

Geol 104 Lecture 21
Cascades: Mt Rainier, Mt St Helens, Crater Lake and Olympic

I. Introduction

- A. Cascade Range is part of the Pacific Ring of Fire
 - Volcanic Arcs produced by subduction of oceanic plates
- B. Location of Cascade Range
- C. Tectonic Setting and mantle melting
- D. Magmatic Systems under Arc Volcanoes
- E. Examples of Volcanoes (parks)
 - Mt Rainer, Mt St Helens, Crater Lake and Olympic

II. Location and Tectonic Setting

- A. Cascade Range Location
 - 1. Extends from northern CA through WA
 - 2. Includes many volcanoes and the surrounding uplands
 - a. Lassen Peak is the furthest south
 - b. Mt Rainer is the furthest North in US
 - c. Garibaldi Volcanic Belt of British Columbia is the furthest north portion of Cascade range
 - i. Meager Mt the furthest North
 - ii. Mt Garibaldi the largest of the GVB
 - 3. Nearly all of the volcanoes are Active or Dormant
 - a. Active = current active in past 100 years
 - b. Dormant = erupted in past 1000 years and likely to erupt again
- B. Tectonic Setting
 - 1. Subduction of Juan de Fuca Plate beneath NA
 - This is the remnant of Farallon Plate
 - 2. Subduction ends in north and south where plate boundary becomes transform

III. Magmatic System

- A. Melting of Asthenosphere
 - 1. Fluids squeezed from subducting slab flow into the overlying asthenosphere
 - 2. These fluids work like antifreeze lowering melting point of asthenosphere
 - a. Example: add salt to Ice and lower the melting point (melt the ice)
 - b. These melts rise into the lithosphere and supply a magma chamber in the crust
- B. Magmatic Model
 - 1. Magma chamber stores melt as it cools and evolves chemically
 - a. Magma = liquid + crystals
 - b. Crystals = minerals crystallizing from the cooling liquid
 - 2. Eruption = times when magma is forced to the surface
 - a. Conduit = pipe system through which the magma rises
 - b. Lava = magma erupted onto surface
 - c. Ash = magma that is exploded into atmosphere (fragmented into clay-sized particles)
 - 3. Cascade volcanoes are of a type called Stratovolcanoes
 - a. Stratovolcanoes = mountains built of layers of Ash and Lava
 - Indicating variations in eruptive style: fluid lava vs. explosive ash eruptions
 - b. Plinian = explosive eruptions, result from rapidly expanding magma
 - gas dissolved in the magma forms bubbles as the magma rises (decompresses).
These bubbles increase the volume of the magma ~1000x very rapidly causing it to explode. Analogy: taking the top of a bottle of soda after you shake it up.

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- c. Risk: since many of these cascade volcanoes are near cities, explosive eruptions pose a risk.
 - i. ash falls are heavy – crush houses
 - ii. ash also burn, chokes you, destroys machines (engines, AC etc.)

IV. Mt. Rainier

A. Location

South of Puget Sound, Wa
Young age <1 Ma!

B. Size – Glaciers

1. Tallest of the cascade volcanoes (14,410 feet)
2. Many glaciers flow from its summit
 - most actually come from middle of the mountain – rising air loses moisture there and ~100 feet of snow accumulate per year.

C. Eruption beginning ~6600 years ago

1. Mountain was ~1000 feet taller
2. 5700 years ago violent eruption destroyed the summit
 - a. Must have released huge ash cloud, lahars flooding the slopes etc.
 - b. 90% of eruptions are of lava and only 10% tephra (ash and pumice) – this is very unusual for a stratovolcano
 - c. Much of the tephra on Mt Rainier comes from Mt St Helens and Mt Mazama

D. Risk - Mass wasting and Lahar are the major hazards

1. Debris flows (mass wasting) are common – avalanche, flows etc.
2. Lahar = volcanic activity melts glacial ice and mixes with eruptive material and flows great distances down the river valleys.

V. Mt St Helens – 1980 eruption

A. Location

- South of Mt Rainier in WA

B. Magma ascended to shallow level in the Volcano

1. Stopped by an igneous plug in the volcanic neck
2. Sides of the volcano began to bulge

C. Eruption

1. Landslide from the bulge reduced the pressure – allowing gas to form bubbles
2. This is like taking the top off a champagne bottle – boom
 - eruption was as powerful as an atomic bomb

VI. Crater Lake

A. Location-southern Oregon

B. Crater Lake

1. Lake fills the caldera of Mt Mazama
 - a. ~1900 feet deep – the deepest lake in US
 - b. more than 5 mi in diameter – 21 square mile area

C. Eruption of Mt Mazama

1. Mt Mazama summit was ~11,000' – some 3500 feet higher than the current rim

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2. Large Plinian Eruption blew the summit off, leaving the crater behind
 - a. began ~7000 years ago with eruptions from flank vents – Llaw rock = dacite flow
 - b. Main eruption began ~6845 with plinian cloud
 - i. Huge column of pumice and ash shot ~5-10 of miles into the air
 - ii. This column then fell into firey avalanche (Nuee Ardent)
 - iii. Ash fell as far away as Yellowstone, and Saskatchewan
 - c. The summit was left unsupported and collapsed
 - i. this forced much of the remaining magma out of the volcano
 - ii. Black (basaltic) tephra from this later event tops the lighter colored tephra from Plinian stage

VII. Olympic

A. Location – NW coast of WA

B. Origin of Olympic Mountains

1. Unlike other cascade parks, this is not volcanic in origin
2. Rather, this is uplifted accretionary prism of subduction zone

C. This area is a rain forest caused by a Rain Shadow

1. Rain Shadow

- a. Moist air off the pacific is forced to rise over the Olympic mountains
- b. Air expands on accent, cools and loses moisture (rain and snow)
~150 inches/year – highest annual precipitation in conterminous US

2. This moisture also feeds many glaciers on the summits of the high peaks