



GEOLOGY OF THE HUEHUE TUBE (ERUPTION 1801) AND THE PUHIA PELE CHANNEL SYSTEM, HUALALAI, HAWAII

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Abstract

Historic records suggest that the Hualalai, the only active volcano in its terminal alkali basalt phase on Hawaii, erupted last in 1801. The precise boundary of this flow, the Huehue flow, was previously confused with another flow similar in age, the Puhia Pele Flow. The flows can now be separated because an extensive tube system, with a length of 10.8 km in total, has been mapped in the Huehue Flow in the past few years by teams of the Hawaii Speleological Survey (Medville and coworkers and Kempe and coworkers).

The tube shows that the 1801 lava issued from an inconspicuous vent at an altitude of ca. 540 m a.s.l. and continued all the way to the sea, keeping to the south of the earlier Puhia Pele flow and partly covering it. The tube covers an altitude difference of 495 m and ends in a lava seal at ca. 30 m a.s.l. The main passage has a length of 6.17 km end-to-end and a sinuosity of 1.2. The Huehue Tube has 29 pukas (collapse holes), part of those already formed when the cave was still active (hot pukas). These allowed ventilation through the incising tube, causing the freezing of extensive secondary ceilings in the upper part of the tube. Puka 17 served as a rootless vent, issuing hot pahoehoe lava to the surface, straddling the Puhia Pele Flow, thereby confusing the surface picture further. In fact the upslope boundary of the smooth Puka 17 lava, where it borders at the hummocky main flow lava, was thought to mark the end of the 1801 flow originally.

Contemporary with the Huehue flow, i.e. active at the same time, was a second small vent, within 50 m of the point where the Huehue tube starts. This vent (possibly a rootless vent above a tube parallel to the Huehue tube) forms a small shield-like dome from which hot pahoehoe lava issued. This lava, termed Mystery lava, covers the upper part of the Huehue lava and interacted in various ways with the lava flowing below in the tube. The Mystery lava gradually changed downslope into prominent aa flows, which, in part, form the roof of the Huehue tube. Two small scale cave systems have been mapped in the mystery flow, Zoe's Puka, 428 m long, and Puka 4 Cave, 292 m long, both caves are rather narrow and not very mature.

Below the Huehue/Mystery lava lies the Puhia Pele Flow. It is very different from the Huehue Flow, having a much higher gas content. This led to the buildup of a spectacular series of spatter cones and spatter ramparts at an altitude of 499 m a.s.l.. At least three of the vents are still open to a depth of over 100 m (ongoing exploration by J. Rosenfeld). Below of the spatter ramparts a spacious tube system started, the beginning of which is now collapsed into a trench. The lower part forms an about 400 m long cave, interrupted by several pukas, before it issued into an open trench. At this point the channel is filled with Mystery aa, obliterating the lower end of the cave system. The entire trench System was now mapped by our group with DGPS (Differential Global Positioning System). It extends down to about 80 m a.s.l.. In this section the trench was blocked several times, leading to the formation of short caves and causing extensive overflows. Two overflow side channels to the north were established. Twice the trench was invaded by Huehue lava from the south. Below an altitude of 80 m a.s.l. a wide lava delta formed, which again featured a central tube. This tube overflowed several times issuing wide and flat lava fields. Today only those parts of the feeding system can be seen, which evolved by breakdown above the original tube. The tube itself seems to be filled entirely by ponded lava. This is especially evident in Giant Room Cave, which is essentially one large 145 m long chamber closed at both ends by lava seals. Apparently the Puhia Pele delta must have flooded the area by at least 10 to 15 m of



lava. This large mass of hot lava cooled over a longer time period, allowing steam venting and causing the deposition of brown mineral deposits along prominent contraction cracks.

At places where thin Huehue lava fingers cross the center of the Puhia Pele flow, these brown mineralizations are seen also on the Huehue lava. This observation suggests that the distance in time between the two flows may not have been more than fifty years, possibly even less than ten years. Clearly the activity of the Puhia Pele Flow had terminated when the Huehue/Mystery lava erupted, but apparently there was still enough heat in the ponded lava to influence the weathering of the transgressed Huehue lava. We therefore suggest that the Puhia Pele Flow must have erupted at around 1780 AD \pm 20 a. This date is consistent with archeological finds which we made in the Puhia Pele Cave, indicating that it has been used for a variety of purposes.