

Intrusive vs. Extrusive

- Melt that exists below the surface is called **magma** and rocks formed by this process are **intruded** (pushed) into preexisting rocks and referred to as **Intrusive Rocks**
- Melt that is erupted on the surface is called **lava** and rocks formed by this process are **extruded** (pushed) onto the surface and referred to as **Extrusive Rocks**

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Extrusive Environments

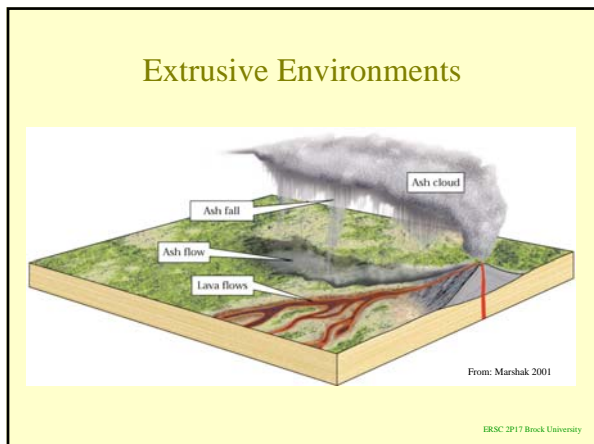
- Not all volcanic eruptions are the same so not all extrusive rocks are the same
- Volcanoes may erupt:
 -
 -
 -

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Volcanic Eruptions

- Volcanic eruptions transfer
- Material erupted falls into three categories:
 - _____
 -
 - _____
 -
 - _____
 -

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Lava and Lava Flows

- Lava displays a variety of compositions, _____

- _____ lavas
-
- _____ lavas
-
- _____ lavas
-
- All are _____, SiO₂-rich are _____ than SiO₂-poor,

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Lava and Lava Flows

- Viscosity (resistance to flow) is dependent on _____:
•
-
-
- Volcanic rock formed by extrusion is a _____, and the shape of the resulting flow reflects _____ of the lava

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Lava and Lava Flows

Basaltic Flow

Andesitic Flow From: Marshak 2001

Rhyolitic Dome Rhyolitic Spire

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Basaltic Lava Flows

- Due to low _____, capable of flowing great distances 10s to 100s of km

From: Marshak 2001 ERSC 2P17 Brock University

Basaltic Lava Flows


- Surface textures of flow reflects the timing of _____ relative to _____

Pahoehoe (ropy) Aa (blocky)

From: Marshak 2001 From: Marshak 2001

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Basaltic Lava Flows

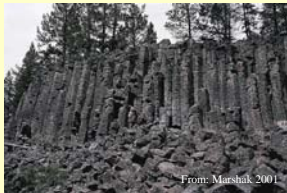


- After the surface of the flow cools the interior remains molten and continues to move downslope, draining out and leaving a _____

From: Marshak 2001

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Basaltic Lava Flows

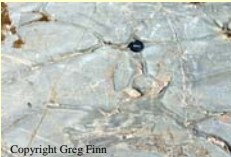




During the final stages of cooling the interior of the lava flow contracts and fractures into roughly hexagonal columns resulting in _____

From: Marshak 2001

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Basaltic Lava Flows



Basaltic lava extruded under water cools much quicker than on land and has a distinctive _____ shape

From: Marshak 2001

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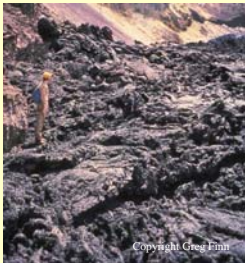
Andesitic Lava Flows

- Due to higher _____ and higher _____ andesitic lava does not flow as easily as basaltic lava
- Andesitic lava moves _____ m/day and rarely reaches lengths of _____ km
- Due to slow movement _____

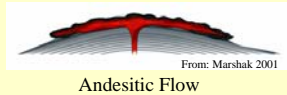
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Andesitic Lava Flows

- Andesitic volcanic cones have _____ slopes than basaltic cones



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From: Marshak 2001

Andesitic Flow

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Rhyolitic Lava Flows

- Rhyolite lava is the most _____ due to its _____ SiO₂ content and lower overall _____
- Does not flow easily, tends to form a _____ or _____ over the vent



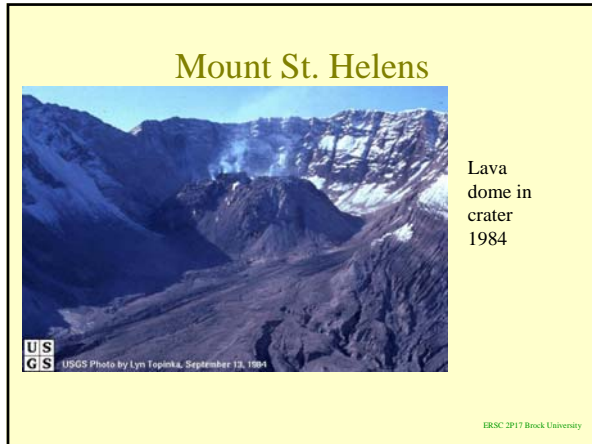
Rhyolitic Dome

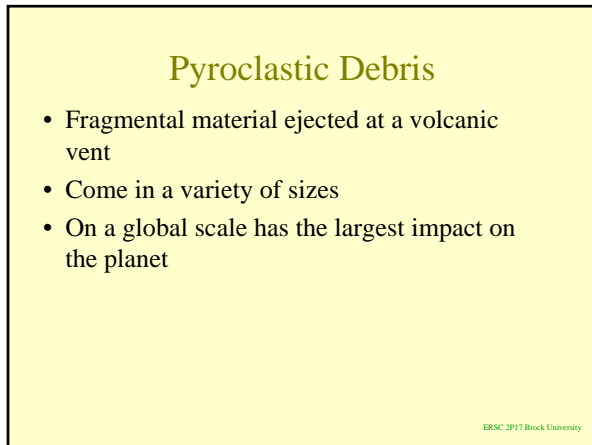
From: Marshak 2001

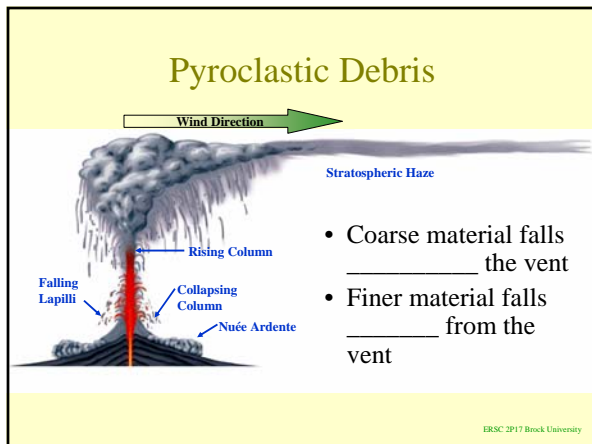


Rhyolitic Spire

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Pyroclastic Debris


-
- powder size
-
- marble to plum sized
-
- basketball to fridge sized
-
- streamlined blocks



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Pyroclastic Debris

- During eruptions lava fountains into the air and freezes into glassy rock before falling to the ground

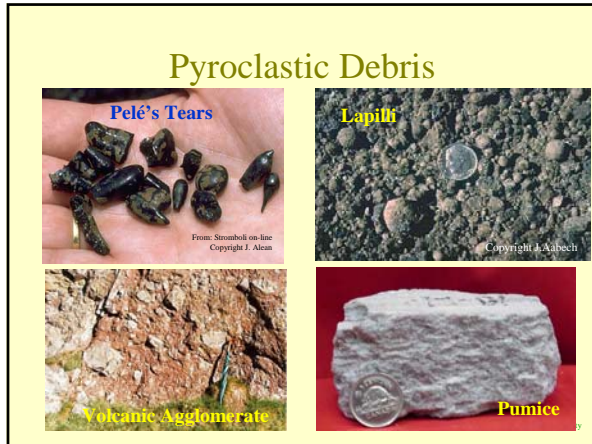


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Pyroclastic Debris

- Basaltic droplets form glassy beads termed _____, named after the Hawaiian goddess of _____
- An accumulation of blocks is termed a _____
- Andesitic and rhyolitic eruptions eject _____ - sponge like volcanic glass filled with _____

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Pyroclastic Debris

- Unconsolidated pyroclastic material is termed _____
- Cemented pyroclastic material is termed _____
- Ash that falls gently from the air is termed an _____
- Where ash mixes with air it forms a fast moving _____ (nuée ardente)

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Mount St. Helens

Pyroclastic flow moving from crater at right to valley floor travelling at 60 mph and at 800°C

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Volcanic Gas

- Most magmas contain dissolved gases
– H₂O, CO₂, SO₂, H₂S, etc.
- Gases come out of solution as the magma rises to the surface and the _____ drops
- Gas bubbles which become frozen in a lava are termed _____
- Vesicles which are eventually filled, as a result of secondary processes, are termed _____

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Igneous Textures

- **Vesicles** - _____
- **Amygdules** - _____




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Volcanic Gas

- In low viscosity lavas (basalt), trapped bubbles can generally escape from the liquid before solidification
- In high viscosity lavas (andesite and rhyolite) the gas bubbles cannot escape from the lava
- As the pressure drops, the gas expands and may cause the violent eruption of the volcano

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Mount St. Helens




Pre 1980 view - Peak is at 2,950 m elevation

USGS Photo by D. Anderson, April 10, 1980

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Mount St. Helens

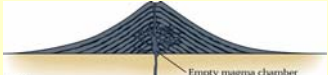


May 18, 1980 Eruption

USGS Photo by Austin Post, May 18, 1980

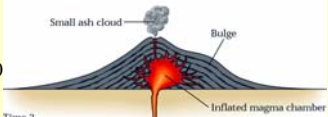
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Pre 1980



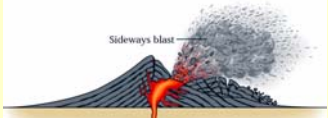
Time 1 Empty magma chamber

May 17, 1980



Time 2 Small ash cloud Bulge Inflated magma chamber

May 18, 1980




Time 3 Sideways blast

From Marshak 2001

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Mount St. Helens




September 1980 peak height now 2,550 m and crater is 1.5 km across following May 18 1980 eruption

USGS Photo by Tom Casadevall, September 16, 1980

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Mount St. Helens




Pyroclastic flow moving from crater at right to valley floor travelling at 60 mph and at 800°C

USGS Photo by Paul Williams, August 7, 1980

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Mount St. Helens




Pumice blocks deposited at the edge of a pyroclastic flow

USGS Photo by J. A. Aguirre, October 17, 1980

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Mount St. Helens




Lava dome in crater 1981

USGS Photo by Lyn Topinka, August 29, 1981

USGS

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Mount St. Helens




Lava dome in crater 1985, Photo taken from same spot as previous photo

USGS Photo by Lyn Topinka, August 12, 1985

USGS

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Mount St. Helens




Lava dome 1983. Note geologist at centre right of photo. Ground is actually ash covered snow.

USGS Photo by Lyn Topinka, May 26, 1983

USGS

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Mount St. Helens




Mount St Helens from Johnston Ridge May 17, 1980

USGS Photo by Harry Glicken, May 17, 1980

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Mount St. Helens




Mount St. Helens from Johnston Ridge September 1980

USGS Photo by Harry Glicken, September 10, 1980

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Mount St. Helens



Mount St. Helens from Johnston Ridge September 1984

USGS Photo by Lynn Topinka, September 24, 1984

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Important Volcanic eruptions

- Santorini ~1645 BC
- Vesuvius 79 AD
- Tambora 1515
- Krakatoa 1883
- Surtsey 1973
- Mount St. Helens 1980
- Pinatubo 1991
- Olympus Mons (Mars)

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