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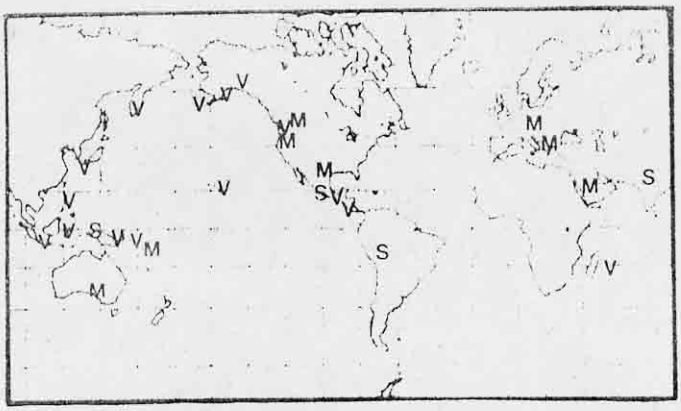

M-Meteoritic S-Seismic V-Volcanic

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BULLETIN

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Rincón de la Vieja Volcano (continued)

to observe white tephra. In addition, the seismic station at the base of the volcano registered an increase in activity (harmonic tremor and A- and B-type events) between September and November, suggesting that the eruption occurred during that time.

"A fan-shaped area of about 0.25 km^3 was affected. The ejecta reached a maximum distance of 500 m to the SE of the active crater. The erupted material is secondary, including ash, sand, and blocks as much as 20 cm across. On one rock, an ash deposit 6 cm thick was observed. The effect of the eruption on rain forest vegetation was marked about 500 m SE of the crater (in the E bank of the Quebrada Azufrosa) where trees had been knocked down in a radial pattern by the activity. This pattern is unusual in that the fallen trees appeared to radiate from a point near their center, not from the crater. In addition, various plant species in this area were affected by the acid in the pyroclastics and the associated water.

"On 19 April there was a strong and constant emission of gas that affected breathing because of its acidity, and made it difficult to observe the lake in the active crater."

Seven eruptions from Rincón de la Vieja have been reported since the mid-19th century. The most recent, a phreatomagmatic eruption in February 1983, deposited tephra to 1.5 km from the summit and generated a small mudflow (see SEAN Bulletin v. 8, no. 3).

Information Contacts: Jorge Barquero Hernández and Erick Fernández Soto, Observatorio Vulcanológico y Sismológico de Costa Rica, Universidad Nacional, Heredia, Costa Rica.

Arenal Volcano, western Costa Rica (10.47°N, 84.73°W).

"Arenal remained very active, with emission of lava from Crater C at 1450 m above sea level. Lava advanced towards the N, NW, W, SW, and S, with flow fronts reaching 900 m altitude. Frequent avalanches, from continuous to every 15 minutes or so, occurred from the flow fronts. Sporadic explosions ejected pyroclastic materials, with some blocks and bombs falling at 800 m altitude. Ash was carried by winds, mainly toward the W and SE, to a distance of 4 km. Gas and vapor emission was continuous."

Arenal's eruption began in 1968, with strong explosive activity that included large pyroclastic flows. Since then summit activity has fed about 5 dozen lava flows.

Information Contacts: Same as for Rincón de la Vieja.

Bezymianny Volcano, Kamchatka Peninsula, USSR (56.07°N, 160.72°E). All times are local (= GMT + 12 hours October-March; GMT + 13 hours April-September).

The following report, on the 1984-5 eruptions, is from G. E. Bogoyavlenskaya, I. T. Kirsanov, P. P. Firstov and O. A. Girina. Observation data obtained by A. I. Malyshev and K. S. Kirishev of the Apakhonchich seismic station region are included in the 1984 eruption report.

"Bezymianny volcano is one of the least conspicuous volcanoes in the Klyuchevskoy volcanic group. Prior to 1956, the volcano was dormant for more than 1,000 years and no historic eruptions were recorded. The altitude of Bezymianny

Bezymianny Volcano (continued)

before the 1956 eruption was 3085 m, and relative altitudes were 700 m to the N and 1200 m to the S. A poorly developed crater containing a small inner cone was located at the top of the volcano. More than 10 extrusive domes of different ages are located on the S flank of the volcano and near its base. The base of the complex is composed of pyroclastic flow deposits from eruptions that occurred during the past 2,000 years. Young lava flows of the same age are also well-exposed on the S flank of the volcano; older lava flows are exposed on the N flank.

"A new cycle of eruptive activity began with the 1955-56 catastrophic eruption and is continuing today. For this eruption, the following stages have been distinguished: (1) A preclimactic stage that consisted of intense seismic activity, vulcanian explosive activity, and deformation of the summit area. (2) A climactic stage including a directed blast that destroyed the summit and plinian activity that erupted a large volume of juvenile tephra and pyroclastic flows. (3) A post-climactic stage characterized by growth of an extrusive dome in the crater.

"In April 1956, after the climactic explosion, an extrusive dome began to form in the new crater. By July 1956, the dome had grown to a height of 320 m, and the diameter of its base was 600-650 m. Since 1956, activity of Bezymianny has been limited to continued growth of the Novy intracrater dome, which is the largest extrusion in recent history at Bezymianny. During the dome growth the character of magma extrusion changed periodically, allowing us to distinguish three stages in the development of intracrater extrusion.

"During the first decade, individual rigid blocks of the dome and occasionally the whole massif squeezed out. This was accompanied by explosive activity. Distinct variations in volume and height of extruding blocks occurred during strong eruptions. Eruptions of different power occurred, as a rule, once or twice a year. The strongest eruptions, which occurred every few years (1961, 1962, 1965), began with a powerful explosive phase, forming pyroclastic flows of 0.01 km^3 volume. This was followed by a decrease in activity, but punctuated by numerous glowing avalanches.

"During the second stage, which began in 1965, the extrusion of rigid blocks was joined by plastic lava as small dikes and lava bulges. In 1967 and 1968, rigid extrusion predominated in the northern and then in the central part of the Novy dome summit. Plastic andesite lavas were extruded only along fissures and weakened zones.

"The third stage began in 1976. At that time the absolute altitude of the Novy dome was 2869 m: the height of the dome itself was 800 m and its volume was about 0.367 km^3 (Seleznev et al., 1983). Eruptions occurred one or two times a year, the strongest in March 1977, February 1979, and August 1980. Long-lasting eruptions with lava extrusion were observed in 1981-2, twice in 1984, and in 1985.

"Almost every eruption was preceded by volcanic earthquakes and accompanied by volcanic tremor. Eruptions generally began with small explosions and rigid andesitic block extrusions. They were generally accompanied by destruction of the upper active part of the dome and by the formation of glowing avalanches. Eruptive clouds rose to heights of 3-10 km and plumes were traced to distances of 50-100 km. Simultaneously, pyroclastic flows 6-8 km long, with volumes of 0.005 to 0.01 km^3 formed. In addition to juvenile material (fragments of vesicular andesites and matrix) they generally contained many large blocks and lithic fragments of the dome. These block and ash flows were erosional and by 1980 they had eroded a 50-m deep trench near the foot of the volcano. The paroxysmal stage of eruptions lasted from several hours to two or three days. During the final stage lava flows reached lengths of 300 to 500 m. The

Bezymianny Volcano (continued)

1981-2 eruption lavas were extruded at small intervals within a period exceeding one year, and covered the E and NE flanks to the foot of the dome.

"In 1984 Bezymianny erupted twice, in February and October. Fissures that formed at the top of the dome and broke it into blocks were the precursors to the February eruption. On 5 February the first small single earthquakes were recorded, and the first small explosions began. Large earthquakes began on 10 February and were most numerous on 15 February. Earthquakes stopped on 16 February and only weak continuous volcanic tremor was recorded. On 13-15 February rigid andesite blocks began to be squeezed out at the top of the dome, and rockslide avalanches formed. On 16 February slow lava extrusion began. By August a lava carapace had covered the E and NE flanks to the foot of the dome (figure 11).

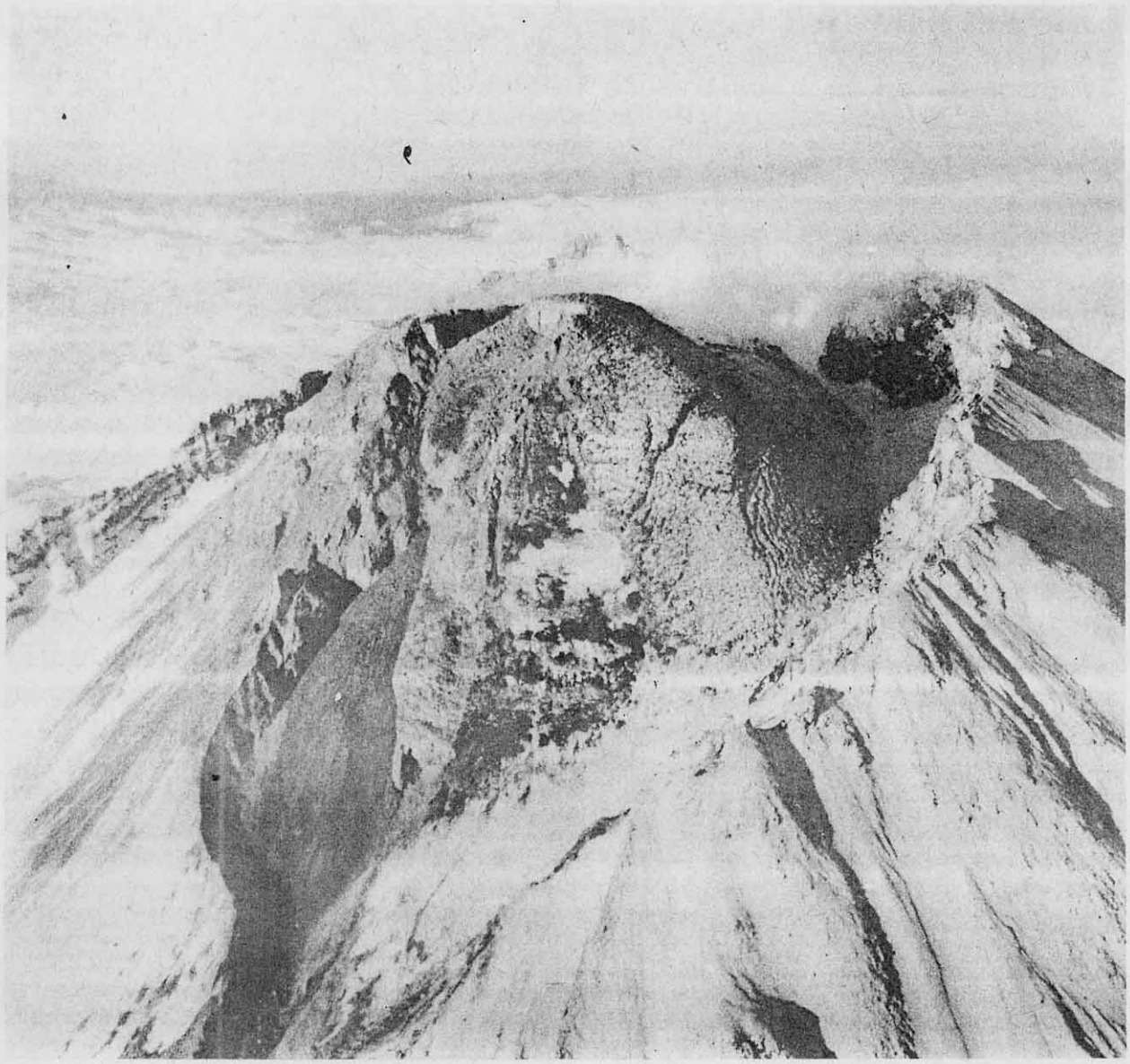

Figure 11: Oblique airphoto of Bezymianny's summit in August 1984, showing the new lava carapace covering the E and NE flanks of the dome.

Bezymianny Volcano (continued)

"The October 1984 eruption was large. The first local earthquakes were recorded on 24 September, simultaneously with the failure of the dome blocks and with the formation of glowing avalanches. At that same time continuous volcanic tremor began, with amplitudes that reached 5 microns during the periods of the most intense explosive activity.

"A dark gray gas-ash plume appeared above the volcano on 13 October. At a height of about 2 km it was traced 40 km ESE. Beginning from 1100-1500, vertical and inclined explosions occurred every 5-10 minutes. Simultaneously, pyroclastic flows were generated, forming a large deposit near the foot of the volcano. Ash clouds rising above moving pyroclastic flows joined with material ejected from the vent to form an eruptive cloud 6-9 km high. The plume was traced 50-100 km ENE. The explosive eruption continued until 15 October. Seismicity ceased the next day, but the extrusion of rigid blocks at the dome summit continued until the end of October. Wreathing gases of white or occasionally gray color were observed continually over the dome. Glowing avalanches periodically rolled down the flanks.

"The paroxysmal eruption was characterized by a powerful explosive phase. A crater formed at the top of the dome and an erosion trench formed on the E flank, essentially dividing the dome into N and S parts. Two pyroclastic flow tongues formed at the foot of the volcano. The S part of the flow, 6 km long, had an area of 2.7 km^2 and a volume of 0.013 km^3. Tephra from this eruption covered an area of approximately 5,000 km^2.

"The next strong eruption occurred in late June-July 1985 and was preceded by small seismic activity. Geologists saw a paroxysmal stage of this eruption from a distance of 8.5 km (P. P. Firstov, A. I. Malyshev, and M. A. Alidibirov). Bad weather limited visual observations, but seismic and acoustic signals (processed by P. P. Firstov from the Apakhonchich seismic station, 16 km from the volcano), in comparison with visual observations, have allowed some interpretation of eruptive dynamics.

"The active phase began, apparently, on 29 June at 1930 when observers heard a strong roar from the volcano lasting for half an hour. Three small pyroclastic flows formed between 1922 and 1941. Deposits of these flows as long as 7-8 km were found the next morning. Then the explosive activity of the volcano sharply increased, and seemed to cause a failure of the E part of the dome. The material from the destroyed part of the dome and juvenile pyroclastic material formed a thick block-ash pyroclastic flow that apparently formed in the period from 0705-0715 on 30 June and was deposited at a distance of 10 km. Strong explosive activity continued, accompanied by lightning in the cloud. From 1229 to 1425, 10 small pyroclastic flows formed. At 1425-1430 the longest pyroclastic flow (10-12 km long) formed, overlapping the deposits of former flows. After that, explosive activity began to decrease. The last small pyroclastic flow formed on 1 July at 1930. Then calm lava flow extrusion began from the new dome crater and continued for several months (figure 12).

"Thus, the main events of this eruption are as follows: (1). Moderate explosive activity resulted in destruction and failure of the E part of the complex intracrater dome. A large (0.04 km^3) crater formed with an active vent in its upper part. (2). Dome material plus fresh juvenile material formed a thick block and ash pyroclastic flow deposit (with a volume of about 0.01 km^3), covering the E foot of the volcano to a distance of 8-10 km from the crater. (3). Failure of part of the dome resulted in rapid decompression of the remainder of the dome. Rapid expansion of volcanic gases

Bezymianny Volcano (continued)

produced a blast directed to the E that covered an area of 10 km^2 and destroyed two volcanologist houses 3.5 km from the crater. Erosion traces on the ruins of the buildings suggest that the ground surge velocity was very high. The temperature, as evidenced by the melting of polyethylene objects, was greater than 150°C. Blast deposits - a layer of stratified sand - had a volume of about 0.001 km^3. (4). Continuing explosive activity formed of a series of hot juvenile pyroclastic flows that covered a 3.5 km^2 area with a layer 1-5 m thick. The total volume of juvenile pyroclastic material apparently did not exceed 0.01 km^3. (5). When the explosive phase of the eruption stopped, calm outpouring of a lava flow began from the newly-formed crater.

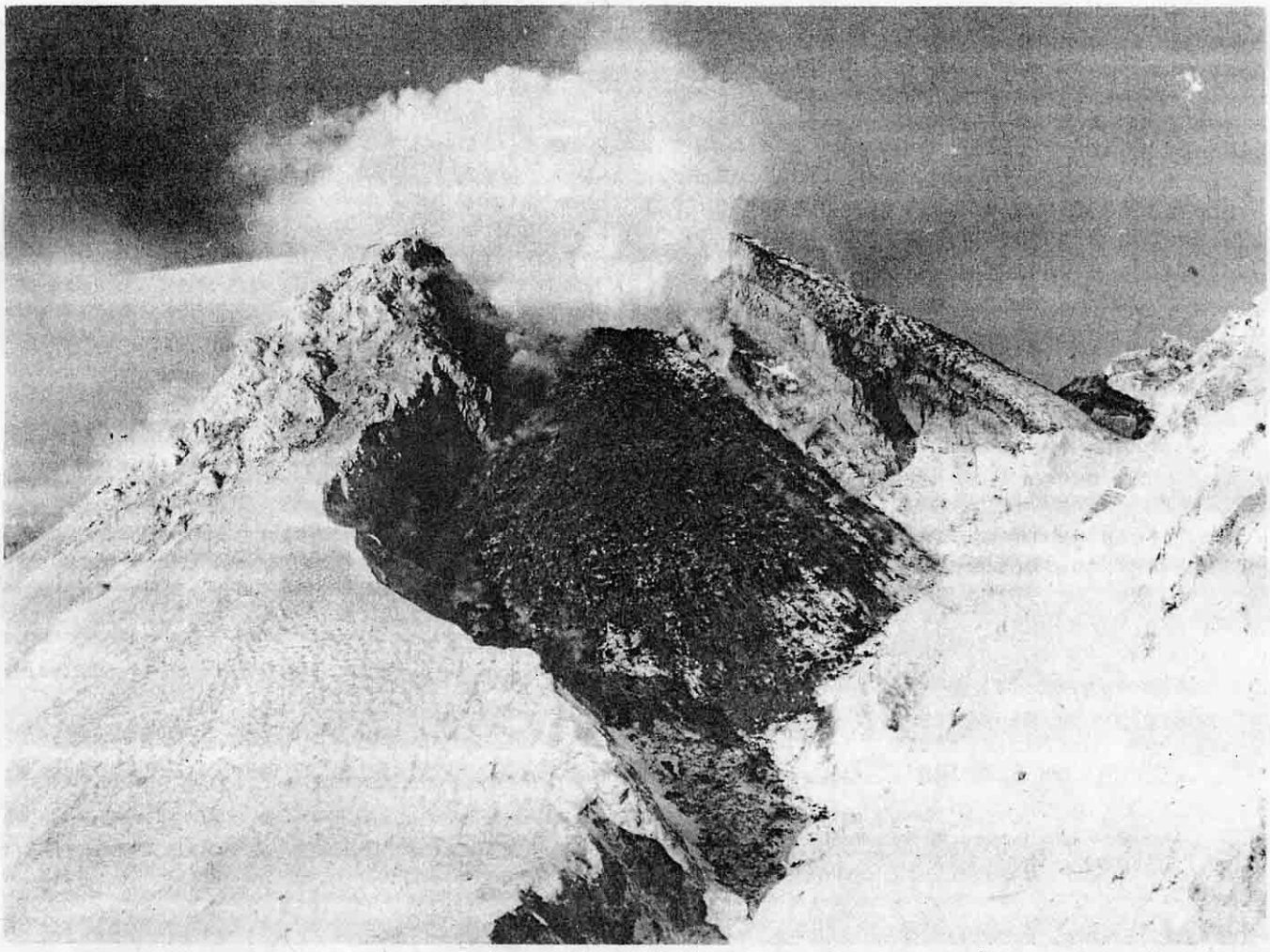

Figure 12: Photo by N. Smelov showing the lava flow extruded from the new dome crater after the June-July 1985 explosions. Lava advances through the crater breach seen (from a higher vantage point) below the dome in figure 11.

"Detailed field investigations of the eruption products allowed us to distinguish the following types of pyroclastic deposits: (1). "Block and ash flow" deposits are the most typical of the eruptions of Bezymianny. They are connected with growth of the intracrater dome, especially during the first two decades, when explosions and extrusion of rigid blocks of the dome occured. During the first

Bezymianny Volcano (continued)

stages of the 1984-5 eruption pyroclastic flows of this type were produced as well. (2). Vesicular (or semi-vesicular) andesite pyroclastic flow deposits are represented by debris of gray vesicular andesites generally of one size (not more than 1-2 m) and by a great amount of fine matrix. The temperature of material at the moment of deposition was about 700°C, and the mean thickness was 2-3 m. The pyroclastic flow deposits represent a complex of separate units. Two main pyroclastic flows are distinguished most clearly, each underlain by ground surge deposits associated with the flow, represented by a layer of well-sorted sand 10-12 cm thick. (3). Deposits from ash clouds that rose from pyroclastic flows are represented by stratified and sorted sand at different sites on and around the pyroclastic flow deposits. Gradual transitions from coarse-grained pyroclastic flow deposits to more fine-grained ash cloud deposits were noted. Everywhere these deposits were overlapped by a thin (1-2 cm) layer of pelitic airfall material. Ash cloud deposits were hot: drying and slightly charring the shrubs and grasses on surrounding hills.

"Small amounts of airfall tephra are a characteristic feature of the 1985 eruption. A thin layer of pelitic material which covered the area around the volcano had apparently fallen from the ash cloud that rose from the pyroclastic flows during their movement. The apparent lack of associated airfall beds with some sequences of pyroclastic flows and surges suggests that these might have been formed directly from the crater without the production of an eruption column, with the eruptive material just topping the crater rim (or "boiling-over") and moving down the outer slopes.

"The chemical composition of dome rocks changed slightly during growth from 59.9% SiO_2 in 1956 to 56% SiO_2 in 1984-5. Variations in mineral composition were more considerable, from hornblende pyroxene andesites in 1956 to two-pyroxene, well-crystallized, basic andesites in the next ten years. An interesting peculiarity of eruptions during the last 2-3 years is the appearance of tephra more acid (61-62% SiO_2) than rocks from either the dome or from pyroclastic flows. Andesites of the dated Novy dome eruptions fall between the curves of tholeiitic and calc-alkaline types, tending to occur close to the latter. In contrast to the rocks from the edifice of the volcano they have a close, slightly differentiated composition. Rocks of the 1984 eruption show a tendency to increase slightly in alkalinity; rocks of the 1985 eruption have a higher Mg content."

Reference: Seleznev, B. V., Dvigalo, V. N., and Gusev, N. A., 1983, Development of Bezymianny Volcano According to Data on Stereophotogrammetric Treatment of the Aerial Survey Materials of 1950, 1967, and 1976-1981; Volcanology and Seismology, No. 1, p. 52-64 (in Russian).

Information Contacts: G. E. Bogoyavlenskaya, I. T. Kirsanov, P. P. Firstov, and O. A. Girina, Institute of Volcanology, Piip Avenue 9, Petropavlovsk, Kamchatsky 683006 USSR.

Bulusan Volcano, Luzon Island, Philippines (12.77°N, 124.05°E). All times are local (+ GMT + 8 hours).

A seismic swarm began on 19 April at 2022 and lasted for about 10 hours. A total of 229 volcanic earthquakes were recorded by most of the 5 seismic monitoring stations. The initial phase was characterized by high-frequency volcanic earthquakes, gradually replaced by low-frequency volcanic earthquakes during the peak and latter part of the activity. Three of the events were felt, with epicenters initally located about 7.4 km SE (azimuth 134°) of the summit crater, within the caldera.