



## VOLCANIC ERUPTIONS

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*Please note that the foundation messages are included in the previous section: Key messages for all-hazards household and family disaster planning. Separate messages are also available for other specific hazards.*

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A volcanic eruption is marked by the discharge (aerially explosive) of fragmentary ejecta, lava and gases from a volcanic vent. A volcano is an opening, or rupture in the earth's surface that allows hot magma, volcanic ash and gases to escape. They are generally found where tectonic plates come together or separate, although some occur in the middle of plates due to volcanic hotspots activity. The Hawaiian volcanic islands are one such example. Volcanoes provide a number of environmental benefits, for example: fertile soils, hydrothermal energy, precious minerals and tourism. However, they also pose several hazards: volcanic ash, gases, lahars, landslides, lava flows, and pyroclastic flows.

All volcanic activity like rock fall, ash fall, lava streams, gases etc. are described both as the transport of magma and/or gases to the earth's surface, which can be accompanied by tremors and eruptions, and the interaction of magma and water (e.g. groundwater, crater lakes) underneath the earth's surface, which can result in phreatic eruptions. Depending on the composition of the magma eruptions can be explosive and effusive and result in variations of rock fall, ash fall, lava streams, pyroclastic flows, emission of gases etc.

**Ash fall:** Volcanic ash is a fine component of tephra, comprised of particles more than 2 millimetres in diameter that spread over broad areas during an eruption. Ash particles can be hard, abrasive and mildly corrosive; they may conduct electricity when wet and do not dissolve in water. Ash can generate thunder and lightning due to friction in the eruption column. Freshly fallen ash can have an acidic coating that irritates eyes and lungs, may pollute local water supplies and damage vegetation. It can quickly build up on roofs causing them to collapse and can damage critical lifelines such as power cables. Ash fall can reduce visibility, and make roads very slippery and impassable. Depending on the thickness of the deposit, over time ash can be incorporated into fertile topsoil in volcanic regions.

**Lahars (mud or debris flows):** These are hot or cold mixture of water and volcanic debris flowing down the slopes of a volcano, often in a river valley. When moving, they act like a mass of wet concrete carrying rock debris and even boulders up to 10 meters in diameter. Lahars vary in size and speed. These may be a few meters wide and several centimetres deep or hundreds of meters wide and tens of meters deep. Depending on water and sediment concentration and slope, they may flow a few meters per second or several tens of meters per second – much too fast for people to outrun. By eroding rock debris and absorbing additional water, lahars can easily grow to more than ten times their initial size. Lahars almost always occur on or near stratovolcanoes since these tend to have explosive eruptions that produce loose material.

**Lava flows:** Lava flows are streams of molten rock that pour or ooze from an erupting vent. Lava flows knock over, bury or burn everything in their path. Most extend less than 8 kilometres from their source and travel slowly. As a result, people have enough time to move out of its path. Fluid basalt flows can extend tens of kilometres and travel 1 kilometre per hour on gentle slopes and up to 10 kilometres per hour on steep slopes. When confined within a channel, they can reach velocities of more than 30 kilometres per hour. Land buried by lava flows must be heavily worked if it is to be used again.

**Pyroclastic flows and surges:** These are high-density mixtures of hot, dry rock fragments and gases that move away from the vent at high speeds. Pyroclastic flows consist of a basal layer of coarse fragments that moves along the ground and a more buoyant upper layer. They generally follow valleys or other low-lying areas and can deposit layers ranging from less than 1 meter to more than 200 meters. A pyroclastic flow will destroy nearly everything in its path. With rock fragments ranging in size from ash to boulders traveling across the ground at speeds typically greater than 80 kilometres per hour, pyroclastic flows knock down, shatter, bury or carry away nearly all objects and structures in their way. The overlying turbulent surge can rise out of low-lying areas,

often traveling well beyond the main portion of the flow. This can happen unexpectedly. The extreme temperatures of the gases within the pyroclastic flow (200 degrees Celsius to 700 degrees Celsius) can cause combustion: especially of petroleum products, buildings, forest and farmland. On the margins of pyroclastic flows, death and serious injury to people and animals may result from burns and inhalation of hot ash and gases.

**Tephra:** Fragments of volcanic rock, less than 2 millimetres to more than 1 meter in diameter, that blast into the air during an explosive eruption.

**Volcanic gases:** Gases released from a volcano include steam, carbon dioxide, sulphur dioxide, hydrogen chloride and hydrogen fluoride. These are emitted during an eruption but may also escape continuously from soil, volcanic vents, fumaroles, and hydrothermal systems. Sulphur dioxide can lead to acid rain locally, and air pollution downwind. Gases released into the stratosphere can lower surface temperatures and contribute to depletion of the earth's ozone layer. Carbon dioxide, heavier than air, can flow into low-lying areas and collect in soil, becoming lethal for people, animals and the vegetation. Fluorine particles concentrated in fine-grained ash can be harmful when ingested by animals.



## Assess and plan

| Key messages  | Context-specific details  |
|---|---|
| Learn your volcano risks and warning signs                        | <ul style="list-style-type: none"> <li>Recognize unusual physical changes around volcanoes and report them to relevant authorities. This includes: <ul style="list-style-type: none"> <li>ash fall or increased ash fall</li> <li>vegetation drying up</li> <li>rumbling sounds or increased noise</li> <li>earthquakes</li> <li>landslides</li> <li>increased foul smells from the volcano</li> <li>any other changes that are out of the ordinary.</li> </ul> </li> </ul>       |
| Learn and participate in early warning systems                    | <ul style="list-style-type: none"> <li>Become familiar with the volcano hazard map and danger zones. Know the risks surrounding your home, place of work or school and other important locations that you visit.</li> <li>Get volcano bulletins and alerts from your local authorities.</li> <li>Learn about your community's early warning systems and emergency plans. Different communities have different ways of providing warnings and different response plans.</li> </ul> |
| Develop plans for evacuation and <i>shelter-in-place</i>          | <ul style="list-style-type: none"> <li>Develop an evacuation plan in case of a volcanic eruption and make sure all members of your household know and practice it.</li> </ul>   |
| Work with schools in volcano risk areas                           | <ul style="list-style-type: none"> <li>Support schools in making plans for volcanic eruption evacuation, sheltering-in-place, and family reunification.</li> </ul>  |
| Be aware of secondary hazards associated with a volcanic eruption | <ul style="list-style-type: none"> <li>Volcanic eruptions can cause earthquakes, flash floods, landslides, lahars (mudflows), thunderstorms and tsunamis.</li> <li>The danger of lahars increases near stream channels and with prolonged heavy rains. Do not cross in front of a lahar and inform others of the danger.</li> </ul>   |



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| Keep volcanic ash out of buildings                                       | <ul style="list-style-type: none"> <li>• Ensure the building is suitable and that the roof will not collapse easily from ash build-up.</li> <li>• During volcanic eruption, stay in doors to avoid unnecessary exposure to ash.</li> <li>• Monitor the build-up of ash on roofs and exit the building if there is a threat of collapse.</li> <li>• Remove ash with extreme caution (it is slippery and can be heavy).</li> <li>• Place damp towels at door thresholds and other sources of inundation.</li> <li>• Remove outdoor clothing before entering clean areas.</li> </ul>  |
| Protect water supplies from volcanic ash                                 | <ul style="list-style-type: none"> <li>• Cover water supplies to avoid contamination by ash fall.</li> <li>• Disconnect drainpipes and downspouts from gutters to prevent drains from clogging and to allow ash and water to empty onto the ground.</li> <li>• If you use rainwater collection system disconnect the tank prior to ash fall.</li> </ul>  |
| Protect machinery and equipment from volcanic ash                        | <ul style="list-style-type: none"> <li>• Protect sensitive electronics (e.g. by wrapping with plastic).</li> <li>• Place machinery indoors to protect from volcanic ash or cover with large tarps.</li> </ul>  |
| Protect your pets and livestock from volcanic ash                        | <ul style="list-style-type: none"> <li>• Evacuate livestock early to paddocks that are elevated and up wind from the volcano.</li> <li>• Bring pets and livestock into closed shelters to protect them from breathing and consuming volcanic ash.</li> <li>• Cover stock feed to avoid consumption of ash.</li> <li>• Ensure that animals have access to clean food and water.</li> </ul>  |
| Protect your lungs and eyes from ash fall, during and after the eruption | <ul style="list-style-type: none"> <li>• Stay indoors and away from volcanic ash fall areas if possible since the fine, glassy pieces of ash can increase health risks for children and people with chronic respiratory conditions.</li> <li>• If outside, seek shelter in a building or vehicle.</li> <li>• Wear goggles to protect your eyes. Those who use contact lens should remove them and wear glasses to prevent corneal abrasion.</li> <li>• Wear masks to protect against lung irritation from small particles. If masks are unavailable use a (damp) handkerchief or cloth over your nose and mouth.</li> <li>• Close windows, doors and other vents, and switch off fans and air conditioners if possible to minimize ash from coming indoors.</li> <li>• Protect your skin. Keep as much of your skin covered as possible by wearing long sleeve clothing and long pants).</li> <li>• Avoid low-lying areas downwind of volcano and river valleys downstream.</li> </ul> |
| Limit driving  | <ul style="list-style-type: none"> <li>• If in a vehicle, keep doors and windows closed.</li> <li>• Drive slowly maintaining a significant distance between vehicles to avoid stirring up ash.</li> </ul>  |



## Mitigate risks: physical or environmental

| Key messages                                    | Context-specific details  |
|---|---|
| Follow instructions to evacuate or take shelter | <ul style="list-style-type: none"> <li>Follow evacuation instructions issued by authorities. The surroundings may seem safe to you but in fact it may be quite dangerous.</li> <li>If warning is given before ash fall starts, go home from school or work.</li> <li>When ash fall starts, <i>shelter-in-place</i> indoors until ash has settled. If the ash fall is heavy, do not remain in a building that has a low-pitched or flat roof.</li> </ul>   |
| Avoid driving during and after ash fall         | <ul style="list-style-type: none"> <li>Driving during ash fall is especially dangerous due to low visibility.</li> <li>After ash fall, do not drive unless absolutely necessary, as roads can be slippery.</li> <li>Volcanic ash abrasion can damage parts of vehicles, including bearings, brakes and transmissions. Filters may need to be changed regularly.</li> <li>If you must drive, drive very slowly and with lights on.</li> </ul>  |
| Protect your lungs and eyes during clean-up     | <ul style="list-style-type: none"> <li>Put on goggles and an effective mask before starting to clean (refer to the International Volcanic Health Hazard Network for further information: <a href="http://www.ivhnh.org">www.ivhnh.org</a>).</li> <li>If you do not have a mask, use a wet cloth.</li> </ul>   |
| Clean up carefully outside                      | <ul style="list-style-type: none"> <li>The removal of ash fall from roofs should only be done if it is safe to do so. Rooftops may be slippery when covered in ash or at risk of collapse if at the limit of their load capacity. Be cautious when climbing on ladders and roofs.</li> <li>Sweep out gutters, if safe.</li> <li>Use shovels for removing thick deposits (more than 1 centimetre) and stiff brooms to remove lesser amounts.</li> <li>Dampen but do not soak ash before removing by shovelling or sweeping, to reduce breathing in particles.</li> <li>Keep roofs free of thick accumulation of heavy wet ash. Most roofs cannot support more than 10 centimetres or 4 inches of wet ash.</li> <li>Place ash in heavy-duty plastic trash bags. Keep ash separate from normal rubbish. Follow official instructions for disposal.</li> <li>Do not dump ash in gardens or on the roadside unless advised to do so.</li> <li>Do not wash the ash into the guttering, sewers, effluent ponds or storm drains since this can damage wastewater treatment systems and clog pipes.</li> </ul> |

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| Clean up carefully inside                    | <ul style="list-style-type: none"><li>• Do not sweep or rub dry ash. Instead vacuum or dampen using water or detergent wetting agent, and dab with a damp rag.</li><li>• Avoid excess rubbing action because sharp ash particles can damage textile fibres and hard surfaces.</li><li>• Wash or beat textiles outdoors.</li><li>• Unplug electronic equipment and clean with a vacuum cleaner.</li><li>• Clean any surface that may blow air and recirculate the ash (stove fans and vents, refrigerator vents, air conditioner, furnace).</li><li>• For several months after an ash fall, electrical filters may need replacing often.</li></ul> |
| Clean up your vehicle                        | <ul style="list-style-type: none"><li>• If driving is crucial, drive slowly, use headlights and ample windscreen fluid. Using wipers on dry ash may scratch the windscreen. In the event of heavy ash fall, driving should only be undertaken in an emergency. Use water bottles and a cloth to clean the windscreen as required.</li><li>• Clean the vehicle, including the engine, radiator and other essential parts daily, if necessary. Use water to flush the ash.</li></ul>  |
| Protect vulnerable people from dust exposure | <ul style="list-style-type: none"><li>• Keep children indoors. Explain what is happening and the precautions you are taking.</li><li>• Do not permit children to play in ash piles.</li><li>• Discourage play in dusty settings and strenuous activity.</li><li>• Organize child-friendly spaces to free parents for clean-up tasks.</li><li>• Those with chronic bronchitis, emphysema or asthma should stay inside and avoid unnecessary exposure to ash.</li></ul>   |
| Protect your animals                         | <ul style="list-style-type: none"><li>• Keep animals indoors where possible.</li><li>• Brush animals and wash paws, fur or skin to prevent them ingesting or inhaling ash while grooming themselves.</li><li>• Use a filter to provide clean drinking water.</li></ul>  |



## Prepare to respond: develop skills and store provisions

| Key messages   | Context-specific details  |
|--|---|
| Store additional supplies for volcanic eruption response | <ul style="list-style-type: none"><li>• Additional supplies for volcanic eruption response include:<ul style="list-style-type: none"><li>• dust masks and eye protection</li><li>• plastic wrap to protect electronics from ash</li><li>• cleaning supplies.</li></ul></li><li>• Evacuation bag stored in the vehicle.</li><li>• Always carry a flashlight, even during the day.</li></ul>                |
| Store clean water and food                               | <ul style="list-style-type: none"><li>• Collect and store clean water in closed containers, in advance. (between 20 to 30 litres, i.e. 5 to 7 gallons per person in the household).</li><li>• Store food in closed containers.</li><li>• If there is ash in water, let it settle and then use the clear water.</li><li>• Ash-covered vegetables are safe to eat after washing with clean water.</li></ul> |