Eruptions on Hawaiian volcanoes occur at the summit caldera or along one of the two narrow rift zones. This is because magma moves upwards from a shallow magma chamber (3-4 km below the summit caldera) or forces itself laterally along deep cracks and fissures that form the rift zones.
Kilauea’s caldera and east rift zone

Map showing the location of the eruption site (Puu Oo) along Kilauea’s east rift zone (ERZ).

Aerial view of the summit caldera and down the east rift zone towards the Puu Oo eruption site.

Map of lava flows from 1983 to the present

- Episode 1-47 flows
- Episode 48 flows
- Episode 49 flows
- Episodic 50-53 flows
- Central vent
The first few days

Typical of Hawaiian eruptions, this one started from long fissures near a prior eruption site of 1977

The only casualties were burning forests. Note the strange lava casts on the trees.

Building the spatter cone of Puu Oo

Activity focused on a single vent, starting to build the Puu Oo Cone. This forest was rapidly replaced by ash and aa flows.

By 1984 the Puu Oo cone had grown quite substantial - note the lack of trees.
Between 1983 and 1986, the eruptions were very episodic, occurring about once a month, each one lasting for a few days.

Here is a view down the throat of the volcano during one of the repose periods.

Changes in tilt and seismic activity at Puu Oo during several eruptive episodes. Note that:

- There is an increase in tilt prior to each eruption
- The tilt rapidly declines after the eruption
- There is an increase in the number of tectonic earthquakes prior to the eruption.
- During the eruption there are volcanic earthquakes.
Puu Oo in 1986

Damage to Royal Gardens

The flows at this stage in the eruption were all aa.
In September, 1986 all activity at Puu Oo ceased and subsequent activity moved down-rift. The nature of the eruption also changed. Instead of a spatter cone producing aa flows, a lava shield with an active lava lake produced pahoehoe flows that quickly formed lava tubes and flowed to the ocean. These flows cut highway 133, destroyed the town of Kalapana, and the Volcano National Park Visitors Center.

Activity at the Lava Lake

Puu Oo, now dormant is in the background.
Lava tubes, drain the lava lake and efficiently transport lava to the coast, where it flows into the sea.

Lava enters the Ocean
Damage to the Kalapana Area

Homes are burnt and property destroyed.

Roads are cut by the lava flows. Including Hwy 131
Destruction of the Volcano National Park Visitors Center

Walter’s Store Kalapana
What do we think actually happened?

The 1984 Mauna Mauna Loa eruption as seen from the town of Hilo
Earthquake activity at Mauna Loa between 1962 and 1983

This together with other data encouraged Decker et al. (1983) to publish a paper predicting the next eruption of Mauna Loa “within the next few years”. What was the evidence?

Note increase in cumulative earthquake frequency prior to 1975 eruption. A similar increase is seen from 1980 onwards

The summit elevation has increased by 10 cms since 1975

Tilt has also increase fairly regularly since the 1975 eruption
Map and Chronology of the Eruption

Eruption in the summit caldera at 1:30 am, March 25th 1984

High on the NE rift zone, fissures cut the Pohaku Hanalei cone at around 12,000 ft
Eruption activity moves down rift to around 11,000 ft

1984 NE Rift Zone Eruption – 11,000 ft level
View to the North

Note the extensive fumes

The main vent at 9,500 ft
The eruption continued from here for 21 days
Main vent at 9,400 ft early in the eruption

Looking down flow from the main vent

The 9,400 ft vent and flow early in the eruption
A view down the channel

Fun and games at the perched lava pond
Sampling at the 9,400 ft vents

The standing lava wave below the vents
Later during the eruption

Looking towards the vents
Looking down the flow

Further down the flow

6000’ level

Dave Clague on the flow
Flow front at 2900’
This view shows the 1984 flows heading towards Hilo.

What saved the town?

Effusion rates declined during the course of the eruption from about one million cubic meters of lava per hour (~280 m³/sec) the first four days to less than one tenth of that during the last few days.
Aa overflow at 6000’ level

Crystal growth over time increases yield strength

Day 1

Day 11

Day 21

Changes in composition with time during the eruption, and with distance along the 20 km vent system – there was none!
Natural System Olivine – Clinopyroxene – Silica projected from Plagioclase

This system fairly accurately predicts the crystallization sequence and liquid lines of descent of natural basaltic magmas. The example is from Mauna Loa (where else!) Rhodes, 1988.