

A Sulfur Lava Flow on Mauna Loa¹

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THE PRESENCE OF SULFUR CRYSTALS formed by condensation around fumarolic vents is a common and widely observed phenomenon in volcanic regions. The flowage of sulfur in a molten state is very rare, however, and is sufficiently unique to suggest a permanent record of its occurrence.

The only two examples of observed sulfur magmas recorded in the literature are the remarkable penetration of a sulfur magma chamber by a bore hole sunk near Te Awapuia, White Island, New Zealand, in 1928 (Hamilton and Baumgart, 1959), and the even more remarkable observations by Watanabe (1940) and others of the sulfur lava eruptions from Siretoko-Iosan Volcano—the “sulfur mountain”—in Hokkaido in 1936. Several brief reports have also appeared in the literature suggesting that sulfur deposits in the Tsurugisan area of Rikuchu, the Gorbea district of Chile (Leiding, 1936), and other areas along the Andean chain may have originated in part as sulfur lavas. In all cases, the magmas were apparently derived by remobilization of condensed fumarolic sulfur as the ground temperatures in the fumarolic areas were raised above 112°C, the melting temperature of sulfur. The few recorded examples in the literature are associated with andesitic volcanism.

It is the purpose of this paper to record a new sulfur lava, apparently the first for the Hawaiian Islands, discovered during a brief visit to Sulphur Cone, Mauna Loa, July 22, 1967.

The Flow at Sulphur Cone

Sulphur Cone is situated on the southwest rift of Mauna Loa at an elevation of about 11,200 feet. It is a pyroclastic cone, about 60 feet high, marking the site of a prehistoric

eruption along the rift. The cone was named by E. G. Wingate, U. S. Geological Survey Topographic Engineer, who mapped the area in 1921 and was impressed by the intense “bloom” from the abundant sulfur sublimate crystals covering the cone and surrounding region. At the time the cone was mapped there was no evidence of sulfur flows in the region (oral communication, E. G. Wingate, July 24, 1967). Sulphur Cone lies on the east side of the line of active vents and fissures which opened during the 1950 Mauna Loa fissure eruption, and the most easterly of the presently steaming line of fissures actually cuts the western edge of the cone near its base. Sulphur Cone itself is now dormant, however, and the distinctive sulfur bloom seen by Wingate has gone.

At the time of the author's visit in 1967, a sheet of solid sulfur, which had all the characteristics of a frozen liquid and was therefore a sulfur lava, was observed on the western slope of the cone. The actual source vent for the sulfur flow, about one-third of the way up the slope, was covered with debris wasted from the higher slopes, and the distal end of the flow was terminated abruptly at a graben wall along the eastern margin of a line of fissures of the 1950 eruption. The geometry of the visible sulfur flow, now partly covered by wasting debris, showed that its minimum dimensions were 15 yards by 30 yards, with a thickness ranging from 4 to 18 inches. The flow may formerly have been much larger. Its lower end is truncated by fissures of the 1950 Mauna Loa flank eruption, and later fumarolic action, which is still intense along the fissures, has ablated and degraded much of the nearby sulfur. The fissures also outline a shallow graben structure which channeled the pahoehoe lavas of the 1950 eruption. If the sulfur lava formerly flowed in the region now occupied by the trough, the 1950 flows have obliterated all evidence of it. The preserved portion

¹ Manuscript received May 13, 1969.

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of the flow is entirely on the flanks of Sulphur Cone.

Origin of the Flow

The sulfur has a smooth upper surface on which small, secondary lobe-forms and rivulets of now-frozen sulfur provide direct evidence of a former liquid state. The main flow moved over loose blocks of scoria, and the liquid-like penetration into the rough surface holes and spaces provides additional evidence of fluidity. Sulfur in the flow is massive and does not resemble in any way the delicate acicular crystal growths formed by sublimation. The flow seems to have been a single event, for no evidence of layering or repeated extrusion was seen, and the flow itself appears to have cooled as a single unit, with large crystals (cleavage surfaces up to 1 cm²) formed near the base, grading upward to microscopic intergrowths at the surface.

Critical in the interpretation of this new sulfur flow is the fact that the flow originated on the flank of Sulphur Cone. Moreover, there is well substantiated evidence that large amounts of sulfur were being deposited within the cone as recently as 1921. It seems clear that this newly discovered sulfur flow originated by the remobilization of the previously deposited sulfur sublimate within the cone, much as has been interpreted for the described examples of other sulfur flows. Analysis of the sulfur (Table 1) shows that it has the same high purity as sublimed sulfur from more recent Hawaiian eruptions.

It is probable, though by no means certain, that the sulfur flow is associated with a local heating of Sulphur Cone by the events of the 1950 eruption of Mauna Loa. The inconclusive evidence of the truncated distal end suggests the flow does not postdate the 1950 eruption. In the absence of recorded examinations of the area between 1921 and 1950, however, it is impossible to say whether or not the flow predated the 1950 event.

TABLE 1
SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSES OF
SULFUR FROM HAWAII¹

(Samples: (1) Sulfur lava, Sulphur Cone, Mauna Loa, (2) sulfur sublimate from mouth of nearest active vent associated with 1950 fissure eruption of Mauna Loa to Sulphur Cone, (3) sulfur sublimate from mouth of active vent of the December 1965 Aloii eruption, Kilauea, and (4) sulfur sublimate from Sulphur Bank, Kilauea—sample taken 3 inches below surface.)

ELEMENT ²	SAMPLE			
	1	2	3	4
Si	0.015%	0.1%	0.015%	0.02%
Al	<0.001	<0.001	<0.001	<0.001
Mg	<0.001	<0.001	<0.001	<0.001
Ca	<0.0001	<0.0001	0.0001	0.0001
Na	0.01	0.01	0.01	0.01
Ba	<0.0003	<0.0003	<0.0003	<0.0003
Cu	0.00015	0.	0.	0.
Se	0.000079	0.00031	0.0042	0.00024
Te	0.00018	0.00014	0.00002	0.00006

¹ Results are reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, etc., which represent approximate midpoints of internal data on a geometric scale. The assigned interval for semiquantitative results will include the quantitative value about 30% of the time. Analyses by Joseph L. Harris, U.S.G.S. Se and Te analyses by neutron activation, P. Greenland, U.S.G.S., analyst.

² Elements looked for, but not found: Ag, As, Au, B, Be, Bi, Cd, Ce, Co, Cr, Cu, Fe, Ga, Ge, Hf, Hg, In, K, La, Li, Mn, Mo, Nb, Ni, Pb, Pt, Re, Sb, Sc, Sn, Sr, Ta, Te, Th, Tl, U, V, W, Y, Yb, Zn, Zr.

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