Domes

References:
Encyclopedia of Volcanoes, pp. 307-320
Francis, pp. 153-165
Cas and Wright, pp. 76-88

Definition
- Domes consist of lavas that didn't flow very far
- They built up around the vent instead
- Most domes are composed of viscous lavas
- On Earth, high viscosity generally means high silica content
- Other factors can affect lava viscosity
- Under what circumstances could mafic lava domes form?

Terrestrial Domes
- Consist of rhyolites, dacites, trachytes or andesites
- Generally form after (rather than before) explosive eruptions
- Commonly are the last phase of activity in a mature volcano

Dome Classification
- Domes and tortas ("cakes")
- Coulees
- Peléean domes
- Cryptodomes

Domes and Tortas
- Steep-sided
- Generally rounded profiles
- Relatively flat or gently rounded tops
- Mount St. Helen's 1980 dome

Mono Domes, California
**Coulees**

- Steep-sided flows
- Elongate planforms
  - Indicate downslope movement
- Big glass mountain
- Chao dacite flow, Chile

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**Peléan Domes**

Tall spines (as high as 600 m)
Extremely viscous magma
Example: Mt. Pelée, 1902

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**Cryptodomes**

Actually near-surface intrusions
Lava never actually breaches the surface
Can cause significant upheaval of ground surface
Showa Shin-Zan, Japan
### Dome Shape

Related to the lava rheology
Blake (1980) relationship from laboratory simulations:

\[ H = 1.76 \frac{S_y R}{\rho g^{1/2}} \]

where
- \( H \) = dome height
- \( S_y \) = yield strength
- \( R \) = dome radius
- \( \rho \) = lava density
- \( g \) = gravitational acceleration

### 1979 Soufriere St. Vincent Dome

Measurements of this lava dome gave:

\[ H = 5.75R^{1/2} \]

computing a yield strength of 2.6 x 10^5 pa
- This value is too high for the lava
- Therefore this value includes the strength of the solid crust encapsulating the dome
- Average dome thickness on earth is 100 m.

### Surface Structures of Domes

- Generally very blocky surface
- Surface may be deformed into ogives (folds)

### Vent Features

- Cleft features ("baby's butts")
- Shallow, saucer-shaped craters
- Deep, steep-sided funnels
- Tall spines
- Explosion craters

### Rhyolite Domes

- Diapirs of coarsely vesicular pumice (CVP)
- CVP is less dense than surrounding obsidian or finely vesiculated pumice
- It buoyantly rises through to surface

### Dome Emplacement

- Endogenous growth:
  - The dome grows because lava is injected beneath the solid crust surrounding the dome
- Exogenous growth: the dome grows because new lava is piled on top of any existing lava and crust
- Most domes grow by a combination of endogenous and exogenous processes
- During dome growth, the domes may collapse and generate block-and-ash flows (e.g., Santa Maria, Guatemala)
**Emplacement Rates**

- 0.14 m³/s (Galeras, Columbia)
- 3.5 m³/s (Unzen, Japan)
- 5.2 m³/s (Montserrat)

Growth is slow compared to basaltic lava flow emplacement.

**Internal Structures**

- Flow banding
  - Often concentric over vent area
  - Can reveal magma mixing
- Ramp structures
  - Indicative of flow direction during emplacement of viscous lavas
  - May change within a single flow
  - Form from endogenous growth

**Extraterrestrial Domes**

- Composition of rhyolite, dacite, or andesite?
- Strange basalt?
  - Lots of bubbles: "shaving cream"
  - Lots of crystals: really viscous
- Identified primarily on Venus
- Rare on Mars

**Domes Near Alpha Regio**

~25 km wide
~ 750 m high
Small central pit
Variety of crack patterns
Obvious overlapping