

O C E A N O G R A P H Y

A REPORT ON THE TEMPERATURE EFFECT OF THE SURTSEY ERUPTION
ON THE SEA WATER

by

Svend Aage Malmberg
University Research Institute
Department of Fisheries

A. Material and Methods.

Nine surveys were carried out in the waters around Surtsey during the one year period November 1963 - November 1964 (Table 1).

Table 1. Hydrographic Work in the Waters around Surtsey
(Nov. 1963 - Nov. 1964).

Ship	Cruise	Date	No. of stations	No. of obs. t°C	S o/oo	
1	Albert	Albert	15.-16.XI	20	88	87
2	María Júlía	P-63	1.-3.XII	21	100	98
3	Ægir	A-64	21.-24.I	37	159	156
4	Dorst.porskab.	K-64	31.III-3.IV	43	198	198
5	"	L-64	10.IV	20	88	87
6	Fanney	P-64	29.-30.V	21	111	112
7	Ægir	R-64	22.-23.VI	9	48	48
8	Albert	Q-64	5.-7.VIII	28	176	177
9	Flókaklettur	RII-64	16.-17.XI	21	83	83
Total			220	1051	1046	

The hydrographic observations consisted of temperature measurements and collection of water samples for salinity determinations and other chemical analyses. The temperature measurements were made with the common reversing thermometer ($\Delta t^{\circ}\text{C} = \pm 0.02$), the water sampling with Knudsen water bottles, and the salinity determinations with the conductivity method

(Auto-Lab Salinometer; ΔS o/oo = \pm 0.003). A continuous sea surface temperature recorder was also operated during some of the cruises.

The observations were made on one N-S going and on one E-W going section, with Surtsey in the middle, and with stations from 12 miles distance up to 300 m distance off the island. During some of the cruises, observations were also made on sections farther to the west, across the shelf area (Selvogsbanki).

All these observations are valuable in connection with detailed oceanographic observations in this very productive area off Iceland.

In addition to data from the surveys in the sea area around Surtsey, some temperature observations and water samplings were made from the shore of Surtsey and also by fishermen in the surrounding waters.

B. Observations and Results.

On November 13, 1963, a day before the visible eruption, a ship conducting herring search in the area (M/T Þorsteinn Þorska-bitur) recorded a distinct temperature maximum of 9.4°C about 2 miles southwest from the eruption center, while temperature in other parts of the region was about 7°C. This indicated that some underwater volcanic activity had already started at this time.

In the next morning, the visible eruption was first noticed by the crew of a fishing boat (Isleifur II), a couple of miles away. At a distance of about 0.4 miles from the eruption center the boat's engineer measured a sea surface temperature of about 11°C, which was at least 3-3.5°C higher than elsewhere in the nearby coastal area. On the other hand, no increase in sea temperature due to the eruption was noticed the day after, during the first oceanographic survey to the area (November 15-16, 1963), not even in 300 m distance from the eruption center.

During the surveys made in December 1963, January and the beginning of April, 1964, again no increase in sea temperature could be found at short distances from Surtsey. On the contrary, the temperature was slightly lower (about 0.2°C) at the stations worked near Surtsey than farther away, probably as a result of cooling on a shallow water during winter time.

On April 3, 1964, a lava eruption began, but up to that date the main eruption material consisted of a tephra-laden mass. On April 10, 1964, during a continuous flow of lava from the island into the sea, a sea surface temperature of 8.3°C was recorded 0.4 miles east of Surtsey, which was 0.5°C higher than farther away.

It would be difficult to trace a slight increase in sea surface temperature during the summer months (May, June, July, August), because of the seasonal warming-up due in the surface layer, but at least no unusual intense warming-up due to the eruption was observed on the cruises in May and June, 1964.

On July 6, 1964, fishermen reported a sea surface temperature of $30\text{--}40^{\circ}\text{C}$ in 50 m distance from the lava-sea interface at the shore of Surtsey. This high temperature was supported by temperature measurements made by a group from the Physics Laboratory of the University of Iceland on September 12, 1964, in a creek at the shores of Surtsey. The weather condition was very favourable. The results are given in Table 2.

Table 2. Sea Temperature and Salinity Measurements on Surtsey on September 12, 1964.

	Depth m	Distance from the lava-sea interface	$t^{\circ}\text{C}$	S o/100
1.	0	30-50 m	33.2	38.13
2.	0	"	27.6 22.8	36.77
3.	0	"	25.6	36.51
4.	0	2-3 m	38.0	38.70
5.	0.3-0.4	2-50 m	$\ll 20.0$	

On October 10, 1964, measurements were again made on Surtsey. The temperature on the SE-coast in about 3 m distance from the lava-sea interface was 16-17°C, and the salinity was 34.98 o/oo S. At this time there was a considerable swell which made observations difficult. Observations were also made in a lagoon on Surtsey during that trip. The temperature there was 6.2°C and the salinity 34.03 o/oo S.

On the cruises in September and November, 1964, again no increase in sea temperature due to the eruption was observed.

Thus it may be concluded that the heating effect of the eruption upon the sea water has been very little, especially after the island was born. The sea water, first in close contact with the crater, and later with the lava mass, must of course have been heated up locally, but owing to the intense mixing with the vast quantity of surrounding ocean water, this effect could not be traced in as short a distance from Surtsey as 0.5-1.0 miles, and only on one occasion in about 0.4 miles distance from Surtsey.