U.S. Geological Survey

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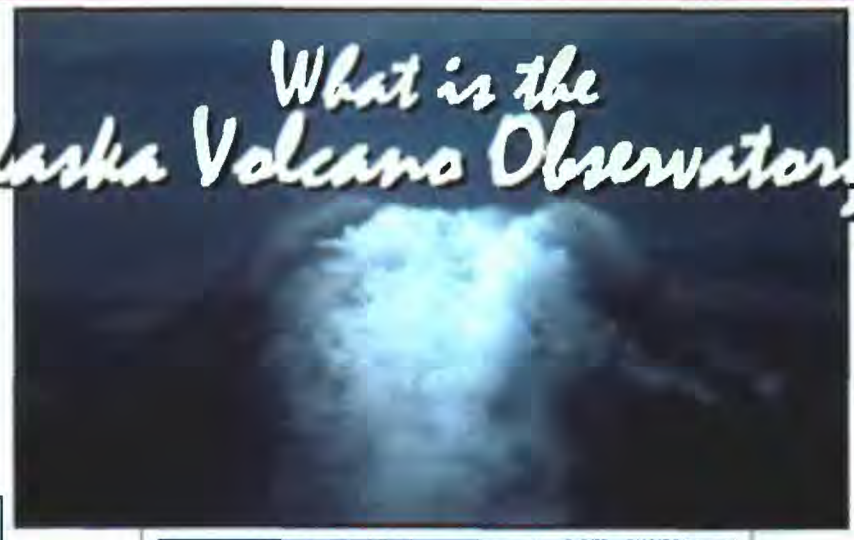
What is the Alaska Volcano Observatory?



Summary

EXPLOSIVE eruptions from Alaska's more than 40 active volcanoes pose a significant threat to aircraft, communities, and commerce in the north Pacific. Because of this threat, the Alaska Volcano Observatory (AVO) was established in 1988 to monitor dangerous volcanoes, issue eruption alerts, assess volcanic hazards, and conduct volcano research in Alaska. Advance warnings and tracking of the 1989-90 eruptions of Redoubt, the 1992 eruptions of Spurr, and the 1996 eruption of Pavlof contributed to public safety and minimized the economic impact of these events.

Introduction

MORE than 40 active volcanoes span the state of Alaska from the Wrangell Mountains to the western Aleutians. The 1912 eruption of Novarupta volcano, in what is now Katmai National Park, located 280 mi southwest of Anchorage, was the earth's most voluminous volcanic event of this century. Eruptions near Anchorage, Alaska's largest city, have caused millions of dollars in damage in the last decade alone. Future explosive eruptions from Alaska's volcanoes pose a significant threat to communities, commerce, and particularly to aircraft in the heavily traveled north Pacific region. The Alaska Volcano Observatory (AVO) was established in 1988 to monitor dangerous volcanoes, issue eruption alerts, assess volcanic hazards, and conduct volcano research in Alaska. AVO also plays a key role in reporting and tracking eruptions in Russia as part of a formal working relationship with the Kamchatkan Volcanic Eruptions Response Team (KVERT).

Who We Are

AVO is a cooperative program of the U.S. Geological Survey (USGS), the University of Alaska Fairbanks, Geophysical Institute (UAFGI), and the Alaska Division of Geological and Geophysical Surveys (ADGGS) and is funded primarily by the USGS with additional support from the State of Alaska. AVO consists of a scientific and crisis-coordination center in Anchorage and a research and seismic recording center in Fairbanks. During volcanic crises, AVO operates around the clock and may augment its staff with colleagues from USGS volcano observatories in Hawaii and Vancouver, WA.

1996: An Expanded Volcano Monitoring Program in Alaska

INCREASED earthquake activity at a volcano is usually the first warning sign of a possible eruption. Since its inception, the backbone of AVO's volcano monitoring program has consisted of continuously recording seismometers at four Cook Inlet volcanoes, Spurr (Crater Peak), Redoubt, Iliamna, and Augustine. In 1996, with supplemental funding from the Federal Aviation Administration (FAA), AVO more than doubled the number of well-instrumented volcanoes, adding new real-time seismic networks at Martin, Pavlof, Akutan, and Makushin and upgrading networks at Griggs, Katmai, Novarupta, Mageik, Trident, and Dutton. AVO has the capability to deploy a temporary seismic array on any remote volcano that becomes restless.

Seismic data from these volcanoes are relayed via radio and telephone to AVO facilities in Anchorage and Fairbanks, where they are displayed, analyzed, and archived. An electronic alarm system alerts AVO to unusual seismicity during non-business hours. Increasingly, AVO scientists are developing ways to view and interpret seismic data remotely via pager alarms and the internet.

Analysis of infrared satellite images is another important tool used to monitor the remote volcanoes in Alaska. Daily, AVO scientists examine NOAA satellite images to search for and identify possible volcanic hot spots and plumes from Alaska to the Kuriles. To augment satellite observations, AVO relies heavily on pilot reports relayed through the FAA, and observations from other Federal and State agencies, residents of villages, the military, and fishing vessels.

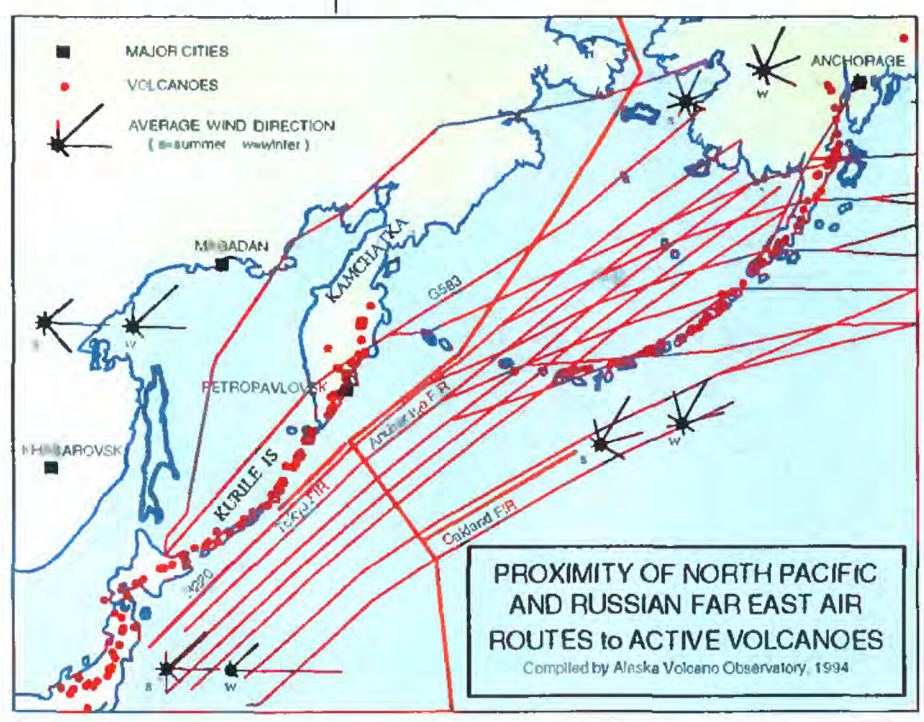
Other components of the AVO volcano-monitoring program include airborne sulfur dioxide and carbon dioxide measurements to detect changes in volcanic gas emissions and periodic observational overflights. AVO has remote video cameras that can send images of Spurr, Redoubt, and Iliamna back to the observatory. AVO is also utilizing Global Positioning System satellite technology to periodically measure changes in the shape of a volcano that can precede and eruption. At Augustine Volcano in southern Cook Inlet, an experiment is in progress to utilize GPS technology to continuously measure ground motion. Together, these monitoring techniques allow AVO to warn of the likelihood of an eruption from an instrumented volcano hours to weeks in advance and to issue notification of an ash-producing eruption, usually within 15 minutes of onset.

Recent Eruptions

THE Alaska Volcano Observatory's response to two major eruptions in the Cook Inlet region, as well as to numerous smaller eruptions and volcano-seismic crises elsewhere in the Aleutian chain and on the Kamchatka Peninsula, illustrates AVO's contributions to increasing public safety.

Less than 24 hours after a public warning from AVO, Redoubt Volcano, 110 mi southwest of Anchorage, erupted violently in mid-December 1989 sending a plume of ash more than 40,000 feet into the atmosphere. While changing course to avoid the ash, a Boeing-747 accidentally encountered the plume and lost power to all four engines. The aircraft came within minutes of crashing before restarting its engines and landing safely in Anchorage. Redoubt Volcano erupted a total of 19 times from December, 1989, until April 1990, each time producing an ash plume that caused major disruptions in air traffic. AVO's rapid dissemination of eruption information and projected ash plume trajectories resulted in the safe and efficient rerouting of air traffic in the north Pacific.

Near Redoubt volcano, hot debris cascading onto the ice- and snow-covered slopes generated numerous fast-moving debris flows which threatened a large oil-storage facility at the mouth of

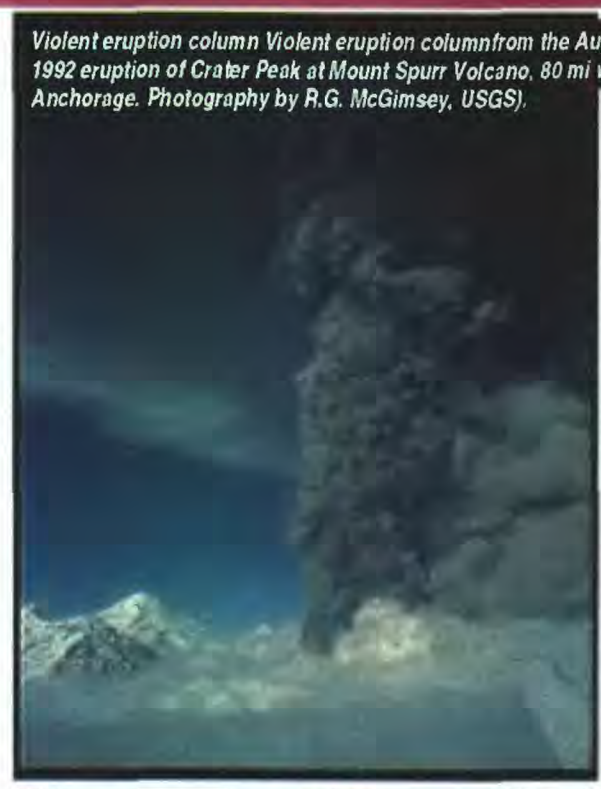


Map of the North Pacific showing active volcanoes (red circles) and the North Pacific and Russian Far East routes for air traffic (purple lines).

the Drift River. Advance notices from AVO of several eruptive episodes were critical in decisions to evacuate the threatened oil facility.

Two years later, in June 1992, the Crater Peak vent of Mount Spurr volcano, 80 mi west of Anchorage, erupted explosively, sending a plume of ash north over the interior of Alaska. This eruption came within weeks of an official announcement by AVO of the increased likelihood of activity at Mount Spurr. Two additional eruptions from Crater Peak in August and September of 1992 dumped up to 3 mm of coarse ash on Anchorage and adjacent communities, interrupting air traffic and commerce in south-central Alaska. Timely warnings of eruptive activity and forecasts of ash plume motion and fallout onto populated areas allowed the public, private industry, utilities, and government agencies to prepare and respond appropriately.

On September 30, 1994, a violent eruption of Klyuchevskoy Volcano in Central Kamchatka produced a widespread ash plume which extended across major north Pacific and Russian Far East air routes. Coordinated by AVO, effective communication among Russian volcanologists, the FAA, NWS, and air carriers resulted in successful rerouting of dozens of aircraft and minimized disruption and economic impact.

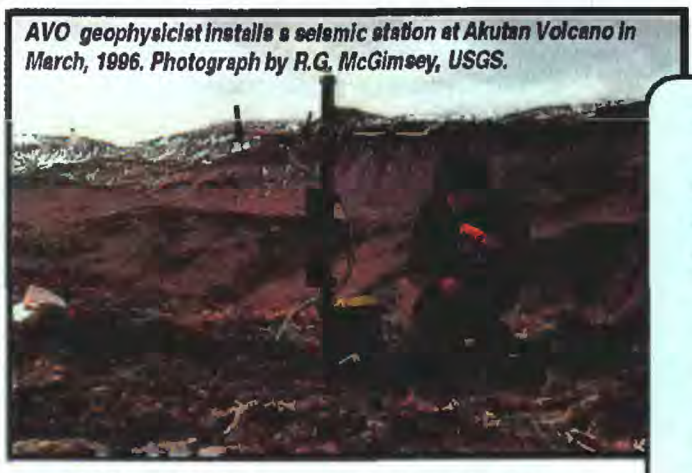


Violent eruption column Violent eruption columnfrom the August 18, 1992 eruption of Crater Peak at Mount Spurr Volcano, 80 mi west of Anchorage. Photography by R.G. McGimsey, USGS).

Alerting the Public about Restless Volcanoes

DURING volcanic crises, AVO-Anchorage becomes the principal point of contact for information on volcanic activity and hazards. AVO-Fairbanks is responsible for interpreting seismic data, often around the clock, and for acquiring and analyzing satellite imagery. At all times and especially during emergencies, AVO maintains close communication links with other agencies and uses a telephone call-down to notify the FAA, NWS, the Department of Defense, the Governor's Office, and the Alaska Department of Emergency Services. Written descriptions of the location, time, size of the eruption, and a forecast of ash cloud motion are distributed by fax and electronic mail to federal, state, and local government agencies, critical industries, the media, and air carriers. Subsequent information releases which include forecasts of the nature and duration of further eruptive activity are prepared as needed. AVO also maintains phone message lines which are updated frequently with summaries of volcanic activity.

During non-crisis periods, AVO releases a weekly written summary of volcanic activity and the status of instrumented volcanoes in Alaska and Kamchatka. AVO fields many calls from the general public and gives interviews with media and tours of the facility as staff time allows. Frequent presentations to schools, trade groups, government agencies, and publication of scientific research are part of a vigorous outreach program.



AVO geophysicist installs a seismic station at Akutan Volcano in March, 1996. Photograph by R.G. McGimsey, USGS.

In March 1996, intense seismic activity began beneath Akutan Volcano in the eastern Aleutians. For several weeks, residents of Akutan and employees of a fish processing facility were shaken by thousands of earthquakes. AVO scientists responded quickly by installing a network of seismometers to locate and monitor the activity. AVO personnel remained on site to assist emergency preparedness officials and to provide information to residents. Although no eruption occurred, extensive ground cracking related to a magmatic intrusion was discovered by AVO geologists the following summer. In addition, a more permanent seismic network was installed to detect future earthquake activity that may lead to an eruption.

In September 1996, Pavlof Volcano on the Alaska Peninsula began a prolonged, low-level eruption that repeatedly dusted nearby communities with ash and forced the FAA to restrict air traffic near the volcano. Three months earlier, AVO scientists had instrumented Pavlof with seismometers and as a result, progress of the 1996 eruption was carefully tracked. AVO worked closely with local residents, airlines, staff of the FAA and NWS, and conducted periodic overflights to monitor activity at this remote volcano. Thanks to the new instrumentation, AVO was able to provide timely warnings of several hazardous ash plumes from Pavlof.

Research Program

AVO scientists study Alaska's active volcanoes to understand how they work and to improve our ability to monitor volcanoes, forecast eruptions and identify hazards. An important component of AVO's mission, therefore, is to conduct and publish research which includes:

- *mapping and dating volcanic deposits to determine eruptive histories of volcanoes*
- *studying the chemistry of volcanic rocks to learn about the origins of magma*
- *understanding the physical processes of volcanic eruptions*
- *exploring the interiors of volcanoes using geophysical methods*
- *studying volcano-glacier interactions and related hydrologic processes*
- *developing new instruments to help monitor volcanic unrest and forecast eruptions*

Results of these studies contribute to comprehensive volcano hazard assessments and to monitoring and predictive capabilities used at observatories worldwide.

Level of Concern Color Code

IN 1989, AVO established a means of rapidly and simply communicating the status of a monitored volcano. This Level of Concern Color Code, shown in the box below, has proven to be an effective tool to broadcast AVO's assessment of the situation and severity of volcanic hazard at any seismically monitored volcano.

Green	Volcano is in its normal "dormant state"	No eruption is anticipated.
Yellow-	Small earthquakes detected locally and (or) increased levels of volcanic gas emissions.	An eruption is possible in the next few weeks and may occur with little or no additional warning.
Orange-	Increased numbers of local earthquakes. Extrusion of a lava dome or lava flows (non-explosive eruption) may be occurring.	Explosive eruption is possible within a few days; non-explosive eruption may be occurring. Ash plumes not expected to reach 25,000 ft above sea level.
Red	Strong earthquake activity detected even if out of normal volcanic station. Explosive eruption may be in progress.	Major explosive eruption is expected within 24 hours; ash plumes expected to reach 25,000 ft above sea level.

Identifying Volcanic Hazards

IN support of public safety, AVO is responsible for assessing potential hazards at high-risk volcanic centers in Alaska. Hazard assessments include a description of the geologic and eruptive history of a given volcano, explanations of likely eruption scenarios, and determination of potential impact zones for a range of expected hazards. A hazard assessment has been published for Redoubt Volcano; an update of this product and new assessments for several other volcanoes are in progress.

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