Description of Kīlauea's July 19, 1974 eruption

Excerpt from:

Magma Migration and Resupply During the 1974 Summit Eruptions of Kīlauea Volcano, Hawai'i

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Description begins on page 4:

CHRONOLOGICAL NARRATIVES

The three spectacular, short-lived, small-volume eruptions that occurred at Kīlauea's summit following the cessation of sustained Mauna Ulu activity in 1974 are the principal focus of this paper. Figure 2 shows the vents and flow fields for each of these individual eruptions. All times given in the following narratives are in Hawaiian Standard Time (UT minus 10 hr).

JULY 19-22, 1974 ERUPTION

The seismic alarm system sounded in an HVO residence at 03:45 on July 19, triggered by a sharp and sustained flurry *(continued on next page)*

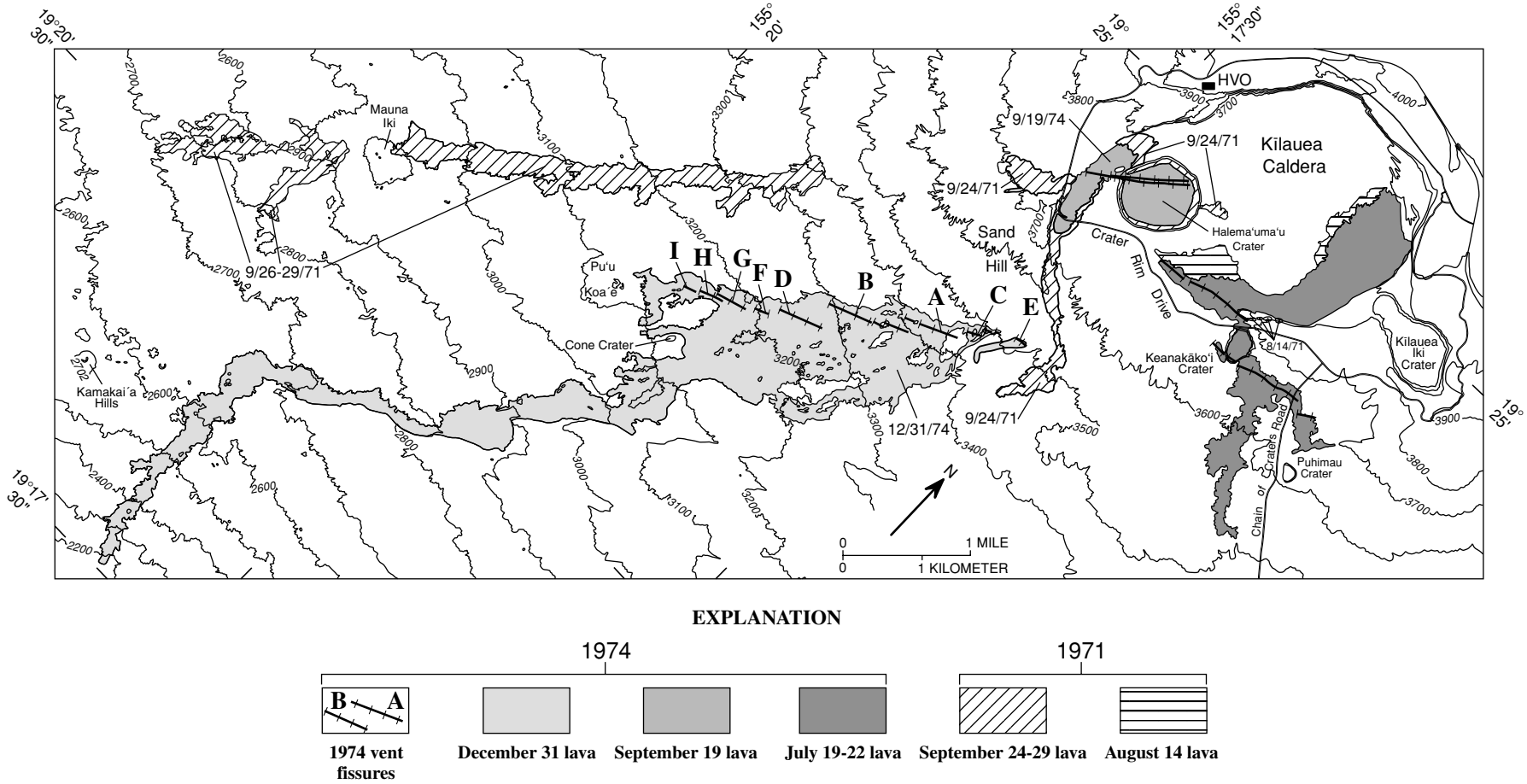

Figure 2.—Map showing the vents and flow fields of the summit and upper southwest rift eruptions of 1971 and 1974 (modified from Holcomb, 1987, Fig. 12.5). The July 19-22, 1974 lava covers much of the August 1971 lava in the southeastern part of Kīlauea Caldera; the September 19, 1974 lava covers much of the September 1971 lava in and near Halema‘uma‘u Crater. For the December 31, 1974 eruption, the bold letters refer to the chronological order of the opening of vent fissures (**A** = first; **I** = last). Contour elevations in feet.

of earthquakes centered near the uppermost part of the ERZ and the southern part of Kīlauea caldera. Some of these earthquakes were strong enough to be felt by local inhabitants. The first observers to HVO at 04:00 noted the normal glow above the summit of Mauna Ulu, reflecting the incandescent parts of a dwindling but still-active lava lake. A field party at Mauna Ulu later reported (~09:00) seeing molten lava during crustal overturn of the lake surface more than 40 m below the crater rim; this was the final sighting of molten lava at Mauna Ulu. The same field party also noted many new holes, or reopening of patched-over areas in the pavement of Chain of Craters Road south of Puhimau Crater (figs. 2 and 3). Volcanic tremor persisted at Mauna Ulu for three more days, before ceasing on July 22. This date (July 22) is arbitrarily taken as the end of the 1969-74 Mauna Ulu eruption (Tilling, 1987).

The onset of seismic activity on the early morning of July 19 coincided with the beginning of abrupt deflation of the summit region. As seismicity increased, strong tremor began about 10:30 and the rate of deflation also increased markedly. Magma was apparently moving towards the surface in the Keanakākoʻi Crater area (fig. 3). About 12:30, lava broke out from a small fissure at the base of the south wall of Keanakākoʻi, accompanied by small rockfalls from the crater wall. The lava fountains were initially about 30 m high. Within a few minutes, a second eruptive fissure, with 15-20 m-high lava fountains, formed north of Keanakākoʻi (fig. 4), in the area between the Crater Rim Road and the fissures of the August 14, 1971 eruption (fig. 2; Duffield and

Figure 4.—Aerial view to south-southeast of eruptive vents north of Keanakākoʻi Crater; Kīlauea Caldera floor in the lower left. The August 1971 fissure is closest to the caldera rim; the July 19, 1974 fissure that opened at 12:35 is just to the south; the 13:15 vents are at the rim of Keanakākoʻi. USGS photo by J.P. Lockwood.

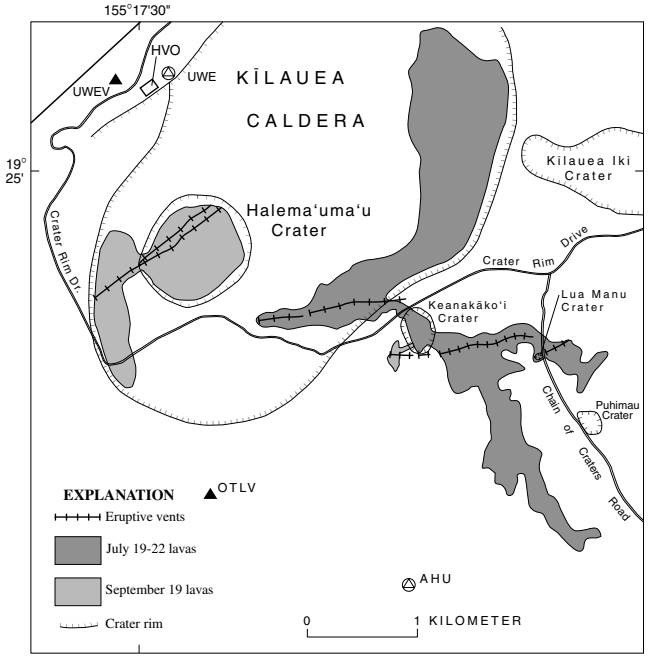

Figure 3.—Kīlauea Volcano summit area, showing location of eruptive vents and lava flows of the July and September 1974 eruptions, along with geographic features described in text. HVO, USGS Hawaiian Volcano Observatory; OTLV, Outlet Vault; UWEV, Uwēkahuna Vault; UWE, Uwēkahuna geodetic station; AHU, Ahua geodetic station.

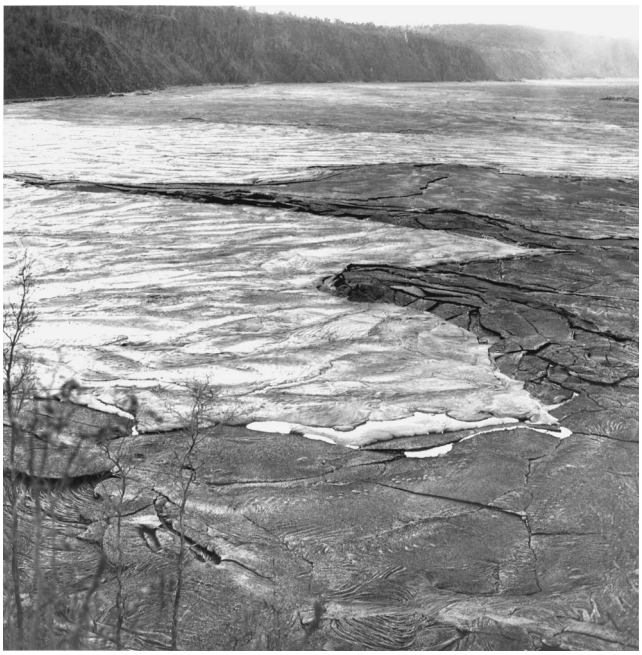

Figure 5.—Thin pāhoehoe flow advancing across the east side of Kīlauea caldera on July 19, 1974 at about 14:00. The active flow is covering an earlier formed flow; note the fresh lava emerging from cracks in the crust of the earlier flow. USGS photo by R.T. Holcomb.

others, 1982). Lava from this fissure flowed into the August 1971 fissure as well as cascaded over the wall of the summit caldera. Shortly thereafter, two en echelon fissures broke out to the west, on the Kīlauea Caldera floor (Figs. 3, 18), and lava from all three fissures north of Crater Rim Road began to advance across the flow field of the August 1971 eruption. The advance eastward across the caldera floor was rapid, and involved complex sheet flow as new lava spread over thin crusts of slightly older flow sheets (fig. 5).

During essentially the same time interval, the activity to the south also increased, and several other new en echelon fissures extended rapidly both to the west and to the east of the initial outbreak in Keanakāko‘i Crater (fig. 3). A fast-moving, fluid flow consisting of slabby pāhoehoe and loose a’a traveled quickly to the south and southeast for more than 2 km (fig. 6). These flows encased large ohia trees with chilled lava near their source vents, forming a field of “lava trees” when the fluid portions of the lava later flowed away from the encased trees (Lockwood and Williams, 1978). Moore and Kachadoorian (1980) used subsequent rheological observations of these lava trees to determine that flow velocities for this branch of the July 1974 flow varied between 5.7 km/hr (near eruptive vents) to 0.5 km/hr (near this flow’s distal end).

By 13:00, lava from fissures on the southern rim of Keanakāko‘i began to cascade into the crater; these spectacular lava cascades, together with lava erupted by the within-crater fissure, completely covered the crater floor to a depth of about 5 m, burying the blanket of 1959 tephra that had previously mantled lava of 1877 age. Also by 13:00, the easternmost of these “southern” fissures had extended 300 m east of Lua Manu Crater (fig. 3), cutting the Chain of Craters Road. Lava cascades poured into Lua Manu and, together with lava

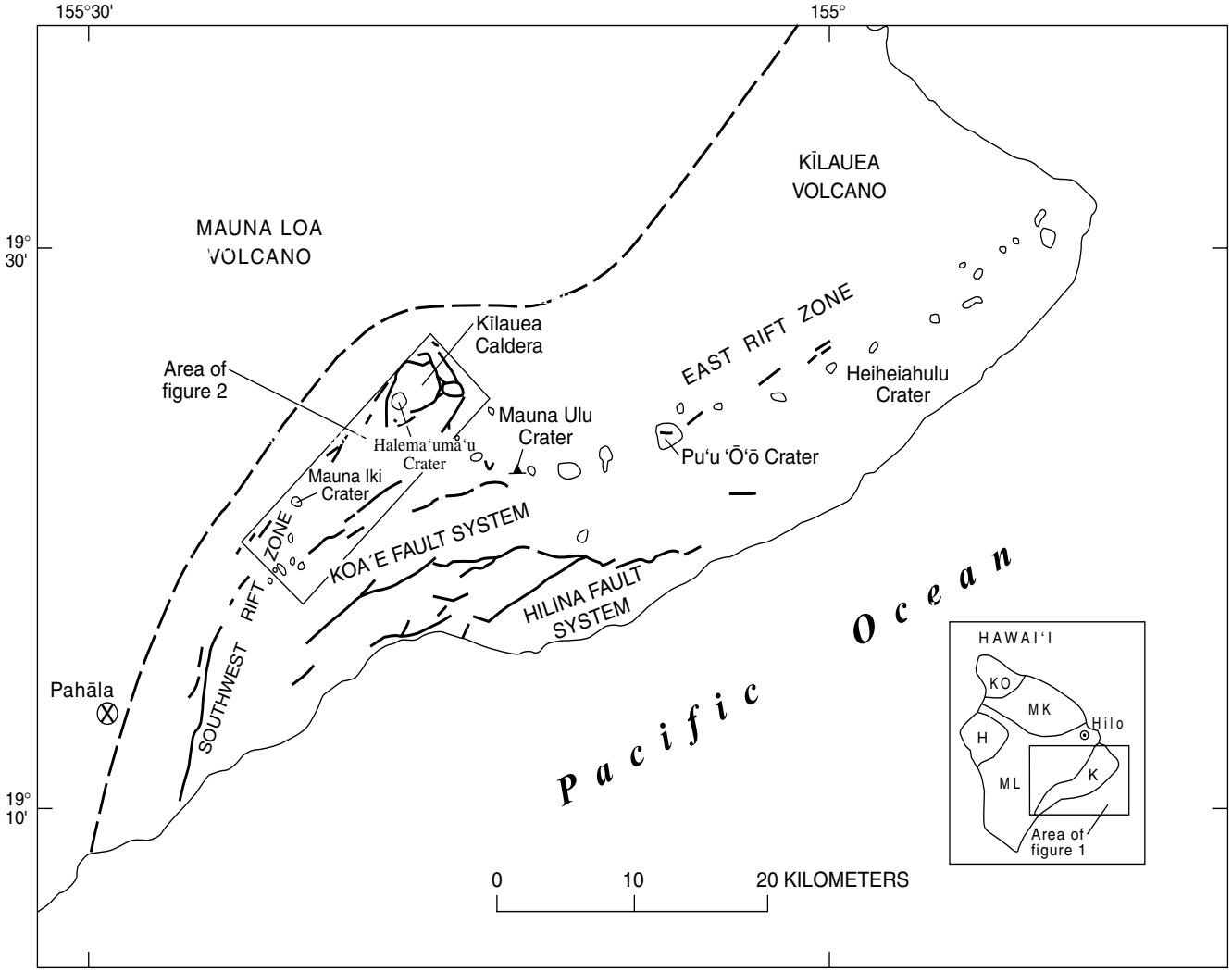

Figure 6.—Aerial view to the northwest of the July 1974 lava flows, which extend south to the bottom of the photo and across the east side of Kīlauea Caldera. Mauna Loa Volcano forms the slopes beyond Kīlauea Caldera; Mauna Kea Volcano in the distant background. USGS photo by J.P. Lockwood.

derived from a fissure on this crater's east wall, partly filled the crater with about 15 m of lava. About two-thirds of this lava later drained back into the fissure, leaving a prominent "lava-subsidence terrace" (high lava mark) half way up the crater's walls.

All fissures north and south of Crater Rim Road were vigorously active when, at 13:15, two new en echelon fissures broke out north of the northern edge of Keanakāko‘i Crater, in the area between the previously formed fissures (figs. 3, 4). Some lava from these latest fissures crossed Crater Rim Road about 10 minutes later and began to cascade down the north wall of Keanakāko‘i Crater. However, most of the lava from the fissures north of the Crater Rim Road poured over the wall of the caldera to feed the flow spreading over the southeastern part of the caldera floor. One of these lava streams into the caldera raced down a curving gully, with lava banking up against and spraying the outside wall of several bends, much as had occurred in the same gully in 1971 (Duffield and others, 1982). This particular stream was later the topic of a detailed flow-dynamics analysis by Heslop and others (1989), who concluded that it was characterized by laminar flow, traveled at a mean velocity in excess of 8 m/s, and had low or negligible yield strength and viscosities in the range of 85-140 Pa-s.

By 13:45, lava from the westernmost of the southern line of fissures (fig. 3) also began to cascade into Keanakāko‘i Crater, while the vent activity at the fissure inside the crater was decreasing. Meanwhile, within the summit caldera, the fissures remained vigorous, feeding lava that had covered about one-half of the August 1971 flow field by 14:35. Although there were momentary surges in lava-fountain heights to 45-55 m, discharge rates at all fissures gradually began to decline; by 16:15, all activity had ceased along the fissures south of Keanakāko‘i. However, low fountaining from the two fissures in the caldera floor persisted until the early morning of July 20. One vent on the caldera floor continued to spatter and feed a small flow through July 21, but all eruptive activity stopped by early morning of July 22.

All lava flows during this 3-day eruption were highly fluid and fast flowing, typically less than a meter thick near their source vents. Near eruptive fissures, lava flows appeared to have been gas rich, as indicated by the formation of cavernous "shelly" pāhoehoe (Swanson, 1973), with vesicle and gas-cavity space locally comprising as much as 80 percent of the bulk volume. The flows consisted entirely of pāhoehoe near Keanakāko‘i Crater and on the caldera floor, but formed platy pāhoehoe and rubbly ´a‘ā in the south-trending flow west of Puhimau Crater (fig. 3), where the flow was only 1.5-m thick at its distal end. Lavas from the July 19-22 eruption covered an area of 2.91 km^2, and the estimated total eruptive volume was about 6.5 x 10^6 m^3 . These vesicular lavas have an estimated DRE (dense rock equivalent) volume of 4.9 x 10^6 m^3.[1]

Methodologies for determination of areas and volumes:

[1]*Area covered* was determined by digital analysis of mapped flows and is accurate to ± 5 percent.

[2]*Volume erupted* was determined by field estimation of flow thicknesses in each of 26 subareas of known area. Such estimates are inherently imprecise (especially for thicker flows) and are accurate to only perhaps ± 25-30 percent.