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Mt. Erebus surprises Ross Island inhabitants

On 13 September 1984, Mt. Erebus, the world's most southern active volcano, was jolted by a number of large explosions. These events were recorded not only by the five seismic stations on the volcano's slopes but also by infrasonic detectors at Windless Bight (29 kilometers away), the seismograph at New Zealand's Scott Base (37 kilometers away), and a tidal gravimeter at the Amundsen-Scott South Pole Station (about 1,400 kilometers from Mt. Erebus). Before September strombolian

activity (volcanic activity characterized by fire fountains of lava from a central crater) has only been recorded by the seismic stations on the volcano's slopes.

From 13 to 19 September, 8 to 19 large explosions occurred each day on the 3,794-meter high volcano. The explosions decreased to two to eight per day between 20 and 26 September, then increased to 12 to 27 per day from 26 to 29 September. During this time personnel at McMurdo,

On 13 September 1984 Mt. Erebus was shaken by the first of a many large explosions. This view of the crater rim of Mt. Erebus was taken from the southwest on 20 October. Large volcanic bombs can be seen on the west side of the mountain. In the background is Mt. Terror.

NSF photo by Philip R. Kyle.



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the U. S. station on Ross Island about 37 kilometers from Mt. Erebus, observed numerous mushroom-shaped plumes of various colors; these rose as much as 2,000 meters above the summit. Early in the morning on 16 September and during mid-morning on 26 September, observers at McMurdo Station reported hearing explos-

ions; a few people also reported feeling slight earth tremors.

From the sea ice near Hut Point, Ross Island, other observers saw a bright glow around the volcano's summit on 17 September. Six minutes later incandescent volcanic bombs were ejected from the summit about 600 meters into the air. Glowing tephra from this explosion, which was one of the largest recorded by the infrasonic and seismic equipment, was observed by people at Butter Point about 70 kilometers away. From Cape Royds others noted that the northwest slopes of Mt. Erebus were covered with new ash down to an elevation of approximately 3,400 meters. Around the summit crater fumaroles were substantially more active, and on the lower eastern flank a 300- to 500-meter high, narrow plume (possibly a geyser) was seen.

During October the seismic network on the volcano, the Scott Base seismograph,



NSF photo by Philip R. Kyle.

The main crater floor is littered with volcanic bombs and other debris; the inner crater, where up until September 1984 there was an active lava lake, has solidified and dommed up by more than 100 meters over previous levels.



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and the Windless Bight infrasonic detectors recorded between 6 and 27 large eruptions daily. Most of these explosions ejected volcanic bombs that averaged about 2 to 4 meters in diameter but were at times as large as 6 to 8 meters in diameter. Some of these bombs were thrown as high as 500 meters above the volcano's summit, and most landed near the upper 150 meters of the outer crater rim.

On 20 October Philip Kyle, the geophysicist who coordinates the U. S., New Zealand, and Japanese seismic investigation of Mt. Erebus, and David Bresnahan, the National Science Foundation Representative at McMurdo Station, flew over the summit crater in a Hercules ski-equipped airplane and made the first direct observations of the crater and lava lake since the beginning of the eruptions. Members of this international team, which established and maintains the seismic stations on Mt. Erebus, last observed the lava lake in late 1983. At that time the lake was a fluid, convecting pool and was about 100 meters below the inner crater rim. After his October flight Dr. Kyle reported that the lava lake surface had solidified and formed a dome that sloped upward to within about 30 meters of the inner crater rim. The hardened lava was piled up against the inner crater's north wall and sloped southward. Near the center of the uplifted, hardened lava, a small vent, which contained incandescent material, was present; scattered fumaroles had formed in the lake surface.

Although Dr. Kyle did not observe any explosions, he reported that about 500 to 1,000 volcanic bombs had accumulated on

the outer crater rim after 3 to 4 days of heavy snow that covered earlier ejected materials. Before September's increased activity, few volcanic bombs ejected from the lava lake had ever reached the crater rim.

The volcano continued to be active into December 1984. Although gas coming from the volcano prevented the scientists from making direct observations, they believe that a small lava lake has formed. Sounds emitted from the crater seem to support this theory.

History of volcanic activity

More than a century ago British explorer James Ross and his party were the first people to see Ross Island's active volcano and observed activity that may have been similar to that which occurred in September 1984. He described the volcano, which he named Mt. Erebus, as follows:

"Mt. Erebus was observed to emit smoke and flame in unusual quantities. . . . A volume of dense smoke was projected at each successive jet with great force, in a vertical column, to the height of between 1,500 and 2,000 feet above the the mouth of the crater. . . . The diameter of the columns of smoke was 200 and 300 feet, as near as we could measure it; whenever the smoke cleared away, the bright red flame that filled the mouth of the crater was clearly perceptible; and some of the officers believed they could see streams of lava pouring down its sides until lost beneath the snow which descended from a few hundred feet below the crater. . . ." (Ross, 1847)

Although since January 1841 Mt. Erebus has continued to be active, this activity has not been as dramatic as that observed by Ross. Between 1841 and 1956, few observations of the volcano were made. A U. S. Navy airplane flew over Mt. Erebus in 1963, and photographs were taken of the inner crater. These photographs suggested to scientists that there was molten lava in the crater at that time (Kyle et al, 1982).

In 1972 geophysicists began making regular observations of the summit crater. Since that time they have watched the inner crater lava lake develop from a few small patches of fluid lava around the crater floor to an oval-shaped convecting lava lake about 120 meters long (Kyle et al, 1982). Mt. Erebus is one of three convecting magma lake volcanos in the world; the others, Erta Ale and Nyiragongo, are in Ethiopia and Zaire, respectively. The Erebus lava lake is at the top of the magma column, which is connected to a magma chamber. From observations geophysicists know that the oval-shaped lake has had a simple convection pattern. Magma wells up from two centers about one-third of the way from each end of the lake and sinks down around the lake's edges and along a zone roughly in the lake's middle (Kyle and Otway, 1982).

In 1982 U. S., New Zealand, and Japanese geophysicists reported that between 8 and 10 October 1982 an unusual number of small earthquakes occurred on Mt. Erebus. The greatest number, 650 micro-earthquakes, were recorded on 8 October; before this an average of 20 to 80 small tremors had been recorded each day. Geophysicists believe that this seismic activity was associated with deep magma movement and the injection of lava from the magma chamber into an arm-like dike (Kienle, Kaminuma, and Dibble, in press).

Possible cause of 1984 activity

Scientists are collecting data to determine what caused the increased level of activity. After microprobe analyses of glass from the volcanic bombs collected in October 1984, Dr. Kyle described these samples as identical in composition to glasses in the anorthoclase phonolite bombs that have been collected since 1972.

U. S., New Zealand, and Japanese scientists continue close observation of Mt. Erebus, but they believe that they know why the explosions occurred. Data indicate that the convection in the lava lake slowed enough to allow the lava to solidify, and the lava lake disappeared completely. The newly formed crust trapped gas coming from the magma column and caused pressure to build up beneath the frozen lava. Because of this pressure, the surface domed up. Eventually, the gas pressure built up sufficiently to cause a series of

large explosions. The geophysicists estimate that the initial explosions threw volcanic bombs as large as 10 meters in diameter more than 1.5 kilometers from the crater. Although Mt. Erebus entered a more explosive phase of activity this austral summer, the geophysicists believe that this activity may indicate that the volcano is declining in activity.

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NSF photo by Gary and Rebecca Heimark.

Elephant seals—breeding bull, cow, and pup—on Elephant Rocks near Palmer Station on 23 October 1983. Observations by Gary and Rebecca Heimark of elephant seals near Palmer Station in 1982 and 1983 indicate that this area now marks the southernmost extension of the breeding range for these seals. Their article, which begins below, provides information on elephant seals, other marine mammals, and birds.

Birds and marine mammals in the Palmer Station area

The ocean surrounding Palmer Station (64°46'S 64°3'W), the U. S. station on Anvers Island near the Antarctic Peninsula, supports many marine birds and mammals. Beginning with Holdgate's study in 1963 and followed by other investigations during the 1970s and early 1980s, ornithologists have reported observations of

birds near Palmer Station during the austral summer; however, they have not made many winter observations. Also, little has been published on the daily and year-round occurrence of marine mammals in this area where five of the six species of antarctic seals, as well as other marine mammals, can be observed regularly.