
Lava Caves in the Hallmundarhraun Lava Flow, Western Iceland

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Abstract

Hallmundarhraun is located in the Borgarfjörður region in western Iceland. The flow is of Holocene age. Tephrochronological studies and ^{14}C datings suggest that the absolute age of the flow could be about 1,050 years, thus it flowed in historical times, in the early tenth century. The flow covers an area of approximately 200 square kilometers. The volume of the flow has been estimated to be two to three cubic kilometers.

This particular flow is unique and outstanding among Icelandic flows due to the enormity of speleological phenomena. Four out of five Icelandic lava caves exceeding one kilometer in length are in the Hallmundarhraun lava flow. The total number of caves and caverns is 12. In some of the caves archaeological remains are to be found, mostly cattle and sheep bone fragments, cairns, fences, and piles of rock. Little is known about these remains.

Brief Outline of the Geology of Iceland

Iceland is predominantly of volcanic origin. The exposed volcanic pile is mostly basalt (80 to 85%) of tholeiitic composition. Altogether Tertiary rocks cover about 50,000 square kilometers or about one half of the total area of Iceland. Radiometric dating suggests that the oldest exposed rocks are 12 to 16 million years old.

Few indications of speleological formations have been noted in the Tertiary lava pile. Walker (1959) mentions a roughly circular section of infilled lava tube 6.5 to 8.0 meters in diameter.

The Plio-Pleistocene and upper Pleistocene areas cover about 40,000 square kilometers occupying broad and distinctive zones between the Tertiary area and the neovolcanic zones. The boundary between Tertiary and Plio-Pleistocene is somewhat arbitrarily fixed at the base of the Mammoth magnetic polarity event (3.1 million years ago) when the first widespread tillites appear in the strata. The Upper Pleistocene formation comprises rocks formed during the Brunhes magnetic epoch which began 0.7 million years ago, excluding the Postglacial which is referred to as rocks formed 13,000 to 10,000 years ago – until 874 AD when the first settlers came to Iceland – younger formations are thus “historical.”

Postglacial volcanism continued along the same pattern as during former interglacial periods and the composition of volcanics is similar to those formed in the Tertiary, Plio-Pleistocene, and Upper Pleistocene. Total lava production in postglacial time is estimated to be 400 to 500 cubic kilometers and the lavas cover about 12,000 square kilometers or about 10% of the surface of Iceland.

Volcanic Activity in Historical Time

Volcanic activity in Iceland in historical time has produced large quantities of lavas and is a direct continuation of the prehistoric postglacial activity and is confined to almost the same areas, i.e. within the neovolcanic zones. Nearly every type of volcano found on the face of our globe is represented in Iceland, and the diversity of volcanic phenomena is much greater than to be expected on an oceanic island.

The number of known volcanic events is about 250 for the last 1,100 years, but the total number of individual flows has never been estimated, as the volume of each ranges from less than 0.1 cubic kilometers to 12 cubic kilometers in the Skaftáreldar (Laki) eruption in 1783. That particular flow is the greatest single lava flow erupted on the earth in the last 1,000 years.

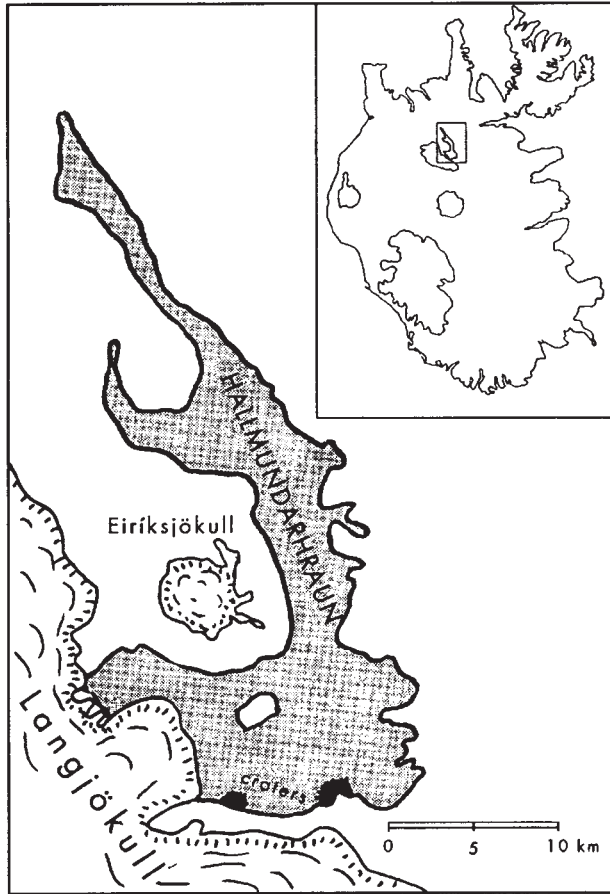


Figure 1—Hallmundarhraun, western Iceland.

Hallmundarhraun

Hallmundarhraun is the largest lava flow in the Borgarfjörður area in western Iceland, originating from craters just off the flanks of the Langjökull glacier. The area of the flow is about 200 square kilometers and the volume has been estimated to be about two to three cubic kilometers. Two craters are visible just off the edge of the Langjökull glacier but others and a possible eruptive fissure could be covered by the advancing ice of the glacier. A ^{14}C dating of peat from beneath the Hallmundarhraun lava flow was published by Saemundsson (1966), giving the age $1,190 \pm 100$ years before present.

Recent reinvestigations of the age of the lava flow were published by Jóhannesson (1989) using tephrochronological methods. The lava flow overlies the "Settlement layer" formed around 900 AD. It is believed that the eruption forming Hallmundarhraun occurred during the first decades of the tenth century.

The distance from the distal margin of flow to the craters is about 50 kilometers. Near the craters the flow is about 600 meters above sea level, the surface being extremely rough, nearly void of any vegetation, and sandy. Large outwash plains exist near the Eiríksjökull glacier. Further downslope the surface type changes from an aa lava to more pahoehoe-like lava. Numerous large collapsed tumuli, shrinkage cracks, pressure ridges, and other cooling and contracting phenomena are present.

The Lava Caves of Hallmundarhraun

Altogether 12 lava caves are known in the Hallmundarhraun lava flow, thus earning the lava flow a special recognition among Icelandic flows. Of five lava caves exceeding one kilometer in total length currently known in Iceland, four are in Hallmundarhraun. Three of the largest caves of Hallmundarhraun have been surveyed, and the remaining ones have only been explored to some extent. Following is a short description of lava caves known in Hallmundarhraun.

1. Surtshellir—Stefánshellir Cave System

The total length of this system is about 3,500 meters. It comprises two lava tubes separated by a collapse pit. Although the lava tubes have been given two separate names, it is believed that they constitute one major system. The cave drops 18 meters in its whole length. Maximum width of the passage is 27 meters, the main passage has an average height of eight meters and the maximum height is ten meters. Ceiling thickness varies from nine meters to zero meters with ten areas of complete ceiling collapse providing the entrances to the system (McKain, 1989).

Surtshellir is the down-flow segment, with 1,970 meters of passage. The cave's ceiling is extensively collapsed, but original floor can be seen in large parts of the cave and flow structures are well preserved on the cave's walls. In one side of the passage archaeological remains consisting of stone benches, fire places, and bone fragments occur. These have suggested the theory that inhabitants lived in the cave because of suitable temperature shortly after the eruption, contrary to a famous Icelandic legend where outlaws had supposedly built and occupied the cave as early as the tenth

century. Surtshellir has been known to locals for a long time, the first mentions of the cave are in the old Icelandic Sagas.

Stefánahellir, the up-flow segment of the system, was rediscovered in the early 1950s and near the entrance was a small cairn. The cave comprises a maze of passages and the cave's ceiling is not collapsed to any extent, as it is in Surtshellir. The total length of passages is about 1,520 meters. The up-flow beginning of the system is a lava seal, the ceiling dropping rapidly to meet the last lava level. The roof rises rapidly and forms a passage 7 meters high and 13 meters wide. The main passage continues relatively linear for about 300 meters, then it assumes its maze-like pattern. The surface of the floor and walls changes from being glazed to more scoriaceous. Less than 35 meters separate the south terminus of Stefánshellir and the north terminus of Surtshellir.

2. Kalmanshellir

The cave closest to the crater area is Kalmanshellir. It has not been surveyed but by viewing aerial photographs it can be estimated that the cave is several kilometers long. The cave is extensively collapsed and the internal surface is highly scoriaceous. The cave has numerous entrances through ceiling collapses, is partially filled with aeolian sand, and is terminated by ice. In some parts of the cave a thin sheet of lava has divided the cave into two levels.

3. Víðgelmir

Víðgelmir is 33 kilometers southwest of the craters. The cave is the most voluminous lava cave in Iceland. The volume has been estimated to be 148,000 cubic meters. The total length of the cave is 1,585 meters, average height 9.2 meters, maximum height 15.8 meters, average width 10.2 meters and maximum width 16.5 meters. Víðgelmir was surveyed by the Shepton Mallet Caving Club from Britain, in 1972. Since then the cave has not been visited due to a frozen siphon 35 meters from the entrance. The condition of the siphon, whether it is frozen or not, depends upon the mean annual temperature in the cave. The level of the frozen water in the siphon rose to the present level in the 1960s, having been dry and passable from 1930 through 1960. In October 1991, local farmers finished the previously attempted opening of the cave by the Icelandic Speleological Society. Inside tem-

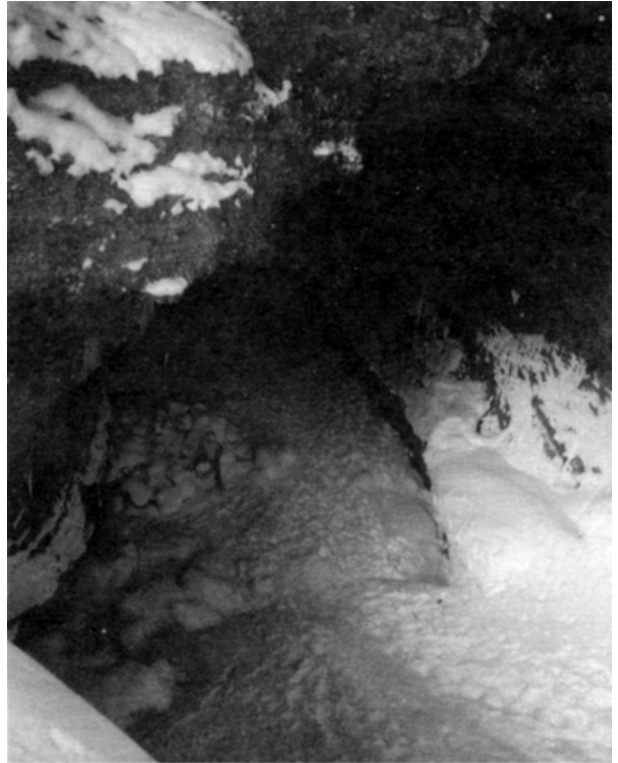


Figure 2—The entrance to Viðgelmir. (photo S.S. Jónsson)

perature of 2.7° Celsius had melted the ice tongue toward the closed entrance of the cave. The Icelandic Speleological Society installed a gate on the cave to protect the delicate lava formations inside.

4. Hallmundarhellir

Hallmundarhellir is a few kilometers south of Kalmanshellir. The total length is not less than 300 meters, but the cave has not been surveyed. The entrance to the cave is almost filled with aeolian sand. In one side passage there is evidence of human inhabitation: piles of rocks, a fire place, and bone fragments.

5. Hvassi

This is a small cave close to Hallmundarhellir. The total length is about 200 meters. The cave has not been surveyed.

6. Rjúpnahellir

A cave passage leads from a huge roof collapse only few hundred meters from the edge of the lava flow near the mountain Syðra-Sauðafell. This cave

is extensively collapsed and the total length is not known, but undoubtedly exceeds 200 meters.

7. Sandi

A less than 100-meter-long cave in the Hallmundarhellir vicinity, Sandi possibly belongs to the same lava tube system as Hallmundarhellir. A connection possibly exists.

8. Bergþórshellir

This is a tumulus close to Víðgelmir. The diameter is about 25 meters and there are two short side passages.

9. Skeggjahola

Skeggjahola is a small tumulus cave near Víðgelmir. It has been known since a human skeleton was found in the cave in the 1930s.

10, 11, 12 Franshellir, Eyvindarhola, Beinahola

These are small tumulus caves near Reykjavatn Lake. The caves are all small, with a diameter of less than 20 meters. In all the caves, archaeological

remains have been found and the caves have therefore been noted.

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