

HRAUNEYJAFOSS 1971

Drilling and other
geotechnical work

by

Birgir Jónsson

Prepared for
LANDSVIRKJUN
THE NATIONAL POWER COMPANY
February 1973

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HRAUNEYJAFOSS

Exploration Drilling 1971

During the summer of 1971 exploration drilling at Hrauneyjafoss was continued. Twelve new holes, HP-51 to HP-62, were drilled, and one inclined hole (HP-48) from the previous year was deepened. All these are core drillholes, except HP-61, which was drilled with a tricone bit only about 5 meters northeast of drillhole HP-56. These two holes were then widened to 8 inches because of a proposed pumping test, which has not yet been done. Location of the holes can be seen in Exhibit 1 along with tectonic lineations and locations of geological sections. Most of the drilling was done at the northern end of the damsite and on the proposed site for powerhouse and pipes.

An account of the general and site geology of the area, based on extensive drilling during the summer of 1970 and a few earlier holes along with other field work, can be found in HRAUNEYJAFOSS HYDROELECTRIC PROJECT, Project Planning Report, Volume II, prepared by HARZINT and THORODDSEN AND PARTNERS, April 1971. In Volume I of the same report, chapter III consists of a short account called Project Engineering Geology.

The drillings of 1971 revealed a few geological points, the most important ones being the following:

1. During 1967, when drilling the hole HR-4 at the Tungná river about 1 km west of the power house site, a tillite layer that separated the two móberg formations Hr₁ and Hr₂ was penetrated.

In 1971 this tillite layer was also found in drillholes HP-56 and 57 at the power house site, but it had not been expected to be at such a high elevation. See the geological section D-D in Exhibit A-10 in Vol. II of the Project Planning Report, and compare it to sections I-I and J-J in Exh. 2 in the present report. In the power house area the tillite layer is at an elevation of about 326-332 meters.

2. The geological section J-J in Exhibit 2 in the present report is at the same location as section D-D in the Project Planning Report. Section I-I is about 80-100 m further west and shows that there the depth to the pillow lava in places is much less than at section J-J, especially at the top of the slope and also halfway down. Furthermore section I-I shows that the surface of the pillow lava formation is very steep between the holes HP-55 and 56.
3. The holes HP-51 and 52 were drilled on the canal site between HP-32 and HP-21, see sections N-N and K-K in Exhibit 3. The former holes showed the depth to the pillow lava to be less than previously thought, see section D-D in Exhibit A-10 in the Project Planning Report. Therefore the depression into the pillow lava at the hole HP-21 is even narrower than one had thought. Two westerly and southwesterly tectonic lineations do cross section N-N in this depression (see Exh. 1) and are perhaps the cause of it, i.e. these tectonic lineations were probably active during the second last glacial epoch, after the Fossalda ridge had been piled up during an eruption earlier in this same glacial. When these lineations were active it was easier for the overriding glacier to scour the bedrock adjacent to them.

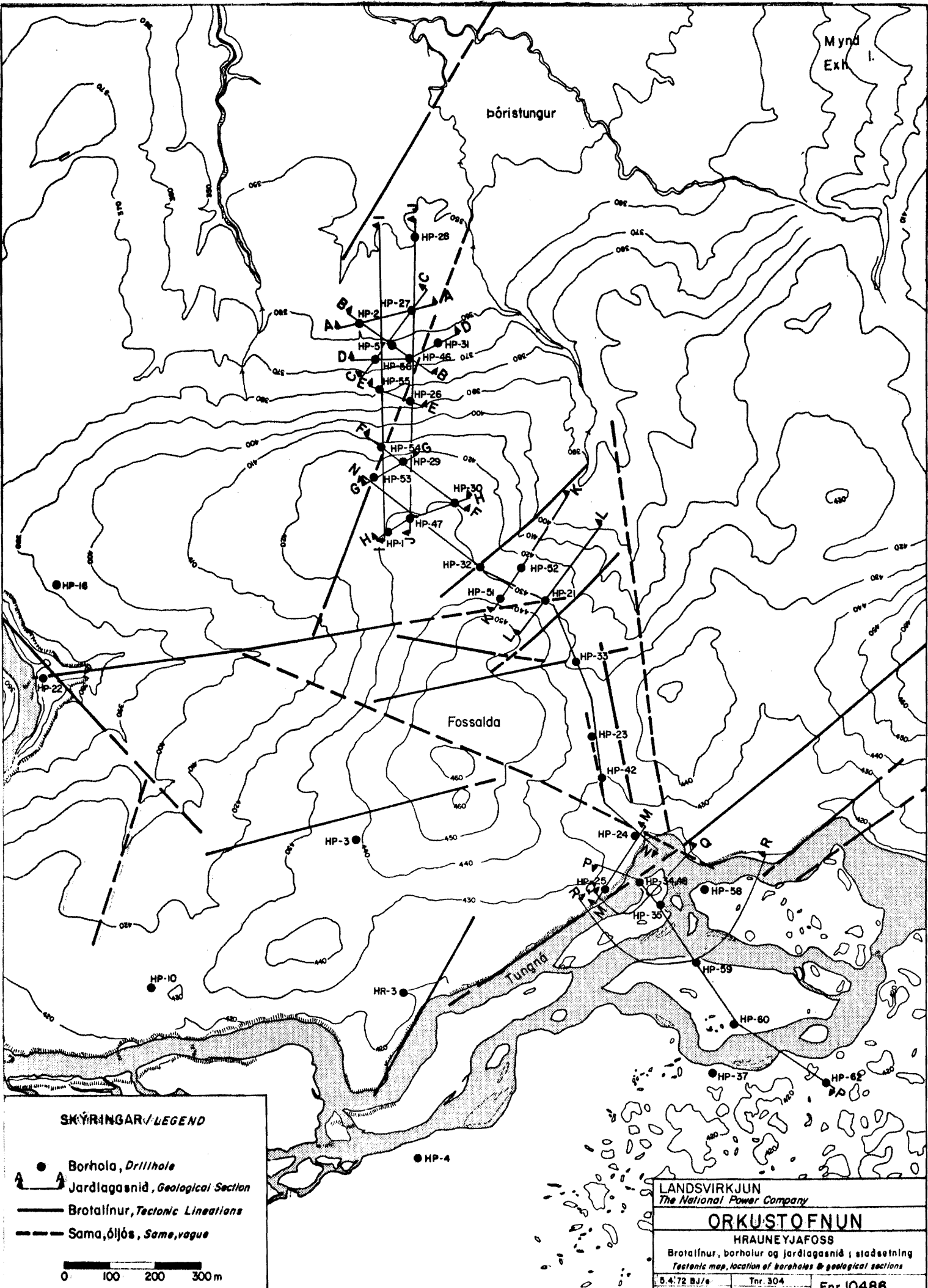
4. The four holes that were drilled in 1971 on the lava at the river, HP-58, 59, 60 and 62, showed the interbed between the lavas TH_j and TH_i to be thinner in these holes than previously thought, see borehole logs in Exhibits 4 and 5. If the geological sections R-R, Q-Q and P-P in Exhibit 3 are compared to sections A-A, B-B and C-C in Exhibit A-9 in the Project Planning Report, one can see how the new holes have changed the picture.
5. In hole HP-62 on the south bank of the river (see Exhibit 1) only the youngest lava, TH_j , was found (see borehole log in Exh. 5 and geological section P-P in Exh. 3), but in the holes HP-60 and 37, which are about 250 m to the west, the lava TH_i is present beneath TH_j , so the edge of the former lava must be between these two holes and HP-62.
6. When the inclined hole, HP-48, was deepened (see geol. section P-P, Exh. 2 and the core log in Exh. 6) it penetrated a SW-NE trending fault running along the course of the river at the damsite. The hole hit the fault zone at an elevation of about 400 m.

T A F L A 1

T A B L E 1

STAÐSETNING OG DÝPI BORHOLA
 LOCATION AND DEPTH OF BOREHOLES

Hola númer Hole number	Hnit Coordinates		Hæð fóður- rörs m y.s. Top of casing elevation	Dýpi depth m	Botn holu m y.s. Bottom of hole el.
	X	Y			
HP 51	559.986	410.944	434.62	20.2	414.4
" 52	559.942	411.005	425.01	15.2	409.8
" 53	560.246	411.192	423.15	30.5	392.7
" 54	560.225	411.253	414.23	26.3	387.9
" 55	560.230	411.380	378.94	30.0	348.9
" 56	560.245	411.449	365.36	46.0	319.4
" 57	560.220	411.475	361.87	43.5	318.4
" 58	559.518	410.311	418.03	15.9	402.1
" 59	559.553	410.150	417.52	40.0	377.5
" 60	559.468	410.013	417.79	51.1	366.7
" 61	560.242	411.453	365.27	51.4	313.9
" 62	559.275	409.890	417.93	41.5	376.4



Mynd
Exh. I.

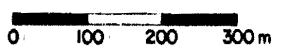
Þórisungur

Fossalda

Tungna

SKÝRINGAR / LEGEND

- Borhola, Drillhole
- A—A Jardiagasnið, Geological Section
- Brotalínur, Tectonic Lineations
- - - Sama, óljós, Same, vague

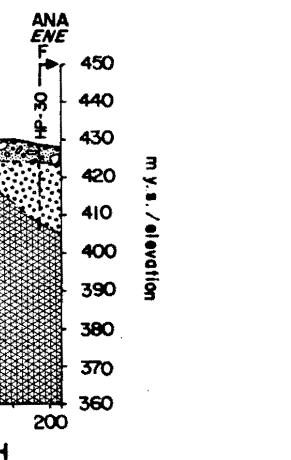
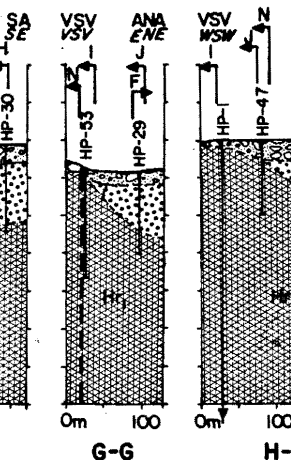
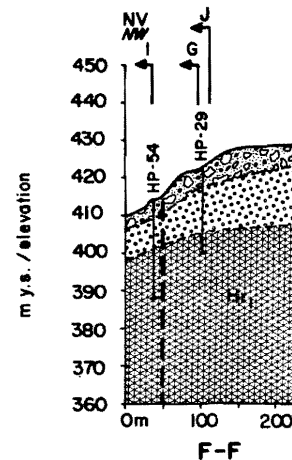
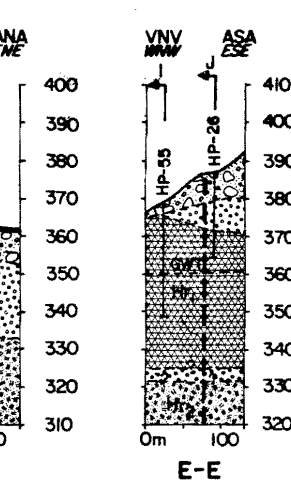
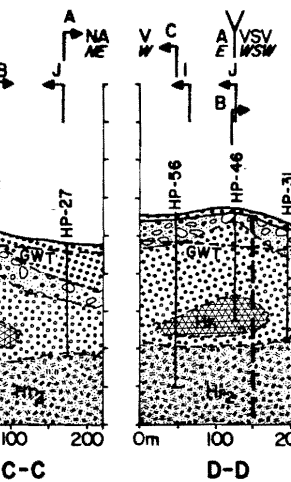
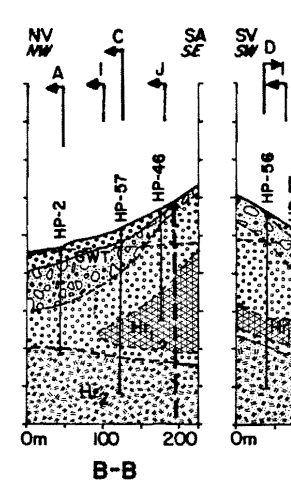
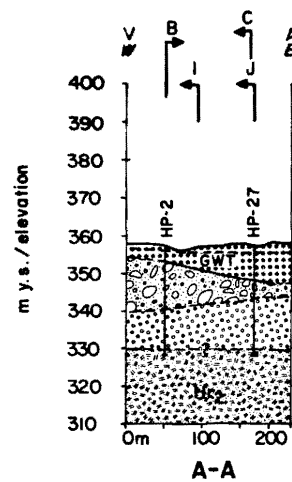
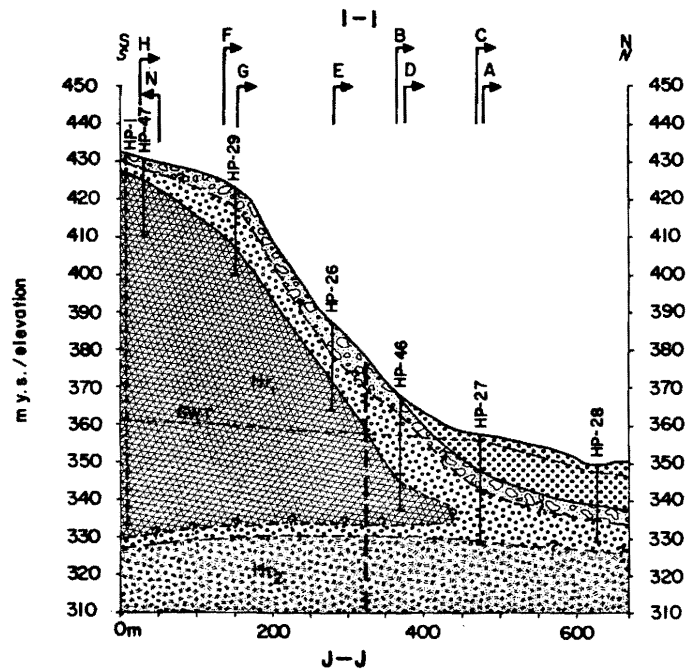
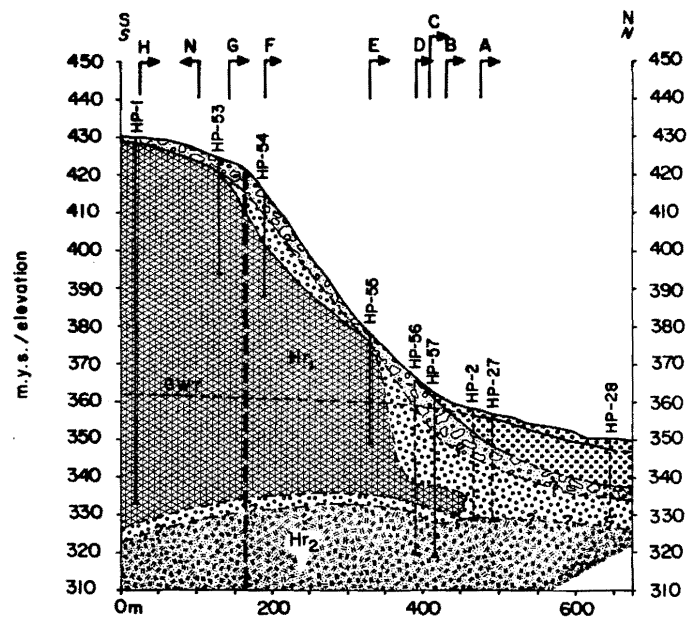


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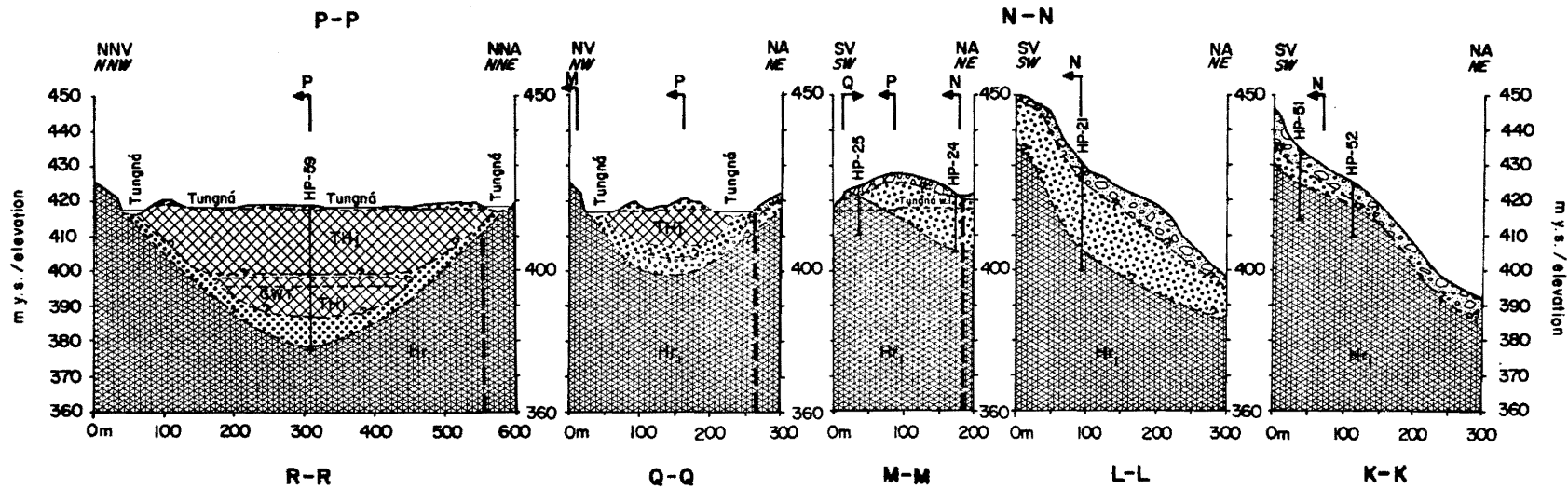
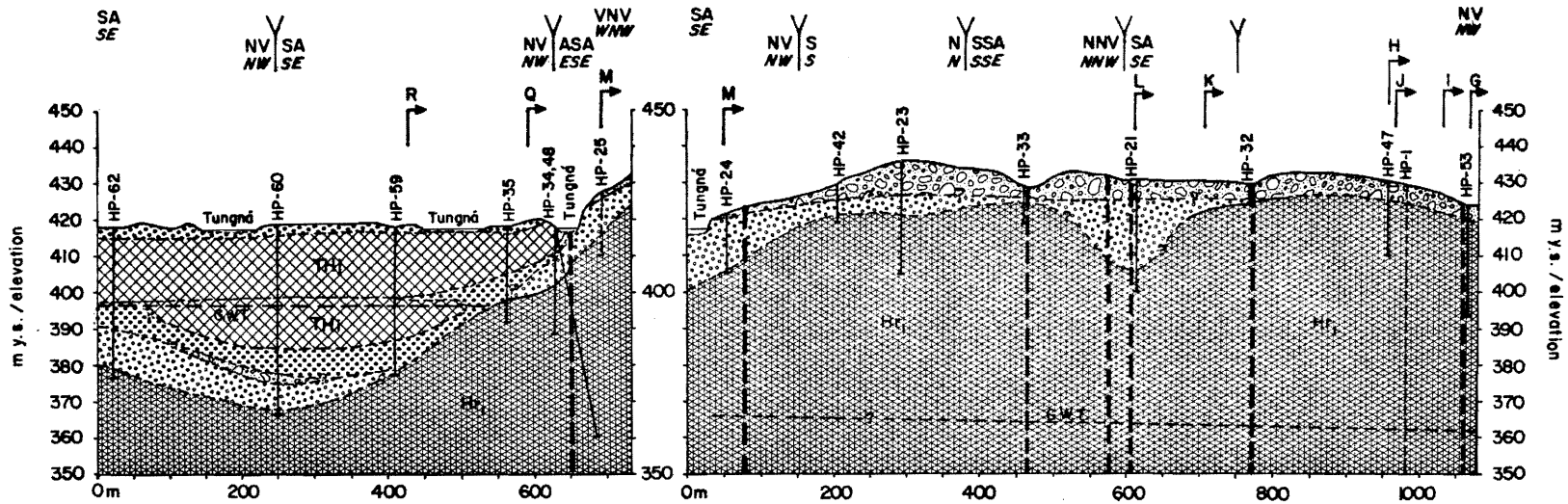
ORKUSTOFNUN
HRAUNEYJAFOS

Brotalínur, borhólur og jardiagasnið; staðsetning
Tectonic map, location of boreholes & geological sections

B. 4:72 BJ/e	Tnr. 304	Fnr. 10486
	B-532	



LANDSVIRKJUN The National Power Company		
ORKUSTOFNUN		
HRAUNYJAFOS		
Jardlaganú A-A III J-J Geological Sections A-A to J-J		
2i. 4. BJ/e	Thr. 306	Fnr. 10488
Blad 2 of 2	B-332	



SKÝRINGAR
LEGEND

- Laust yfirbörð og millilög, sand- og gjallkennd
Overburden and interbeds, sandy and scoriaceous
- TH Tungnáhraun, stórdílt basalt
Tungná lava, porphyritic basalt
- Mo/Ti Mórena og jökulberg undir
Moraine and tillite beneath

- G.W.T. Jarðvatnsborð
Ground Water Table
- Hr₁/Hr₂ Hrauneyjafoss móberg
Hrauneyjafoss Móberg Formations
- Brotalínur
Tectonic Lineations
- Borðhola
Drillhole

- Borðhola utan jarðlagasíða
Drillhole projected into section
- Sníð breytir stefnu
Section turns
- Óviss jarðlagaskil
Uncertain rock contacts
- Sníð skarast
Sections intersect

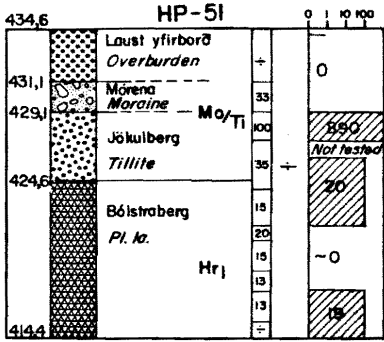
LANDSVIRKJUN The National Power Company		
ORKUSTOFNUN		
HRAUNEYJAFOSS Jarðlagasíð K-K til R-R Geological Sections K-K to R-R		
17. 4. B.J/s Blad 1 of 2	Tnr. 305 B-332	Fnr. 10487

Depth
Dýpi
m

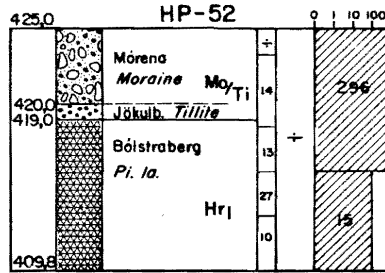
Depth
Dýpi
m

Depth
Dýpi
m

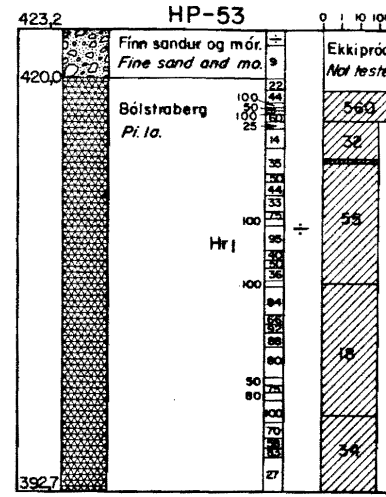
H.E.D. Elevation	GREINING CLASSIFICATION	Kjarni Core J.V.B. G.W.T.	LEKT PERMEA- BILITY LU
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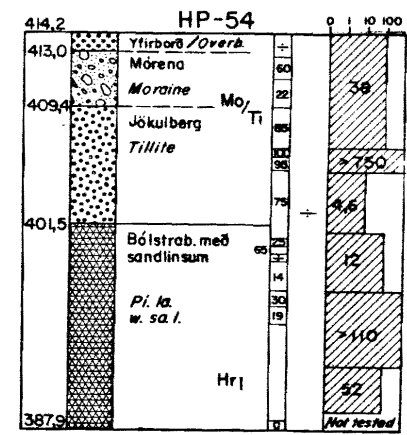
H.E.D. Elevation	GREINING CLASSIFICATION	Kjarni Core J.V.B. G.W.T.	LEKT PERMEA- BILITY LU
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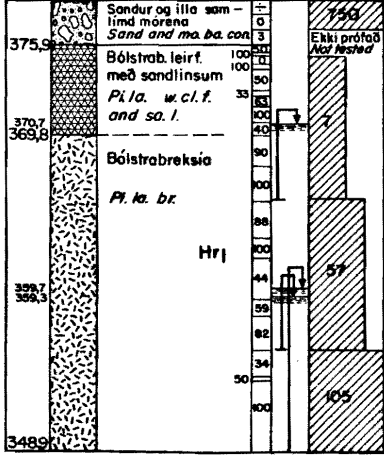
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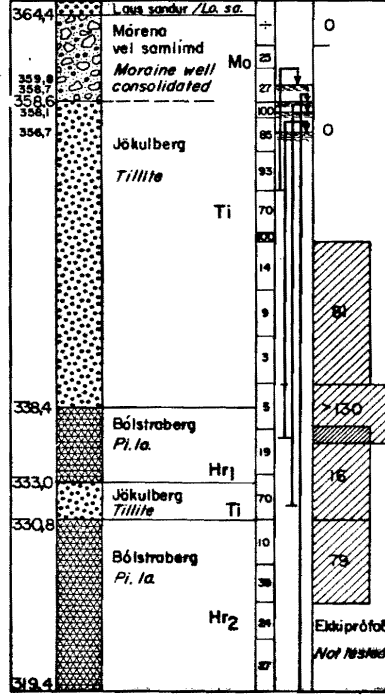
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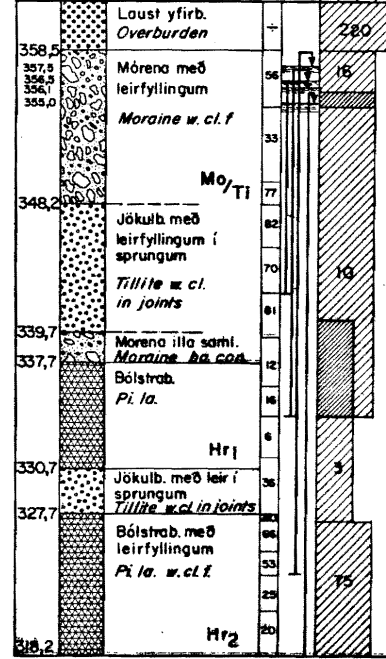
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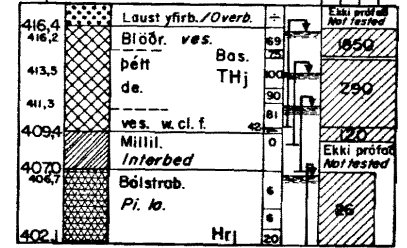
H.E.D. Elevation	GREINING CLASSIFICATION	Kjarni Core J.V.B. G.W.T.	LEKT PERMEA- BILITY LU
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H.E.D. Elevation	GREINING CLASSIFICATION	Kjarni Core J.V.B. G.W.T.	LEKT PERMEA- BILITY LU
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H.E.D. Elevation	GREINING CLASSIFICATION	Kjarni Core J.V.B. G.W.T.	LEKT PERMEA- BILITY LU
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HRAUNEYJAFOSS
SNÍÐ AF BORHOLUM HP-51-58
GRAPHIC CORE LOGS HP-51-58

229.71 SF/IS. Thr. 290
Bláð 1 af 8-332 Fnr. 10099

Depth
Dýpi
m

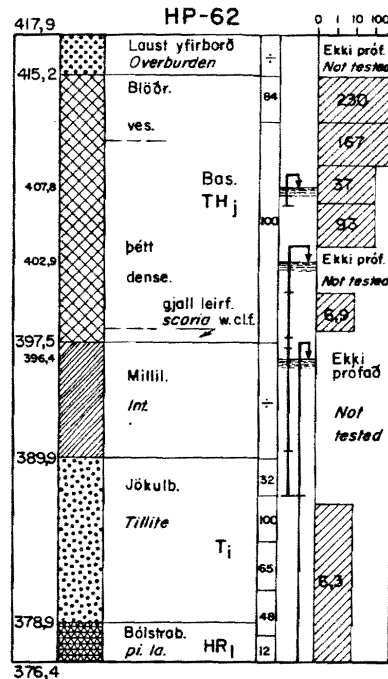
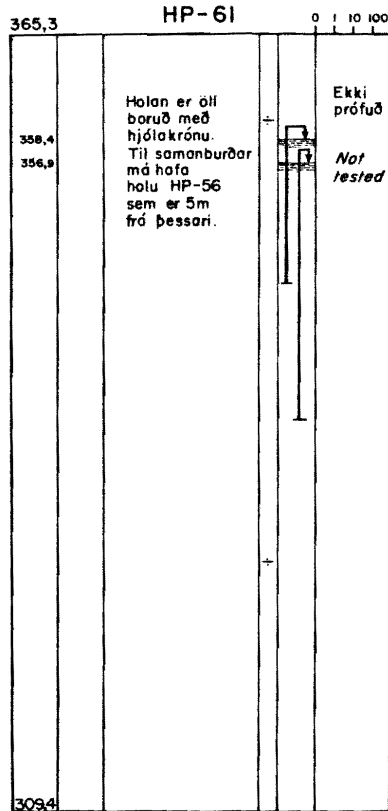
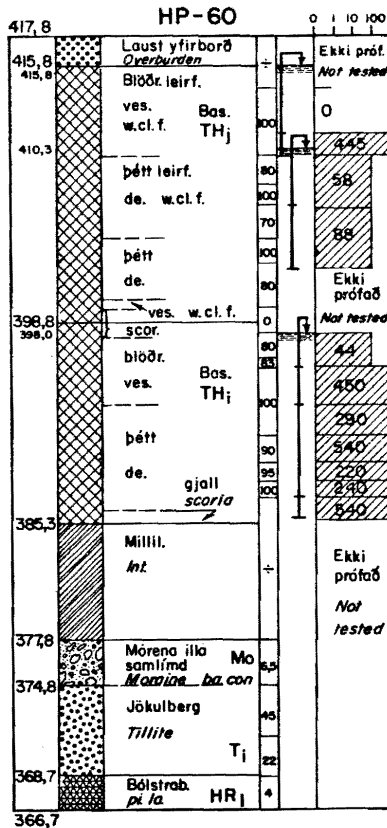
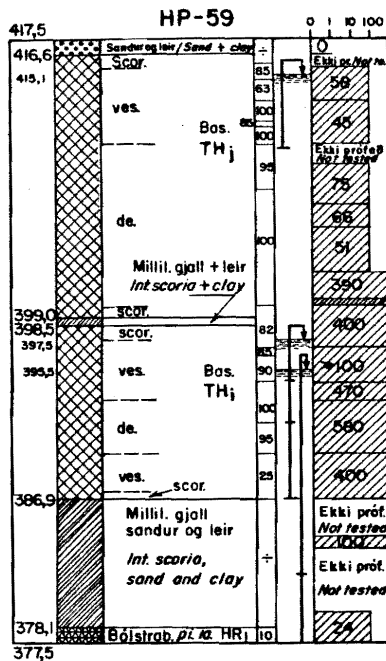
Depth
Dýpi
m

HÆÐ Elevation	GREINING CLASSIFICATION	Kjarni Core	J.V.B. G.W.T.	LEKT PERMEABILITY LU
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HÆÐ Elevation	GREINING CLASSIFICATION	Kjarni Core	J.V.B. G.W.T.	LEKT PERMEABILITY LU
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HÆÐ Elevation	GREINING CLASSIFICATION	Kjarni Core	J.V.B. G.W.T.	LEKT PERMEABILITY LU
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HÆÐ Elevation	GREINING CLASSIFICATION	Kjarni Core	J.V.B. G.W.T.	LEKT PERMEABILITY LU
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SKÝRINGAR - LEGEND

- Bólstraberg
Pillow lava Hr
- Bólstrabreksia
Pillow lava breccia Hr₁
- Kubbaberg
Cube jointed basalt Hr₁
- Mórena og jökulberg undir
Moraine and Tillite underneath Mo/Ti
- Basalthraun
Basaltic lava TH
- Fokmold, gjöska og sandur
Loess, tephra and eolian sand
- Millilög
Interbed
- Ársæt, sandur og leir
Alluvial deposits
- Laust yfirborð
Overburden

SKAMMSTAFANIR
ABBREVIATIONS

- all. = alluvial
- ba.con. = badly consolidated
- bret. = brecciated
- ca. = coarse
- cu. j. = cube jointing
- de. = dense
- dol. = doleritic
- eo = eolian
- fragm. = fragments
- ox. = oxidation
- scoc = scoraceous
- ves. = vesicular
- w. = with
- bas. = basalt

- br. = breccia
- cl. = clay
- cl. f. = clay fillings
- int. = interbed
- la. = lava
- lo. = loess
- mo. = moraine
- pi. la. = pillow lava
- pi. la. br. = pillow lava breccia
- sa. = sand
- sa. l. = sand lenses
- te. = tephra
- te. l. = tephra layers
- ti. = tillite

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ORKUSTOFNUN

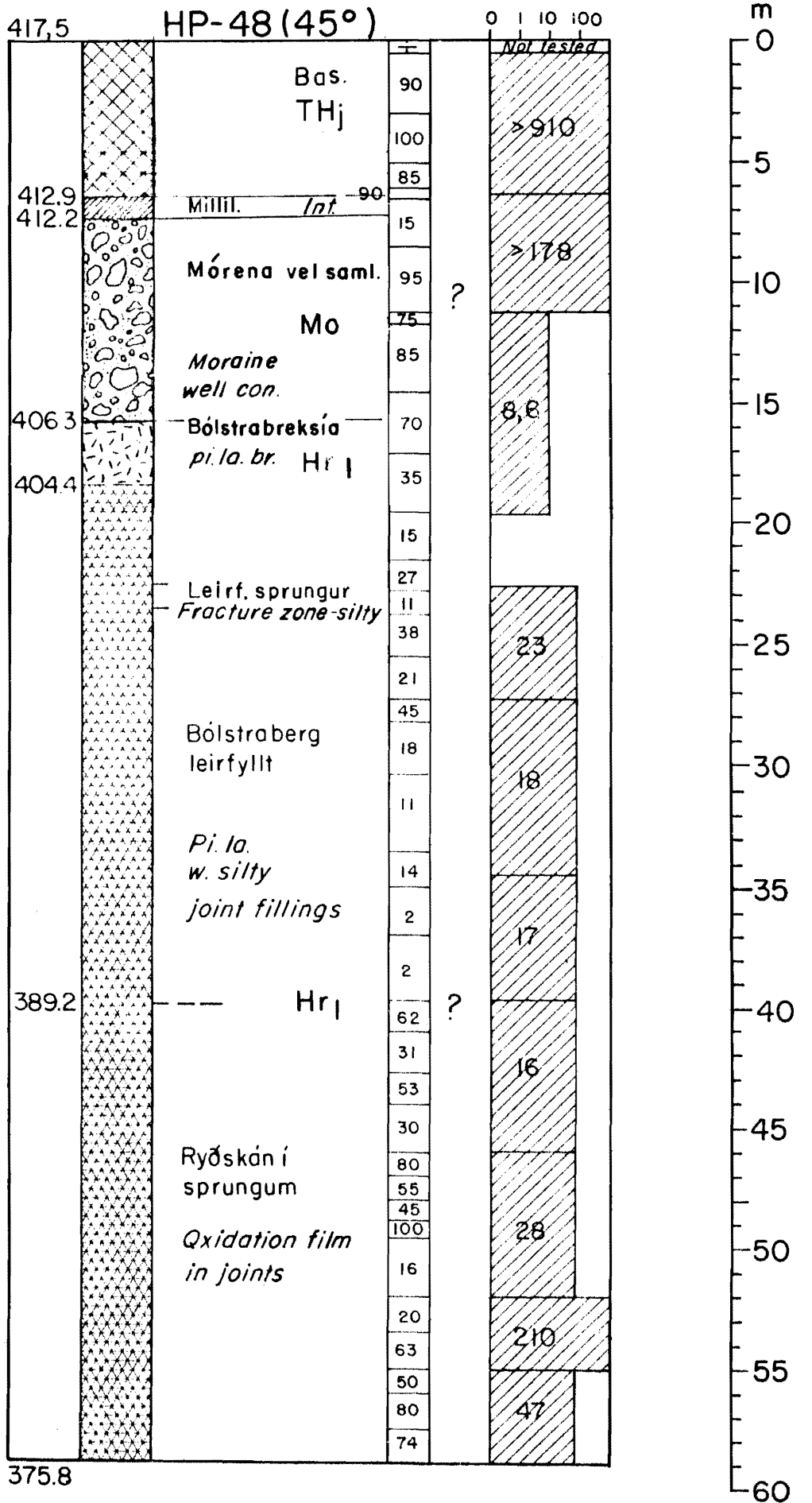
HRAUNEYJAFÖSS

SNÍÐ AF BORHOLM HP-59, 60, 61 OG 62
GRAPHIC CORE LOGS HP-59, 60, 61 AND 62

16.9.71 SF/IS. Tnr. 291
B-332 Fnr. 10100

HÆÐ Elevation	GREINING CLASSIFICATION	Kjarni Core	J.V.B. G.W.T.	LEKT PERMEA- BILITY LU
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Mynd 6
Exh.



MYND 7
Exh.

ORKUSTOFNUN
Raforkudeild

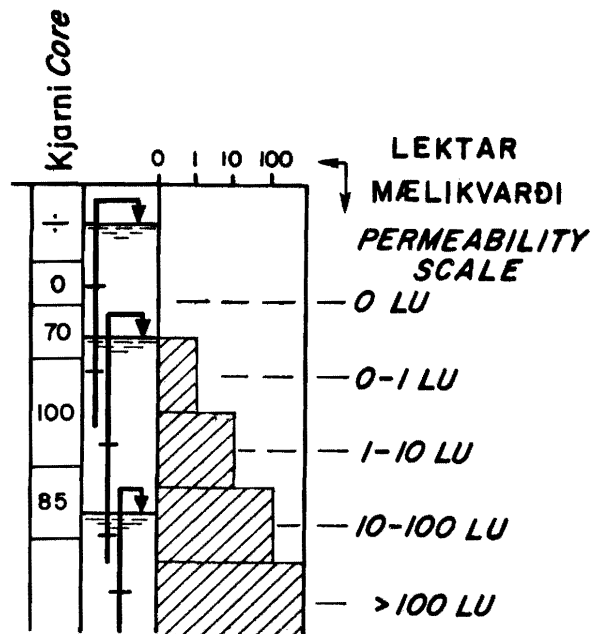
KJARNA-, LEKTAR OG JARÐVATNSÚTSKÝRING
NOTE ON CORE PERMEABILITY
AND GROUND WATER

18/9'70 HVEK

Tnr. 204

B-Ým.

Fnr. 9586



LEKTAR-OG JARÐVATNSÚTSKÝRING
NOTE ON PERMEABILITY AND GROUND WATER

Jarðvatnsborð er sýnt með örvum. Neðri endi örvarinnar og þverstrikin sýna holudýpið, þegar jarðvatnsborðið var mælt. Ef jarðvatn breytist ekkert í borun, nær örin í botn.

*Ground water levels are shown by arrows.
Base of the arrows and the horizontal bars indicate the hole depth when the water level was measured. If no change in level was observed during drilling, the arrow reaches the bottom of the hole.*

1 LU = Lugeon Unit = 1 l/mín/m í 76 mm Ø holu við þrýsting 10 kg/cm²

1 LU = Lugeon Unit = 1 l/mín/m in 76 mm Ø hole at pressure 10 kg/cm²

Hæðartölur jarðvatns eru ritðar smærri lettri en hæðartölur bergs, á borholusniðum.

Figures for ground water levels are shown with smaller lettering on graphic core logs.

Kjarni: Tölur sýna kjarnaheimtur í %
÷ kjarnataka ekki reynd.

*Core: Numbers indicate % core recovery
÷ core sampling not attempted.*

HRAUNEYJAFOSS

Tests done on Interbeds 1971

Samples were taken from the interbed between the lava pile and the tillite on top of the pillow lava. The samples, most of which were disturbed, were from two of the holes, HP-59 and HP-62 (see geological section P-P in Exh. 3). Three samples were taken from the former hole at a depth of 31 to 34.5 m and nine from the latter, all taken from 21 to 22 m depth (see bore hole logs in Exh. 5).

In the case of the samples from HP-59, only the grain size analysis was done and the moisture content measured as was done in the case of seven out of nine of the samples from HP-62, but the remaining two were very little disturbed cylinders and they were permeability tested using the constant head permeability test. These two samples were tested at the Building Research Institute but all the others were tested at the National Energy Authority laboratories.

From table 2 it can be seen that the interbed clearly consists of a few layers with a very different grain size and therefore different permeability. In borehole HP-62 the most finegrained layer is from 21.4 m to a depth of at least 21.6 m. It consists mostly of diatomaceous earth. Above 21.4 m the interbed is mostly scoriaceous sand. Layering is also present in borehole HP-59, where two adjacent samples from a depth of 34.4 and 34.5 meters show very different grain size curves (see Exh. 8).

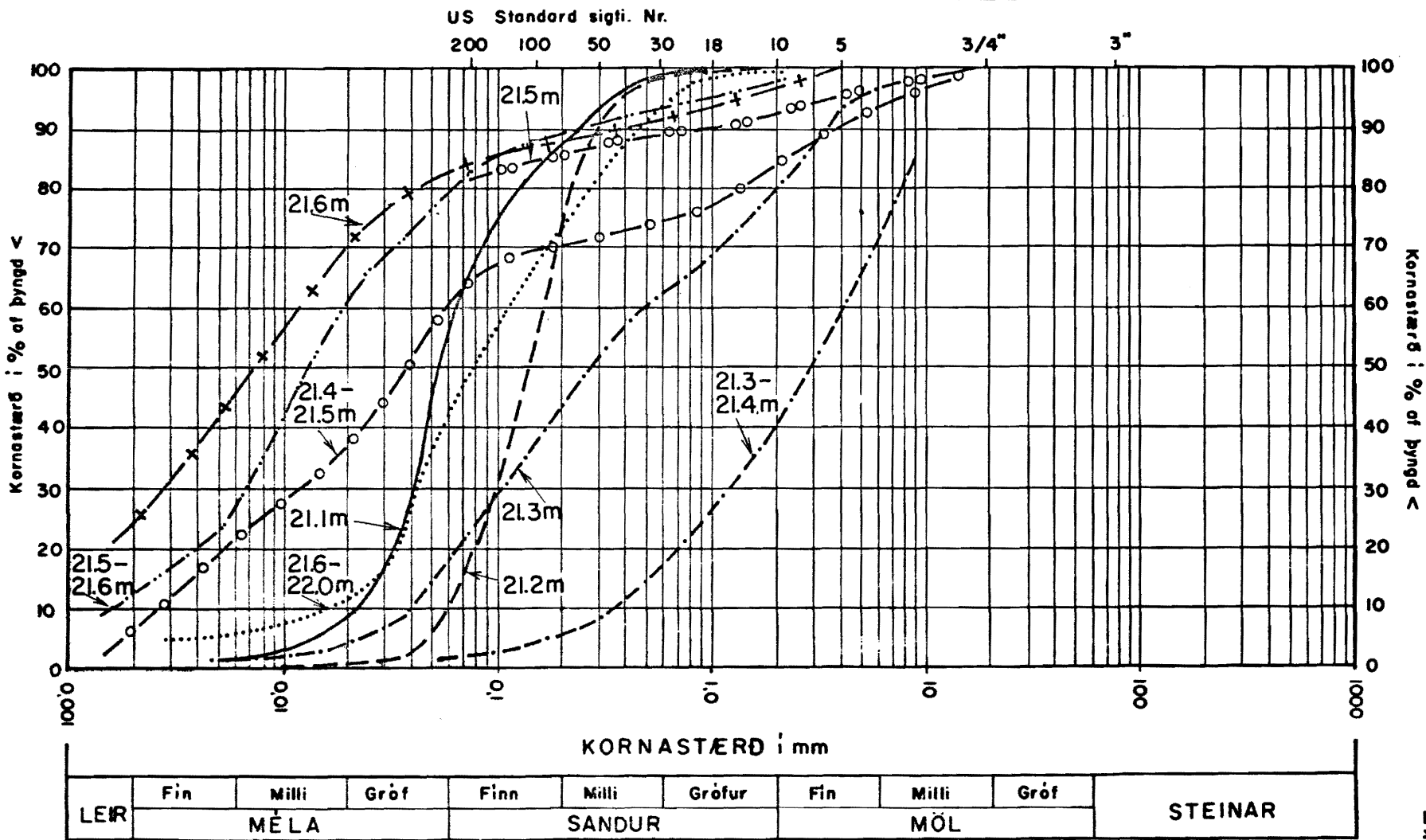
Table 2 shows simplified results of the tests and Exhibits 8 and 9 show the grain size curves from the two holes.

T A F L A
2
T A B L E

dýpi depth m	méla silt content (<0.06 mm) %	<U.S. Std. 200 sigti mesh (<0.074 mm) %	raki moisture content %	lekt permeability $k = \text{cm/sec}$
Hóla Hole <u>HP-59</u>				
31.0	33	37	28	-
34.4	4	5	11	-
34.5	42	45	8	-
Hóla Hole <u>HP-62</u>				
21.1	57	66	35	-
21.2	11	18	27	-
21.3	19	23	26	-
21.3-21.4	2	ca. 2	11	-
* 21.4-21.5 ⁽¹⁾	62	64	139	2.0×10^{-5}
* 21.5 ⁽²⁾ ca.	80	81	140	1.9×10^{-5}
* 21.5-21.6	80	83	137	-
* 21.6	83	84	133	-
21.6-22.0	42	49	37	-

*Sýni að miklu kísilgúr
Sample is mostly diatomaceous earth

Þurr rúmpýngd
Dry density
(1) 630 kg/m^3
(2) 560 kg/m^3



Samples from 21.4 to at least 21.6 m depth are mostly diatomaceous earth

Mynd 9
Exh.

ORKUSTOFNUN	23.1'73 SP/BJ/EK
Hrauneyjafoss	Tnr. 333
Syni í millilagi í borholu HP-62	B - 332
Samples from interbed in borhole HP-62	Fnr. 10975

Reykjavík, 10. jan. 1972.

Nafn greiðanda	Orkustofnun - raforkudeild.	Rannsókn nr.	H71/931.
Mannvirki	Hrauneyjafoss.	Bréf nr.	bh-18
Heimilisfang	Laugaveg 116, Reykjavík.	Dags. beiðni	15.11. '71.
Nafn sendanda	Haukur Tómasson.	Reikn. nr.	2590.
Afrit		Verð	5.162.00
Rannsóknarefni	Óhreyfð jarðvegssýni.		
Fjöldi sýnishorna	2.		
Merki	H-1, H-8		
Upplýsingar frá sendanda	Ath. vatnslekt, rúmþyngd og kornastærðadreifingu.		

AV8705000

Meðfylgjandi töflur og línurit sýna niðurstöður rannsókna er gerðar voru á tveimur litlum borkjörnum úr jarðvegi nálægt Hrauneyjafossi. Voru þeir merktir H-1 og H-8. Kjarni H-1 var rúmlega 6 cm í þvermál og 7.5 cm há, var annar endi hans þakinn smásteinum, sem einungis voru á yfirborðinu. Kjarni H-8 var rúmlega 6 cm í þvermál og 3.0 cm að hæð.

HÓ/sp



