



## THE GENESIS OF ISOLATED LAVA CAVES ON HAWAII

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### **Abstract**

The recent exploration of very long lava tubes on Hawaii has somewhat left isolated, smaller caves in the leeway of interest. Nevertheless there is much to learn from these as well. Here I present four lava caves which we have mapped on Hawaii over the past few years (Kempe, Halliday, Werner, Oberwinder). They occur somewhat isolated from others and are closed at both ends by lava seals. These are: Shield Cave, Big Room Cave, Giant Room Cave, and Kahiko Pele Cave.

Shield Cave is located in the Hawaii Volcanoes National Park (access only by permission). It is accessed through one of the right-lateral fault cracks dissecting a small, about 10 m high shield volcano belonging to the SW-Rift of Kilauea. The roof consists of a single 4 to 6 m thick lava sheet, much thicker than the lava sheets comprising normal lava tube roofs. To the east a 12\*20 m wide and up to 4 m high chamber is entered. It has a solid floor with a concentric upwelling structure. Apparently this is a chamber developed above the once active vent for the shield volcano itself. To the west a semicircular, later gothic passage leaves the chamber, curving gently to the SW. At about 35 m the solid, flat floor is reached, which extends all the way to the very end of the cave where the descending ceiling touches the floor. The total length amounts to 112 m. This apparently was the lava conduit, which was fed by the vent and which was closed by ponding towards the end of the eruption.

Big Room Cave is situated at the south eastern coast of Hawaii in Kilauea E-Rift flows. Genetically the cave appears to be quite an enigma. It is entered through a central breakdown hole and essentially consists of one chamber 16 m wide, 20 m long and originally 5 m high. Upslope the cave's ceiling meets the floor, while downslope the passage becomes narrow and is blocked by breakdown. At high surf some water apparently can enter the cave, carrying fragments of marine shells into the cave. The walls are covered with a lining and where the central breakdown cone is situated the structure of the roof is exposed. The lower part is composed of lava laminae and the upper part is composed of small surface Pele's Toe type flows, apparently a later flow not directly associated with the formation of the cave. At best one can interpret this cave as a breakup cupola over a much larger tube, which at a time late in the eruption filled entirely with lava (hence the lining) which then subsided only partially, so that the original upslope continuation of the tube is blocked.

Giant Room Cave is even larger. It is situated in the lava delta of the Hualalai Puhia Pele Flow north of the Kona Airport. The cave has a length of 145 m, a width of up to 25 m and a height of up to 8 m. It is also entered through a central hole in its ceiling by rope or ladder. The floor is 11 m below the entrance and is composed of large slabs of lava, suggesting, that lava ponded to a great depth and then shrunk while cooling. At the upslope end, one can see spatter on the wall, as if lava had risen from below, bubbling up gas and throwing up spatter. Again the only explanation is, that the cave is not representing the lava conduit itself, but rather an early breakout cupola, albeit of enormous size, over the original tube, which now is inaccessibly by ponded lava. In case of Giant Room Cave other segments of the original tube-system are accessible as trenches above (Lava Curtain Trench) and below (Centashaft Trench and Cave) the cave.

Kahiko Pele Cave is another isolated section of cave. In this case no section of the same conduit is known either above or below of the cave. It is situated in the Aila'au Flow Field of the Kilauea west of the Pahoa Road. It also is entered through a central puka. It is 80 m long, forming one long hall, up to 12 m wide and 6 m high, petering out at both ends where the ceiling touches the floor.



The original floor appears at both ends below breakdown and seems to be completely level, at least we could not measure a slope over the length of the cave with the handheld inclinometer. Again, the best explanation we can give for the genesis of this cave is that it is a breakdown cupola over a much deeper rooted conduit, which ponded in the final phase of the activity. Alternatively, the floor could also be a secondary ceiling, consolidated above the lava conduit because of the opening up of the puka. However, the puka does not seem to be a hot puka, since much of the central part of the cave is covered by breakdown. Furthermore, there is a spectacular column of lava from a later flow, which invaded the cave forming a 15 m wide lava base around the 3 m wide stalagmitic column. It is conceivable, that the transgressing lava loaded the roof to a point causing the collapse of the puka. In view of this, the formation of a hot puka and the consolidation of a secondary ceiling seems unlikely.

It appears, that still much needs to be learnt about lava caves and that the wealth of processes which can form and shape caves in lava is by no means limited.