ORKUSTOFNUN
Raforkudeild

GRUNDARTANGI
HVALFJÖRÐUR

GEOLOGICAL INVESTIGATIONS OF THE INDUSTRIAL PLANT SITE

BY

BIRGIR JÓNSSON

Prepared for
VERKFRÆÐIÞJÓNUSTA
Dr. GUNNARS SIGURÐSSONAR

OS-ROD-7516

Apríl 1975

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I Introduction.

The site investigation of the industrial plant site at Grundartangi has been conducted by Verkfræðiþjónusta Dr. Gunnars Sigurðssonar, who requested Oskustofnun to handle the geological side of the investigation. Orkustofnun started work at the end of January 1973, when a few borro soundings (Swedish ram-soundings) were made offshore at Grundartangi. This was done in order to find out the thickness of unconsolidated sediments on the seabottom. A few samples of the sediments were collected. Orkustofnun also carried out an offshore seismic survey from a boat for the same purpose and this survey extended over a larger area. The survey was not successful as the equipment did not perform as expected.

It had been planned to let a diver drill a 15 m deep core drillhole (GB-3) from the sea bottom at a depth of a few meters. However, due to bad weather in October 1973, when the drilling was carried out, the hole never reached deeper than 3.7 m and coring was only attempted in the uppermost 1.4 m. On land 2 core drillholes, GB-1 and 2, 15 and 25 m deep respectively, were drilled in late August 1973 and at the same time a seismic survey was carried out in the area, mostly in order to find out the thickness of the overburden. The surface rocks on the shore in the immediate vicinity of Grundartangi were also looked at.

II Investigation at Sea

a) Seismic refraction survey

b) Borro soundings and soil sampling

c) Core drilling

a) Seismic refraction survey.

On January 24th 1973 a marine seismic survey (refraction) was carried out in Hvalfjörður off the Grundartangi area. The equipment used was an ABEM TRIO multichannel seismograph, 12 hydrophones and a sparker for giving the shock. The results of this survey were not satisfactory, as the equipment did not perform as expected.

b) Borro soundings and soil sampling.

At the end of January and beginning of February, a few Borro soundings (Swedish ram-soundings) were made from a boat off the Grundartangi area. The results are shown in fig. 3, where it can be seen that unconsolidated sediments are quite thin. Underneath there is probably in most places moraine and tillite, varying in hardness and thickness, on top of the basaltic bedrock.

A few samples of the sediments were obtained with a Kullenberg sampler. Grain size analysis of these can be seen in fig. 4. One sample was tested for organic material and another for moisture content, see fig. 4.

c) Core drilling

In October 1973, borehole GB3 (a and b) was drilled by a diver on the sea bottom, using an air powered drill fitted with a core barrel. See location on fig 2 and borehole log on fig. 5. The air compressor was fastened to a raft that could not stand large waves. During this time the weather was often quite bad, so frequently the divers boat had to tow the raft for shelter.

The intended depth of the hole was 10-15 m, but due to the bad weather and the slow drilling rate the hole reached only 3.7 meters out of which core recovery was only attempted in the topmost 1.4 m. One cannot really say if the core is from large boulders or fractured basalt. However, below 2 m depth the rock seems solid according to the diver's description, but coring was not attempted there.

III Investigation on Land

a) Geology

b) Core drilling

c) Seismic refraction survey

a) Geology.

The northern coast of Hvalfjörður is mostly made up of a basalt lava pile from the very end of the Tertiary period (the age being approximately 3.3 million years). These basaltic lavas are cut by near vertical basaltic dykes, which in the Grundartangi area have a direction of approximately North 30° East. The basalt dips at least 10° towards SSE (strike close to North 50° East, dip 10-14°), see figs. 2, 6 and 7. Similar dip and strike can be seen in the Akrafjall hill nearby. Most vesicles and cracks in the basalt lavas are filled with secondary minerals but less so with the dykes. The basalt in the dykes looks more sound than the country rock, suggesting a much lower age for the dykes.

The area from Lake Eiðisvatn down to the shore at Grundartangi is mostly covered with peaty soil and vegetation, so no rock esposures can be seen except on the shore (see fig. 2). From the borehole logs it can be seen that under the peat there is moraine, varying in thickness. The lower part of the moraine is consolidated and hard (tillite), but the upper part is looser.

The geomagnetic polarity of the core from boreholes GB-1 and 2 was measured with a fluxgate magnetometer. All the core in GB-1 has reversed magnetism, but the core in GB-2 shows very disordered magnetism, varying between reversed and normal. The explanation of this is that younger basaltic dykes with normal magnetism have been intruded into the reversely magnetized bedrock causing induced normal magnetism to occur adjacent to the dykes. Borehole GB-2 is drilled close to one of these dykes (see fig. 6.) and intercepts it at a depth of 16.5 m. The bedrock belongs to the very top of the reversed Gilbert geomagnetic epoch, so the age of the rock is just over 3.3 million years. The normally magnetized dykes are younger.

b) Core drilling.

Between August 20th and September 1st 1973, two core boreholes, GB-1 and 2, totalling 41 m, were drilled at Grundartangi. See location on fig 2 and borehole logs on fig. 5. Both these drillholes showed similar geological conditions.
A layer of peat was at the top in both holes, just over 3 m thick in GB-1 and 1 m in GB-2. Underneath this is moraine, getting hard and consolidated near the bottom. The moraine is very thin in GB-1 but up to 3 m tick in GB-2. The bedrock under this is basalt giving 100 per cent core recovery.
GB-1 seems to penetrate only one basalt layer, but showing altered basalt, reddish in colour at 10-12 m depth. GB-2 goes through a lava contact in 6.5 m and a steep contact between the lava and a near vertical basaltic dyke at about 16-17 m.

The rock seems to be quite watertight, as all holes and fractures are filled with secondary minerals. A primitive pumping test was attempted in GB-1 using the drill-pump. About 10 m long hose was put down the hole. When pumping started the ground water level in the hole fell in a few seconds down to the end of the hose. After that less than 0.1 l/sec was obtained and most of it must have flowed into the hole from the peat at the top.

c) Seismic refraction survey.

At the end of August and beginning of September a seismic refraction survey was carried out at Grundartangi mainly for detecting the overburden thickness. About 20 profiles were shot (see location on fig. 2). Most of the profiles are on a line through the drillholes GB-1 and 2 (Geological section B-B on fig. 6). The rest of the profiles are on geological profiles A-A and C-C (see fig. 7), parallel to A-A, at one hundred meters distance on each side. The time-distance graphs for all the profiles make up figures 8 to 12.

Most of the profiles are acceptable, but a few were shot only from one end of the profile and therefore do not give good results if the bedrock surface is inclined. Some profiles are only shot in the middle, making up two short profiles on each side, which may not be long enough in some cases. The profiles that are shot from both ends should give the most reliable results.

The seismic refraction seems to show quite well the thickness of the loosest overburden which is peat in most cases and has seismic velocity of about 0.3 km/sec. Profiles 4 and 10, shot right at the boreholes GB-1 and 2 are in quite good agreement with the borehole log regarding the thickness of the peat. In both boreholes there was a layer of hard moraine or tillite under the peat and on top of the basalt. Where the moraine is hard it has probably a seismic velocity in excess of 2 km/sec. However,as the moraine seems to be quite thin, or less than 3 m in most places, it does not appear on the seismic graphs, which only show a two layer case, i.e. overburden and "bedrock", the top of which is the hard moraine on top of the basalt as can be seen if one compares the borehole logs to seismic profiles 4 and 10.

Therefore one can assume that in figs. 6 and 7 there should be a thin moraine layer on top of the basalt in most places.

One of the seismic profiles, no. 7, shows a three layer case, the middle layer having a velocity of 1.1 km/sec. This was assumed to be loose moraine and was actually confirmed when backhoe trenches were made in the area recently.

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GRUNDARTANGI HVALFJÖRÐUR
Location map

2.5'75 BJ/IS
Tnr. 46
B-90
Fnr. 12744

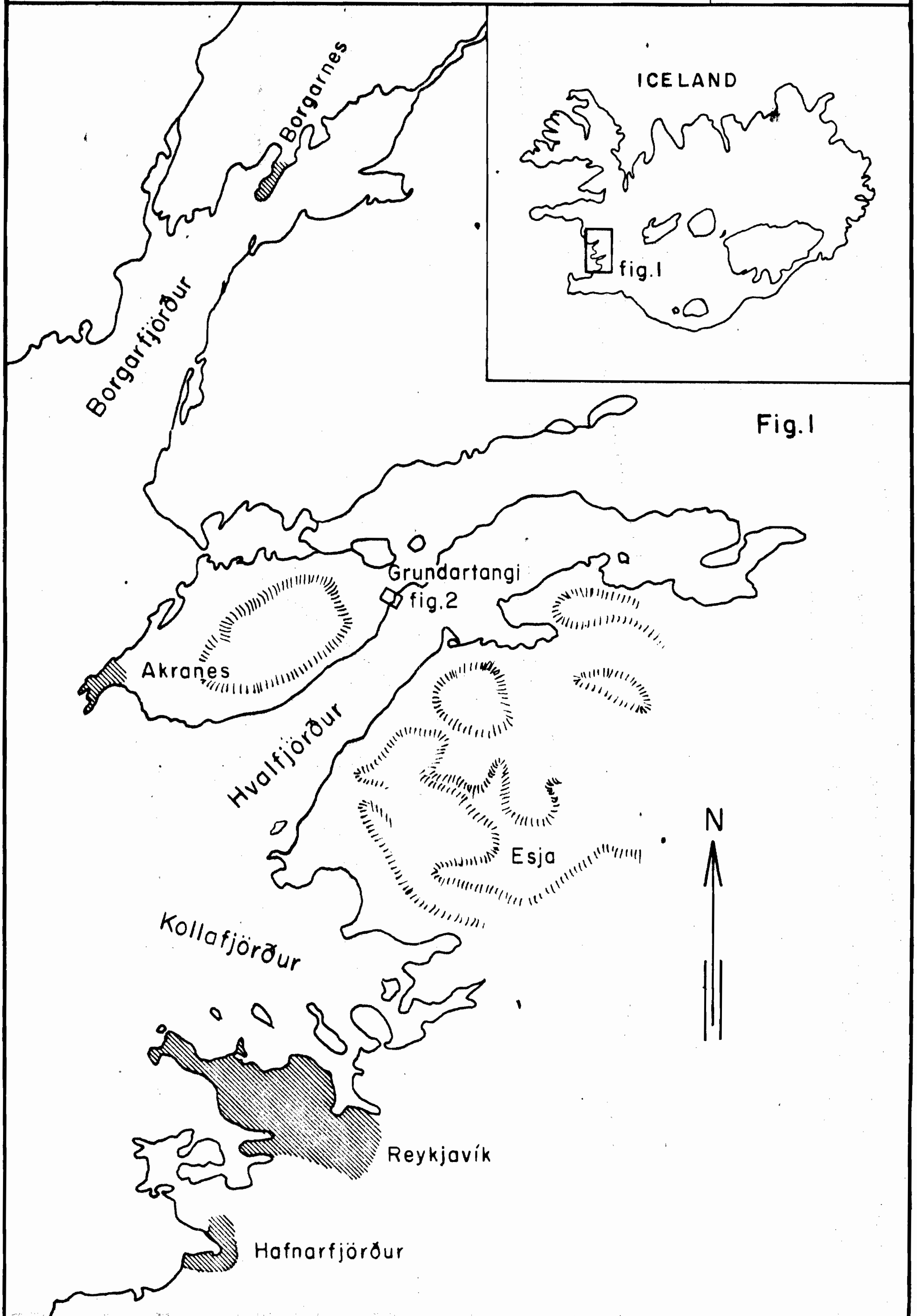


Fig.1

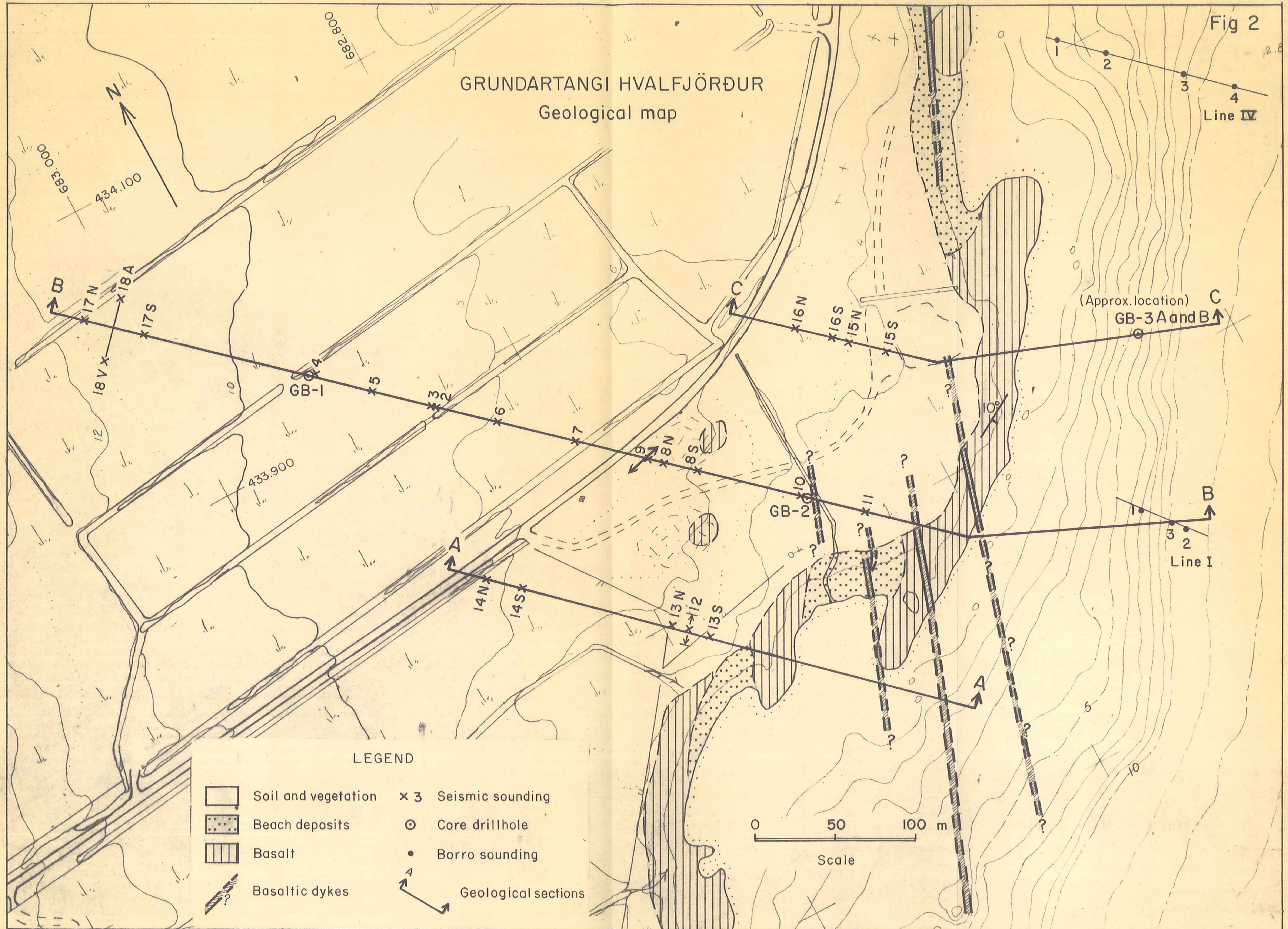
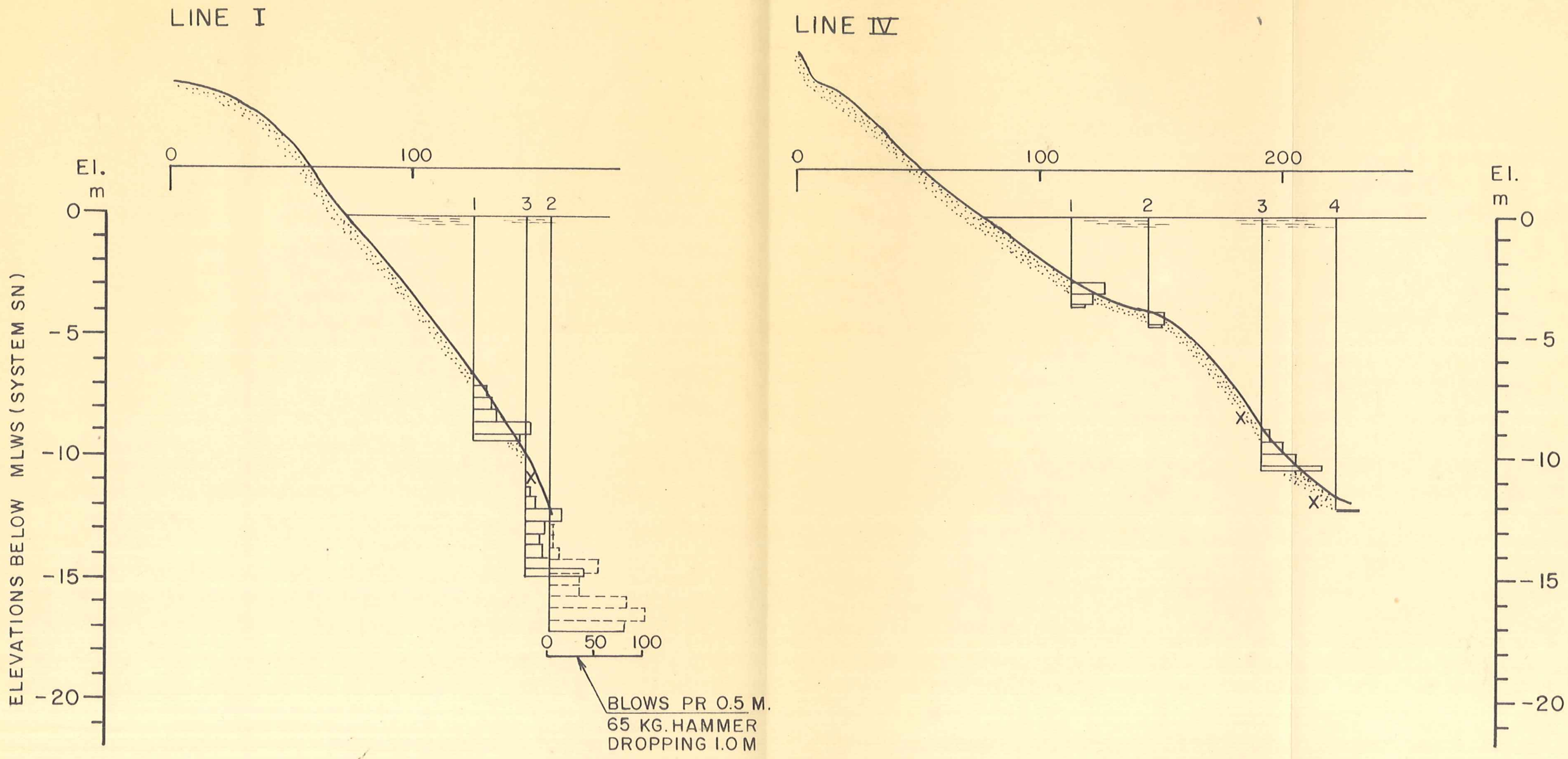

GRUNDARTANGI HVALFJÖRÐUR
Geological map
N
683.000
434.100
682.800
433.900
B
17 N
18 A
17 S
18 V
GB-1
4
5
3
2
6
7
9
8 N
8 S
C
16 N
16 S
15 N
15 S
(Approx. location)
GB-3 A and B
GB-2
10
11
A
14 N
14 S
13 N
12
13 S
10°
Line IV
Line I
LEGEND
Soil and vegetation
Beach deposits
Basalt
Basaltic dykes
× 3 Seismic sounding
Core drillhole
Borro sounding
Geological sections
0 50 100 m
Scale

Fig 2

ORKUSTOFNUN	2.5'75 BJ/IS
GRUNDARTANGI HVALFJÖRDUR	Tnr. 53
Borro soundings at Grundartangi þarbour site	B-90
	Fnr. 12785

Fig. 3



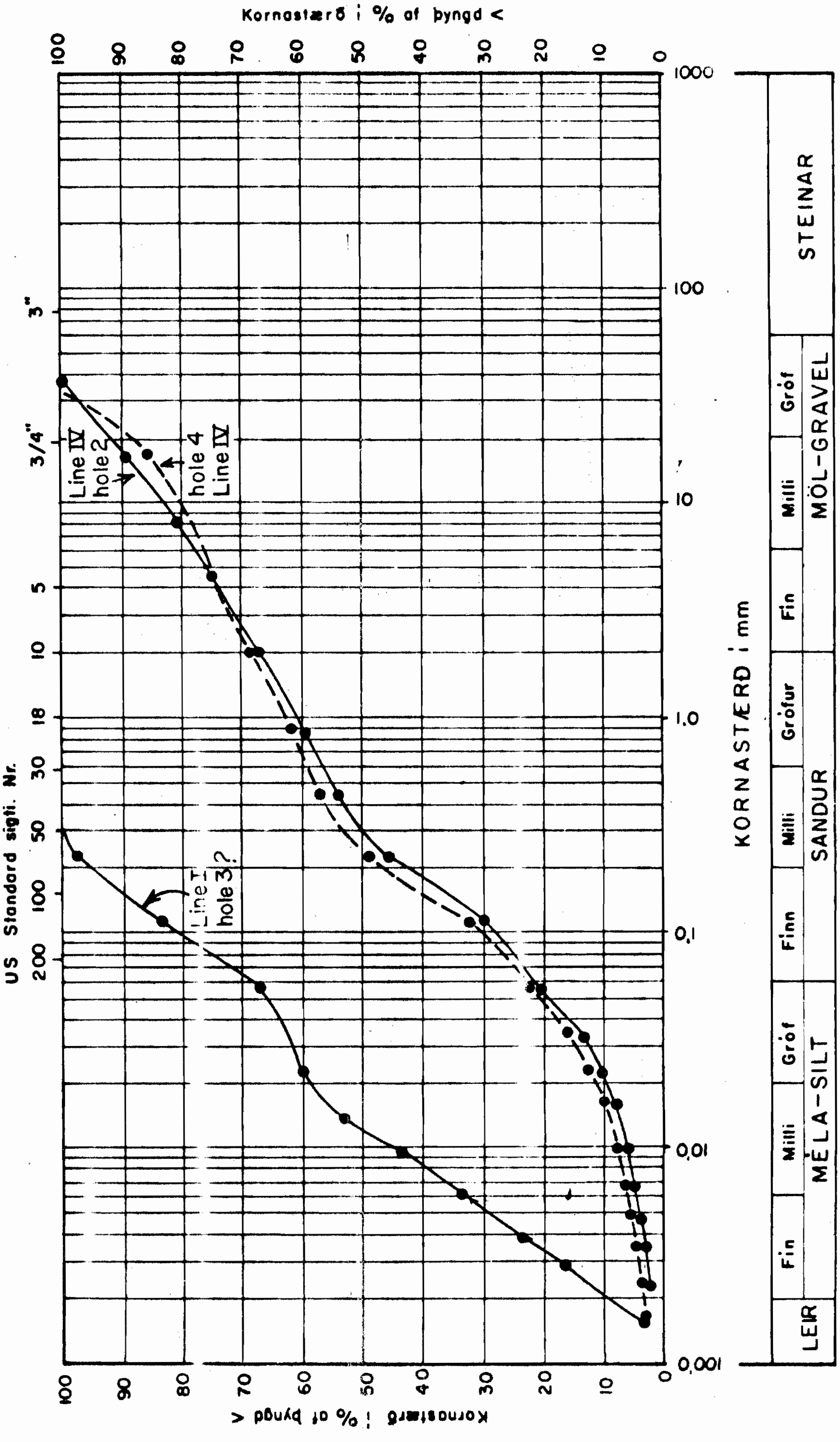
LEGEND:

LOCATION OF LINES SHOWN ON FIG. 2

X SAMLE FOR LABORATORY TESTS

	ORKUSTOFNUN	2.5 '75 SP/BJ/IS
	GRUNDARTANGI HVALFJÖRDUR	Tnr. 47
		B-90
	Bottom Samples–Grainsize Analysis	Fnr. 12745

Fig 4

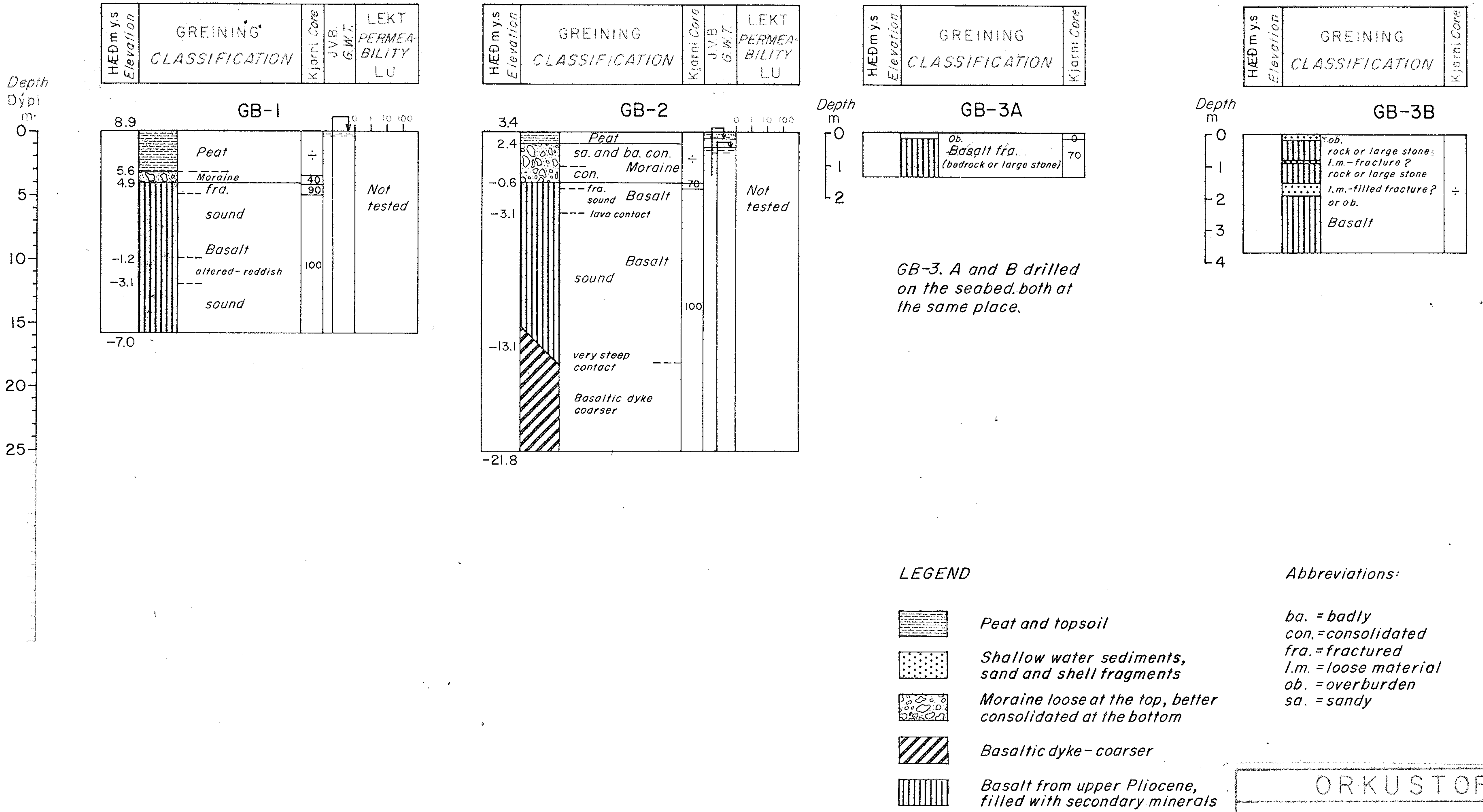


Line I: Hole 3(?) It is possible that the kink at grainsize 0.053 mm results from clots as the sample showed great cohesive properties.

Line IV: Hole 2: Content of organic matters other than carbonates was 7%. (H_2O_2 was used)

Hole 4: Moisture content 47%

Fig. 5



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GRUNDARTANGI

GRAPHIC CORE LOGS

16.4 '75 BJ/SL | Tnr. 45 | B-90 | Fnr. 12641

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GRUNDARTANGI

Geological Section B-B

2.5'75 BJ/IS	
Tnr. 43	
B-90	
Fnr. 12639	

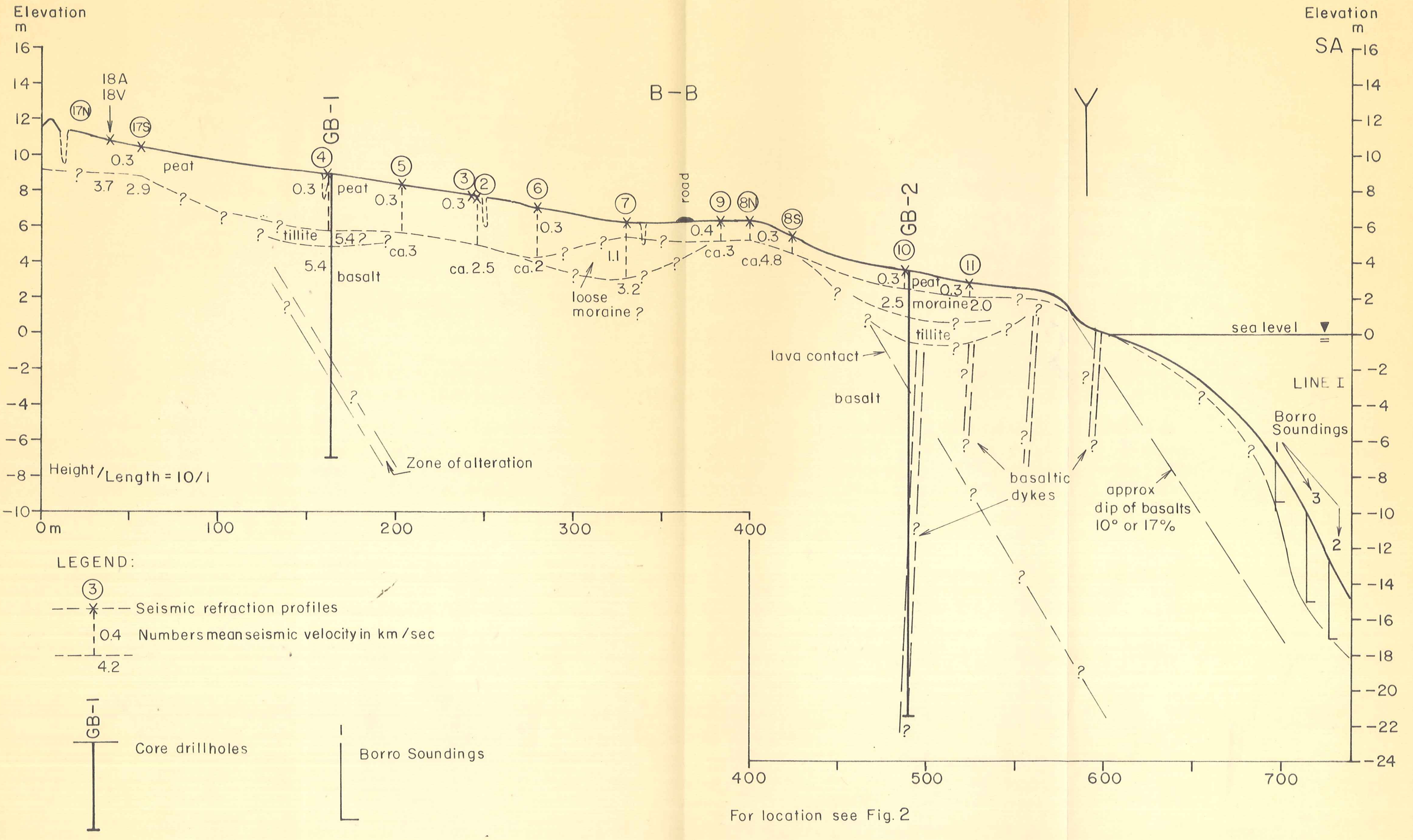
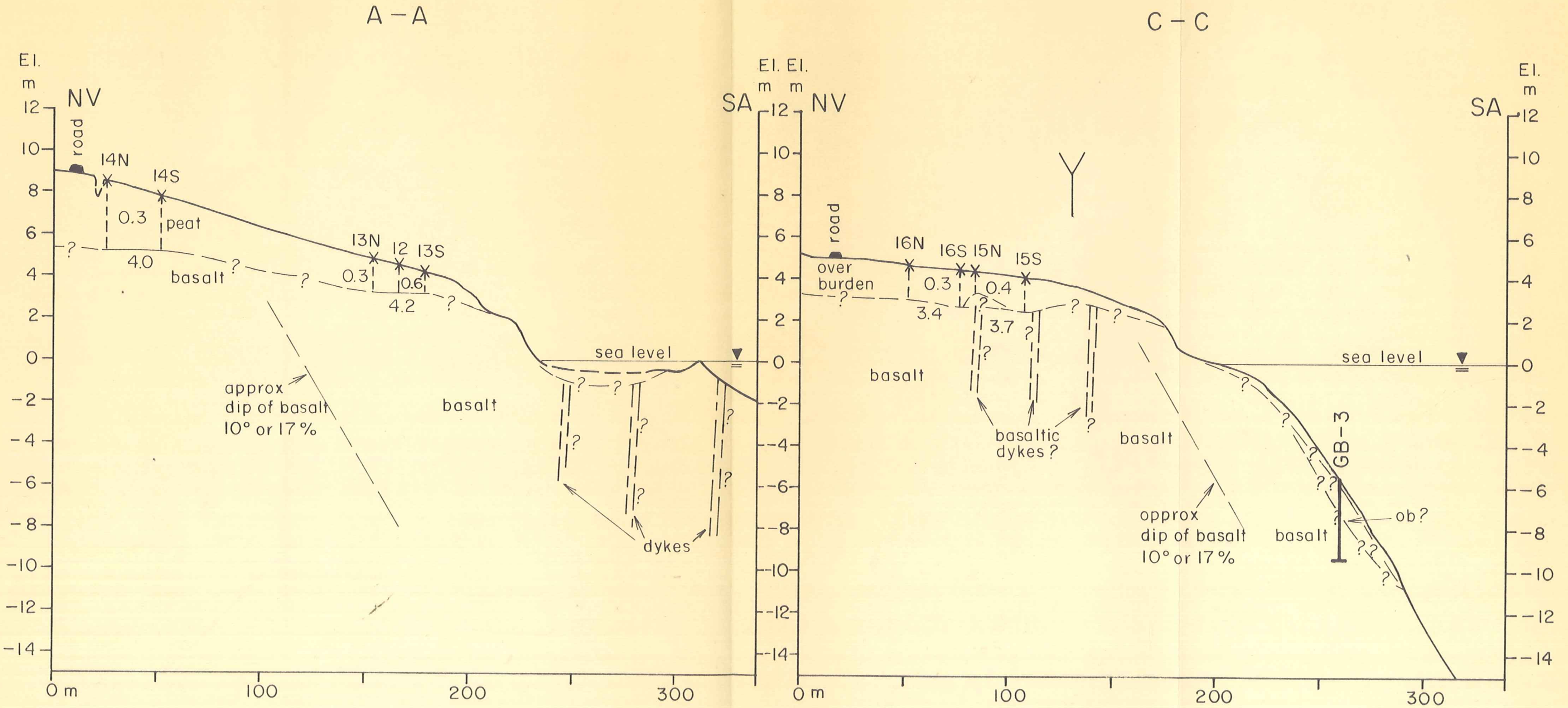


Fig. 6

ORKUSTOFNUN	2.5'75 BJ/IS.
GRUNDARTANGI	Tnr. 44
Geological Section A-A and C-C	B-90
	Fnr. 12640

Fig. 7



Legend see fig. 6

Location see fig. 2

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GRUNDARTANGI

Seismic Profiles 2-5

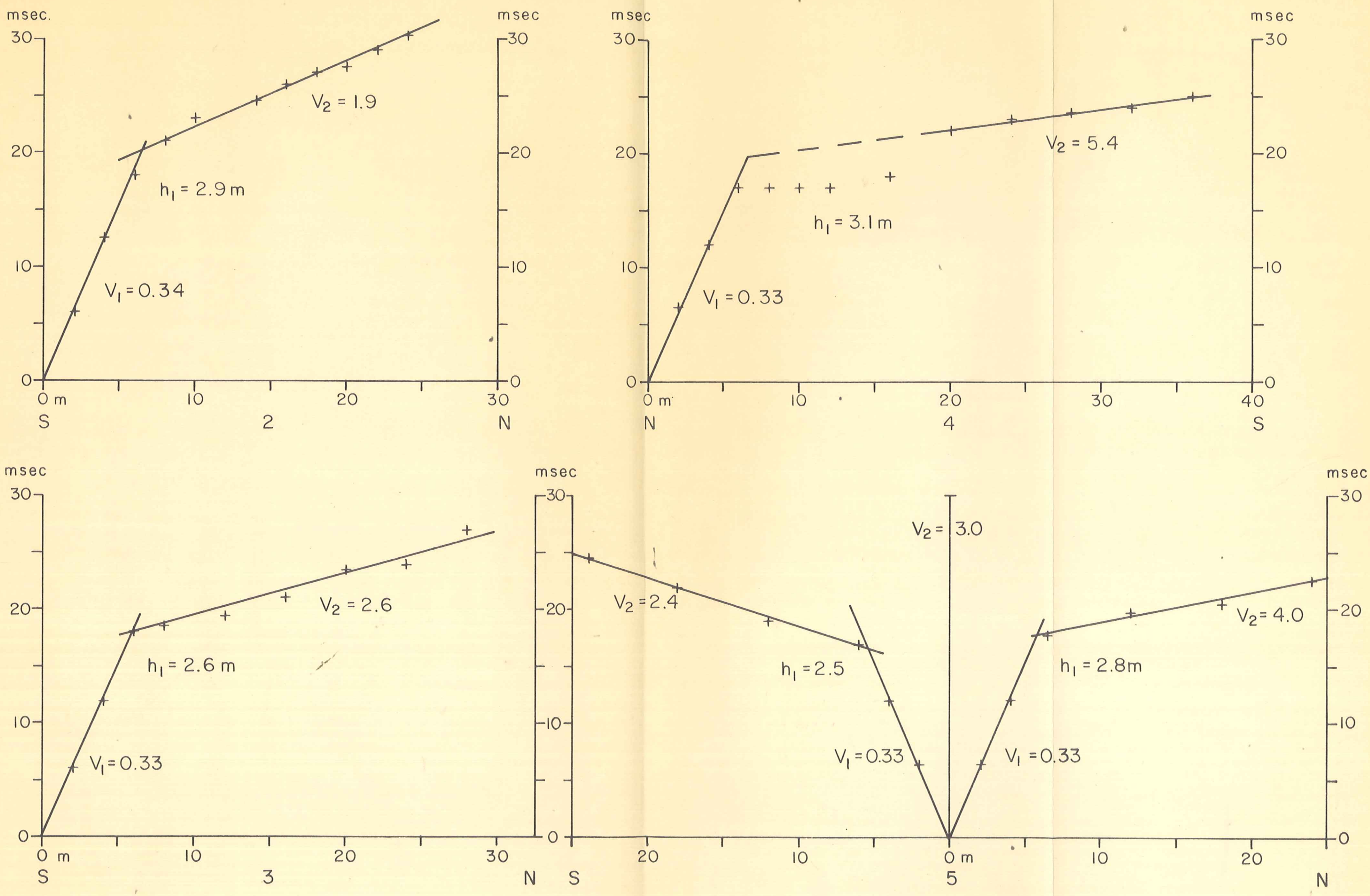
34.4.'75 BJ/IS	
Tnr. 48	Tnr. 198
B-90	J-Jarðsvm.
Fnr. 12746	

Fig. 8

LEGEND:

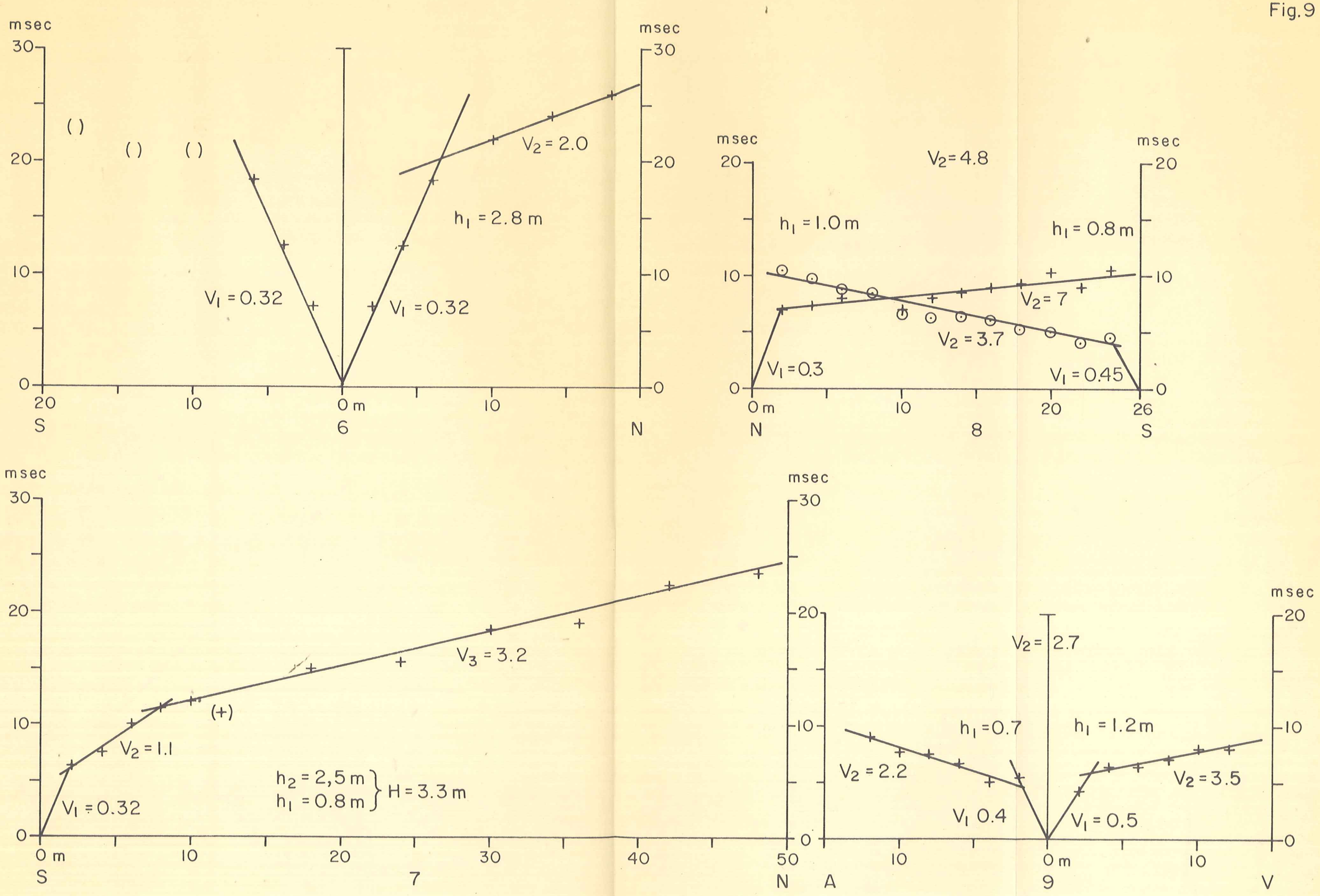
V: seismic velocity km/sec

h: thickness of layers in meters



ORKUSTOFNUN GRUNDARTANGI Seismic Profiles 6-9	30.4 '75 BJ/IS Tnr. 49 Tnr. 199 B-90 J-Jarsvm. Fnr. 12747

Fig. 9



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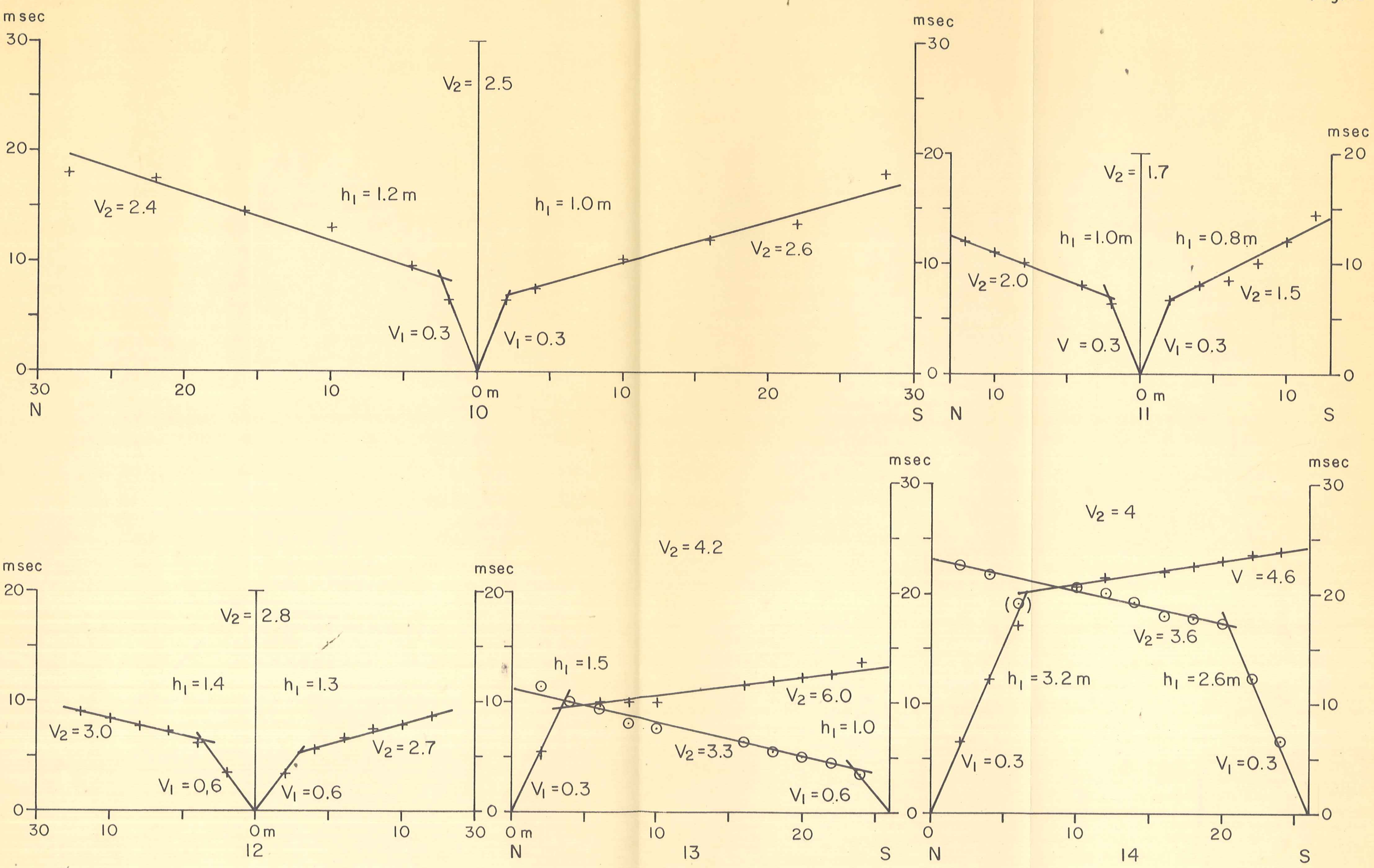
GRUNDARTANGI

Seismic Profiles 10-14

30.4'75 BJ/IS	
Tnr. 50	Tnr. 200
B-90	J-Jarðsvm.
Fnr. 12748	

Fig.10



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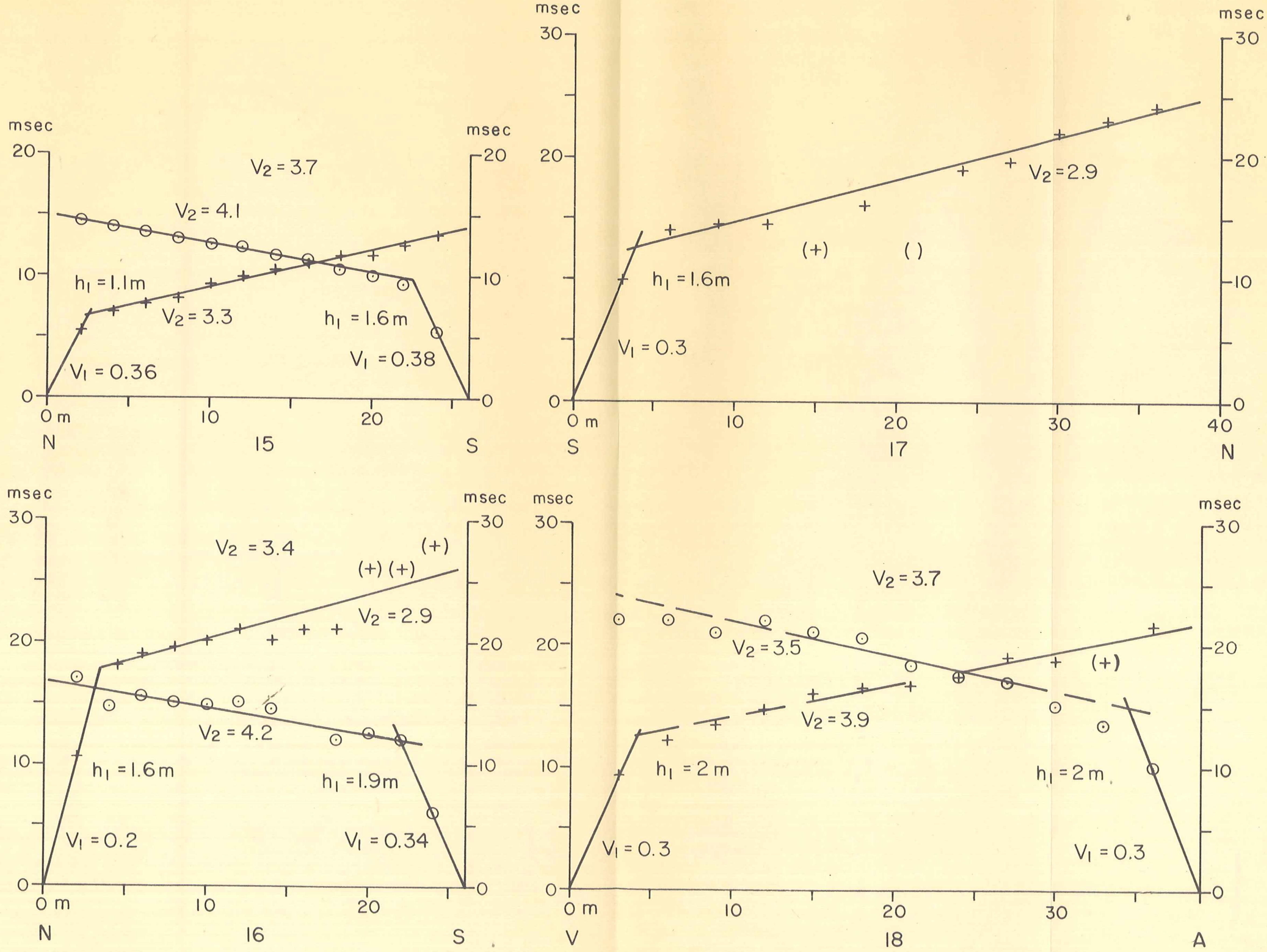
GRUNDARTANGI Seismic Profiles 15–18	30.4 '75 BJ/IS Tnr. 51 Tnr. 201 B-90 J-Jarðsvm Fnr. 12750

Fig. II



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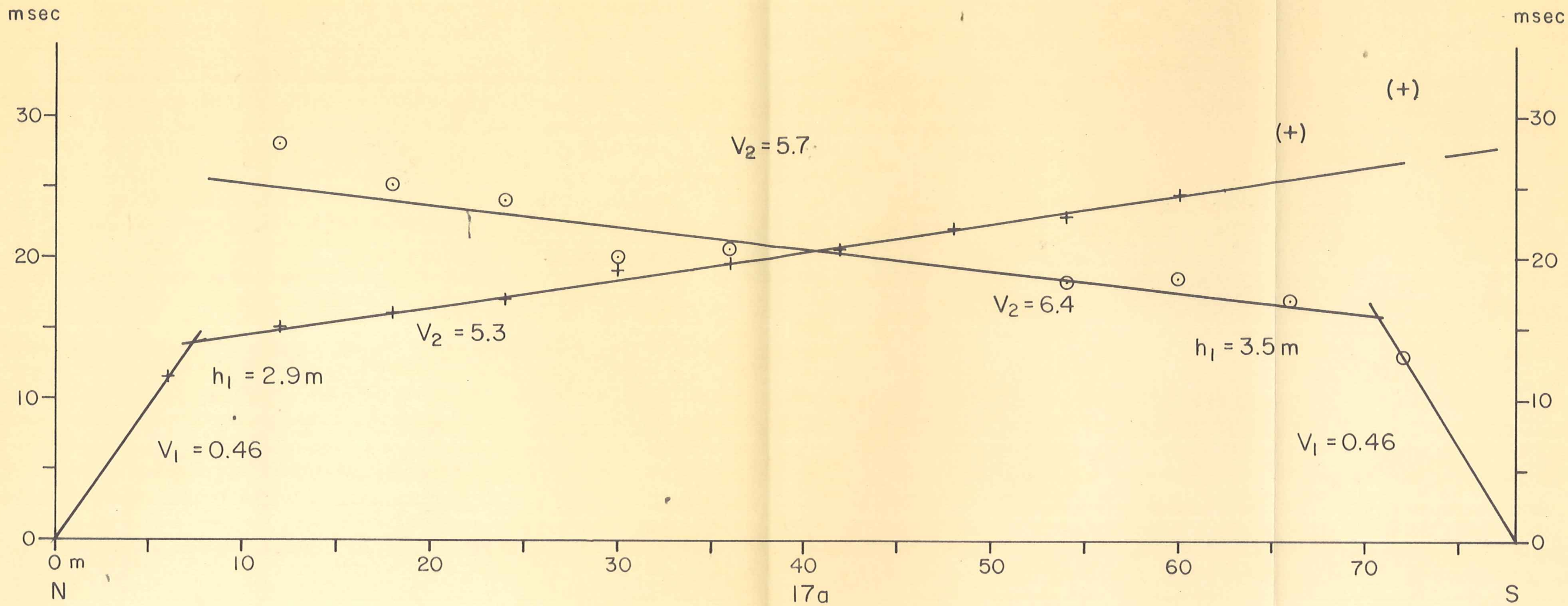
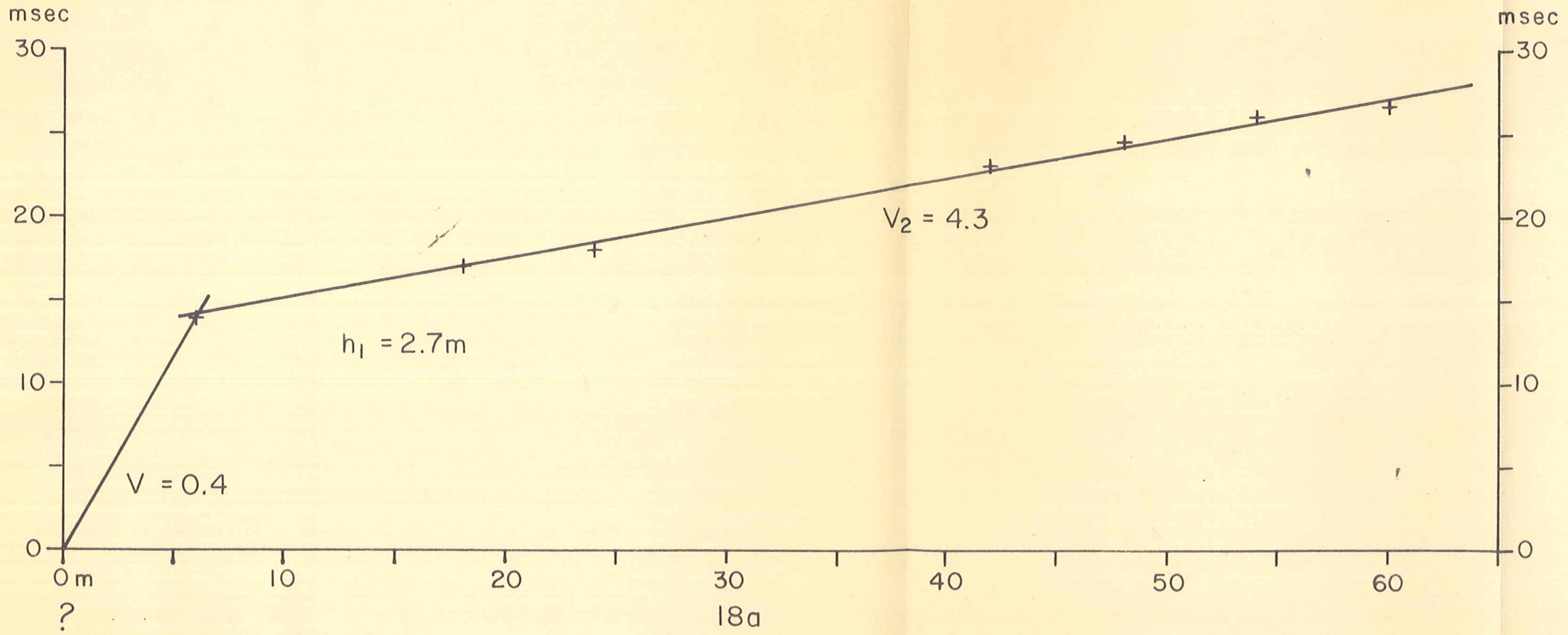
GRUNDARTANGI

Seismic Profiles 17a–18a

30.4 '75 BJ/IS	
Tnr. 52	Tnr. 202
B–90	J-Jarsvm.
Fnr. 12751	

Fig. 12





Note: Seismic profiles 17a and 18a are in the same area as 17 and 18 (see fig 2) but exact location is not known.