

Iceworm Alerts Seismologists to Volcanic Eruptions

Computerized alarms that help scientists detect volcanic eruptions were designed and tested recently by seismologists from the Geophysical Institute.

Doctoral students Kent Lindquist and John Benoit worked with Alaska State Seismologist Roger Hansen to develop an automatic alarm and near-real-time data collection and processing system to help predict and monitor volcanic eruptions in Alaska.

The system, affectionately known as "Iceworm," signals potential eruptions and helps scientists estimate the size and height of ash plumes once an eruption occurs.

Ash plume detection is critical in Alaska where eruptions can cripple transportation, power generation and communication.

Even small volcanic eruptions pose a potentially lethal hazard to aircraft because intake of airborne ash can damage jet engines and substantially reduce visibility.

Iceworm proved its value as a detection tool during monitoring tests of the 1996

eruptions of Pavlof Volcano, located on the Alaska Peninsula. Iceworm alarms announced all of Pavlof's intensified eruption sequences, some of which led to Alaska Volcano Observatory Code Red Alerts, which were relayed to the Federal Aviation Administration and other agencies concerned about ash-cloud hazards.

Iceworm is part of a new data collection and automatic processing system under development at the Alaska Earthquake Information Center.

The Alaska Volcano Observatory, a cooperative project of the Geophysical Institute, the U.S. Geological Survey, and the Alaska Division of Geological and Geophysical Surveys, shares the seismic data collection facilities for the combined monitoring of earthquakes and volcanoes.

Unlike earthquakes, which often occur without warning, volcanoes usually give evidence of impending eruption several hours to several months in advance.

Lindquist and Benoit studied a wide range of computerized alarm signals dur-

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INSERT: *Gee Whiz is a new educational supplement to the Geophysical Institute Quarterly written and designed to help children understand geophysics.*

ing the Pavlof eruption to help them distinguish non-threatening signals, such as wind and ocean noise, from dangerous volcanic signals, such as seismic tremor and earthquakes associated with fluid movement that often precede eruptions.

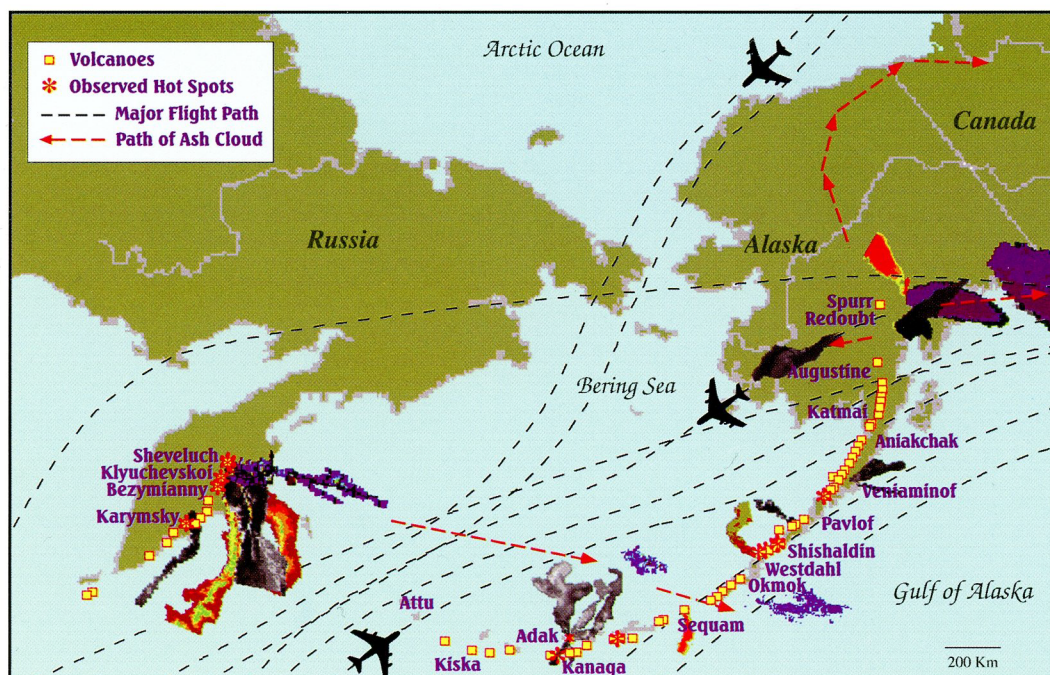
Characterized by explosive, ash-producing blasts, volcanoes in Alaska pose a serious threat to public safety because they are located beneath major international air travel routes.

Alaska is home to more than 80 active volcanoes, many of which are located in the Aleutians, where trans-oceanic air traffic is increasing.

More than 10,000 passengers travel over the Aleutian volcanoes each day, in addition to most of the air cargo between eastern Asia and North America.

The operation of seismic networks on suspect volcanoes is the primary tool for monitoring eruptive activity.

The adjacent graphic, designed by Geophysical Institute Graphic Artist Deborah Coccia and Research Assistant Professor Ken Dean, shows air traffic travel crossing the volcano-laden North Pacific.



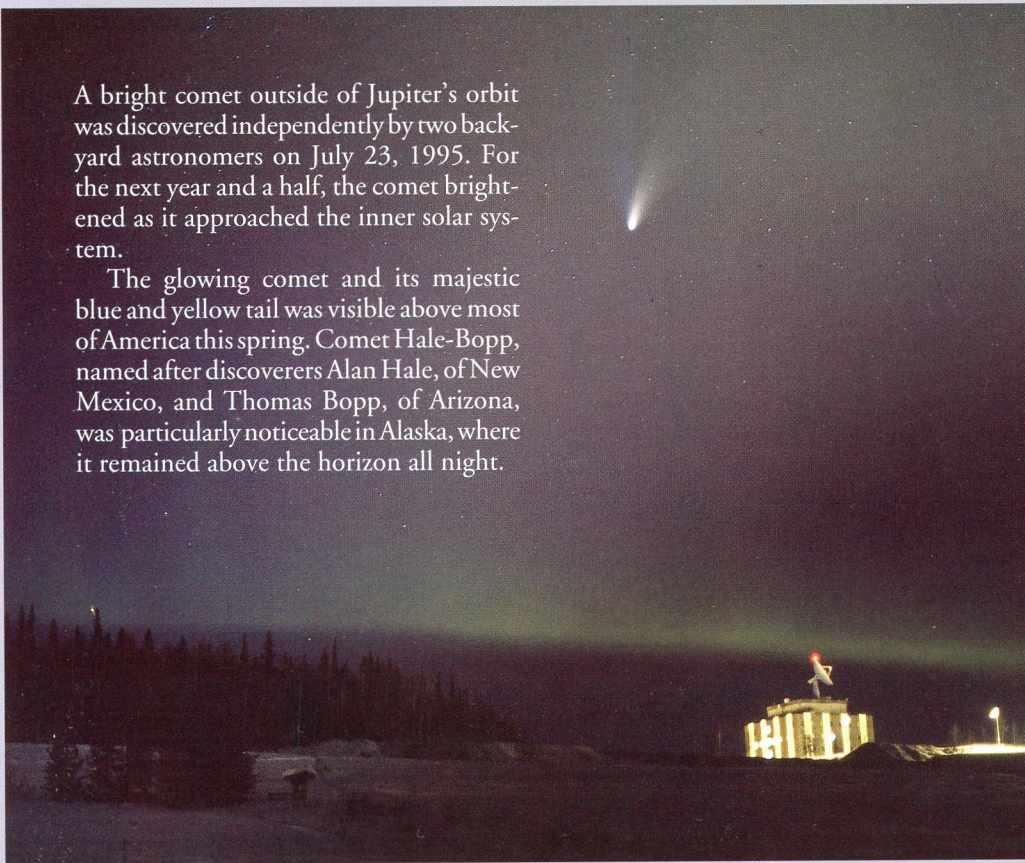
Comet Hale-Bopp Shines Through the Aurora

A bright comet outside of Jupiter's orbit was discovered independently by two backyard astronomers on July 23, 1995. For the next year and a half, the comet brightened as it approached the inner solar system.

The glowing comet and its majestic blue and yellow tail was visible above most of America this spring. Comet Hale-Bopp, named after discoverers Alan Hale, of New Mexico, and Thomas Bopp, of Arizona, was particularly noticeable in Alaska, where it remained above the horizon all night.

"I had no idea the comet would be so big. I never imagined this would happen." —Thomas Bopp

(see *Gee Whiz* insert, page 4)



Like Earth, Comet Hale-Bopp orbits around the sun. Unlike Earth, however, the comet travels on an elliptical path that keeps it isolated well beyond Pluto most of the time.

On March 22, Comet Hale-Bopp made its closest approach to Earth, passing just 122 million miles away. Two weeks later,

the frozen mass traveled to within 85 million miles of the sun.

Professor of Geophysics Hans Nielsen refers to comets as dirty snowballs, composed of frozen water, ammonia, methane, carbon dioxide and other compounds embedded with dust and rock.

With each pass near the sun, a comet loses size until it disintegrates. During the evaporation process, the comet releases a long tail of flowing plasma and dust, a feature that prompted its original Greek name "kometes," or hairy.

As a comet approaches the sun, it releases carbon monoxide and cyanogen gas; then, as it moves closer, it releases water vapor. Astronomers say that during its recent journey toward the sun, Comet Hale-Bopp released nearly a ton of carbon monoxide per second, creating a tail that stretches for millions of miles.

Although Comet Hale-Bopp is significantly farther away, it is much brighter than Comet Hyakutake, which was visible for about two weeks in night skies last year.

Part of Comet Hale-Bopp's splendor is due to its tremendous size, according to Nielsen.

Comet Hale-Bopp's nucleus of dirty ice measures between 30 and 40 kilometers, which is more than three times larger than the nucleus of Halley's Comet, one of the most popular comets in history.

Comet Hale-Bopp's brilliance may also be due to what scientists say are geyser-like explosions that blow off pieces of old crust and expose fresh material that reacts with solar heat. The glowing comet is bright enough to see with the naked eye, at least for a while longer.

Take a good look now, because Comet Hale-Bopp won't pass by Earth again until the year 4997.

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Can Earthquakes Be Predicted?

Predicting the next major earthquake may depend more on finding quiet ground than on listening for rumbles and shakes.

New research shows that periods of "seismic quiescence"—times when there are far fewer small earthquakes in an area than normal—sometimes precede the world's strongest and most damaging earthquakes.

Geophysical Institute Professor Max Wyss, who holds the Wadati Chair in Seismology, is developing new methods to test the hypothesis that major earthquakes often occur after the ground has been unusually quiet for months or years.

Much of Earth shakes with a constant number of small earthquakes created by the continual movement of plates around the globe. The theory of plate tectonics suggests that these semirigid plates move independently on a viscous underlayer in Earth's mantle. When the plates grind against each other, the contact can cause earthquakes or volcanic eruptions.

"When there is a sudden decrease of earthquakes in an area, it suggests something unusual is happening," Wyss said.

Wyss hopes that identifying periods of seismic quiescence in areas that normally shake with small tremor will someday help scientists forecast moderate and large earthquakes around the world. Periods of quiet activity already have been observed before the occurrence of large earthquakes in California, Hawaii, Turkey, Utah, Japan, Italy, Armenia, and the Pacific.

In a recent study, Wyss and Seismologist Walter Arabasz, director of the University of Utah Seismograph Station, searched for periods of seismic quiescence before seven large earthquakes recorded in Utah from 1974-'96. Quiet periods preceded at least three of those earthquakes.

To find out why large earthquakes don't always follow seismic quiescence, Wyss researched earthquakes in Japan, where much has been published in support of the quiescence hypothesis. There, Wyss found that seismically quiet periods precede significant earth-

quakes only when sufficient underground stress has accumulated.

Wyss studied three areas around Tokyo that have been experiencing seismic quiescence for three years. Each of the areas has experienced large earthquakes in the past.

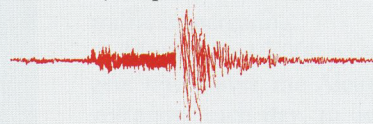
Within the areas, Wyss mapped and tested asperities, or hard spots, which can supply the source of energy for an earthquake. He assigned each asperity a "b-value" as a measure of the accumulation of underground stress. The measuring of b-values can help seismologists rule out other reasons for a decrease in the rate of small earthquakes caused by physical factors, such as ground water movement.

High b-values mean it is unlikely the ground contains enough stress or energy to produce an earthquake. Low b-values mean the ground has great potential for producing an earthquake.

All three of the areas of seismic quiescence near Tokyo contained asperities with high b-values. Consequently, Wyss predicts there is less than a 20 percent chance of major earthquakes occurring in those areas any time soon. Wyss calls areas containing seismic quiescence that do not produce major earthquakes, "false alarms."

"False alarms do not disprove the hypotheses. They just mean the hypothesis doesn't work in this case," Wyss said. "Scientists who predict the weather experience false alarms quite frequently."

Wyss has made progress in confirming his hypothesis, but he is careful to say it is not ready yet to be used as a prediction tool. He advocates using multiple methods of prediction because earthquakes follow a variety of patterns.



The adjacent photographs taken by Jack Finch show Comet Hale-Bopp as it glowed through auroral displays over the Geophysical Institute this spring. Nearly 700 people saw the comet gleam through an aurora over the university's west ridge during a "Comet Watch Party" sponsored by the Physics Department in March.



The Aurora Inspires Rocket Launches

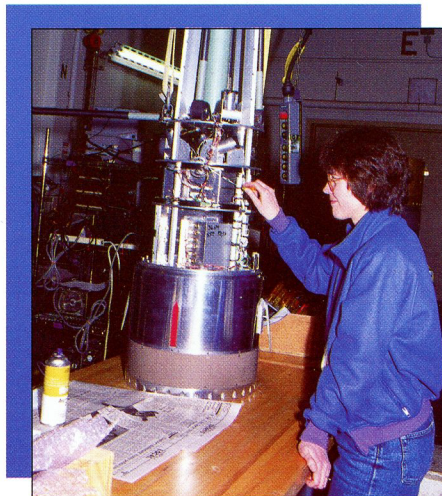
Three rockets were launched from Poker Flat Research Range through auroral displays this winter. The next launch from the range is scheduled for January 1999.

The first rocket of the 1997 winter season launched from Poker Flat at 8:17 p.m. on Sunday, February 9. The rocket was visible from Fairbanks and throughout the Interior as it flew 550 miles high, arched over Kaktovik and landed in the Arctic Ocean.

During the rocket flight, 18 detectors inside the payload took rapid measurements of the aurora. The data was sent back to Poker Flat while simultaneous measurements were made from ground-based observatories in Kaktovik and Deadhorse.

University of New Hampshire Physics Professor Roger Arnoldy, the principal investigator for the mission, said the information gained during the flight will help him verify theories developed to explain the movement of the aurora.

The second rocket of the season launched from Poker Flat at 11:36 p.m. on Monday, February 11. The four-stage, 73-foot-tall rocket flew nearly 300 miles high



EVELYN TRABANT

Project Scientist Ruth Skoug designed the payload for a rocket launched through a pulsating aurora this winter.

through brilliant auroral arcs before it splashed down as scheduled 23 minutes later in the Arctic Ocean.

During the flight, about a dozen instruments in the rocket payload, including three that had never before been flown, successfully measured electrical currents and radio emissions in the aurora.

Professor Roy Torbert, from the University of New Hampshire, spent about 10 years perfecting the instruments in the payload, which was among the most complex ever flown on a sounding rocket by NASA. The payload alone weighed more than 925 pounds.

Once high in the atmosphere, Torbert's payload separated into three parts so measurements of the aurora could be taken from different angles. Measurements from all three angles were transmitted successfully to Poker Flat.

The last rocket of the winter season was launched from Poker Flat at 1:20 a.m. on Thursday, March 13. The 48-foot rocket flew 212 miles high through a pulsating aurora before landing in the Brooks Range. Principal Investigator George Parks was assisted in payload design by Project Scientist Ruth Skoug, both of the University of Washington.

Poker Flat Research Range Manager Ron Pierce described a pulsating aurora as one that throbs at irregular intervals.

"These kind of auroras pulsate like strobe lights, getting bright all of a sudden and then dissipating quickly," Pierce said.

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