

Drilling, Construction, and Caliper Logs for Well 8-3207-04, Mountain View Exploratory Well, Island of Hawaii

By Charles J. Ewart

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Conversion Factors

Multiply	By	To obtain
foot (ft)	0.3048	meter
gallon (gal)	3.785	liter
mile (mi)	1.609	kilometer
square mile (mi ²)	2.590	square kilometer
inch (in.)	25.4	millimeter

Elevations in this report are referenced to mean sea level.

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Abstract

The Mountain View exploratory well was drilled on private property near the Hawaii County Department of Water Supply storage tank at an elevation of 1,687 feet and about 1.4 miles southwest of the community of Mountain View. Water was encountered at a depth of 675 feet below land surface (1,012 feet above mean sea level) and remained at that level for the duration of drilling. The extent of this high-level water body and the nature of the impounding structures are not known. This report presents a summary of the occurrence of ground water in the Puna District and geohydrologic data and the construction details of the well.

INTRODUCTION

The Mountain View exploratory well was the third of three deep exploratory wells drilled on the island of Hawaii between September 1994 and April 1995. These wells were drilled by the U.S. Geological Survey (USGS) as part of a program of exploratory/monitor well drilling carried out in cooperation with the County of Kauai Department of Water, the County of Hawaii Department of Water Supply, and the City and County of Honolulu Board of Water Supply. The program, begun in 1993, is designed to provide hydrologic and geologic information for aquifers in three island counties. This information is vital to the understanding of the ground-water systems on each island and for estimating the amount of available ground water.

In addition to providing needed hydrogeologic information the exploratory wells completed under this program will be used as long-term monitoring sites to provide data and information for the management, pro-

tection, and conservation of the ground-water resources. The rotation of the drilling rig between the islands and the duration of drilling on each island are determined by the three county water managers. Drilling sites are selected and prioritized jointly by the county water departments and the USGS.

The purpose of the Mountain View exploratory well was to provide information on the little known ground-water resources of the upper Puna District (fig. 1). The well was drilled on private property near the Hawaii County Department of Water Supply storage tank at an elevation of 1,687 ft and about 1.4 mi southwest of the community of Mountain View (fig. 2). Water was encountered at a depth of 675 ft below land surface (1,012 ft above mean sea level) and remained at that level for the duration of the drilling. The extent of this high-level water body and the nature of the impounding structures are not known. This report presents a summary of the occurrence of ground water within the Puna District and geohydrologic data and the construction details of the well.

Acknowledgments

The USGS gratefully acknowledges the assistance of the Hawaii County Department of Water Supply in site preparation and logistical support throughout the period of well construction. We also acknowledge the cooperation of Mr. and Mrs. Albert Paiva and AMFAC/JMB Hawaii, lessees and land owner respectively, for their cooperation in allowing the USGS access and permitting the well to be drilled.

Setting

The Puna District has a land area of 318,054 acres and includes the eastern slopes of Mauna Loa Volcano

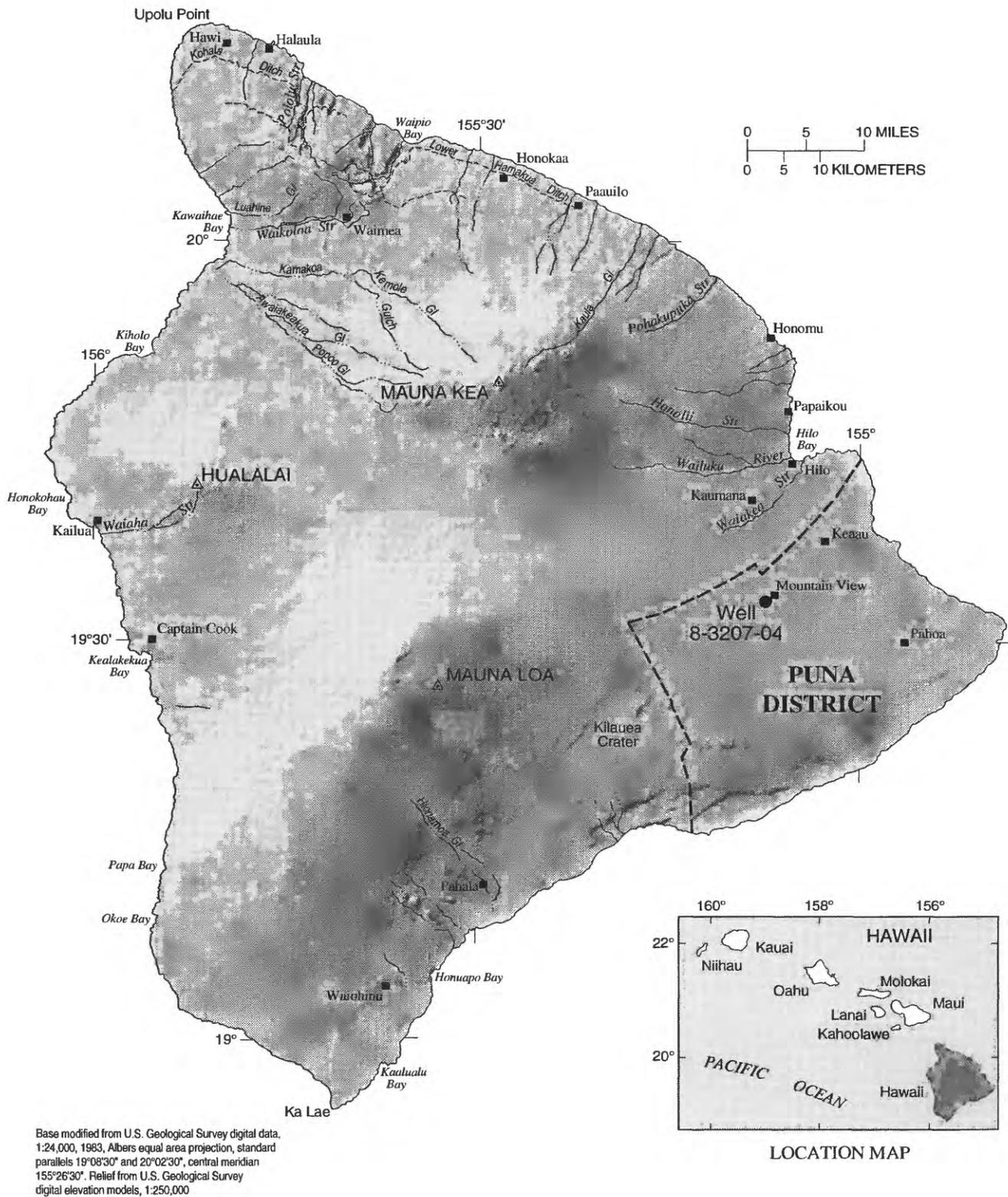


Figure 1. Location of Hawaiian islands, island of Hawaii, Puna District.

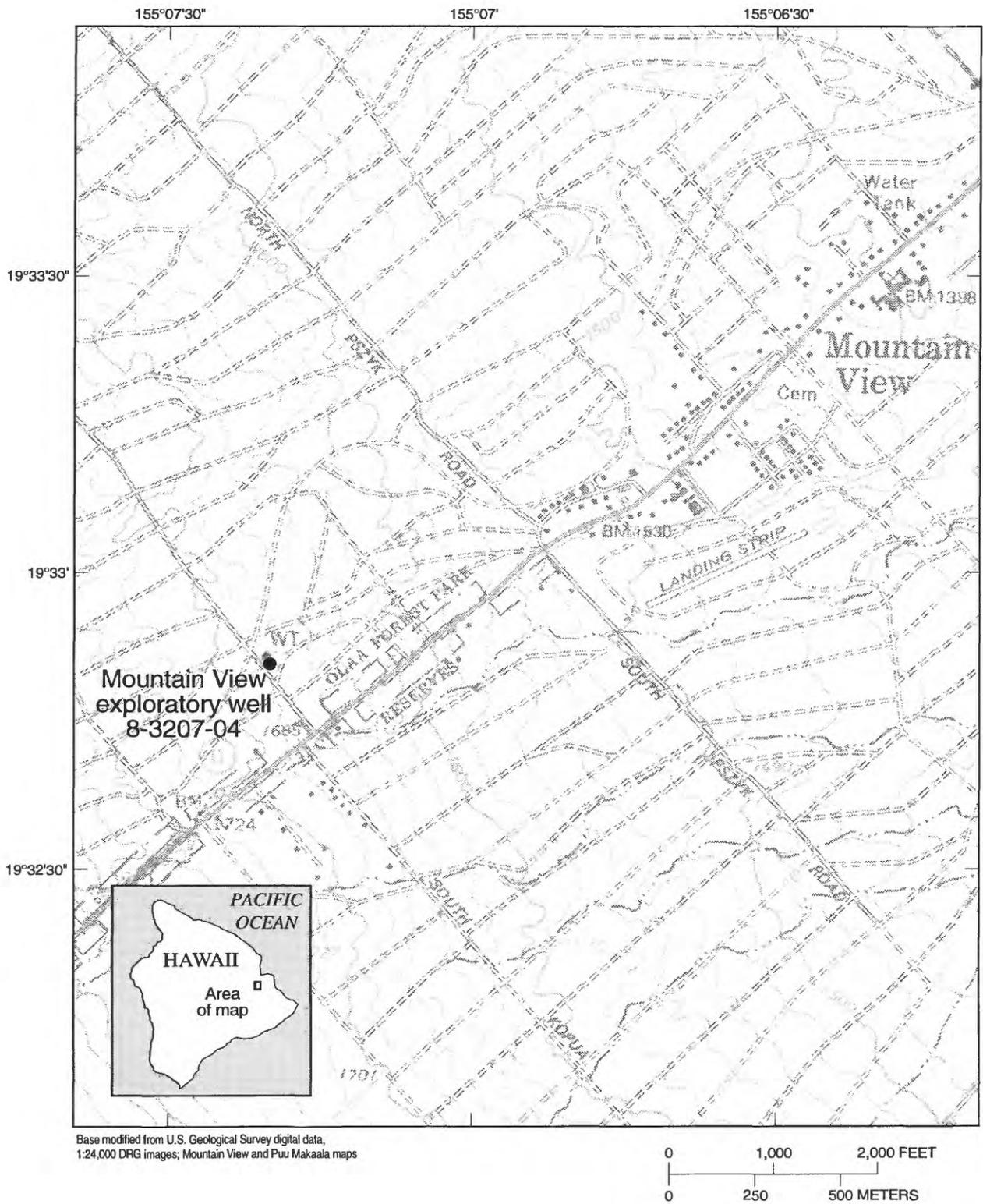


Figure 2. Location of the Mountain View exploratory well (State well number 8-3207-04), island of Hawaii.

and the east and southeast slopes of Kilauea Volcano (fig. 1). Elevations within the district range from sea level to 5,000 ft on the slopes of Mauna Loa. Average annual rainfall near the coastal boundary is about 60 in. along the southern coast to 120 in. along the windward or eastern coast. In the interior, annual rainfall ranges from about 200 in. between the 2,000 and 3,000 ft elevations in the Mountain View area to about 120 in. at the higher elevations (Hawaii County Department of Water Supply, 1991). The Mountain View exploratory well (State well number 8-3207-04) is located adjacent to the Hawaii County Department of Water Supply's storage tank about 1.4 mi southwest of the community of Mountain View and 900 ft from State Highway 11 at an elevation of 1,687 ft (fig. 2). Lava flows and pyroclastic deposits from Mauna Loa and Kilauea Volcanoes form most of the Puna District. The northern part of the District consists of the basaltic lava flows of the Kau and Kahuku Basalts while the southern part is made up of basaltic lava flows from the Puna Basalts (fig. 3). In both parts of the District pyroclastic deposits, primarily ash, which are a few feet to a few tens of feet thick are intercalated with lava flows. The lava flows of each volcano are extremely to highly permeable while the ash deposits are much less permeable (Davis and Yamanaga, 1968). Within the Puna District there is no perennial streamflow that reaches the sea.

GROUND-WATER OCCURRENCE

Ground-water occurrence in the Puna District has been described in detail by Stearns and Macdonald (1946) and Davis and Yamanaga (1968). The following is a generalized summary from these works.

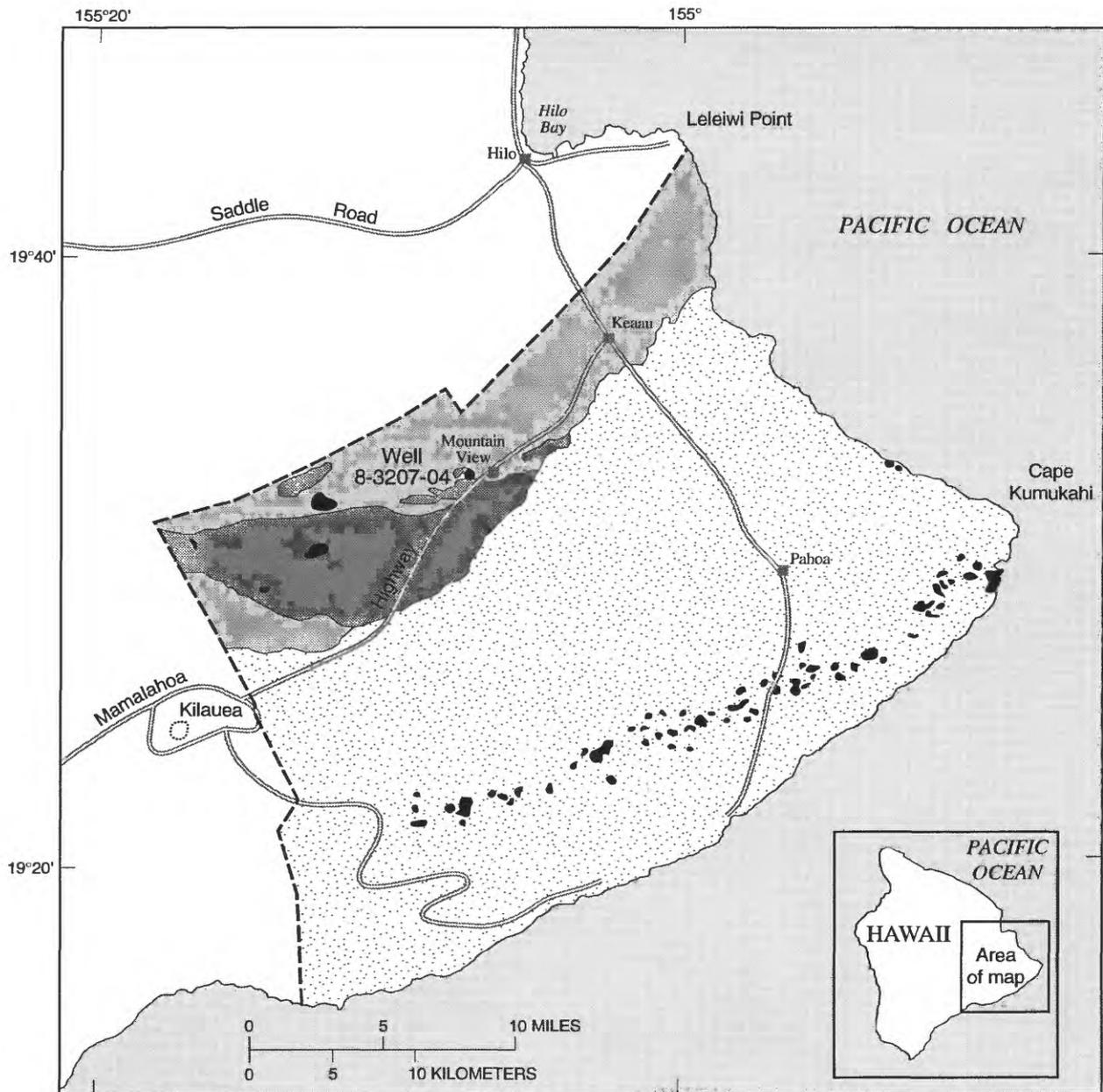
Within the Puna District, ground water is found as basal water, which is that roughly lens-shaped body of freshwater near sea level floating on seawater, and as high-level ground water which may be impounded by volcanic dikes or other structures or perched on low-permeability units such as volcanic ash. Recharge to the basal ground-water body is from direct infiltration of rainfall on the permeable land surface, from subsurface discharge of high-level ground-water bodies, and from the infiltration of water flowing over permeable rock in stream channels. Recharge to the high-level ground-water bodies is from direct infiltration of rainfall. Discharge from basal water is by springs and seeps visible at or near the coast or discharging below sea level off-

shore. Discharge from high-level ground-water bodies is from springs and seeps and from sub-surface leakage to basal water bodies.

The largest and most accessible freshwater supplies in the Puna District can be found in the basal water body. The greatest volume of ground-water flow is concentrated between Hilo and Pahoa. There are few streams draining this high rainfall area and the natural discharge of ground water to the sea is estimated at several hundred million gallons per day. The water table rises inland from near sea level at the coast along gradients of between 1 and 4 ft/mi. Wells located about 5 mi inland and tapping this basal water body have freshwater levels of 15 to 19 ft above sea level which are among the highest water levels in basal wells on the island and produce water of excellent quality with chloride concentrations of less than 25 mg/L (Davis and Yamanaga, 1973). South of Pahoa, basal water wells are located much closer to the coast with freshwater levels of 1 to 3 ft above sea level and chloride concentrations of 190 to 6,000 mg/L. A summary of selected drilled wells in the Puna District is found in table 1 and well locations are shown in figure 4.

While numerous perched springs discharge from the lava flows of Mauna Loa near Hilo, and along the upper reaches of Waiakea Stream, which is just north of the northern boundary of the Puna District, no evidence of high-level springs is found within the District. Ten test holes were drilled in 1936 near Mountain View over an area of about 10 mi² to explore for high-level perched water. The test holes, all but one of which were located at elevations between 1,000 and 2,000 ft, were drilled to depths ranging from 60 to 160 ft below the ground surface. Each hole penetrated one or more thin zones of water perched on ash layers or dense lava flows. Driller's notes indicated that water in the holes drained quickly when the perching beds were pierced by the drill bit. A few miles northeast of these test holes near Keaau, shaft 7 (State well number 8-3702-01) was dug in 1936. The shaft penetrated lava flows to a depth of 217 ft. A 2-ft thick ash bed was encountered at 54 ft below ground surface and no water was perched and no water entered the shaft at that level even after heavy rain (Davis and Yamanaga, 1968).

The Mountain View exploratory well was drilled through the rocks of Mauna Loa to a depth of 1,155 ft below ground surface in the same general area where most of the 10 test wells noted above were drilled. The



Base modified from U.S. Geological Survey digital data, 1:24,000, 1983, Albers equal area projection, standard parallels 19°08'30" and 20°02'30", central meridian 155°26'30"

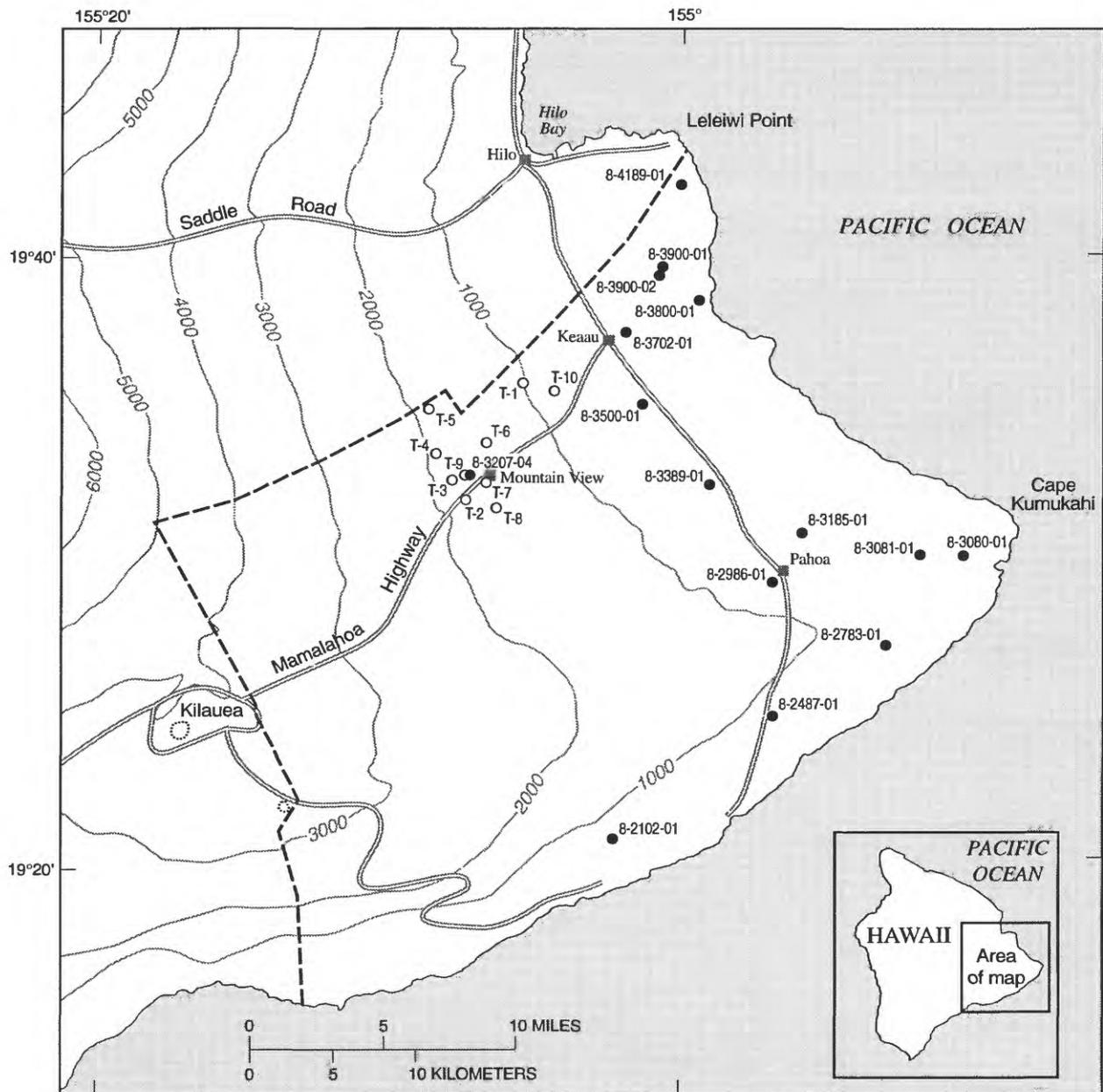
EXPLANATION

- CINDER AND SPATTER CONES
- MAUNA LOA VOLCANO
 - Kau Basalt (Pleistocene)
 - Kahuku Basalt capped by Pahala Ash (Pleistocene)
- KILAUEA VOLCANO
 - Puna Basalt (Holocene-Pleistocene)
 - CRATER
- PUNA DISTRICT BOUNDARY

Figure 3. Generalized geology of the Puna District, island of Hawaii (modified from Davis and Yamanaga, 1968 and Langenheim and Clague, 1987).

Table 1. Elevation, water-level, and chloride-concentration data for selected drilled wells and shafts in the Puna District, island of Hawaii
 [Data from Davis and Yamanaga (1973) and State of Hawaii Commission on Water Resource Management. Datum is mean sea level; --, not sampled or no data]

State well no.	Year drilled	Elevation (feet)	Water level (feet)	Chloride concentration (milligrams per liter)
8-2102-01	1963	230	3	278
8-2487-01	1961	752	3	72
8-2783-01	1962	274	1	5,350
8-2986-01	1960	705	18	2
8-3080-01 (shaft)	1965	38	3	174
8-3081-01	1961	287	3	345
8-3185-01	1964	402	11	16
8-3207-04	1995	1,686	1,012	--
8-3389-01	1960	427	19	12
8-3500-01	1961	311	16	10
8-3702-01 (shaft)	1936	220	15	10
8-3800-01	1950	40	7	120
8-3900-01	1949	92	9	31
8-3900-02	1964	95	8	207
8-4189-01	1959	36	3	680



Base modified from U.S. Geological Survey digital data, 1:24,000, 1983, Albers equal area projection, standard parallels 19°08'30" and 20°02'30", central meridian 155°26'30"

EXPLANATION

- | | | | |
|-------------|-------------------------|--------|--|
| 8-3207-04 ● | DRILLED WELL AND NUMBER | —2000— | TOPOGRAPHIC CONTOUR--Interval 1,000 feet |
| T-6 ○ | TEST HOLE AND NUMBER | ○ | CRATER |
| | | --- | PUNA DISTRICT BOUNDARY |

Figure 4. Selected drilled wells and test holes in the Puna District, island of Hawaii.

Table 2. Construction data for the Mountain View exploratory well, island of Hawaii

[Datum is mean sea level; USGS, U.S. Geological Survey]

Well name	Mountain View exploratory well
State well number	8-3207-04
Latitude and longitude	19°32'50" 155°07'21"
Hawaii tax map key number	1-8-5-18
Landowner	AMFAC/JMB Hawaii
Well completed	March 23, 1995
Driller	G. Wayne Heick, USGS
Surface hole diameter	12-3/4 inch
Bottom of surface casing	1,612 feet
Surface casing type and diameter	Steel, 0.188-inch wall, 8-inch inside diameter
Final hole diameter	6-3/4 inch
Bottom of well elevation	544 feet
Inner casing type and diameter	Steel, solid and slotted, 4.5-inch outside diameter
Slotted interval elevations	1,122 feet to 544 feet
Reference mark elevation (bolt in concrete pad)	1,686.86 feet
Measuring point (top of 4-inch casing) elevation	1,687.84 feet
Water level and date of measurement	1,012.34 feet; March 23, 1995

well encountered high-level ground water standing at an elevation of 1,012 ft above sea level. The extent of this ground-water body and the nature of the impounding structures are not known.

DRILLING, CONSTRUCTION, AND CALIPER LOGS FOR THE MOUNTAIN VIEW EXPLORATORY WELL (STATE WELL NUMBER 8-3207-04)

The Mountain View exploratory well was drilled with an air-rotary drill rig using water, drilling foam, and polymer as the drilling fluid to stabilize the borehole and aid in the removal of cuttings and water. Samples of materials penetrated by the bit were obtained at 5 ft intervals except at those depths where drilling-fluid circulation was lost. Drilling began on February 28, 1995 and was completed on March 23, 1995. A 12-3/4 in. hole was drilled to a depth of 75 ft and 8-in. inside-diameter steel casing was grouted in place. The remainder of the hole was drilled using a 6-3/4 in. tricone tungsten carbide bit. Well-construction data are provided in table 2, driller's log provided in table 3, and construction details are shown in figure 5.

A caliper log (fig. 6) was made after reaching the final depth of 1,155 ft. The caliper tool is a means to indirectly measure hole diameter and smoothness. The tool has three 16-in. spring-loaded arms that are extended when the tool is at the bottom of the hole. As the tool is slowly raised, the logging unit records the extension of the arms as they drag against the walls of

the borehole. The maximum extension of the caliper arms is 32 in.

Finally, the hole was cased with 4-in. inside-diameter, flush joint, steel casing (table 3). Blank casing was installed to a depth of 660 ft and slotted casing from 660 ft to 1,120 ft, as 12 ft of hole was lost due to caving. The 4.5-in. outside-diameter casing was grouted from a depth of 95 ft to the surface and a 4-ft² 4-in. thick concrete pad was constructed.

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Stearns, H.T., and Macdonald, G.A., 1946, Geology and ground-water resources of the island of Hawaii: Hawaii Division of Hydrography Bulletin 9, 363 p.

Table 3. Driller's log of Mountain View exploratory well (State well number 8-3207-04), island of Hawaii
 [Drill crew--G. Wayne Heick, Kimo K. Akina, Charles J. Ewart; °F, degrees Fahrenheit]

Date	Depth (feet)	Log/remarks	
2/28/95		Begin drilling	
	0-3	Fill debris, dry to damp	
	3-7	Grey aa core, hard, dry	
	7-15	Grey aa core, uniform, hard, dry	
	15-20	Grey-brown aa core, hard, dry	
	20-23	Red, oxidized aa, medium soft, moist	
	23-30	Grey-brown, aa core, medium to hard, dry	
	30-61	Blue-gray aa core, hard, dry	
	61-63	Void, lost circulation	
	63-68	Blue rock, very hard, no return	
	68-73	Broken aa, clinker zone?, no return	
	73-74	Aa core?, hard, no return	
3/1/95		Weld pipe, set surface casing	
3/6/95	74-76	Aa core, very hard, good returns	
	76-78	Puka rock, good returns	
	78-82	Aa core, hard, uniform, good returns	
	82-90	Aa, broken, clinkery, caving in hole	
	90-93	Aa core, medium hard, good returns	
	93-109	Aa core, very hard, good returns	
	109-117	Red puka rock, medium soft, good returns	
	117-122	Grey aa core, medium hard, good returns	
	122-130	Aa, broken, loose, clinkery, good returns	
	130-134	Aa core, hard, red-brown to grey, good returns	
	134-143	Aa, broken, red, clinkery, medium soft, returns okay	
	143-146	Aa core, brown to grey, hard, good returns	
	146-150	Aa, soft, broken, grey-red, good returns	
	150-156	Aa core, grey, medium hard, some breaks, return okay	
	156-168	Blue rock, very hard, uniform, good returns	
3/7/95	168-179	Blue rock, very hard, good returns	
	179-183	Void, lost circulation	
	183-194	Aa, broken, clinkery, grey to red, medium soft	
	194-196	Aa core, medium hard, red to grey, good returns	
	196-209	Aa, grey to red, medium soft, clinkery, good returns	
	209-212	Aa core, red-brown, medium hard, good returns	
	212-248	Aa, red, soft, loose, good returns	
	248-252	Aa core, red to brown, medium hard, good returns	
3/8/95	252-260	Aa core, brown-grey, hard, good returns	
	260-267	Aa, grey-red, broken, soft, good returns	
	267-276	Red ash?, very soft, possible water	
	276-281	Aa, grey-red, broken, medium soft, good returns	
	281-299	Aa core, blue-grey, hard, good returns	
	299-304	Red ash?, very soft, clay like, good returns	
	304-324	Aa, reddish brown, broken, soft, good returns	
	324-336	Aa core, medium hard, uniform, good returns	
		336-345	Aa, grey-red, broken, clinkery, soft, return okay
		345-377	Aa core, grey-green, olivine, medium hard, returns okay
		377-388	Aa, red-pink, broken, soft, stable, good returns
		388-393	Aa core, pink-grey, good returns
		393-406	Aa, grey-reddish brown, medium soft, returns okay
		406-421	Aa core, red-grey, medium hard, good returns

Table 3. Driller's log of Mountain View exploratory well (State well number 8-3207-04), island of Hawaii--Continued
 [Drill crew--G. Wayne Heick, Kimo K. Akina, Charles J. Ewart; °F, degrees Fahrenheit]

Date	Depth (feet)	Log/remarks
	421-429	Aa, red, broken, loose, good returns
	429-441	Aa core, red-grey, broken, medium hard, good returns
	441-452	Aa, grey-red, broken, medium hard, good returns
3/9/95	452-455	Aa, grey-red, loose, broken, good returns
	455-472	Aa core, grey-lt.brown, medium hard, uniform, return okay
	472-477	Aa, grey-brown, loose, soft, good returns
	477-479	Ash layer?, red, very soft, good returns
	479-496	Aa, red-brown, medium hard to soft, good returns
	496-510	Aa core, grey-brown, medium hard, good returns
	510-512	Void, lost circulation, stiffer foam but no good
3/10/95	512-528	Aa, very broken, unstable, no returns
	528-550	Aa core, medium hard, grey, no returns
	550-569	Aa, red-grey, medium to soft, no returns
	569-582	Aa core, red-grey, soft, broken, some returns
	582-596	Aa, grey-red, soft, broken, some returns
	596-604	Aa core, red-grey, hard, some broken, good returns
	604-620	Aa, grey-red, broken, medium soft, good returns
	620-626	Aa core, red-grey, good returns
	626-630	Aa, red, medium soft, good returns
	630-632	Ash? grey, soft, good returns
	632-647	Aa, grey-red, medium soft, good returns
	647-651	Aa core, grey-blue, hard, uniform, good returns
	651-679	Aa, grey, medium hard to soft, unstable
	679-692	Aa core, grey-brown, hard, return lost about 680 feet
3/11/95	692-734	Aa, red, broken, clinkers, return back at 712 feet
	734-750	Aa core, red-grey, good returns
	750-765	Aa, red-grey, medium soft, spotty returns
	765-780	Aa core, red to grey, medium to hard, good returns
	780-786	Aa, grey-red, loose, broken, soft, returns okay
	786-799	Aa core, red to grey, broken, good returns
	799-830	Aa, grey-red, broken, good returns, water??
	830-844	Aa core, grey-brown, uniform, good returns
		Increase in air back pressure at 834 feet, ran static air test for 10 minutes. Water at 824 feet
	844-854	Aa, red-grey, broken, medium to soft, good returns
3/12/95	854-908	Aa, grey to red, broken, unconsolidated, return okay Olivine in samples from 880-895 feet, water temperature 66.2°F
	908-913	Aa core, red to grey, medium hard, good returns
	913-1,023	Aa, grey to red, unconsolidated, soft, more water Water temperature at 940 feet 64.9°F; 63.7°F at 980 feet
	1,023-1,031	Aa core, grey with some olivine, medium hard, return okay
	1,031-1,034	Aa, broken, grey-red, medium to soft, good returns
3/13/95	1,034-1,046	Aa core, red-grey, uniform, good returns
	1,046-1,051	Aa, grey to red, medium to soft, good returns
	1,051-1,054	Blue rock, medium hard, good returns
	1,054-1,060	Aa, grey with some red, medium to soft, good returns
	1,060-1,074	Aa core, grey, medium hard, uniform, good returns
	1,074-1,089	Aa, grey to red, broken, some clinkers, returns okay
	1,089-1,115	Blue rock, very hard, some breaks, good returns
	1,115-1,121	Aa, grey-red, broken, voids, good returns

Table 3. Driller's log of Mountain View exploratory well (State well number 8-3207-04), island of Hawaii--Continued
 [Drill crew--G. Wayne Heick, Kimo K. Akina, Charles J. Ewart; °F, degrees Fahrenheit]

Date	Depth (feet)	Log/remarks
	1,121-1,126	Aa, void, very soft, possible cinder, returns okay
	1,126-1,137	Aa core, red to grey, medium hard, good returns
	1,137-1,141	Aa, grey-red, very loose, small clinkers, return okay
	1,141-1,155	Aa core, grey, very hard, good returns, water temp 61.7°F at 1,155 feet. Hole standing okay. Drilling ended---Total depth 1,155 feet
3/14/95		Stripped out tools, debris in hole, tools dragging Attempt to get depth to water at 1,100. Hole plugged at 90 feet. Ran tools back in drilled to 140 feet, pulled tools. Attempt to get depth to water, bridge at 220 feet. Ran tools in drilled to 360, stripped out Another bridge at 624 feet
3/15/95		Loaded casing at yard, set up to perforate pipe
3/20/95		Finished perforating.
3/21/95		Drilled from bridge at 624 to 712 feet. Bit plugged. Unplugged bit drilled to 852. Pulled tools, added de-foamer to hole. Measured depth to water to be 728.2 at 1,450 (poor reading). Tripped to bottom of hole. Lost 12 feet of hole due to caving. Total depth now 1,143 feet
3/22/95		Pull tools out. Caliper log hole at 12 noon. Cased hole 1330-1900 hours. Depth to water at 1900 hours is 678.6 feet, from drill table. Total depth of hole is 1,143 feet
3/23/95		Depth to water 675.5 feet from ground level at 0900, grouted hole. Constructed pad. Job complete
3/24/95		Depth to water 677.06 feet from top of 4-inch casing at 1100
3/25/95		Depth to water 677.50 feet from top of 4-inch casing at 0900
3/26/95		Depth to water 677.30 feet from top of 4-inch casing at 0900
3/27/95		Depth to water 677.00 feet from top of 4-inch casing at 1300
3/28/95		Depth to water 677.30 feet from top of 4-inch casing at 1300

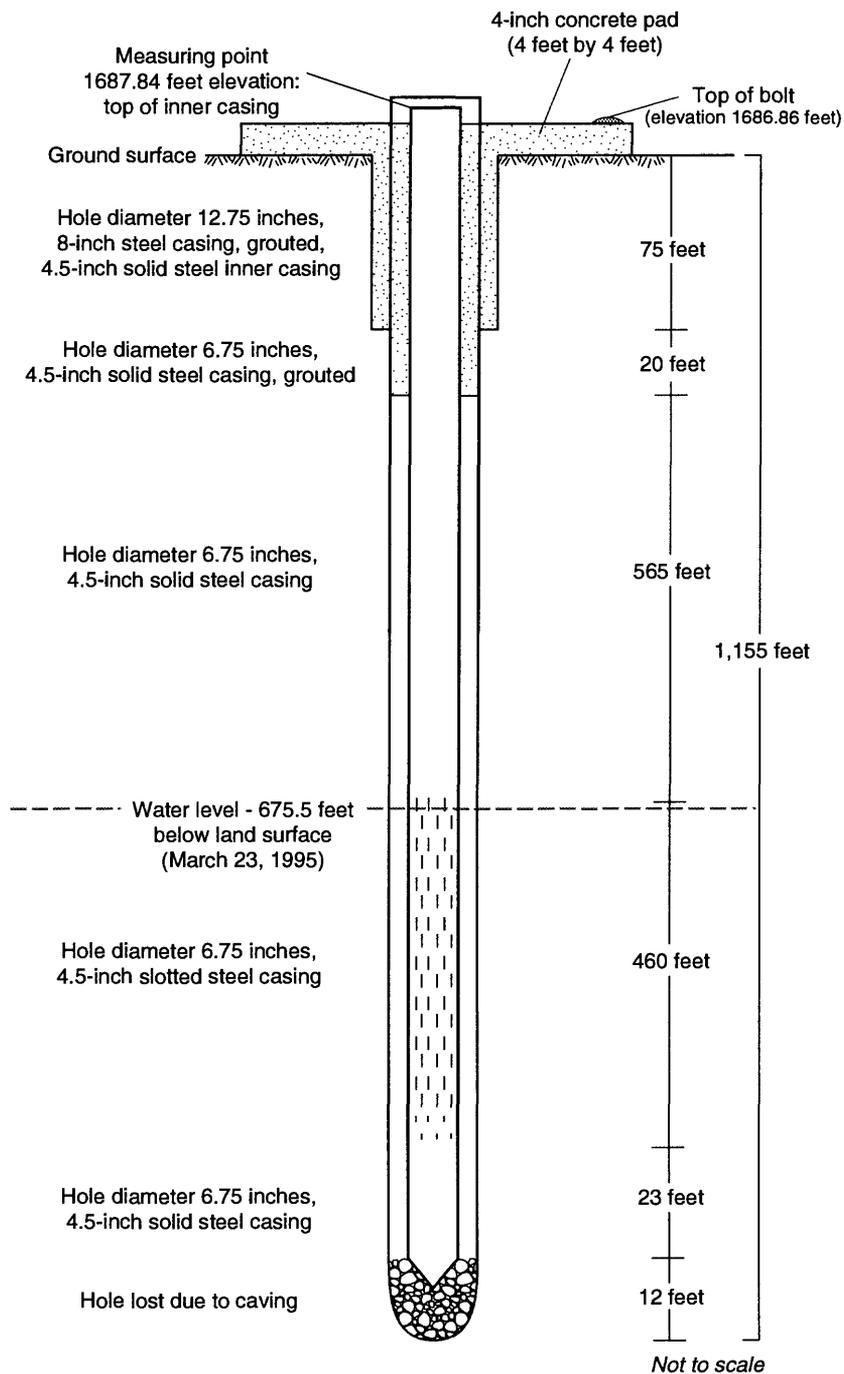


Figure 5. Construction details of the Mountain View exploratory well (State well number 8-3207-04), island of Hawaii.

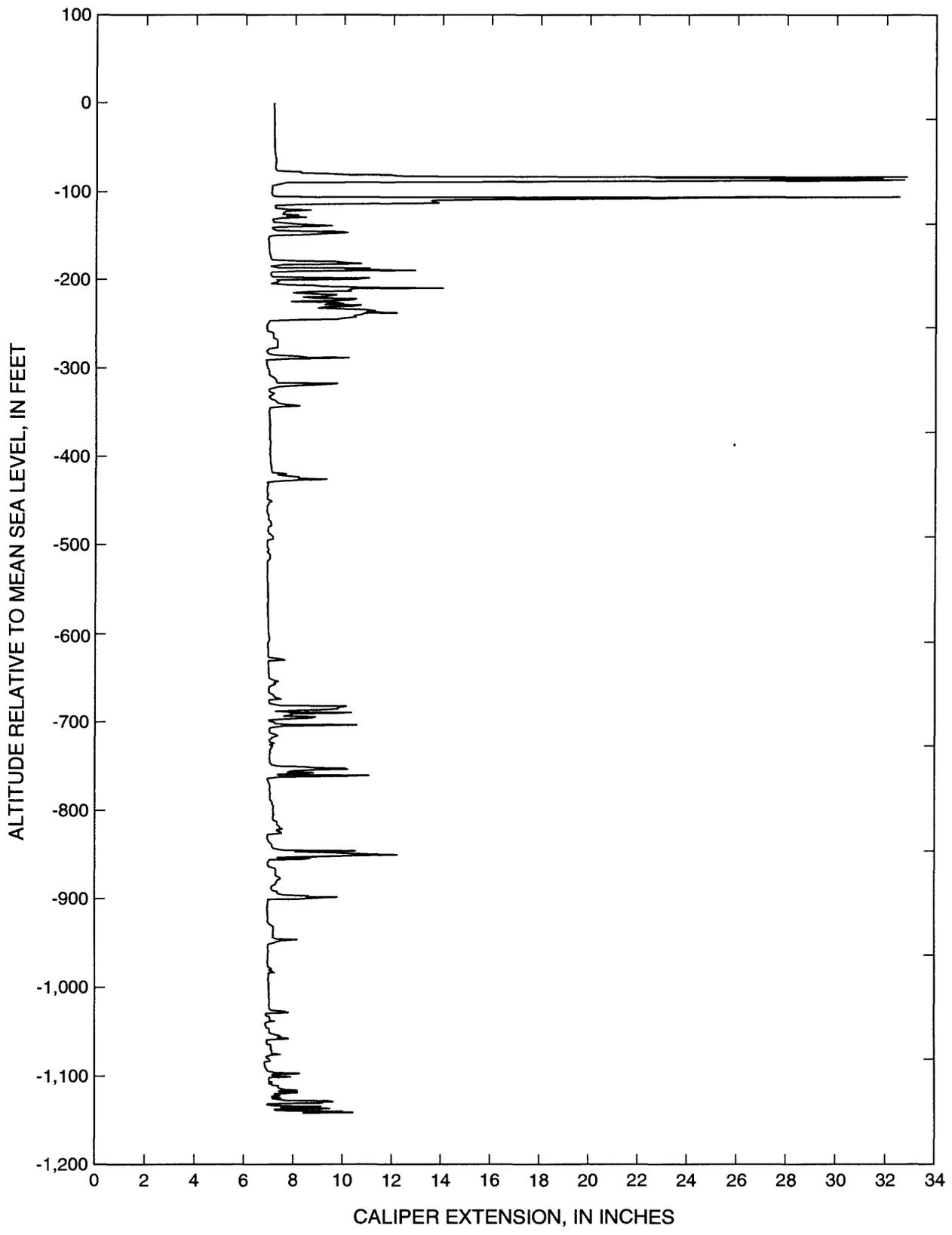


Figure 6. Caliper log for the Mountain View exploratory well (State well number 8-3207-04), island of Hawaii.