Impact of Richter 6.1 Temblor Upon Malama Cave, Puna District, Hawaii, Hawaii: An Insider's View

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Abstract

In June 1989, the author was 50 feet into Malama Cave when the earthquake struck. The cave is located in the eastern rift of Kilauea Volcano, a zone of multiple crustal fractures and lava resurgences. Malama Cave is a concatenation of hollow spatter cones with several skylights opening through their mouths. This paper describes the events which took place during the 15-second seismic occurrence.

On June 25, 1989, at 17:00, Malama Cave was entered by Marlin Spike Werner and three companions, Sadanand Singh; his wife, Angie; and 10-year-old son, Samir.

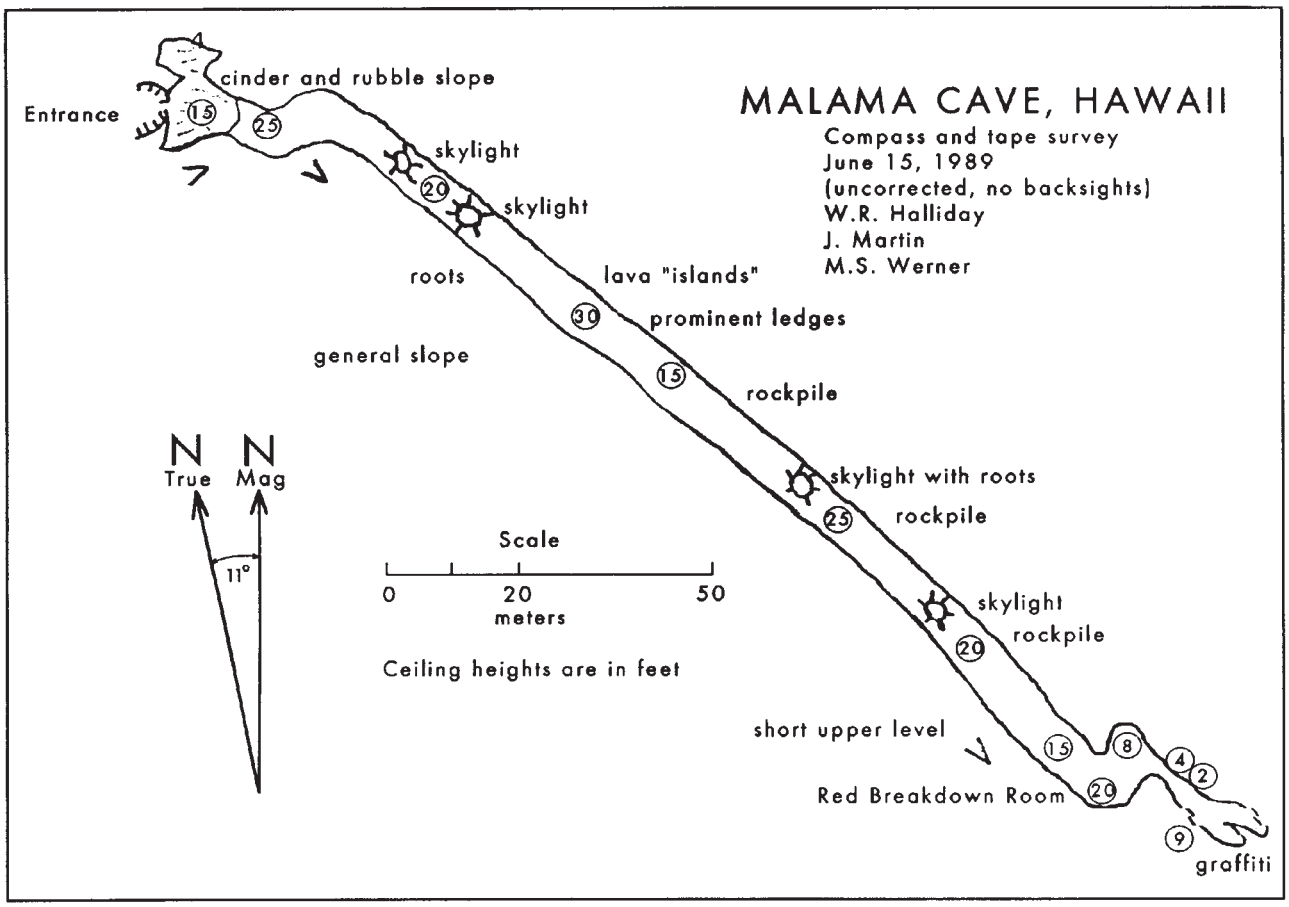
Malama Cave is located in the northeast rift zone, not far from the recently closed Pilot Geothermal Plant in the Puna District of the Island of Hawaii. The entrance to the cave is at the margin of Malama Avenue. The surrounding terrain is one of complex pseudokarst, clinkers, and tangled overgrowth of climbing fern, ohia, and ha'u. The subject cave appears to be a concatenation of hollow spatter cones, each bell-like in cross section. The deepest human penetration is probably limited to 150 feet.

The investigators picked their way carefully down the steep talus to a floor of pahoehoe, approximately 40 feet below the entrance threshold and 12 meters further in. One of the spattercones afforded a skylight at its apex, another 15 meters further down passage. Werner had placed a propane lamp at the floor and was offering Mrs. Singh assistance when the circumstances of the exploration were altered by several swift-moving events. About 15 feet in from the entrance, Sadanand Singh was bringing up the rear. Mrs. Singh was about ⅔ down-slope, and Samir was standing by the video-camera and the propane lamp at the bottom. Mrs. Caroline Werner and Kalpana Singh occupied the front seat of the Werner car, the Singh's rented car parked just ahead. The sun was shining, and several birds were resting on the wires of the telephone line that passed seven meters overhead.

Werner was reaching out to offer Mrs. Singh a hand when the floor – no – the whole setting, people, floor, walls, contained air – moved upward, forward, downward, backward, upward, forward, downward, backward, upward. . . The motion appeared to be in alignment with the axis of the cave. The air seemed to huff and puff. An irregular boulder weighing 300 pounds or more seemed to rise slowly from the talus, tilt downslope, and flop. Mrs. Singh was saying something about "Holy Jesus, Mother Mary," when Werner took her hand and said, "It's alright," – an admitted lie.

From the entrance, Sadanand called, "Samir, run," and the boy's velocity in passing was approximately 1.5 meters per second. Werner looked upward at walls and ceiling. Previous rockfalls attested to the shedding of secondary accretions – hints of rockfalls to come. A sinuous curtain of dust rained from a narrow crack which ran from the entrance to the skylight. The boulder languidly rose, teetered forward, and flopped again. Werner stood with one foot up-slope so that his stance was aligned with the axis of the cave. With each displacement of the floor his center of gravity was shifted up, left, down, right, up, left. . . Was Malama slipping into the sea?

The occupants of the Werner car watched in horror as the Singh's rented automobile began to pitch from side to side, the telephone poles whipping back and forth, their wires whistling overhead. The birds emitted something unquotable. Mrs. Werner tried to open her car door only to have



it thrown back at her. Kalpana shouted, "Daddy!" Meanwhile the slothful boulder in the cave heaved one more time, teetered, and flopped on its face to rest at Werner's feet.

The magnitude of the temblor was R = 6.1. The epicenter was 19°22'N × 155°05'W, and the hypocenter was at 9.4 kilometers (data supplied by Hawaii Volcanoes Observatory staff). The distance from the epicenter to the cave is approximately 3.17 kilometers. Although the angle of incidence at which the temblor encountered the cave was about 90°, lack of data as to senses and ranges of oscillatory displacement and planes of acceleration places limits on our evaluation of the events experienced.

In Conclusion

The participants discussed the above events. Samir suggested that the duration of the quake was three minutes. The seismologist at the Hawaii Volcanoes Observatory said the duration was subjective, and anybody's guess. Angie suggested, "maybe four minutes." By counting the seconds, one-one-thousand-two... the group concluded that the experience had a duration of approximately 14 seemingly interminable seconds. Risking the possibility of an aftershock, Werner returned to the cave to retrieve his video-camera and propane lamp – without incident.