Coastal Development of Surtsey Island, 1968–69

By
JOHN O. NORRMAN
Department of Physical Geography, Uppsala University, Sweden

INTRODUCTION

The aim of the geomorphological field investigations carried out in July 1969 was to determine coastal changes during the last year and to map the submarine morphology around the island by echo sounding. The latter object will be dealt with in a separate report.

Height stations used in the 1968 aerial survey were remounted and air photographs were taken by Landmaelingar Íslands on 3 August, 1969. These photographs have been utilized for a new photogrammetric model by which the coast line and the northern ness have been mapped.

THE CLIFF COAST

The retreat of the lava cliffs have continued to smooth the coast line of the pear-shaped island but the bulge on the eastern coast still remains (Fig. 1).

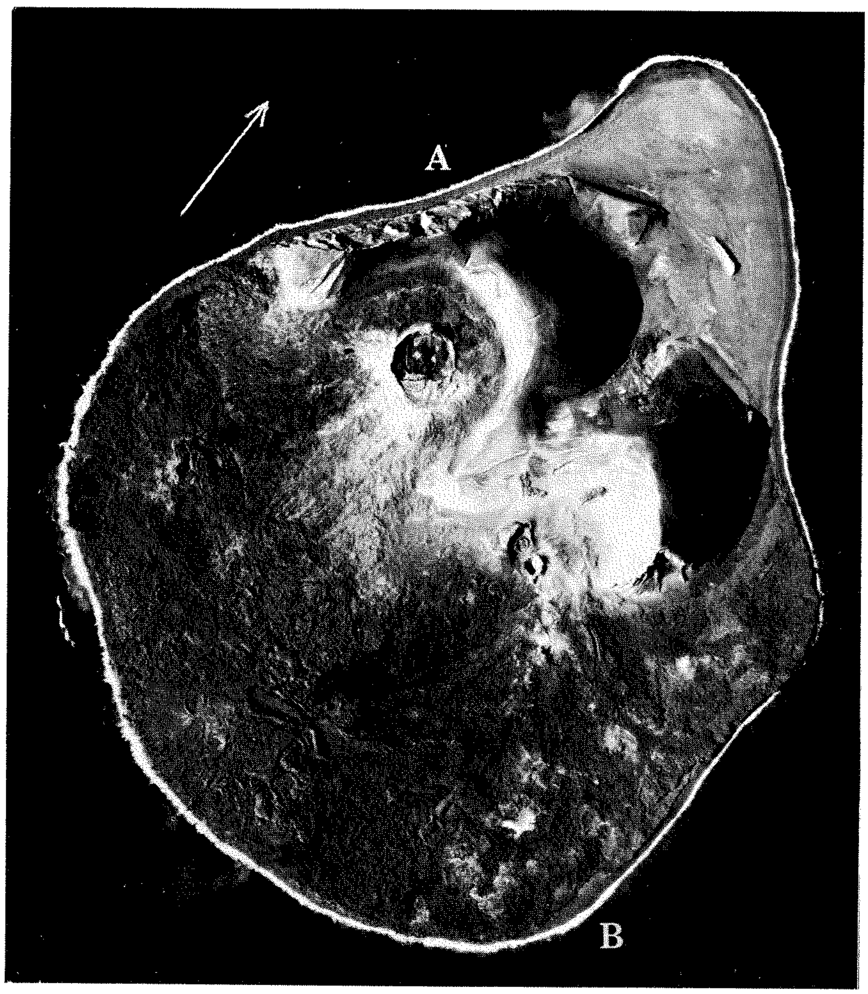

Fig. 1. Aerial photograph of Surtsey Island, 3 August 1969. A, western boulder terrace. B, eastern boulder terrace. Photograph by Landmaelingar Íslands.

The rate of abrasion during the last year has been far less than during the preceding year. As before the strongest activity is found along the southern coast. There is still no sign of development of a stable abrasion platform. Storm waves hit the vertical cliff walls almost unbroken. Even under fairly good weather conditions with 1-m to 2-m waves the wave action is effective (Fig. 2).

THE BOULDER TERRACES

The western terrace below the tephra cliff of the crater Surtur Junior (Fig. 1) is still intact and protects the cliff base (c. Norrman 1970. Fig. 5). The terrace has been slightly broadened in its southern part by deposition of lava blocks which have been broken off the cliff immediately south of this area.

Tephra material that falls from the cliff wall or is deposited on the terrace by mud flows is swept into the sea by wave swash (Fig. 3).

The eastern boulder terrace (Fig. 4) was somewhat narrowed in the winter 1967—68 (Norrman 1970, Fig. 3). Most of the material seems to have incorporated in the narrower but higher terrace that in fact contained more material than before. The shift in shore line position was explained as a resultant effect of the severe abrasion of the cliff to the south of the beach that made this lava cliff retreat 140 m.

Last year the retreat in the same cliff area was 35—40 m (Fig. 8). By this a cross section of the terrace became exposed to waves from the south and the main part of the terrace material was washed out. In the central part of the terrace the shore has been cut back 50—55 m (Fig. 8).

THE NORTHERN NESS

The ness was originally built up by spits that fringed a tectonically formed lagoon. This lagoon occupied the entire area inside the narrow tephra ridge which at present is found in the central part of the ness (cf. Figs. 1 and 7). For details of this development and further references see Norrman (1970).

The wave built ness mainly consists of gravel and sand but within this mass there are tongues and ridges made up of large boulders. The present ridge-shaped high berm along the western beach is mainly composed of boulders.

By re-sorting in the swash zone, especially along with shift of shore position, sandy material has gradually been removed from the beach. It has partly slid down the steep offshore slope and partly been washed inland by up-rush overtopping the berm. In July 1969 only about 150 m of the foreshore at the northern end of the ness was covered with sand.

The transportation along the eastern and western coasts that supplies material to the ness has not kept pace with the loss of material from its beaches. As in 1967—68 the main shore retreat is found along the eastern beach (Fig. 8, cf. Norrman 1970, Fig. 7). During the last year considerable amounts of material have been swept over the berm into the central parts of the ness (Fig. 5).

The major changes in the morphology can be found by comparison of contour maps depicting the situation in July 1968 and August 1969 (Fig. 6). The lagoon inside the narrow tephra ridge has disappeared because the whole area has been filled up with sand to a height above mean sea level. The aggradation is mainly caused by swash floods but wind transported silt and sand and material carried by mud flows from the slopes of the tephra cones have also contributed to this development (Fig. 7).

The berms along the eastern and western shores have been built out towards the north at 4 to 5 m above m.s.l. Thus the ness is now encircled by a more than 4 m high barrier. The closed depression inside the barrier with a height of less than 2 m indicates the site of a lagoon that was filled up with sand in the winter 1967—68 (Norrman 1970, Figs. 7 and 8).

AREAL CHANGES

From photogrammatric maps in the original scale of 1:5,000 areal changes form 6 July 1968 to 3 August 1969 have been calculated (Fig. 8). The following figures were obtained for different parts of the coast.

The lava cliff of the southern and southwestern coast	Loss 6.3 hectares
The lava cliff of the eastern coast	Loss 0.9
The northern ness and the western boulder terrace	Gain 1.1
	Loss 5.9
	Net Loss 4.8
The eastern boulder terrace	Loss 4.8
	Total Loss 16.8 hectares

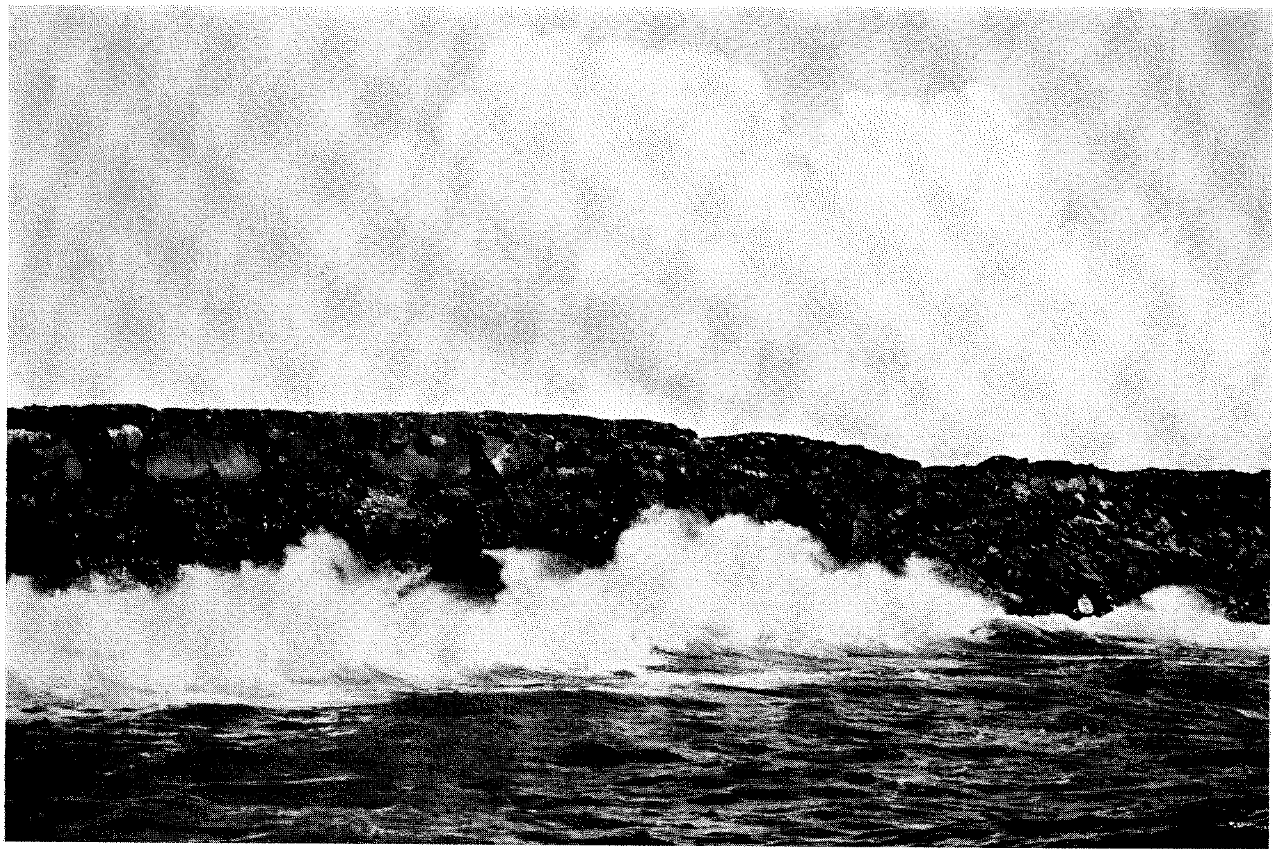

Fig. 2. A 2-m wave breaking on the lava cliff of the southern coast. The height of the cliff is 16 m.

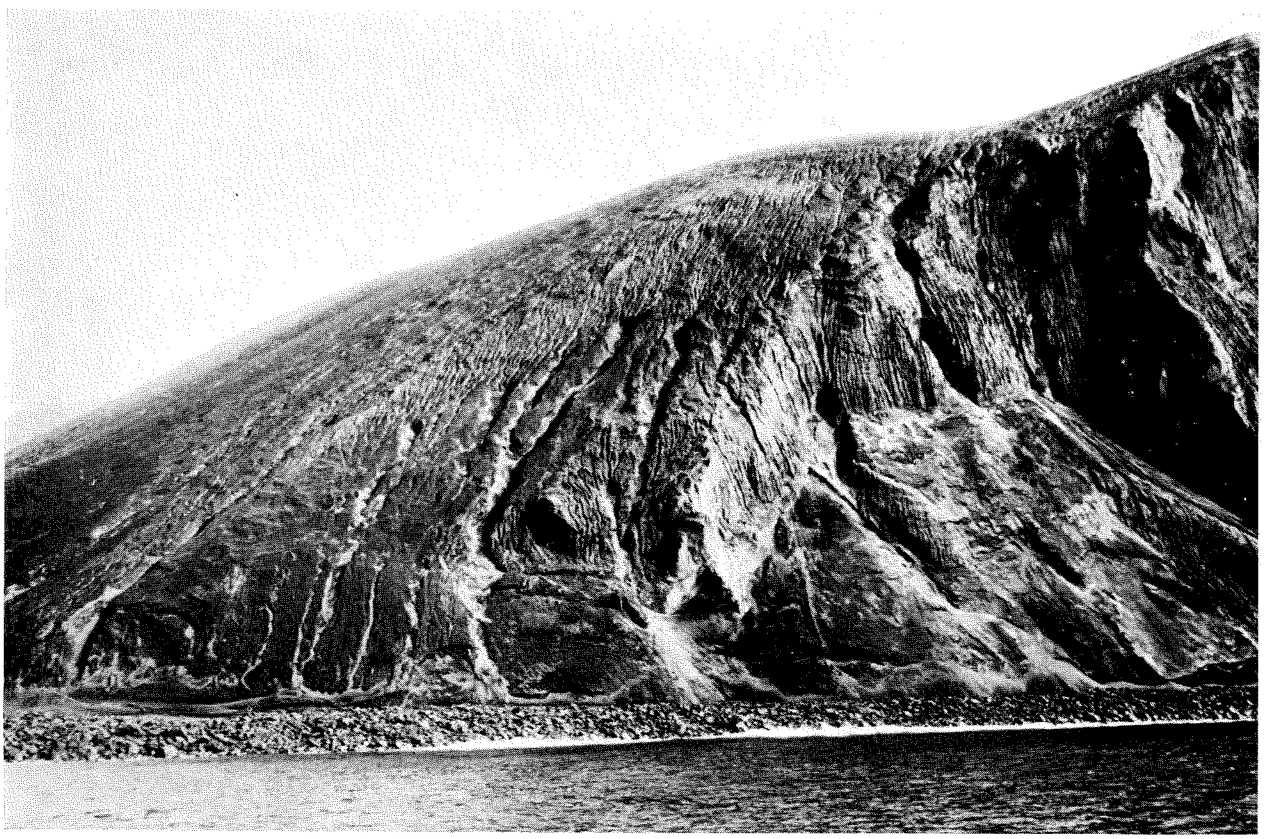

Fig. 3. The northern part of the western boulder terrace below the cliff of the crater Surtur Junior.

Fig. 4. The eastern boulder terrace viewed from its southern end. The lava surface seen in the foreground is situated at 10 m above m.s.l.

Fig. 5. Stream pattern from swash that has overtopped the berm of the northern ness.

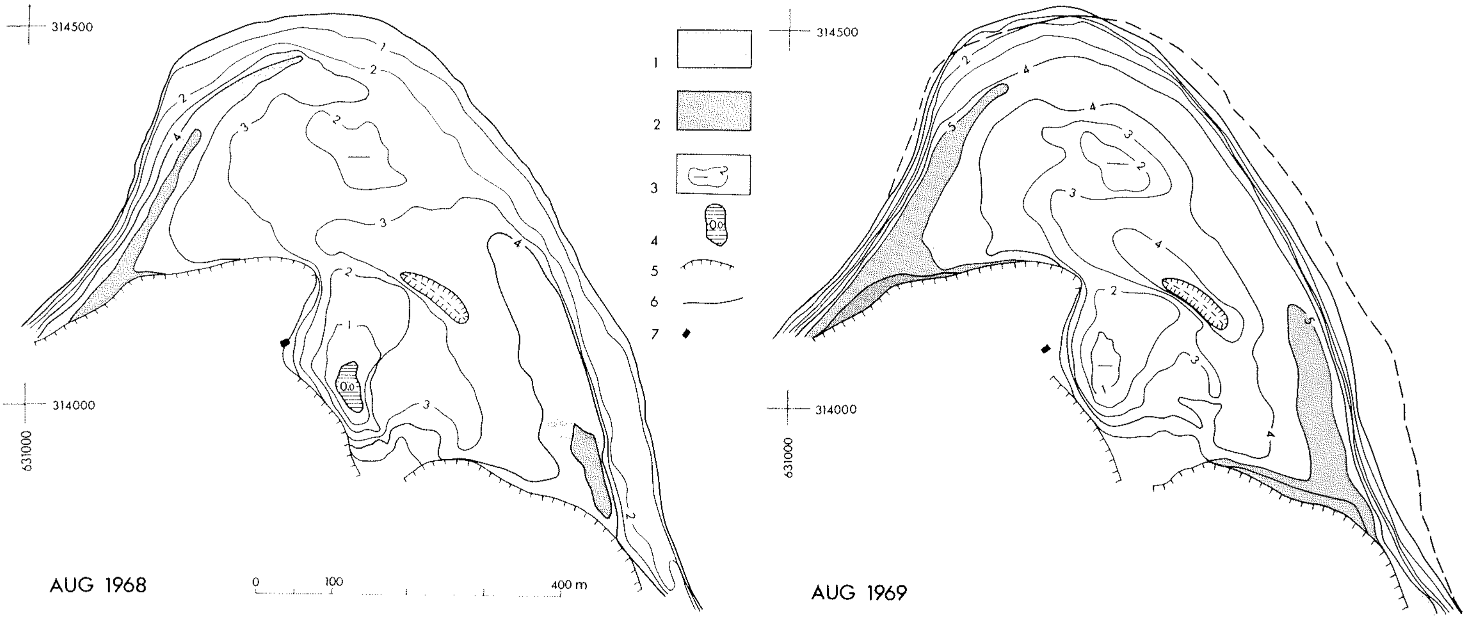

Fig. 6. Photagrammetric map of the northern ness as developed on 6 July 1968 and 3 August 1969. Contour interval 1 m. Heights above m.s.l. 1, Areas between 4 and 5 m above m.s.l. 2, Areas above 5 m. 3, Closed depression. 4, Lagoon. 5, Base of tephra slopes. 6, Shoreline of 6 July 1968 in the right hand map. 7, Research station. Photogrammetric construction by the Geographical Survey of Sweden based on photographs by Landmaelingar Íslands and ground control by the author.

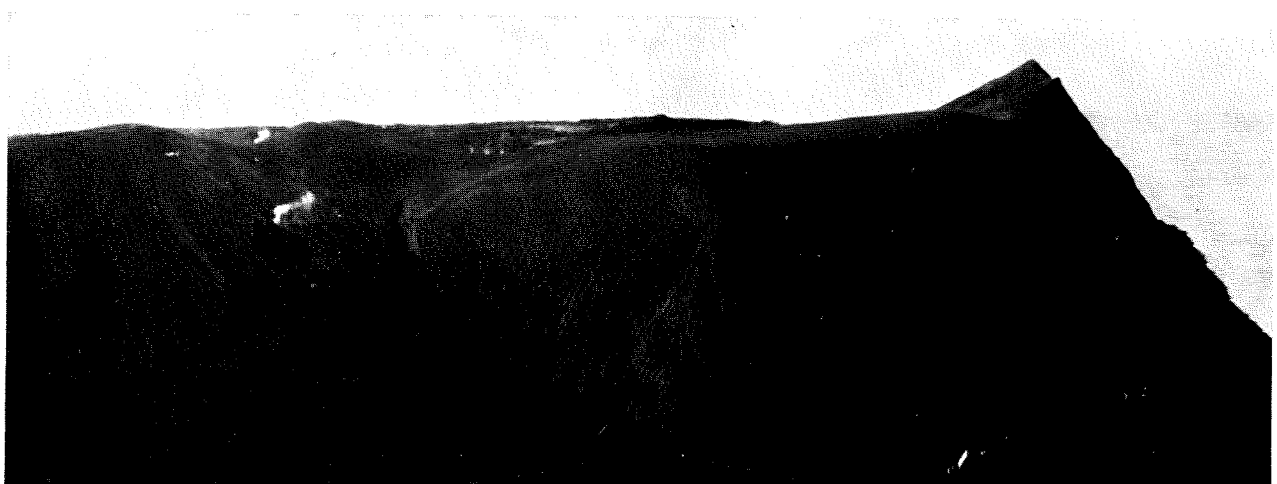

Fig. 7. Aerial view of the eastern and central parts of the northern ness. Note the site of the former lagoon at the research station and the vapor steaming from a vent on the slope of Surtur Senior. Photograph by J. D. Friedman, September 1969.

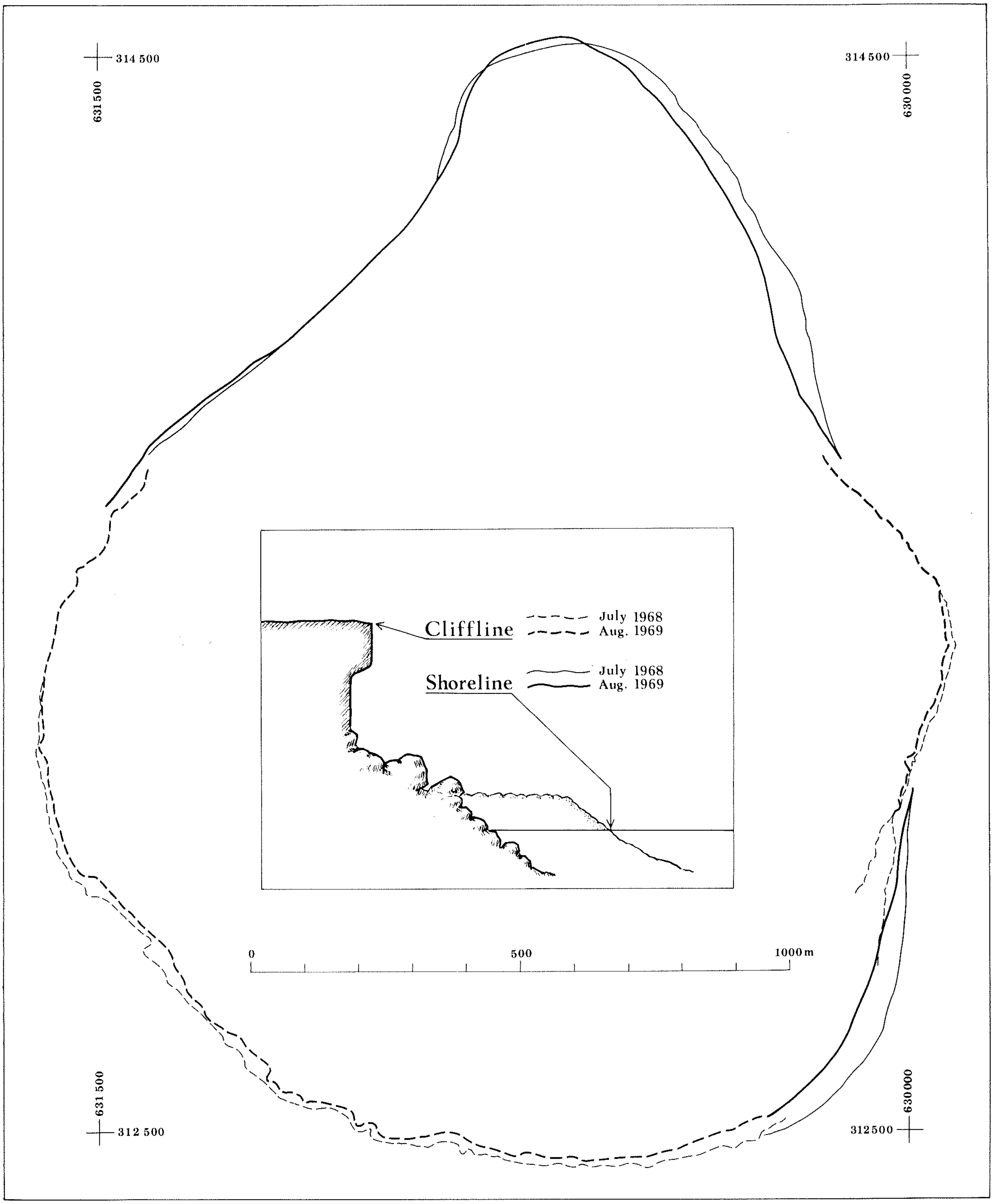

Fig. 8. Cliffline and shoreline of 6 July 1968 and 3 August 1969. Photogrammetric construction by the Geographical Survey of Sweden based on aerial photographs by Landmaelingar Íslands and ground control by the author.

CONCLUDING REMARKS

The trends in postvolcanic development outlined in the report on geomorphological activities in 1968 have not changed. The retreat of the lava cliffs have continued and there is still no evidence for considerably more resistant rocks to exist closer to the craters. The variation in yearly cliff reterat is of an order that can be expected from variable weather conditions.

The reduction of the size of the northern ness and the aggradation in its central part continues. It does not seem likely that the fringing berm will grow much higher.

The future coastal development should be followed up by yearly aerial surveying and photo interpretation.

ACKNOWLEDGEMENTS

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Author's address: Dept. of Physical Geography, Box 554, S-751 22 Uppsala, Sweden.

Refernce:

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