LAHAR FLOWS

ABOUT

Lahar is an Indonesian term that describes a hot or cold mixture of water and rock fragments flowing down the slopes of a volcano and (or) river valleys. When moving, a lahar looks like a mass of wet concrete that carries rock debris ranging in size from clay to boulders more than 10 m in diameter. Lahars vary in size and speed. Small lahars less than a few meters wide and several centimeters deep may flow a few meters per second. Large lahars hundreds of meters wide and tens of meters deep can flow several tens of meters per second--much too fast for people to outrun.

As a lahar rushes downstream from a volcano, its size, speed, and the amount of water and rock debris it carries constantly change. The beginning surge of water and rock debris often erodes rocks and vegetation from the side of a volcano and along the river valley it enters. This initial flow can also incorporate water from melting snow and ice (if present) and the river it overruns. By eroding rock debris and incorporating additional water, lahars can easily grow to more than 10 times their initial size. But as a lahar moves farther away from a volcano, it will eventually begin to lose its heavy load of sediment and decrease in size.

TRIGGERING

Eruptions may trigger one or more lahars directly by quickly melting snow and ice on a volcano or ejecting water from a crater lake. More often, lahars are formed by intense rainfall during or after an eruption--rainwater can easily erode loose volcanic rock and soil on hillsides and in river valleys. Some of the largest lahars begin as landslides of saturated and hydrothermally altered rock on the flank of a volcano or adjacent hillslopes. Landslides are triggered by eruptions, earthquakes, precipitation, or the unceasing pull of gravity on the volcano.

Lahars almost always occur on or near stratovolcanoes because these volcanoes tend to erupt explosively and their tall, steep cones are either snow covered, topped with a crater lake, constructed of weakly consolidated rock debris that is easily eroded, or internally weakened by hot hydrothermal fluids. Lahars are also common from the snow- and ice-covered shield volcanoes in Iceland where eruptions of fluid basalt lava frequently occur beneath huge glaciers.

EFFECTS

Lahars racing down river valleys and spreading across flood plains tens of kilometers downstream from a volcano often cause serious economic and environmental damage. The direct impact of a lahar's turbulent flow front or from the boulders and logs carried by the lahar can easily crush, abrade, or shear off at ground level just about anything in the path of a lahar. Even if not crushed or carried away by the force of a lahar, buildings and valuable land may become partially or completely buried by one or more cement-like layers of rock debris. By destroying bridges and key roads, lahars can also trap people in areas vulnerable to other

hazardous volcanic activity, especially if the lahars leave deposits that are too deep, too soft, or too hot to cross.

After a volcanic eruption, the erosion of new loose volcanic deposits in the headwaters of rivers can lead to severe flooding and extremely high rates of sedimentation in areas far downstream from a volcano. Over a period of weeks to years, post-eruption lahars and high-sediment discharges triggered by intense rainfall frequently deposit rock debris that can bury entire towns and valuable agricultural land. Such lahar deposits may also block tributary stream valleys. As the area behind the blockage fills with water, areas upstream become inundated. If the lake is large enough and it eventually overtops or breaks through the lahar blockage, a sudden flood or a lahar may bury even more communities and valuable property downstream from the tributary.

REAL WORLD EXAMPLES OF EFFECTS

1.Lahars can destroy by direct impact: Cement foundation is all that remains of a building that was crushed and carried away by the direct impact of a lahar as it swept through Armero, Colombia. The building was near the main channel of the Lagunillas River and took the full force of the lahar that swept 74 km from Nevado del Ruiz volcano on November 13, 1985.

2.Lahars can lead to increased deposition of sediment: In the years since the 15 June 1991 eruption of Mount Pinatubo in the Philippines, sediment carried by rain-induced lahars have displaced more than 50,000 people from their homes and covered at least 400 km2 of rich agricultural land. The Abacan River shows sediment deposited on farmland and a nearby community within 2 months of Pinatubo's explosive eruption. Nearly all the post-eruption lahars have been caused by intense rainfall, especially during typhoons and monsoon season, which easily erodes the loose pyroclastic-flow deposits that fill the headwaters of all rivers draining the volcano.

3.Lahars can block tributary streams: A lake formed in 1994 behind a blockage created chiefly by lahar deposits in the Pasig-Portrero River about 12 km from Mount Pinatubo in the Philippines, though some secondary pyroclastic flows may have contributed (the river flows right to left). After a moderate rainfall, the lake broke out on the night of 22 September 1994. A sudden surge of water swept downstream, increasing in size as the rushing water eroded sediment from previous lahar deposits. Approximately 25 people were killed by the lake breakout, mostly in a community located about 15 km downstream.

4.Lahars can bury valleys and communities with debris: Hundreds of lahars sweeping down from nearby Unzen Volcano in Japan buried, crushed, or carried away more than a thousand homes like this one along the Mizunashi River. Between August 1992 and July 1993, lahars triggered by heavy rains damaged about 1,300 houses. Each period of heavy rain required the sudden evacuation of several thousand residents along two rivers heading on the volcano. The deposits from these lahars consisted chiefly of lava fragments derived from partial collapses of the summit lava dome located 5 to 8 km upstream.