Subaqueous and Subglacial Volcanoes

References:

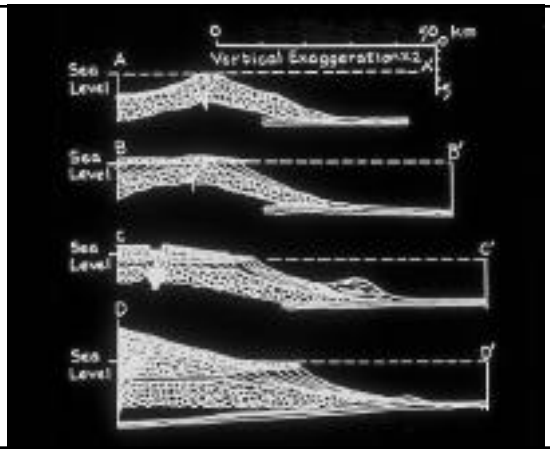
Encyclopedia of Volcanoes, pp. 383-402

Francis, pp. 21-339

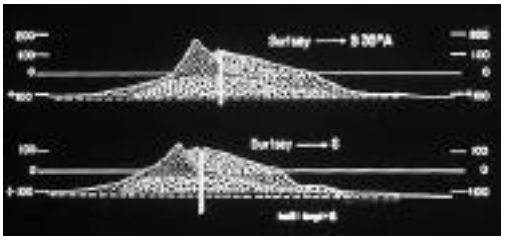
Cas and Wright, pp. 406-409

Seamount Morphology

- Typically circular and flat-topped
- With or without summit caldera
- A summit caldera indicates a magma chamber (however long- or short-lived) within the construct of the seamount itself



Surtsey Example



Seamount Composition

- Most seamounts are basaltic
- Larger ones evolve to more alkalic compositions with time
- Rare rhyolitic examples

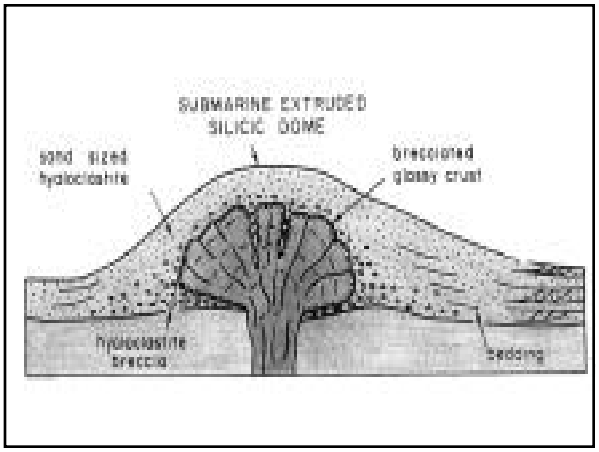
Stratigraphy

- Commonly composed of pillowed flows
- Capped with ponded sheet flows in the caldera
- Hyaloclastites occur if the seamount is tall enough (within ~2000 m of sea surface)

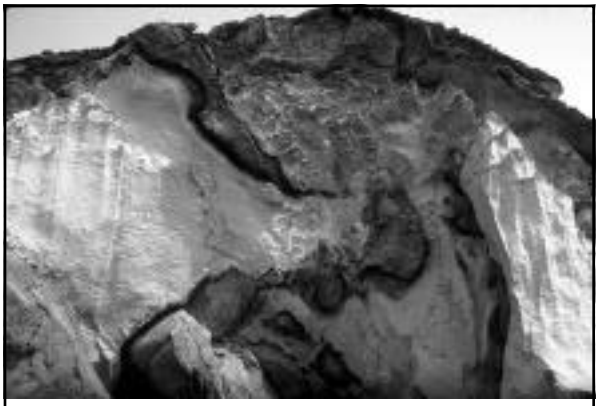
Pillow Basalt, Japan

Rhyolite Seamounts

- Rare features
- Island of Ponza
  - Tyrrhenian Sea
- Obsidian feeder dikes
- Pumice breccia



Ponza, Italy – Subaqueous Rhyolite



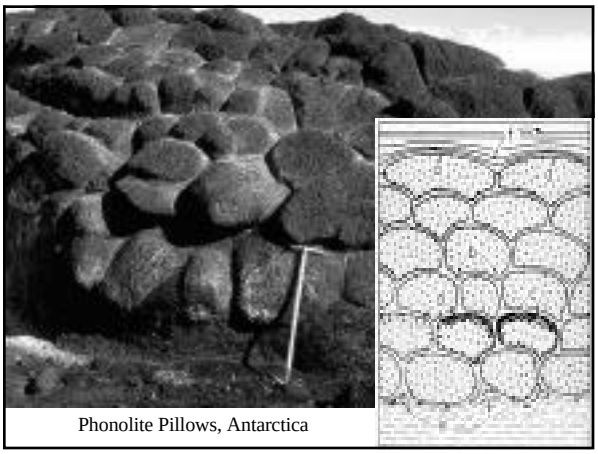
Ponza, Italy – Subaqueous Rhyolite

Subglacial Volcanoes

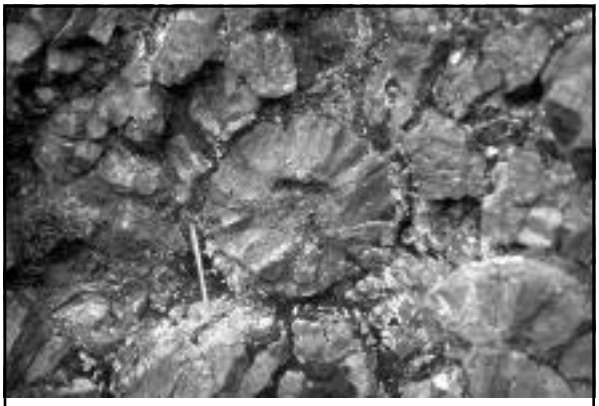
- Form table mountains
- Also called "tuyas“ in Iceland
- These volcanoes erupted beneath a sheet of ice

Main Units

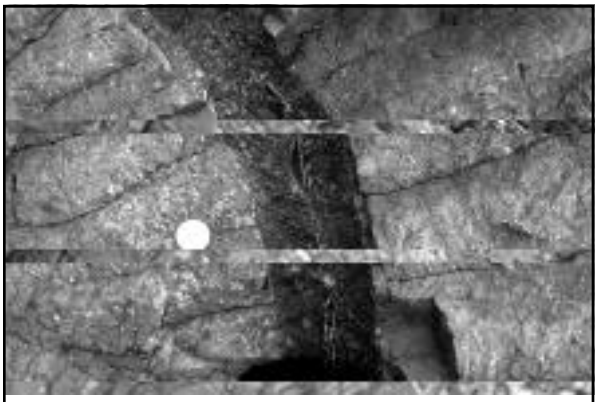
- Pillows
- Pillow breccias
- Hyaloclastites
- Capping lavas



Phonolite Pillows, Antarctica

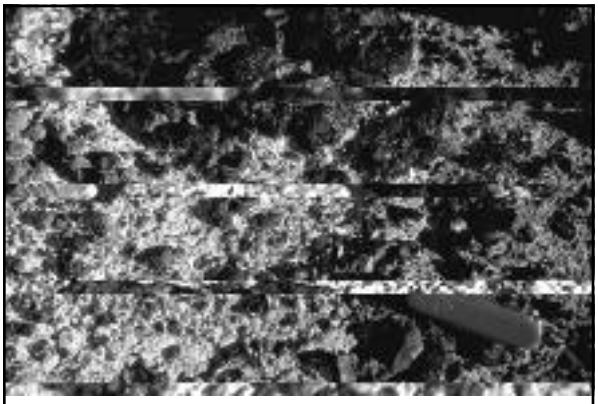


Basalt Pillows, Antarctica



Glassy Pillow Selvage, Antarctica

Pillow Breccia, Antarctica



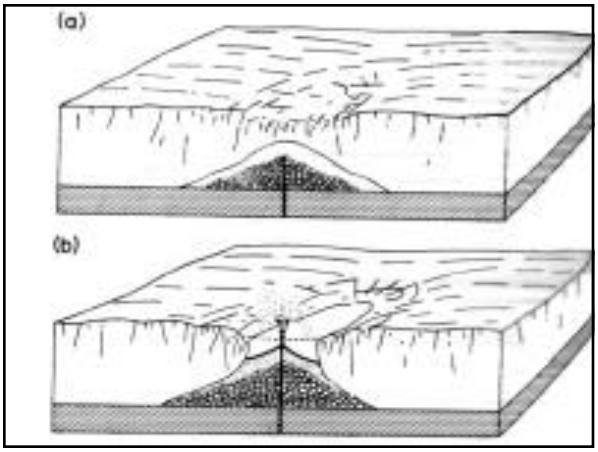
Hyaloclastite Breccia, Antarctica

Initial Stage

- Lava is under a great deal of pressure
- Behaves similarly to deep-marine lavas
- Typical pillow lavas form

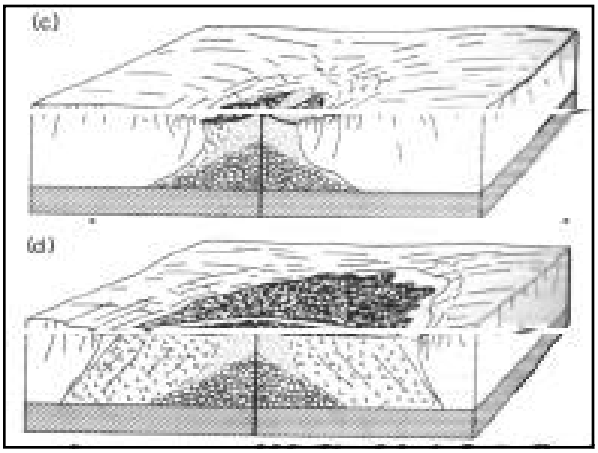
Later Stage

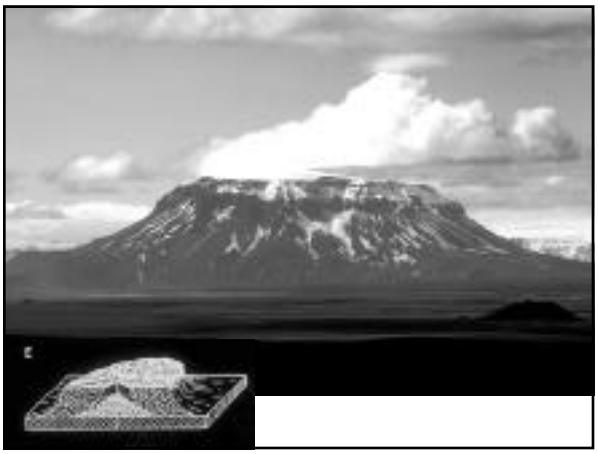
- As the lava pile grows, the overlying pressure decreases
- Eventually, the lava is overlain by a relatively thin layer of meltwater
- Explosions can occur
- This produces hyaloclastites above the pillow lavas

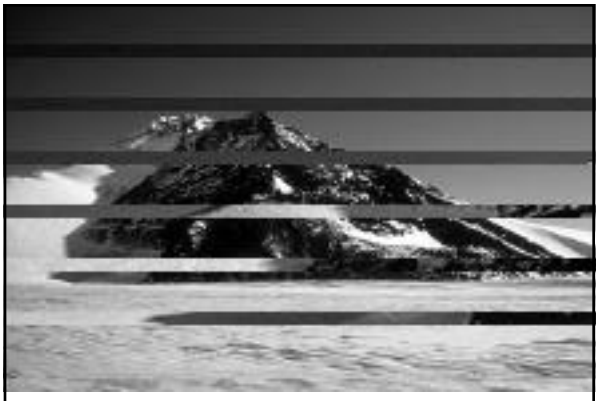


Final Stage

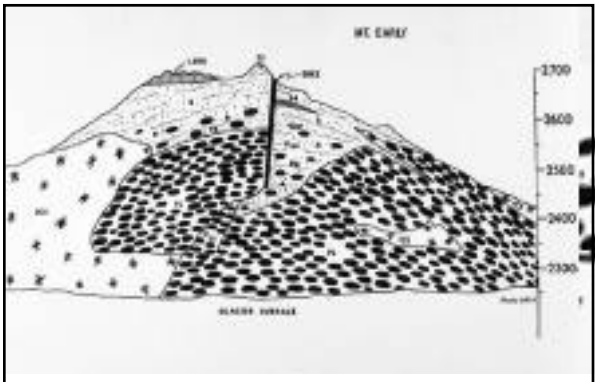
- When the lava pile reaches the surface of the glacier
- “Normal" subaerial basaltic lava (usually pahoehoe) is emplaced
- The resulting volcano can be used to determine the thickness of ice at the time of eruption.







Mount Early, Antarctica



Dike in Hyaloclastite

McMurdo Sound, Antarctica