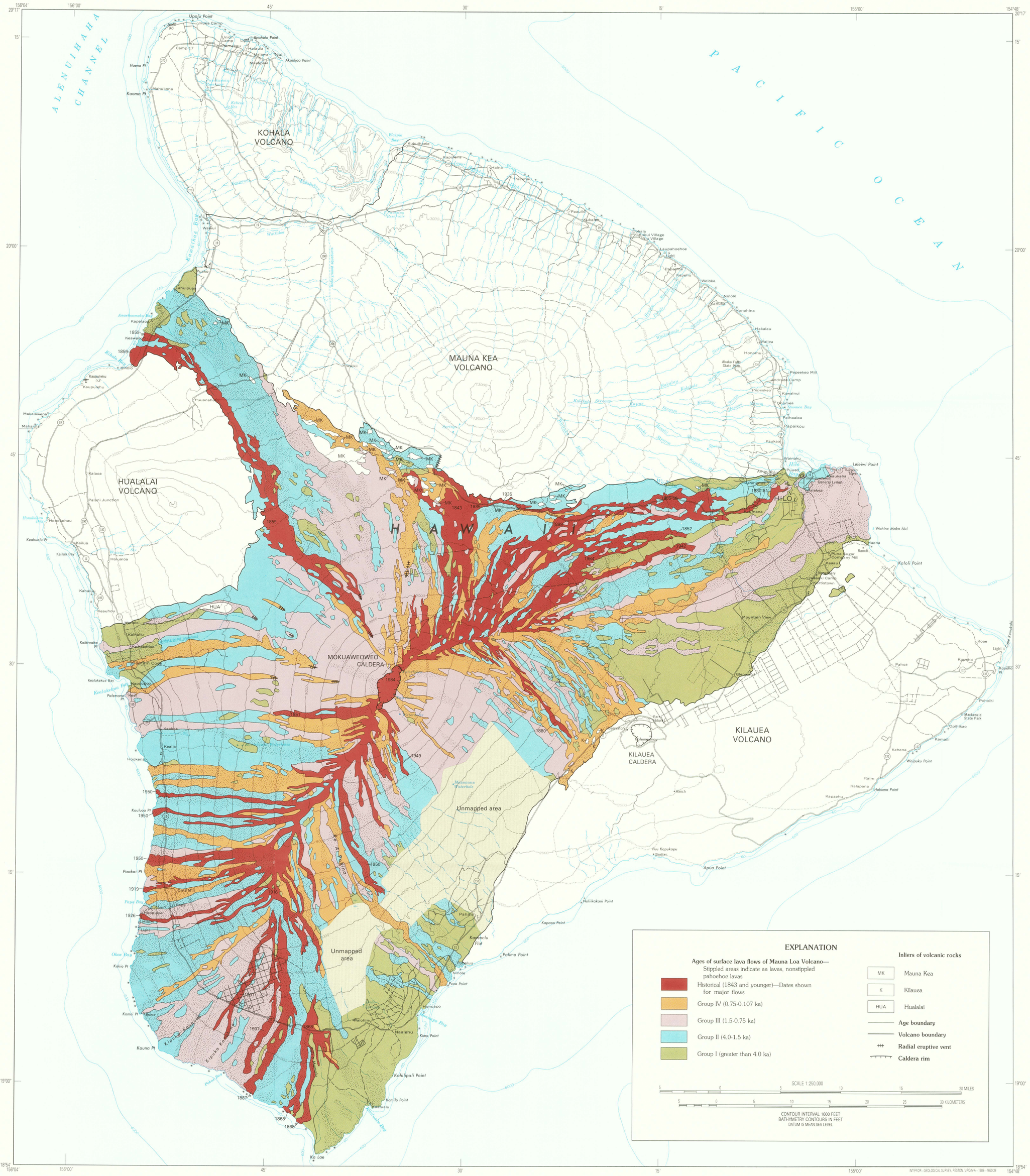
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–1908



Base from U.S. Geological Survey, 1975
Universal Transverse Mercator projection

Geology compiled in 1985-86
by J.P.Lockwood, L.D. Peterson
and F.R. Warshauer

INTRODUCTION

Mauna Loa, the largest active volcano on Earth, is a classic shield volcano, which rises to 13,680 ft above sea level on the island of Hawaii. The volcano is composed of numerous, relatively thin basalt lava flows, overlain in places by ash deposits derived from adjoining volcanoes. These flows were erupted from Mauna Loa's summit and from rift zones extending to the northeast and southwest, as well as from isolated radial fissures on the north and west flanks. Mauna Loa basalts are entirely of tholeiitic composition; olivine and plagioclase are the only common megascopically visible minerals. The highly generalized ages of these flows are shown on this 1:250,000-scale map, as well as the approximate distribution of aa and pahoehoe lavas.

METHODS

This map is derived from a larger scale reconnaissance geologic map that was prepared for the quantitative evaluation of the Holocene eruptive history of Mauna Loa (Lockwood and Lipman, 1987). That map was compiled at a scale of 1:24,000 from unpublished geologic maps of the 47 U.S. Geological Survey 7 1/2-minute quadrangles that comprise the subaerial part of Mauna Loa. The mapping quality varied from relatively detailed along Mauna Loa's rift zones (see Lipman and Swenson, 1984, Lockwood, 1984) to aerial photographic interpretation with only limited field control, especially on the north and west flanks. In generalizing the 1:24,000 mapping at 1:250,000 scale, the flow patterns were greatly simplified, and contacts between individual lava flows of the same age group were eliminated.

Radiocarbon dating of charcoal recovered from beneath Mauna Loa lava flows was used for quantitative age assignments for prehistoric flows. More than 170 radiocarbon ages for Mauna Loa flows (Rubin and others, 1987) have been determined from samples recovered using the methods described by Lockwood and Lipman (1980). Flows which do not yet have absolute ^{14}C ages were assigned to age categories based on weathering characteristics (Lipman, 1980, table 1) or stratigraphic position relative to dated flows.

AGE GROUPS

Mauna Loa surface lava flows are divided into five age categories on the map: (1) greater than 4. ka[1], (2) 4-1.5 ka, (3) 1.5-0.75 ka, (4) 0.75-0.107 ka, and (5) historical (A.D. 1843[2]-1984). Age assignments of many prehistoric flows are approximate and may be revised as future radiocarbon, paleomagnetic, and stratigraphic data become available.

Group I flows—greater than 4 ka

Group I flows generally are deeply weathered and are typically orange-red. They are mostly overlain by discontinuous ash deposits, especially on the northeast and southeast flanks, where they are mantled by pyroclastic tephra from Mauna Kea and Kilauea Volcanoes, respectively. These old flows are most commonly exposed near sea level because they are largely covered elsewhere by younger Mauna Loa lavas.

Groups II flows—4 to 1.5 ka

Flows of this age are typically weathered to yellow-tan, and are commonly overlain by thin, discontinuous ash deposits, especially on the northeast and southeast flanks below 2,000 m elevation. At higher elevations many Group II pahoehoe flows weather to orange tan. These lavas are mostly exposed at middle elevations of Mauna Loa's flanks. They are the youngest flows that were present when Polynesian voyagers discovered Hawaii about A.D. 400 (Kirch, 1985).

Group III flows—1.5 to 0.75 ka

Pahoehoe flows of this age are typically light tan-gray; aa flows are typically light brown. These widespread flows are especially abundant as pahoehoe downslope from Mokuaweoweo (Mauna Loa's summit caldera) and record a period of repeated overflows from a precaldera summit lava lake[3]. Group III flows postdate the arrival of Man on Hawaii.

Group IV flows—0.75 to 0.107 ka

Pahoehoe flows of this age are typically medium gray; aa flows are typically medium dark brown. These flows were erupted mainly along the rift zones and from isolated eruptive vents along Mauna Loa's north and west flanks. Long-term eruption rates over this period were relatively low, compared to rates for Group III or historical time (Lockwood and Lipman, 1987). The present Mokuaweoweo caldera formed at about the beginning of Group IV time, and much now-buried Group IV lava may have been erupted within the caldera.

Historical flows

The colors of historical lavas are typically dark gray black (pahoehoe) and dark brown (aa), contrasting with the lighter colored prehistoric Mauna Loa flows. Historical eruptions on Mauna Loa's summit, rift zones, and northwest flank produced lava flows at rates substantially higher than for Group IV flows (Lockwood and Lipman, 1987). About 40 eruptions have been recorded from Mauna Loa since 1780, but most of them occurred within Mokuaweoweo, and their lavas are no longer exposed. The earliest identified historical flow is that of 1843; the latest 1984. The ages of some historical flows are indicated, although contacts between individual flows cannot be shown at the 1:250,000 map scale.

AA AND PAHOEHOE DISTRIBUTION

Aa and pahoehoe lavas are roughly equal in surface distribution on Mauna Loa (Lockwood and Lipman, 1987). Aa is more characteristic of lavas erupted along the rift zones than at the summit and is also more characteristic of lower elevations. Aa is somewhat more typical of Historical and Group IV lavas than for earlier flows. The distribution of aa and pahoehoe (indicated by a stippled pattern for aa and by no overprinting for pahoehoe) is highly generalized.

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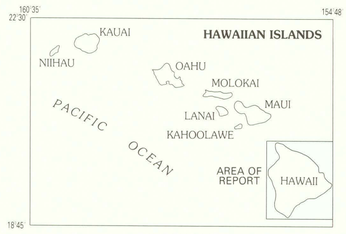
[1]ka = thousands of radiocarbon years before A.D. 1950 (for example, 0.75 ka = 750 yr B.P. = ca. A.D. 1200).

[2]A.D. 1843 = 0.107 ka. Although earlier historical eruptions are recorded, the locations of the associated flows are unknown.

[3]Recent mapping and radiocarbon dating have shown that some of these overflows are actually of Group II age; these older flows are included with Group III flows on the map.



INDEX MAP

GENERALIZED AGES OF SURFACE LAVA FLOWS OF MAUNA LOA VOLCANO, HAWAII

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