THE CATLIN GABEL LAVA TUBES OF WEST PORTLAND, OREGON
Remnants of a Plio-Pleistocene Cave System

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During mapping of the Portland Hills, the author and his students found evidence of lava tubes. Their existence was first noted during a foundation study of the St. Vincent Hospital, but their origin and extent was not apparent until our field investigation in May 1974. They occur among a cluster of cinder cones and associated lava flows of Pliocene to late (?) Pleistocene age that occupy an area of approximately 25 square miles on the west side of the Portland Hills (probably they are the westernmost of this age in Oregon), and the fragmentary remains of their lava tubes present a very unusual opportunity to study the effects of the passage of time on such cave systems.

During detailed mapping of the Portland Hills for the Portland Environmental Geology project, the author and his students found evidence of lava tubes near Catlin Gabel School on the western slope of the Portland Hills. While only fragmentary remnants remain, they are the oldest known in Oregon and present a very unusual opportunity to study the effects of the passage of time on such cave systems.

Existence of the tubes was first noted by R. J. Deacon (Shannon and Wilson, Inc. 1968) during a foundation study at the St. Vincent Hospital site just west of the Catlin Gabel School and was later discussed by Squier (1970). But the origin and extent of these interesting volcanic features were unknown until our field investigation in May 1974.

The Catlin Gabel lava tubes occur among a cluster of cinder cones and associated lava flows of Pliocene to late (?) Pleistocene age (between 5 and 1 million years old) that occupy an area of approximately 25 square miles on the west side of the Portland Hills (Figure 1). Lava tubes have not previously been described in Oregon lava flows older than Holocene (last 10,000 years).

Mount Sylvania is the largest of the Pliocene-Pleistocene volcanoes in the map area, but at least four and possibly as many as eight other volcanic vents and associated lava flows lie to the northwest as far as Germantown Road, 12 miles north of Mount Sylvania, and one other lies to the southeast. These volcanoes are probably the westernmost of this age in Oregon.

The area covered by lava flows and vents was first mapped by Trimble (1963), who assigned these rocks to the Boring Lava, a geologic unit first named by Treasher (1942) after a cluster of volcanoes around the town of Boring about 10 miles southeast of Portland.

The source of the lava containing the tubes is a small volcanic vent situated between two others near the southern end of the northern area of volcanoes (Figure 1). Its elevation is 974 feet above sea level. From the base of this vent, the lava extends south and then west for about 2-1/2 miles. It is about 500 feet wide and slopes approximately 150 feet per mile, or 3 percent (Figure 2). Near its center, the total thickness of lava is 235 feet, as shown by a drill hole located 1,000 feet south of the central depression (Schlicker and Deacon, 1967, pl. 2, C-C').

The lava overlies 434 feet of silt of the Troutdale Formation, which in turn lies upon Columbia River Basalt. The surface of the Columbia River Basalt rises very steeply to the northeast and crops out only 2,000 feet east of the vent (Figure 3).

During foundation excavation for the St. Vincent Hospital, Shannon and Wilson (1968) found that the upper lava unit containing the tubes was about 90 feet thick and the overlay was very compact silt.

Recent erosion has modified the original surface expression of the lava, and a mantle of Portland Hills Silt as much as 30 feet thick has further masked the surface. It is perhaps surprising, in view of the age of the flow, that its outlines can still be mapped with a reasonable degree of confidence (Figure 2).

A southern lobe of lava, which extends almost a mile south of Sunset Highway (Fig. 2), is interpreted to be an older flow unit, possibly from the same vent, that filled most of a pre-Boring valley.

Multiple eruptions from the source vent produced several flow units which apparently followed down a pre-existing valley on the west slope of the Portland Hills. The lava tubes developed in the uppermost flow when the surface

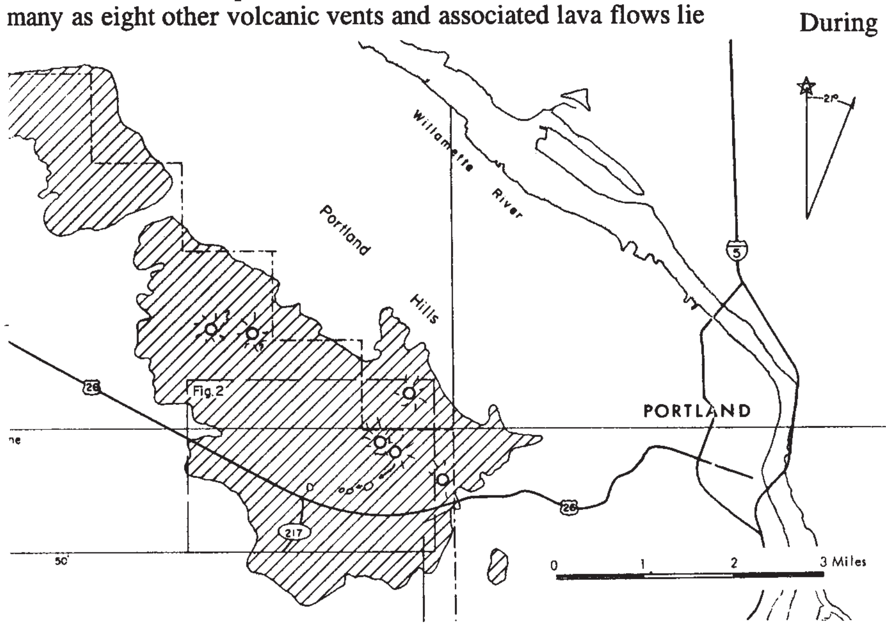

Figure 1. Location of Catlin Gabel Lava Tube and nearby vents. Shaded areas are Boring lava of Plio-Pleistocene age.

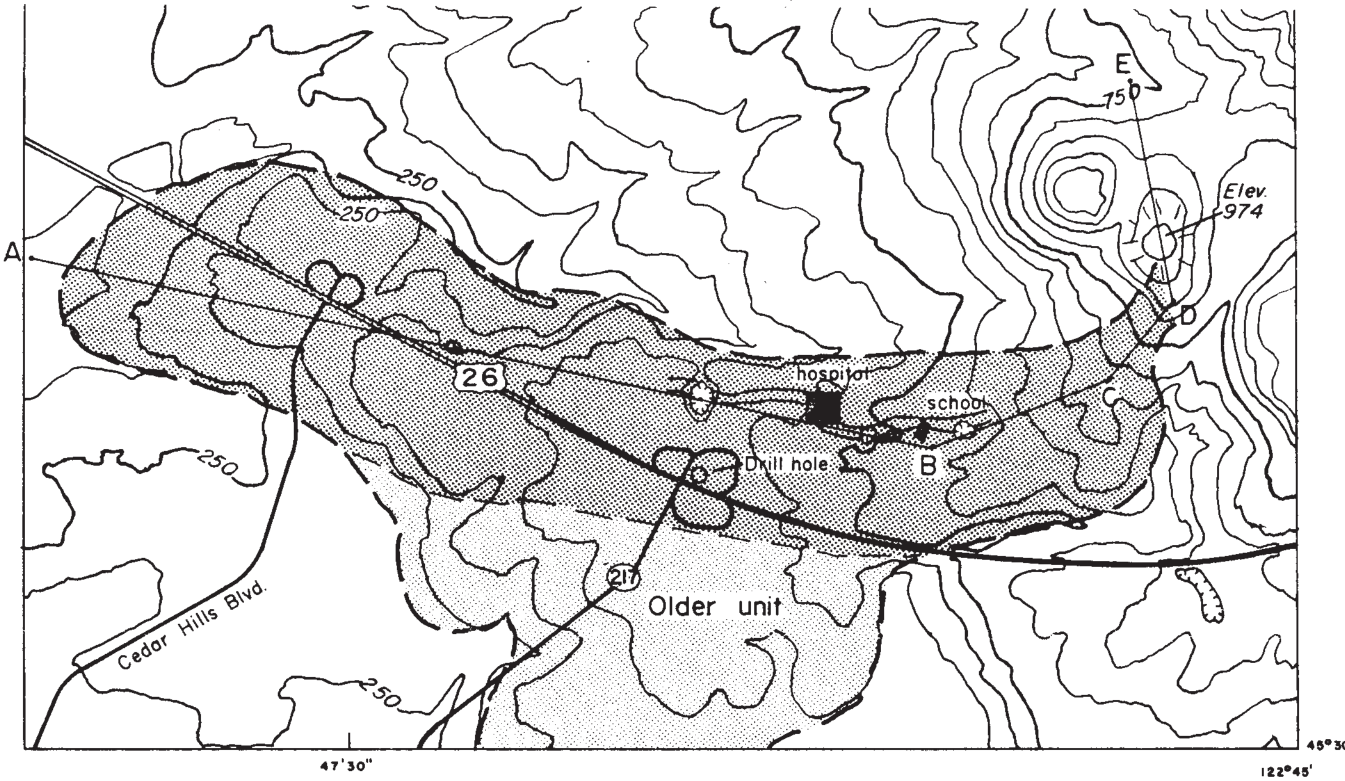

Figure 2. Catlin Gable lava flow and lava tube depressions.

of the lava congealed and the interior continued to advance until drained.

Tne lava of the latest flow extends south from the vent and then west in an arc which lies just north of and nearly parallel to Barnes Road (Figure 2). Along the center of the arc, within a distance of 6,000 feet, are five closed depressions.

From east to west, the five depressions are as follows: The first (55 feet deep and 500 feet across) lies just east of Catlin Gabel School; the next two depressions (35 and 45 feet deep, 100 and 200 feet across) lie just west of the school; the fourth (30 feet deep and 400 feet across) is north of the interchange of Highway 217 with Sunset Highway; and the fifth depression (50 feet deep, 150 feet across) lies just north of Sunset Highway and 1,000 feet east of the Cedar Hills Boulevard interchange. (See USGS Linnton 7-1/2 minute topographic quadrangle).

Since there are no visible openings to uncollapsed segments of the tube system, little is known of its characteristics. Apparently, at least part of its course was made up of branching or tributary lava tubes. At the St. Vincent Hospital site, excavation revealed two northwest-trending collapsed tubes that joined to the northwest. The two rubble-filled channels were up to 40 feet wide and 60 feet deep and required special engineering design for the foundation of the 15-story building (Squier 1970).

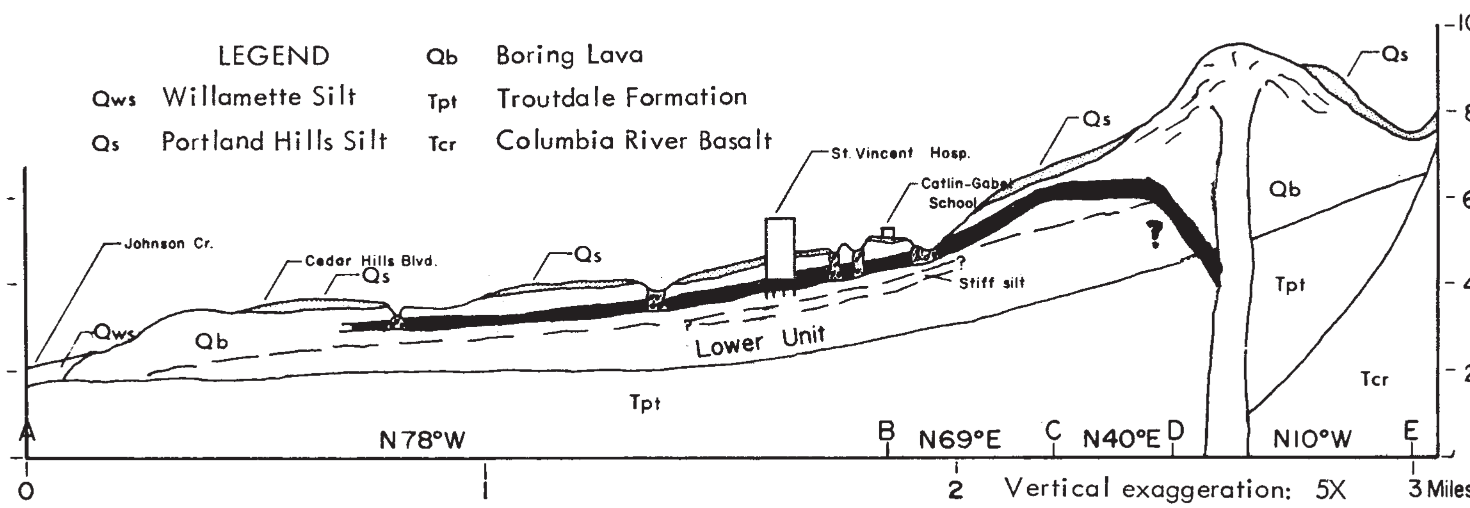

Figure 3. Generalized longitudinal section of the Catlin Gable lava flows showing relative positions of tube and latest collapse depressions. Plan of cross section A through E shown in Figure 2.

Although the cross section (Figure 3) shows segments of the tube still intact, an alternate possibility exists — the entire tube system may have collapsed. In that event, the tubes would consist of channels filled with the debris of the collapsed roofs. According to R. J. Deacon (Shannon and Wilson 1968), the "rubble-filled channels" beneath the hospital site were masked by undisturbed layers of ash and silt. This indicates that the roof of the two tubes at that location may have fallen in before the ash and silt were deposited. If this alternative is valid, it has important engineering implications: those structures such as Catlin Gabel School, that directly overlie the projected course of the tubes, would be in less danger of collapse.

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PROCESSES OF DEVELOPMENT OF LAVA TUBES AT MAUNA ULU, KILAUEA VOLCANO, HAWAII

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ABSTRACT

During the prolonged eruption of basaltic lava at Mauna Ulu from 1969 to 1974, many lava tubes developed. Conditions frequently allowed close and systematic observations, which greatly improved understanding of the processes involved.

A basic requirement for a lava tube to form is a prolonged flow at a steady rate, during which the flow becomes confined to a discrete channel. Chilling of the upper surface of the flow results in the development of thin, scum-like crust on the molten surface. Such crusts commonly adhere to the margins of the channel, and during extended flow, the crust grows outward from the margin across the flow surface. If the level of the surface remains constant, the crusts growing from opposite sides of the channel merge in the center. This initial roof is thin and weak, and either a rise or fall of the lava surface will cause it to break. But if the flow rate remains constant, continued cooling allows the crust to become thicker and stronger, and

Figure 1. Lava stream emerging from an earlier-formed tube and flowing toward the camera. A thin crust is accreting to both lateral margins of the stream and growing across the surface of the flowing lava. A few days later the crust had grown completely across the stream, forming a roof and creating a new lava tube. August, 1970.

Figure 2. Lava stream flowing from right to left, emerging from beneath a newly formed crust. On the right, the crust has been growing completely across the surface, and it is accreting downstream toward the left. Slender, flexible fingers of crust extend from the downstream edge; they gradually thicken and merge laterally and new fingers then develop along the advancing edge of the crust. The downstream growth rate may reach as much as several meters an hour. February 13, 1971.