

Final Report on Geomagnetic Measurements on Surtsey

By

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Since my report in 1968 (Sigurgeirsson 1968) the following total field intensity measurements have been made at the three fixed geomagnetic stations Surtsey I, Surtsey II and Surtsey III. The field intensity, F , is given in gammas and compared with the value at Leirvogur Geomagnetic Observatory.

TABLE 1

Station	Date	U. T.	F.	$F_{\text{Leirv.}}$	ΔF
Surtsey I	1968 Dec. 27	13:28	51390	51187	203
" "	1970 May 8	17:52	51442	51286	156
" "	1971 Oct. 19	12:35	51400	51276	124
" "	1973 May 13	19:16	51488	51391	97
Surtsey II	1968 Dec. 27	12:30	51634	51198	436
" "	1970 May 8	16:45	51713	51278	435
" "	1971 Oct. 19	12:35	51702	51277	425
" "	1973 May 13	19:50	51823	51390	433
Surtsey III	1968 Dec. 27	14:24	49117	51178	-2061
" "	1970 May 8	18:26	53273	51292	+1981
" "	1970 June 14	12:05	53300	51208	2092
" "	1971 Oct. 19	13:05	53717	51279	2438
" "	1973 May 13	18:44	53954	51393	2561

Fig. 1 shows the location of the magnetic stations inserted on the map of John Norrman (Norrman 1970) together with the profile a going SE and E through Surtsey III and b going SSW through Surtsey III.

Between December 1968 and May 1970 there has been a drastic change in the magnetic field at Surtsey III as total field intensity has increased by some 4000 gammas. This station was originally established in 1966 to investigate the nature of a deep magnetic low just SSW of the rim of the crater Surtur II.

Fig. 2 shows the magnetic field intensity on two cross sections (profiles a and b) through this magnetic trough, as it was in 1966 one year after the end of eruptions in Surtur II. The trough is

about 100 m across with field intensity of about 49000 gammas at the bottom while the rim in places reaches a height of 57000 gammas. The measurement was repeated in 1970 on approximately the same profiles as in 1966 and again in 1971 on profile a. The field is measured about 3 m above the surface of the lava. The later measurements show an increased field intensity in the area surrounding Surtsey III and also in the area east of the station.

The mean magnetic field intensity in the Surtsey area is about 51450 gammas as referred to Aug. 31, 1965 when a detailed areomagnetic survey was made (Sigurgeirsson 1968). Since then the field intensity at Leirvogur Geomagnetic Observatory has increased by about 50 gammas per year (Sæmundsson 1973) and this also seems to apply to the Surtsey area. To refer all magnetic profiles of fig. 2 to this date the profiles of 7.4.66 should be reduced by 50 gammas, those of 14.6.70 by 240 gammas and the profile 19.10.71 by 310 gammas.

The sudden increase in field intensity at Surtsey III during 1969 and early 1970, as seen on fig. 3, indicates that large amounts of underlying basalt were cooled down through the Curie point and became magnetized during this time. The Curie point of the basalt may be assumed to lie around 580°C, the Curie point for magnetite. For comparison a temperature of 460°C was found in August 1970 in gas ascending from a fissure in the lava NV of Surtur II. (Jóhannesson 1972).

Whereas we find increasing field intensity at a place on top of lava with increasing magnetization, a place outside the lava will at the same time experience a decrease in field intensity. This is demonstrated in fig. 4 showing the time

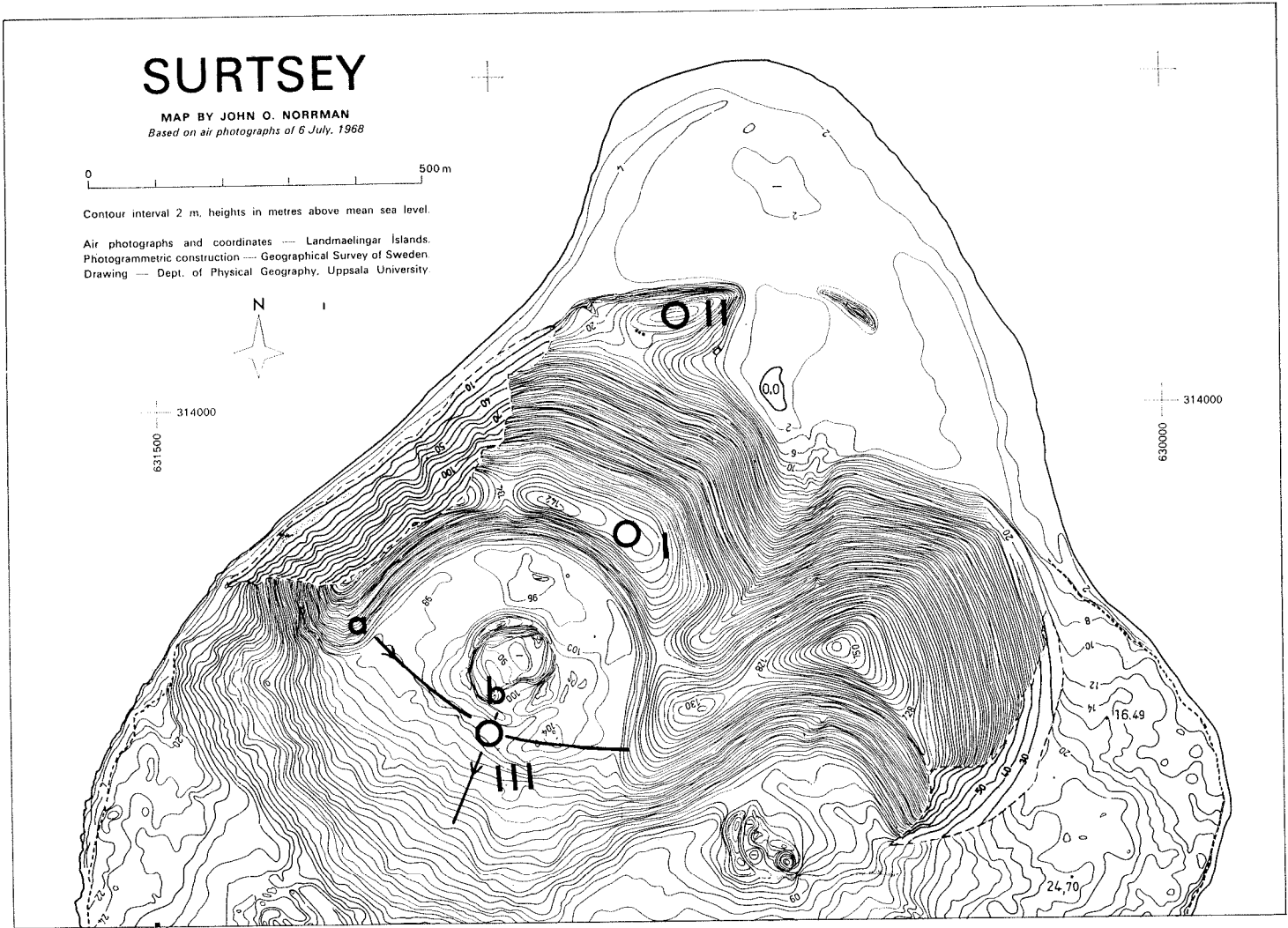


Fig. 1

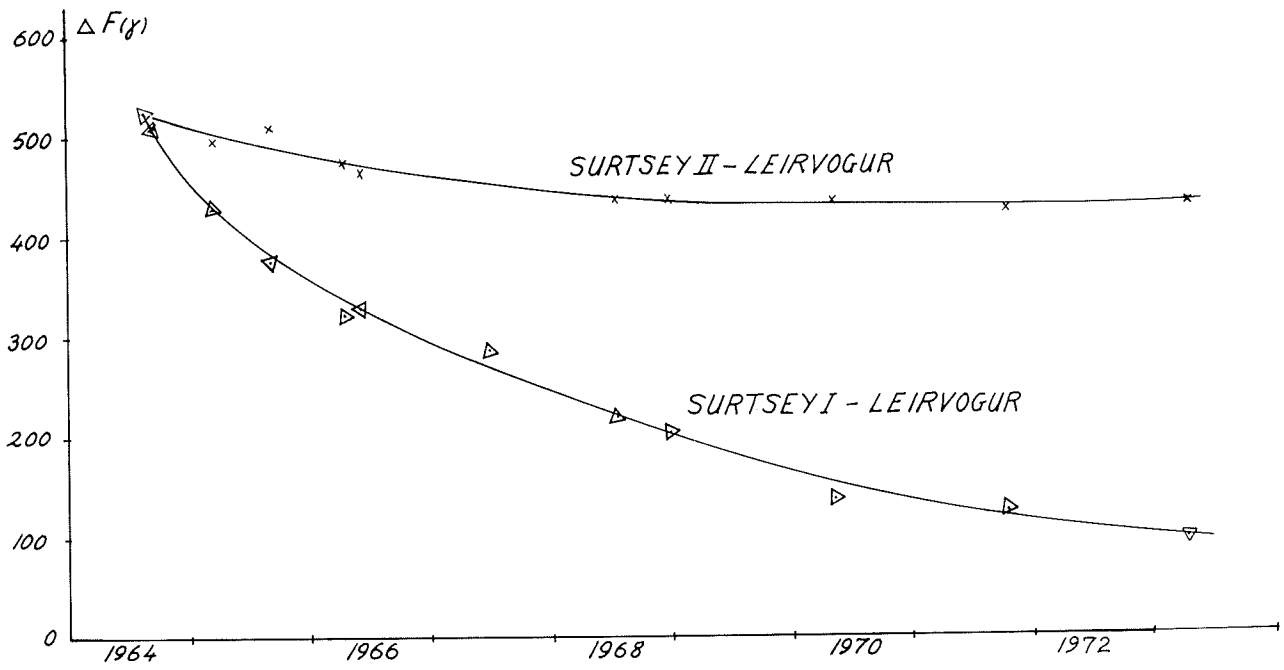


Fig. 4

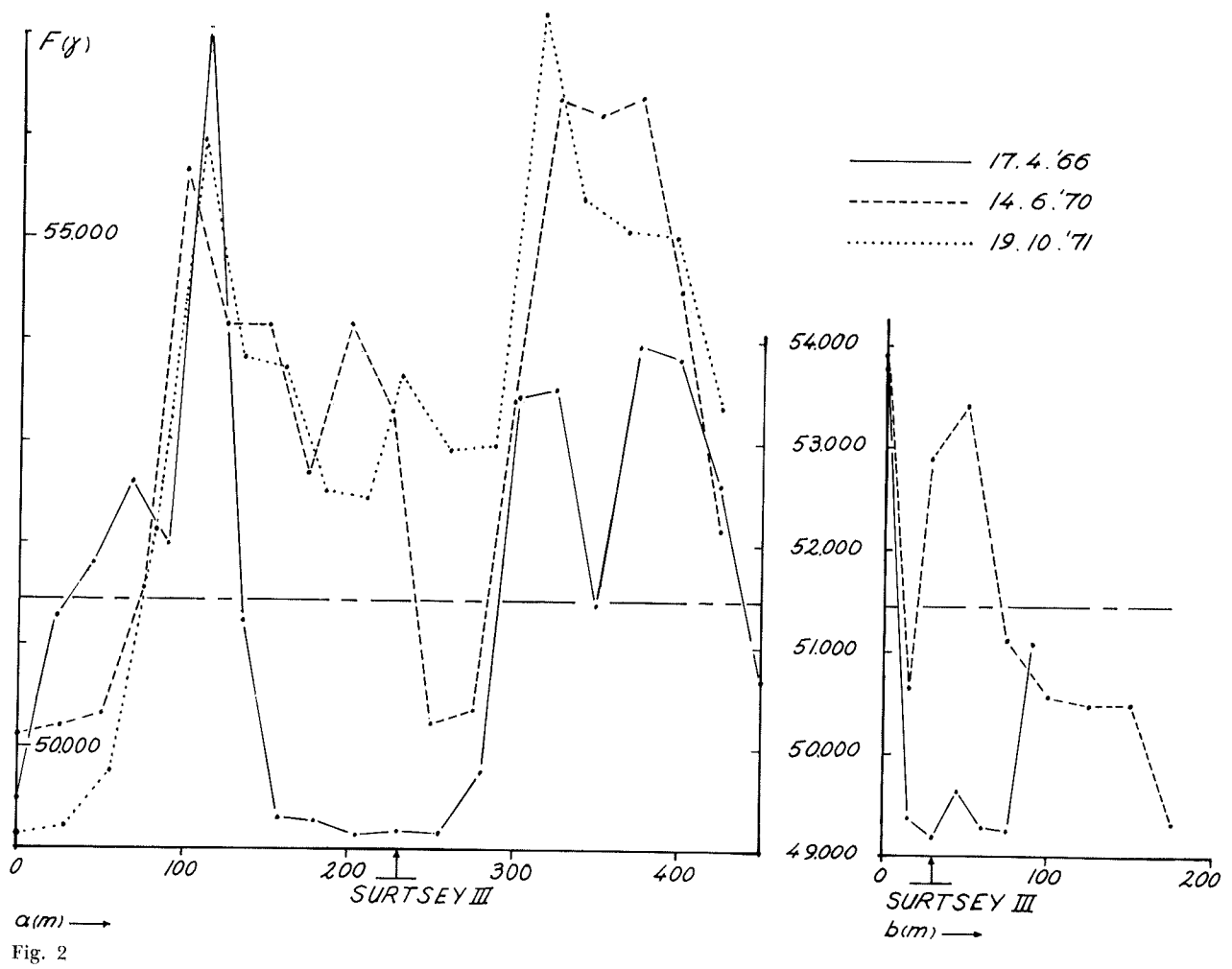


Fig. 2

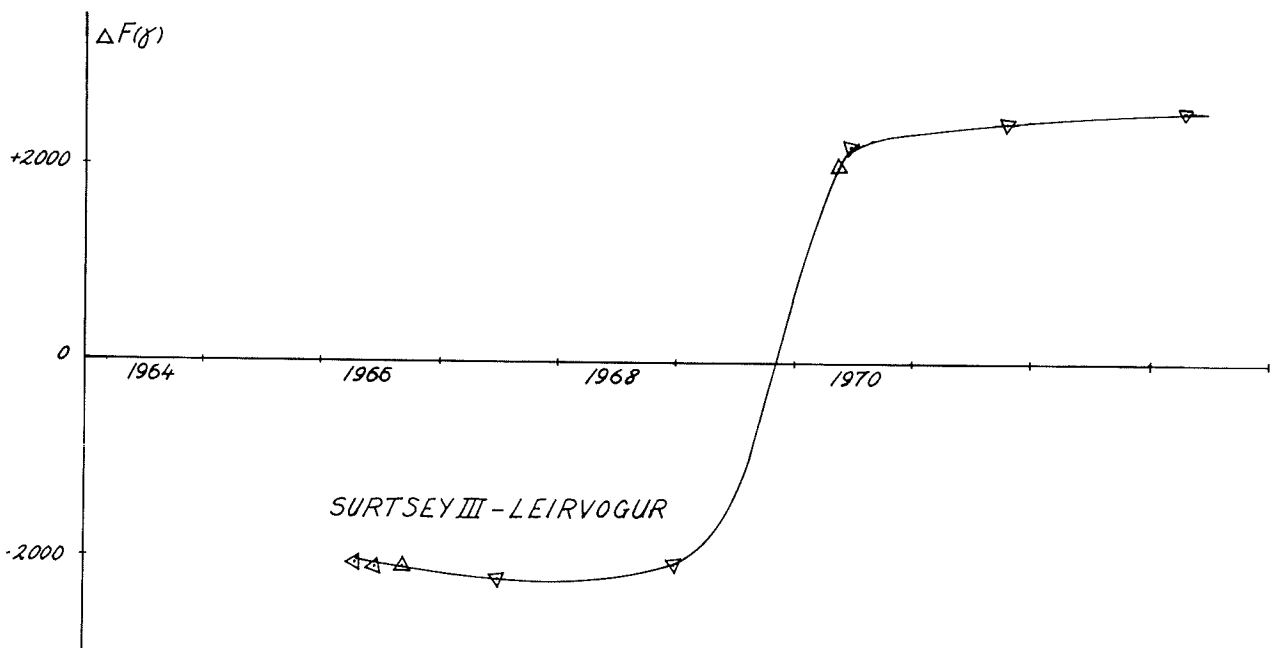


Fig. 3

variation of $\Delta F = F - F_{\text{Leirv.}}$ at Surtsey I, 100 m from the edge of the lavafield, and at Surtsey II which is 400 m from the lava. At the beginning of measurements in 1964 the field intensity was the same at these two stations. At Surtsey II ΔF decreased slightly during the first three or four years, altogether some 60 gammas, but has remained constant since 1968. This is due to weak magnetization of the underlying tephra formation and a large distance to the magnetic lava-pile. At Surtsey I ΔF has decreased about 400 gammas from 1964 to 1973, but seems to be reaching a final value.

As a whole the basaltic pile of Surtsey seems

to be about to reach its full magnetization in 1973.

References:

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