FEDERAL COORDINATING OFFICE

federal emergency management agency

MOUNT ST. HELENS TECHNICAL INFORMATION NETWORK

Friday, June 27, 1980

BULLETIN #28 - "Volcanic Hazard Analysis"

An earlier bulletin in this series (see TIB #4) described the hazards associated with Mount St. Helens. This bulletin describes some of the features of volcanoes so that the processes underway and the way that they are being monitored at Mount St. Helens can be better understood.

Volcanoes owe their structure and behavior to processes which originate at great depths in the earth's interior. The magma (molten rock) consists of partially or completely molten silicate minerals and various gases, principally water vapor, hydrogen, carbon monoxide and carbon dioxide. Beneath active volcanoes the magma occasionally moves towards the earth's surface and erupts in a variety of ways. These ways include lava flows, pyroclastic flows (moving masses of hot gas and rock fragments) and tephra fall (fragmented material of all sizes including ash, ejected during an explosive eruption). The term ash can be somewhat misleading; as far as volcanic eruptions are concerned, "ash" refers to fine particles of pulverized rock or glassy solidified molten magma that are explosively erupted from a vent. In addition, stiff, pasty lava may pile up over and around a vent to form a dome. Rock debris mixed with water may move downslope as a mudflow. Mudflows resemble masses of wet concrete, generally move down river channels, and may be preceeded or followed by floods. This phenomenon should

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not be confused with mudslides, which frequently occur in areas of unstable ground not associated with volcanoes.

The exact form that an eruption takes is dependent on the magma's viscosity, which in turn is a function of magma temperature, the available gas, and the chemical composition of the lava. The most common types of lava include basalt, andesite, dacite and rhyolite. These lavas are distinguishable by the amount of silica, a compound (SiO_2) formed from silicon and oxygen. Basalts are relatively low in silica--in the range of 46% to 55%--are highly fluid and may move rapidly over great distances. Andesite has a silica content of 56% to 62% and is less fluid than basalt. Dacite has a silica content of 62% to 70%.

Because of the interest and controversy surrounding the role of "free silica" in the ash and in respiratory illness (TIB #13), it is emphasized that almost all of the silica mentioned above is "locked up" or combined with other elements to form a variety of silicate minerals such as feldspars.

Some Cascade volcanoes have been consistent in their lava composition. Others, including Mount St. Helens, are quite variable and erupt basalts, dacites, and andesites. The latest Mount St. Helens eruptions were dacitic (See TIB #4).

Since the birth of the earth, about 5 billion years age, volcanoes have been erupting on its surface. A volcano is considered active, however, only if it has erupted during "historic time". During its active life, though, most volcanoes enter periods of dormancy which may last tens or hundreds of years. Mount St. Helens had been dormant since 1857. Although it is certain that Mount St. Helens will continue

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to burst into eruptive episodes, it is not yet possible to pinpoint the time of future eruptions.

Presently, both the U. S. Geological Survey and the University of Washington are monitoring various phenomena associated with Mount St. Helens in an effort to understand what the volcano's possible behavior might be and to continually assess the hazard posed by eruptions. The University constantly monitors seismic activity in Washington State with a network of seismograph stations. They maintain a local network of 20 seismographs centered in the Mount St. Helens area which is part of a large regional network of about 100 seismographs located throughout Western and Central Washington. The signals from all of these seismographs are sent via radio links and telephone lines directly to the University for analysis. The stresses related to magma movements within a volcano often generate earthquakes prior to an actual eruption, and in the case of Mount St. Helens, such earthquake activity led the USGS to issue a warning of possible eruption activity to the State of Washington in March, 1980. Besides earthquakes another type of ground motion, called harmonic tremor, is observed by seismographs around active volcanoes. Scientists believe that harmonic tremor is caused by magma below the surface moving through conduits and that it is often indicative of a higher than normal potential for eruptive activity.

As the magma moves from the depths upwards into the volcano, it often causes the ground surface to swell or "inflate". This effect can be detected by an instrument called a tiltmeter. As more and more magma moves upwards and the volcano becomes more and more swollen, the flanks of the volcano tilt more steeply. The continued inflation of a volcano usually is accompanied or followed by an eruption; thus, tiltmeters can be used to predict eruptions.

Although volcanoes and their behavior can be grouped according to type of lava and character of eruptions, they act essentially as individuals. What is learned from observation and monitoring will add to our understanding of Mount St. Helens' behavior and will thereby improve our ability to predict eruptions and assess volcanic hazards.

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