UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF KIHOLO QUADRANGLE, HAWAII

By

David A. Clague and Wendy A. Bohrson

Open-File Report 86-336

DESCRIPTION OF MAP UNITS

Map unit labels are interpreted as follows: The first entry, H, identifies the Hualalai Volcanics of Hualalai Volcano (Macdonald, 1949), whereas M identifies the Kau Basalt of Mauna Loa Volcano (Stearns and Macdonald, 1946). The second entry describes the type of lava; b is alkalic basalt and th is tholeiitic basalt. The third entry is a morphologic description; f indicates a flow whereas v indicates vent deposits. The final entry is an identification number. Each flow not associated with a vent is described with a unique number. Identification numbers were assigned in numerical order with the lowest numbers located in the southwestern corner of the quadrangle and the highest numbers located in the northeastern corner. Exceptions to the sequence are Hbf79 and Hbf80 which are located south of Highway 19 and east of the historic 1800 Kaupulehu flow. Flows associated with vents are described with the approximate latitude-longitude of the source vent. Vent entries also include the approximate latitude-longitude of the vent. For example, Hbf1945.9,15558.7 describes a flow of alkalic basalt from the Hualalai Volcanics that issued from a vent at 19 ° 45.9' and 155 ° 58.7'.

Age assignments for all prehistoric map units are based upon ^{14}C ages, paleomagnetic data, surface morphology, presence of soil, and coastal expression. Younger flows usually form coastal deltas whereas submergence of older flows creates inlets. Note that map patterns distinguish age groups.

Phenocryst abundances are reported on a vesicle free basis and are approximate. Several occurrences of crystal settling within one flow have been observed during field mapping. Well exposed sections of thick flows may contain 1-3% olivine near the top and 10-12% olivine near the base. Petrographic descriptions are intended to serve as a guide for flow distinction.

Map units assigned to youngest, intermediate, and oldest prehistoric age categories are listed in numerical rather than stratigraphic sequence; descriptions of flows associated with mapped vents follow descriptions of flows without mapped vents. Many flows will be identified with their eruptive vents when the Kailua Quadrangle mapping is completed. Age relations among many units in each category are poorly understood, and therefore, complete stratigraphic sequences are not known. Known stratigraphic sequences are presented in the Correlation of Map Units.

QUATERNARY ALLUVIUM

Qal — Beach sand and carbonate cobble deposits, or swampy areas.

HISTORIC UNITS

Mthf1931.9,15537.0 — Historic 1859 Mauna Loa lava flow located in northeastern corner of quadrangle. Phenocryst mineralogy is 1-3% olivine. Includes both pahoehoe and aa. Chemical analyses of this tholeiitic basalt flow are presented in Wright (1971).

Hbf1945.7,15558.6 — Historic 1801 Huehue lava flow located at western boundary of

quadrangle and north of Puu Io, Hbv1945.4,15559.1. Phenocryst mineralogy is 1-3% olivine and 0-2% plagioclase. Chiefly pahoehoe. The vent for this phase of the historic 1801 Huehue eruption, labeled Hbv1945.7,15558.6, is poorly developed and not an obvious topographic feature.

Hbv1945.9,15558.7 Historic 1801 Huehue spatter cone, Puhia Pele, located northeast of Puu Io, Hbv1945.4,15559.1 and south of Puu Nahaha, Hbv1946.7,15558.7. Phenocryst mineralogy is 0-2% olivine.

Hbf1945.9,15558.7 Historic 1801 Huehue lava flow located south of Puu Nahaha, Hbv1946.7,15558.7 and north of Puu Io, Hbv1945.4,15559.1. Phenocryst mineralogy varies with location. Distal flow phenocryst mineralogy is 4-6% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Proximal flow phenocryst mineralogy is 0-2% olivine. Chiefly pahoehoe. Chemical analyses of this flow are presented in Clague et al. (1980).

Hbf1943.4,15555.0 Historic 1800 Kaupulehu lava flow located adjacent to and west of Hbf57, the 3030± 200 year old flow. Flow extends from the southern boundary of the quadrangle to the coastline. Phenocryst mineralogy is 1-3% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Analyses of this flow are presented by Clague et al. (1980). The flow is mostly pahoehoe near the vent but is thick, blocky aa near the coast. The flow is well known for the abundant dunite and gabbro xenoliths it contains. One site, labeled on the map, contains millions of xenoliths deposited in beds. See Jackson and Clague (1982) for a detailed map of this xenolith locality. Size, mineral modes, and chemistry of these xenoliths are presented in Jackson et al. (1981).

Hbf1944.1,15556.1 Historic lava flow located west of 1800 Kaupulehu lava flow and at southern boundary of quadrangle. Exposure in Kiholo quadrangle is small in areal extent. Phenocryst mineralogy is 3-5% olivine and 0-1% plagioclase. The flow is distinctive because it contains clear, gem quality plagioclase megacrysts. Chiefly aa. ^{14}C age for this flow is $<$ 200 years (Moore et al., in press). Because the 1800-1801 eruptive events are the only historic events recorded for Hualalai Volcano, the flow is inferred to have been erupted during the 1800 to 1801 event. Hbf1944.1,15556.1 and its associated vent are newly discovered as historic products.

YOUNGEST PREHISTORIC UNITS (200-2500 YRS B.P.)

Hbf18 Lava flow located south of the historic 1801 Huehue lava flows and near the southwestern corner of quadrangle. Phenocryst mineralogy is 1-2% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Small dunite xenoliths are rare. Chiefly aa. Hbf18 is younger than Hbf16.

Hbf19 Lava flow located south of the historic 1801 Huehue lava flows and near southwestern boundary of quadrangle. Phenocryst mineralogy is 2-8% olivine. Chiefly aa. Hbf19 is younger than all adjacent flows.

Hbf30 Lava flow located adjacent to and east of Hbf1945.3,15557.4 and south of Highway 19. Phenocryst mineralogy is 9-13% olivine, 1-3% plagioclase, and 0-1% clinopyroxene. Dunite and gabbro xenoliths are rare. Chiefly pahoehoe.

Hbf33 Lava flow surrounded by Hbf43 and located at Highway 19. Phenocryst mineralogy is 1-2% olivine. Chiefly pahoehoe.

Hbf40 Lava flow located west of the historic 1800 Kaupulehu lava flow and adjacent to Hbf1945.3,15557.4. Phenocryst mineralogy is 1-5% olivine, 0-2% plagioclase, and 1-3% clinopyroxene. Dunite and gabbro xenoliths are common. Chiefly pahoehoe.

Hbf41 Lava flow located west of the historic 1800 Kaupulehu lava flow and at the southern boundary of quadrangle. Phenocryst mineralogy is 3-6% olivine and 3-5% clinopyroxene. Dunite xenoliths are common. Chiefly aa.

Hbf42 Lava flow located west of the historic 1800 Kaupulehu lava flow and at the southern boundary of quadrangle. Phenocryst mineralogy is 2-4% olivine. Chiefly aa.

Hbf43 Lava flow located west of and surrounded by the historic 1800 Kaupulehu lava flow. Phenocryst mineralogy is 1-5% olivine. Gabbro and dunite xenoliths are rare. Chiefly aa. Includes large, perched lava lakes located approximately 1.75 mi south of Highway 19. The lakes are labeled on map.

Hbf44 Lava flow located west of the historic 1800 Kaupulehu lava flow

and at southern boundary of quadrangle. Phenocryst mineralogy is 1-4% olivine. Dunite xenoliths are common. Chiefly aa.

Hbf66 — Lava flow located near eastern boundary of quadrangle. Phenocryst mineralogy is 9-12% olivine. Chiefly aa.

Hbf67 — Lava flow, mapped as 3 distinct exposures, located at eastern boundary of quadrangle. Phenocryst mineralogy is 1-3% olivine. Chiefly aa. This flow probably issued from Luamakami vent, Hbv1942.0,15552.4, about 2350± 80 years ago (Moore et al., in press).

Hbf73 — Lava flow located near the eastern boundary of quadrangle. Lava flow extends to historic 1859 Mauna Loa lava flow. Phenocryst mineralogy is 0-2% olivine and 0-1% plagioclase. Includes both pahoehoe and aa. ^{14}C age is 2030± 80 years (Moore et al., in press). Charcoal collection site is located in the adjacent Puu Anahulu quadrangle.

Hbf79 — Lava flow located north of Kolekole, Hbv1947.5,15558.1 , and west of Hbf43. Phenocryst mineralogy is 1-3% olivine and 5-7% plagioclase. Chiefly pahoehoe. Hbf79 is younger than all adjacent units. The flow traveled through a lava tube system and surfaced through a skylight.

Hbf80 — Lava flow located north of Kolekole, Hbv1947.5,15558.1, and adjacent to and west of Hbf40. Phenocryst mineralogy is 1-3% olivine and 0-1% plagioclase. Chiefly aa.

Hbv1945.3,15557.4 — Spatter cone located east of Kileo cone, Hbv1945.3,15558.0 and near southern boundary of quadrangle. Phenocryst mineralogy is variable 3-15% olivine, 0-2% plagioclase, and 0-1% clinopyroxene.

Hbf1945.3,15557.4 — Lava flow, from Hbv1945.3,15557.4, located east of Puu Nahaha flow, Hbf1946.7,15558.7. Flow interfingers with other flows near vent and extends to the coast where it forms Kahuwai Bay. Phenocryst mineralogy is variable 3-15% olivine, 0-2% plagioclase, and 0-1% clinopyroxene. Includes pahoehoe and aa. A flow with the same lithology traveled underground through a lava tube and surfaced in Hbf25 through a skylight. Near Highway 190 the main volume of this flow traveled through a large pre-existing lava tube that formed during the Puu Alauawa eruption. The flow surfaced through large skylights in this tube. The map pattern northeast of

Highway 190 near benchmark 2082 schematically shows this flow issuing from several skylights.

Hbv1945.3,15557.6 Spatter cone, Puu Alauawa, located adjacent to and northwest of Hbf1945.3,15557.4. Phenocryst mineralogy is 2-4% olivine.

Hbf1945.3,15557.6(1) Lava flow from Puu Alauawa, mapped as 4 distinct exposures, located adjacent to and south of Puu Nahaha, Hbv1946.7,15558.7 and associated flow, and north of and adjacent to Puu Alauawa at Highway 190. Phenocryst mineralogy is 0-4% olivine and 0-2% plagioclase. Chiefly pahoehoe.

Hbf1945.3,15557.6(2) Lava flow, from Puu Alauawa, mapped as 2 distinct exposures, located adjacent to and northeast of 1801 Huehue lava flows and adjacent to Hbf1945.3,15557.4. Phenocryst mineralogy is 1-3% olivine. Chiefly pahoehoe.

Hbv1946.7,15558.7 Spatter cone, Puu Nahaha, located west of Hbf1945.3,15557.4. Phenocryst mineralogy is 5-8% olivine and 0-2% plagioclase.

Hbf1946.7,15558.7 Lava flow, from Puu Nahaha, located adjacent to and west of Hbf1945.3,15557.4. Phenocryst mineralogy is variable 0-7% olivine and 0-2% plagioclase. Chiefly pahoehoe. Dunite xenoliths are rare. Puu Nahaha flow is distinctive because it locally includes lava balls up to 4 feet in diameter. A small exposure of lava located south of Poopoomino, Hbv1948.3,15559.2, is inferred to be part of the Puu Nahaha flow because of similar lithology and presence of large lava balls.

Paleomagnetic data for Puu Nahaha flow and Hbv1945.3,15557.4 flow indicate these events are related. The two flows have the same unusual paleomagnetic orientation (D. Champion, pers. comm., 1985). Puu Nahaha is the oldest eruption; Puu Alauawa is intermediate in age whereas Hbv1945.3,15557.4 is the youngest. Because paleomagnetic data indicate Puu Nahaha and Hbv1945.3,15557.4 eruptions are related, we infer all three flows erupted as part of a single event.

INTERMEDIATE PREHISTORIC UNITS (2500-5000 YRS B.P.)

Hbf15 — Lava flow located in southwestern corner of quadrangle. Phenocryst mineralogy is 1-2% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Olivine-plagioclase-clinopyroxene crystal clots as well as small dunite and gabbro xenoliths are common. Chiefly aa.

Hbf16 — Lava flow located in southwestern corner of quadrangle. Phenocryst mineralogy is variable 3-10% olivine, 0-1% plagioclase, and 2-5% clinopyroxene. Plagioclase-clinopyroxene crystal clots are rare. Includes pahoehoe and aa.

Hbf24 — Lava flow surrounded by Puu Nahaha flow, Hbf1946.7,15558.7 and located at western boundary of quadrangle. Tumuli are rare. Phenocryst mineralogy is 1-4% olivine. Chiefly pahoehoe.

Hbf25 — Lava flow located adjacent to Hbf1945.3,15557.4 and at the western boundary of quadrangle. Hbf25 forms Kukio Bay in the Makalawena quadrangle. Phenocryst mineralogy is 1-5% olivine. Chiefly pahoehoe.

Hbf27 — Lava flow, mapped as 2 distinct exposures, located at southern boundary of quadrangle. Phenocryst mineralogy is 1-4% olivine, 1-3% plagioclase, and 0-1% clinopyroxene. Includes both pahoehoe and aa.

Hbf28 — Lava flow located east of Muheenui, Hbv1947.7,15559.4. Phenocryst mineralogy is 0-1% olivine. Includes pahoehoe and aa.

Hbf31 — Lava flow located adjacent to Hbf37 and south of Highway 19. Phenocryst mineralogy is 0-2% olivine and 0-2% plagioclase. Chiefly pahoehoe.

Hbf37 — Lava flow located adjacent to Hbf43 and south of Highway 19. Phenocryst mineralogy is 4-6% olivine. Chiefly aa.

Hbf39 — Lava flow located south of Kileo, Hbv1945.3,15558.0 and near the southern boundary of quadrangle. Phenocryst mineralogy is 0-1% olivine. Chiefly aa.

Hbf45 — Lava flow located adjacent to and west of the historic 1800 Kaupulehu lava flow and at the southern boundary of quadrangle. Phenocryst mineralogy is 1-3% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Gabbro and

dunite xenoliths are rare. Chiefly aa.

Hbf48 — Lava flow, mapped as 5 distinct exposures, located in the historic 1800 Kaupulehu lava flow at or near Highway 190. Phenocryst mineralogy is 1-3% olivine. Chiefly aa.

Hbf49 — Lava flow located in the historic 1800 Kaupulehu lava flow between Highways 19 and 190. Phenocryst mineralogy is 0-1% olivine and 1-3% plagioclase. Chiefly pahoehoe.

Hbf52 — Lava flow, mapped as 2 distinct exposures, located in the historic 1800 Kaupulehu lava flow and between Highways 19 and 190. Phenocryst mineralogy is 1-4% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Plagioclase-clinopyroxene crystal clots are common. Chiefly aa. Hbf52 is younger than Hbf53 but older than the historic 1800 Kaupulehu lava flow.

Hbf56 — Lava flow surrounded by Hbf57, the 3030± 200 year old flow, and located east of the historic 1800 Kaupulehu lava flow. Phenocryst mineralogy is 2-4% olivine and 0-2 % plagioclase. Chiefly pahoehoe.

Hbf57 — Lava flow located adjacent to and east of the historic 1800 Kaupulehu lava flow. Phenocryst mineralogy is 3-6% olivine and 0-2% plagioclase. Chiefly aa. ^{14}C age is 3030± 200 years (Moore et al., in press). Part of Hbf57 traveled underground through a lava tube and surfaced in Hbf58 through a skylight. Phenocryst mineralogy of this portion is 2-7% olivine. Chiefly aa.

Hbf58 — Lava flow located at Kiholo Bay adjacent to and east of Hbf57, the 3030± 200 year old flow. Phenocryst mineralogy is 1-5% olivine and 0-1% plagioclase. Includes pahoehoe and aa. Hbf58 is younger than Hbf59.

Hbf59 — Lava flow located at Kiholo Bay adjacent to and south of the historic 1859 Mauna Loa lava flow. Phenocryst mineralogy is 0-2% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Dunite and gabbro xenoliths are rare. Includes pahoehoe and aa.

Hbf60 — Lava flow, mapped as 2 distinct exposures, located south of the historic 1859 Mauna Loa lava flow and at Highway 19. The lava flow is aphyric. Chiefly aa.

Hbf62 — Lava flow located adjacent to and south of historic 1859 Mauna Loa lava flow and west of and in Hbf73, the 2030± 80 year old flow. Phenocryst mineralogy is 0-3% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Small dunite xenoliths are rare. Includes pahoehoe and aa. Hbf64, with 0-2% olivine, variable 2-10% plagioclase, and 0-2% clinopyroxene, interfingers with Hbf62.

Hbf64 — Lava flow located near eastern boundary of quadrangle. Lava flow extends to 1859 Mauna Loa lava flow. Phenocryst mineralogy is 0-2% olivine, variable 2-10% plagioclase, and 0-2% clinopyroxene. Chiefly pahoehoe.

Hbf68 — Lava flow, mapped as 2 distinct exposures, located at eastern boundary of quadrangle and at Highway 190. Phenocryst mineralogy is 1-3% olivine and 3-7% plagioclase. Includes both pahoehoe and aa. Hbf68 and Hbf67 are in contact in the adjacent Puu Anahulu quadrangle; Hbf68 is older than Hbf67.

Hbf69 — Lava flow, mapped as 2 distinct exposures, located at eastern boundary of quadrangle and at Highway 190. Phenocryst mineralogy is 0-1% olivine, 0-1% plagioclase, and 1-2% clinopyroxene. Chiefly pahoehoe.

Hbf70 — Lava flow located at eastern boundary of quadrangle and adjacent to and east of Hbf73, the 2030± 80 year old flow. Phenocryst mineralogy is 2-5% olivine and 0-1% plagioclase. Includes pahoehoe and aa.

Hbf74 — Lava flow located at eastern boundary of quadrangle and in Hbf73, the 2030 ± 80 year old flow. Phenocryst mineralogy is 4-8% olivine. Chiefly pahoehoe.

Hbf75 — Lava flow located near the eastern boundary of quadrangle and adjacent to and south of the historic 1859 Mauna Loa lava flow. Phenocryst mineralogy is 2-6% olivine and 0-1% plagioclase. Includes pahoehoe and aa.

Hbv1945.2,15557.3 — Spatter cone located near southern boundary of quadrangle and west of the historic 1800 Kaupulehu lava flow. Phenocryst mineralogy is 5-7% olivine.

Hbf1945.2,15557.3 — Lava flow, from Hbv1945.2,15557.3, located west of the historic 1800 Kaupulehu lava flow and near the southern boundary of quadrangle. Phenocryst mineralogy is 5-7% olivine. Chiefly aa.

Hbv1945.3,15558.0 Spatter and cinder cone, Kileo, located adjacent to and southeast of the historic 1801 Huehue lava flows. Phenocryst mineralogy is 1-3% olivine and 0-1% clinopyroxene.

Hbf1945.3,15558.0 Lava flow, from Kileo, located adjacent to and southeast of the historic 1801 Huehue lava flows. Phenocryst mineralogy is 1-3% olivine and 0-1% clinopyroxene. Chiefly aa.

Hbv1945.3,15558.4 Spatter cone, Akahipuu, located adjacent to and south of Kileo flow, Hbf1945.3,15558.0. Phenocryst mineralogy is 1-3% olivine.

Hbf1945.3,15558.4 Lava flow, from Akahipuu, located adjacent to and south of Kileo flow, Hbf1945.3,15558.0. Phenocryst mineralogy is 1-3% olivine. Chiefly pahoehoe.

Hbv1945.4,15559.1 Spatter cone, Puu Io, located south of the historic 1801 Huehue lava flows. Phenocryst mineralogy is 5-7% olivine and 0-2% plagioclase.

Hbf1945.4,15559.1(1) Lava flow, from Puu Io, located south of the historic 1801 Huehue lava flows and at western boundary of quadrangle. Phenocryst mineralogy is 5-11% olivine, 0-1% plagioclase, and 1-3% clinopyroxene. Small dunite and gabbro xenoliths are rare. Chiefly pahoehoe.

Hbf1945.4,15559.1(2) Lava flow, from Puu Io, located south of the historic 1801 Huehue lava flows and at the western boundary of quadrangle. Phenocryst mineralogy is 1-2% olivine and 2-4% plagioclase. Chiefly aa.

Hbf1945.4,15559.1(3) Lava flow, from Puu Io, located south of the historic 1801 Huehue lava flows and adjacent to and west of Puu Io. Phenocryst mineralogy is 0-2% olivine. Chiefly pahoehoe.

Hbf1945.4,15559.1(4) Lava flow, from Puu Io, located adjacent to and south of the historic 1801 Huehue lava flows. Phenocryst mineralogy is 3-5% olivine. Chiefly aa.

Hbf1945.4,15559.1(5) Lava flow, from Puu Io, located south of the historic 1801 Huehue lava flow and adjacent to and east of Puu Io. Phenocryst mineralogy is 8-11% olivine, 0-1% plagioclase, and 3-6% clinopyroxene. Chiefly aa.

OLDEST PREHISTORIC UNITS (> 5000 YRS B.P.)

Hbf32 — Lava flow surrounded by Hbf1945.3,15557.4 and located north of Highway 19. Phenocryst mineralogy is 3-6% olivine, 1-3% plagioclase, and 0-1% clinopyroxene. Lava surface is cinder covered. Chiefly slabby pahoehoe.

Hbf34 — Lava flow surrounded by Hbf43 and located at Highway 19. Phenocryst mineralogy is 1-4% olivine. Lava surface is cinder covered. Chiefly pahoehoe.

Hbf35 — Lava flow surrounded by Hbf43 and located south of Highway 19. Phenocryst mineralogy is 3-7% olivine. Lava surface is cinder covered. Chiefly pahoehoe.

Hbf36 — Lava flow located adjacent to and west of Hbf43 and south of Highway 19. Phenocryst mineralogy is 2-7% olivine, 0-2% plagioclase, and 0-2% clinopyroxene. Lava surface is cinder covered. Chiefly aa. Hbf36 is older than Hbf37.

Hbf38 — Lava flow, mapped as 2 distinct exposures, located adjacent to and west of Hbf43. Phenocryst mineralogy is 3-5% olivine and 0-1% clinopyroxene. Lava surface is cinder covered. Chiefly aa.

Hbf46 — Lava flow surrounded by the historic 1800 Kaupulehu lava flow and located near the southern boundary of quadrangle. Phenocryst mineralogy is 0-1% olivine and 2-4% plagioclase. Chiefly aa.

Hbf50 — Lava flow located in the historic 1800 Kaupulehu lava flow and between Highways 19 and 190. Phenocryst mineralogy is 4-6% olivine, 0-2% plagioclase, and 1-3% clinopyroxene. Chiefly pahoehoe.

Hbf51 — Lava flow surrounded by the historic 1800 Kaupulehu lava flow and located between Highways 19 and 190. Phenocryst mineralogy is 1-3% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Chiefly aa.

Hbf53 — Lava flow located in the historic 1800 Kaupulehu lava flow and between Highways 19 and 190. Phenocryst mineralogy is 2-4% olivine and 0-1% plagioclase. Dunite xenoliths are common. Soil is present on lava surface. Chiefly aa. Hbf53 is older than Hbf52.

Hbf54 — Lava flow located in the historic 1800 Kaupulehu lava flow and between Highways 19 and 190. Phenocryst mineralogy is 1-3% olivine, 2-7% plagioclase, and 0-1% clinopyroxene. Gabbro xenoliths are rare. Flow surface is cinder covered. Chiefly aa.

Hbf55 — Lava flow located adjacent to and east of the historic 1800 Kaupulehu lava flow and south of Highway 19. Phenocryst mineralogy is 7-10% olivine, 0-2% plagioclase, and 0-4% clinopyroxene. Gabbro and dunite xenoliths are rare. Chiefly aa.

Hbf61 — Lava flow located south of the historic 1859 Mauna Loa lava flow and at Highway 19. Phenocryst mineralogy is 1-2% olivine and 2-5% plagioclase. Plagioclase-clinopyroxene crystal clots are common. Soil is present on lava surface. Includes pahoehoe and aa.

Hbf63 — Lava flow located adjacent to and south of the historic 1859 Mauna Loa lava flow and at Highway 19. Phenocryst mineralogy is 1-3% olivine and 5-8% plagioclase. Gabbro xenoliths are rare. Chiefly pahoehoe. Hbf63 is older than all adjacent flows.

Hbf65 — Lava flow surrounded by Hbf64. Phenocryst mineralogy is 0-1% olivine. Soil is present on lava surface. Chiefly aa.

Hbf71 — Lava flow located adjacent to and west of Hbf73, the 2030± 80 year old flow and near the eastern boundary of quadrangle. Phenocryst mineralogy is 0-2% olivine, 2-7% plagioclase, and 1-2% clinopyroxene. Soil is present on lava surface. Chiefly pahoehoe.

Hbf72 — Lava flow located adjacent to and west of Hbf73, the 2030± 80 year old flow and near the eastern boundary of of quadrangle. Phenocryst mineralogy is 0-2% olivine. Chiefly aa.

Hbf76 — Lava flow located adjacent to and south of the historic 1859 Mauna Loa lava flow and east of Highway 19. Phenocryst mineralogy is 1-2% olivine, 7-10% plagioclase, and 1-2% clinopyroxene. Chiefly pahoehoe.

Hbf77 — Lava flow located in the historic 1859 Mauna Loa lava flow and at the northern boundary of quadrangle. Phenocryst mineralogy is 1-3% olivine, 0-1% plagioclase, and 0-1% clinopyroxene. Chiefly pahoehoe.

Hbf78 — Lava flow located in the historic 1859 Mauna Loa lava flow and at the northeastern boundary of quadrangle. Phenocryst mineralogy is 1-3% olivine, 1-2% plagioclase, and 1-2% clinopyroxene. Plagioclase-clinopyroxene crystal clots are common. Chiefly pahoehoe.

Hbv1945.1,15557.6 — Spatter cone located at the southern boundary of quadrangle and south of Puu Alauawa, Hbv1945.3,15557.6. Phenocryst mineralogy is 3-5% olivine and 2-4% clinopyroxene. Hbv1945.1,15557.6 is older than all adjacent flows.

Hbv1947.1,15558.3 — Spatter cone, Puu Mau, located in Puu Nahaha flow and northeast of Puu Nahaha, Hbv1946.7,15558.7. Phenocryst mineralogy is 3-5% plagioclase.

Hbv1947.5,15558.1 — Spatter cone, Kolekole, located adjacent to and east of Hbf1945.3,15557.4. Phenocryst mineralogy is 5-8% olivine and 0-1% clinopyroxene. The lava lake which is adjacent to Kolekole is a product of the Kolekole eruption. Note that lava lake is labeled on map.

Hbf1947.5,15558.1 — Lava flow, from Kolekole, located adjacent to and east of Hbf1945.3,15557.4. Phenocryst mineralogy is 5-8% olivine and 0-1% clinopyroxene. The lava surface is cinder covered. Chiefly aa. Hbf1947.5,15558.1 is older than all adjacent flows.

Hbv1947.0,15558.9 — Spatter cone located in Puu Nahaha flow and northwest of Puu Nahaha vent, Hbv1946.7,15558.7. Phenocryst mineralogy is 0-2% olivine. Cone is deeply weathered.

Hbv1948.3,15559.2 — Spatter cone, Poopoomino, located south of Highway 19 and adjacent to and west of Hbf1945.3,15557.4. Phenocryst mineralogy is 0-2% olivine and 0-2% plagioclase. Hbv1948.3,15559.2 is older than all flows. Cone is deeply weathered.

Hbv1947.4,15559.9 — Spatter cone, Puu Oo, located near the western boundary of quadrangle and in Puu Nahaha flow, Hbf1946.7,15558.7. Phenocryst mineralogy is 0-2% olivine, 1-3% plagioclase, and 0-2% clinopyroxene. Cone is deeply weathered.

Hbv1947.7,15559.4 — Spatter and cinder cone, Muheenui, located south of Highway 19 and near the western boundary of quadrangle. Phenocryst mineralogy is 2-4% olivine, 10-13% plagioclase, and 0-2% clinopyroxene.

Hbf1947.7,15559.4 Lava flow, from Muheenui, located south of Highway 19 and near the western boundary of quadrangle. Phenocryst mineralogy is 2-4% olivine, 10-13% plagioclase, and 0-2% clinopyroxene. Chiefly aa.

/ Contact, approximate in areas of poor exposure.

y/o indicates young/old age relations between adjacent lava units; most age relations are labeled on map. Due to lack of space, some age relations are not labeled on map but are discussed in the text.

REFERENCES

Clague, D.A., Jackson, E.D., and Wright, T.L, 1980, Petrology of Hualalai Volcano, Hawaii: Implication for Mantle Composition: Bull. Volcanol., v. 43-4, p. 641-656.

Jackson, E.D. and Clague, D.A., 1982, Distribution of the Nodule Beds of the 1800-1801 Kaupulehu Flow, Hualalai Volcano, Island of Hawaii: U.S. Geological Survey Misc. Field Studies Map MF-1355.

Jackson, E.D., Clague, D.A., Engelman, E., Friesen, W.B., and Norton, D., 1981, Xenoliths in the Alkalic Basalt Flows from Hualalai Volcano, Hawaii: U.S. Geological Survey Open-File Report 81-1031, 33 p.

Macdonald, G.A.,1949, Hawaiian Petrographic Province: Geol. Soc. America Bull., v.60, p. 1541-1596.

Moore, R.B., Clague, D.A., Rubin, M., and Bohrson, W.A., in press, Hualalai Volcano, Hawaii: A Preliminary Summary of Geologic, Petrologic, and Geophysical Data: U.S. Geological Survey Prof. Paper 1350.

Stearns, H.T. and Macdonald, G.A., 1946, Geology and Ground Water Resources of the Island of Hawaii: Hawaii Division of Hydrography, Bull. 9, p. 76.

Wright, T.L., 1971, Chemistry of Kilauea and Mauna Loa in Space and Time: U.S. Geological Survey Prof. Paper 735, p. 1-39.