

Coastal Changes in Surtsey Island, 1969–1970

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INTRODUCTION

The present report is essentially based on comparisons of air photographs from 3 August 1969 and from 3 September 1970. The shore characteristics of 1969 have been dealt with in a previous report (Norrman 1972). For a general description of the coastal morphology of the island the reader is referred to the report on the 1968 field season (Norrman 1970).

Mounted height stations on the lava used in earlier aerial surveys (Norrman 1970, 1971) could be identified in the 1970 photographs and they have formed the geodetic basis for a new photogrammetric mapping of the island. Unfortunately, all height stations placed on the sands of the northern ness had been swept away and thus the absolute height of the contour lines of the ness is less precise than in previously published maps.

As the morphological changes in the inland areas are small it was found unnecessary to print a new complete height contour map of the island. Separate copies of the map published in 1970, which was based on photographs from 1968, can be obtained from the author.

In this report only net changes over the 13-month period up to September 1970 are presented as no data have been collected within this period of investigation. Along the high energy beaches of Surtsey large short term variations exist in shore-line position and in morphology. Thus a comparison of the conditions on a day in one year and another day in the next year does not tell much about the morphological activity level nor necessarily about trends in shore development. Along the lava cliffs where there is only coastal retreat the changes from one year to another more simply reflect the summed effect of a series of events.

THE CLIFF COAST

It is of interest to note that during the last two years there has been very little abrasion in the northernmost part of the lava cliff on the western coast. This 300 m long cliff faces WNW and it ends in the north at the large scar formed in the tephra cliff of the crater of Surtur Junior (cf. Fig. 1). Because of the temporary stability of this lava cliff there has also been small changes in the adjacent tephra wall.

The west facing lava cliff further to the south has suffered much more from wave attack. The maximum cliff retreat is 40 m and the average retreat about 25 m (cf. Fig. 2).

The most strongly affected cliffs are found along the southwestern shore. The maximum retreat is 50 m and the average retreat 35 m. The highest lava cliffs are found here. The vertical wall of the projecting head at the northern end of this coast is 32 m high. It will probably take many years before any much higher lava cliffs are formed because along the south-western and southern coasts the inland slope of the lava surface is low.

Along the southern coast there has again been less abrasion. The maximum retreat is 40 m and the average figure about 20 m.

On the eastern coast the bulge formed by lava flows from Surtur Senior is gradually vanishing by a steady but comparatively slow cliff retreat. The retreat during the last year amounts to ca. 10 m.

THE BOULDER TERRACES

According to the air photographs there are only small changes along the western boulder terrace. A heavy shadow in the photographs precludes studies of any morphological details (Fig. 1).



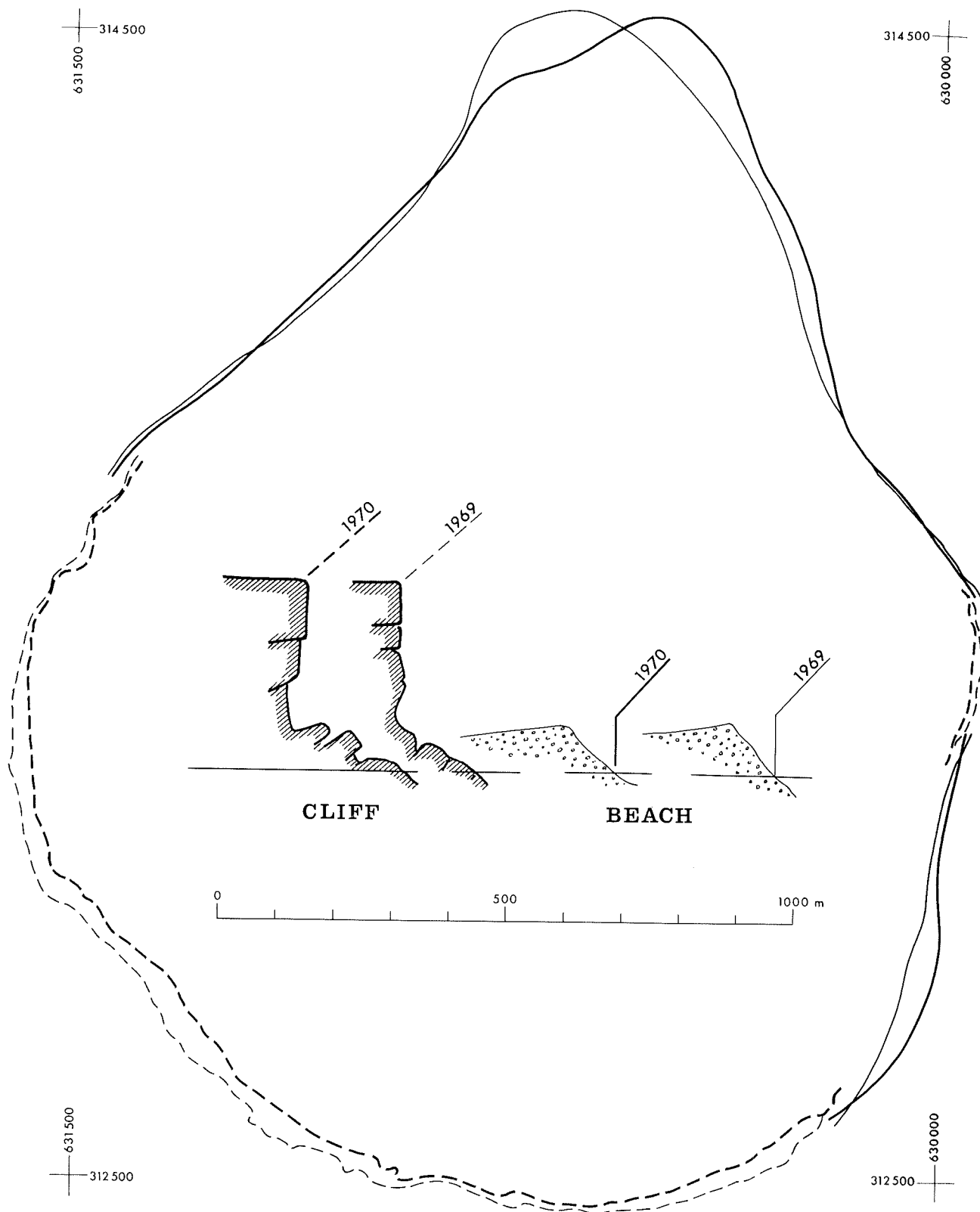


Fig. 1. Aerial photography of Surtsey Island, 3 September 1970. Photograph by Landmaelingar Íslands.

Fig. 2. Cliffline and shoreline of 3 August 1969 and 3 September 1970. Photogrammetric construction by the Geographical Survey of Sweden based on aerial photographs by Landmaelingar Íslands and ground control by the author.

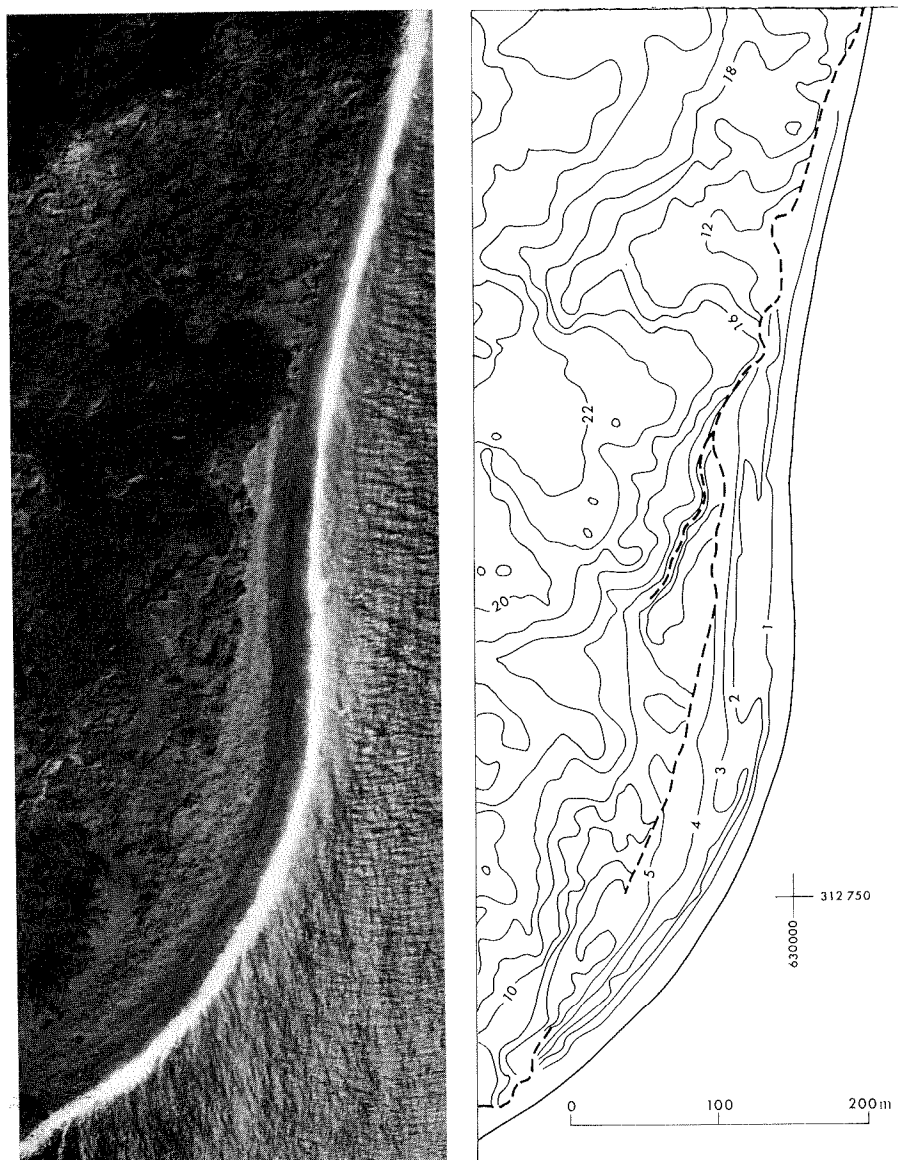


Fig. 3. Aerial photography and height contour map of the eastern boulder terrace, 3 September 1970. Contour interval in shore area (below cliffline) is 1 m, above cliffline 2 m.

The eastern boulder terrace has changed considerably. The year before it was severely eroded (Norrman 1972). The terrace has now been broadened in its northern and central parts where the shore line again follows the 1968 contour.

A steep terrace slope along the shore towards the north was noted in 1968 and has previously been discussed (Norrman 1970, p. 100). The same slope is developed in the 1970 morphology as can be seen from a contour map (Fig. 3). The average slope along the southern half of terrace is 1:50, and in the northern half 1:150.

THE NORTHERN NESS

A comparison between contour maps of 1969 and 1970 (Fig. 4) reveals considerable changes in the morphology of the ness.

The 1969 map depicts a situation where rather balanced wave activities on the eastern and west-

ern beaches have formed a more than 4 m high barrier which encircles the entire ness. The two depressions mark the positions of former lagoons which have been filled up by sand deposited by floods.

The 1970 map reflects a strong wave activity from the west, that has significantly changed the shore line configuration by a shift over to the east. Swash overtopping the high western berm has flooded the ness and the height contours dramatically illustrate how draining flood water has eroded the eastern berm and cut a wide channel across the ness.

AREAL CHANGES

From photogrammetric maps in the original scale of 1:5,000 areal changes from 3 August 1969 to 3 September 1970 have been calculated (Fig. 2). The following figures were found for different parts of the coast.

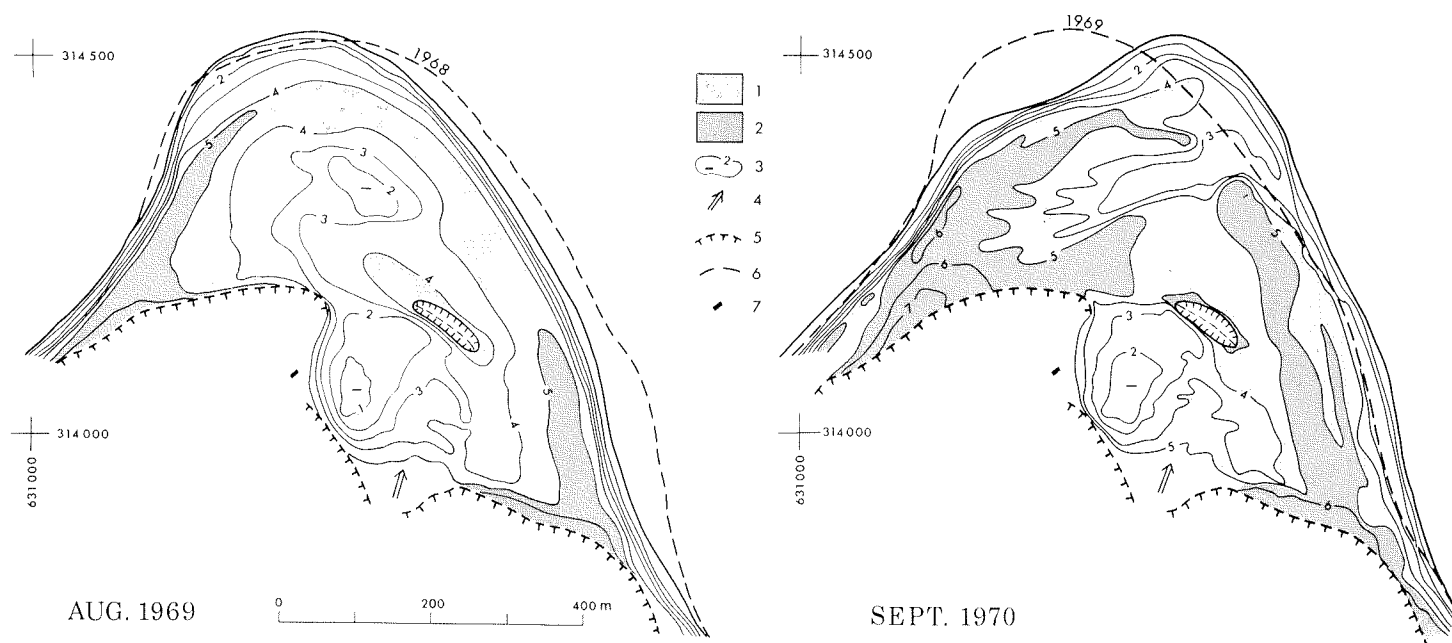


Fig. 4. Photogrammetric maps of the northern ness as developed on 3 August 1969 and 3 September 1970. Contour interval 1 m. Heights above m.s.l. 1, Shore areas between 4 and 5 m above m.s.l. 2, Shore areas above 5 m. 3, Closed depressions. 4, Lava flow of 1967. 5, Base of tephra slopes. 6, Shorelines of 1968 and 1969 respectively. 7, Research station. Photogrammetric construction by the Geographical Survey of Sweden based on photographs by Landmaelingar Íslands and ground control by the author.

The lava cliff of the southern and southwestern coast	Loss 6.2 hectares
The lava cliff of the eastern coast	Loss 0.3
The northern ness and the western boulder terrace	Loss 2.5
	Gain 5.2
	Net Gain 2.7
The eastern boulder terrace	Loss 0.2
	Gain 1.7
	Net Gain 1.5
Total Loss 2.3 hectares	

The loss of lava land on the southern and southwestern coast is almost the same as in the previous year (6.3 hectares) but then there was also a considerable retreat of the beaches which made the total loss amount to 16.8 hectares.

CONCLUDING REMARKS

In the year 1969–1970 the lava cliffs of Surtsey Island have been broken down by wave attacks at the same rate as in the last years. The position of the wave-built northern ness shifts with the direction of storm winds.

There is still a depression left in the innermost part of the ness that has not yet been filled up by flood transportation and wind drift.

The rate of coastal changes makes it essential to have air photographs taken at least once a year. For further photogrammetric work it is necessary to make complementary levellings for new height stations along the northern coast.

ACKNOWLEDGEMENTS

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References:

- Norrman, J. O., 1970: Trends in Postvolcanic Development of Surtsey Island. Progress Report on Geomorphological Activities in 1968. Surtsey Res. Progr. Rep. V.
- 1972: Coastal Development of Surtsey Island, 1968–69. Progress Report on Geomorphological Activities during 1969. Surtsey Res. Progr. Rep. VI.