Volcanic Hazards Summary

Ashfall

Ash mantles topography. It moves as fast as the wind that carries it. Therefore, it is distributed in the direction the wind is blowing during the eruption, at the same speed as the wind is blowing. For example, with winds of 66 km/hr, if a farm is in the down wind direction during an eruption, and is 66 km away, it will take 1 hour for the ash to arrive, and the farmers have 1 hour to evacuate. Towns and agriculture in the up wind direction are likely to be unaffected by ash during the eruption.

The thickness of ash deposited during eruptions is related to how far away from the summit you are. For example, in a small eruption, if you are 80 km downwind from the eruption, you get 2 cm of ash falling. In an extreme eruption, you could get as much as 90 cm. Note: if you lived 80 km away in the opposite direction of the wind, you would probably receive nothing. As you get closer to the wind direction, the ash thickness would increase until it reaches the maximums described above.

Much of the volume of ash produced in an eruption will be deposited outside the 1 cm boundary, but such small amounts generally constitute only a mild hazard, significant only under special circumstances, for example for people with severe respiratory disease and for jet engines if ash enters intakes.

- **Zone 1 – Moderate Hazard – Thickness between 1 and 10 cm .** Less than 10 cm thick, ash can cause plenty of damage by clogging machinery, overwhelming sewage treatment plants when it gets into storm drains, causing auto crashes due to sliding and decreased visibility, covering grass that animals normally graze, etc. But less than 10 cm of ash is unlikely to cause much loss of life.
- **Zone 2 – Severe Hazard – Thickness between 10 cm to 100 cm (1 meter).** 10 cm of ash is enough to collapse roofs (crushing the inhabitants), especially if the ash gets wet, which increases load on roofs.
- **Zone 3** – **Extreme Hazard – Thickness exceeds 1 m.** One meter of ash is enough to collapse nearly all roofs, and it would bury vegetation so deeply, recovery would be impossible. The size of the pumice lumps and rocks torn from the vent increases toward the vent (big particles fall out of the column closer to the vent than smaller particles), just as the thickness of the deposit does. Where the deposit is thick, there is also a severe hazard of being clobbered by falling pumice lumps and rocks.

Lava Flows

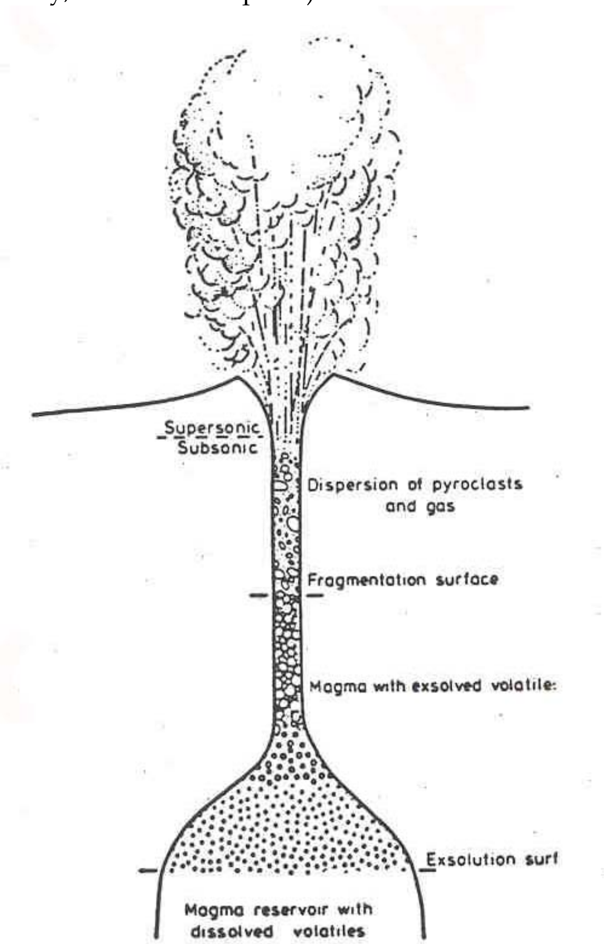
Lava flows are composed of 100% molten lava, originating from a vent or fissure. They tend to move slowly: the higher the viscosity (higher the silica content) of the lava, the slower the flow. Andesitic lava flows move about 4 km/hr on steep slopes and only about 0.5 km/hr on flat areas. Gravity pulls lava flows downhill, while increased magma supply from above gives them added push. The slower the lava flow, the closer it stays to the vent. Low viscosity pahoehoe lavas can flow thousands of kilometers (if volume is high enough, like in flood basalts). High viscosity rhyolitic lavas never flow more than a kilometer or two. Where magma supply is high (like in hotspots), flow rate increases.

Volcanic Mudflows

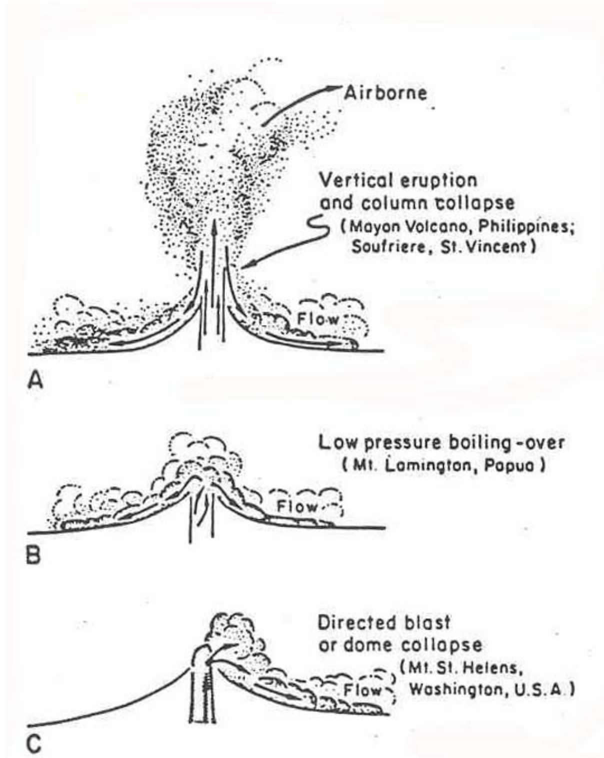
Mudflows are composed of ash and usually meteoric water (nonmagmatic) such as melted ice, lake water, sea water, and groundwater. They move rapidly (30 km/hr), pulled downhill by gravity. They stick to river valleys, basins, and lakes. They usually involve such large amounts of water that they cause lakes and rivers to overflow their banks. Mudflows (often referred to as Lahars when they occur on volcanoes) can take out bridges, houses, and cars, and can travel hundreds of kilometers from the vent. Because they flow down existing river valleys, they do most of their damage in the flood plains of rivers. Note: lahars can occur during and after eruptions. Lahars that occur during eruptions usually are the result of hot ash raining down on and melting glaciers, or the combination of hot ash and water breaking through dams. Lahars that occur after eruptions usually result from rains that mobilize recently deposited ash and carry it to streams.

Pyroclastic Flows

Pyroclastic flows form in a variety of ways. Hot ones form by initial collapse of the outside of an ash column. They can also form as colder rock and glass from the front of lava flows falls off, exposing magma underneath that is still full of gases. Another cause is catastrophic depressurization of a hydrothermal system (as in the Mt. St Helens eruption, when the bulge on the side of the mountain slid away, after an earthquake).



Pyroclastic flows are composed of original magmatic material. They are fast because they are light and contain gases, which help reduce friction (75 km/hr). Pyroclastic flows are intensely heated with minute fragments of magma, crystals, gas, ash and any other rocks or sediments they can entrain as they flow from the vent or fissure, much like an avalanche.



Surges

A surge is the fastest and most dangerous type of pyroclastic flow (200 km/hr). They are sometimes referred to as nuee ardentes. They differ from a more typical pyroclastic flow because of increased volume of gas and the small size of particles they carry. Pyroclastic flows can carry large sizes; surges transport mostly fine-grained material.

Warm to cold surges usually come from nonmagmatic water, such as melted ice, lake water, sea water, and groundwater. This water comes in close contact with magma or hot rock and flashes to steam. Most surges don't go very far, because either they entrain cooler air and rise upwards, or they literally run out of steam. The biggest surges will extend a few kilometers beyond the base of the volcano. Surges mantle topography, but tend to be thick in valleys and thin on ridges. They are powered partly by the initial gas expansion (blast), which gives them a lateral component. (Close the vent, surges cover everything!) But surges also are flowing in response to gravity, so they tend to prefer to go downhill. They can climb topography near the vent if they are going fast enough, just as large snow avalanches can go uphill.