ORKUSTOFNUN
NATIONAL ENERGY AUTHORITY

THORODDSEN AND PARTNERS

ÞÓRISVATN
GEOLOGICAL REPORT

Volume III

by

Haukur Tómasson geologist NEA
Elsa G. Vilmundardóttir " "
Birgir Jónsson " "

Prepared for
LANDSVIRKJUN
THE NATIONAL POWER COMPANY
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CHAPTER 4

RJÚPNADALUR

4.1 Introduction

Rjúpnadalur is a col, located on the northwestern part of the brim of the Þórisvatn basin, immediately south of the Harðhausar and Fremri-Ósalda hills. The col runs from the inlet Flöguvík towards southwest and opens into a semirounded basin north of the Launöldur hills. The elevation of the col is about 587 m or about 16 m higher than the water level of Lake Þórisvatn. See Exhibits 1.02 and 4.01.

It is very likely that a temporary storage for the Búrfell Power Plant will be needed very soon, and by excavating a canal through the Rjúpnadalur col, a storage reservoir is created in the lake basin.

4.2 Geology and Tectonics.

For general description of the geological formations in the area, see chapter 1. The rock formations found in the Rjúpnadalur area are the following; youngest on top.

Kaldakvísl Grey Basalt	KKG
Harðhausar Andesite	HHA
Launöldur Pillow lava	LÖM
Ósöldur Móberg	ÓSM

Most of the ÓSM and LÖM formations is covered with moraine from the last glacial period. The uppermost few meters of the moraine form a loose sandy overburden. The HHA andesite is mostly bare rock. The KKG grey basalt is not within the actual project area but further west.

Ósöldur Móberg: This is the oldest formation in the area. It is overlain by the HHA andesite to the southeast and the LÖM pillow lava to the south (Exh. 4.01). The ÓSM móberg makes up the Ósöldur hills and most of the bottom of the Rjúpnadalur col. Most of it is covered with moraine varying in thickness. The canalsite is almost completely within the ÓSM-móberg. There the móberg is tuffaceous, brownish in colour, with abundant joint fillings made of silt and secondary minerals such as calcite and zeolites. About 2-300 m southwest of hole RD-2 coarse móberg breccia outcrops in a few places within the ÓSM-móberg. The móberg is rather sound and tight, the permeability being 3-30 LU and the core recovery was near 100%.

Launöldur Pillow lava: This formation makes up low cliffs of pillow lava at the lake shore south of Flöguvík. The rock is slightly porphyritic; contains small feldspar phenocrysts. This rock was found at the bottom of hole RD-3, about 9 m below the watertable of Þórisvatn. The hole reaches only 1 m into the surface of the pillow lava, the uppermost part of which is probably badly broken up as only a few fragments of the core were obtained, the core recovery being about 30%.

Harðhausar Andesite: This formation makes up the northwestern shore of Þórisvatn. It consists of a few lavaflows, intermediate in composition, showing strong flow banding which causes horizontal cleavage, or "basal cleavage" in columns where the andesite is columnar. This causes the andesite to weather out as large flakes or slates. A sheet of reddish contact breccia found in the cliffs at the southwestern end of the andesite formation shows the extrusive character of the rocks. The andesite is not on the canalsite itself, but right beside it and talus debris, consisting of the thin andesite slates, makes up much of the loose overburden on the canalsite.

Kaldakvísl Grey Basalt: This formation consists of rather coarse grained olivine basalt (grey basalt), traditionally called dolerite in this country. The rock is feldspar porphyritic and shows ophitic texture. It is most likely from the last interglacial or even from an interstadial during the last glacial stage, so it is the youngest rock in the area. These basaltic lavas have flowed down the present valley of Kaldakvísl. The actual canalsite is about 3 km southeast from the edge of the grey basalt.

Superficial deposits: In the Rjúpnadalur area these are mostly glacial and glaciofluvial deposits (Exh. 1.03).

As mentioned before much of the area is covered with moraine (except the HHA andesite). The moraine has become hardened and only the topmost weathered overburden can be penetrated by borro soundings. Table 4.2 shows location and depth of the borro soundings, and Exhibits 4.05 to 4.08 show the number of blows graphically.

In the basin, southwest of the Rjúpnadalur col, and along the Kaldakvísl river, alluvial sediments make up distinct terraces, so the Kaldakvísl valley, as well as the Rjúpnadalur basin, seem to have been filled or flooded with water for some time. The terraces are generally at 510-520 m elevation. These deposits have been explained as flood deposits formed in a glacier burst, due to an eruption in the Brandur volcano at the southeastern coast of Þóris-vatn (see chapter 1).

The small Flögufit plain at Flöguvík is made up of beach deposits, mostly slightly rounded andesite slates that have been carried by wave action from the andesite cliffs north of Flöguvík. The slates cover the lake bottom 160 m out from the shore to a depth of about 8 meters.

Along the cliffs at the southern edge of the HHA andesite, there is some talus present, mostly made of andesite slates.

Tectonics: All tectonic lineations in the Rjúpnadalur area have a SW-NE direction. No recent tectonic activity can be seen; the youngest one is probably the fault running along the crest of the Ósöldur hills (Exh. 4.01). A few faults can be seen within the HHA andesite, and the Rjúpnadalur col seems to have been formed due to a fault running along the northwestern coast of the lake.

Exhibit 4.02 shows the location of boreholes and borro soundings, and Tables 4.1 and 4.2 show the location and depth of core boreholes and borro soundings respectively.

4.3 Ground Water.

Two ground water levels have been detected in the Rjúpnadalur col. In hole RD-3, which is right on the beach, the ground water level is about the same as the elevation of the lake level (Exh. 4.04). In hole RD-1 two ground water levels were detected. The upper one is at a similar elevation as the lake level and the lower one is at an elevation of approximately 559 m, or about 12 m below the lake level. This one is at a depth where the hole goes through a joint which has a low water pressure, much less than that of the surrounding rock, and can receive a lot of water. This ground water level does not have to be that of the joint itself, but is probably just the tight lower part of the hole filled with water up to the joint.

In hole RD-2, which is west of the topographic water divide or about 600 m from the lake, only one ground water table is present at an elevation of 579 m or 8 m higher than the lake level. As the ground water table in the Rjúpnadalur col is higher than the lake level of Þórisvatn, there seems to be very little leakage from the lake through the col. As the rock is rather impervious, the groundwater flow should be very slow except through major joints, which probably have their own ground water levels. Table 4.3. shows elevation of the ground water table in the drillholes.

4.4 Canalsite Geology

Section A-A in Exhibit 4.01 shows a longitudinal section of the canalsite. The top layer is a loose overburden, made of sandy and weathered moraine mixed with talus debris consisting of andesite flakes. The seismic wave velocity in this material is 300-500 m/sec. Beneath this but on top of the bedrock proper, is the unweathered moraine. It is present in holes RD-1 and 2 where the thickness was 6 and 3 m respectively. Attempts to get core from the moraine were unsuccessful, so the holes were drilled with a tricone bit until the ÓSM móberg was reached. Two permeability tests were done in the upper part of RD-1, but neither of them was completely within the moraine proper (Exh. 4.04); the upper one was partly within the overburden and the lower one included the contact between the moraine and the ÓSM móberg. Both tests showed greater permeability than that of the móberg below. The seismic wave velocity in the moraine has a lower limit of about 1300 m/sec; the upper limit is rather obscure, but is near 2.000 m/sec. The seismic wave velocity in weak and fractured rock is inversely proportional to the ability of heavy equipment ot excavate the rock. In this case a heavy bulldozer is adequate as has already been proven by bulldozer trenches in the moraine, both in Rjúpnadalur and Þórisós.

The bedrock proper on the canalsite consists mostly of ÓSM móberg but at the extreme eastern end, LÖM pillow lava is present. As mentioned before, the ÓSM móberg is a sound and tight rock, the core recovery being just about 100% and the length of the core stubs was never less than 15 cm. The permeability tests done in hole RD-1 showed a permeability of 3-8 LU except in one joint where the leakage was much greater or 237 LU. In hole RD-2 the permeability was greater or 8-32 LU and even more, close to the surface of the móberg where it was 101 LU.

Numerous joints can be seen in the móberg core from holes RD-1 and 2, especially in the upper part. The joints are most abundant in RD-1. Most of the joint planes have an inclination near vertical and near to 45° (see Exh. 4.03). Very few joint planes are near to horizontal. Fig. a) Exh. 4.03, does not show the relative amount of near vertical joints in the rock, as the vertical boreholes are approximately parallel to these joints and do therefore seldom cut across them. Fig. c) gives a more correct picture of the relative abundance of each group of joint planes. The amount of joints in the ÓSM móberg in hole RD-2 is similar to what was observed in this type of rock during the construction of the Búrfell Power Plant. The amount of joints in hole RD-1 seems to be a little more than normal.

The seismic sounding did not detect the boundary between the moraine and the móberg and apart from the loose overburden, the seismic wave velocity seems to be the same down to 20-30 m depth in each case. This means that the seismic wave velocity is similar in the móberg and the moraine, perhaps slightly higher in the former. The velocity range, according to the tests, is from about 1500 to just over 2000 m/sec. These velocity values may not be very accurate, since joints in the móberg may cause some interference. A velocity of 3300 m/sec was detected at a depth of 21 m near hole RD-1, which is the depth to the joint mentioned before, where the lower ground water table is situated and the leakage is greatest. The joint can cause an increase in the seismic wave velocity, but, in addition to this, the core samples show the rock to be more compact below 21 m depth.

Basaltic rocks are assumed rippable with heavy bulldozers if the seismic wave velocity in the rock is below 2350 m/sec and in some cases even if the velocity is higher. Although the móberg chemically is a basaltic rock, its texture and structure is more like that of sedimentary rocks, which explains that although the seismic wave velocity is below the value quoted above, ripping tests, performed with a Cat D8 H bulldozer, showed the móberg to be very resistant to ripping. In the móberg, blasting would most likely give the best results.

The bedrock at the easternmost end of the canalsite consists of the LÖM pillow lava. The bottom of the RD-3 reaches the pillow lava of which the uppermost 1 m is very broken up, giving only about 30% core recovery. No permeability tests were carried out on this rock. The seismic wave velocity in the pillow lava is about 2400 m/sec. In the lake we have rather thin sediments resting on moraine or bedrock.

CHAPTER 5

ÞÓRISÓS

5.1 Introduction.

The Þórisós area is to the north of Lake Þórisvatn, named after the river Þórisós, which is the present surface drainage of the lake. The river flows around the northeastern end of the Innri-Ósalda hill, between the hillslope and the edge of a postglacial lava flow which is one of the Tungná lavas (see Exh. 1.02 and 5.01) and meets the Kaldakvísl river north of the hill, about 1 km downstream from the westernmost lava tounge. The discharge of Þórisós is fairly constant at approximately 5 m^3/sec at the outlet of the lake, but downstream the river is fed by numerous springs that issue from the edge of the lava, so the discharge increases to 10-15 m^3/sec.

Kaldakvísl is a glacial river, much larger than Þórisós, and has a mean discharge of about 30-35 m^3/sec where the two rivers meet. Most of its glacial water comes from the northwestern part of the large ice-cap, Vatnajökull (Exh. 1.01).

The plan is to dam the outlet of Lake Þórisvatn and divert the flow of Kaldakvísl into Þórisvatn. Two alternatives have been considered, as to how this could be done. One is by building one dam across both rivers north of the northeastern end of Innri Ósalda (Exh. 5.01 section A-A). The other way is to build two separate dams, one across each river, further upstream (sections B-B and D-D). In this case it is necessary to conduct the water from the lake above the Kaldakvísl dam, across a low ridge, by at least a 1 km long canal, over to the main Þórisvatn reservoir into which the canal would open just south of the Þórisós dam.

5.2 Geology and Tectonics.

The geological formations around Þórisvatn have already been described in general in chapter 1.

The rock formations found in the Þórisós area are the following, youngest on top.

Tungná Lava TH
Moraine and Tillite
Harðhausar Andesite HHA
Sauðafell and Ósöldur Móberg Formations SFM and ÓSM

The Sauðafell and Ósöldur móberg form the two main hills in the vicinity. The Harðhausar andesite and the Tungná lava lie on top of them in a depression between the two hills (Exhibits 5.01 and 5.02). The complete occurrence of each formation can be seen on the general geological map of the whole Þórisvatn area (Exh. 1.02). Location map of boreholes and borro soundings is in Exh. 5.03, and location and depth of boreholes and borro soundings is shown in Tables 5.1 and 5.2 respectively.

Sauðafell and Ósöldur Móberg-formations: These two are probably of a similar age, and may in fact be the same formation. The hills Sauðafell and Ósöldur look rather smooth and lack the rugged topography of the younger móberg ridges. They are certainly not formed during the last glacial period as the SFM and ÓSM móberg is overlain by the glacially eroded Harðhausar andesite, which puts the age at least to the second last glacial, the Riss or Illinoian. The SFM and ÓSM móberg is a rather sound rock, better consolidated and therefore less permeable than the younger móberg. The only permeability tests on the ÓSM formation were done in 1962 in the drillholes on the lower damsite (section A-A). Only two reliable tests were done completely within the ÓSM formation. This was in holes K-5 and K-6, the permeability being 30,4 LU and 10,3 LU respectively. Where these two tests were performed the ÓSM formation is not an ordinary móberg, but pillow lava or brecciated basalt.

Section A-A in Exh. 5.02 shows that the móberg outcrops in the lower parts of the cliffs in the northern wall of the Kaldakvísl gorge, overlain by the Harðhausar andesite, that makes up the upper part of the cliffs. In the southern end of the section, the móberg is overlain only by 2-4 m of moraine. So on the lower damsite the móberg makes up about two thirds of the foundation of the dam.

The móberg does not outcrop at the upper damsites in sections B-B and D-D, but in places it is covered only by moraine, varying in thickness. In section C-C the móberg is not seen but it probably lies at some depth underneath the Harðhausar andesite.

The Harðhausar Andesite: In the Þórisós area the andesite is found on both sides of the Kaldakvísl river, south of the Sauðafell hill, resting on the Sauðafell and Ósöldur móberg (see Exh. 5.01 and 5.02). The Harðhausar andesite is also found on the northwestern shore of Lake Þórisvatn, north of the Rjúpnadalur col (see Exh. 1.02 and 4.01). This formation consists of a few andesitic lava flows. They are finegrained, with a strong flow banding. The flows are separated by a reddish contact breccia, that can, for instance, be seen just above the watertable of Kaldakvísl at the upper damsite (Exh. 5.02, D-D). The breccia was also found in the ÞÓ-6 drillhole.

Three holes have been drilled into the andesite, one in 1956, hole F and two in 1969, ÞÓ-5 and 6. The two recent ones were permeability tested and showed very small or no leakage at all through the andesite, except nearest the surface. The upper damsite on Kaldakvísl is within the andesite formation, with only a couple of meters thick layer of moraine on top (section D-D). At the lower damsite the andesite makes up the upper half of the cliffs north of Kaldakvísl, where it lies on top of SFM móberg. The canal linking the Kaldakvísl river with Lake Þórisvatn will be excavated down to the HHA andesite, but need not go deep into it as the moraine on top is so thick.

The moraine and tillite: This is not represented on the geological map of the Þórisós area, because it is generally not regarded as bedrock proper, being a superficial glacial deposit, covering most of the area after the retreat of the last great ice-sheet, which took place about 9.000 years ago in the high plateau of Iceland. The moraine does of course not cover the postglacial Tungná lava which is younger. Although it is not regarded as bedrock, the moraine can be quite thick in places or up to 10-20 m, and the lower half can be so well consolidated and hard, especially where the moraine is thickest, that it can be called tillite. The uppermost 1-2 m are weathered and mixed with aeolian sand to form a loose overburden with the aid of frost action. This is in fact the only part of the moraine that can be penetrated by borro soundings. Exhibits 5.06 to 5.08 show the number of blows graphically.

The workability of the moraine was tested by various equipment. A small bulldozer without a ripper (Cat D-5) only managed the uppermost 1 m or slightly more than that, i.e. only the weathered, sandy overburden. A small back-hoe type power-shovel gave similar results. A larger bulldozer (Cat D-8) with a ripper, managed easily down to 4 m depth near the canalsite (Exh. 5.02, C-C) northeast of hole ÞÓ-5. It did not go deeper due to lack of time. This is well into the upper half of the moraine proper, but between 9 and 14 m the moraine becomes a hard rock, tillite (TL in section C-C), and the drilling speed was 2 or 3 times less than above

9 m depth in hole ÞÓ-5. The core recovery of the tillite in ÞÓ-5 was of the order of 60-70%.

The material making up the weathered, sandy moraine overburden, was permeability tested after compaction to see if it could be used as an impervious core in the dams. The coefficient of permeability was found to be $k=10^{-5}$ cm/sec, which is typical of mixtures of fine sands and silts. According to grainsize analysis of material from this layer in hole ÞÓ-7, at least 20% is silt. The permeability of the moraine was tested in holes ÞÓ-1,5 and 7, and ranged from 0 up to about 45 lugeon units. In holes ÞÓ-2, 3 and 4, the permeability tests of the moraine below the lava showed much higher leakage but in these cases water escaped up to the lava.

The Tungná Lava: This is a postglacial, basaltic lava flow, extremely porphyritic, the average size of the plagioclase phenocrysts being about 5 mm. The lava is of the pahoehoe-type, but its surface is very uneven and broken up at the damsites. The lava is derived from a crater row on the northeastern continuation of the so called Brandur graben, which stretches from just south of the Vatnsfell area to the northeast through Brandur and Austurbotn and onwards out of the map (Exh. 1.02). The crater row itself is outside the map, northeast of Austurbotn. The approximate age of this lava is known, as a layer of white, acid ash of a known age is found in the soil immediately beneath the lava. The age of this ash layer has been determined by the C_{14} method as being about 4.000 years. It is called H_4 and is derived from the volcano Hekla, situated about 35 km southwest of Lake Þórisvatn.

At the end of the last glacial period, approximately 900 years ago, the lowest col out of the Þórisvatn basin was between the Innri Ósalda hill, consisting of ÓSM móberg and the low hills, made up of HHA andesite, that lie further towards northeast, immediately south of the Kaldakvísl river (Exh. 1.02 and 5.01). The two hills and the pass between them were covered with moraine, 10-20 m thick. A river, that was the surface drainage of Þórisvatn at that time, flowed through the col for about 5.000 years and had by then, i.e. 4.000 years ago, eroded a rather gently sloping river-course (Exh. 5.02, B-B). Then an eruption took place in the above mentioned Brandur graben and a crater row was formed that poured a huge amount of lava over the surrounding plain, consisting of slightly older lavas. A great deal of this lava flowed towards northwest, then turned west and flowed into the northeastern end of the Þórisvatn basin, north of the Útigönguhöfði hill, where an older lava, or lavas, had probably flowed into the basin earlier. The lavas make up the 5 km long shoreline towards the Innri Ósalda hill. North of Þórisvatn a small branch of the lava forked out of the main stem and flowed towards north through the above mentioned col northeast of Innri Ósalda and down to where the Kaldakvísl river-course was at that time, where the flow ceased (Exh. 5.01 and 5.02 A-A and B-B). The distance from this place to the crater row is at least 10 km. By flowing into Þórisvatn and through the col mentioned above, the youngest lava raised the water table of the lake to 571 m elevation, but the lake level had previously been raised, at least once, because of older lavas, that flowed into the lake and dammed the outlet. The lava also caused great changes in the river-courses of Kaldakvísl and the old Þórisós. The lava dammed the Kaldakvísl, so a few meters deep and 2 km long lake that was subsequently filled with sediments, was formed upstream from the lavaflow. When flowing out of the lake the river had to make a new course along the lava edge, where it since has cut a gorge, deep enough to drain out most of the sediments of the lake, but a distinct terrace is still present on the south bank. The changes at the Þórisós river were far greater; a complete new river-course was formed, both further to the west and higher above sea level, as the watertable of Þórisvatn was raised to 571 m elevation. Raising of the lake level causes an increase in the subsurface discharge out of the lake, so the "old Þórisós" was probably a larger river than the present one. Þórisós now flows along the lava edge, adjacent to the slope of Innri-Ósalda, turns sharply to the west and flows into Kaldakvísl about 1 km downstream from the lava front.

It is not certain whether only the youngest lava flow has flowed through the col or if the second youngest did so too. Some parts of the edge and the front of the lava flow make it look suspiciously like two separate flows, often with springs issuing from the possible contact zone. This is clearly shown where the Kaldakvísl river has cut the front of the flow and quite a few springs issue from a scoriaceous or brecciated zone, that seems to divide the flow into two sheets. The core from many of the boreholes drilled through the lava at the upper damsite (B-B) showed scoriaceous zones in between a more solid lava. But if these are two lava flows, then there was certainly a very short time lapse between them, as no interbed, of aeolian sand for instance, was found in the drillholes. This may very well have been two subsequent phases of the same eruption.

When the molten lava solidifies, its volume decreases and hexagonally shaped columns are formed throughout the mass. As the lava is so young, the cracks between the columns are not yet filled by secondary material, so the lava is extremely permeable. The leakage is often of the order of 100-300 lugeon untis.

Tectonics: The main tectonic lineation in the Þórisós area is southwest-northeast. This is the direction that the Kaldakvísl river tries to follow, but succeeds in to a limited extent only, as its general direction is too westerly, but in detail the river flows en echelon with the longer limbs having a direction very near to SW-NE (Exh. 5.01). This is also the direction along the elongated Ósöldur hills and onwards to the Sauðafell hill, north of Kaldakvísl and suggests that Sauðafell is another eruption centre on the continuation of the Ósöldur eruptive fissure. There seems to have been a slight reactivation of the Ósöldur fissure some time ago as a fault is clearly seen running almost along the crest of the hills. At the northeastern end the downthrow is to the SE, but at the other end the downthrow is to the NW (see Exh. 1.02 and 5.01).

There are a few faults in the HHA andesite formation northeast of Þórisós. They form a graben running SW-NE which crosses Kaldakvísl just upstream from the upper damsite (Exh. 5.01). None of the faults in the area seems to have been active during postglacial time and certainly not during the last 4.000 years as the youngest Tungná lava is not faulted at all.

5.3 Ground Water.

The ground water flow in the area to the north and northeast of Þórisvatn is greatest through the Tungná lava, that forms the NE-shore of the lake, and has also flowed north to the Kaldakvísl river along the river-course of the outlet of Þórisvatn, east of the Innri Ósalda hill (Exh. 2.01). The ground water flow in the Tungná lavas is towards northwest in general. Some of it enters Þórisvatn, but most of it flows into Þórisós and some amount flows north to Kaldakvísl through the small northern branch of the lava. (Exh. 1.02 and 5.01). Most of the water flows through cracks between the columns in the lava, and especially along the scoriaceous zone at the bottom of the lava and the possible contact zone.

The older fromations in the area, the SFM and ÓSM móberg and the HHA andesite are rather impervious and act as barriers that prevent the groundwater in the lava from flowing further west or northwest, except in the col through which the lava flowed. Southeast of the col, the ground water table is rather flat, but through the col down to Kaldakvísl, the hydraulic gradient gets steeper or on average 1%. The ground water table is at about 570 m elevation where the lava flow begins to get narrower above the upper damsite, but 2 km further north, at Kaldakvísl, the ground water table is near 550 m elevation. The contour lines of the ground water table have a sharp kink where they cross the edge of the lava. In the hills on both sides, the ground water is kept higher; there the rock is less pervious than the lava.

At the upper damsite of Þórisós, the ground water table is almost horizontal across the lava flow, but slopes very gently towards the river. The ground water in the four drillholes, ÞÓ-2, 3, 4 and 7, across the lava, is from 564,7 to 564,8 m elevation, a few cm lower in ÞÓ-2 and 3 than in ÞÓ-4 and 7. This shows that, as well as flowing north towards Kaldakvísl, the ground water is also flowing towards the Þórisós river and there are in fact one or two springs issuing from the edge of the lava into the river at the damsite. Upstream from the damsite quite a number of large springs issue into the Þórisós river. Table 5.3. shows the elevation of the ground water table in the drillholes on the upper damsite.

At the lower damsite the ground water table is sloping rather steeply through the lava towards Kaldakvísl, but Þórisós on the other side of the lava lies 7-8 m higher than Kaldakvísl where the lava is narrowest. This suggests that there is some leakage from Þórisós to Kaldakvísl and some of the springs issuing into Kaldakvísl may contain water derived from Þórisós. The springs at the lava edge further to the east are probably mostly derived from the main ground water flow through the lava, but not due to leakage from the Þórisós river.

5.4 Damsite Geology.

The geology of each damsite and the problems involved will be described here in greater detail. As mentioned earlier, there are two alternatives; a single large dam on the lower damsite, or two smaller dams and a canal on the upper damsites (Exhits 5.01, 5.02, 5.04 and 5.05).

a) The upper damsites: This alternative means building a dam SW-NE across Kaldakvísl (Exh. 5.02, D-D), which will cause a lake to be formed in a large part of the graben, upstream from the damsite. From this lake the water will be conducted by a canal (C-C) through a small rise to the main Þórisvatn reservoir, just south of where a dam is going to be built E-W across the Þórisós river and the lava-flow where it is narrowest (B-B). The damsite at Kaldakvísl looks very good; there the river runs through a narrow gate, where both banks and the river bottom consist of HHA andesite. The rock is very cracked at the surface but sound and tight just below. In hole ÞÓ-6, the permeability tests showed that the surface of the andesite is very permeable, but deeper down the leakage gets very small and below 15 m depth in the hole no leakage at all was found. A reddish, brecciated zone, about 2 m thick, is seen near the water table on both sides of Kaldakvísl and was also found in hole ÞÓ-6. This is a contact between two andesitic lava flows. According to permeability tests, the leakage through this zone is very little, or 1-2 LU. A sheet of moraine covers the andesite but it is only 1-3 m thick on the southern abutment and probably similar on the northern one. The moraine may be slightly thicker in the depression at the NE-end of section D-D; at least the loose sandy overburden is thicker there.

There is a graben running SW-NE that crosses Kaldakvísl as mentioned before and the nearest fault is only about 50-100 m upstream from where section D-D crosses the river. The graben is not likely to interfere or cause any problems in the construction of the dam, although the fault mentioned above might even be within the foundation area. This is because the faults have been inactive for quite some time, and the longer the inactive period, the less permeable the fault zone becomes. The small grained cataclastic material formed in the fault zone may in fact, with the aid of precipitation of secondary minerals and deposition of silt from glacial rivers, form an almost water tight barrier that can divert and/or raise the ground water table on one side of the fault if it crosses the ground water flow. The above mentioned fault, which is parallel to the proposed dam and approximately perpendicular to the flow of ground water, might therefore, act as an impervious "curtain" underneath the dam, if joined to the water tight core.

At Þórisós (section B-B) the dam will be rather low, not more than about 12 m high at the river itself, where the dam is highest. The middle part of the dam will be founded on the postglacial Tungná Lava, but the eastern part and most of the western part will rest on a thick moraine; more than 20 m thick in places. Below the moraine is the HHA andesite and the ÓSM móberg but they are not seen at the surface near the damsite.

The thickness of the lava at this place is well known, as 8 holes have been drilled through it here; 4 in 1956 and 4 in 1969. The greatest thickness found in section B-B is 21 m. The lava is extremely permeable; the cracks between the columns are still wide open and the scoriaceous bottom layer of the lava as well as the possible contact zone. The holes drilled in 1969 were permeability tested and the leakage in lugeon units was usually of the order of a few 100's. It is absolutely necessary to build an impervious cutoff through the lava flow to prevent enormous leakage through the lava under the dam.

Right beneath the lava is an interbed, made mostly of sandy silt, which is the continuation of the loose, sandy overburden of the moraine and has been covered by the lava flow. This bed is still badly consolidated and usually about 1-2 m thick. A sample was obtained from this layer in hole ÞÓ-7. Grain size analysis showed it to be a typical moraine. The layer was permeability tested under pressure up to 2,7 kg/cm^2 without giving way.

Below it is the dense moraine, the lower part of which is hard like rock (TL on section B-B). The most reliable permeability test done in the moraine beneath the lava was in hole ÞÓ-7, where the leakage was 34 LU in the upper half and 16 LU in the lower half, or the tillite.

The site of the canal, that will link the lake at Kaldakvísl with the Þórisvatn reservoir, is almost solely within the HHA formation. Here the andesite bedrock is covered with thick glacial deposits, over 10 m thick in places, so the surface of the andesite is probably at 570-575 m elevation in most places (section C-C). Accordingly, most of the material that will have to be excavated when the canal is built, is going to be glacial deposits. Only the uppermost few meters of the andesite need be touched.

Information about the workability and permeability of the moraine can be found in description of the moraine in chapter 5.2. According to core recovery and permeability tests in hole ÞÓ-5 on the canalsite, the andesite is a very sound and tight rock. In the NE-part of the canalsite section, it crosses a fault at an oblique angle. The exact position and downthrow of this fault is not known.

b) The lower damsite: This alternative means building one dam across both rivers, where they run on each side of the Tungná lava to the north of the NE end of Innri Ósalda (section A-A). At this damsite, 6 holes, K-1 to K-6, were drilled in 1962.

Most of the bedrock consists of the ÓSM and SFM móberg-formations which generally is a sound and compact rock. Part of the ÓSM formation is not móberg, but brecciated basalt or pillow-breccia with a permeability of 10-30 LU. No tests were done within the móberg proper as most of the holes only just reached the móberg. North of Kaldakvísl the móberg makes up the lower half of the cliffs and the HHA andesite the upper half. The andesite is also a solid and tight rock. At the southern half of the damsite, the ÓSM-móberg is covered with thin moraine. In the middle part of the section, between the rivers, we have the Tungná lava, which here is 3-9 m thick, underlain by unconsolidated alluvial sediments, sand and gravel. The lava and the alluvium beneath are very permeable. Although the lava is much thinner here than at the upper damsite, the alluvium is probably much weaker and more permeable than the moraine at the latter. An impervious cutoff has to go through both lava and alluvium in this case.

TABLE 4.1

LOCATION AND DEPTH OF CORE BOREHOLES

Hole no.	Co-ordinates		Surface Elevation	Depth	Bottom Elevation
	X	Y		m	
RD-1	544.206	422.730	579.7	26.5	553.2
RD-2	544.501	422.535	580.2	25.0	555.2
RD-3	543.964	422.837	572.4	11.7	560.7

T A B L E 4.2

LOCATION AND DEPTH OF BORRO SOUNDINGS

Hole No.	Co-ordinates		Surface Elevation	Depth	Bottom Elevation	Hole No	Co-ordinates		Surface Elevation	Depth	Bottom Elevation
	X	Y		m			X	Y		m	
R-1	543,988	422,793	571,8	5,7	566,1	R-11	544.358	422.617	585,6	2,4	583,2
R-1B	543,977	422.816	571,8	8,3	563,5	R-12	544.393	422.586	584,8	4,2	580,6
R-1C	544.012	422.798	572,3	6,8	565,5	R-13	544.444	422.559	582,2	3,4	578,8
R-1E	544.002	422.815	572,2	8,8	563,4	R-14	544.495	422.537	588,4	3,4	585,0
R-2	543.965	422.838	571,9	10,6	561,3	R-15	544.547	422.526	578,2	2,4	575,8
R-2B	543.939	422.877	571,9	3,8	568,1	R-16	544.588	422.497	577,6	3,5	574,1
R-2C	543.952	422.857	571,9	5,7	566,2	R-17	544.644	422.494	576,7	4,6	572,1
R-2D	543.950	422.985	572,1	8,5	563,6	R-18	544.673	422.436	575,8	4,5	571,3
R-2E	543.991	422.837	572,2	9,9	562,3	R-19	544.705	422.408	574,2	1,1	573,1
R-2F	543.970	422.860	572,2	8,4	563,8	R-20	544.747	422.380	569,7	2,6	567,1
R-3	544.038	422.802	572,9	5,8	567,1	R-21	544.780	422.357	568,2	2,6	565,6
R-3B	544.047	422.828	573,3	3,2	570,1	R-22	544.815	422.324	566,8	2,2	564,6
R-3C	544.026	422.818	572,7	6,5	566,2	R-23	544.864	422.294	565,2	1,8	563,4
R-4	544,014	422.836	572,5	6,0	566,5	R-24	544.903	422.258	564,0	2,7	561,3
R-4B	543.957	422.894	572,3	4,6	567,7	R-25	544.918	422.214	563,3	2,3	561,0
R-4C	543.993	422.870	572,3	2,9	569,4	R-26	544.919	422.164	562,2	1,9	560,3
R-4D	543.975	422.882	572,3	3,8	568,5	R-27	544.934	422.113	561,4	1,8	559,6
R-4E	544.005	422.852	572,4	4,0	568,4	R-28	544.981	422.075	560,4	3,4	557,0
R-4F	544.030	422.832	572,9	4,1	568,8	R-29	545.025	422.061	559,8	3,6	556,2
R-5	544.087	422.803	573,3	5,1	568,2	R-30	545.082	422.040	559,0	2,6	556,4
R-6	544.130	422.788	574,6	2,6	572,0	R-31	545.132	422.023	558,2	2,5	555,7
R-7	544.170	422.759	577,7	4,1	573,6	R-32	545.175	422.007	557,6	1,8	555,8
R-8	544.249	422.704	582,5	4,5	578,0	R-33	545.224	421.984	556,9	1,3	555,6
R-9	544.286	422.676	585,3	3,6	581,7	R-34	545.282	421.964	556.0	1,6	554,4
R-10	544.321	422.646	586,3	5,4	580,9	R-35	545.325	421.935	555,0	1,8	553,2
R-133	543.897	422.866	567.0	7,5	559,5	R-105	543.836	422.844	566,0	4,5	561,5
R-134	543.872	422.865	567.0	7.6	559.4	R-106	543.810	422.845	565,4	5,2	560,2
R-135	543.845	422.867	567.0	6.2	560.8	R-107	543.785	422.846	565.0	7,7	557,3
R-101	543.938	422.840	569.0	8.4	560.6	R-108	543.760	422.848	562,0	8,7	553,3
R-102	543.912	422.841	567.0	5.4	561.6	R-122	543.924	422.815	567,0	2,4	564,6
R-103	543.887	422.842	567.0	4.2	562.8	R-123	543.898	422.816	567,0	3,1	563,9
R-104	543.861	422.843	566.0	3.4	562.6	R-124	543.872	422.817	566,0	1,7	564,3

TABLE 4.3

ELEVATION OF GROUND WATER TABLE IN DRILLHOLES

Date of measurement	HOLE No.											
	RD-1	RD-2	RD-3									
1/8 '69	558.85											
13/8 '69		579.10	570.90									
6/10'69	559.10	579.35										

T A B L E 5.1

LOCATION AND DEPTH OF CORE BOREHOLES

HOLE No.	Co-ordinates		Surface Elevation	Depth	Bottom Elevation
	X	Y		m	
A	537.732	428.410	564.4	16.3	548.1
B	537.362	428.517	569.4	22.0	547.4
C	537.277	428.542	573.2	28.8	544.4
D	537.200	428.570	571.3	20.4	550.9
E	537.120	428.585	570.7	20.2	550.5
F	536.723	428.650	590.5	26.0	564.5
K-1	538.085	429.620	553.1	10.5	542.6
K-2	- " -	429.522	552.3	13.5	538.8
K-3	- " -	429.402	557.8	14.5	543.3
K-4	- " -	429.312	556.9	8.2	548.7
K-5	- " -	429.136	563.4	6.6	556.8
K-6	538.280	428.850	564.6	12.2	552.4
ÞÓ-1	537.542	428.457	565.0	22.5	542.5
ÞÓ-2	537.345	428.449	568.2	19.9	548.3
ÞÓ-3	537.233	428.443	570.8	25.0	545.8
ÞÓ-4	537.140	428.442	574.1	18.6	555.5
ÞÓ-5	536.663	428.445	585.8	20.2	565.6
ÞÓ-6	534.987	430.460	575.8	19.8	556.0
ÞÓ-7	537.193	428.460	572.2	24.6	547.6

TABLE 5.2

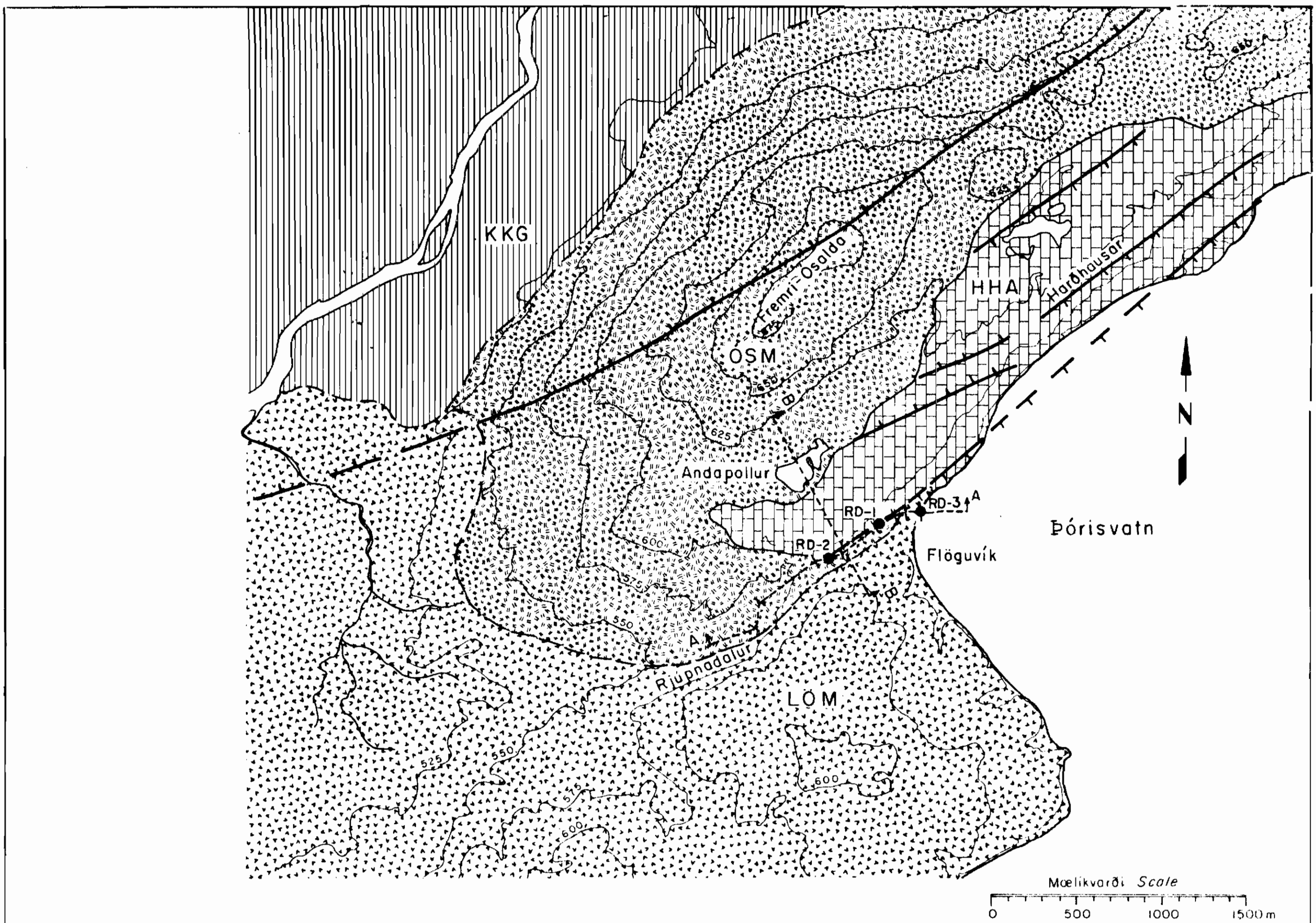
LOCATION AND DEPTH OF BORRO SOUNDINGS

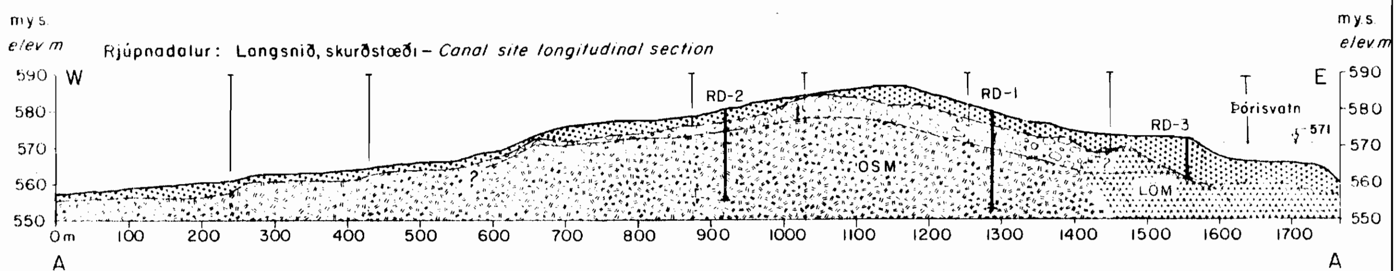
Hole No.	Co-ordinates		Surface Elevation	Depth	Bottom Elevation	Hole No	Co-ordinates		Surface Elevation	Depth	Bottom Elevation
	X	Y		m			X	Y		m	
σ-1	538,011	428,264	587,2	1,4	585,8	σ-46	536,308	429,076	580,5	1,3	579,2
σ-2	537,965	428,290	583,1	0,8	582,3	σ-47	536,244	429,143	578,3	0,2	578,1
σ-3	537,927	428,311	580,1	1,0	579,1	σ-48	536,180	429,210	578,7	1,2	577,5
σ-4	537,888	428,333	576,5	1,6	574,9	σ-49	536,120	429,276	582,2	0,9	581,3
σ-5	537,848	428,355	572,9	0,8	572,1	σ-50	536,060	429,337	584,6	0,7	583,9
σ-6	537,793	428,385	567,5	0,8	566,7	σ-51	535,997	429,403	583,9	1,1	582,8
σ-7	537,718	428,425	564,8	1,6	563,2	σ-52	535,933	429,470	583,7	0,6	583,1
σ-8	537,670	428,450	564,3	3,1	561,2	σ-53	535,870	429,536	583,9	3,6	580,3
σ-9	537,630	428,453	564,1	1,9	562,2	σ-54	535,808	429,602	581,0	1,6	579,4
σ-10	537,585	428,450	564,5	2,0	562,5	σ-55	535,745	429,666	580,9	1,4	579,5
σ-11	537,534	428,444	564,5	3,1	561,4	σ-56	535,682	429,733	582,2	2,4	579,8
σ-12	537,468	428,450	565,0	1,8	563,2	σ-57	535,618	429,800	581,9	1,9	580,0
σ-12B	537,443	428,450	565,0	2,3	562,7	σ-58	535,555	429,865	584,2	2,7	581,5
σ-13	537,417	428,451	565,3	1,9	563,4	σ-59	535,493	429,930	588,6	4,8	583,8
σ-14	537,376	428,452	565,8	0,6	565,2	σ-60	535,438	429,988	589,0	2,9	586,1
σ-15	537,290	428,443	569,7	0,6	569,1	σ-61	535,370	430,059	583,2	1,3	581,9
σ-16	537,165	428,448	572,7	0,8	571,9	σ-62	535,309	430,123	581,8	0,5	581,3
σ-17	537,087	428,451	573,1	0,5	572,6	σ-63	535,242	430,193	577,9	1,0	576,9
σ-18	537,046	428,434	572,8	0,6	572,2	σ-64	535,179	430,259	576,2	0,3	575,9
σ-19	537,004	428,416	573,7	1,3	572,4	σ-65	535,110	430,331	575,3	0,9	574,4
σ-20	536,960	428,398	574,8	2,1	572,7	σ-66	535,044	430,400	575,7	1,6	574,1
σ-21	536,918	428,370	579,2	2,4	576,8	σ-67	534,978	430,470	575,0	1,5	573,5
σ-22	536,874	428,362	581,6	0,9	580,7	σ-68	534,910	430,540	569,5	0,8	568,7
σ-23	536,833	428,344	583,1	1,4	581,7	σ-69	534,867	430,586	561,3	0,7	560,6
σ-24	536,787	428,324	584,8	1,6	583,2	σ-101	534,727	430,646	564,7	0,6	564,1
σ-25	536,709	428,387	585,7	0,7	585,0	σ-102	534,700	430,690	568,5	0,8	567,7
σ-26	536,637	428,444	584,6	0,6	584,0	σ-103	534,673	430,730	569,7	1,1	568,6
σ-27	536,543	428,517	584,3	1,2	583,1	σ-104	534,652	430,771	572,0	0,8	571,2
σ-28	536,455	428,588	586,4	2,0	584,4	σ-105	534,631	430,810	575,2	0,6	574,6
σ-29	536,373	428,649	588,1	2,6	585,5	σ-106	534,612	430,848	582,0	0,6	581,4
σ-30	536,297	428,703	588,0	1,2	586,8	σ-107	534,596	430,891	586,2	2,1	584,1
σ-31	536,222	428,758	585,0	1,9	583,1	σ-108	534,576	430,929	585,7	1,3	584,4
σ-32	536,171	428,829	584,2	0,8	583,4	σ-109	534,548	430,970	581,5	0,7	580,8
σ-33	536,116	428,904	581,8	1,4	580,4	σ-110	534,522	431,011	576,5	2,7	573,8
σ-34	536,060	428,982	576,8	0,8	576,0	σ-111	534,494	431,053	574,6	4,7	569,9
σ-35	536,002	429,062	572,0	1,1	570,9	σ-112	534,465	431,095	574,9	2,6	572,3
σ-36	535,921	429,125	571,0	1,6	569,4	σ-113	534,438	431,138	575,2	3,2	572,0
σ-37	535,837	429,187	570,3	2,7	567,6	σ-114	534,409	431,180	576,4	4,2	572,2
σ-38	535,794	429,222	569,7	1,5	568,2	σ-115	534,382	431,221	578,5	3,5	575,0
σ-39	536,744	428,623	590,1	1,2	588,9	σ-116	534,356	431,262	581,5	1,2	580,3
σ-40	536,682	428,685	589,2	0,9	588,3	σ-117	534,325	431,315	585,5	1,5	584,0
σ-41	536,626	428,741	586,7	2,5	584,2	σ-118	534,296	431,357	588,7	1,3	587,4
σ-42	536,555	428,817	584,5	1,2	583,3	σ-119	534,274	431,392	592,4	0,9	591,5
σ-43	536,495	428,881	582,2	2,6	579,6	σ-120	534,247	431,435	595,5	2,0	593,5
σ-44	536,435	428,944	582,7	1,1	581,6	σ-121	534,212	431,492	603,0	1,0	602,0
σ-45	536,371	429,010	582,1	1,7	580,4						

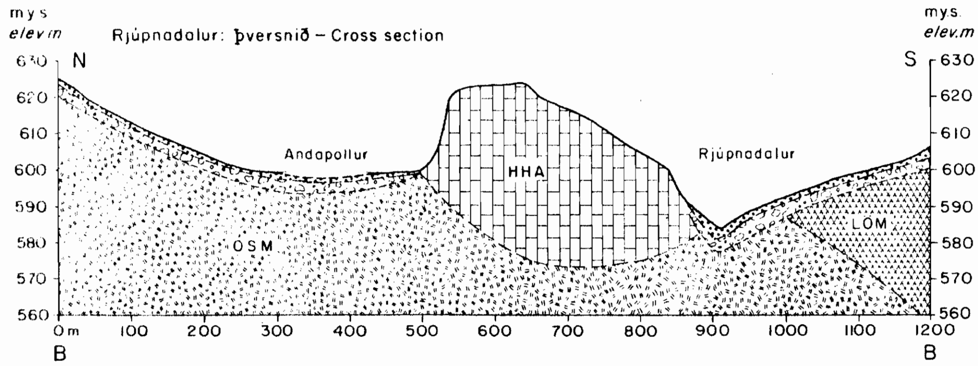
T A B L E 5.3

ELEVATION OF GROUNDWATER TABLE IN DRILLHOLES

Date of measurement	HOLE NO.											
	A	B	C	D	E	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7
7/9 '69		564.37	564.34	564.31	563.22	563.22	564.71	564.61		566.14	561.96	
12/9 '69		564.52	564.59	564.61	563.52	563.27	564.71	564.66	564.80	566.34	561.86	564.78
20/9 '69	562.89	564.52	564.58	564.55	563.48	563.25	564.73	564.78	564.76			564.83
6/10'69			564.64	564.56		563.22	564.66			566.94	561.89	564.88
10/10'69		564.56	564.56	564.54	563.50	563.23	564.71	564.70	564.79	566.37	562.01	564.85







Frh. SKÝRINGAR: *LEGEND*

- KKG Koldukvíslargrágrýti *Kaldakvísl grey basalt*
- ÖSM Ösöldumyndun túffríkt móberg. *Ösoldur formation tuffaceous mob.*
- Borholur - boraðar 1969 *Drillholes - drilled 1969*
- Misgengi – *Faults*
- Jarðlagasnið – *Geological section.*
- Snið beygir *Section turns*

SKÝRINGAR: *LEGEND:*

- Laust sendið yfirborð. *Loose sandy overburden*
- Mórena. *Moraine,*
- HHA Harðhausa-andesit. *Harðhausar-andesite.*
- LÖM Launöldumyndun, bólstraberg. *Launöldur formation, pillow lava.* (Sjá snið *See section*).
- LÖM Launöldumyndun, bólstraberg. *Launöldur formation pillow lava.*

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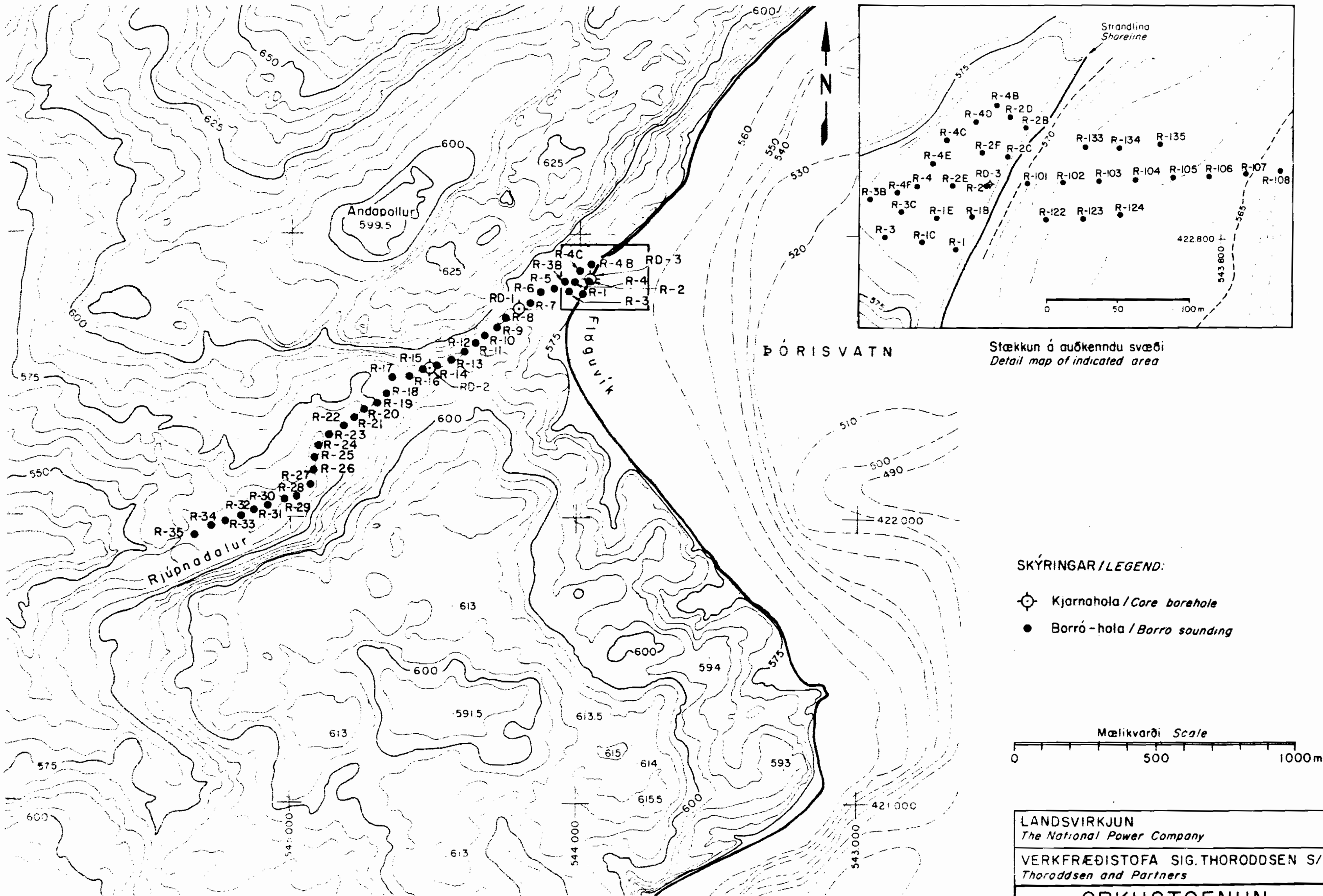
Thoroddsen and Partners

ORKUSTOFNUN

ÞÓRISVATN RJÚPNADALUR
Jarðfræðikort og jarðlagasnið
Geological map and sections

10.11.'69 BJ/IS	Tnr. 43 B-332	Fnr. 9063



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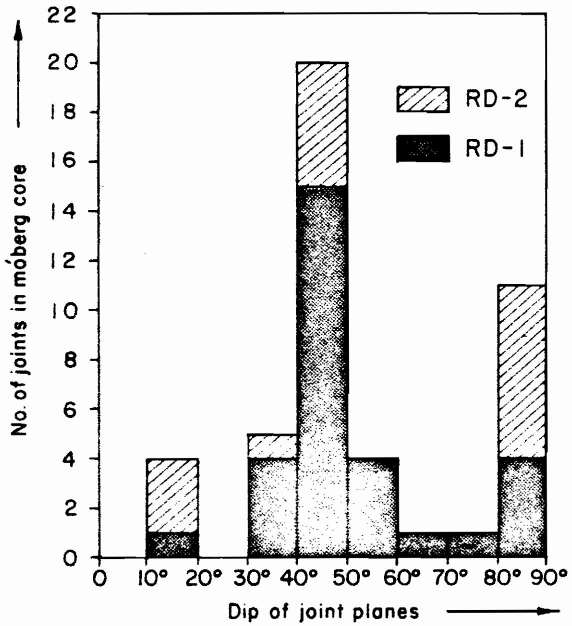
ÞÓRISVATN RJÚPNADALUR
Staðsetningarkort borhola
Location Map of Drill Holes and Borro Soundings

13.11.'69 HT/Gyða	Tnr 84	Fnr. 9110
	B-332	

EXHIBIT NO. 4.03

A



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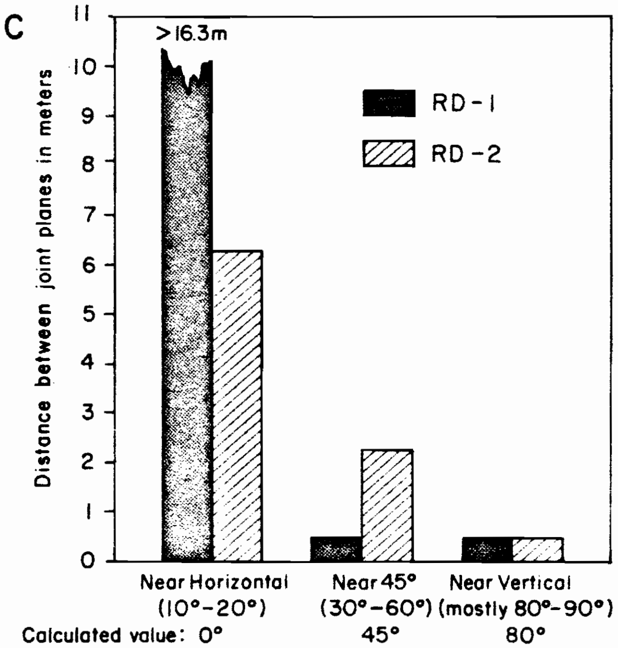

B

Core drillholes	RD – 1		RD – 2	
Length of móberg core	10.2 – 26.5 = 16.3 m		6.0 – 25.0 = 19.0 m	
Inclination of joint planes	No. of joints in móberg core	No. of joints per m of móberg core	No. of joints in móberg core	No. of joints per m of móberg core
Near Horizontal (10°–20°)	1	0.06	3	0.16
Near 45° (30°–60°)	23	1.41	6	0.32
Near Vertical (mostly 80°–90°)	6	0.37	7	0.37
Total	30	1.84	16	0.84

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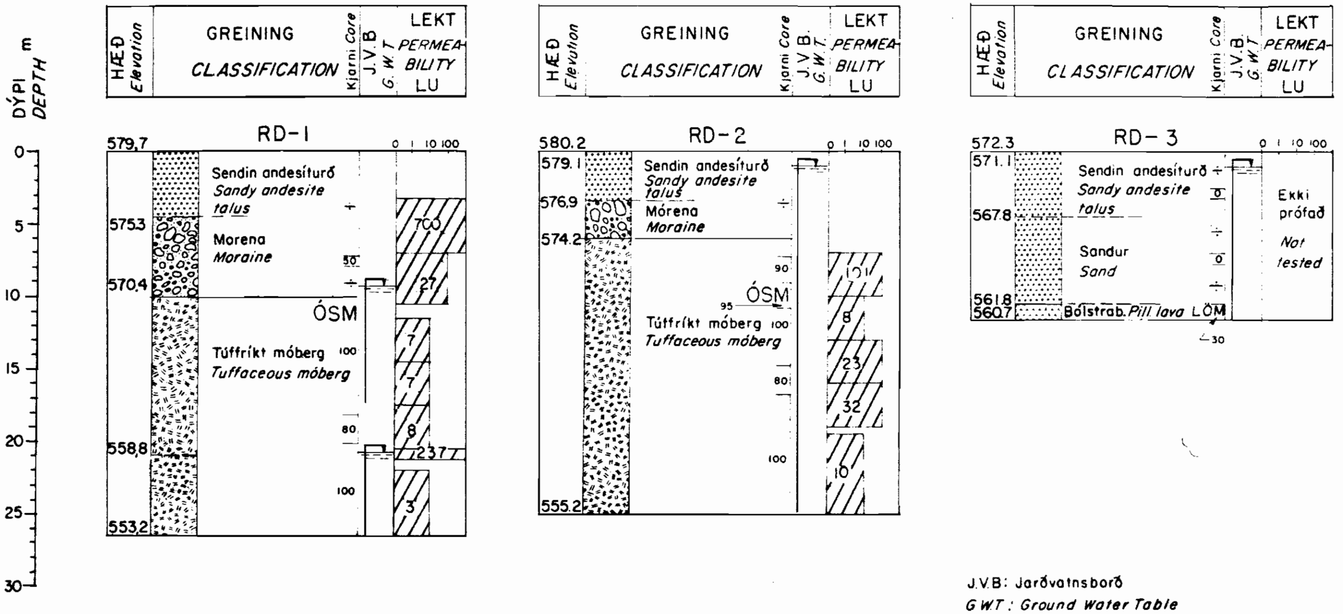
ÞÓRISVATN - RJÚPNADALUR
JOINT PLANES IN THE ÓSM MÓBERG IN RJÚPNADALUR

7.1.1970 BJ/Gyða
Tnr. 108
B-332
Fnr. 9256

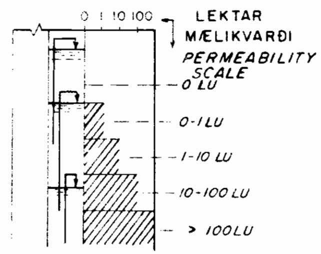


Staðsetningar, sjá fylgiskjöl 4.01 og 4.02
Locations, see Exhibits No. 4.01 and 4.02

J.V.B: Jarðvatnsborð
GWT: Ground Water Table

Kjarni: Tölur sýna kjarnaheimtur í %
÷ kjarnataka ekki reynd

Core: Numbers indicate per cent core core recovery
÷ core sampling not attempted



LEKTAR OG JARÐVATNS ÚTSKÝRINGAR
NOTE ON PERMEABILITY AND GROUND WATER

Jarðvatnsborð er sýnt með örvum. Neðri endi örvarinnar sýnir holudýpið, þegar jarðvatnsborð breytist. Jarðvatnsörvunum er raðað frá vinstri til hægri í sömu röð og jarðvatn breytist.
Ef jarðvatn breytist ekkert í borun, nær örin í botn.

Ground water levels are shown by arrows. Base of the arrow indicates the hole depth when water level changed. Successive levels are shown from left to right in the same sequence as observed during drilling, if no change in level was observed the arrow reaches the hole bottom.

1 LU = Lugeon Unit = 1 l/min/m 76 mm Ø holu við þrýsting 10 kg/cm²
1 LU = Lugeon Unit = 1 l/min/m 76 mm Ø holu at pressure 10 kg/cm²

SKÝRINGAR – *LEGEND*

- Laust sendið yfirborðslag. *Loose sandy overburden.*
- Mórena *Moraine*
- LÖM Launöldumyndun – bólstraberg *Launöldur formation – pillow lava*
- ÓSM Ósöldumyndun – túffríkt móberg *Ósöldur formation – tuffaceous móberg.*

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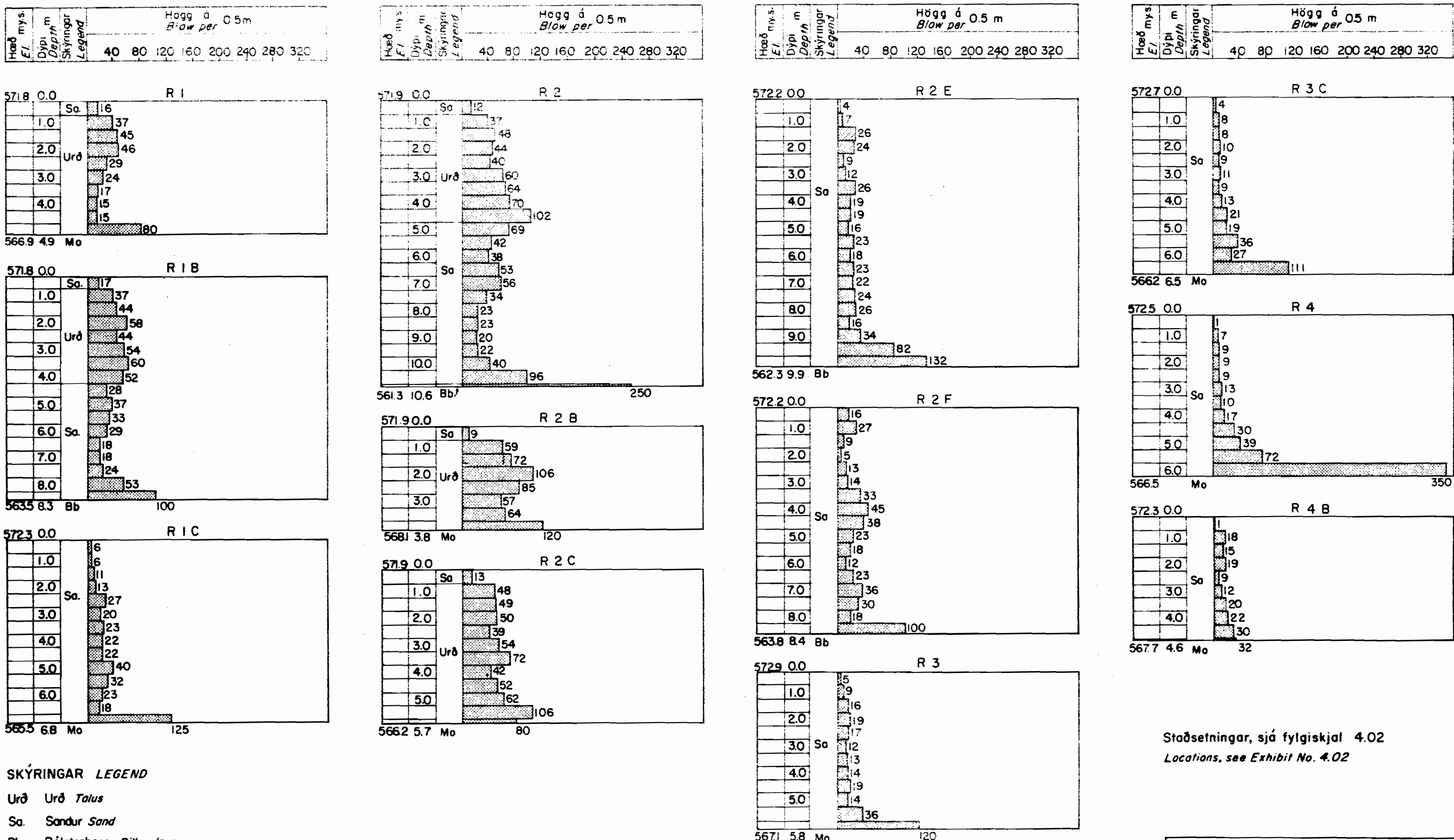
ÞÓRISVATN-RJÚPNADALUR
SNIÐ AF BORHOLUM RD-1–RD-3
GRAPHIC CORE LOGS

10.11.'69 HT/EK. Tnr 41 | B5-72 B-332 | Fnr 9061



Staðsetningar, sjá fylgiskjal 4.02
Locations, see Exhibit No. 4.02

SKÝRINGAR *LEGEND*

- Urð — Urð *Talus*
- Sa. — Sandur *Sand*
- Bb. — Bólstraberg *Pillow lava*
- Mo — Mórena *Moraine*
- Tu — Túff

Þvermál borstanga *Rod diameter 32 mm*
Þyngd lóðs *Hammer weight 65 kg*
Fall lóðs *Hammer drop 1 m*

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ÞÓRISVATN RJÚPNADALUR
Borra-borholu R-1 — R4B
Borro-Soundings

Nov. 69 HT/EK | Tnr. 66 | Bl. 1 af 4 | Bb. 89 B-332 | Fnr. 90 92

Skýringar, sjá fylgiskjal 4.05
Staðsetningar sjá fylgiskjal 4.02
Legend, see Exhibit No. 4.05
Locations, see Exhibit No. 4.02

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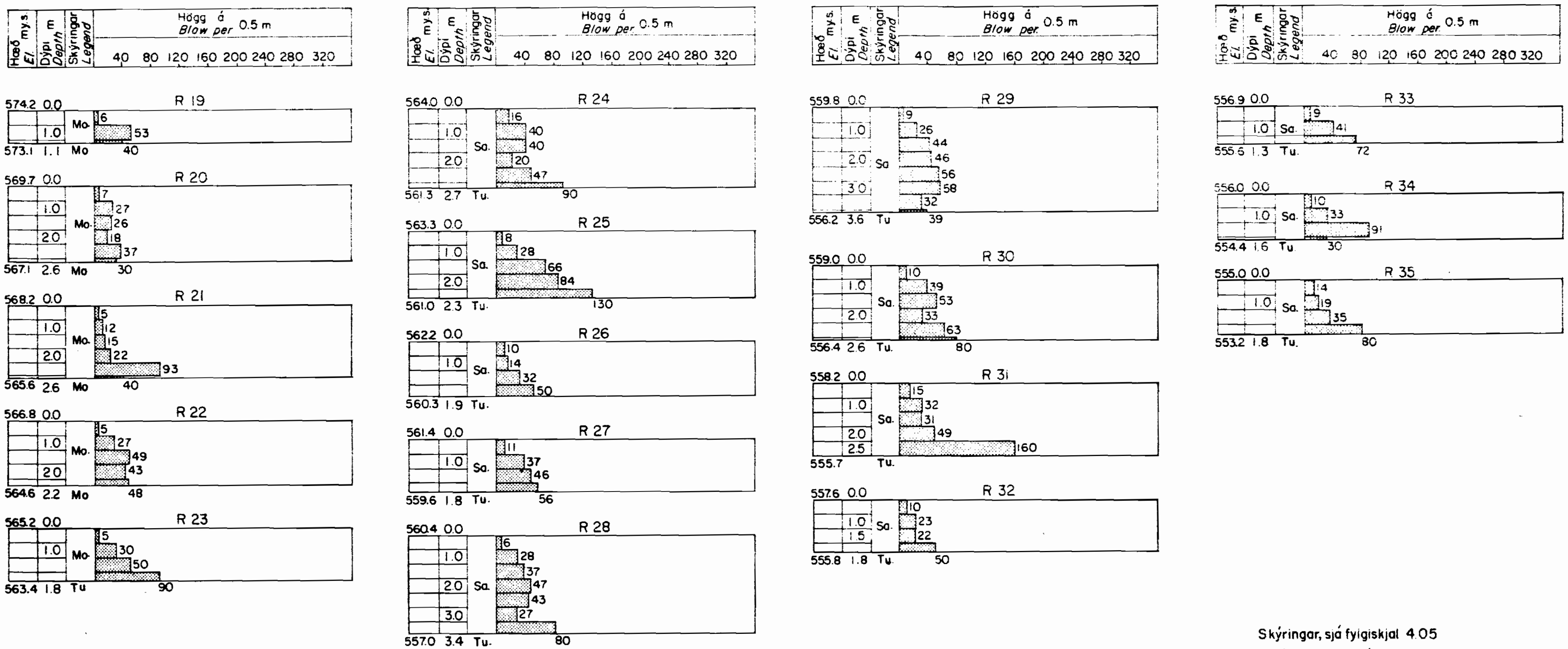
ÞORISVATN RJÚPNADALUR
Boro-bornolur R-1-E — R-18
Borro Soundings

Nov. '69 HT/EK	Tnr 67	Fhr. 9093
Bl 2 of 4	Bb90 B-332	



Skýringar, sjá fylgiskjal 4.05
Staðsetningar sjá fylgiskjal 4.02
Legend, see Exhibit No. 4.05
Locations, see Exhibit No 4.02

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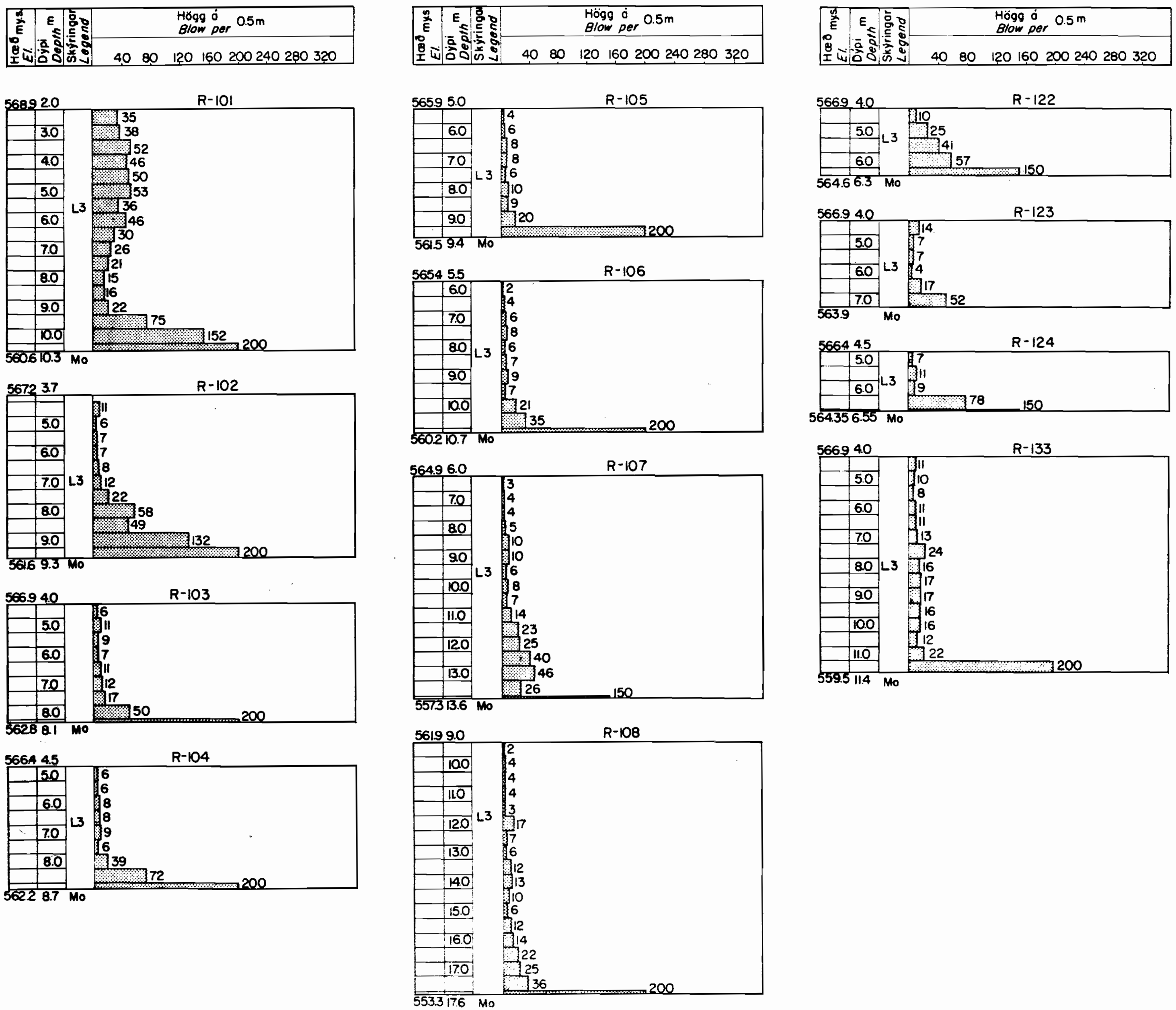
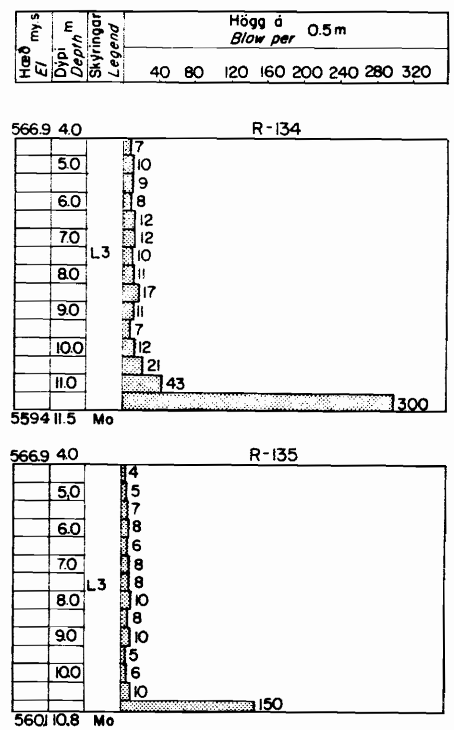
ÞORISVATN RJÚPNADALUR
Borro-borholur R-19 — R-35
Borro-Soundings

Nov'69 HT/EK Tnr. 68 | Bl. 3 af 4 | Bb 91 B-332 | Fnr. 9094





Skýringar, sjá fylgiskjal 4.05
Staðsetningar, sjá fylgiskjal 4.02

Legend, see Exhibit No. 4,05
Locations, see Exhibit No. 4.02

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ÞÓRISVATN RJÚPNADALUR
Borro-borholur R-101 – R-135
Borro Soundings

15-12-'69 HT/S.J.	Tnr. 97	Fnr. 9186
Bl. 4 af 4	Bb. 104 B-332	

EXHIBIT NO. 5.01

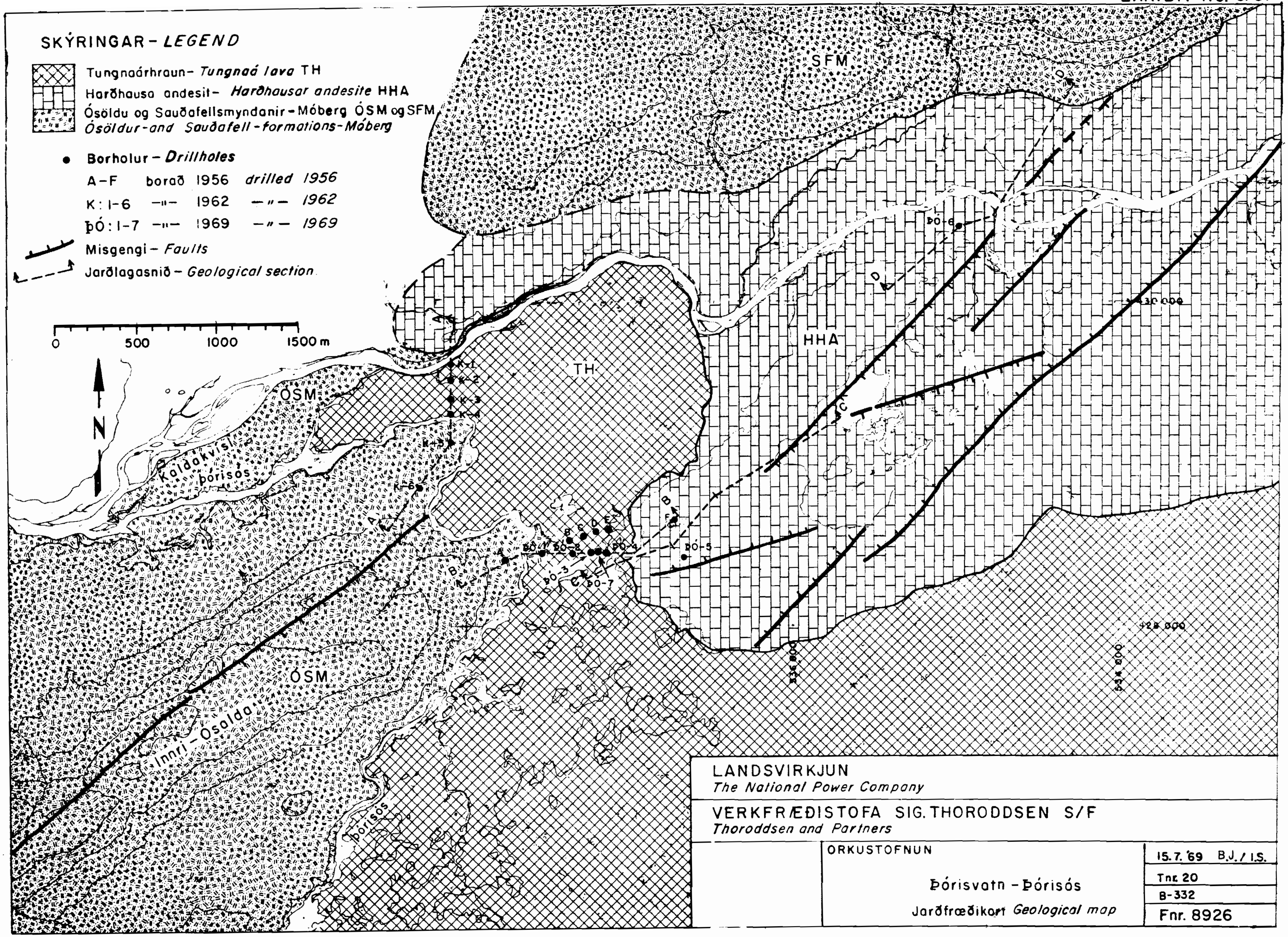
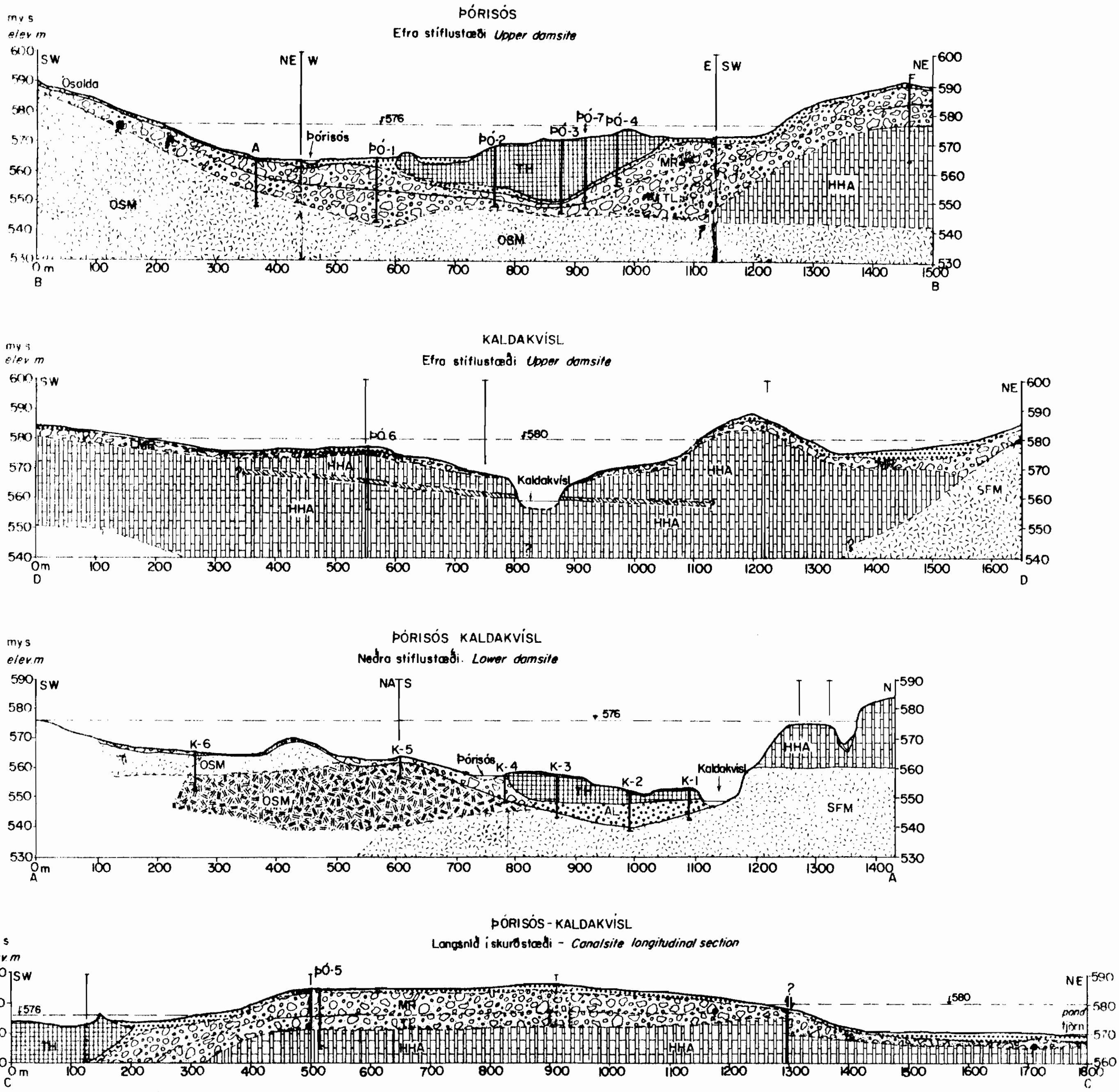


EXHIBIT NO. 5.02



SKÝRINGAR - *LEGEND*:

- Laust sendið yfirborð hrauns og mórenu. *Loose sandy overburden of lava and moraine.*
- TH Tungnaárhraun, stórdílótt basalt. *Tungnaá lava porphyritic basalt.*
- MR Mórena, jökulberg neðst. *Moraine, tillite beneath.*
- HHA Harðhausa-andesít. *Harðhausar andesite.*
- Lagamóta breksía. *Contact-breccia*
- ÓSM SFM Ósöldu-og Sauðafellsmyndanir móberg. *Ósöldur-and Sauðafell-formations-móberg.*
- ÓSM Ósöldumyndun, bólstra breksía. *Ósöldur-formation, pillow-breccia*
- AL Árset. *Alluvium.*
- Misgengi. *Faults.*
- T Snið breytir stefnu. *Section turns*

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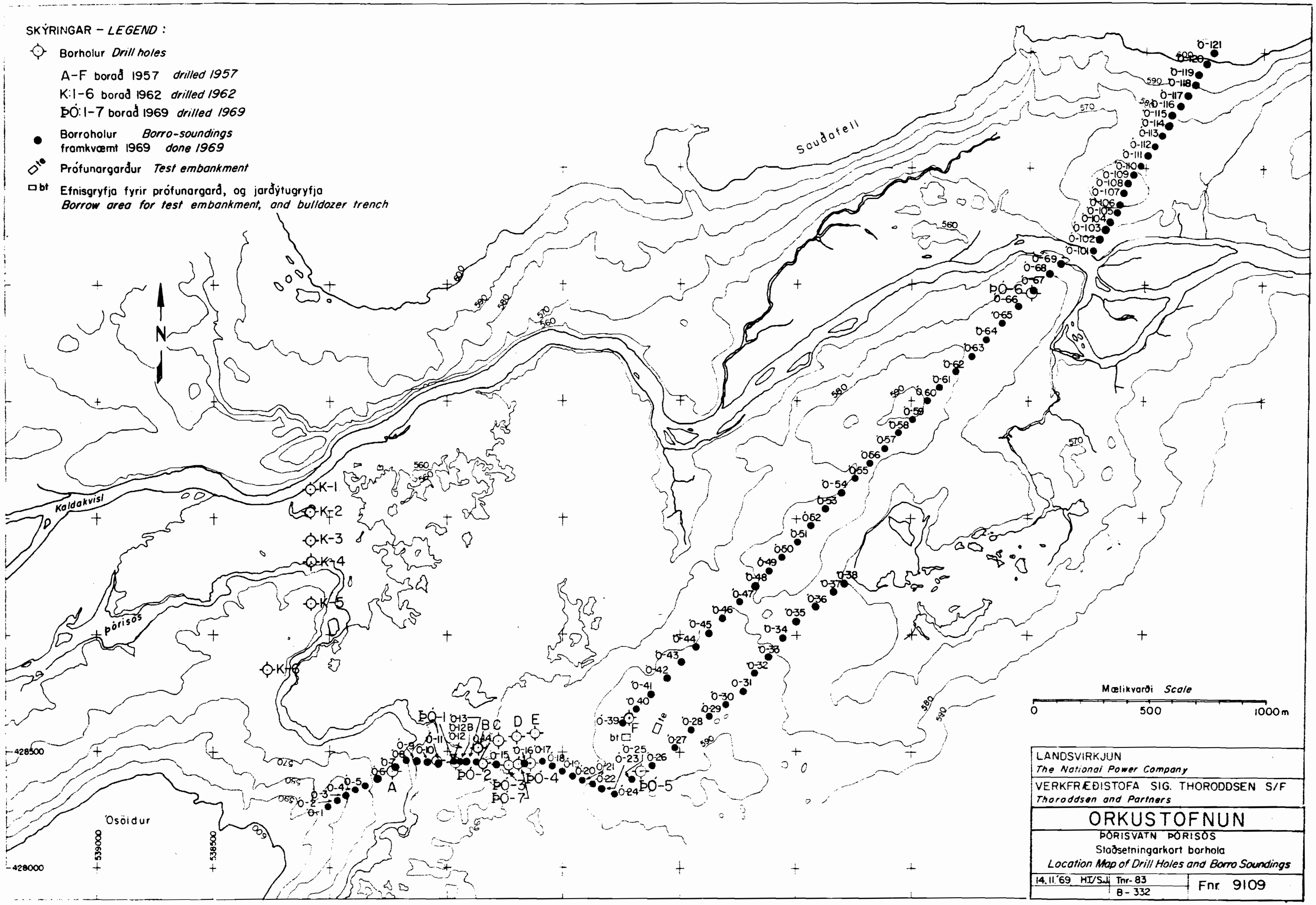
ÞÓRISVATN ÞÓRISÓS
JARÐLAGASNIÐ
GEOLOGICAL SECTIONS

10.11.69 B.J./S.J	Tnr. 44 / B-332	Fnr. 9065

EXHIBIT NO. 5.03



J.V.B.: Jarðvatnsborð
G.W.T.: Ground Water Table

Útskýringar á jarðvatnsborði og lekt, sjá fylgiskjal 4.04
Notes on Ground Water Level and Permeability, see Exhibit No. 4.04

Staðsetningar, sjá fylgiskjöl 5.01 og 5.03
Locations, see Exhibits No 5.01 and 5.03

Skýringar, sjá fylgiskjöl 5.02 og 5.05
Legend, see Exhibits No 5.02 and 5.05

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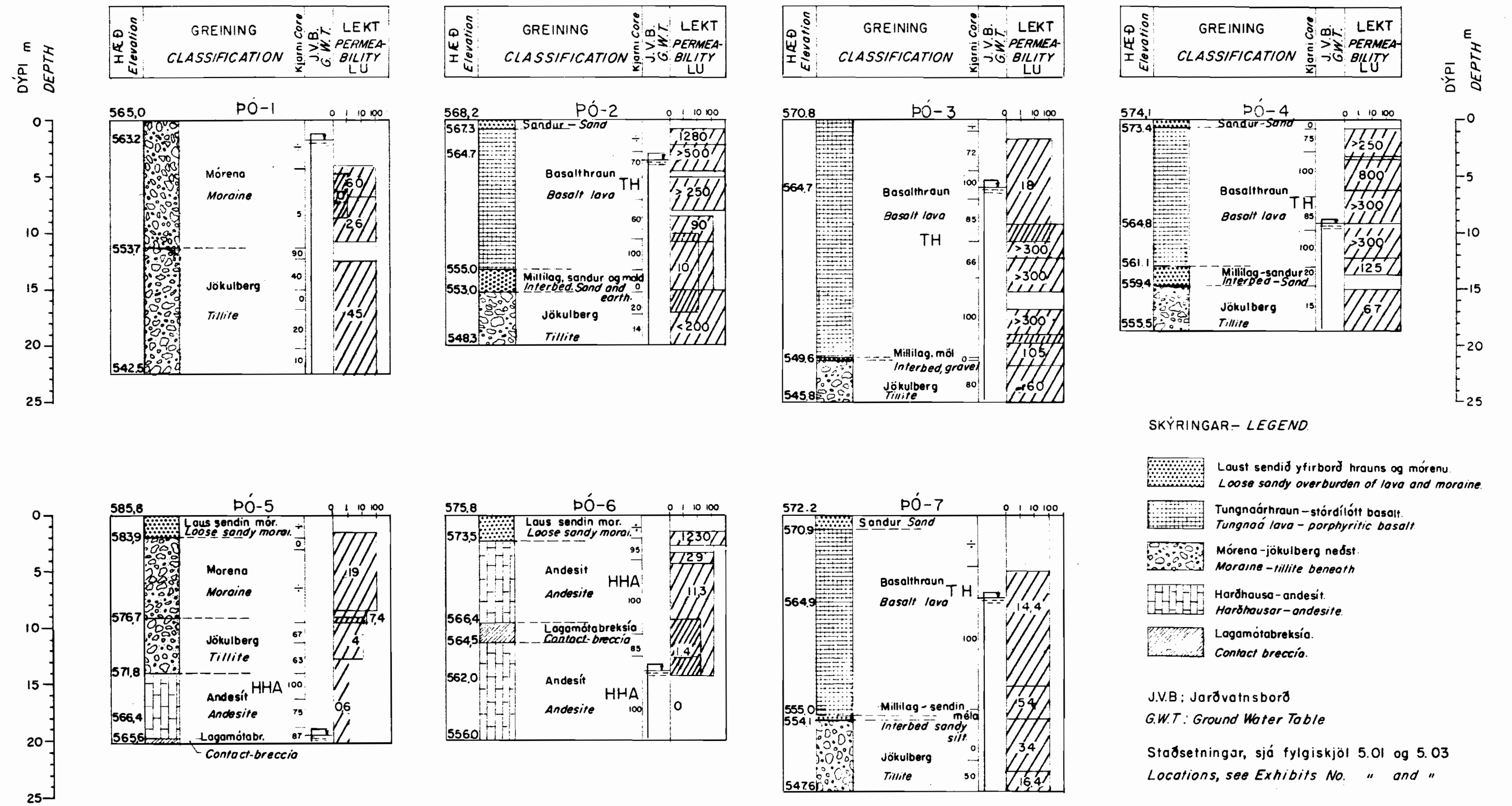
ÞÓRISVATN ÞÓRISÓS
SNIÐ AF BORHOLUM A-F OG K-1-6
GRAPHIC CORE LOGS " " "

13.11.'69 BJ/EK | Tnr. 82 | B-332 | Fnr. 9108

EXHIBIT 5. 05



Útskýringar á kjarna, jarðvatnsborði og lekt, sjá fylgiskj. 4.04
Notes on Core, Ground Water Level and Permeability, see Exhibit No. 4.04

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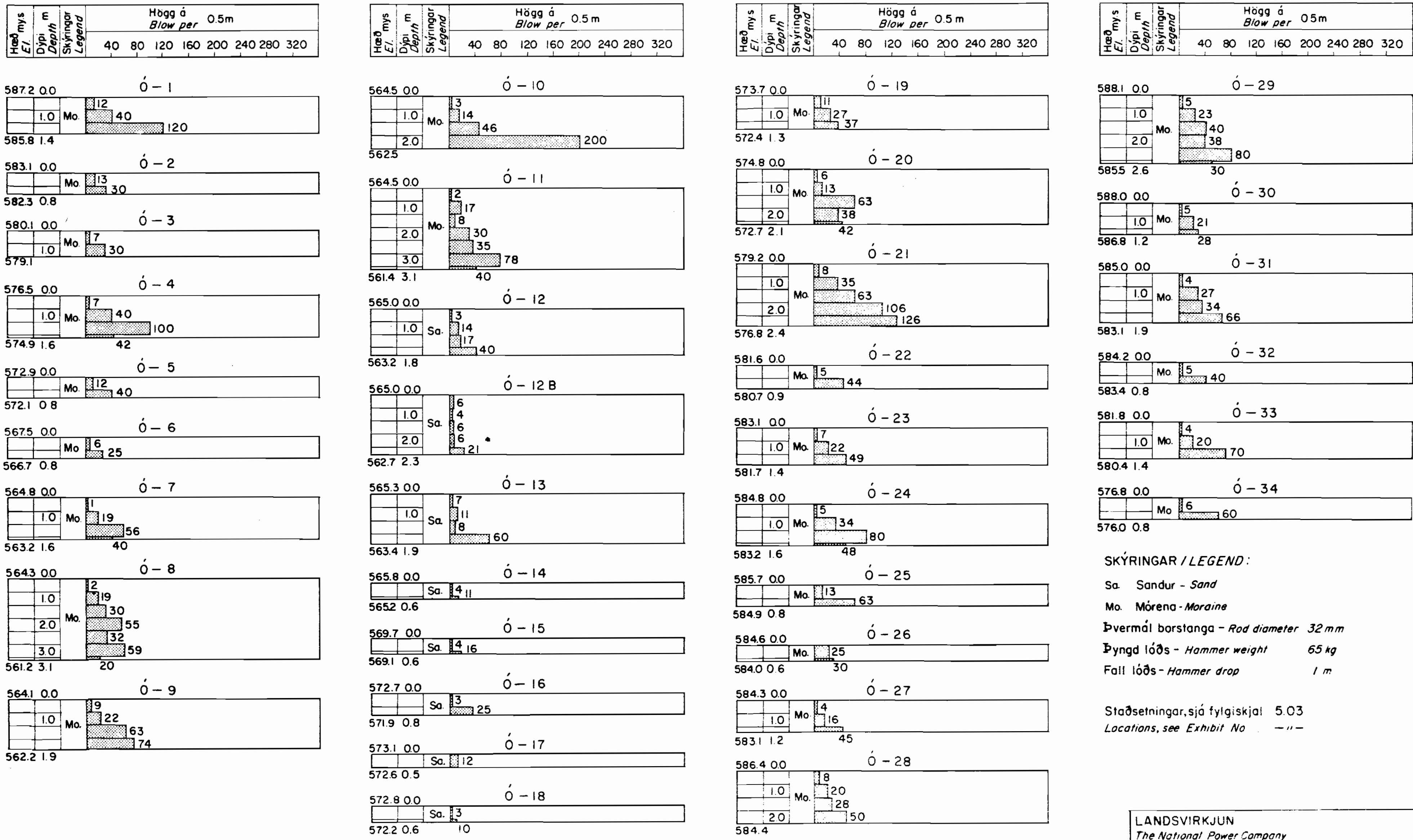
ÞORISVATN ÞORISÓS
SNIÐ AF BORHOLUM ÞÓ-1 – ÞÓ-7.
GRAPHIC CORE LOGS.

8.11.69 BA / P | Tnr. 42 | Bb 73 B-332 | Fnr. 9062



SKÝRINGAR / *LEGEND*:

Sa. Sandur - *Sand*

Mo. Mórena - *Moraine*

Þvermál borstanga - *Rod diameter* *32 mm*

Þyngd lóðs - *Hammer weight* *65 kg*

Fall lóðs - *Hammer drop* *1 m*

Staðsetningar, sjá fylgiskjal 5.03
Locations, see Exhibit No — " —

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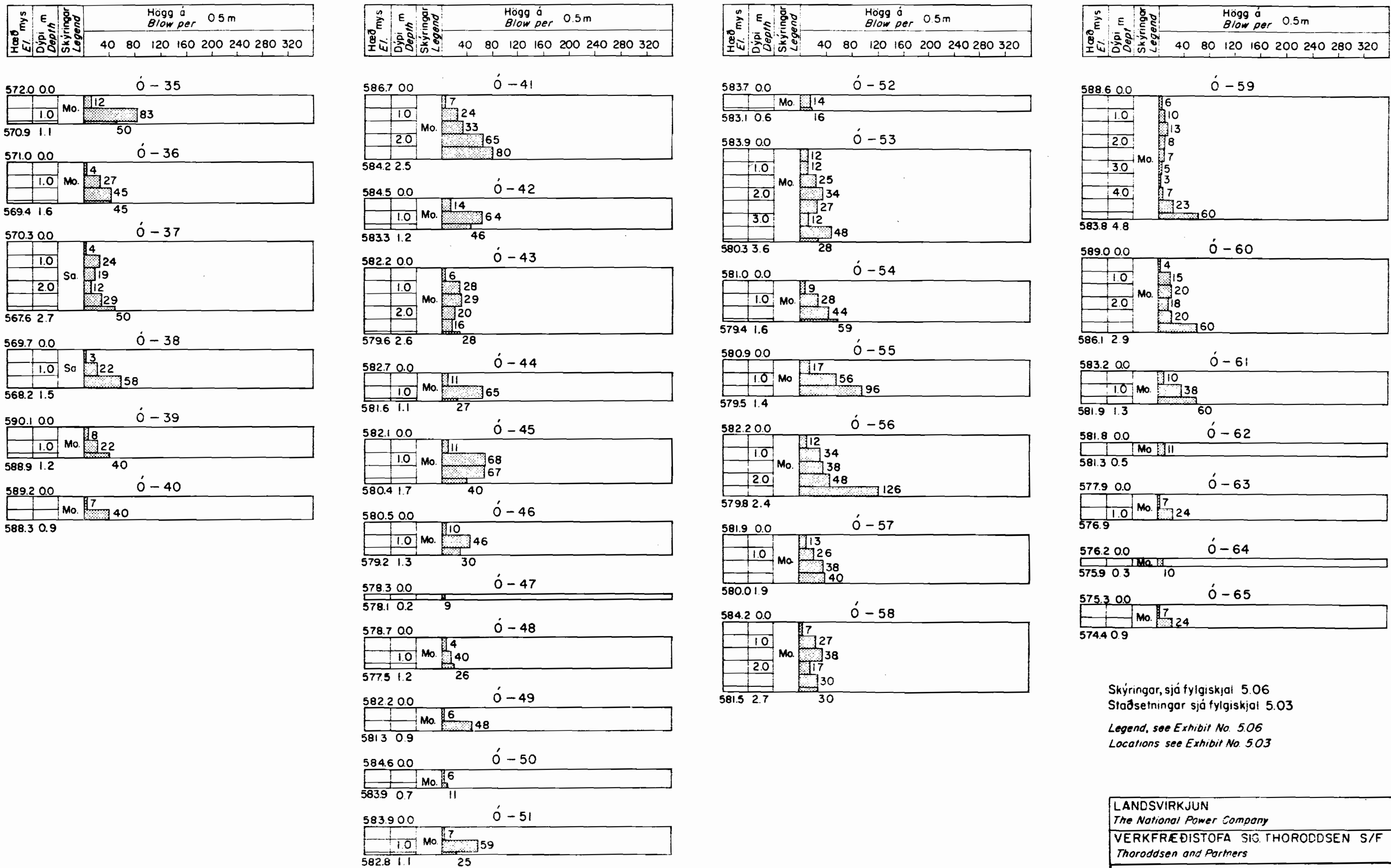
ÞÓRISVATN ÞÓRISÓS

Borro-borholur *Borro-Soundings* Ó-1—Ó-34

Okt '69 HT/Gyða	Tnr. 67	Fnr 9095
Bl. 1 of 3	Bs 90 B-332	



Skýringar, sjá fylgiskjal 5.06
Staðsetningar sjá fylgiskjal 5.03

Legend, see Exhibit No. 5.06
Locations see Exhibit No. 5.03

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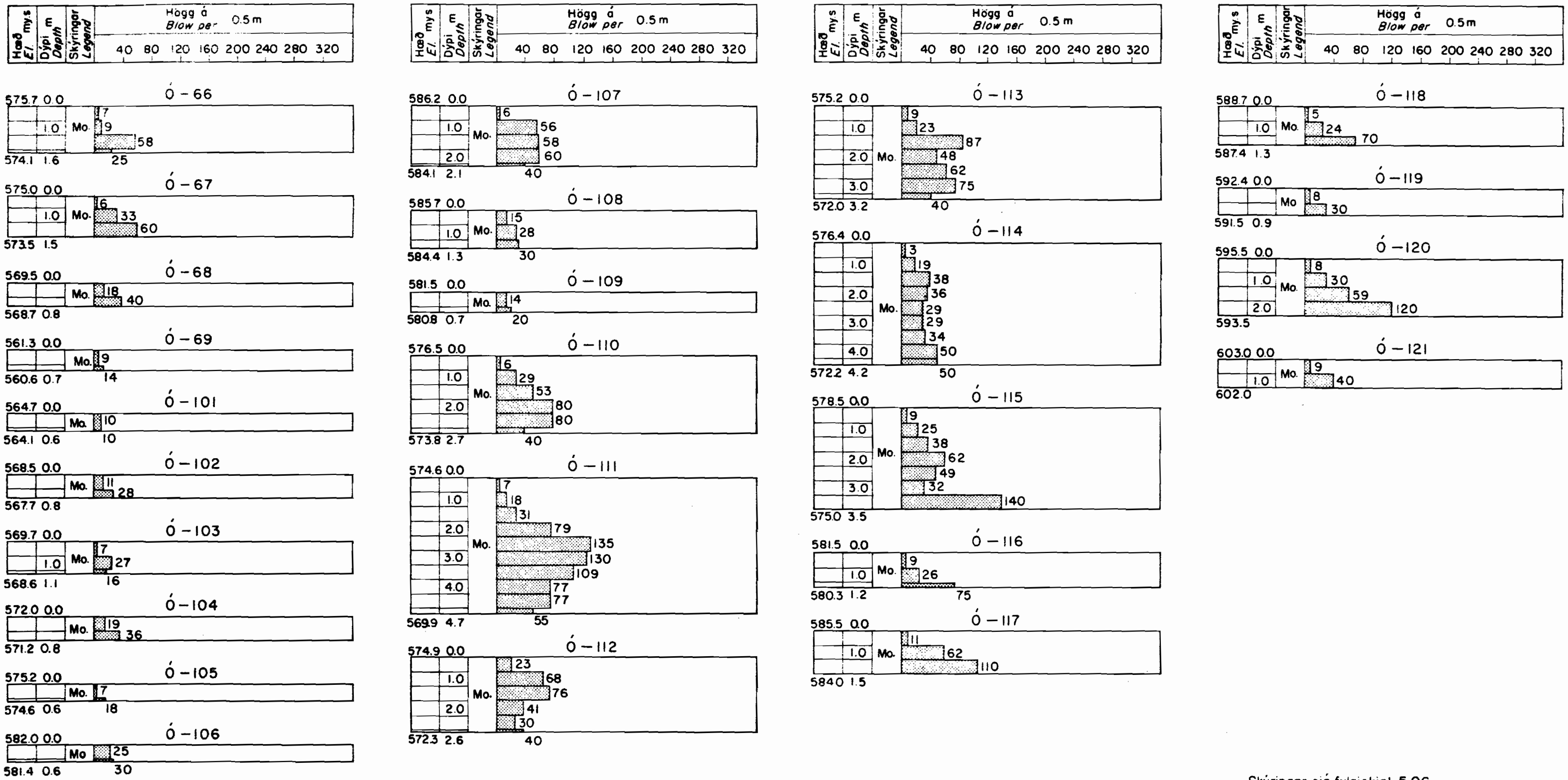
ÞÓRISVATN ÞÓRISÓS
Borro-borholur
Borro-Soundings Ó-35—Ó-65

Okt 69 HT/Gyða Tnr. 68 Fnr. 9095ᴬ
Bl 2 af 3 Bb 91 B-332

EXHIBIT NO. 5.08



Skýringar, sjá fylgiskjal 5.06
Staðsetningar, sjá fylgiskjal 5.03

Legend, see Exhibit No. 5.06
Locations see Exhibit No. 5.03

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ÞÓRISVATN ÞÓRISÓS Borro-borholur *Borro-Soundings* Ó-66 — Ó-121
Okt.'69 HT/Gyða · Tnr. 69 · Fnr. 9095*
Bl 3 af 3 · Bb. 92 B-332