A’a, Kilauea Volcano
Photot: Dorian Weisel

COMPOSITION OF LAVAS

	SiO_2%	phenocrysts*
rhyolite	> 69	kspar, qtz, plag, bi (h'e, px, fa)
dacite	63 - 69	plag, h'e, px, bi (qtz)
andesite	52 - 63	plag, h'e, px (ol)
basalt	45 - 52	px, plag, ol

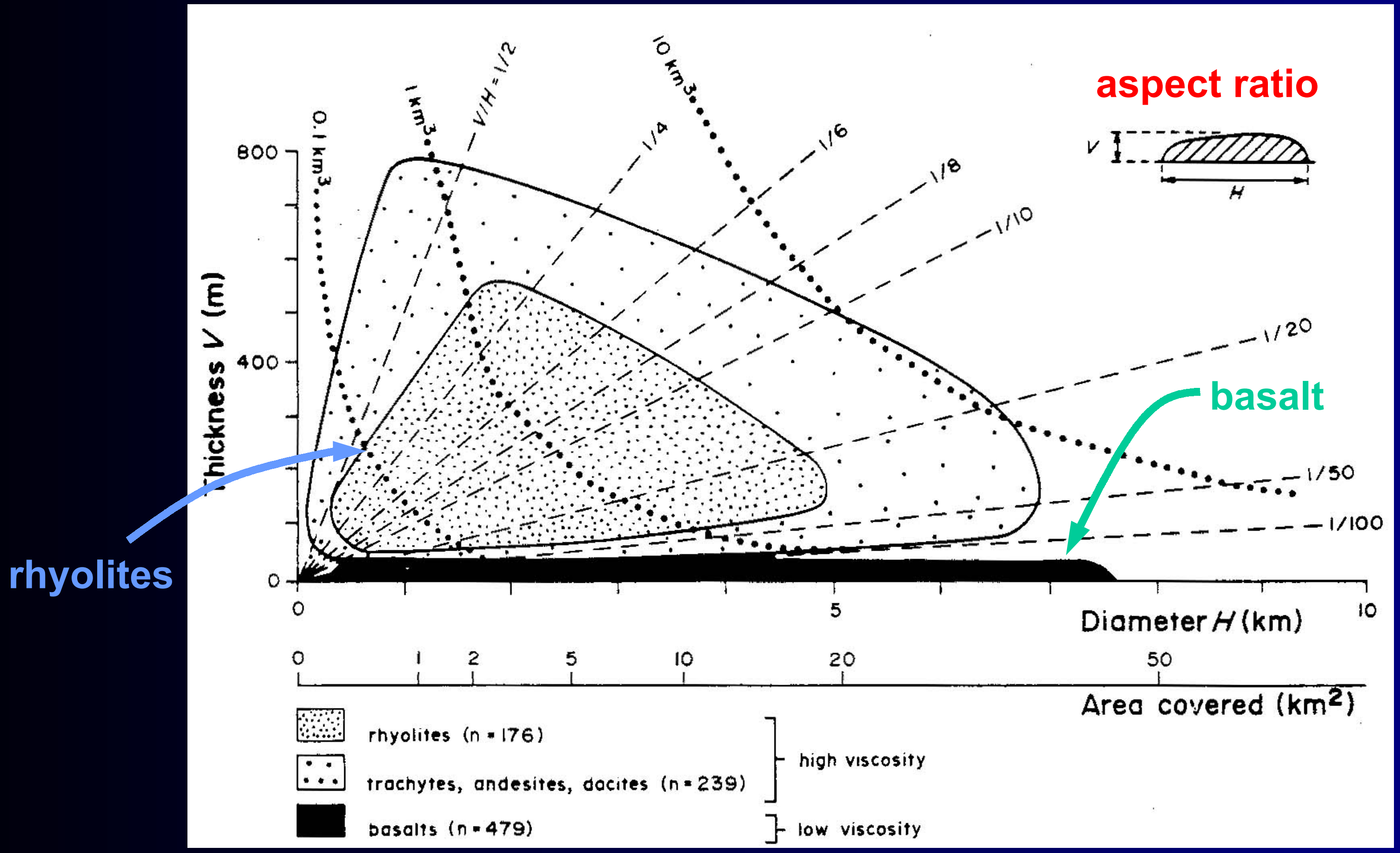
* approximate guide only

silicic, felsic........... rhyolite, dacite

intermediate........... andesite

basic, mafic………. basalt

DIMENSIONS OF LAVAS

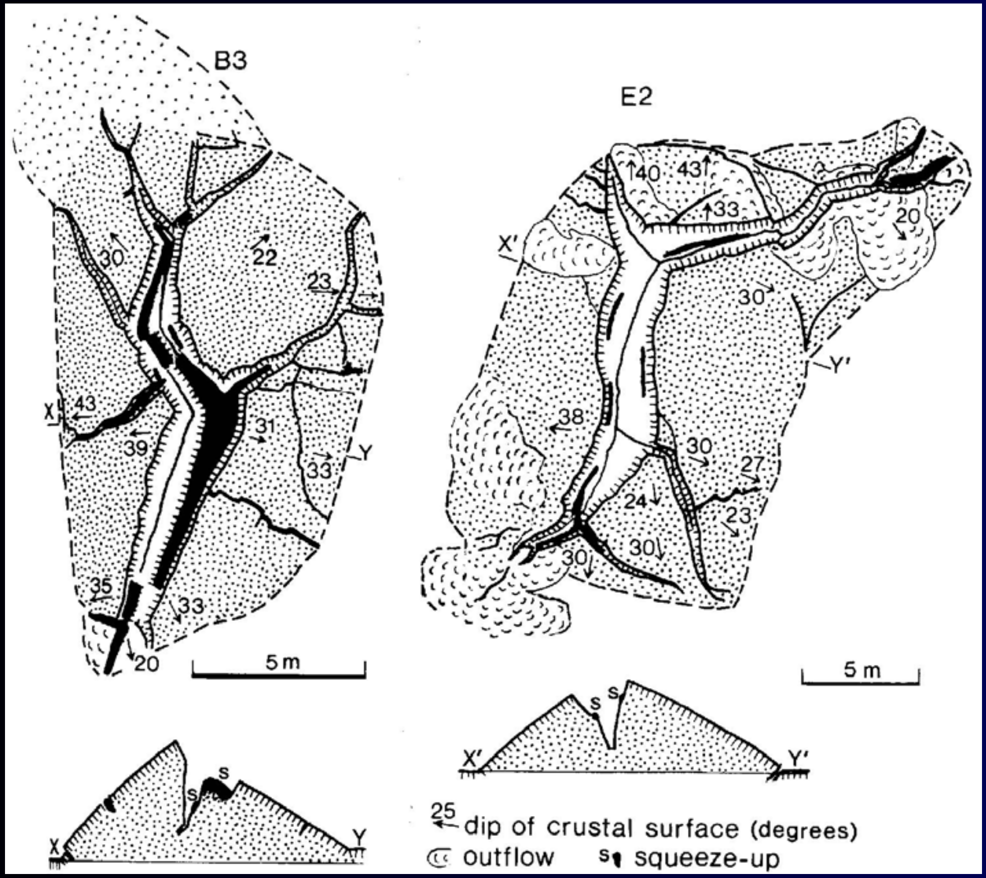


Dimensions of lavas of different compositions. The two scales along the x-axis give the area and the lateral extent (Walker 1973).

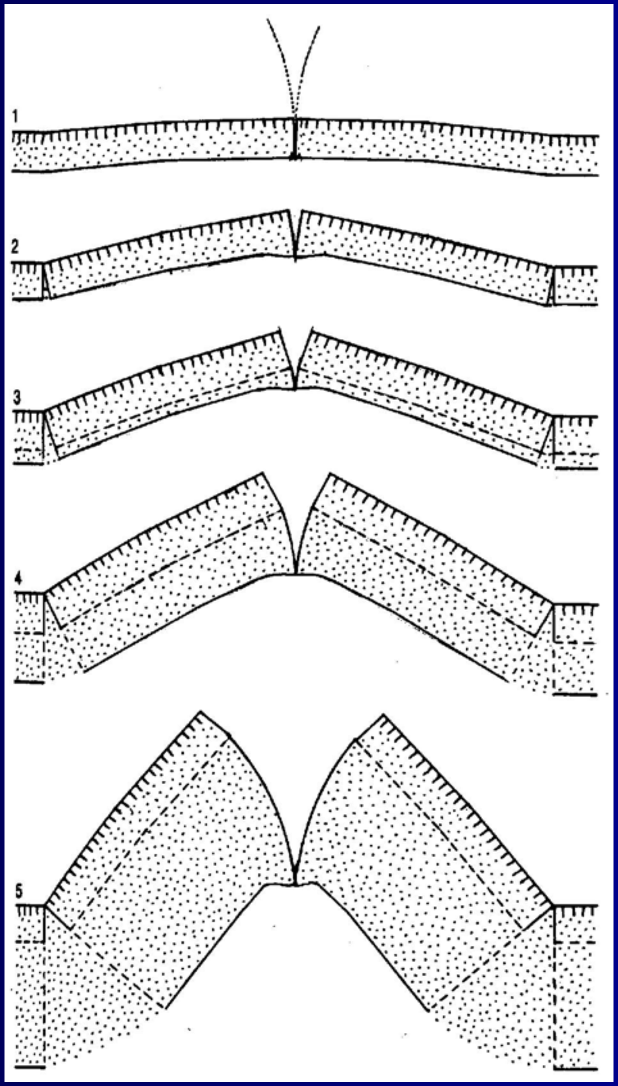
BASALTIC LAVAS

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

TUMULI

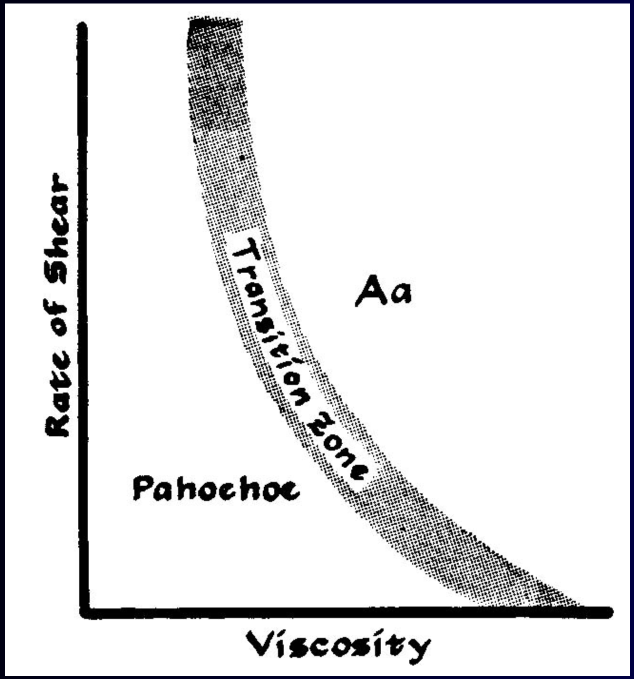


Tumuli in plan view and profile (Walker 1991).



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

BASALTS



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

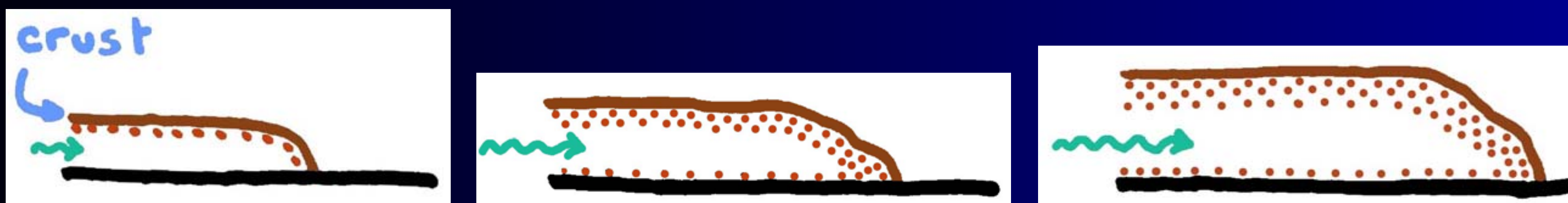
Effusion rates of some basaltic lavas

Eruption	Effusion rate (m^3s^{-1})
Laki 1783	5 x 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

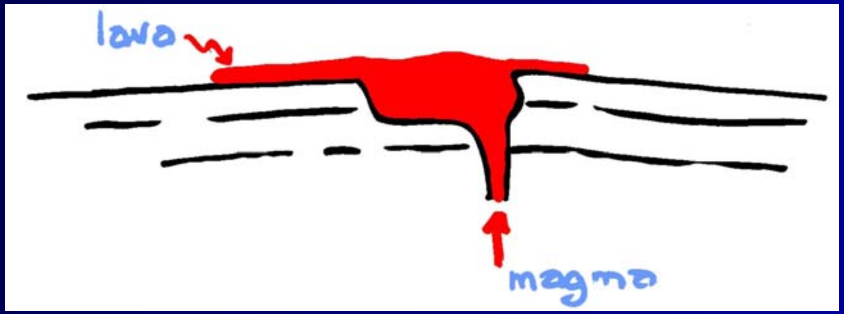


  extent: commonly several km; longest are >hundred km (tube-fed) eg. Undara, Qld
  (low viscosity, well insulated)

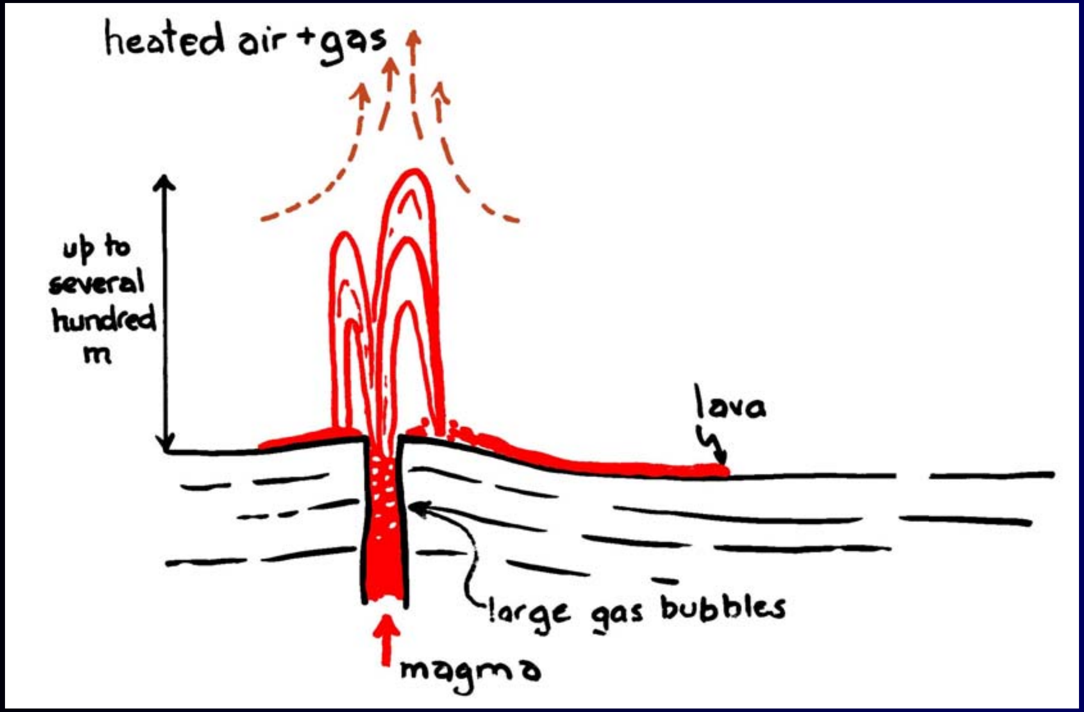
  volume: generally <<15km^3 but the largest (flood basalts) are hundreds km^3 in volume

BASALTIC LAVAS

- eruption styles: ..



upwelling & overflow



"fire fountain"
driven by high discharge & volatile exsolution

- central vent vs. fissure vent

↳ shield volcano

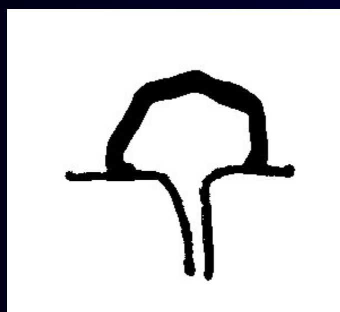
↳ flood basalt provinces

RHYOLITIC LAVAS

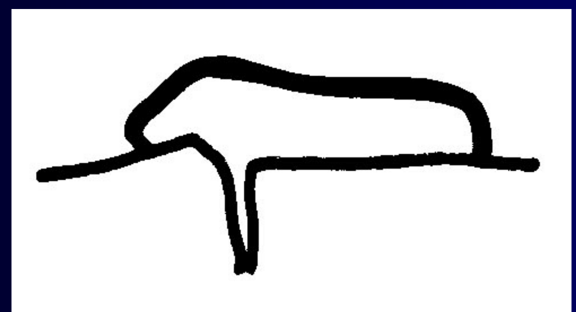
small

...

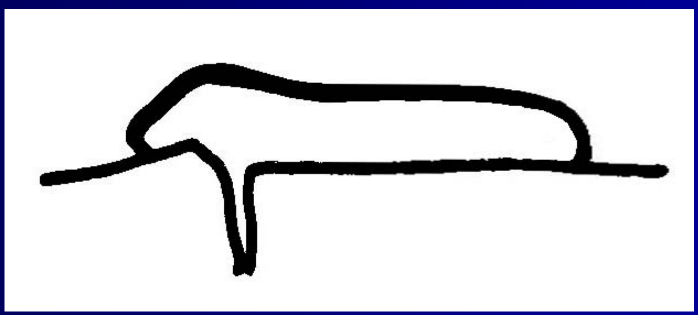
dome



coulée



flow



cross section

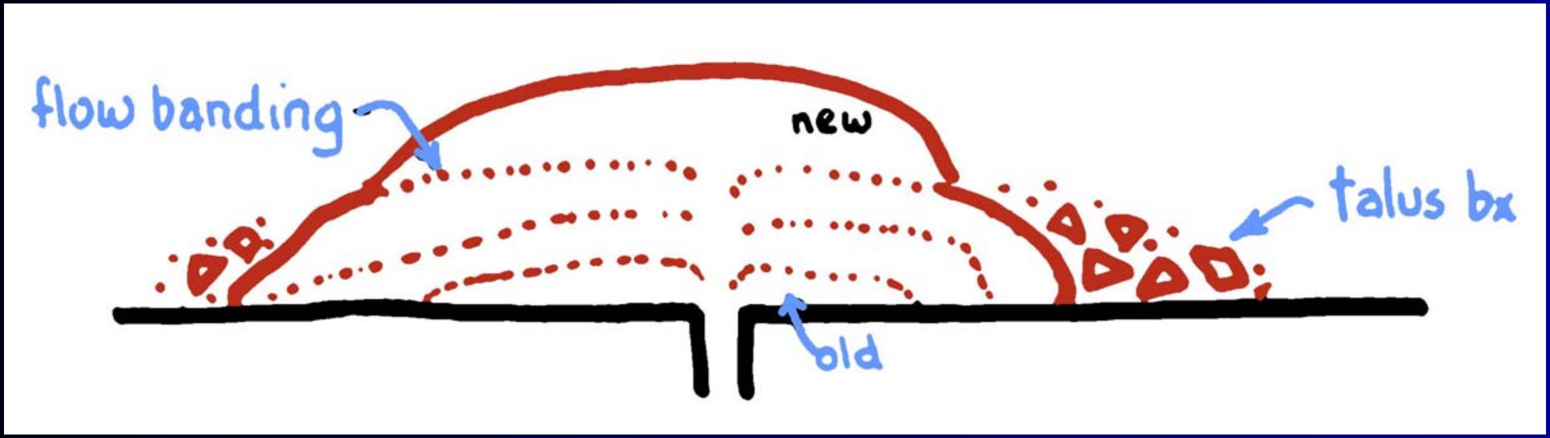
dimensions

thickness	tens to a few hundred m
extent	< 5 km
volume	< 5 km^3, most < 1 km^3

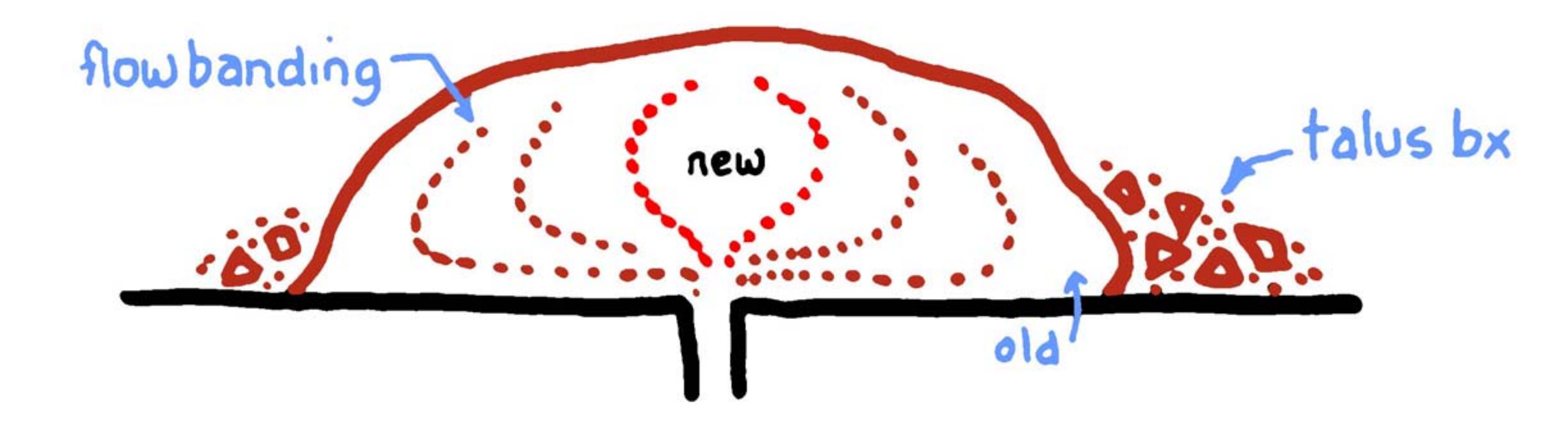
RHYOLITIC LAVAS

growth mechanism

EXOGENOUS - addition to the outside



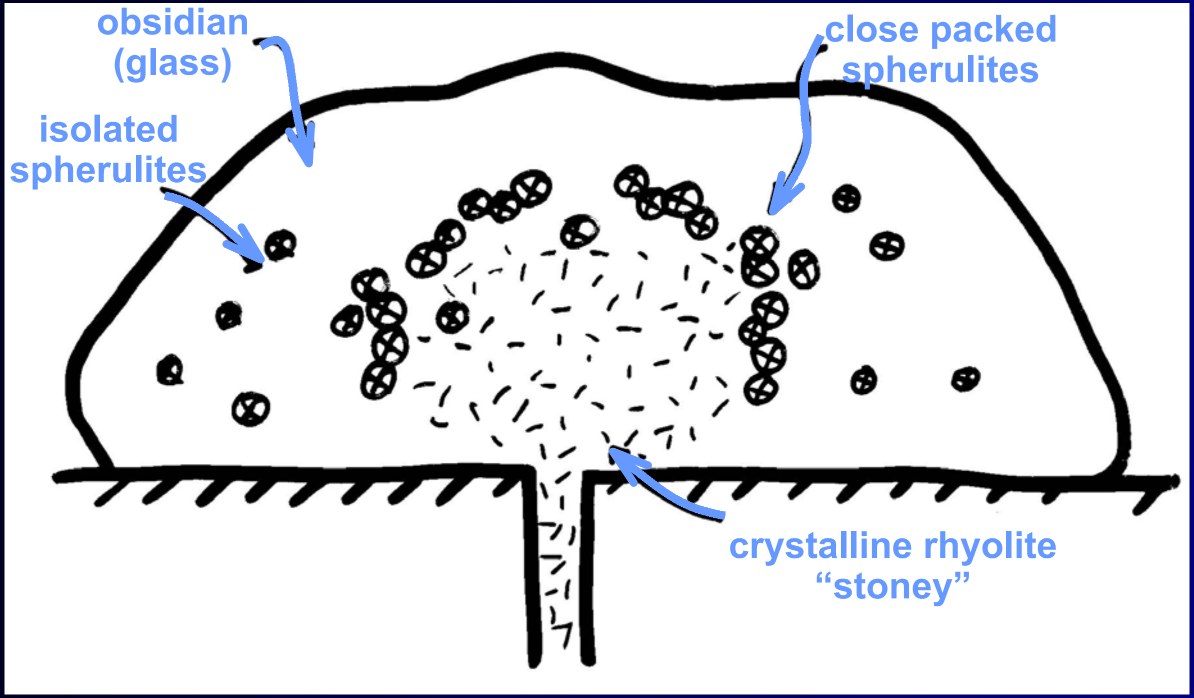
ENDOGENOUS - addition to the inside



RHYOLITIC LAVAS

crystallisation ...

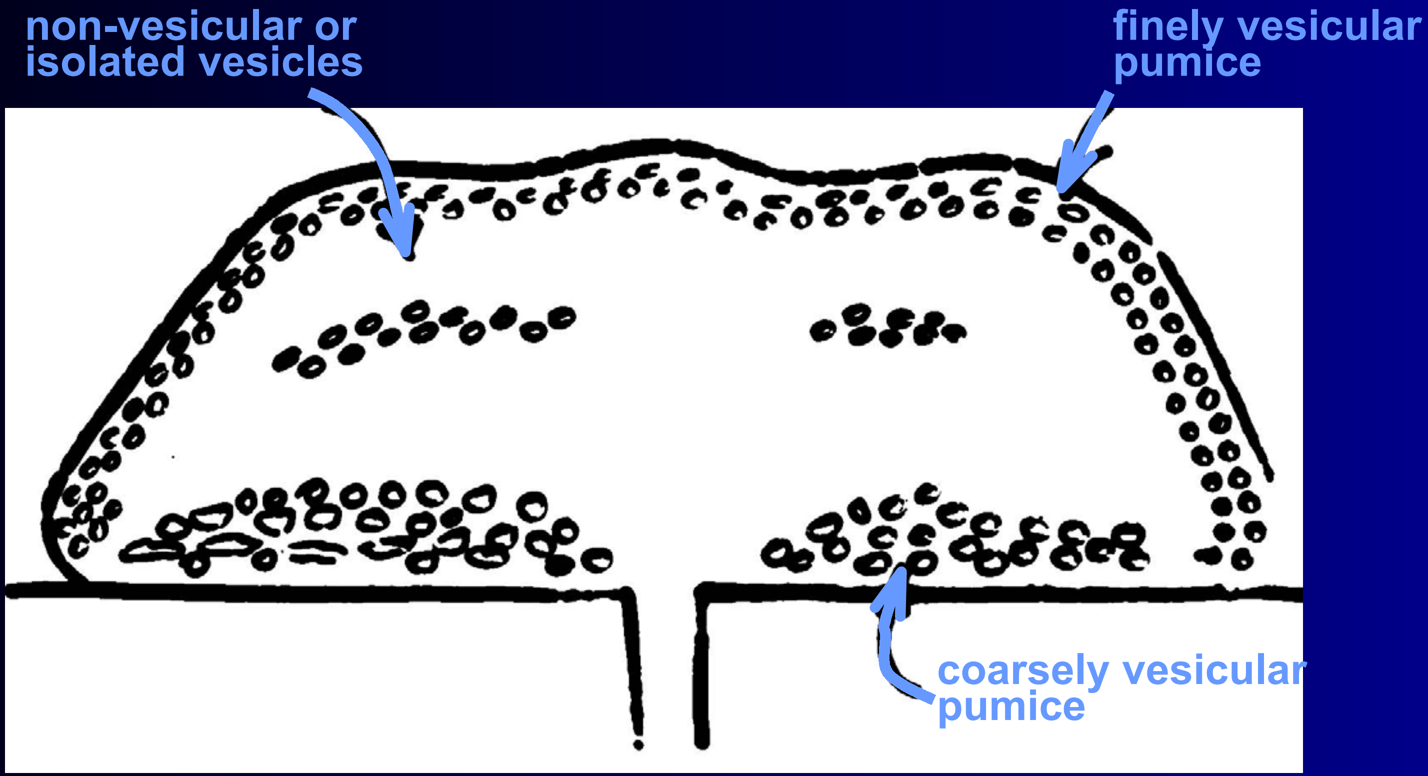
- reflects internal temperature gradients and insulating effects of cool outer crust



RHYOLITIC LAVA

vesicularity

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



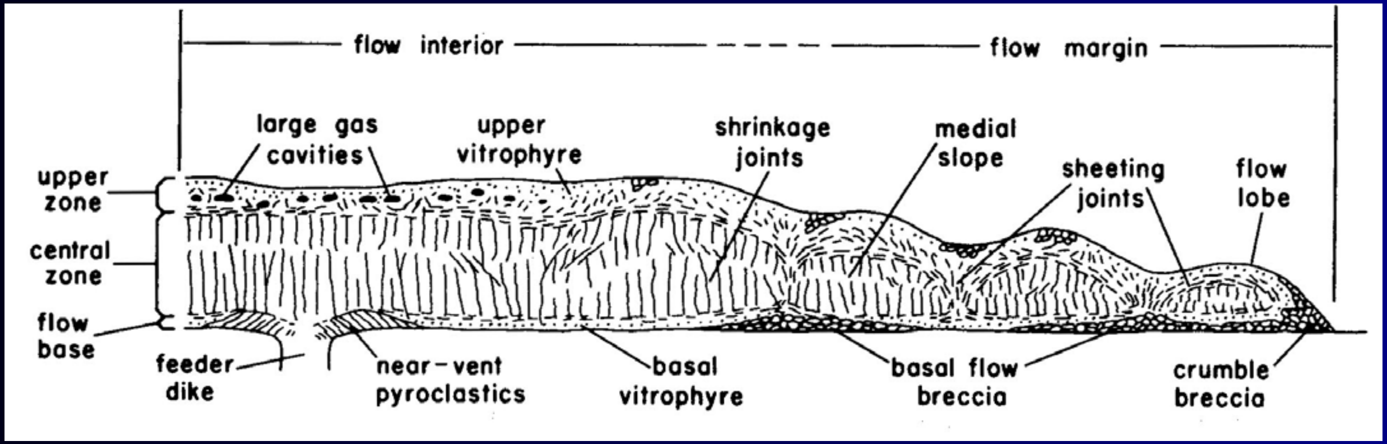
RHYOLITIC LAVAS

big: **extensive sheets** .

dimensions

thickness	100 m to 250 m
extent	several tens km
volumes	10 km^3 to 100 km^3

eg. Miocene rhyolites, Idaho, USA
Cretaceous quartz latites, Namibia ...



Bonnichsen & Kaufmann, 1987

RHYOLITIC LAVAS

conditions for big rhyolites

temperature	high (900 - 1050°C)
volume	large

thick, hot, slow moving flows $\Rightarrow$ small heat loss

$\Rightarrow$ active for decades

Examples of BIG rhyolites

Southwestern Idaho (Bonnichsen & Kauffman 1987)

Name of Unit	Phenocryst Minerals	SiO_2	N	Maximum Thickness (m)	Minimum Volume (km2)
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_2	7I.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	$<1km^3$ to $>20\ km^3$

ANDESITIC & DACITIC LAVAS

examples

Oni-oshidashi lava: basaltic andesite ..

Asama, 1783; 7 km long; 0.17 km^3

Chao Dacite: dacite .

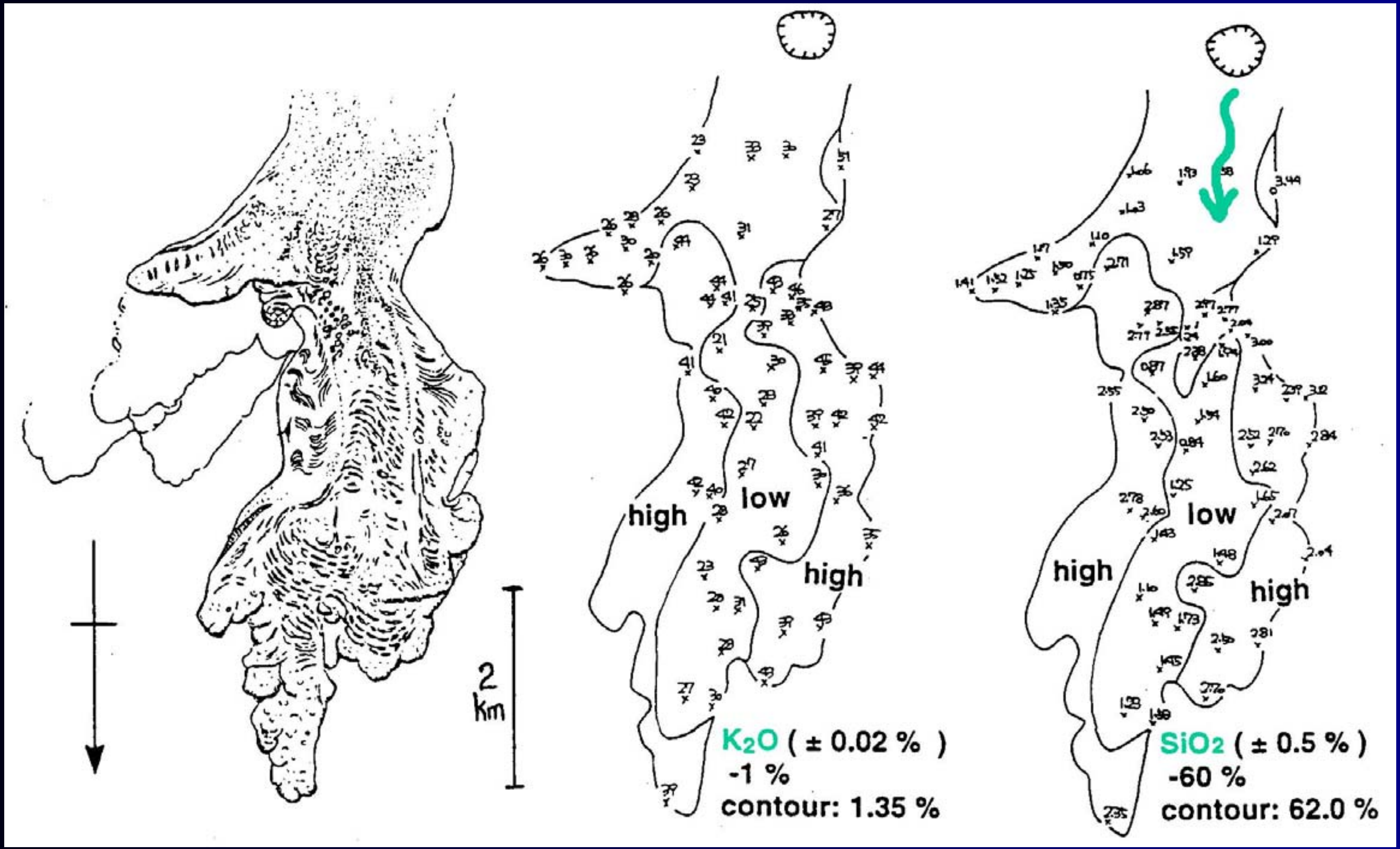
Chile, 0.1 Ma; up to 400 m thick; 12 km long; 26 km^3

Mount Saint Helens: dacite dome .

USA, 1981 - 83; diameter ~ 700 m; 0.04 km^3

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

Eruption	Average effusion rate (m^3s^{-1})
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 Laminqton**	**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^3)	0.044	1.0	1.6	0.8
Growth rate,first 3 years (km^3/yr)	0.014	0.70 (first 1.4 yrs)	0.06	0.06
SiO_2	61-64%	58-60%	56-60%	62-65%

(Swanson *et al* 1987)

AUTOBRECCIA

- volcaniclastic (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