Mount Rainier threatens with fire and ice

Looming above the skylines of Seattle and Tacoma, Mount Rainier represents one of the greatest volcanic hazards in the United States. But scientists know too little about the mountain to prepare adequately for a future disaster, according to a report released this week by the National Research Council (NRC).

"A major volcanic eruption or debris flow could kill thousands of residents and cripple the economy of the Pacific Northwest. Despite the potential for such danger, Mount Rainier has received little study," the report says.

Rainier could cause problems even without erupting, says Richard S. Fiske, a geologist at the Smithsonian Institution in Washington, D.C., who directed the study for the NRC. In the past, major sections of the mountain have simply collapsed, creating large avalanches and mudflows that swept through low-lying regions now home to 100,000 people.

The U.S. Geological Survey (USGS) mapped the geology of Mount Rainier in the 1960s and early 1970s. Since then, however, USGS has moved on to study other Cascade volcanoes, including Mount St. Helens, which erupted catastrophically in 1980. Most information on Mount Rainier therefore is out of date, says Carolyn L. Driedger of the survey's Cascade Volcano Observatory in Vancouver, Wash.

Driedger, who has studied the record of mudflows — or lahars — at Mount Rainier, says USGS now considers this volcano the most dangerous of the Cascade range, in part because the mountain has a thick mantle of snow and ice that can melt to form floods and lahars. The growing population along the base of the volcano compounds this threat.

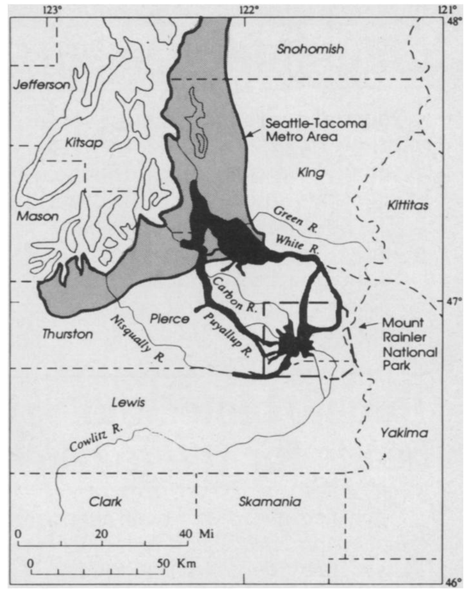
Volcanologists around the world have paid more heed to the danger of lahars since 1985, when a moderate eruption in Colombia triggered a mudflow that claimed 25,000 lives. From deposits to the northwest of Mount Rainier, geologists know that this mountain spawned a lahar 5,000 years ago that carried 40 times the volume of the Colombian flow. The most recent giant lahar swept down off Rainier roughly 200 years ago; many small ones have occurred in recent decades.

According to Fiske and his colleagues on the NRC committee, debris avalanches, lahars, and floods pose the most likely hazard at Mount Rainier. The mountain is prone to landslides because internal heat and glacial water have altered the original rock, turning it into relatively weak clay in places. The volcanic edifice could collapse during an eruption, during an earthquake, or perhaps without any obvious trigger.

Fiske notes that nothing unusual is happening at Mount Rainier at the moment. "There's no unrest. We don't want to convey any sense of that. But there are actions that can be taken now before a disaster occurs," he says.

The committee recommends that scientists adopt a multipronged approach, combining fundamental research, monitoring systems, and community education efforts, to reduce the hazard at Rainier.

At other sites around the world, volcanologists have used a number of different techniques to keep tabs on a dangerous mountain. Seismometers can detect movement of magma below ground or landslides on the surface. Researchers can use the Global Positioning System to monitor changes in the volcano's surface. Stream sensors can detect floods or lahars hours before they reach population centers.



Mount Rainier has spawned large mudflows (dark shading) that swept toward Puget Sound through now heavily populated land.

But numerous past disasters, including the 1985 Colombian catastrophe, have taught experts that scientific information alone will not save lives. Researchers must work with social scientists, civil authorities, and the general population to prepare for the inevitable upheaval at Mount Rainier, says Fiske.

— R. Monastersky

Probing nuclear fusion at high powers

At sufficiently high temperatures, nuclei of the two hydrogen isotopes deuterium and tritium fuse to create neutrons and alpha particles (helium nuclei). This nuclear reaction also releases copious quantities of energy.

But it hasn't been clear to researchers what happens to the energetic alpha particles generated in the fusion reaction. Do they remain largely confined to the hot, ionized gas (or plasma) within the reactor, or does a significant fraction escape before the alpha particles can deposit their energy in the plasma?

Last December, using a magnetically confined mixture of equal parts deuterium and tritium, researchers at the Princeton University Plasma Physics Laboratory and their collaborators achieved record outputs of fusion power at the Tokamak Fusion Test Reactor (TFTR) (SN: 1/1/94, p.12). Subsequent experiments and measurements suggest that no unexpected losses of alpha particles occurred.

Such a result is encouraging for the design of future fusion reactors. Alpha particle losses of more than 15 percent would present difficulties in sustaining the temperature of about 250 million kelvins needed for initiating fusion. In addition, large numbers of vagrant particles could deposit enough heat in the reaction vessel's walls to cause damage.

The measured rate of loss of alpha particles is approximately 5 percent, the physicists report. They see no evidence of unexpected wave activity or disruptive magnetic forces that could destabilize the plasma.

The researchers also note that the tritium-deuterium plasma used in the experiments stores about 20 percent more energy in its electrons and ions than a pure deuterium plasma. Such an increase indicates that the presence of tritium improves particle confinement and that alpha particles may be directly heating electrons in the plasma.

Princeton Univ. Plasma Physics Lab.

The Tokamak Fusion Test Reactor.

In producing a record power output of 6.2 megawatts, the researchers pushed the plasma's ion temperature to 430 million kelvins and its electron temperature to 120 million kelvins. Now the TFTR team is aiming for a power output of 10 megawatts.

The researchers describe these preliminary results in two papers to be published in the May 30 PHYSICAL REVIEW LETTERS. *— I. Peterson*