The Surtsey Eruption
Course of events during the year 1967

by
Sigurdur Thorarinsson
Department of Geology and Geography
Museum of Natural History, Reykjavik

Introduction

My contribution to the Surtsey Research work in 1967 was to follow the course of events of the eruption and the morphological changes of Surtsey. In the latter I was assisted by Guttormur Sigbjarnarson, cand.real., The National Energy Authority. In Aug. 1967 Dr. John O. Norrman from the Department of Physical Geology, University of Uppsala, was on my proposal appointed Principal investigator of the littoral morphology of Surtsey and its changes. Dr. Norrman started his field work on Surtsey on Sept. 9, 1967, and spent about 10 days on the island.

During 1967 I made 17 reconnoitring flights over Surtsey. Six times the aircraft landed on the island and two times I landed there by boat. My stays on the island varied from a few hours to four days. Like in previous years I have enjoyed the helpfulness of the Director General of Aviation, Agnar Kofoed Hansen, and the director of the Coast Guard Service, Pétur Sigurdsson. The trips to Surtsey with the aim of landing have been paid by the Surtsey Research Society. I am indebted to the pilots Sigurjón Einarsson and Thórólfur Magnússon for valuable information from their many flights over Surtsey.

Aerial mapping

Using the Coast Guard Service's aircraft SIF the Icelandic Survey Department aerial-photographed Surtsey three times in 1967, viz. on January 3rd, March 29th and July 17th. The photographs of July 17th came closest to picturing the island as it was when the eruption ended and will be used for the preparation of a topographical map, scale 1:5000 with 5 m contour intervals.

The Surtsey eruption Dec 1966 - June 5 1967

In the Surtsey Research Progress Report III I gave a short description of the beginning and first months of the effusive activity that began when a 220 m long fissure opened up on the floor of the Older Surtur Crater (Surtur I) on Aug 19, 1966 From the beginning of December the lava flowed almost exclusively in small tunnels which opened up at or a short distance inside the sea-shore.

On December 12 it was observed that vapour was rising from a fissure on the inner slope of the Older Surtur Crater Examination of Sigurjón Einarsson's pictures showed that the fissure is faintly discernible on a photo taken Oct. 2. On Dec 15 I observed the fissure from the air It stretched from the lava floor of the crater up the slope to about 105 m height above sea level and its direction was W20°N. A very small amount of lava had been poured out from its lower half, and from the upper half vapour was rising Dec. 17 Sigurjón Einarsson observed glowing lava in the lower half of the fissure, but there was no outpouring at that time, and this was the only time lava was observed glowing in that fissure. The lava produced by this fissure formed a small apron of a-a lava on top of the ropy lava floor in the Older Surtur Crater.

In the morning of Jan 1, 1967 it was observed from the Westman Islands that a fissure had opened up on the north slope of the Older Surtur Crater and lava flowed down the slope towards the lagoon. At 11 a.m. the following day, when I flew over Surtsey, the lava had filled half of the lagoon and was advancing westwards, seriously threatening the scientists' hut, Pálsbær (named after professor Paul Bauer, the benefactor of the Surtsey Research Society) situated on the west side of the lagoon (cf. the map, fig. 1).

The following morning I landed on Surtsey and studied the new eruption closer The production of lava had slowed up, and lava flowed then only from the lower one of two small craters that had been formed on the north slope of the Older Surtur Crater. The higher one of these small craters was about 110 m above sea level,

the lower one about 20 m farther down on the slope, and from the higher crater the fissure stretched upwards to about 120 m height above sea level (All the height figures may have to be corrected a little when the photogrammetric map has been worked out). From this part of the fissure some sand had been blown out, but no lava had been extruded. On the south (viz. the inner) slope of the Older Surtur Crater a fissure had opened up - probably on Jan. 1 and certainly before the morning of Jan. 2 - to an elevation of about 100 m and poured out lava although on a smaller scale than the fissure on the north side. Two small craters were active on this fissure. By this new activity the nearly N - S running system of fissures pouring out lava had reached a total length of about 0.5 km. The lava level had now been raised to about the same height as it had reached in the Younger Surtur Crater during the autumn and winter 1964/65.

On Jan. 2, shortly after noon, a miniature fissure opened up on the NE side of the Older Surtur Crater in about 60 m height and lava was seen glowing there for some hours, but practically no lava was poured out there.

Fortunately enough, the lava front that advanced over the lagoon stopped on Jan. 4 at a distance of 120 m from the scientists' hut. In the crater on the north slope the lava was last seen glowing Jan. 6, while on the south slope the lavaflow ceased two days later. It had by then formed a narrow stream of a-a lava which had flowed about 150 m towards SE along the foot of the slope.

When landing on Surtsey Jan. 7, 1967, I observed on the inner side of the Older Surtur Crater two parallel curved fault scarps - the downthrow about 1 m - and some lava had been squeezed out along the lower one. The lava filling such a fissure has actually formed a cone sheet.

From the fissures that had opened up on Aug. 19, 1966, lava flowed incessantly, but on the whole on a gradually diminishing scale, during the entire winter and spring of 1967. The average rate of lava production was about 2 m^3/sec. On June 5 it was last seen

glowing at the south shore of Surtsey, but now and then some vapour was observed rising from the south coast of Surtsey until the middle of October 1967.

As mentioned before the lava flowed mainly in tunnels In the craters on the Aug. 19-fissure the height of the lava level varied a lot, and the small lava lake boiling there gradually diminished in area. One of the last things to happen in the craters was a building up of a nearly 10 m high hornito on the floor of the northern crater during the first half of May 1967. The map, fig. 1, shows the craters as they were when the eruption ended.

At the end of the year 1967 the emission of vapour from the Aug. 19-fissure and its craters had nearly ceased, but there was still some vapour rising from the fissures that opened up in early October and on Jan. 1 on the inner side of the Older Surtur Crater and also from the upper crater on the north slope. The emission of vapour around the lava crater of 1964 seemed rather to increase during the autumn and early winter, especially on the west side of that crater.

The lava from the 1966/67 effusive phase of the Surtsey eruption covers about 250 acres, whereof 10 on the north side of the island. Of these 250 acres 125 are outside the shore as it was when the lava flow began. The area of Surtsey when the eruption ended was 2.8 km^2 (280 ha).

Although it is a question of definition when an eruption really ends, the author regards the 1966/67 lava phase of the Surtsey eruption as having come to an end on June 5, 1967, when lava was last seen glowing and showing signs of being still moving, and so long a time has now elapsed since then that a renewed activity in Surtsey or adjacent area will probably be regarded as a new eruption - this is also a question of definition.

On June 5, 1967, the Surtsey eruption had lasted 3 years and 7 months and been visible for 3 years and 4 1/2 month. It is the second longest eruption in Iceland since its settlement began 1100 years ago, and only a few months shorter than the longest one,

the "Mývatn Fires" 1725 - 1729, which were in many ways a similar eruption except for the difference caused by different environment in which the eruptions took place; one in the sea, the other on dry land The total production also was on a similar scale.

In the previous reports on the Surtsey eruption as well as in other papers published on the eruption I have tried to calculate approximately the average lava and tephra production in m^3/sec for the various phases of the eruption. According to these calculations the total production of lava and tephra should amount to about 1.1 km^3. A bethymetric map 1:10 000 based on measurements carried out by an English research vessel in cooperation with the Icelandic Hydrographic Service on July 12 - 25, 1967, is now available. According to a hypsographic curve based on that map the total volume of Jólnir, Surtsey, Syrtlingur and Surtla above 120 m depth is about 0.94 km^3, and above 125 m depth it is about 1.02 km^3. The average depth in the area before the Surtsey eruption started did probably not exceed 125 m.

Taking into consideration the distribution of Surtsey tephra on the Westman Islands and the isopach maps of the Syrtlingur and Jólnir tephra on Surtsey I have roughly calculated that the volume of tephra deposited outside the area covered by the hypsographic curve to be 115 $\pm$ 25 million m^3. Consequently the total amount of tephra and lava produced by the Surtsey eruption is 1.1 to 1.2 x $10^9 m^3$, whereof about 70% is tephra. Only about 9% of this material is now above sea level.

Text to pictures

Figure 1: The outlines of Surtsey, Syrtlingur and Jólnir at different times.

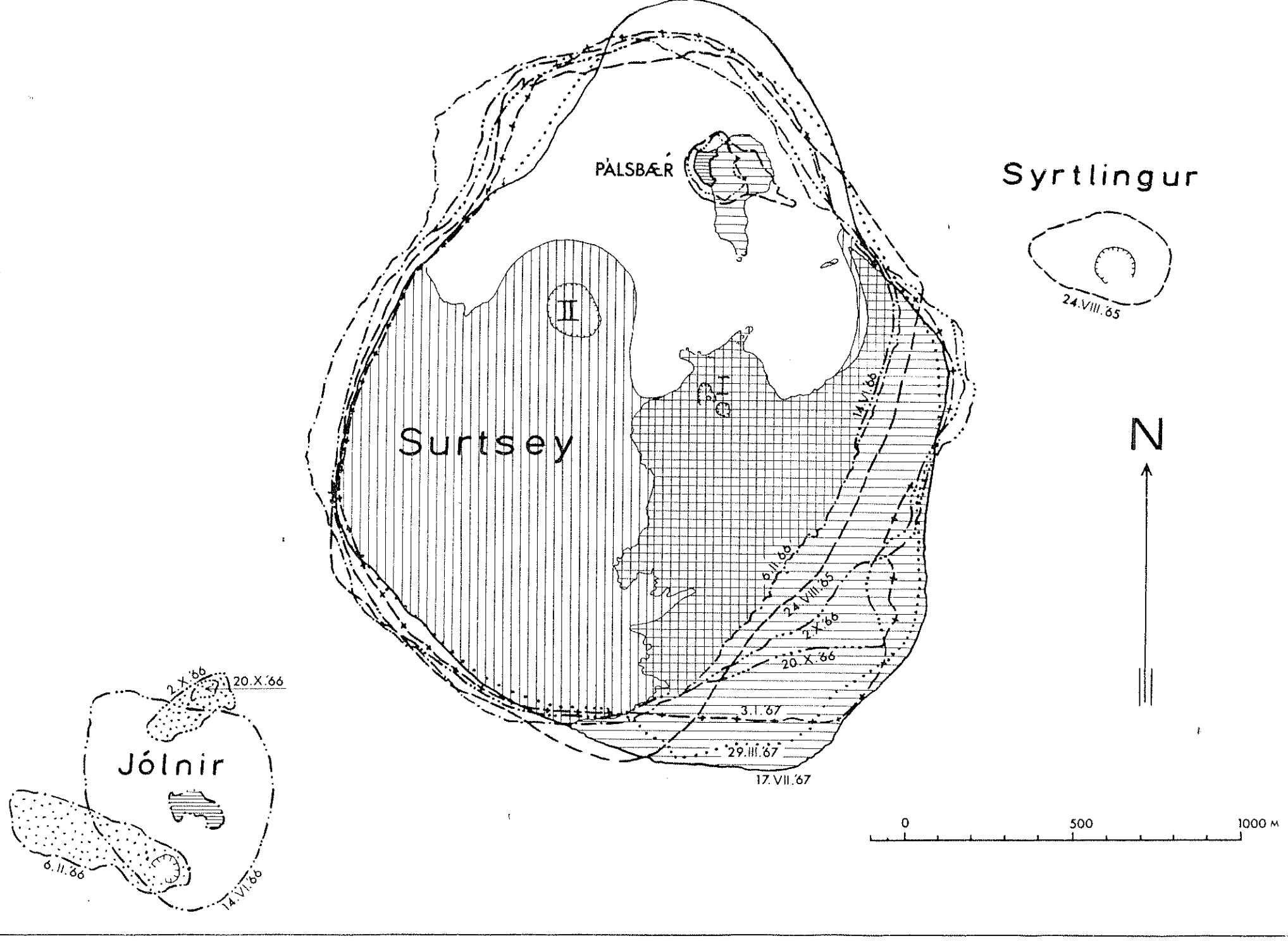
I. The Older Surtur Crater as it was on July 17, 1967.
II. The Younger Surtur Crater.

Vertical and cross striation: areas covered by the 1964/65 lava.

Horizontal and cross striation: areas covered by the 1966/67 lava.

Dense striation: lagoon.

Dotted areas (Jólnir): shoals more or less visible at low tide.


PÁLSBÆR
II
III
Surtsey
14.VI.66
6.II.66
24.VIII.65
2.X.66
20.X.66
3.I.67
29.III.67
17.VII.67
Syrtlingur
24.VIII.65
N
0
500
1000 m
Jólnir
2.X.66
20.X.66
6.II.66
14.VI.66