GLG 101 - CHAPTER 5 - VOLCANIC AND PLUTONIC ACTIVITY

- The nature of volcanic eruptions is controlled by the magma **composition** (mafic, intermediate or felsic – really, hot thick and sticky it is), its **temperature**, and the amount of **dissolved gases** it contains.
- The higher the silica content, the more pasty and thick the magma is, and the more likely it is to produce a violent explosion by pent-up gas pressure.
- **Mafic (thin and runny)** magmas can erupt easily (rarely explosive), and can flow for tens of kilometers before solidifying. Mafic lava flows of **basalt** tend to be long and thin for this reason. Lava tubes and channels commonly bring liquid lava to the ends of the flows to lengthen them. Hawaii and Iceland are almost entirely composed of this type of lava. **Shield** volcanoes are commonly produced by accumulations of basaltic lava flows from a central vent. Basalt commonly erupts from volcanoes at **divergent** boundaries and over mantle **hotspots**. Partial melts from the asthenosphere probably all start out as basaltic (mafic) magmas. Small eruptions of gas-rich basalt can pile up pea- to fist-sized **cinders** to form a **cinder cone**.
- Huge amounts of basaltic lavas are sometimes released from long **fissures** to produce **flood basalts**. These are the largest eruptions known, and can cover areas of thousands of square kilometers (though not all in one eruption).
- **Intermediate** magmas can produce either quiet flows of **Andesite** or violent explosions of ash. Andesite flows tend to be shorter and thicker than those made of basalt. **Interlayered piles of andesite flows and ash layers commonly produce composite cones (or Stratocones)**. The "Ring of Fire" volcanoes around the Pacific Ocean are predominantly of this type. Andesite commonly erupts from volcanoes above **subduction** zones at **convergent** boundaries. It can also be produced by **differentiation** (which results in concentrating of silica) of an initially basaltic magma.
- **Felsic (thick and sticky)** magmas flow with great resistance and have a very hard time getting out of the ground. Gas pressure builds up when the bubbles can't escape as quickly as they are produced, leading to extremely explosive eruptions of felsic pumice and ash. If there is very little dissolved gas in felsic magma, it can erupt to form very thick, stubby flows of **rhyolite** lava or even **obsidian**. Felsic (rhyolitic) magmas are probably produced by rocks in the continental crust and/or by differentiation of intermediate magmas. The huge volumes of ash that erupt from these volcanoes leave a gaping hole where the magma chamber empties out. This commonly leads to a collapse of the overlying land into the hole producing a broad, crudely circular valley called a **caldera**. Caldera-forming eruptions can spew tens of cubic

kilometers (or more) of rhyolitic **ash** into the atmosphere as **pyroclastic flows**. The gases released by these eruptions can affect global climate for months to years at a time.

- Ash, cinders and larger **volcanic bombs** (they don't really explode!) are all types of **pyroclastic** (literally, "fire pieces") materials. The driving pressure that throws these materials out of the volcanic vent is built-up gas pressure from dissolved gases escaping the magma as pressure is released near and at the Earth's surface.
- In addition to gases that originate within the magma, **groundwater** can be flashed to steam by contact with magma, producing explosive activity. These steam explosions can produce volcano-like craters called **Maars**.
- The largest volcanic hazards are not lava flows themselves, but fast-moving **ash flows** (nuée ardentes) and **mudflows (lahars)** produced by massive rain-induced erosion of recent volcanic ash deposits. These flows can travel tens of kilometers from volcanoes, at speeds well over 100 km/hr, and can wipe out any settlements in their paths.
- **Intrusive** bodies of igneous rock are classified by their shapes and orientations. **Plutons** are blob-shaped masses of intrusive rock formed from solidifying diapirs. Plutons that are exposed at the surface over areas less than 10 km^2 are called **stocks**, those that are exposed over areas greater than 10 km^2 are called **batholiths**.
- Thin, tabular (sheet-like) intrusive bodies that cut across the pre-existing layers of **country rock** are called **dikes**. Tabular intrusive bodies that are parallel with pre-existing country rock layers are called **sills**. The thin tabular bodies are most commonly mafic in composition (because it is easier for the runny basaltic magmas to squeeze far into cracks to form these features), but can also be intermediate or felsic.
- Most intrusive and extrusive activity (particularly the active volcanoes) occurs at or near plate boundaries. The major exceptions to this rule are several dozen **hotspots** within the plates. Yellowstone valley is a huge caldera produced by an explosive eruption above a mantle hotspot. The geysers there (and elsewhere around the world) are produced when groundwater is heated by the magma below the Earth's surface.