Geologic Hazard Assessments Subactivity

Program	1999 Estimate	Uncontrol. & Related Chgs	Program Redirect	Program Changes	FY 2000 Budget Request	Change from 1999
Earthquake Hazards	48,560	1,075	-7,120	1,600	44,115	-4,445
Volcano Hazards	**19,759**	**354**	**-2,845**	**-250**	**17,018**	**-2,741**
Landslide Hazards	2,370	60	-237	0	2,193	-177
Global Seismographic Network	3,831	42	-392	0	3,481	-350
Geomagnetism	1,849	50	-296	400	2,003	154
Total Requirements $000	76,369	1,581	-10,890	1,750	68,810	-7,559

Note: The Program Redirect column reflects the redirection of funds to the Integrated Science, Science Support, and Facilities activities.

Volcano Hazards

Current Program Highlights

The Volcano Hazards Program helps reduce the human and economic losses and disruptions associated with volcanic activity by (1) assessing and monitoring potential volcanic hazards, (2) providing warning information on volcanic activity and rapid monitoring response to volcanic crises, and (3) improving the scientific understanding of volcanic processes. With 70 active and potentially active volcanoes, the United States is among the most volcanically vigorous countries in the world. During the twentieth century, volcanic eruptions in Washington, California, Alaska, and Hawaii devastated thousands of square miles and caused substantial economic and societal disruption and, in the worst instances, loss of life. The Volcano Hazards Program exists to lessen the harmful impacts of volcanic activity by monitoring potentially active volcanoes, forecasting volcanic eruptions, delineating the effects that may result, and helping determine appropriate mitigation actions.

Monitoring Potentially Active Volcanoes — The USGS monitors selected volcanoes with a combination of instruments and techniques to detect the rise of magma in the Earth's crust so that timely warnings of eruptions can be issued. Priorities for deciding which volcanic areas to monitor and the extent of monitoring are based on the likelihood, style, and magnitude of eruptions and on the potential impacts of volcanic activity on people and economic systems. USGS monitoring is conducted primarily at its four volcano observatories which collaborate as appropriate with universities or State and Federal agencies: (1) the Hawaiian Volcano

Observatory (HVO) on the Island of Hawaii, where the most recent eruption of Kilauea Volcano, which began in 1983, still continues; (2) the Cascades Volcano Observatory in Vancouver, Washington, which monitors the volcanoes of the Cascade Range in Washington and Oregon (in partnership with the University of Washington) and northern California; (3) the Alaska Volcano Observatory (AVO), a cooperative effort of the USGS, the University of Alaska Fairbanks, and the State of Alaska Division of Geological and Geophysical Surveys. AVO monitors the volcanoes of Alaska, which threaten not only local populations but also aircraft and travelers using the major air routes across the North Pacific. AVO also is responsible for disseminating warnings about dangerous eruptions and ash clouds from Kamchatkan volcanoes that may affect planes flying in U.S.-controlled airspace; and (4) the Long Valley Volcano Observatory in California, which focuses on the large Long Valley volcanic center where complex signs of volcanic unrest have recurred episodically since 1978. The USGS Volcano Hazards Program also supports seismic monitoring of the Yellowstone volcanic region in partnership with the University of Utah.

Through a joint effort with the U.S. Agency for International Development (AID), the Volcano Hazards Program operates a mobile volcano-monitoring observatory to respond to selected volcanic crises around the world. At the request of other countries and working through AID and the State Department, USGS scientists provide rapid-response volcano monitoring to determine the nature of volcanic unrest and assess possible consequences of eruptive activity. The USGS benefits from this activity abroad by refining monitoring methods for use in domestic volcanic crises (such as at Redoubt Volcano and Mt. Spurr in Alaska in 1989 and 1992). A stunningly successful emergency response occurred in 1991 at Mt. Pinatubo in the Philippines where USGS and Philippine scientists predicted the volcano's large explosive eruption, saving tens of thousands of lives of the people living around the volcano and providing critical advice to the U.S. Air Force at Clark Air Base and the U.S. Navy at Subic Bay Naval Station.

Assessing Volcanic Hazards — USGS assessments of volcanic hazards are used to anticipate the effects of future eruptions and to identify the appropriate level of monitoring at specific volcanoes. Information obtained through geologic mapping, analysis of eruptive deposits, hydrologic investigations, seismicity, and geophysical analysis is combined in hazard-zonation maps, digital databases, and probabilistic recurrence and inundation models. Assessments are updated by the Volcano Hazards Program as new data become available and are critical input to emergency preparedness and land use planning.

Studying Volcanic Processes — USGS volcano-monitoring strategy and analysis of precursory unrest are founded on an understanding of magmatic processes and eruption dynamics. The Volcano Hazards Program uses many tools from seismology, geophysics, geochemistry, field geology, and hydrology to acquire that fundamental understanding. Topics of interest include the relation of magma movement to seismicity and ground deformation, mechanisms by which volcanic systems originate and change over time, the circulation of thermal fluids in and around magma bodies, the role of magmatic gases in eruption dynamics, interaction of magma and eruptive products with ground or surface water, and the dynamics of mudflows and debris avalanches at volcanoes.

Disseminating Information About Volcanoes — The results of volcano-hazard studies and monitoring are effectively conveyed to many different audiences through various channels.

The USGS works closely with scientists in other agencies; public-safety officials at the Federal, State, and local levels; government land managers; business leaders; the media; land developers and planners; educational institutions; and citizens' groups. Information is disseminated through briefings, workshops, maps, scientific publications, videos, digital databases, web sites, newspaper articles, and interviews with news and education media. During volcanic crises, USGS personnel work directly with authorities responsible for public safety. Information concerning volcano hazards can be obtained at the Volcano Hazards Program's web site at **http://volcanoes.usgs.gov**.

Recent Accomplishments

Greater Volcanic Hazard Recognized in Hawaii — The USGS continues to monitor the long-lived (since 1983) eruption of Kilauea volcano, which lies within the heavily visited Hawaii Volcanoes National Park. Along with this sustained vigilance, scientists of the Hawaiian Volcano Observatory (HVO) have amassed geological evidence to show that Kilauea had several large explosive eruptions between about 1450 and 1790 AD when ground water and magma interacted. This finding establishes that Kilauea is a particularly hazardous volcano during periods when its caldera floor is near or below the water table. The next major collapse of the caldera floor, a possible consequence of long-lasting rift-zone eruptions such as the current one, would usher in an extended period of explosive activity that would adversely impact the National Park and nearby residential communities. Accordingly, HVO's monitoring strategy now includes heightened awareness of potential caldera collapse.

Improved Monitoring Capability in California — Recurring signs of volcanic unrest (earthquake swarms, ground uplift, and gas emissions) at Long Valley caldera, adjacent to a popular recreational area in California, were carefully monitored by the USGS using a variety of sensors and techniques. Following a period of intense unrest from July 1997 through January 1998, the USGS has improved its monitoring capability by installation of state-of-the-art real-time sensors to detect ground deformation associated with subsurface magma movement and by addition of real-time data telemetry to hydrologic monitors. Plans call for additional improvements in seismic, geodetic, and geochemical monitoring techniques so that any renewed eruptive activity at this large, long-lived volcanic systems can be better forecast.

Probabilistic Assessment of Lava Inundation at Hawaiian Volcano — Mauna Loa is the largest volcano on Earth and one of the world's most active volcanoes. Since its last eruption in 1984, Mauna Loa has shown signs of unrest that likely portend another eruption. To help with the design and siting of a large new prison facility on Mauna Loa's flank, probabilities of lava inundation within the next 50 years were estimated for three possible locations by using data on the extent and age of past lava flows in combination with geospatial software tools. The USGS assessment report also highlights the need to incorporate eruption warnings by the Hawaiian Volcano Observatory into prison-evacuation plans.

Prototype for Lahar Detection and Notification at Mount Rainier — Communities around Mt. Rainier, Washington, face potential hazards from catastrophic mudflows (lahars) originating from the volcano. The recurrence intervals of such events are several hundred to 1,000's years, but their impacts would be devastating. Scientists from Cascades Volcano Observatory in cooperation with emergency-response agencies in Pierce County, Washington,

developed a prototype lahar-detection and notification system for valleys northwest of Mount Rainier volcano. Should a lahar occur, telemetered signals from sensors able to detect ground vibrations of lahars traveling down these valleys would trigger an automatic notification to key county and city emergency-response nodes so that, in turn, preplanned mitigative measures such as getting to high ground could be activated. As part of a two-year pilot project, sensors have been installed in two river valleys for testing and incorporation into the county's emergency-response network. Upon successful completion of the pilot project, long-term operation of the notification system will be the responsibility of county officials with USGS in an advisory role.

Expanded Monitoring for Aviation Safety in the North Pacific — With funding supplemented by the Federal Aviation Administration (FAA), the Alaska Volcano Observatory (AVO) continued expansion of its seismic and satellite monitoring efforts in the Aleutian Islands of Alaska, where ~40 active volcanoes (erupting 2-3 times per year on average) threaten safe air travel in busy routes across the North Pacific. As a result of this effort, 20 Alaskan volcanoes are now well monitored, although the more remote volcanoes of the western Aleutians are not instrumented. Volcanic ash erupted into the high atmosphere is highly hazardous to modern high-performance jet aircraft because it erodes compressor blades, melts onto critical engine parts, and causes loss of engine power. Hazardous concentrations of volcanic ash can drift at air-traffic altitudes for hundreds to thousands of miles downwind following a volcanic eruption. Worldwide, nearly 100 jet aircraft in the last 18 years have accidentally entered volcanic-ash clouds, putting thousands of passengers at risk. Using data from its monitoring networks, AVO provides eruption reports and prognoses of future activity to the National Weather Service (NWS), the FAA, and the aviation industry. The NWS and USGS collaborate in the interpretation of information to help track eruption clouds, and the FAA uses the USGS and NWS information to route air traffic away from dangerous ash clouds. In addition to the expansion of monitoring, hazard-assessment reports have been prepared for several Alaskan volcanoes, and a comprehensive catalog of the historically active volcanoes of Alaska was published. AVO also continued to maintain scientific links with the Russian Far East and disseminated warnings about Kamchatkan volcanic activity threatening U.S. controlled airspace.

International Volcanic Hazard Mitigation — Through the joint USGS/USAID Volcano Disaster Program, USGS scientists continued to help respond to the eruption of Popocatepetl Volcano near Mexico City, which began to erupt from its ice-clad summit in March 1996. USGS involvement has included installation of instruments on the volcano’s flank to detect eruption-caused mudflows (lahars) and development of a ground-based radar technique to track ash clouds headed toward Mexico City’s international airport. USGS expertise also was sought by Ecuadorean officials to help interpret signs of unrest at Pichincha Volcano, adjacent to the capital city of Quito. Working with host-country scientists, USGS volcanologists aided with monitoring-equipment upgrades, data interpretation, assessment of potential lahar hazards, and development of a public-notification scheme. At the time of this writing, Pichincha’s unrest had not escalated to eruption, but USGS scientists remain poised to renew their involvement, if requested.

Justification for Program Change

	FY 2000 Request	Program Change
$(000)	17,018	-250

The proposed reduction of $250,000 will terminate a cooperative agreement with the University of Hawaii to support monitoring and research activities of the Hawaiian Volcano Observatory.