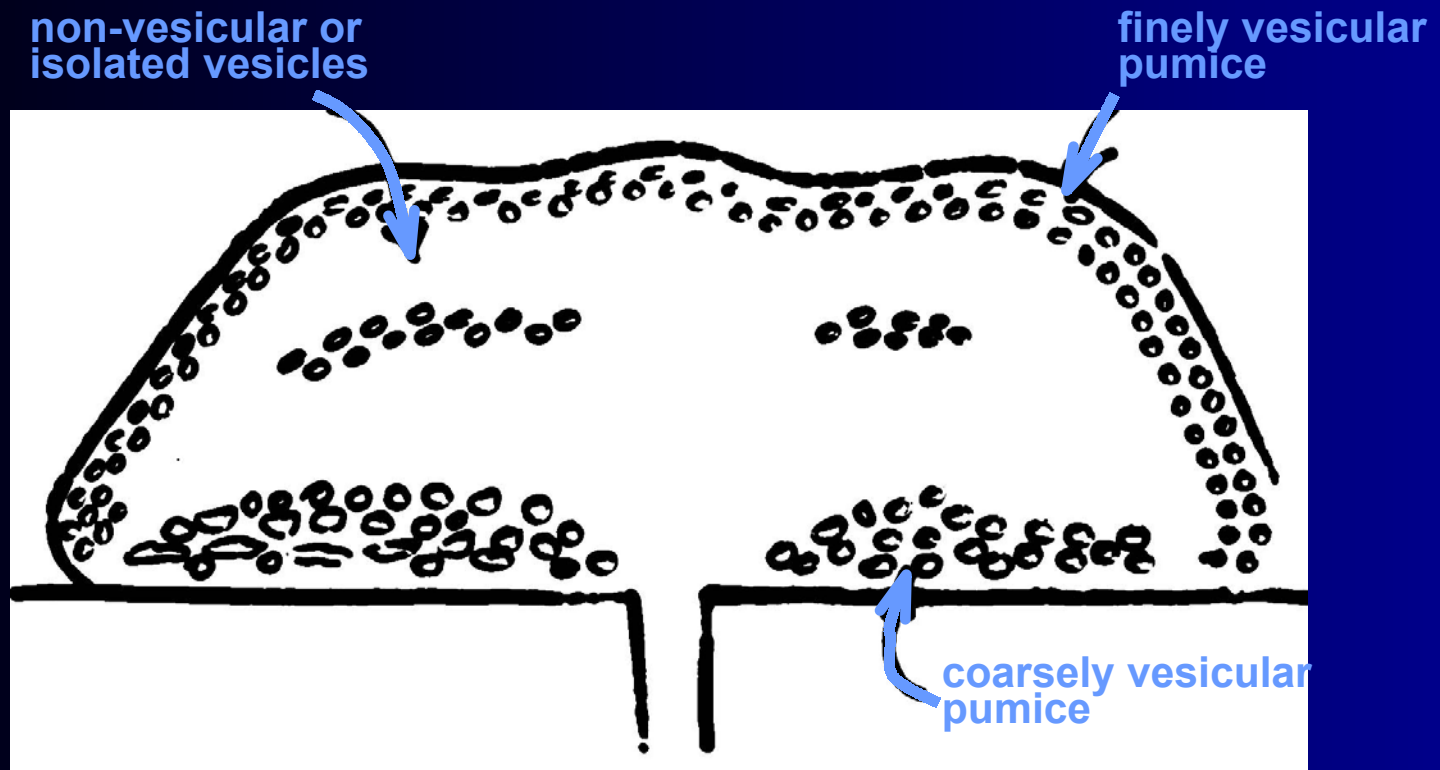
- reflects internal temperature gradients and insulating effects of cool outer crust



# RHYOLITIC LAVA

## vesicularity

- reflects pre-eruption volatile gradients in the magma, syn-eruptive degassing and post-emplacement degassing



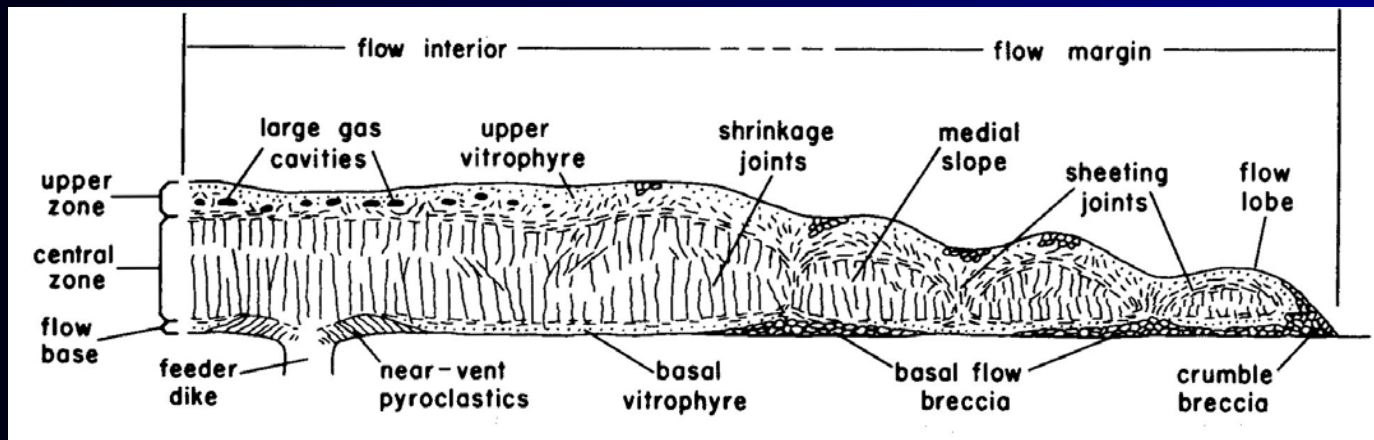
# RHYOLITIC LAVAS

**big:** extensive sheets  
dimensions

thickness	100 m to 250 m
extent	several tens km
volumes	10 km <sup>3</sup> to 100 km <sup>3</sup>

eg. Miocene rhyolites, Idaho, USA

Cretaceous quartz latites, Namibia



# RHYOLITIC LAVAS

## conditions for big rhyolites

temperature	high (900 - 1050°C)
volume	large

thick, hot, slow moving flows ⇒ small heat loss  
⇒ active for decades

# Examples of BIG rhyolites

Southwestern Idaho (Bonnichsen & Kauffman 1987)

Name of Unit	Phenocryst Minerals	SiO <sub>2</sub>	N	Maximum Thickness (m)	Minimum Volume (km <sup>2</sup> )
Three Creek Rhyolite	plag gtz aug pig ox	73.7	1	---	10
rhyolite, Juniper-Clover area	plag gtz aug pig ox	73.1	4	---	very large
Dorsey Creek Rhyolite	plag qtz aug pig ox	72.7	6	>200	75
Poison Creek Rhyolite	plag gtz aug pig ox	70.7	2	about 100	---
Sheep Creek Rhyolite	plag qtz aug pig ox	70.4	6	about 250	200
Brureau Jasper Rhyolite	plag san qtz aug pig ox	73.9	3	about 150	---
lower rhyolite, Louse Creek	plag aug pig ox	70.1	2		
Long Draw Rhyolite	plag aug pig ox	71.0	3	about 100	10
Cedar Tree Rhyolite	plag man gtz aug pig ox	72.5	2	>100	---
Marys Creek Rhyolite	plag san qtz aug pig ox	72.0	2	---	large
Indian Batl Rhyolite	plag aug pig ox	70.1	3	>100	12
Triguero Homestead Rhyolite	plag aug pig ox	71.1	4	about 100	10
	Average SiO <sub>2</sub>	71.8			

# ANDESITIC & DACITIC LAVAS



wide range in structures

a'a

block lava

coulée, dome



## dimensions

thickness	5 m to a few hundred m
extent	<1 km to >10 km
volume	<1km <sup>3</sup> to >20 km <sup>3</sup>

# ANDESITIC & DACITIC LAVAS



## examples

Oni-oshidashi lava: basaltic andesite ..

Asama, 1783; 7 km long; 0.17 km<sup>3</sup>

Chao Dacite: dacite .

Chile, 0.1 Ma; up to 400 m thick; 12 km long; 26 km<sup>3</sup>

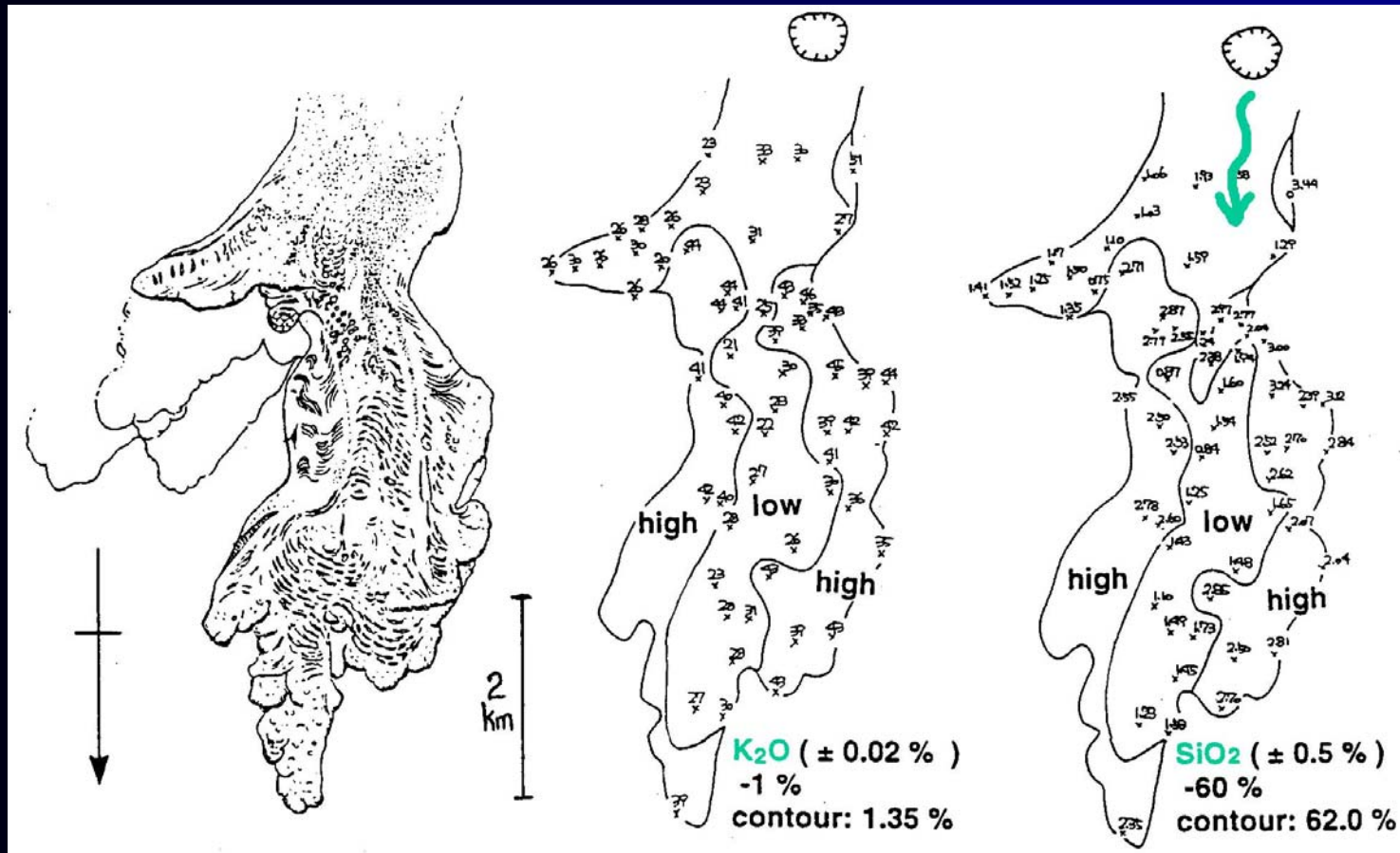
Mount Saint Helens: dacite dome .

USA, 1981 - 83; diameter ~ 700 m; 0.04 km<sup>3</sup>

# ANDESITIC & DACITIC LAVAS



## Oni-oshidashi Andesite, Japan



Maps showing the topography and variations in composition of the Oni-oshidashi lava (Aramaki 1992)

# ANDESITIC & DACITIC LAVAS



## effusion rates

<b>Eruption</b>	<b>Average effusion rate (m<sup>3</sup>s<sup>-1</sup>)</b>
Santorini, Greece 1886-70	0.7
Santlaguito Santa Maria volcano 1922-present	0.4
Mt Lamington 1951-6	5.8
Bezymianny 1955-present	1.8
Colima 1975-6	0.05
Augustine 1976	11.6
Mt St Helens 1980-present	0.5
Usu 1910 (Meiji-Shinzan cryptodome)	3.5
Usu 1943-5 (Showa-Shinzan cryptodome)	1.2
Usu 1977-present (Usu-Shinzan cryptodome)	0.6

(Newhall & Melson 1983)

# ANDESITIC & DACITIC DOMES



	Mount St. Helens	Mount Lamington	Bezymianny	Santiaguito
Dome Growth				
From	October 1980	February 1951	April 1956	June 1922
To	December 1983	June 1952 (?)	December 1982	December 1982
Duration (yr)	3.2+	1.4 (?)	27.3	61.5
Dome volume (km <sup>3</sup> )	0.044	1.0	1.6	0.8
Growth rate, first 3 years (km <sup>3</sup> /yr)	0.014	0.70 (first 1.4 yrs)	0.06	0.06
SiO <sub>2</sub>	61-64%	58-60%	56-60%	62-65%

(Swanson *et al* 1987)

# AUTOBRECCIA

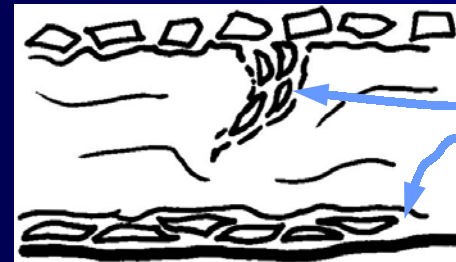
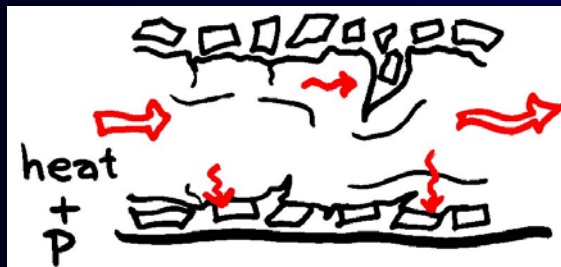
- volcanoclastic (primary)
- by-product of lava flow
- brittle fracture of cooler, more viscous lava during flowage; mainly affects margins



clasts are slabby or blocky, commonly flow banded

- may be welded (stuck, deformed), especially at the flow base:

active lava flow



welded breccia