LECTURE FIFTEEN: Volcanoes and Volcanic Deposits 2

IN THIS LECTURE
- Shield Volcanoes
- Stratovolcanoes
- Other Types of Volcanic Centres
- Flood Basalt Provinces

SHIELD VOLCANOES GENERAL

- Symmetrical and circular to elliptical in shape
- Convex-up piles of basaltic lava with slopes < 10°
- Built up by fluidal eruptions of basaltic lavas from central vents and/or flank eruptions
- Shield basal diameter (Ws) varies between a few kilometers to over 100kms
- Shield heights (Hs) are on average 1/20 Ws
- Composed almost entirely of lava flows but also may contain
  - < 1% pyroclastic deposits including scoria fall
  - Deposits from phreatomagmatic and phreatic explosions
  - Some oxidised soil horizons and epiclastic sediments

HAWAIIAN SHIELD VOLCANOES

- Summit calderas and major rift zones marked by spatter cones, spatter ramparts, collapse craters (pit craters), scoria cones and smaller superimposed monogenetic shields
- Shape usually controlled by eruptions from the rift zones
- Eruptions within the calderas occur slightly more frequently than on the rifts but the eruptions from the lateral rifts that give the shields their elongate form.
- Calderas range from 5 to 20kms in diameter
- Shields are built by lavas and minor pyroclastics as well as high level intrusives which may be present in the summit caldera walls.
- Compositional differences occur as the shield volcano evolves changing from tholeiitic to progressively more alkalic
- More explosive activity accompanies the eruptions of alkaline magmas.
- Eruption frequency decreases with time

ICELANDIC SHIELD VOLCANOES

- Smaller – Ws < 15 km
- Symmetrical
- Almost entirely built up by effusive eruptions from a central summit vent
- Summit crators usually < 1 km across and often have raised rims of spatter
- Few radial fissures or lines of parasitic cones
- Generally composed of large numbers of thin pahoehoe flows
- Mostly monogenetic and usually constructed in less than 10 years.

GALAPOGAS SHIELD VOLCANOES

- Very similar to Hawaiian shield volcanoes but the shape of the upper summit is different
- Gentle lower slopes that rise to steeper central slopes that flatten off around spectacular summit calderas.
- Usually more alkaline than Hawaiian volcanoes

STRATO- VOLCANOES

- Stratovolcanoes or composite volcanoes are the characteristic volcanic landform found at subducting plate margins
- They represent the most abundant large volcano on the Earth's surface
- Stratovolcano morphology results from repeated eruptions of pyroclastics and relatively short lava flows from a central vent.
- Volcaniclastic deposits (pyroclastic and epiclastic) are usually very important volumetrically and can make up more than 70% of the volcanic succession the rest being lavas.
- At destructive plate margins, stratovolcanoes are built by eruptions of calc-alkaline magmas that are usually broadly andesitic or basaltic-andesite in composition.
- Alkaline magmas generate stratovolcanoes which are on average larger than their calc-alkaline counterparts.
- Average slopes on stratovolcanoes range from 15° to 33°.
- Most active stratovolcanoes are less than 100,000 years old and have repose periods of up to 10,000 years
- Stratovolcanoes are composed of a wide variety of primary volcanic products including: (1) Various lava types from basaltic through to rhyodacitic; (2) Pyroclastic flows; (3) Welded air-fall tuffs; (4) Ash deposits; (5) Ignimbrite deposits; (6) Pumice fall deposits
- This variety of volcanic products arises because the generation, evolution and type of magma erupted from these volcanoes is complex and could represent magma chambers on different levels with complex conduits between them and replenishment by different batches of primary basaltic magma rising through the system.

FLOOD BASALTS

- The source vents to flood basalts are not central or point-source volcanoes
- They usually have high discharge rates up to 106 m3 per second
- Flood basalts represent the largest single eruptive units known and usually have flowed great distances from their source.
- Flood Basalts built up by repeated eruptions forming a vast lava plateau which may cover areas > 106 km with slopes generally less than 2-3°
- Often closely associated with the initiation and early development of rifted margins
- Dominantly tholeiitic but alkali basalts are also common
- Many of the larger flows must have formed vast lava lakes that took many years to solidy as indicated by the well-developed massive columnar jointing preserved in many flood basalt provinces
- Columnar jointing is often two-tiered related to cooling fronts propagating inwards from both the top and bottom of the lava flow.

IMPORTANT EXAMPLES OF FLOOD BASALT PROVINCES

Mid-Tertiary Ethiopian-Yemen plateau
Cretaceous Deccan Traps Northwestern India, 500,000 km2 and volume of more than 1 million km3
Cretaceous Parana-Etendeka province of southern Brazil-Uruguay-Namibia
Jurassic Karoo in South Africa
Jurassic Ferrar in South America
Mid-Miocene Columbia River Basalts, USA, cover 220,000 km2 and have an estimated volume of 195,000 km3