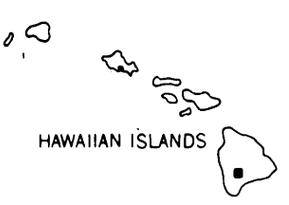
MAP GQ-957

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEOLOGIC QUADRANGLE MAPS OF THE UNITED STATES

GEOLOGIC MAP OF THE KIPUKA PAKEKAKE QUADRANGLE HAWAII

By
Gordon A. Macdonald



QUADRANGLE LOCATION

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MAC DONALD—KIPUKA PAKEKAKE, HAWAII 1:24,000 MAP GQ-957

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TO ACCOMPANY MAP GQ-957

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GENERAL DESCRIPTION

All of the Kipuka Pakekake quadrangle lies on the southeastern flank of Mauna Loa Volcano. The slope is southeastward at an average angle of about 6°, flattening to less than 5° in the southeastern corner, where it is crossed by a series of southwest-trending escarpments. The original constructional surface is essentially untouched by erosion.

The area is completely covered by subparallel southeastward-dipping lava flows erupted from vents higher on Mauna Loa. All the lavas are basalt (Macdonald, 1949). Most of them contain 1-10 percent olivine phenocrysts, generally ranging from about ¼ to 2 mm in diameter (and rarely as much as 4 mm). In a few flows olivine phenocrysts up to about 8 mm in diameter make up 30 percent or more of the rock. Lath-shaped plagioclase crystals up to about 1 mm long are present in some rocks. The groundmass is medium to dark gray, and rarely black, and it consists of microscopic crystals of plagioclase, pyroxene, magnetite, ilmenite, and sometimes olivine and small amounts of interstitial glass.

Both pahoehoe and aa types of lava flows are present. Pahoehoe is more common on the upper slopes, and aa on the lower slopes. The pahoehoe flows have a smooth, billowy, and locally ropy upper crust, which in a few places is broken into irregular plates several feet across that are tilted, jumbled, and sometimes imbricated. This slab pahoehoe is particularly common along flow channels. The pahoehoe flows are moderately to highly vesicular, and commonly contain lava tubes from less than a foot to more than 10 feet in diameter.

The aa flows are covered by layers of jagged, spinose fragments of clinker, beneath which the central part of the flow is massive, with sparse to moderately abundant vesicles. Only rarely, however, are the central parts of the flows exposed. Pahoehoe and aa have been described in detail by Wentworth and Macdonald (1953) and Macdonald (1967).

Short sections of aa river channels, and troughs formed by collapse of pahoehoe tubes, are common. Some of the channels can be followed continuously for more than half a mile and are indicated on the map.

On the lower slopes the older lavas have a discontinuous cover of vitric ash from a fraction of an inch to 2 feet thick. The cover is 3 feet thick in some hollows into which it has been blown by wind or washed during heavy rains. The thickness of the ash cover decreases upslope, with increasing distance from Kilauea Volcano, the apparent source, and above 8,500 feet altitude the lava-flow surfaces are nearly devoid of ash.

The youngest flows are bare of ash even on the lower slopes, and flows of intermediate age have a moderately thick ash cover. Vegetation cover also becomes progressively heavier on the older flows. However, neither the amount of surficial ash nor the vegetation is more than a general indication of the age of the flow. The succession of units on the map is determined by superposition.

Except for the tiny patch of Pahala Ash along the southern boundary of the quadrangle 2 miles west of the southeast corner, all of the rocks exposed in the quadrangle belong to the Kau Volcanic Series (Stearns and Macdonald, 1946).

The escarpments in the southeastern part of the map are traces of the Kaoiki fault system (Stearns and Macdonald, 1946). This zone of faults extends for 16 miles along the southeastern base of Mauna Loa, parallel to its contact with Kilauea. The lower slope of Mauna Loa has been displaced downward along these faults in relation to the upper slope. At most places the faults truncate and displace older lava flows, but at other places the flows have been bent into a monocline rather than broken. At still other places later flows have mantled an earlier fault scarp. Displacement throughout the fault zone commonly is distributed between several faults. In the map area the highest single scarp is 120 feet, but the southeastern corner of the quadrangle is at the top of the southeasternmost scarp in the fault system, which is more than 500 feet high (Peterson, 1967).

Mauna Loa is a compound volcano. The present shield volcano appears to have almost completely buried two earlier shields, the summit of one of which lay only a few miles northeast of the Kipuka Pakekake quadrangle (Macdonald, 1955, p. 12). The earlier shield was covered by several feet of volcanic ash, partly from Kilauea Volcano and partly from other sources, during the long interval between the end of activity of the volcano northeast of the quadrangle and its burial by lavas of the present Mauna Loa. This ash has been named the Pahala Ash (Stearns and Macdonald, 1946). The lavas beneath the ash, which were originally included in the Pahala Basalt (Stearns and Clark, 1930), are now included in the Kahuku Volcanic Series (Stearns and Macdonald, 1946, p. 67).

Maps of the Kilauea Crater quadrangle, just to the east of the Kipuka Pakekake quadrangle, and the Mauna Loa quadrangle, just to the west, have already been published (Peterson, 1967; Macdonald, 1970).

DESCRIPTION OF MAP UNITS

Lava flow of 1880.—Aa lava, containing a few small phenocrysts of olivine and scattered small laths of plagioclase. The flow came from vents on the northeast rift zone of Mauna Loa at an altitude of about 10,400 feet, 3½ miles northwest of the place where the flow crosses the north edge of the map area. Other flows of the same eruption moved northeastward, one of them reaching Hilo.

Very late prehistoric Keamoku lava flows.—Two lava flows, a lower lobe (kl) and the Kipuka Lulalio lobe (kkl), cross only the northeasternmost corner of the quadrangle but are extensive in the adjacent Kilauea Crater quadrangle (Peterson, 1967). They are aa, containing only scattered small phenocrysts of olivine and a few glomerocrysts of plagioclase and olivine. The Keamoku flows issued from vents on the northeast rift zone of Mauna Loa about 5 miles north of the northern edge of the map area. There is no Hawaiian tradition of the eruption of the Keamoku lava flows, and because no carbon has as yet been found associated with them they cannot be dated; however, the freshness of their surfaces indicates that they probably were erupted within the last thousand years.

Late prehistoric lava flows, undivided.—The other late prehistoric lavas (lp) consist principally of the Ke a Poomoku lava flow, which extends diagonally across the quadrangle from northwest to southeast. Judging from its appearance, it is a little older than the Keamoku flows. In the northwestern corner of the quadrangle and just beyond, it joins a complex of other late prehistoric flows erupted from vents on the northeast rift zone.

Prehistoric lava flows of intermediate age.—The lavas of Kipuka Maunaiu are overlapped by the Keamoku lava flows in the Kilauea Crater quadrangle. They consist of both pahoehoe and aa, with the latter predominating. Olivine phenocrysts are small and sparse. The principal unit, the middle lava of Kipuka Maunaiu (mm) consists of several separate lava flows that were probably formed by the same eruption, but possibly by separate eruptions at short intervals from neighboring vents. The upper unit of the lava flows of Kipuka Maunaiu, present in the Kilauea Crater quadrangle, has not been recognized in the Kipuka Pakekake quadrangle but the underlying lower unit (ml) is restricted to the northeastern part of the Kipuka Pakekake quadrangle. Other lavas, of about the same age as the Kipuka Maunaiu lavas, also consist of several different flows, but are shown as a single unit (lpc) on the map. The lobe of this unit in Kipuka Pakekake, in the east-central part of the map, may be a tongue of the Kipuka Maunaiu flows.

Early prehistoric lava flows.—The oldest lavas exposed at the surface on this part of Mauna Loa consist of many separate lava flows, including the so-called Na Puu Kulua flows, which themselves appear to vary considerably in age. The lava of Kipuka Pakekake (pk), named in the Kilauea Crater quadrangle by Peterson (1967), is only part of one of the many flows of this group. Undoubtedly, it is more extensive than is shown on the map. The patch of early prehistoric lava just to the north, in Kipuka Loihi, may be part of it. The Kipuka Pakekake lava is chiefly aa, mostly nonporphyritic, but with rare olivine phenocrysts up to about 3 mm across. The other earlier prehistoric lavas are principally pahoehoe, the surface of which is now generally reddish brown owing to weathering and is covered with a few inches to 3 feet of ash. In most of them olivine phenocrysts are rare or lacking, but some contain moderately abundant olivine, and in a few flows olivine phenocrysts up to 8 mm across make up 30 percent or more of the rock.

Some aa flows (pca), including the Na Puu Kulua flows, can be mapped as separate units, but they are essentially equivalent in age to some of the undivided flows (pc), and farther upslope, in the adjacent Mauna Loa quadrangle, they change to pahoehoe.

The undivided earlier prehistoric lavas (pc) in the Kipuka Pakekake quadrangle are the same as the lavas called "lower lava of Mauna Loa" in the Kilauea Crater quadrangle (Peterson, 1967). Although they include the lowest lavas of Mauna Loa exposed in the Kilauea Crater quadrangle, they were erupted very late in the history of Mauna Loa Volcano, and the designation "lower lava of Mauna Loa" is inappropriate for other quadrangles on the mountain. In the Mauna Loa quadrangle, lava flows of the same general age are truncated by the caldera wall; thus, the unit as a whole must have formed before the caldera collapsed to its present size, and it is indicated on the map by the letter symbol pc, meaning "pre-caldera." In the explanations of both the Mauna Loa and Kipuka Pakekake quadrangles, these rocks are designated as "earlier prehistoric."

Pahala Ash.—Yellow to yellowish-brown volcanic ash reaches a thickness of more than 50 feet in kipukas (islandlike areas of older land surrounded by later lava flows) between the lava flows of the Kau Volcanic Series in the area south and southwest of the quadrangle. This ash has been named the Pahala Ash (Stearns and Macdonald, 1946). It is mostly of sand size, but it contains a few Pele's tears and lapilli of basaltic pumice up to about 2 cm across. Most of the ash was originally vitric, but it has been partly altered to palagonite. The Pahala Ash passes gradationally upward into the thin ash deposits that cover the earlier prehistoric lava flows of the Kau Volcanic Series, and it can be mapped separately only where a considerable thickness of ash is present. In a kipuka just south of the Kipuka Pakekake quadrangle, 2 miles west of its southeastern corner, more than 8 feet of ash can be seen in the sides of gullies, although the base of the ash is not exposed. This area of thick ash barely extends into the Kipuka Pakekake quadrangle and is shown as a thin sliver at the south edge of the map.

At other places outside the quadrangle, the Pahala Ash rests on lava flows that are closely similar petrographically and in structure to those of the Kau Volcanic Series. These flows have been assigned to the Kahuku Volcanic Series (Stearns and Macdonald, 1946). Presumably, lava flows of the Kahuku Volcanic Series underlie the Pahala Ash at depths ranging from a few tens of feet to a few hundred feet at the south edge of the Kipuka Pakekake quadrangle. The Pahala Ash and underlying lava flows of the Kahuku Volcanic Series are shown diagrammatically beneath the lavas of the Kau Volcanic Series in the cross section.

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