Caves of the Great Crack, Kilauea Volcano, Hawaii

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Abstract

The Great Crack ("17 Mile Crack") is the most prominent feature of Kilauea volcano's Southwest Rift Zone. Rather than consisting of a single crevice, much of the "crack" consists of en echelon crevices of various widths in a strip locally more than 1 km wide. Numerous grabens and collapse pits are present.

Detailed studies of this complex have been begun only in the past decade. Some of the participating geologists have requested support and some leadership by speleologists in investigating cavernous pits at the bottom of steep talus slopes. The Hawaii Speleological Survey of the National Speleological Society subsequently has cooperated with University of Hawaii and U.S. Geological Survey researchers in investigating cavernous pits in the principal axis of the crevice complex. Two pits yielded minimal spelean findings, but the third—labelled Pit H by University of Hawaii geologists—was found to require SRT expertise. In 2001 it was explored and mapped to a depth of 183 m. Despite extensive breakdown, accretion by laterally flowing lava was identified on several levels. A total of 600 m of passage was mapped.

In a similar crevice at the bottom of Wood Valley Pit Crater (which is nearby but off the principal axis of the rift zone), accreted linings and tube segments have been found along the crevice at a depth of almost 90 m. No such tube segments are present in Pit H Cave. These findings indicate that tube formation is not essential to lateral flow of lava in rift crevices, but occurs in some locations. Numerous other pits remain to be investigated along the Great Crack and elsewhere.

Introduction

The Great Crack ("17 Mile Crack") is the most conspicuous feature of the Southwest Rift Zone of Hawaii's Kilauea Volcano (Figure 1,2). The section of this feature discussed in this report is about 2 km long and is located about 2 km north (up-rift) of the historic 1823 Keaiwa lava flow which emerged from its lower end. Okubo and Martel (1998) identified and described 14 collapse pits here, located along two dominant crevices (or paired crevices). The present study reports initial investigations of crevice caves associated with some of these collapse pits, as conducted by members of the Hawaii Speleological

Figure 3. Main (lower) entrance. Cathedral Cave, Pit B of the Great Crack. Photo by the Author.

Figure 4. Looking upward along talus slope to upper entrance of Cathedral Cave located at edge of Pit A. Photo by the Author.

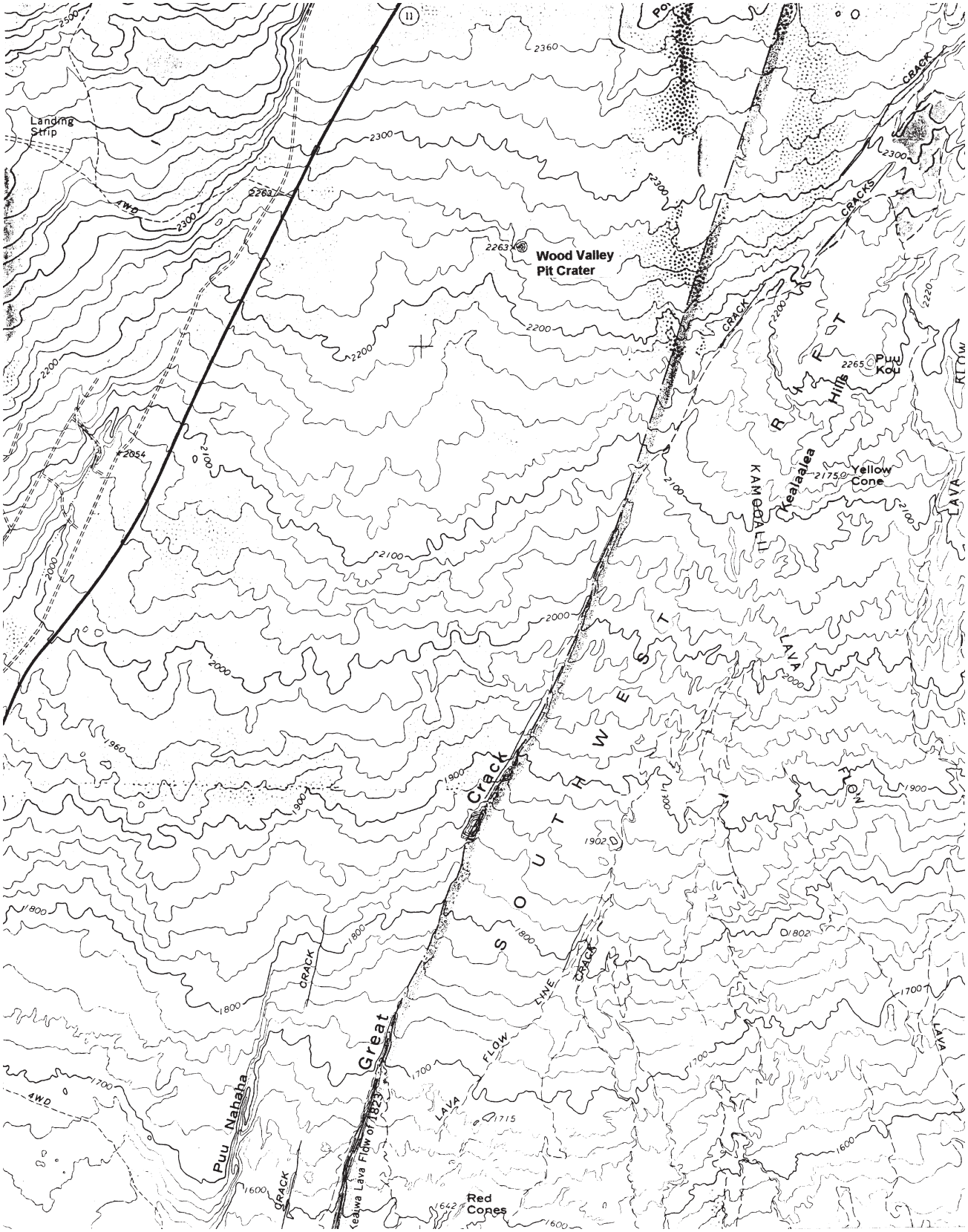


Figure 1. Section of 1981 US Geological Survey 1:24,000 Wood Valley Quadrangle showing the Great Crack and Wood Valley Pit Crater.

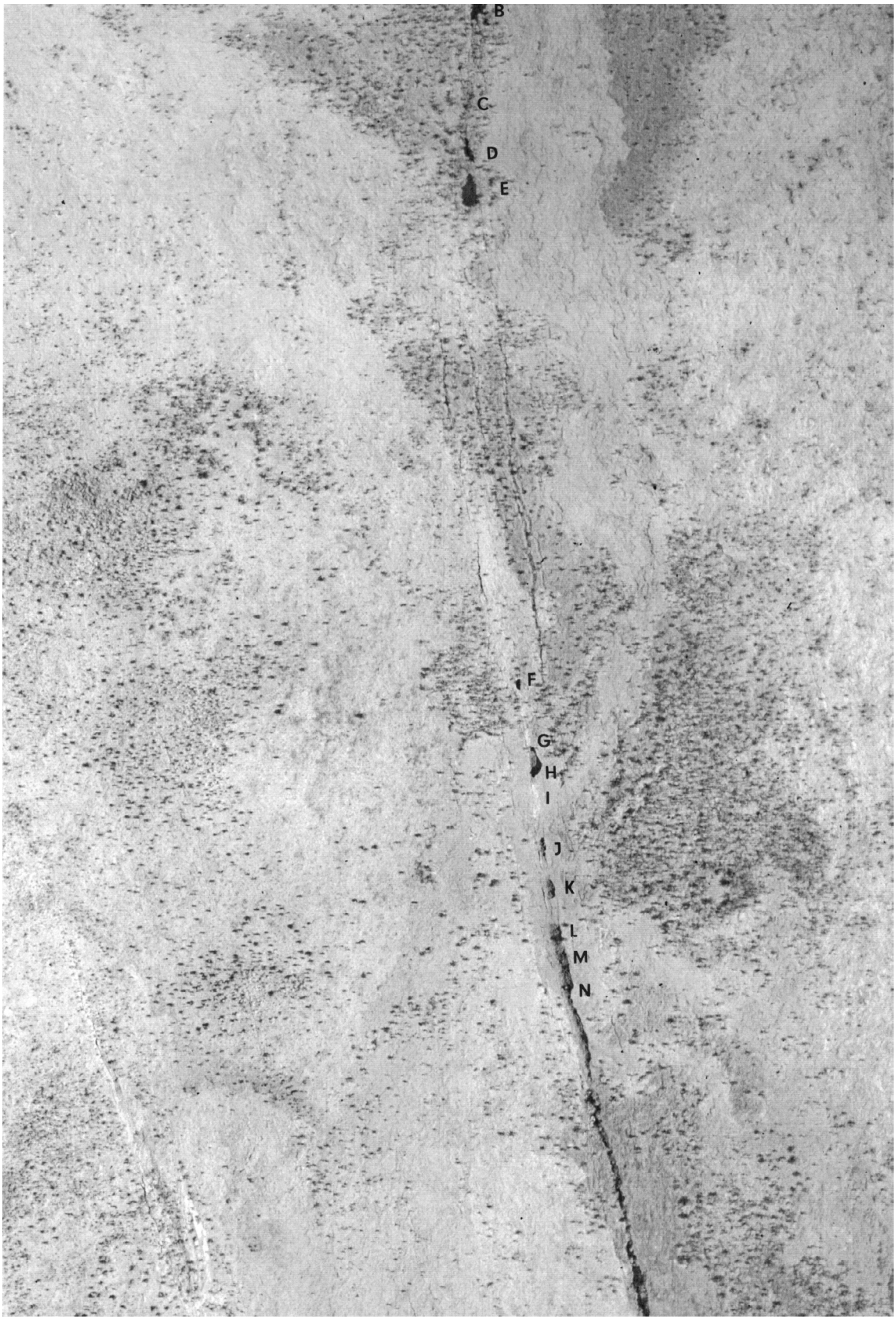
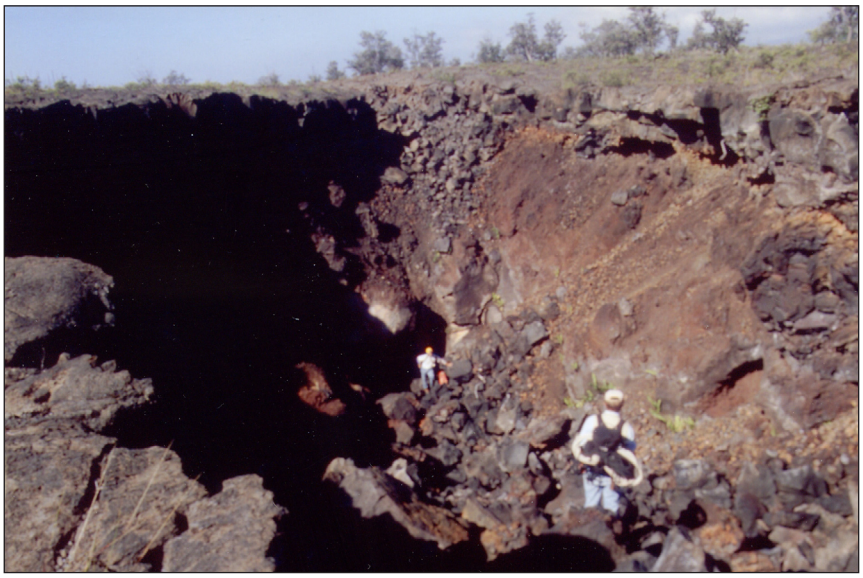


Figure 2. October 1988 NASA aerial photo of study area showing collapse pits B to N. Courtesy Chris Okubo.



Survey of the National Speleological Society in cooperation with Okubo and Martel and with Don Swanson of the U.S. Geological Survey. It compares findings during these explorations with those by Favre et al (Favre, 1993) during exploration of the nearby Wood Valley Pit Crater Complex.

Overview of the study area

The term "Great Crack" implies that the principal rift structure here consists of a single dominant crevice, but this is not the case. Instead, the feature consists of a complex of en echelon crevices of various widths. These are encompassed in a strip locally more than 1 km wide. The area is geologically active, and at least one important collapse pit has developed in the last few years (Okubo and Martel, 1998). As Okubo and Martel have shown, the pits are from 8 to 45 m in diameter and 6 to 28.5 m in depth. They occur in two groups along shallow linear depressions which are not quite aligned with each other. Pairs of deep, near-vertical cracks with apertures of several cm are characteristic of the collapse pits,

Pits A through E (Figure 2) are located along a narrow graben 5 to 7 m wide and 2 to 15 m deep. Locally it is nearly filled with talus and volcanic ash. Individual pits are separated by septae of talus extending almost to ground level. Pits F through N are in a slightly wider depression which is generally shallower but locally contains steep-walled troughs 5 to 7 m wide and 2 to 3 m deep. No tephra is present south of Pit F. Lava exposed in their walls largely consists of pahoehoe and a basaltic lava flows 0.5 to several m thick. Rubble and blocks of talus of similar dimensions mantle pit and cave floors and lower walls. Overhanging pit walls are common; some overhangs initially were mistaken

Figure 5 (top). Hollow dike, Cathedral Cave. Photo by the Author.

Figure 6 (middle). Entrance sink, Pit H Cave of the Great Crack. Photo by the Author.

Figure 7 (bottom). Entrance of Pit H Cave, located beneath dense lava core. Photo by the Author.

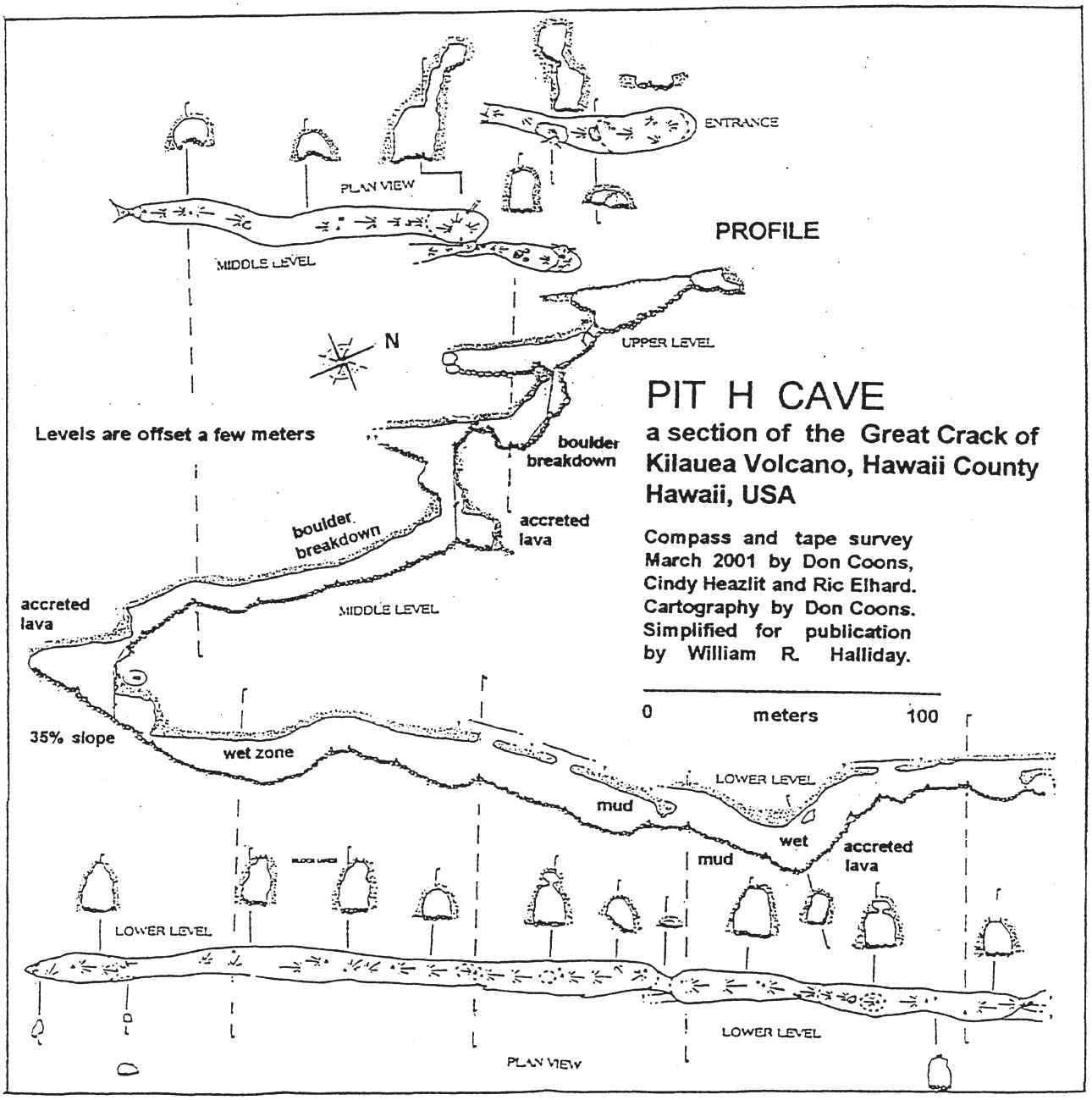


Figure 8, Map of Pit H Cave, redrawn by the author from map courtesy Don Coons.

for cave entrances. Some unusual lava injection features also are seen locally (Figures 5, 10) these are discussed below. Farther downrift are additional collapse pits, then a continuous steep-walled depression from which emerged the historic 1823 flow.

Initial investigations

Based primarily on views from the ground surface, Okubo and Martel (1998) listed all pits from Pit A to Pit I as having known caves. In July 1998 and August 1999, this writer and Chris Okubo investigated cave entrances in the northern group (Pits A - Pit E) which were accessible without special climbing gear. At the north (up-rift) end of Pit B we clambered down into a spacious crevice cavern. Locally almost 10 m wide, its lower portion was both impressive and scientifically significant; its walls contain unusual lava structures which show flow of molten lava into the cavity from within the wall (Figurers 5, 10). The upper portion of this cave extends steeply upward through large talus fragments to a narrow upper entrance which is just within the down-rift margin of Pit A - a vertical extent of nearly 20 m. Because of the spaciousness of its main chamber, we called it Cathedral Cave.

Investigations of Pit H Cave

We planned to return and map Cathedral Cave. On 18 February 2000, however, Okubo and I investigated Pit H Cave in the lower group, Descending a steep entrance slope with large talus blocks at

Figure 9. Mapping the entrance slope of Pit H Cave. Photo by the Author.

Figure 10. Hollow dike in twilight zone of Pit H Cave. Photo by the author.

Figure 11. Composite photograph of upper level of Pit H Cave, looking across pit at end of twilight. Photos by the Author.

Figure 12. Don Coons at narrows of pit leading to lower levels. Photo by the Author.

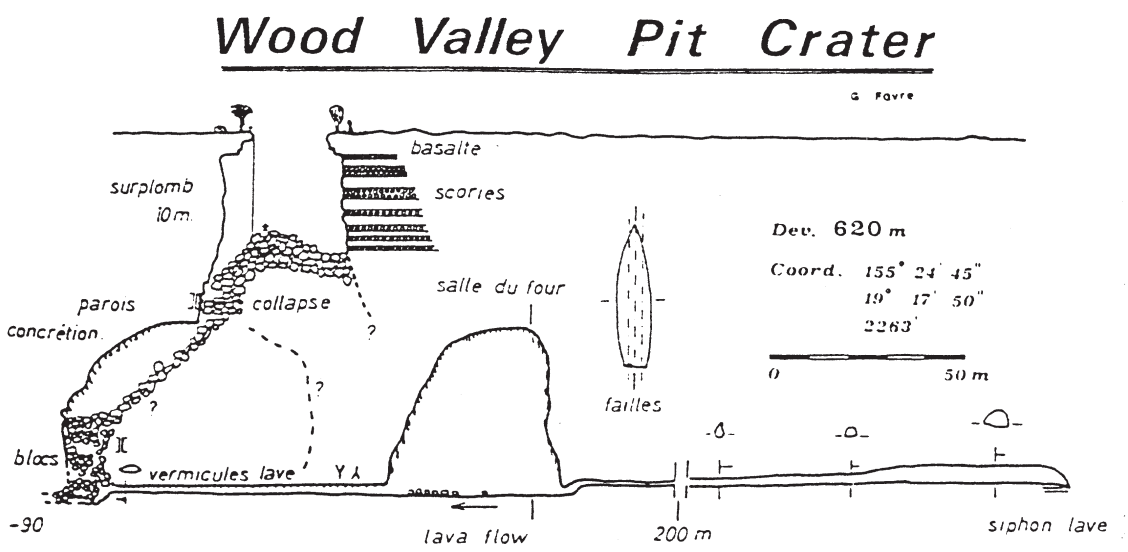


Figure 13. Plan and longitudinal section of Wood Valley Pit Crater Complex. Courtesy Gerald Favre.

the angle of repose, we mapped as far as a funnel-shaped pit in wedged talus, located at the inner margin of twilight This pit extended completely across a near-horizontal passage 5 to 6 m wide, floored by wedged talus. Its depth could not be determined but eventually was found to be 26 m. We photodocumented the accessible area (including a hollow dike exposed in section - Figure 10) but could do no more without specialized climbing gear.

On August 7, 2000 Don Coons accompanied Don Swanson and myself to Pit H Cave. Coons traversed the pit where Okubo and I had stopped, finding about 25 m of additional passage on this level. Then he descended the pit to the next level, 26 m below. After a minor initial ascent here, he encountered an additional pit for which he needed additional rope and a support team (Coons, 2001).

Coons was designated chairman of a formal project of the Hawaii Speleological Survey. On 23 February 2001 he returned to Pit H Cave, accompanied by Rick Elhard and Cindy Heazlitt. In one vigorous day, 30 survey stations yielded 600 m of passages which reached a depth of 183 m. The second vertical pitch was found to be 37 m, with a third pitch of 22 m farther downslope (Figure 8).

Remnants of accreted linings were found at several levels in Pit H Cave. Near the lowest point in the cave, the lining was found to be 25 cm thick and composed of two units: a porous brownish inner layer and a dense black outer layer. Closer to the surface, the accreted lava is increasingly thin and none was found above the second pitch. Nothing suggesting the presence of a lava tube was observed (Coons, 2001).

Comparison with previous observations

Okubo and Martel (1998, page 10) summarized Jaggar's 1947 observations of lava entering the principal Southwest Rift Zone conduit in the wall of Halemaumau. They concluded that Jaggar described "stoping into a previously widened subsurface fracture", rather than a rift tube. This is consistent with findings in Pit H Cave.

On the other hand, Favre (1993) reported dissimilar findings in a crevice passage in the nearby Wood Valley Pit Crater Complex. Wood Valley Pit Crater also is within Kilauea volcano's Southwest Rift Zone, but is off its principal axis (Figure 1). Here, "totally glazed" lava tube segments were found along the crevice, forming most of a cave more than 460 m long at a depth of almost 90 m. Average height of the tube segments is 8 m, average width, 12m. Two large linear chambers also are present. One is directly beneath the shaft of Wood Valley Pit Crater and is nearly filled with talus. The other is 80 m farther along the crevice and is 40 m high, 10m wide and 40 m long. It is intact and is lined with accreted lava ("congealed basalt"). Comparison of these findings with those in Pit H Cave indicates that lava tubes can form in active rift crevices but some lateral flow exists without tube formation.

To confirm and amplify these findings, much more exploration and investigation of volcanic crevice caves and pit craters is needed, along the Great Crack and elsewhere.

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