Geologic Hazard Assessments Subactivity

Subactivity	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Earthquake Hazards	43,893	+867	+2,600	47,360	+3,467
Volcano Hazards	**17,181**	**+284**	**[1]+250**	**17,715**	**+534**
Landslide Hazards	2,580	+48	[0]	2,628	+48
Global Seismographic Network	3,464	+33	0	3,497	+33
Geomagnetism	1,993	+43	0	2,036	+43
Total Requirements $000	69,111	+1,275	+2,850	73,236	+4,125

[1] See Program Change section for details on Safer Communities (+$500) and program decrease (-$250)

Volcano Hazards

Current Program Highlights

The USGS 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 approximately 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. With rising populations, development pressures, and expanding national and international air traffic over volcanic regions, the exposure of human life and enterprise to volcanic hazards is increasing. Under the Stafford Act (Public Law 93-288), the USGS has the responsibility to issue timely warnings of potential volcanic disasters to civil authorities and affected communities. The Volcano Hazards Program exists to lessen the harmful impacts of volcanic activity by monitoring potentially active volcanoes, forecasting eruptions, delineating the effects that may result, and helping determine appropriate mitigation actions.

Monitoring Potentially Active Volcanoes -- The USGS monitors volcanoes with a combination of instruments and techniques to detect the rise of magma in the Earth's crust so that forecasts and timely warnings of eruptions can be issued. By the end of FY 1999 the program was monitoring 42 U.S. volcanoes at its four volcano observatories which collaborate as appropriate with universities and State and Federal agencies:

1) The Hawaiian Volcano Observatory on the Island of Hawaii, where the most recent eruption of Kilauea Volcano, which began in 1983, still continues unabated.
2) The Cascades Volcano Observatory in Vancouver, Washington, near Mt. St. Helens.
3) The Alaska Volcano Observatory (AVO), a cooperative effort of the USGS Volcano Hazards Program, 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 U.S.-controlled airspace.

4) (4) The Long Valley Volcano Observatory in California, which focuses on the large Long Valley volcanic center where volcanic unrest has recurred episodically since 1980. Current program emphasis is on enhancing monitoring capabilities with improvements to equipment, software, and telemetry so that data from all restless, active, or potentially hazardous U.S. volcanoes can be acquired, processed, analyzed, and disseminated very rapidly.

Through a joint effort with the U.S. Agency for International Development (USAID), the USGS operates a mobile volcano-monitoring observatory to respond to selected volcanic crises around the world. At the request of other countries and working through USAID and the State Department, USGS scientists provide rapid-response volcano monitoring to determine 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 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, dating and analysis of eruptive deposits, hydrologic investigations, and geopyhsical 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. Current program emphasis is on preparing new hazards assessments for volcanic centers in Hawaii (Hawaii Island, East Maui), California (Lassen Volcanic National Park), and Alaska (Aleutian Islands, Cook Inlet) and revised assessments for volcanoes in Washington (Mount Rainier, Mount Baker). New methods for probabilistic assessment are being developed for application along with more traditional means of describing hazard potential.

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 process of magma movement in relation to seismicity and ground deformation, mechanisms by which volcanic systems originate and change over time, 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 must be effectively conveyed to the community they are intended to serve. Accordingly, the Volcano Hazard Program works closely with scientists in other institutions, 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 media. During volcanic crises, USGS personnel work directly with authorities responsible for public safety, and current

program emphasis is on preparation of interagency operational response plans. Information concerning volcano hazards can be obtained at the Volcano Hazards Program's (VHP) website at *http://volcanoes.usgs.gov*.

Recent Accomplishments

Eruption Response in Alaska -- On April 17, 1999, following more than three months of precursory seismic and thermal activity, Shishaldin volcano in the eastern Aleutian Islands began a brief but vigorous episode of explosive eruptions that sent volcanic-ash plumes to over 50,000 feet above sea level intermittently for about one month. This explosive activity from one of Alaska's most active volcanoes (28 eruptions since 1774) was successfully monitored by the Alaska Volcano Observatory using a newly installed real-time seismic network and improved techniques for rapidly examining meteorological satellite imagery. Volcanic ash from Shishaldin posed a threat to jet aircraft in the heavily traveled North Pacific air routes, but because of information provided by the USGS to the National Weather Service and the Federal Aviation Administration, aircraft were diverted and rerouted around potentially hazardous ash clouds. 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, approximately 100 jet aircraft in the last 18 years have accidentally entered volcanic-ash clouds, putting many thousands of passengers at risk.

Sustained Vigilance in the Face of Long-lived Eruptions and Unrest -- The USGS Hawaiian Volcano Observatory continued to monitor the ongoing (since 1983) eruption of Kilauea volcano on Hawaii Island, helping the National Park Service and County Civil Defense to keep people out of harm's way while still allowing them to enjoy the island's natural beauty. In addition to scorching lava flows, Kilauea's hazards include sulfurous vog (volcanic smog) that has debilitating respiratory effects on people, explosive eruptions caused by mixing of magma and groundwater, sudden collapses into the ocean of oversteepened new lava benches, damaging earthquakes, and local tsunamis, all of which HVO helps to assess. At Long Valley caldera, adjacent to a popular recreational area in California and in the path of heavily traveled West Coast air-traffic routes, USGS scientists continued to monitor the latest signs of the area's two decades of recurring volcanic unrest. By providing objective interpretation of the significance of the unrest and by openly communicating with affected communities and agencies, the USGS is reducing uncertainties about potential volcanic activity there and contributing to informed decision-making by private individuals, businesses, and public officials. At Mount St. Helens in Washington, the USGS Cascades Volcano Observatory and its partner the University of Washington kept a vigilant eye on the volcano, monitoring the intermittent seismic swarms and small mudflows that still persist there long after the catastrophic eruption of 1980. With a heavily visited U.S. Forest Service visitor center now situated a few miles north of the summit crater excavated in the explosive 1980 eruption, continuing watchfulness is well warranted.

Volcano Monitoring Improvements -- In Hawaii, seismic monitoring was initiated for the Island of Maui, in response to recent geologic studies that identified Haleakala volcano as having had more frequent eruptions than previously recognized. On the Island of Hawaii, a network of borehole tiltmeters was established on Mauna Loa and Kilauea, providing the first reliable real-time deformation monitoring of the two volcanoes. In Alaska, the Alaska Volcano Observatory established a real-time seismic monitoring node on Adak Island, proving that it is possible to work in the remote western Aleutians and paving the way for eventual monitoring of all of

Alaska's potentially active volcanoes. Concurrent geologic field studies established that volcanoes on Adak have produced larger, more explosive eruptions that previously realized. At Long Valley, enhancements of the network to monitor ground deformation continued, and improvements in on-site computer processing and telemetry were initiated to improve availability to scientists of data from different types of sensors. In Yellowstone National Park, monitoring of the very large Yellowstone caldera was improved with additional continuously recording ground-deformation sensors used in combination with an innovative satellite radar technique.

International Volcanic Hazard Mitigation -- Through the joint USGS/USAID Volcano Disaster Assistance Program, during the past year USGS scientists responded to official requests to help interpret precursory unrest and eruptions at two volcanoes in Ecuador: Guagua Pichincha, adjacent to the capital city of Quito, and Tungurahua, near the popular tourist destination of Banos. Over a period of several months and working with host-country scientists, USGS volcanologists aided with monitoring-network upgrades, data interpretation, assessment of potential hazards, and development of a public-notification scheme. To minimize disruption of operations at Quito International Airport, USGS personnel provided information about the effects of ash falls to airport officials and American air carriers, and arranged for staff of Anchorage International Airport experienced with ash impacts to visit and advise Quito's airport managers. At the time of this writing, both Pinchincha and Tungurahua simultaneously were in eruptive phases, with ~25,000 people displaced from areas at greatest risk.

Emergency Preparedness -- Progress was made on interagency efforts to lay groundwork in advance of emergency operations during potential volcanic activity: An interagency plan to respond to volcanic hazards at Mount Rainier, Washington, was finalized among USGS, municipal, county, state, and other Federal agencies. The plan lays out responsibilities of the various entities during a volcanic crisis, including aspects of public education and information dissemination. For the Long Valley area in California, the USGS participated in an exercise that used a hypothetical eruption to test the emergency communication systems between about two dozen government agencies and private industry. Results from the communication exercise are being used by other agencies to improve the delivery of information during diverse future emergencies, not just volcanic ones. The Interagency Volcanic Ash Warning Plan for Alaska was updated and signed by the USGS, Federal Aviation Administration, National Weather Service, U.S. Air Force, and Alaska Department of Emergency Services. The plan establishes integrated and timely communications for air-traffic safety during volcanic eruptions in the North Pacific region.