



Property Risk Consulting Guidelines

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VOLCANISM

INTRODUCTION

Volcanic belts of the world are well documented as are the types of events expected to occur at all known active volcanoes. Areas of the U.S. subject to volcanism are mostly confined to the western states. Explosive type volcanoes are in the Washington, Oregon, California, Idaho, Wyoming, and Alaska. Areas susceptible to volcanic effects in the contiguous U.S. are shown in Figure 1. Figure 2 is a generalized geographic location map of active volcanoes throughout the world. Beyond the U.S., active explosive type volcano belts are located in such regions as Japan, Southeast Asia, New Zealand, Central America, Mexico, South America, Italy, Western Mediterranean to East Africa and the Caribbean. Hawaii and Iceland are noted for nonviolent volcanism. At present there are 19 volcanoes that are in various stages of active activity in Alaska, Costa Rica, Indonesia, Japan, Mexico, and Russia. There have been over 70 others worldwide that have had eruptions since 2000.

POSITION

Absolute prevention of damage to structures in areas susceptible to volcanic eruption is unrealistic. Review the hazards of volcanism when choosing new construction sites in regions subject to volcanic effects. The following recommendations should be followed:

Ash Fall

- Clear flat roof areas frequently to prevent collapse.
- Provide air filtration for rotating equipment, such as electric motors, internal combustion engines, and air conditioning equipment that circulate or ingest atmospheric air.
- Clean furnishings frequently. Cover goods in process and finished product to minimize contamination.

Lava flow

- Provide a barrier wall, diversion ditch or retaining areas to deflect and direct the flow away from structures.
- Provide surface cooling of the advancing lava front to slow the advance and divert its direction.
- Provide water spray cooling of the lava crust and nearby combustible surfaces to reduce the threat of ignition due to radiation heat.

Mudflow

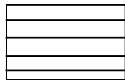
- Evacuate and avoid river basin and valley floors within the hazard zone.



Figure 1. Volcanic Hazards of U.S. Northwest. (Revised From U.S.G.S. Map MF - 786)

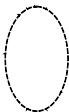
AREAS SUBJECT TO SPECIFIC VOLCANIC HAZARDS

Lava Flows



Areas of groups of volcanic vents termed “volcanic fields,” in which geologically recent volcanic activity indicates that future eruptions, chiefly of lava flows and small volumes of ash, are more likely than in other nearby areas.

VOLCANIC ASH



Area subject to 5 cm or more of ash from “large” (· ·) or very “large” (– –) eruption, similar to the Mount St. Helens eruption about 3,400 years ago.



Sectors downwind from relatively active and explosive volcanoes - Most ash (75% - 80%) from those volcanoes expected to fall within these areas.

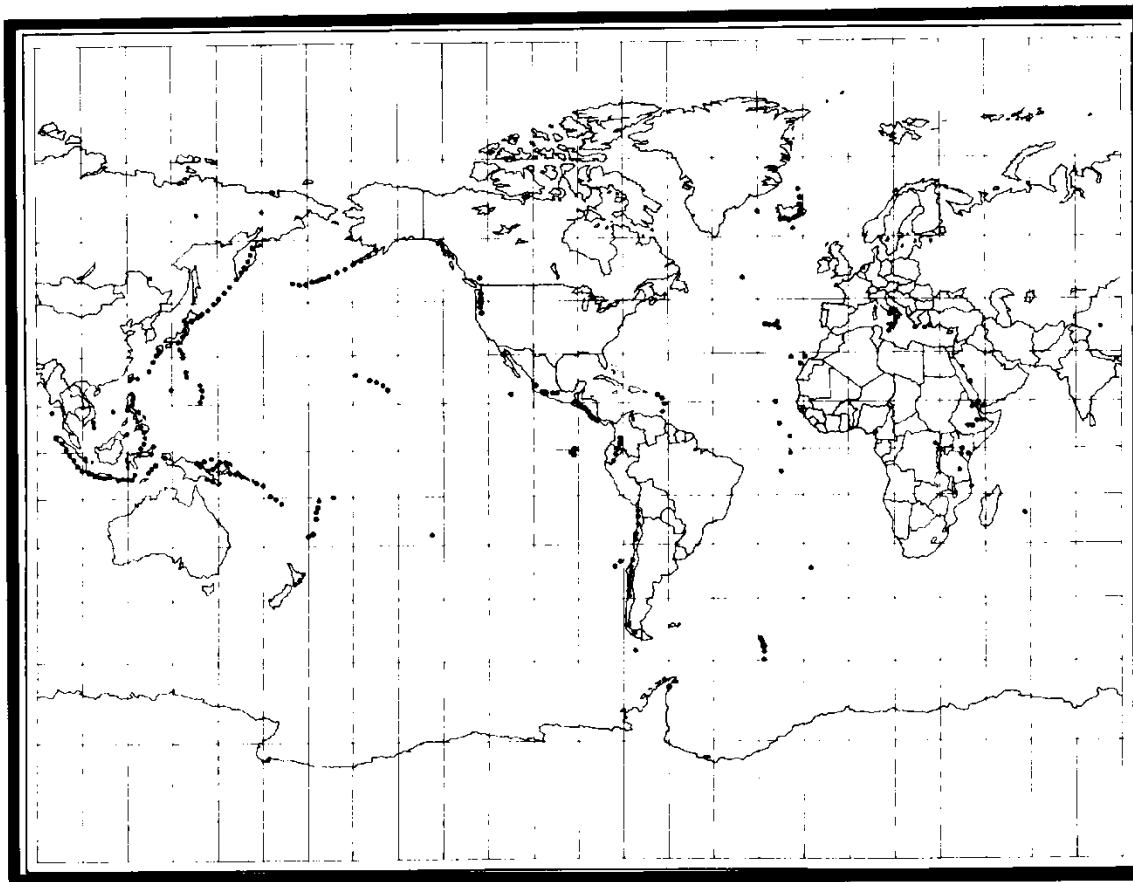


Figure 2. Significant Global Volcanoes.

Poisonous gases

Evacuate the region, and avoid low areas.

Pollution and Contamination

Wash down equipment with fresh water, and clean goods where there has been exposure to volcanic gases.

DISCUSSION

Volcanoes act as vents or surface outlets through the earth's crust through which molten rock and hot gases are expelled from the earth. During a nonexplosive eruption, molten rock flows downslope as lava; during an explosive eruption, molten rock ejects or blows out violently as rock and gases. The June 1991 Mount Pinatubo eruption in the Philippines, and the Mount St. Helens May 1980 in Washington State were an explosive type event.

The hazard for major earthquake damage does not exist at volcanic sites. Earthquakes associated with the movement of magma (molten rock) are usually of small magnitude (less than 4 on the Richter scale). Because volcanic belts are closely associated with tectonically active areas, earthquakes directly related to global tectonics may also occur. Volcanic belts do occur in proximate location with tectonic earthquake epicenters. Local uplift, subsidence, fissuring and displacement of surface rock also occur as a result of volcanic events. However, the effect of earth movement associated with volcanism is inconsequential compared to major earthquake events caused by global plate tectonics.

Primary or direct effects of volcanic activity are:

- Explosion phenomena
- Pyroclastics
- Ash cloud
- Ash fall
- Lava flow
- Ground deformation
- Poisonous gases

Secondary or indirect effects are:

- Tsunami
- Mudflow
- Pollution

The generalized loss exposure zones shown in [Figure 3](#) indicate high exposure within 20 mi (32.2 km) of an active volcano and moderate exposure continuing to 40 mi (64.4 km). Volcanic effects within this range can include glowing ash cloud, tephra, pyroclastic flow, ash flow, lava flow, gases and mudflow.

The explosion phenomena, aside from the audible report, is a strong airborne shock wave. The wave itself can carry several miles and, by virtue of the pressure, can be extremely damaging. The explosion surge may pick up and carry debris (projectiles).

The Pyroclastic flow includes material ejected as incandescent volcanic fragments interspersed in a cloud of gases. Direct effects may be felt 15 mi – 20 mi (24 km – 32 km) or more away. When it mixes with water on the ground, it becomes a volcanic mudflow which can travel faster than 50 mph (81 km/h). The mud flows downslope within rivers and valleys of the volcano flanks.

Ash Cloud (Nuée ardente) consists of superheated gases and incandescent volcanic fragments. A glowing ash cloud is extremely hot, 1800°F (1000°C), and travels 90 mph – 115 mph (145 km/h – 185 km/h). It is a devastating force for several miles, and usually levels everything within a few miles of origin. Mitigation of loss resulting from this hazard within the 20-mile range is generally beyond practical measures.

Ash Fall consists of fragments and particles ejected during volcanic eruption and carried airborne in the atmosphere before they settle to earth. Depth and particle size diminish away from the volcano. The ash becomes widely dispersed, covering extensive areas, moving downwind with the heavier particles falling out of the lower atmosphere within hours or days after the eruption. Finer particles reaching the upper atmosphere have been known to circle the globe on high altitude wind currents for long periods of time. Because the material is airborne, prevailing wind direction and velocity are dominant forces in distributing ash fall, defining both direction and distance, and consequently depth of deposition.

[Figure 1](#) also suggests patterns of windward distribution for active volcanoes of the western U.S.. Measurable quantities (greater than 0.25 in. [6.5 mm]) of ash fall from a moderate event, such as the Mt. St. Helens 1980 eruption, can be expected between 140 and 300 mi (225 and 483 km) away.

Ash is heavy and adds weight to building roofs. A steep sloped roof sheds ash. This construction design is preferred to a flat or low pitched roof design. Airborne ash dust will penetrate normal building closure devices such as doors and windows. The ash will settle as fine grit throughout the building. Ash is also fine grained.

Poisonous Gases, such as hydrogen chloride, hydrogen sulfide, carbon dioxide, carbon monoxide, hydrogen fluoride, methane and ammonia are dispersed during volcanic activity in sufficient quantities to cause death.

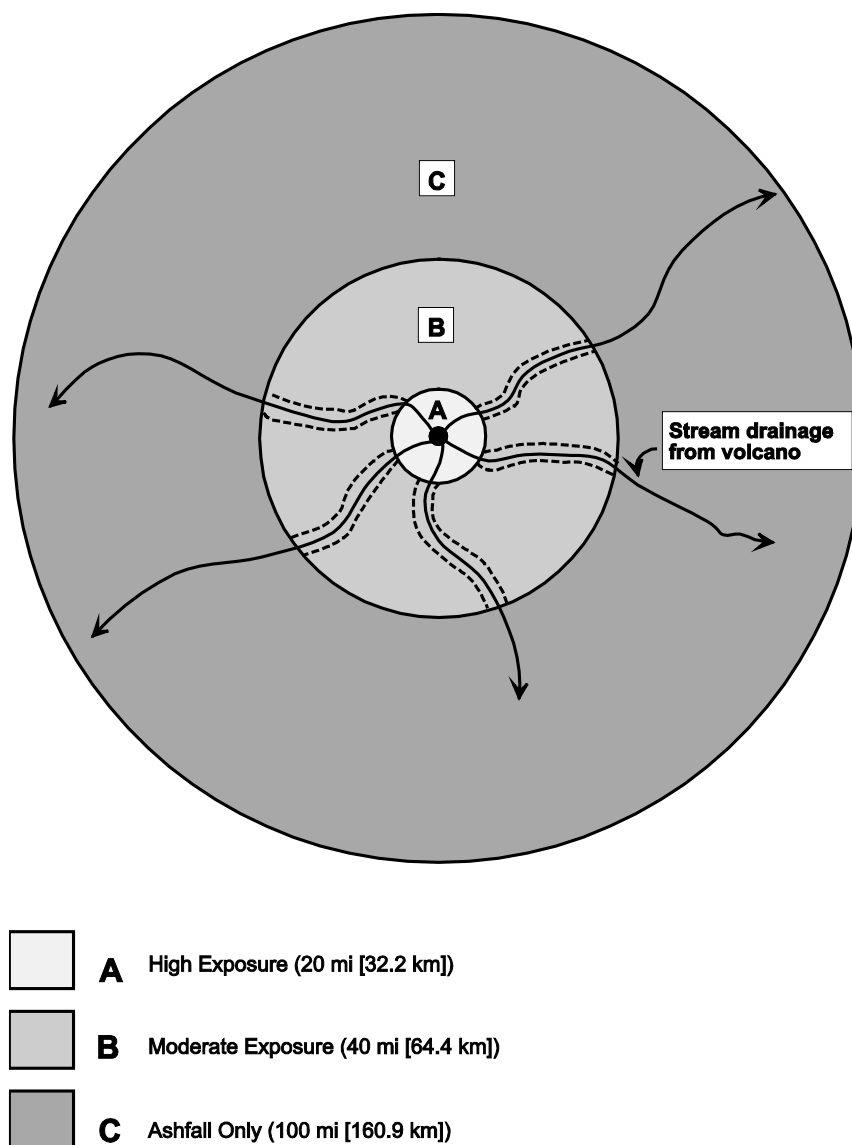


Figure 3. Volcanic Hazard Zones.
 (From Earthquakes, Volcanoes and Tsunamis-Anatomy of Hazards, K.V. Steinbrugge, 1980.)

Lava, the molten or liquid state of rock, issues from fractures and fissures on the flanks or from the neck of the volcano and flows downslope. Flows are known to travel over 40 mph (64 km/h) and up to 30 mi (48 km) from origin. Usually, however, speeds are much slower, distances are shorter and flows are confined to the flanks of the volcano and to the floors of surrounding valleys.

Ground deformation resulting from volcanic activity in the form of uplift, subsidence, fracturing, fissuring and swelling (expansive movement) is generally of low order and is usually confined to the volcano cone and flanks. Ground surface changes usually range from inches to a few feet in height and are not known beyond 20 mi (32 km). Spectacular exceptions occur with explosive eruption such as the Mt. St. Helens event when two separate lava vents exploded. One vent was vertical through the summit and the other was a horizontal fissure through the side of the mountain. The result involved fragmentation and relocation of nearly half the mountainside.

Secondary volcanic effects are flood, tsunami, fire and pollution. Flooding can result from mudflow in rivers and valleys, tsunami from the explosion phenomena of a volcano in or near the ocean. Fire can result from explosion, pyroclastics or lava; pollution from gases and ash; building collapse from accumulation of ash.

Mudflow beyond the flanks of the volcano is confined to streams, rivers and valley floors. Volcanic mudflow can dam a watercourse and create flooding; forcefully move, collapse or damage a structure; or inundate the flood plain.

Several gases in a humid atmosphere will form corrosive solutions and result in pollution and contamination.