Geophysical Measurements in Surtsey Carried Out During the Year of 1965

by

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Geomagnetic field measurements.

Repeated measurements at the two fixed magnetic stations, Surtsey I (20° 36' 30" W, 63° 18' 22" N) and Surtsey II (20° 36' 30" W, 63° 18' 32" N), have given the following results:

Surtsey I

Date	U. T.	F (γ)	H (γ)	Z (γ)	D
1964, Aug. 19	14:45	51487			
1964, Sept. 12	10:50	51453.3	12784.8	49839.7	336° 19'.1
1965, March 14	10:30	51387.4			
1965, Sept. 4	17:00	51404.2	12824.8	49779.3	336° 01'.4

Surtsey II

Date	U. T.	F (γ)	H (γ)	Z (γ)	D
1964, Sept. 12	13:30	51461.9	12848.2	49832.5	336° 44'.8
1965, March 14	9:55	51453.2			
1965, Sept. 4	14:26	51569.7			

Simultaneous field values have been read from the recordings of Leirvogur Magnetic Observatory. The differences in magmetic field components are the following:

	Date	ΔF (γ)	ΔH (γ)	ΔZ (γ)	ΔD
Surtsey I	1964, Aug. 19	525			
	1964, Sept. 12	509	783	329	- 29'.6
	1965, March 14	429			
	1965, Sept. 4	377	710	212	- 41'.4
Surtsey II	1964, Sept. 12	512	831	320	- 0'.3
	1965, March 14	497			
	1965, Sept. 4	510			

The results at Surtsey II show no indication of a changing magnetic field. The closest distance to the lava is here 400-500 m. At Surtsey I there is a continuous change in the magnetic field. The place is on the tephra formation only 100 m from the edge of the lava and 200 m from the lavacrater. The decrease in total field intensity is caused by increasing magnetization of the lava due to cooling. This decrease is shown graphically in Fig. 1.

The map on Fig. 2 shows the location of magnetic profiles measured with a proton precession magnetometer. Profile designations are in continuation of those reported in a previous progress report (Surtsey Research Progress Report I).

Fig. 3 shows the magnetic field intensity along profile D. This profile starts in an early crater just outside the edge of the lavastream. The low field intensity at the beginning of the profile is caused by the edge of the lava. The extensive minimum near the western end of the profile may be due to heating from flowing lava although it is not visible at the surface. The high value at the western end of the profile is due to the fact that it is on the top of a cliff.

Profile E, shown in Fig. 4, was measured on March 3 from a rubber boat. The route runs from east to west about 300 m from the southern coast of Surtsey without any accurate positioning. The depth along the route is not known accurately, but it is believed that the magnetic anomailies are caused by basalt which the eruption has deposited on a flat sedimentary seabottom.

Profile F in Fig. 5 was measured on June 6 from a small boat across the submarine hill of "Surtla" from south to north. This hill was formed at the end of 1963 by a submarine eruption which was only visible at the surface for one or two weeks, but an island was never formed. A bottom profile, taken by means of an echo sounder, is shown below the magnetic profile. The results show that this hill contains some core of magnetized basalt although most of it may be nonmagnetic material as in the northern part of Surtsey.

On August 31 an aeromagnetic survey was carried out over Surtsey from a helicopter at an altitude of 200 m with the proton precession probe hanging 20 m below the helicopter. Measurements were automatically made every 3 seconds and recorded on a film. At the same time another camera takes photographs straight down for positioning. In all 28 profiles were flown, all crossing the island in different directions. The map has not yet been worked out, but one profile flown from southwest to northeast is reproduced in Fig. 6 and shown on the map as profile G. The cross section of the island and the seabottom profile are taken from the Icelandic Geodetic Survey map from August, 1965, and the Icelandic Hydrographic Survey map from July, 1964. The bottom profile close to the shore is uncertain.

The magnetic profile indicates a magnetized body at the bottom of the sea southwest of Surtsey. It also shows that the sourhern part of the island is strongly magnetic, while the northern part hardly causes any anomaly in the magnetic field.

Temperature measurements.

Temperature measurements were continued using the same thermometer as previous year. The results are the following:

Feb. 20, 1965	Flowing lava SSE from crater 50-100 m from the sea.	1139°C 1141°C
	Flowing lava S of crater 50-100 m from the sea.	1139°C 1141°C
March 13, 1965	Small lavatongue SSE of crater. 50 m from the sea.	1144°C 1145°C
	Same place. Lava emerging from a small opening.	1137°C
	Same place. Open lavastream 1-2 m broad. Lava velocity 0,5 m/sec.	1133°C 1134°C 1141°C
	Same place. Lava emerging from a small hole.	1134°C
	Same place. Small lavastream	1132°C
March 14, 1965	Lava in crater	1151°C 1162°C

During the last measurement in the small lavastream it was noted that while the thermometer was at rest the temperature only went to 1117°C, but when it was slowly withdrawn and moved back and forth close to the surface of the lava the temperature rose to 1132°C. Possibly the rise in temperature was due to oxidation of the lava. The temperature quoted is always the maximum temperature found in each place and may not be the true temperature of the lava.

On March 14th the lava was high enough in the crater so the thermometer could reach it from the edge. The thermometer was thrown out from the edge into the crater and pulled back by the leads connecting its cold end to the voltmeter, until the cold junction was about 1 m up on the edge of the crater. A second observer watched the voltmeter and when it stopped rising the thermometer was pulled up. It was important not to keep the thermometer too long in the crater as it then would stick to the edge. Two measurements were made. One gave an e.m.f. of 46,40 mV with a cold junction temperature of 16^{o}C, the other 46,74 mV with a cold junction temperature of 18^{o}C. According to tables of thermoelectric e.m.f. for chromel-alumel thermocouples this corresponds to 1151 and 1162^{o}C respectively.

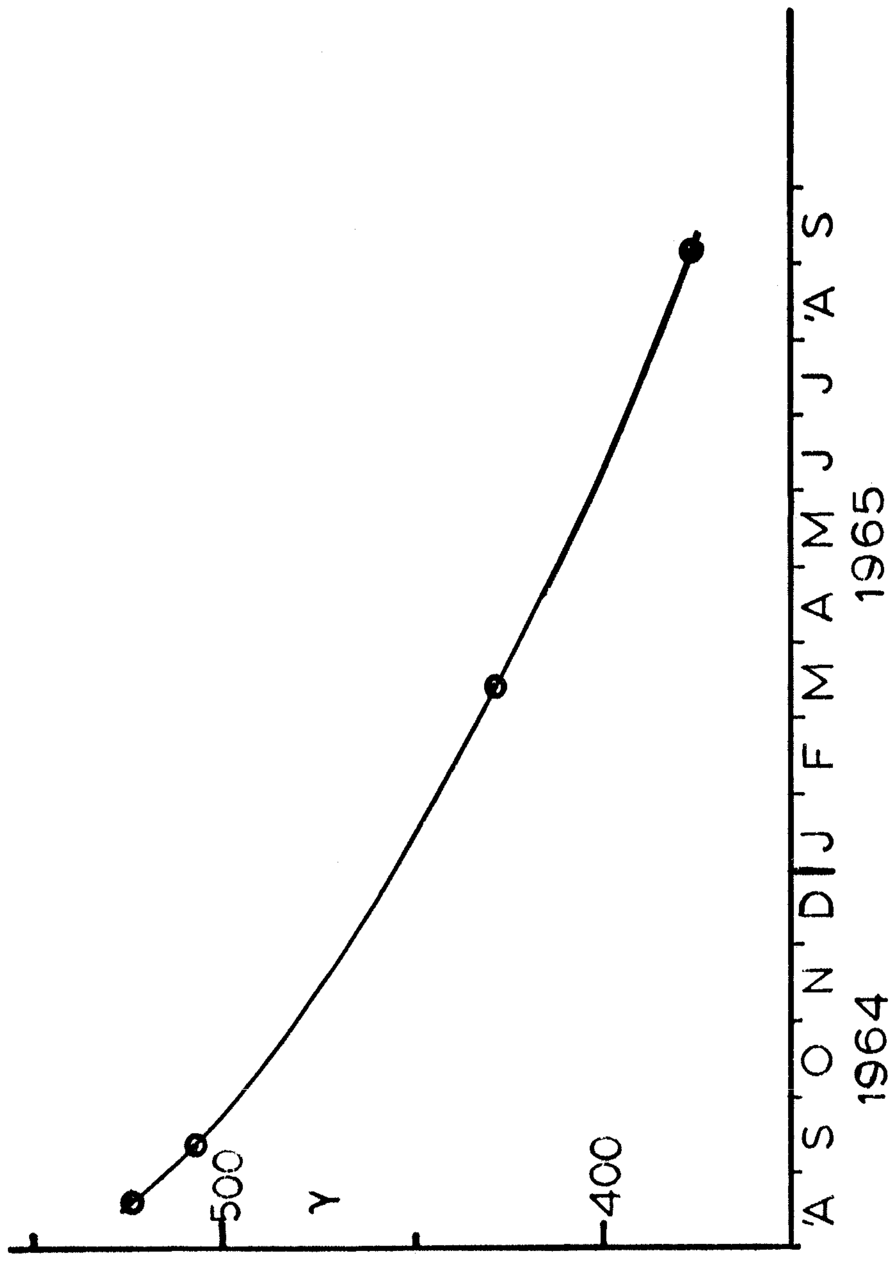

500
γ
400
A S O N D J F M A M J J A S
1964
1965

Fig. 2

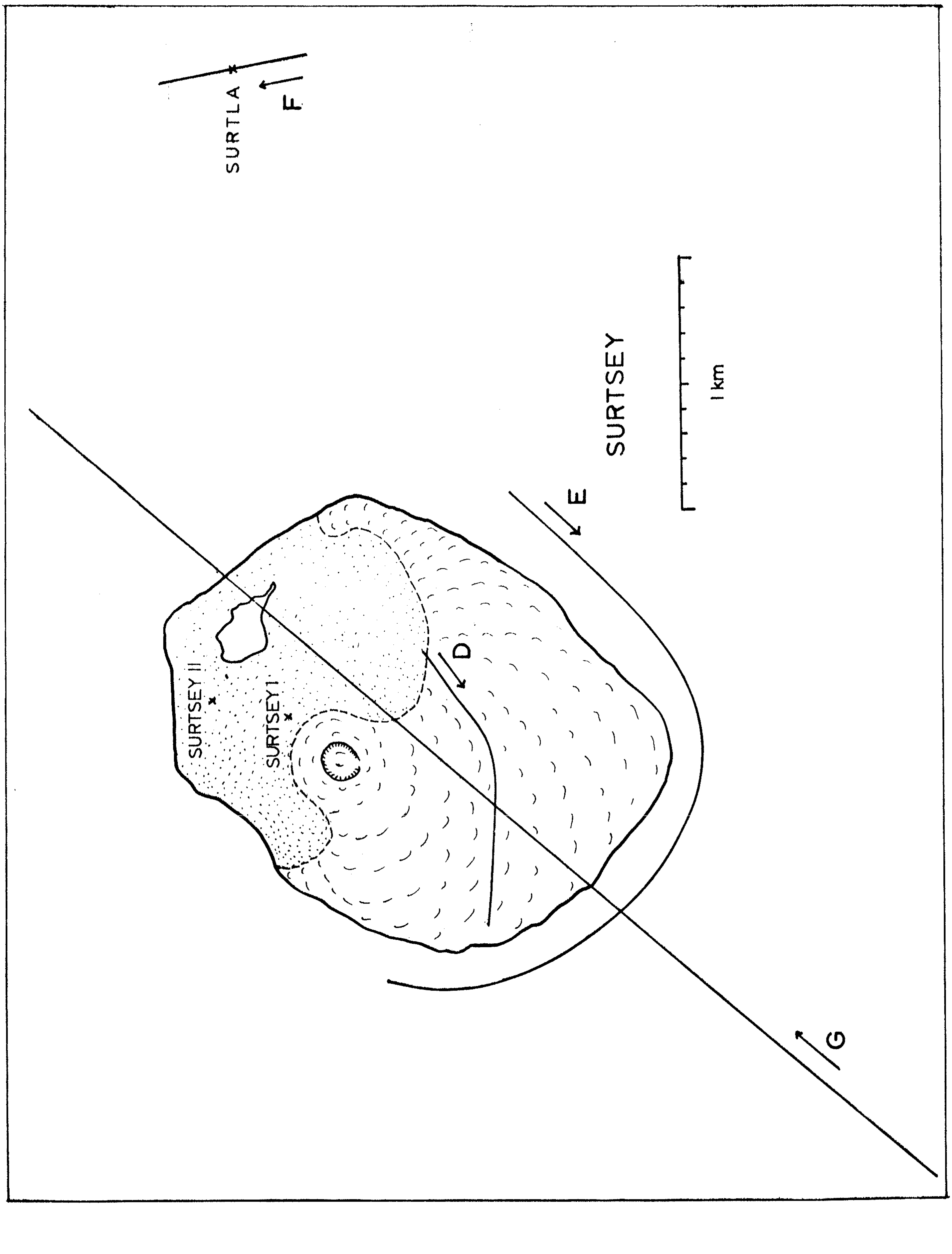


Fig. 3

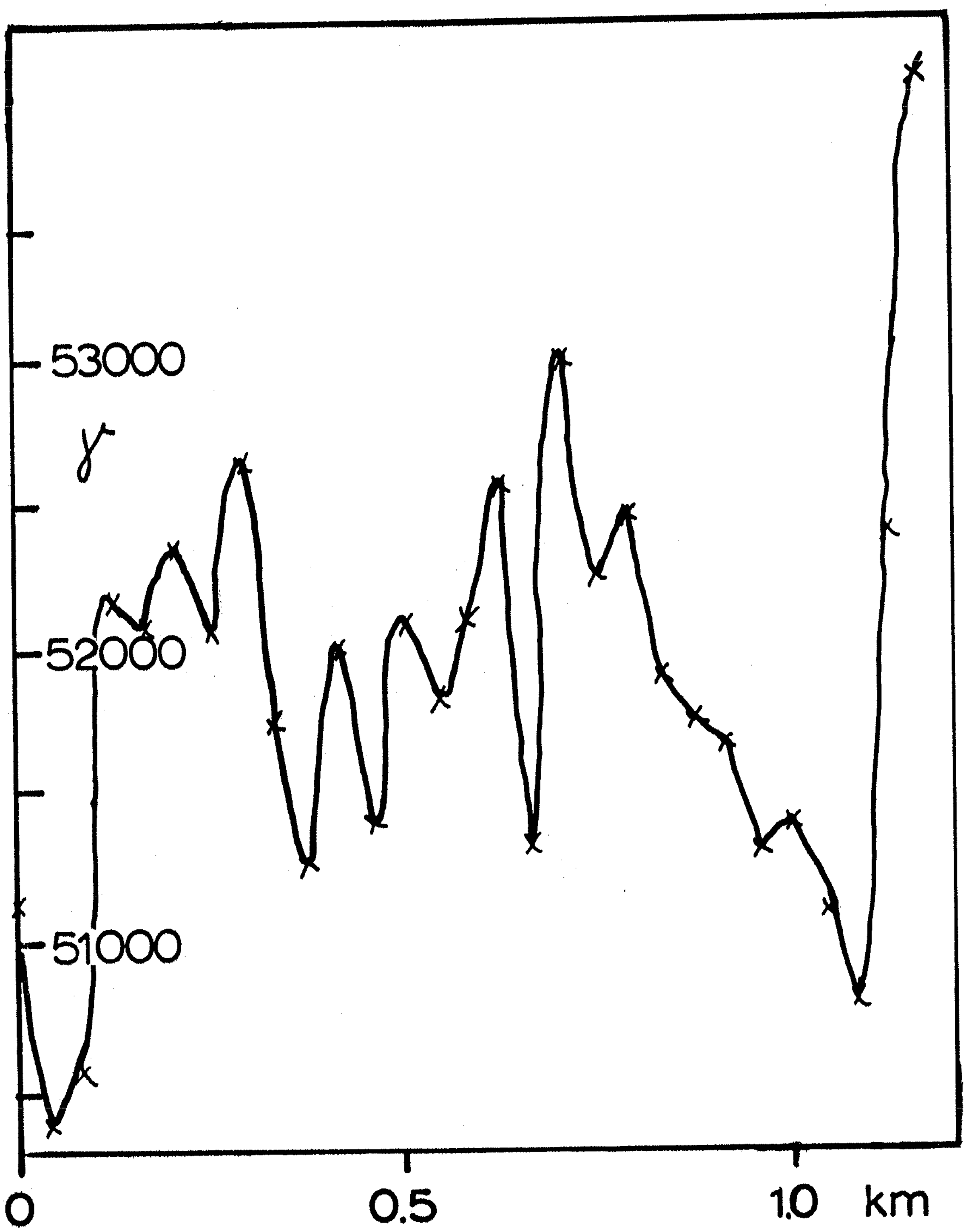


Fig. 4

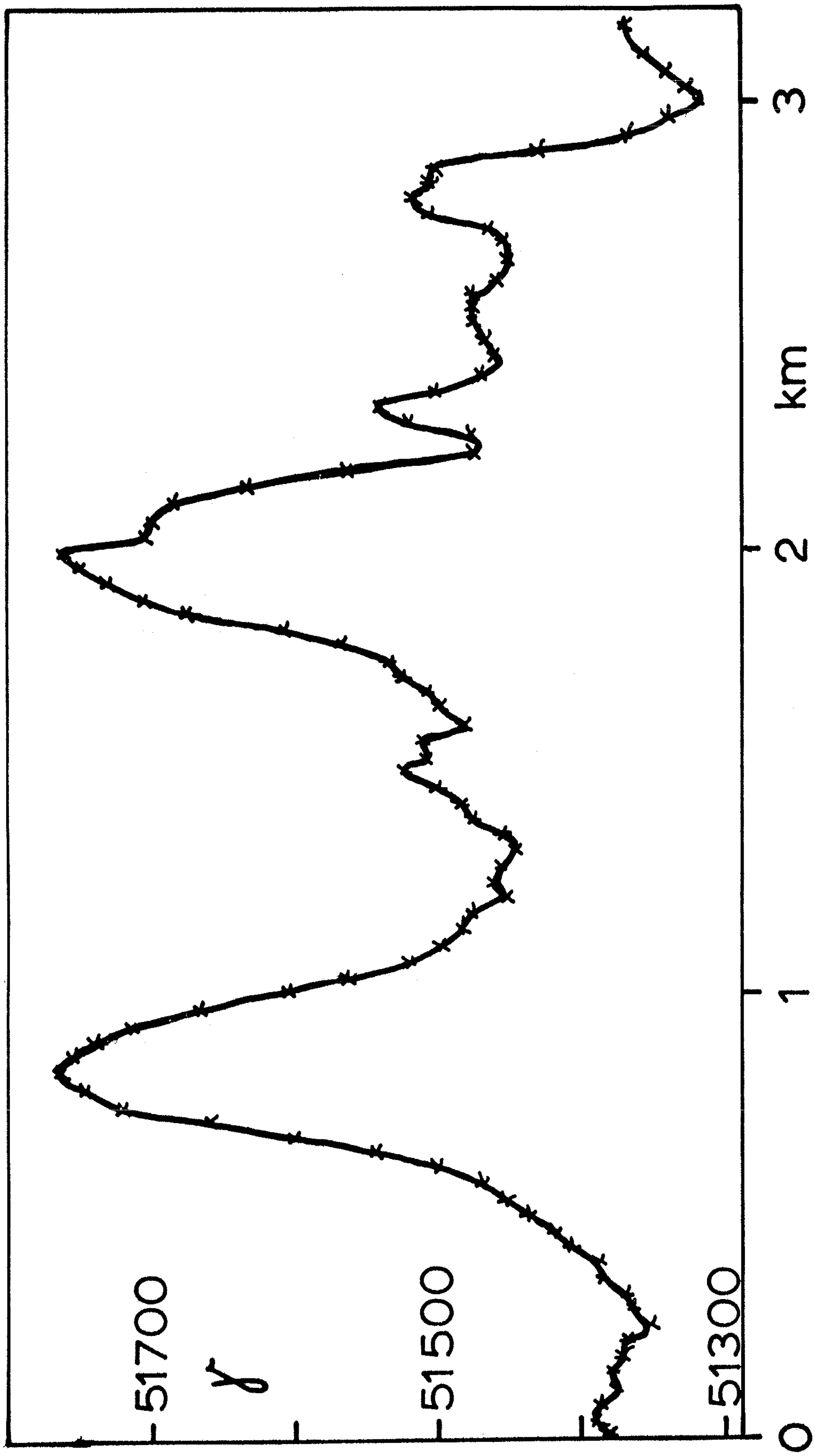


Fig. 5

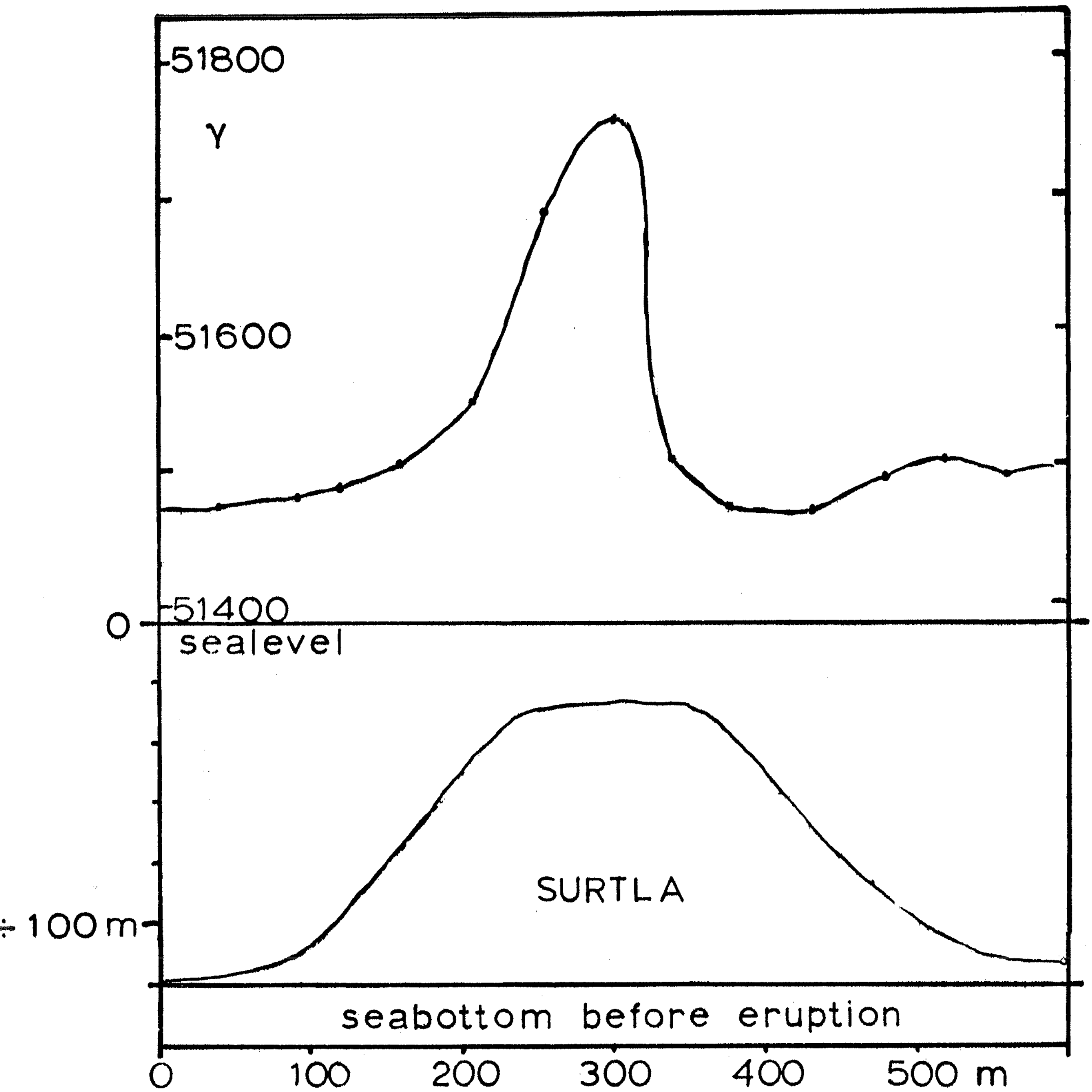
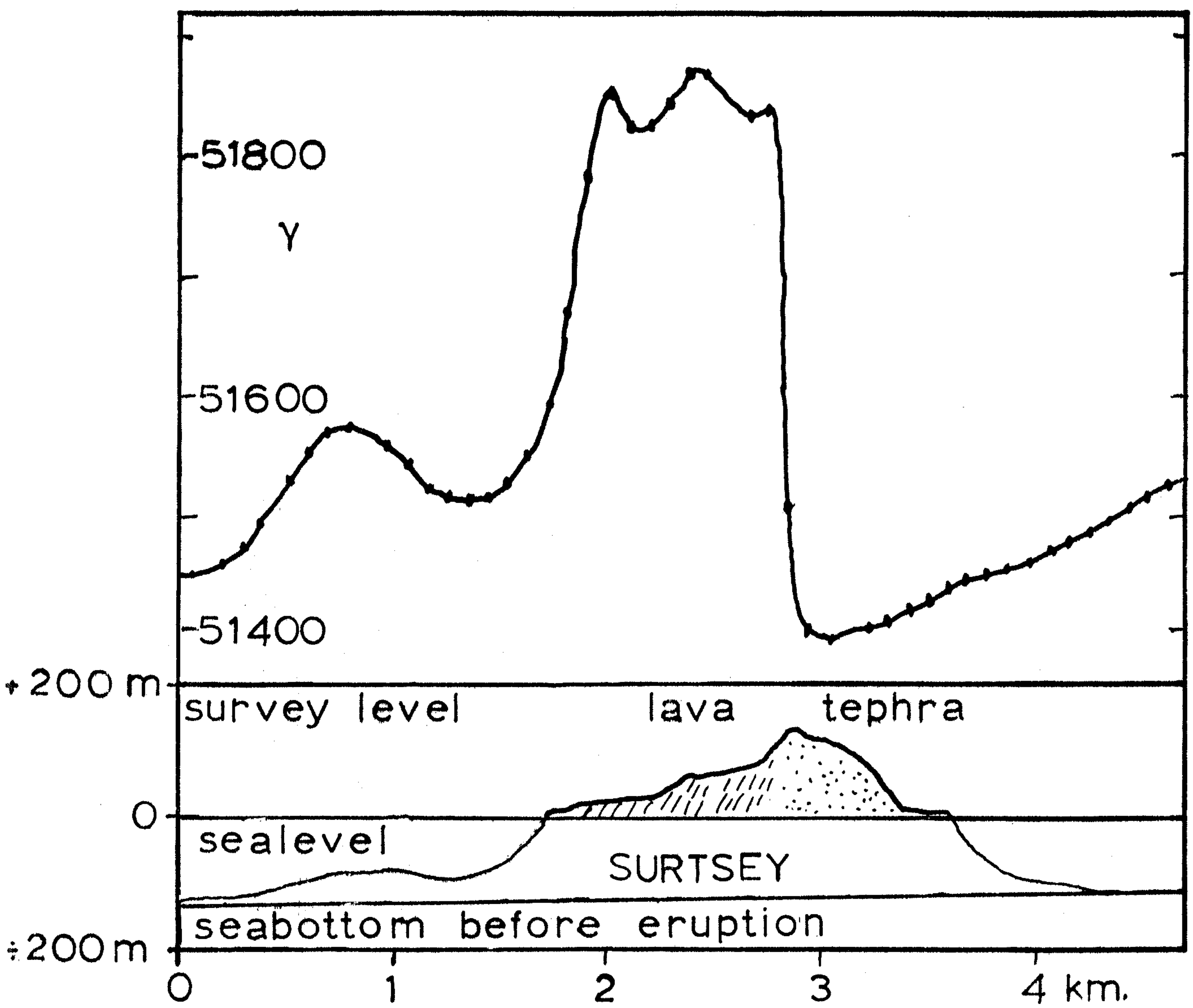

51800
γ
51600
51400
0
sealevel
SURTLA
÷100 m
seabottom before eruption
0
100
200
300
400
500 m

Fig. 6


51800
γ
51600
51400
+200 m
survey level
lava
tephra
0
sealevel
SURTSEY
seabottom before eruption
÷200 m
0
1
2
3
4 km.