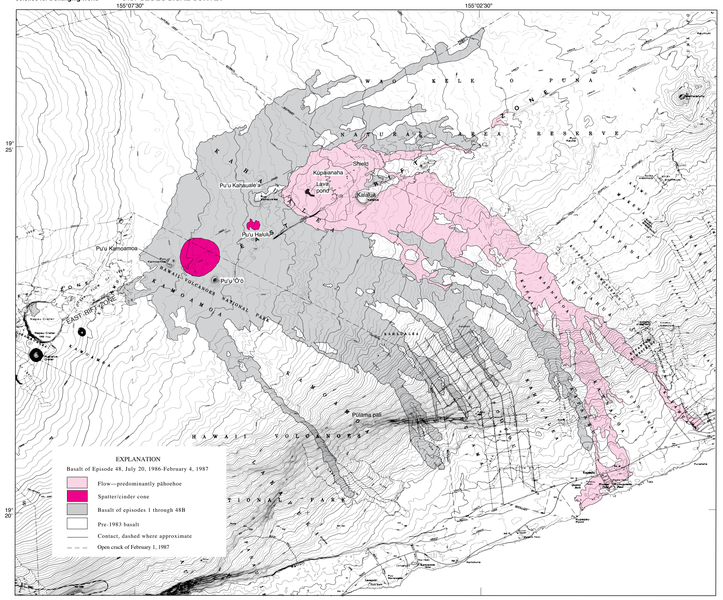
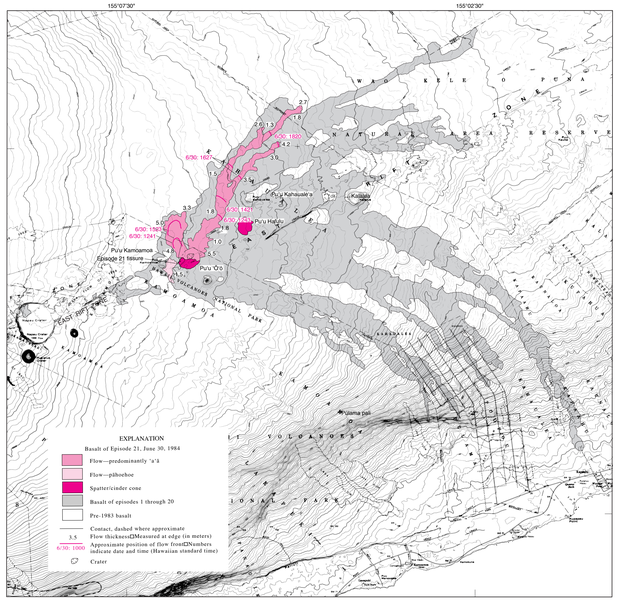
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

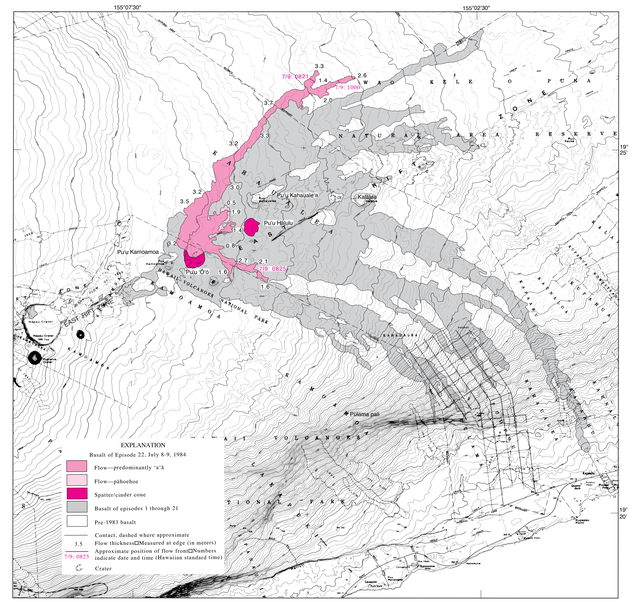
MISCELLANEOUS INVESTIGATIONS SERIES
MAP I-2685 SHEET 1 OF 4



Distribution of flows, Episode 1 - early Episode 48, January 3, 1983 - February 4, 1987



EPISODE 21



EPISODE 22

OVERVIEW OF THE PU'U 'Ō'Ō - KŪPAIANAHA ERUPTION

The Pu'u 'Ō'ō - Kūpaianaha eruption on the middle east rift zone of Kīlauea began in January 1983 with intermittent activity along several fissures. By June 1983, the eruption had localized at the Pu'u 'Ō'ō vent, and the activity settled into an increasingly regular pattern of brief eruptive episodes characterized by high lava fountains. The first 18 months of this eruption are chronicled in Wolfe and others (1988), which includes maps of the flows erupted in episodes 1-20. The maps presented here extend this series through the beginning of episode 48.

In the two years following episode 20, Pu'u 'Ō'ō produced another 27 eruptive episodes (Heliker and others, 1987). Episodes 21-47 lasted an average of 13 hrs and were separated by repose periods averaging 26 days (table 1). Lava fountains as high as 467 m fed mostly channelized 'a'ā flows, which covered 42 km^2 by the end of episode 47. Flow thickness measurements, obtained for episodes 21-40, averaged 3.4 m; lava volumes averaged 11 x 10^6 m^3 per episode (excluding the 16-day fissure eruption of episode 35).

The Pu'u 'Ō'ō cinder-and-spatter cone grew to a height of 255 m above the pre-eruption surface by episode 47. Short-lived eruptive fissures and vents on or near the base of the Pu'u 'Ō'ō cone accompanied episodes 21, 25, 29, 35, 39, and 44. These satellitic vents opened just before or coincident with the start of high fountaining from the main Pu'u 'Ō'ō conduit, and they died within a few hours once some of the pressure on the system was relieved (Ulrich and others, 1985). Episode 35 (sheet 3) was the exception: a fissure on the uprift flank of the cone erupted early in the episode, then extended 2.5 km uprift after the high fountaining was over and erupted for the next 16 days (Heliker and others, 1985).

The volcano was primed for the 48th episode of high fountaining on July 18, 1986, when the vertical conduit of Pu'u 'Ō'ō ruptured and magma erupted through new fissures at the base of the cone (Ulrich and others, 1987). The "A" and B" fissures of episode 48 (sheet 4) were active only 22 hours, but the "C" fissure, which opened 3 km downrift of Pu'u 'Ō'ō on July 20, evolved into a single vent, later named Kūpaianaha, that continued to erupt for the next 5.5 years (the main phase of episode 48). This marked the end of episodic high fountaining and the beginning of continuous, quiet effusion (Heliker and Wright, 1991a). A lava pond developed over the new vent, and overflows from the pond built a broad low shield that reached a height of 50 m by February 1987. After weeks of continuous eruption, the main lava channel leading from the pond gradually roofed over, forming a lava tube. By November 1986, the tube had extended from the pond to the ocean, 12 km to the southeast, closing the coastal highway. Tube-fed flows overran 28 houses in the coastal communities of Kapa'ahu and Kalapana in the next month (Heliker and Wright, 1991b).

On February 4, 1987, pāhoehoe from Kūpaianaha flowed into an old crack of unknown age and followed it for approximately 800 m before reappearing at the surface to create a small isolated flow to the northeast of the main flow field (sheet 1).

METHODS

Lava flow contacts were typically mapped on aerial photographs taken between eruptive episodes. The contacts were then transferred via zoom transfer scope to a 1:24,000 topographic base. The aerial photography was not of photogrammetric-mapping quality, and cloud cover frequently necessitated piecing together frames from several different flight lines to get the required coverage. The accuracy of the flow contacts depends in part on whether the pilot maintained a steady elevation above the ground surface, particularly above the steep slope of Pūlama pali, and on how successful the photographer was at keeping the camera level. The lack of identifiable, pre-eruption landmarks on the aerial photographs was a problem that grew progressively worse as the flow field expanded. Close to roads or the coastline, the contacts are probably accurate to within 10 m. On the slopes of Pūlama pali, the error may be as great as 100 m in a few places, but in general is much less.

Bad weather or lack of an airplane prevented us from obtaining aerial photographs following episodes 26 and 27 and episodes 42 through 47. Following these episodes, contacts were mapped from a helicopter onto older aerial photos; consequently the contacts are less detailed. Flow-advance lines were mapped from either the ground or air during each episode.

Flow thicknesses for episodes 21-47 were measured by handlevel along the margins of the cooled flows, picking places where the thickness seemed representative of that section of flow. During the first few months of episode 48, volumes were determined by the amount of deflation recorded by the tiltmeter at Kīlauea's summit and by estimates of the thickness of the composite pāhoehoe flows.

ACKNOWLEDGEMENTS

We gratefully acknowledge the staff members of the Hawaiian Volcano Observatory for their many and various contributions to the eruption monitoring effort. We relied heavily on the expertise of Jim D. Griggs, HVO staff photographer, who shot and printed most of the aerial photographs we used for mapping. Helicopter pilot Bill Lacey, III, was essential for his skillful flying and ability to land on 'a'ā flows. We also thank the volunteers who contributed to field observations and helped us draft and digitize the maps.

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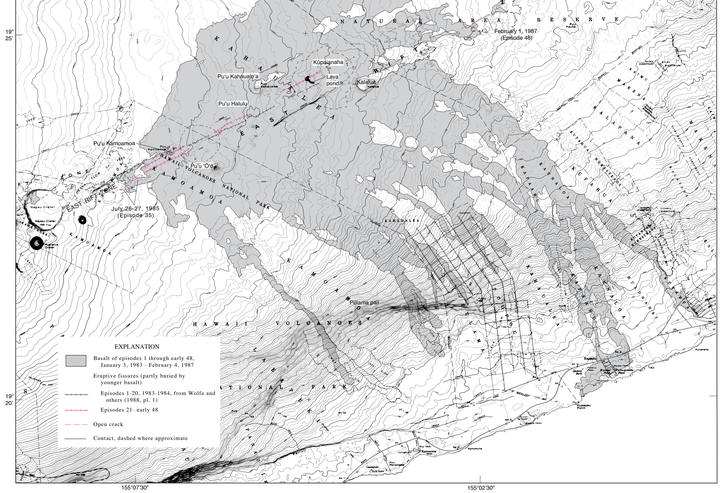
Table 1. *Eruption statistics for episodes 21 through early 48*

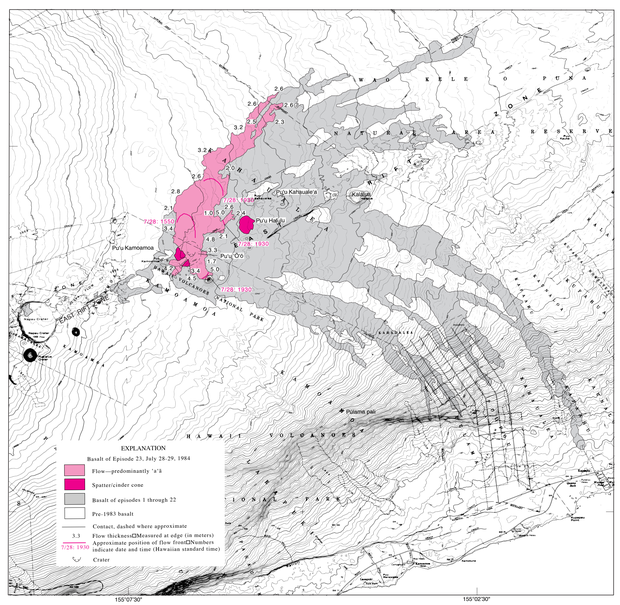
Episode	Date	Duration (hr)	Flow area (km^2)	Lava volume (m^3 x 10^6)
21	6/30/84	8	1.9	5.7
22	7/8-9/84	15	2.7	7.7
23	7/28-29/84	18	3.3	9.5
24	8/19-20/84	20	3.7	11.6
25	9/19-20/84	13.5	3.3	11.1
26	11/2/84	5	1.6	6.6
27	11/20/84	10	2.3	8.4
28	12/3-4/84	14.5	3.6	12.5
29	1/3-4/85	16	3.8	12.9
30	2/4-5/85	21	4.1	14.1
31	3/13-14/85	21.5	4.8	19.4
32	4/21-22/85	17.5	4.8	16.3
33	6/12-13/85	6	2.2	7.9
34	7/6-7/85	14	2.3	10.5
35	7/26/85	7	2.9	7.2
35	Fissure eruption: 7/27-8/12/85	384	0.8	4.5
36	9/2/85	9.5	2.7	11.5
37	9/24-25/85	12	4.4	14.7
38	10/21/85	8.5	3.9	14.8
39	11/13-14/85	10	4.2	13.7
40	1/1-2/86	13.5	4.0	11.6
41	1/27-28/86	11.5	5.0	13.7*
42	2/22-23/86	13.1	3.5	12.1*
43	3/22/86	11.4	4.8	10.3*
44	4/13-14/86	11	5.2	11.5*
45	5/7-8/86	12.4	5.5	9.4*
46	6/2/86	10.9	4.6	9.8*
47	6/26/86	12.3	3.8	8.8*
48	A&B fissures: 7/18-19/86	21.6	4.5	7.2
48	Kūpaianaha: 7/20/86-2/4/87	200 days	11.8	~100

* Volume estimated from amount of deflation recorded by the tiltmeter at Kīlauea's summit

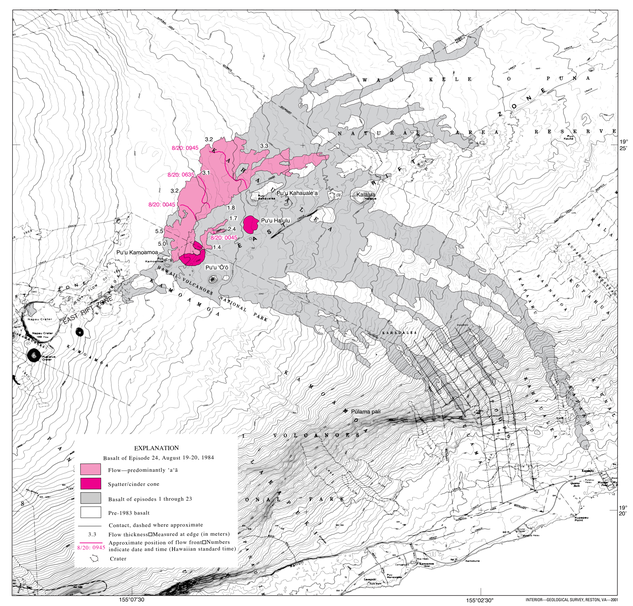


Base map from U.S. Geological Survey 1:24,000
Kalapana, Makaopuhi Crater, Volcano, 1981;
Kaluiuia, 1982

Eruptive fissures, January 3, 1983 - February 1987



EPISODE 23



EPISODE 24

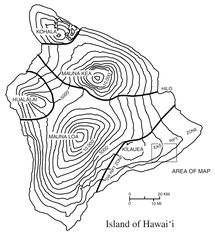
INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—2861

SCALE 1:50 000

1 ½ 0 1 2 3 4 5 MILES

1 0.5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL



Island of Hawai'i

MAPS SHOWING THE DEVELOPMENT OF THE PU'U 'Ō 'Ō - KŪPAIANAHA FLOW FIELD, JUNE 1984-FEBRUARY 1987 KĪLAUEA VOLCANO, HAWAII

By
Christina Heliker, George E. Ulrich, Sandy C. Margriter, and John P. Hoffmann

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