OS ORKUSTOFNUN
Raforkudeild

NORÐLINGAALDA

GEOLOGICAL REPORT

by

Haukur Tómasson geologist NEA

and

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CHAPTER 1

Introduction

The Þjórsá river at Norðlingaalda and the surrounding area have, for nearly two decades, been under study as a potential site for a storage reservoir for development of the water power potentials of the Þjórsá river basin. The mean discharge of Þjórsá at its confluence with Svartá is about 100 m^3/sec from a drainage area of 2.020 km^2. A maximum lake level of between 581-600 m elevation has been under discussion, which could yield a reservoir of 350-3500 Gl. The proposed dam will be an earthrockfill type and the maximum height will be 34-50 m.

Investigations on the geology of the Norðlingaalda area were initiated as early as in the summer of 1953. Then G. Kjartansson geologist made a reconnaissance survey of the geological conditions at some localities in the general area, e.g. a dam site on Þjórsá at the mouth of Svartá and a tunnel route through Norðlingaalda. The results were published in a report : "Skýrsla um jarðfræði-athuganir á vatnasviði Þjórsár sumarið 1953".

In a report prepared by Harza Engineering Company International "Hydroelectric Power Resources Hvítá and Þjórsá River Systems, Southwest Iceland", March 1960, there is an evaluation of the geological conditions south of the mouth of Svartá in the Þjórsá gorge at Norðlingaalda. This evaluation was done by Hower Mackins.

During the summer of 1963 seismic soundings were performed on the damsites in the area especially in attempt to determine the thickness of overburden, mainly moraine. These measurements were done by a team of NEA personnel under the direction of V. Stefánsson, who also prepared a report on these.

In the summers of 1962, 1963 and 1964 T. Tryggvason and Th. Einarsson geologists at the University Research Institute investigated the Þjórsárver area from Norðlingaalda to Sóleyjarhöfði. Their work was published in a rather detailed report : "Greinargerð um jarðfræði Þjórsárvera ; Norðlingaalda - Sóleyjarhöfði", with an English summary, dated March 1965. Because of the lack of topograpical names they introduced some new place names for greater clarity and definition. These names have been adopted unchanged in the present report.

In the autumn of 1969 drilling on the damsite was initiated and continued throughout the summer of 1970. Up to 1970 these investigations were performed by Orkustofnun, the National Energy Authority (NEA). The drilling and accompaying geological investigations in 1970 were requested and financed by Landsvirkjun (National Power Company), but conducted by NEA personnel.

Consulting engineers since 1970 for this hydroelectric scheme have been Verkfræðiþjónusta dr. Gunnars Sigurðssonar. From that time all research has been performed under the supervision and in close cooperation with them.

The main purpose of the drilling was :

1. To determine the thickness and nature of overburden on the damsite. For these purposes Borro sounding was mainly applied, while a bulldozer and tractor-mounted back-hoe were also used. The core drilling also gave important information on the nature of the moraine.
2. To investigate the bedrock, its nature and the stratigraphy. For this purpose core drilling was applied.
3. To measure the permeability and ground water gradient in the superficial deposits and bedrock.

In the year 1969 10 boreholes were drilled, designated NA-1 to NA-5 east of Þjórsá and NA-6 to NA-10 west of the river, totalling 229,2 m. All the holes on the east side were drilled to the planned depth, while three of the holes west of the river had to be abandonned before requested depth was reached, because of severe winter weather. In a report on these drillings by H. Tómasson and B. Jónsson, NEA geologists, the results are summarized.

In summer 1970 a more extensive drilling programme covering the entire dam site area was undertaken and completed, primarily consisting of core drillings with supplementary Borro soundings. 12 new core boreholes were drilled designated NA-11 to NA-21 and GS-2, the last one being located at the upper end of the proposed canal route going from the reservoir down to the future power plant at Gljúfurleit 25 km downstream on the river. Besides these new holes, two holes from the previous year were deepened, i.e. NA-7 and NA-9. Total depth of the holes is 297.8 m.

When the investigations were finished in autumn 1970 altogether 22 boreholes had been drilled on the dam site at Norðlingaalda, totalling 527,0 m.

The Borro soundings were done along the entire dam site and on the proposed route of the spill-water. Also at various other localities. In all 392 Borro soundings were done totalling 1110 m.

Exhibit 1 is a location map for drillholes and Borro soundings. On Exhibits 2-5 are graphic core logs and Exhibits 6-21 show the Borro soundings. Table 1 lists the coordinates and elevations of drillholes and table 2 lists these of the Borro soundings.

During the summer of 1970 a rather extensive examination and sampling of superficial deposits in the search for construction materials was accomplished, making use of a bulldozer and a tractor-mounted back hoe. The bulldozer excavated 20 test pits chiefly for exploration of the moraine, but with the back hoe there were dug 95 pits for exploring other types of superficial deposits. This aspect of the investigations will not be discussed further in the present report.

All drillholes were permeability tested and measurements of ground water level were made on a weekly basis throughout the period of investigation. Temperature measurements of springs at the Þjórsá river itself, and the air temperature for comparison were also carried out. In addition, samples for determination of deuterium and tritium content were collected from springs, the Svartá and Þjórsá rivers and drillholes NA-10, NA-2, NA-12 and NA-15.

CHAPTER 2

Geography

The area investigated at Norðlingaalda is located on the southern part of the interior highland plateau of Iceland and lies at elevation of 535-665 m (see Exh. 1). The area is less than 12 km long and 6 km wide making it about 70 km^2 in size. It covers the damsite and its nearest vicinity. Near the southern limit of the project area, Þjórsá is at 535 m elevation, at the mouth of Svartá it has 556 m elevation, while at the northern limit of the area its elevation surpasses 565 m.

On both sides of Þjórsá the topography of the area is rather flat, marked by a gradual rise to both sides away from the river. Rising above the plain are some low, rounded ridges and hills. A prominent feature are coarse gravel plains with sand-filled depressions and eskers in between, but to the north of Svartá and Eyvafen Þjórsá is usually by sandy plains and esker chains. Eyvafen in the northern part of the area west of the river is a wet sandy plain with some vegetation a semi-tundraic landform. Lesser semi-tundraic tracts of land are widely scattered around the area, especially nort of Svartá.

The discharge of Þjórsá at the mouth of Svartá is about 100 kl/sek. The river is glacier-fed, flowing from the SE part of the Hofsjökull glacier. The gradient of the river across the project area is low. Below Svartá the river has eroded a shallow gorge into the bedrock, but above the confluence it flows in braided channels between gravel bars. While eroding its channel through the low hills Þjórsá had wider shannel than at present as evidenced by a distinct terrace on both sides of the river covered with loose sand and gravel beds.

To the west of Þjósá the sandy plain Fjórðungssandur ensues bounded by the tributaries Kisa to the south and Hvítá to the north. The rivers are basically spring-fed. Fjórðungssandur is devoid of vegetation wherefrom Norðlingaalda rises to 665 m elevation. Adjoining it to the east lies Eyvafensalda (alda=hill) extending to Þjórsá. The Eyvafen semi-tundra is north of the alda, it is cut across by a small confluent, Eyvafenskvísl, joining Þjórsá at Krókur.

East of Þjórsá the topography is more level than west of the river. To the south and east the area is bordered by low hills of moraine with sandfilled depressions and patches of semi-tundra in between. The morainic hills are rather low as said above. At this point two rivulets flow into Þjórsá, the upper

one has been named Skuggi. Svartáralda is a collective name of a row of moraine hillocks extending from Skuggi north to Svartá, which is a spring-fed river flowing into Þjórsá north of Svartáralda.

The bedrock in the area is for the most part covered with glacial drift and glacio-fluvial deposits. Openings are rare, but the bedrock is visible at Þjórsá and at isolated spots elsewhere.

CHAPTER 3

Stratigraphy

The area between Hvítá and Kaldakvísl in middle south Iceland can be looked upon as an anticline with the oldest rock in the center and decreasing in age towards the margins. The oldest rock units are late Tertiary in age while the bulk was formed during the Pleistocene epoch. The stratigraphic column is comprised of basalt layers, most of which have flowed as lavas, and pyroclastic rocks formed in subglacial eruptions, and sedimentary layers, which are formed as alluvial and lacustrine deposits during interglacials and tillite deposite during glacials.

The rock formations found at Norðlingaalda all date from the latter half of the Pleistocene and are the following in cronological order, the oldest first :

1.	Norðlingaalda móberg	NAM
2.	Hvanngil sedimentary rocks	HS
3.	Eyvafen sedimentary rocks	ES
4.	Sóleyjarhöfði tholeiite	SÞ
5.	Dark tholeiite	DÞ
6.	Þjórsá basalt	ÞB

The geological units are shown on Exhibit 22.

The oldest rock in the area is móberg outcropping in Norðlingaalda and in the "öldur" east of Sóleyjarhöfði located just north of the damsite area. This is called the Öldur group but on the damsite the Norðlingsalda formation is a part of the Öldur group. It is not unlikely that the Öldur group is almost continous over some area. This led to the conclusion that the group underlies at least the northern and western parts of the area comprising there the oldest part of the bedrock penetrated in the drilling.

The móberg is rather heterogeneous in structure, ranging from tuff through breccia to pillow lava with veins of basaltic intrusions. The basaltic veins make up only a minor part of the mass, which consists of glassy basalt with individual small phenocrysts. All the "öldur" are elongated from SW to NE, probably formed in sub-glacial eruptions.

The NAM formation was only encountered in one borehole, NA 21, overlain by a 20 m thick conglomerate layer, the so-called Eyvafen sedimentary rocks ES. The conglomerate has small pebbles, is rich in rhyolite and is only slightly bedded. The uppermost 6 m consists of highly tuffaceous, bedded sediments with badly consolidated sand on top. This formation was not encountered in other bereholes, while at the same elevation another conglomerate is to be found at all other localities, the so-called Hvanngil sedimentary rocks HS (Þ. Einarsson and T. Tryggvason '65).

The Hvanngil sedimentary rocks draw their name from a waterfall, Hvanngiljafoss, where there are good outcrops. At Gljúfurleit the sediment lies discordantly on the Older Grey Basalts. The uppermost portion of this formation is composed of dense, tuffaceous, bedded sandstone with interbedded small pebbles. Underlying this is a bedded well-compacted conglomerate, while at the bottom there is a bed of coarse conglomerate consisting of slightly rounded boulders. At Norðlingaalda the sandstone is relatively thin, only 1-3 m in thickness, but is present over the whole area. The conglomerate has a sand and clay matrix with small pebbles. The bedding is much coarser than in the sandstone ranging from 10 cm to 2.5 m. The finer grained beds are mainly almost pure clay or tuff.

This sediment is alluvial or glaciofluvial as indicated by the irregular bedding and the coarseness of the deposits.

On top of the sedimentary layers there are alternatively three formations of lava flows, i.e. Sóleyjarhöfði tholeiite SÞ, which is light-coloured tholeiite; dark tholeiite DÞ, which is a dark, glassy tholeiite and Þjórsá basalt, a basalt with scattered penocrysts of feldspar. The age relationship between the tholeiite lava flows on one hand and the Þjórsá basalt on the other is not quite clear, but judging from the relative position the latter is almost certainly the youngest.

The Sóleyjarhöfði tholeiite SÞ is grey in colour, fine-grained with homogeneous crystal structure. It was encountered in drillholes NA-1, -2, -15, -19 and -20 east of Þjórsá and drillholes NA-9 and -21 west of the river.

The tholeiite has probably been continuous over a large part of the project area extending beyond its limits to the north and east as far as Sóleyjarhöfði. Later it was scoured down by glaciers during glacials to such an extent that at present only isolated remnats are left.

Below the moraine ridges The Sóleyjarhöfði tholeiite has a normal magnetic polarity and is most likely from the Brunhes magnetic epoch or less than 700 thousand years old.

The dark tholeiite DÞ was cored in two boreholes, NA-4 and NA-21 (the upper layer). The tholeiite is micro-crystaline, very glassy and cube-jointed. East of Þjórsá the layer lies somewhat lower than the Sóleyjarhöfði tholeiite, but there adjoins the latter in an erosion channel.

The third lava formation is the Þjórsá basalt ÞB, a basalt with scattered phenocrysts of feldspar. The Þjórsá basalt was found in drillholes NA-3, -6, -7, -10, -12 and -18.

This formation is rather heterogeneous in structure varying from sound-looking basalt patches to discontinuous pillow breccia and even móberg breccia. This formation is rather well exposed in the banks of Þjórsá where it cuts through Eyvafensalda and Svartáralda.

The formation can be divided into three facies, a) breccia facies b) lava facies and c) intrusions. Lying on top of the HS rock unit there is in most cases a layer of breccia of variable thickness, having alternatively pillow breccia and móberg breccia structure interwoven with rather wellformed pillows and basaltic veins. Higher up the rock becomes richer in basalt veins, which are cube-jointed with small cubes, while on top a continuous cube jointed basalt is widespread. Both these facies are intruded by radially-jointed basalt and basaltic dykes. These intrusions evidently stem from the same magma, but are somewhat richer in olivine. The intrusions are most frequent at the Skuggi gully and on the next 2 km further down east of Þjórsá.

On the preceeding pages the main characteristics of the different rock units have been discussed. Their age cannot be stated with certainity, yet the Norðlingaalda formation is almost definately the oldest unit. This alda is an elongated ridge mainly consisting of pillow lava and móberg. It is formed subglacially in a linear eruption probably during the third glacial form now.

At the end of that glacial, there were formed thick beds of conglomerate of variable grain sizes deposited by glacial water flowing in a broad valley east of Norðlingaalda. During the latter half of this stage the glacial river had a tributary from the west. This tributary river probably, originated from

the rhyolite areas in Hofsjökull or in the Kerlingafjöll mountain massif. The deposits of this river make up the ES unit. The physical features of the Þjórsárver area were probably similar to the present ones, marked by pools, shallow lakes and semi-tundra landforms.

Early in the succeeding interglacial the Sóleyjarhöfði tholeiite SÞ covered at least the N and NE parts of the project area forming an extensive continuous lava plateau. After the formation of the lava plateau the glaciers have advanced during a brief advance stage and eroded it somewhat in the NE part.

Into these erosion channels the DÞ flowed in the succeeding interstadial and also across the SÞ at the roots af Norðlingaalda.

The last but one glacial caused great erosion of the area and the present Þjórsá gorge probably dates from that time having then been considerably wider. The alluvial plains were subsequently covered by an inter-canyon lava flow, but due to the frequency of pools and lakes and braided channels on the plain the liquid lava flow was shattered by the action of rapid cooling producing móberg. Since that time the lava cover has been videly stripped off by the scouring action of glaciers and running water during the last glacial.

The sequence of rock formations proposed above is deduced from the results of the drilling and from field evidence. There are many other possible interpretations, but only one other alternative is of importance for the proposed construction on the location. This alternitive is the possibility that the pillow breccia drilled into near the bottom of hole NA-21 should not be interpreted as Norðlingaalda formation but rather as belonging to an older formation dating from a previous glacial. In that case the Hvanngil sedimentary layers and the tholeiite basalts (and possibly also the Þjórsá basalt) would constitute interglacial formations most likely the last interglacial subsequent to the glacial in which the pillow breccia originated.

These formations should then underlie Norðlingaalda, which was formed in the following glacial (the last glacial).

CHAPTER 4

Superficial Deposits

The superficial deposits forming the overburden are derived from various sources, being glacial, glaciofluvial, fluvial and eolian and some organic. In many places the overburden may be rather thick such as in the moraine ridges which often exceed 20 m thickness. Exhibit 23 (Map of superficial deposits) illustrates the nature and distribution of loose surface layers covering the bedrock.

The moraine is by far the most voluminous and widely distributed sediment. It is rather rocky at the surface, but where cut through it appears silty with a few blocks and boulders. On the whole only the topmost meter seems to be weathered into loose material, mainly through frost action. The surface is rocky mainly due to frost lifting. Generally the moraine is hard and compact and is classified as tillite at about 10-20 meters depth, where coring was generally possible. Most of the moraine hillocks on the dam site therefore have a tillite core. As a whole the moraine seems to have a rather uniform strenght, but in the depression at NA-11 and NA-16 it is much less consolidated and weaker. This weak moraine seems to be restricted to a rather small area as at NA-12 the moraine has got its usual strength.

Most of the depressions in the area are filled with sandy gravel usually a few meters thick. The sand is bedded and cross bedding indicates that it is alluvial deposit. This deposits are particularly characteristic for the lower part of the area east of the river.

The sand is well sorted, mostly medium to coarse. The sorting suggests an eolian origin of the sand. In the depression where the spillway site is propased considerable proportion falls within the range of coarse sand and fine gravel seemingly pointing to alluvial deposition.

East of Norðlingaalda there are sand ridges extending all the way down to Eyvafen. These consist of fine and medium sand with small pebbles intermingled. The ridges strongly indicate wind-borne origin of the sediments, probably laid down in marshy land, the Eyvafen most likely constituting its last remains.

River alluvium is mainly found in and bordering Þjórsá in the uppermost part of the area, but also at Svartá and below the slopes of Norðlingaalda. At the

foot of Norðlingaalda coarse sediments are widespread, transported by snow meltwater from higher up in the alda. This is primarily coarse sand and pebbles, rather collovium than alluvium, yet here it is classified as such.

The area is traversed by two eskers. One of them can be traced from Hnífárbotnar southward along Hnífá at first and then southeast across Þjórsá and Svartá terminating east of Svartáralda. This esker has been named Hnífárás. The other esker stretches from Norðlingaalda north of Eyvafen across Þjórsá continuing along Svartá to the north east to Þúfuverskvísl. This esker could be named Svartárás. The material composing these eskers is mostly medium sand to fine gravel.

Adjacent to Svartá north of Svartáralda there is a gravel terrace, the material of which is considerably finer grained than that of the eskers being mostly fine and medium sand.

At Norðlingaalda there are left various marks of the retreat of the glaciers of the last glaciation. The local retreat was towards ESE. Striated bedrock and fluted moraine surface definitely point to this and also the orientation of drumlins such as Svartáralda and Eyvafensalda. At this time the ice divide was in the Tungná area.

At this time the glacier front was blocking the drainage of Þjórsá to the south thus creating a large lake in the basin presently occupied by the Þjórsárver.

The southern limit of the ice-dammed lake was in the depression north of Svartáralda and Eyvafensalda. The lake extended a considerable distance upstream in the present channels of Svartá and Þjórsá. The lake was gradually silted up with alluvial deposits, mainly fine grained sand, well bedded and sometimes cross-bedded. These are the lake deposits on the map.

Remains of the lake are also flat sand and gravel terraces found at 575 m elevation. At first the outlet of the lake was probably through the col between Norðlingaalda and Eyvafensalda, but the present channel was subsequently eroded back exposing a more easily erodible bedrock.

During the warm period of the postglacial time (2.500-5.000 years ago) the main part of the highlands was grassgrown and it is estimated that the forest limit reached as high as 600 m el. Bogs or marsh land most likely occupied

most depressions. The slices of green turfs in the area are probably remains from this time, but at present the vegetated spots are restricted to the semi-tundraic tracts. The distribution of the semi-tundra is strictly limited to small isolated patches, but north of the area, in Þjórsárver, one of the largest semi-tundra areas in the country is to be found.

Loessial soil and soil remains are widely scattered around the area, but mainly at the foot of Norðlingaalda downstream of NA-21. The soil is here a few meters thick, most likely remains of a dried-up bog.

CHAPTER 5

Tectonics

The faults and fissures in the Norðlingaalda area are shown on a map, Exh. 24. They are also illustrated by two rose-diagrams of fissure orientation, Exh. 6. The rose-diagrams are explained by tables, Table 3. The more prominent tectonic features indicate that the eruption fissures in the area are connected to the dominating SW-NE fissures trend of the country. To some extent the same also applies to the river courses.

The regional tectonics were studied by two approaches, field investigations on one hand and interpretation of aerial photographs on the other. Two faults with displacements were detected with fair degree of certainty. The former traverses the western part of the spillway depression. This is a normal fault with about 8 m displacement having the downthrow on the east side, and the direction 10° E. The other fault crosses Þjórsá about 1300 m downstream of Svartá. Being also a normal fault it also has about 8 m downthrow on the north side and the direction being 75° W. Horizontal displacement along the fault could not be detected, but is difficult to determine. This fault does not cross the proposed dam site. On the map the faults are drawn as far as they can be detected on aerial photos, while it is likely that they extend somewhat farther especially the former one.

The rose-diagram A illustrates the major fractures in the area and their orientation. There appear to be three main trends, i.e. 270° - 310° (25%), 360° - 20° (27%), 30° - 50° (25%) and 60° - 80° (20%). The last one is in fact continuation of the fissure trend 270° -310° although deviating somewhat from it in the graphic representation. Besides there is a 340° (3%) trend, which most likely presents a deviation from the N-S orientation. The 30° - 50° fractures coincide with the main SW-NE trend which dominates the neo-volcanic zone of the country. Rectangular to this direction is the Snæfellsnes fissure trend, locally parallelled by the 270° - 310° fissure group, yet a little more southward trending here. The fissure trend 360° - 20° is a common orientation in the oldest rocks of southern Iceland and also in the northern part of the country. Rectangular to this trend is the orientation 60° - 80°, also common in northern and southern parts of the country.

The tectonic activity, as it appears to us, is mainly late Pleistocene and finiglacial, from the time of the maximum isostatic movements.

CHAPTER 6

Ground Water Studies

Concurrent wich the core drillings, permeability testing and ground water measurements were carried out. Measurements of ground water levels was continued throughout the exploration period on a weekly basis and after that nearly once a month. The results of the permeability testing are shown on the graphic core logs, Exhibits 2 to 5, but the ground water measurements are listed in Table 4. Exh. 26 illustrates the ground water surface lines according to the water level measurements and also the results of deuterium and tritium determinations (see also Table 5). Ground water level fluctations are shown graphically on Exh. 27 and 28.

All drillholes were permeability tested, the length of the tested section depending on the leakage, yet the tested section never exceeded 5 m length. Generally a single Craelius type self expanding packer was used, but percolation tests were also performed in some cases.

The common permeability of the different rock units in LU-values[x)] is as follows : Conglomerate (Hvannagil sedimentary rocks) 0-10 LU ; basalt (undefined) 0-25 LU ; tuff sandstone (Hvannagil sedimentary rocks) 5-50 LU ; móberg breccia and pillow lava (Þjórsá basalt) 50-100 LU ; tillite and well consolidated moraine 0-50 LU ; moraine 50-200 LU ; sand and loose superficial deposits 200-800 LU.

The obtained permeability values indicate the permeability. The bedrock is a poor aquifer. Generally this also applies to the contact zones. In a few cases fissured zones caused higher permeability. Almost all fissures and fractures are filled with a yellow-brownish glacial clay, which tightens the rock to a considerable degree.

On the ground water map, Exh. 26, there are drawn ccontour lines of ground water elevation with 5 m intervals, primarily on the basis of measurements in drillholes. The ground water flow is somewhat influenced by the topography, but little by rock types except in the depression between Norðlingaalda and Eyvafensalda.

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x) LU-value is defined as leakage in l/m/min in 7.5 cm wide borehole at 10 kg/cm^2 pressure.

The ground water contour lines seem to indicate an inflow from two directions, i.e. north-west and north-east. The eastern gradient is considerably steeper, which may be caused by local conditions. In drillholes NA-2 the observed ground water table is markedly highter than in surrounding borholes or at about 596 m el. producing a mound of 15-20 m. The reason for this is probably an artesian aquifer below, which leads to the surface via fractures. It is probably feeding the mapped ground water table elsewere too, but the headloss through the aquiclude is unusually small at NA-2.

Along the banks and from the bottom of Þjórsá downstream of its confluence with Svartá there are fairly big springs issuing (see Exh. 29 and 25; spring zone and main spring zone). During the summer of 1970 their temperature was measured a few times (Table 6). This showed the temperature to be very constant at about 3.2°C.

Other temperature measurments performed during summer and winter showed similar results indicating that the water has a distant origin. The water temperature of the Þjórsá river during winter is slightly above zero, while on a hot summer day it rises to as high as 10°C.

Samples for determining tritium and deuterium were also collected. The results of the deuterium measurements (see Table 5)[x] show that the water is accumlated from an area not higher than 800-900 m elevation, which only excludes the glaciers and the highest parts of the Kerlingafjöll mountain massif. The tritium measurements (Table 5)[xx] on the other hand reveal a distinct difference between spring water and ground water from borehole NA-10 on one hand and the water of Svartá on the other. The tritium value of Svartá is representative for the surface water of rivers and lakes as it is at the present time. The difference between the spring water and ground water is 6 T.U. (Tritium units), which is hardly a significant difference, but still this difference supports the theory that artesian water is involved. The age of the water is at least 8 years probably amounting to some decades since intermingling with younger water is supposed to have occurred to some degree.

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x) The sesults are expressed as δ = promille deuterium enrichment (depletion negative) relective to SMOW (Standard Mean Ocean Water).

xx) The results are expressed as T.U. (Tritium Units) T.U. = $T/H \cdot 10^{18}$

The springs issue under some artesian pressure through fissures in the Hvannagil sedimentary formation and in some places in the Þjórsá basalt. The water-carrying fissures have a direction of 270° - 280° (N90° - 80° W), but one has a direction of 310°. The fissures are usually filled with clay, mostly of glacial origin.

The discharge from the springs and the artesian pressure is impossible to assess from our present knowledge of the local ground water behaviour. Exh. 29 shows the relative size of the springs, but only a rough approximation.

In spite of a fairly good knowledge of the ground water gradient in the area it is not clear from what direction the water is coming. In our opinion it originates from the uppermost part of the Þjórsárver area, and higher ground east or west of it. The water flows in a rather open aquifer, consisting of igneous rocks, most likely a móberg formation. The móberg may be the Öldur group.
The Hvannagil sedimentary rock constitute an aquiclude capable of retaining the water under considerable pressure.

CHAPTER 7

Engineering Geology

The reservoir area is mostly covered by glacial and glaciofluvial sediments. The underlying bedrock is of a similar character as the rock at the damsite, consisting of fairly tight formations. Water loss from the reservoir is expected to be very small. The initial leakage will be rapidly reduced because of silting. The leakage paths are mostly under the dam and the southern rim of the reservoir. The seepage will reenter Þjórsá some distance downstream of the dam.

An engineering significance of the filling of the reservoir will be its influence on the artesian ground water at the damsite. It should be expected that it will raise the pressure of the artesian ground water which could cause troubles at the damsite. The main catchment area of the groundwater probably lies higher up than the reservoir. The influence would therefore mainly be to prevent the artesian groundwater aquifer to release water upstream of the dam, which it probably to some extent does now. This water would be added to the groundwater flowing under the dam.

The damsite is shown in Exhibit 30 on the general geologic section and in Exhibit 31 showing the stratigraphic relationship at the damsite area. Exhibit 32 and 33 show a larger scale section along the specified damsite proposed by Verkfræðiþjónusta Dr. Gunnars Sigurðssonar.

The bedrock is mainly the tholeiite or basalt flows, but at the western end outcrops of móberg of the NAM formation can be seen. In the river-course itself the bedrock consists of the Hvannagil sedimentary rocks and at a few other localities this formation underlies the moraine. The surface layer is mostly moraine, often of considerable thickness, and in the lower part it is so hard that it is designated as tillite. At one place an esker is found on the damsite.

Fractures are found at many places in the bedrock on the damsite but only one normal fault was found there. There may be other normal faults hidden below the thick overburden.

The artesian aquifer at the damsite can be either the Öldur group or some still lower laying formation. The appearance of springs in the river clearly indicates

that the aquifer is tapped through fractures and faults through the generally impervious Hvannagil sedimentary rocks. A sealing of these fractures below the core of the earth dam will be necessary and even other fractures now closed, which might open up under the higher pressure to be expected after the filling of the reservoir. Increased water pressure may also reach under the moraine cover. This may have a deteriorating effect on the strength of the moraine and tillite, but can be adjusted by drainage holes.

The most pervious part of the dam foundation is the contact between moraine and underlaying rock and the contact DÞ-SÞ at the western end of the dam. These contacts have a relatively high horizontal permeability. The contacts do not reach the surface in the reservoir area, so to enter the contact the leakage has either to go through the moraine or the tholeiite layer DÞ. Seepage loss through these contacts should therefore not be a matter of concern, but short path leakage in the upper contact should be considered as a possibility. Grouting or some other type of piping prevention is advisible where short path leakage can be envisaged. This is at both ends of Eyvafensalda and at the eastern bank of the Þjórsá river.

Most of the earth dam foundation will be on moraine or tillite. The moraine is usually a mixture of all grain sizes down to silt and with high enough silt content to be fairly water-tight. Still, in the moraine there are often sand or gravel lenses of considerable dimensions which are not suitable as foundation for an empervious core.

The moraine can for convenience be divided into 3 layers. The uppermost layer usually 1.5 m thick, is the weathered moraine and is quite loose. It can be dug with any equipment. Below is a layer 10-15 m thick where the moraine is workable with heavy bulldozers but is quite hard. Usually this part yielded some core in diamond drilling. The lowest part is the so-called tillite often quite thick where the moraine is hardly rippable and often gives good core recovery in drilling. The boundaries between these layers are not sharp and they are not formational boundaries. The lower part of the tillite has often a fairly high permeability which must be due to joints as the material itself is fairly tight.

The moraine as a foundation for an earth-rockfill dam is good. Problems are mainly due to the jointing in the harder type of the moraine. A grouting or some other precautionary measures to prevent piping of the core foundation may be advisable.

The only suitable rocks for spillway foundation are some of the lava flows. The one which has been selected for this is the flow SÞ. The most studied site, which is topographically favourable for the lowest proposed maximum water level, is in the vicinity of drillhole NA-20 (see section E-E). For a higher reservoir level, a higher bedrock elevation would be more economical. Therefore another site has been studied just east of drillhole NA-13. This site is on a hillshoulder west of the former mentioned site. This ridge had been interpreted as beeing made of SÞ-basalt under the moraine and a seismic study was done to check this. The result of this was that it is doubtful if the basalt covers the whole area in the hills.

The main problem with the spillway is the scouring of the rock downstream of the dam. The SÞ layer is probably excellent in this rexpect, except where it is broken up by faults and fractures. On the first mentioned spillway site (near NA-20), there is one fault and a few other fractures in the vicinity, but as the ground surface downstream from the proposed spillway is gentle, scouring should be of litle importance. At the latter spillway site, the ground surface slopes steeply away from it. The bedrock is probably partly basalt and partly sedimentary rock. Fractures are also present at this site, so scouring can therefore be envisaged.

TABLE 1
TAFLA

Staðsetning og dýpi borhola
Location and depth of drillholes

Hola Nr. Hole No.	Hnit Co-ordinates Y	X	Toppur fóðurrörs, m y.s. Top of casing, el.	Dýpi Depth m	Botn holu m y.s. Bottom of hole, el.
NA-1	442 118,59	537 968,59	595,55[X]	17,0	578,6
NA-2	441 797,31	540 157,06	606,96[X]	23,3	583,7
NA-3	440 982,64	543 118,40	583,86[X]	51,8	532,7
NA-4	443 581,68	540 170,33	571,61	25,0	546,0
NA-5	440 715,86	541 758,88	573,51	25,1	548,4
NA-6	441 422,33	543 282,80	567,53	26,0	541,5
NA-7	442 537,85	545 280,96	580,38	33,7	552,7
NA-8	442 790,96	546 025,58	572,16	11,8	560,4
NA-9	444 693,63	545 369,84	574,78[X]	25,8	549,0
NA-10	440 967,93	545 815,61	560,19	25,0	535,3
NA-11	440 672,00	542 340,00	580,44	10,8	569,3
NA-12	440 556,99	543 037,96	568,97	21,8	546,9
NA-13	441 587,00	540 969,00	582,40	27,4	555,0
NA-14	441 791,55	539 647,87	583,54	13,0	570,4
NA-15	441 655,64	538,580,06	589,94	21,4	568,4
NA-16	440 991,42	542 276,12	585,80	27,9	557,8
NA-17	440 098,90	543 911,92	565,84	23,2	542,4
NA-18	439 732,79	544 937,04	569,47	33,0	536,5
NA-19	441 781,09	538,964,37	587,60	15,7	571,5
NA-20	442 061,02	539 321,49	584,32	5,3	578,9
NA-21	442 860,08	545 999,39	571,75	47,8	523,8
GS-2	439 974,87	547 329,69	555,80	17,0	538,8

X pisómeterrör í holunni
piczometer pipe in the hole

T A B L E

2

T A F L A

Staðsetning og dýpi borrohola.

Location and depth of Borroholes

Hola nr. Hole No NAB	Dýpi Depth m	Hæð Elevation m y.s.	Hnit Coordinates Y	 X	Botn holu Bottom of Hole m y.s.
0201	1.5	570.87	441 235.2	542 986.3	569,4
02	1.2	575.94	441 181.0	542 902.4	574,7
03	1.3	583.65	441 126.80	542 818.3	582,4
04	1.4	587.15	441 072.6	542 734.3	585,8
05	1.5	585.74	441 018.4	542 650.3	584,2
06	1.1	584.11	440 964.2	542 566.2	583,0
07	1.3	581.91	440 910.0	542.482.3	580,6
08	1.1	581.98	440 855.8	542 398.3	580,8
09	1.3	(582.00)	440 801.6	542 314.3	580,7
0301	1.3	567.77	441 365.7	543 284.5	566,5
02	0.9	570.98	441 430.7	543 360.5	570,1
03	1.4	579.92	441 495,8	543 436.4	578,5
04	0.7	583.19	441 560.9	543 512.4	582,5
05	1.1	584.41	441 625.9	543 588.4	583,3
06	1.1	585.20	441 691.0	543 664.3	584,1
07	0.7	584.64	441 756.1	543 740.3	583,9
08	1.4	585.53	441 821.1	543 816.2	584,1
09	1.4	591.18	441 886.2	543 892.2	589,8
10	1.3	596.06	441 951.3	543 968.2	594,8
11	1.2	599.27	442 016.4	544 044.1	589,1
12	1.2	602.84	442 081.4	544 120.1	601,6
13	1.3	604.70	442 113.9	544 158.1	603,4
14	1.8	604.46	442 122.48	544 266.0	602,7
15	1.2	602.67	442 124.26	544 366.0	601,5
0401	0.5	573.44	440.876.30	544 345.43	572,9
02	1.6	575.45	440 913.1	544.438.4	573,9
03	1.4	576.75	440 949.8	544.531.6	575,4
04	0.7	575.63	440 971.96	544 587.66	574,9
05	1.2	566.50	441 015.1	544 613.0	565,3
06	2.6	565.09	441 101.4	544 663.6	562,5
07	1.8	571.53	441 144.5	544 688.9	569,7
0501	1.2	(577.0)	441 086.6	542 425.9	575,8
02	1.3	585.57	440 988.6	542 406.0	584,3
03	1.0	586.31	440 890.62	542 386.04	585.3
04	1.2	581.42	440 792.6	542 366.1	580,2
05	0.4	580.44	440 694.6	542 346.2	580,0
06	1.0	576.8	440 596.6	542 326.3	575,8
07	1.9	(573.7)	440 547.6	542 316.3	571,8
0601	1.4	583.14	440 808.1	542 241.1	581,7
02	1.2	586.35	440 860.7	542 156.0	585,2
03	1.7	588.78	440 913.3	542 070.9	587,1
04	1.3	592.17	440 965.9	541 985.8	590,9
05	0.6	599.33	441 018.5	541 900.7	598,7
06	1.3	603.43	441 071.1	541.815.7	602,1
07	1.1	605.82	441 123.7	541 730.5	604,7

Hola nr. Hole No NAB	Dýpi Depth m	Hæð Elevation m y.s.	Hnit Coordinates Y	 X	Botn holu Bottom of Hole m y.s.
0701	1.3	605.55	441 172.25	541 641.93	604,3
02	0.8	605.54	441 220.9	541 554.6	604,7
03	1.3	605.16	441 269.6	541 467.2	603,9
04	1.2	604.55	441 318.3	541 379.9	603,4
05	1.8	602.03	441 367.0	541 292.5	600,2
06	1.4	597.71	441 415.7	541 205.2	576,3
07	1.0	588.74	441 464.4	541 117.8	587,7
08	1.4	591.5	441 683.5	540 724.8	590,1
09	2.0	592.9	441 707.9	540 681.1	590,9
0801	1.1	585.35	441 510.59	541 086.29	584,3
02	1.5	583.07	441 559.3	540 998.9	581,6
03	2.2	582.44	441 607.9	540 911.6	580,2
04	2.2	583.68	441 656.7	540 824.2	581,5
0901	0.4	582.50	441 466.91	541 061.95	582,1
02	1.5	581.4	441 515.6	540 974.6	579,9
03	2.0	582.2	441 564.3	540 887.3	580,2
04	1.4	583.7	441 612.9	540 799.9	582,3
1001	0.7	581.78	441 818.0	540 913.0	581,1
02	1.8	581.5	441 719.0	540 921.0	579,7
03	1.2	582.1	441 608.0	540 929.0	580,9
04	1.7	581.0	441 493.0	540 938.0	579,3
1101	0.8	591.79	441 716.8	540 571.9	591,0
02	1.3	596.93	441 720.6	540 472.1	595,6
03	0.6	601.13	441 724.4	540 372.2	600,6
04	1.0	605.35	441 728.2	540 272.4	604,4
05	1.0	608.22	441 731.9	540 172.6	607,2
06	1.1	608.22	441 735.8	540 072.7	607,1
07	1.5	605.85	441 739.6	539 972.7	604,4
08	0.7	599.26	441 743.4	539 872.8	598,6
09	1.0	589.01	441 747.3	539 772.9	588,0
10	1.2	597.05	441 787.61	538 719.59	595,9
11	1.3	595.48	441 445.1	537 939.5	594,2
12	1.0	600.35	441 404.9	537 848.0	599,4
1201	0.9	584.57	441 776.1	539 673.9	583,7
02	5.5	582.76	441 779.9	539 573.9	577.3
03	3.3	582.37	441 783.7	539 474.0	579,1
04	1.3	583.98	441 787.6	539 374.1	582,7
05	1.9	585.07	441 791.4	539 274.2	583,2
06	1.4	586.34	441 795.2	539 174.3	584,9
07	1.2	586.41	441 799.0	539 074.3	585,2
08	1.7	587.3	441 802.9	538 974.4	585,6
09	1.0	587.92	441 806.7	538 874.5	586,9
10	1.4	592.75	441 810.5	538 774.5	591,4
11	1.7	592.85	441 790.4	538 661.8	591,2
12	3.2	588.19	441 750.1	538 570.2	585,0
13	1.5	589.65	441 709.8	538.478.7	588,2
14	6.0	590.07	441 669.5	538 387.1	584,1
15	3.6	590.65	441 629.2	538 295,6	587,1
16	7.9	589.01	441 588,9	538 204.1	581,1
17	1.7	587.71	441 548.6	538 112.5	586,0
18	6.3	589.71	441 508.3	538 020.9	583,4

Hola nr. Hole No NAB	Dýpi Depth m	Hæð Elevation m y.s.	Hnit Coordinates Y	 X	Botn holu Bottom of Hole m y.s.
1301	1.7	584.54	441 726.1	539 672.0	582,8
02	3.5	582.13	441 729.9	539 572.1	578,6
03	1.6	582.59	441 733.8	539 472.1	581,0
04	3.2	584.30	441 737.6	539 372.2	581,1
05	1.3	585.50	441 741.4	539 272.3	584,2
06	3.4	586.21	441 745.3	539 172.3	582,8
07	1.8	586.12	441 749.1	539 072.4	584,3
08	1.2	586.89	441 752.9	538 972.5	585,7
09	1.6	587.81	441 756.7	538 872.5	586,2
10	1.0	591.23	441 760.6	538 772.6	590,2
11	1.1	595.35	441 744.6	538 681.9	594,3
12	5.1	589.06	441 704.3	538 590.4	584,0
13	6.1	589.47	441 664.0	538 498.8	583,4
14	7.8	588.98	441 623.7	538 407.3	581,2
15	2.3	588.79	441 583.4	538 315.7	586,5
16	2.7	587.87	441 543.1	538 224.2	585,2
17	8.7	588.57	441 502.8	538 132.7	579,9
18	2.8	590.96	441 462.5	538 041.1	588,2
1401	0.3	(581.5)	442 083.5	539 485.5	581,2
02	1.5	582.5	441 983.6	539 481.7	581,0
03	2.9	582.47	441 883.7	539 477.9	579,6
04	1.3	584.19	441 633.8	539 468.3	581,9
05	2.9	584 40	441 533.9	539 464.5	581,5
1501	1.2	590.43	441 938.6	538 377.9	589,2
02	2.3	588.41	441 892.9	538 398.1	586,1
03	5.0	588.78	441 801.3	538 438.4	583,8
04	2.5	589.09	441 572.5	538 539.11	586,6
05	5.9	588.14	441 480.9	538 579.4	582.3
1506	4.2	587.7	441 435.1	538 599.6	583,5
1601	5.0	582.23	441 653.0	539 592.0	577,2
02	2.0	581.61	441.568.0	539 645.0	579,7
03	3.5	581.58	441 312.3	539 811.9	578,1
04	3.2	582.55	441 226.18	539 862.77	579,4
05	4.1	582.35	441 140.1	539 913.7	578.3
1701	1.9	577.37	441 120.14	543 097.74	575,5
02	1.1	580.68	441 095.7	543 002.2	579,6
03	1.3	584.79	441 071.3	542 906.7	583,5
04	0.6	586.82	441 046.9	542 811.2	586,2
05	1.6	587.07	441 022.5	542.715.7	585,5
1801	1.1	(572.40)	440 701.97	542 891.16	571,3
02	3.7	(568.00)	440 631.1	542 961.8	558,3
03	3.4	(568.60)	440 560.3	543 032.4	565,2
04	1.4	(568.50)	440 489.5	543 103.1	567,1
05	2.6	(569.80)	440 418.7	543 173.7	567,2
06	1.3	(577.00)	440 347.8	543 244.3	575,7
1901	2.0	576.17	440 630.54	544 160.17	574,2
02	1.5	580.05	440.631.4	544 060.2	578,6
03	1.2	583.72	440 632.3	543 960.2	582,5
04	1.4	586.59	440 633.2	543 860.2	585,2
05	1.5	587.96	440 634.0	543 760.2	586,5
06	1.2	586.32	440 558.5	543 685.7	585,1

Hola nr. Hole No NAB	Dýpi Depth m	Hæð Elevation m y.s.	Hnit Coordinates Y	 X	Botn Bottom of Hole m y.s.
1907	1.7	581.12	440 482.9	543 620.2	579,4
08	1.3	580.41	440 445.1	543 587.5	579,1
09	1.2	585.75	440 369.5	543 522.1	584,6
10	1.3	587.47	440 329.68	543 487.58	586,2
11	1.2	586.71	449 289.3	543 396.1	585,5
12	1.1	584.11	440 248.9	543 304.6	583,0
13	1.3	578.22	440 208.5	543 213.2	576,9
14	3.7	567.40	440 164.9	543 114.6	563,7
15	6.9	566.42	440 124.5	543 023.2	559,5
16	2.5	570.48	440 084.1	542 931.7	568,0
17	1.0	573.56	440 043.7	542 840.2	572,6
18	1.0	579.42	440 003.3	542 748.8	578,4
19	1.2	585.12	439 961,89	542 655.03	583,9
20	1.4	583.52	439 868.3	542 619.9	582,1
21	2.0	578.60	439 774.7	542.584.7	576,6
22	2.2	580.23	439 681.0	542 549.6	578,0
23	1.0	579.35	439 587.4	542 514,4	578,4
24	0.8	576.41	439 493,8	542 479.2	575,6
25	1.6	577.56	439 400.2	542.444.1	576,0
26	1.4	585.39	439 306.6	542 408.9	584,0
27	0.8	592.29	439 252,78	542 388.70	591,5
28	1.3	584.17	439 170.2	542 332.3	582,9
29	1.4	582.01	439 087.7	542 275.9	580,6
30	0.6	580.51	439 005.10	542 219.44	579,9
31	1.0	586.39	438 922,5	542 163,0	585,4
32	1.1	590.10	438 840.0	542 106,6	589,0
33	1.5	587.64	438 762.3	542 045.8	586,1
34	1.5	583.34	438 686.4	541 980.7	581,8
35	0.6	583.69	438 610.6	541 915.5	583,1
36	2.3	584.52	438 534.7	541 850,4	582,2
37	1.0	589.06	438 458.8	541 785.2	588,1
38	1.2	590.94	438 421.17	541 752.88	589,7
2001	3.0	(569.5)	440 229.1	543 753.4	566,5
02	2.9	565.2	440 165.7	543 830.8	562,3
03	0.9	(563.2)	440 134.0	543 869.4	562,3
04	0.5	(565.5)	440 102,2	543 908.1	565,0
05	0.5	567.7	440 038.8	543 985.4	567,2
06	1.4	568.8	440 018.1	544 028.4	567,4
07	1.3	572.8	440 010.6	544 128.1	571,5
08	1.0	(574.2)	440 003,2	544 227.8	573,2
2101	1.5	(580.5)	439 146.2	542 013.0	579,0
2102	0.5	(581.0)	439 089.7	542 095.6	580,5
2103	1.7	(580.5)	439 033.3	542 178.2	579,8
2104	4.7	(579.0)	438 976.9	542 260.7	574,3
2105	4.0	(578.5)	438 920.5	542 343.3	574,5
2106	4.0	(578,5)	438 864.1	542 425.8	574,5
2201	0,9				
02	1,8				
03	3,3				
2301	1.2	600.56	442 126.64	544 500.19	599,4
02	0.9	597.23	442 167.3	544 591.6	596,3
03	1.1	593.40	442 207.9	544 683.0	592,3
04	1.4	586.89	442 248.6	544 774.4	585,5
05	1.1	583.10	442 289.2	544 865.8	582,0
06	0.6	582.37	442 329.9	544 957.2	581,8

Hola nr. Hole no NAB	Dýpi Depth m	Hæð Elevation m y.s.	Hnit Coordinates Y	 X	Botn Bottom of Hole m y.s.
2307	1.7	584.75	442 370.5	545 048,7	583,1
08	1.4	585.84	442 411.2	545 140.1	584,4
09	1.5	582.90	442 451.8	545 231.5	581,4
10	3.2	584.63	442 492.5	545 322.9	581,4
11	0.5	587.09	442 533.1	545 414.3	586,6
12	1.0	585.68	442 573.8	545 505.7	584,7
13	1.0	585.93	442 614.4	545 597.1	584,9
14	1.5	592.79	442 655.1	545 688.5	591,3
15	1.1	593.35	442 695,70	545 779.96	592,3
16	1.0	591.08	442 736.4	545 871.4	590,1
17	2.5	579.91	442 773.7	545 916.4	577,4
18	3.2	(571.50)	442 840.4	545 987.5	568,3
19	4.0	572.35	442 907.2	546 058.5	568,4
20	2.5	575.15	442 973.9	546 129.6	572,7
21	0.8	(585.2)	443 040.6	546 200.6	584,4
2401	1.2	594.2	443 163.6	546 177.4	593,0
02	1.3	581.9	443 095.5	545 104.6	580,6
03	1.3	575.8	443 061,4	546 068.2	574,5
04	1.5	574.2	443 027.3	546 031.8	572,7
05	3.0	573.0	442 993.2	545 995.4	570,0
06	1.3	572.1	442 959.1	545 959.0	570,8
07	1.3	572.2	442 925.0	545 922.6	570,9
08	1.0	572.3	442 890.9	545 886.2	571,3
09	0.5	573.6	442 856.8	545 849.8	573,1
10	1.0	579.0	442 822.7	545 813.4	578,0
2501	2.2	576.15	442 776.30	546 330.31	574,0
02	6.2	574.40	442 715.7	546 244.4	568,2
03	8.1	573.09	442 656.9	546 161.1	565,0
04	5.2	571.86	442.598.1	546 077.7	566,7
05	1.0	573.73	442 537.2	545 991.4	572,7
06	2.1	573.73	442 507,9	545 949.9	571,6
2601	0.8	604.78	441 911.80	539 997.15	604,0
02	1.5	601.73	441 921.9	539 897.7	600,2
03	0:8	595.77	441 932.1	539 798.2	595,0
04	1.7	587.38	441 942.2	539 698.8	585,7
05	0.5	583.61	441 952.3	539 599.3	583,1
06	1.1	582.23	441 962.5	539 499.9	581,1
07	1.0	583.72	441 972.6	539 400,4	582,7
08	0.9	584.58	441 982.7	539 300.9	583,7
09	2.8	585.62	441 992.9	539 201.5	582,8
10	0.8	588.77	442 003.0	539 102.0	588,0
11	1.7	589.85	442 013.1	539.002,6	588,2
12	1.0	588.01	442 023,2	538 903.1	587,0
13	1.3	589.03	442 033.4	538 803.6	587,7
14	1.4	590.16	442 043.9	538 704.2	588,8
15	1.7	590.64	442 053.6	538 604.7	588,9
16	1.4	583.77	442 063.8	538 505.3	582,4
17	1.4	590.44	442 073.9	538 405.8	589,0
18	1.1	587.52	442 084,0	538 306.3	586,4
19	0.7	591.02	442 094.1	538 206.9	590,5
20	1.2	596.80	442 104.31	538 107.50	594,6
21	1.6	594.13	442 114.4	538 008.0	592,6
22	0.9	593.27	442 124.6	537 908.6	592,4

Hola nr. Hole No NAB	Dýpi Depth m	Hæð Elevation m y.s.	Hnit Coordinates Y	 X	Botn Bottom of Hole m y.s.
2623	4.4	589.08	442 104.31	538 107.50	594,6
24	4.7	589.31	442 144.8	537 709.7	584,6
25	1.2	590.86	442 154.9	537 610.2	589,7
26	1.8	590.92	442 165.1	537 510.7	589,1
27	1.0	593,29	442 175.2	537 411.3	592,3
28	0.9	597.8	442 185.4	537 311.8	596,9
2701	3.0	573.9	440 167.4	543 409.0	570,9
02	1.9	568.01	440 105.0	543 487.2	566,1
03	2.3	566.16	440 042.6	543 565.5	563,9
04	5.2	564.01	439 980.3	543 643.7	558,8
05	5.0	564.18	439 917.9	543 722.0	559,2
06	2.0	567.05	439 855.49	543 800.20	565,1
07	2.2	567.76	439 793.1	543 878.5	565,6
08	16.2	567.70	439 730.7	543 956.7	551,5
09	17.3	568.03	439 668.4	544 035.0	550,7
10	17.0	567.68	439 606.25	544 113.27	550,7
11	16.3	567.65	439 543.9	544 191.5	551,4
12	18.9	567.73	439.481.5	544 269.8	549,8
13	14.5	566.44	439 419.1	544 348.0	551,9
14	2.4	564.27	439 356.7	544 426.3	561,9
15	21.3	566.39	439 294.05	544 504.23	545,1
16	.	566.64	439 229	544 585	.
17	19.2	566.48	439 165	544 667	547,3
18	15.5	566.20	439 100	544 748	550,7
19	14.2	565.16	439 036	544 829	551,0
2801	0.9	568.3	439 388.5	543 840.2	567,4
02	1.3	567.87	439 419.7	543 879.3	566.6
03	2.3	565.93	439 450.8	543 918.4	563,6
04	2.7	566.00	439 481.6	543 956.9	563,3
05	2.9	567.14	439 543.9	544 035.1	564,2
06	13.1	567.64	439 668.6	544 191.5	554,5
07	7.6	567.44	439 730.9	544 269.7	559.9
08	6,1	565,9	439 791,4	544 345,4	559,8
09	3,7	568,4	439 851,9	544 421,4	564,7
2901	1.7	566.5	440 042.6	543 878.3	564,8
02	4.1	566.5	439 980.2	543 800.1	562,4
03	11.0	566.70	439 855.5	543 643.8	555,7
04	12.7	566.28	439 793.2	543 565.7	553,6
05	7.5	568.39	439 732.2	543 489.1	560,9
06	4.9	569.75	439 670.4	543 411.6	564,9
07	2.2	569.46	439 610.1	543 336.0	567,3
3001	12.0	561.44	439 145.7	544 361.3	549,4
02	8.2	561.41	439 051.0	544 393.2	553,2
03	11.2	561.31	438 956.2	544 425.2	550,1
04	1.1	561.77	438 861.5	544 457.2	560,7
05	2.0	561.92	438 766.70	544 489.19	559,9
3103	9.0	564.85	438 989.6	544 519.7	555,9
3104	8.8	561.72	439 021.86	544 614.35	552,9
02	5.5	561.84	438 957.4	544 425.0	556,3
01	10.3	564.87	438 925.2	544 330,3	554,6
05	3.6	566.19	439 053.0	544 707.0	562.6
06	14.5	566.28	439 085,0	544 801.0	551,7
07	3.0	561.17	439 117.0	544 894	558,2
08	1.8	563.77	439 149.0	544 987	562,0
09	1.5	563.43	439 181.0	545 080	561,9

Hola nr. Hole No NAB	Dýpi Depth m	Hæð Elevation m y.s.	Hnit Coordinates Y	 X	Botn Bottom of Hole m y.s.
3110	0.7	563.59	439 196.0	545 127.0	562,9
11	0.3	564.87	439 212.0	545 174.0	564,6
12	0.0	565.43	439 228.0	545 220.0	565,4
3201	1.2	580.17	440 961,6	540 790.3	579,0
02	1.8	576.77	440.912.4	540 781.6	575,0
03	1.3	577.51	440 860.5	540 772.4	576,2
04	1.0	578.37	440 813.2	540 764.1	577,4
05	1.5	581.8	440 772.9	540 757.0	580,3
3301	1.5	576.55	441 007.5	541 241.7	575,1
02	4.8	575.46	440 958.4	541 238.6	570,7
03	5.2	575.68	440 909.3	541 235.4	570,5
04	3.5	574.96	440 858.4	541 232.1	571,5
05	1.9	576.13	440 808.3	541 228.9	574,3
06	1.6	579.2	440 769.7	541 226.4	577,6
3401	0.9	575.21	440 664.5	541 826.5	574,3
02	1.2	572.87	440 626.4	541 797.6	571,7
03	1.4	572.75	440 586.6	541 767.3	571,4
04	2.5	573.89	440 547.6	541 737.6	571,4
05	2.9	574.40	440 509.29	541 708.5	571,5
06	1.5	575.69	440 471.41	541 679.6	574,2
07	0.9	578.4	440 435.02	541 651.94	577,5
3501	4.4	571.44	440 574.0	542 637.7	567,0
02	2.7	570.50	440 524.47	542 637.91	567,8
03	0.6	570.85	440 476.3	542 638.1	570,3
04	2.9	571.19	440 428.1	542 638.3	568,3
05	0.7	569.62	440 380.6	542 638.4	568,9
06	3.0	568.82	440 330.92	542 638.6	565,8
07	2.2	568.83	440 282.22	542 638.8	566,6
08	3.8	570.42	440 233.62	542 639.0	566,6
09	1.5	572.33	440 187.39	542 639.1	570,8
10	2.5	572.23	440 141.07	542 639.3	569,7
3601	2.6	578.93	441 075.9	540 175.7	576,3
02	2.5	579.91	441 031.4	540 159.0	577,4
03	1.4	581.17	440 989.3	540 143.2	579,8
04	1.6	580.10	440 946.3	540 127.8	578,5
05	1.3	580.56	440 901.6	540 111.0	579,3
06	1.4	580.46	440 856.7	540 094.1	579,1
07	2.7	581.54	440 811.8	540 077.3	578,8
08	1.2	582.38	440 768.4	540 061.0	581,2
09	0.9	583.02	440 725.94	540 045.07	582,1
3701	0.6	581.35	441 222.0	539 953.4	580,8
02	3.7	582.08	441 184.6	539 925.3	578,4
03	3.7	582.76	441 150.33	539 899.54	579,1
04	4.2	582.14	441 114.0	539 872.2	578,0
05	5.0	582.04	441 076.6	539 844.1	577,0
06	1.5	581.87	441 041.0	539 817.3	580,4
07	7.7	581.59	441 004.6	539 790.1	573,9
08	1.9	583.59	440 929.7	539 733.8	581,7
3801	7.8	582.64	441 410.0	539 590.6	574,8
02	4.3	583.57	441 377.84	539 502.88	579,3
03	4.3	584.86	441 346.6	539 417.8	580,6

Hola nr. Hole No NAB	Dýpi Depth m	Hæð Elevation m y.s	Hnit Coordinates Y	 X	Botn Bottom of Hole m y.s.
3804	3.1	585.12	441 314.9	539 331.2	582,0
05	1.8	586.71	441 283.49	539 245.61	584,9
06	5.6	586.44	441 250.9	539 156.9	580,8
07	1.2	585.35	441 218.0	539 067.4	584,2
08	1.9	585.14	441 186.0	538 980.0	583,2
09	5.5	585.38	441 152.9	538 889.7	579,9
3901	1.7	584.12	441 283.2	539 510.7	582,4
02	0.9	584.22	441 191.4	539 518.2	583,3
03	6.3	584.03	441 097.6	539 525.1	577,7
04	1.8	584.79	441 001.8	539 533.8	583,0
05	1.6	586.4	440 908.7	539.541.4	584,8
4001	3.6	584.97	441 469.3	539 240.5	581,4
02	1.9	586.28	441 373.1	539 243.1	584,4
03	5.0	585.88	441 190.4	539 248.2	580,9
04	3.5	586.12	441 098.4	539 250.7	582,6
4005	12.5	585.06	441 000.5	539 253.5	572,6
06	3.0	584.85	440 906.4	539 256.1	581,9
07	6.0	584.07	440 810.0	539 258.7	578,1
08	1.2	585.32	440 718.0	539 261.3	584,1
4101	20.0	566.92	439 366.6	544 565.3	546,9
02	17.9	564.98	439 439.6	544 626.7	547,1
03	10.7	559.76	439 477.3	544 658.5	549,1
04	4.3	560.96	439 552.6	544 721.8	556,7
05	3.7	564.44	439 588.9	544 752.3	560,7
06	1.1	567.61	439 662.09	544 813.32	566,5

TABLE 3

TAFLA

Direction of fractures at Norðlingaalda as measured on aerial photographs, also presented on Rose Diagram.

Sprungur við Norðlingaöldu mældar á loftmyndum, notaðar við gerð sprungurósar.

270°	=	5%		
280°	=	11%		
290°	=	6.5%		
300°	=	2%	=	46%
310°	=	2%		
60°	=	4,5%		
70°	=	7,5%		
80°	=	7,5%		
340°	=	3%	=	3%
360°	=	19%		
10°	=	6%	=	26,5%
20°	=	1,5%		
30°	=	4,5%		
40°	=	17%	=	24,5%
50°	=	3%		

TABLE
TAFLA 4

ORKUSTOFNUN
Raforkudeild

JARÐVATNSMÆLINGAR Í BORHOLUM

Groundwater measurements in drillholes

Svæði :

Dags. mælingar	Heiti holu/jarðvatnsborð m y.s.											
	NA 1	NA 2	NA 3	NA 4	NA 5	NA 6	NA 7	NA 8	NA 9	NA 10	NA 11	NA 12
20.8.70		591,43	556,21	570,37	caved in	555,60	blocked	562,57		547,40	dray	
27.8.70	587.4	591,80	556,1	570,41	"						"	556,95
03.9.70	588,99	593,60	556,31	570,54	"	555,38	"	563.11	573,88	547,54	"	558,06
10.9.70	588,81	594,83	556,22	570,51	"	555,46	"	563,41	573,85	548,41	"	558,09
17.9.70	588,81	595,08	556.26	570,54	"	555,25	566,02	563,37		547,46	"	557,84
24.9.70	588,71	595,18	556,40	570,51	"	555,63	564,22	563,19		547,59	"	557,53
02.10.						555,59	569,38	563,45	571,27	547,74	"	558,75
07.10.	588,95	596,07	556,61	570,73	"	555,67	564,56	563,70	571,23	547,79	"	558,83
15.10	589,10	596,46	557,07	570,80	"	555,79	565,06	563,84	571,23	547,91	"	563,90
16.2.71	blocked		blocked	570,42	"	555,42	560,85	blocked	571,07	547,07	"	552,55
20.3.71	blocked	blocked	556.59	570.41	"	blocked	560.61	blocked	blocked	547,19	"	554,97
20.6.71	588,16	590,10	blocked	570.45	"	blocked	blocked	563,90	570,83	blocked	"	558,01
08.7.71		590,87	"	570,27	"							556,65
12.7.71						555,27	561,37	561,10	570,58	547,16		
17.7.71	588,35	590,02	555,82	570,50	"							556,25
25.7.71	588,59	590,11	555,96	570,36	"							557,17
07.8.71	588,69	590,39	555,93	570,44	"							557,31
22.8.71	588,65	591,66	555,97	570,43	"							557,15
15.9.71	589,10	596,46	557,06	570,84	"							559,36

Dags. mælingar	Heiti holu/jarðvatnsborð m y.s.											
	NA 13	NA 14	NA 15	NA 16	NA 17	NA 18	NA 19	NA 20	NA 21	GS 2		
20.8.70	574,80	576,23	587,45	573,20								
27.8.70	575,25	576,95	587,46	573,0	560,0							
03.9.70	574,40	576,63	587,69	573,25	560,96		585,85	582,23				
10.9.70	574,33	577,62	587,65	573,36	560,86	560,05	585,62	581,56				
17.9.70	574,04	577,49	587,62	573,50	560,79	557,08	585,41	581,44				
24,9.70	573,53	577,34	587,59	573,53	560,80	554,98	585,25	581,50				
2.10.70	573,41	577,70	587,88	573,41	562,34	556,00	585,76		564,05			
7.10.70	573,69	576,93	587,84	573,68	562,34	blocked	584,64	581,74	563,80	dray		
15.10."	573,71	578,12	587,89	573,52	562,79	560,7	585,92	581,93	563,88	-		
16.2.71	569,52	574,24	586,95	573,08	560,74	caved in	584,38	581,85	blocked	caved in		
20.3.71	569,37	573,86	586,90	573,06	561,14	"	584,22	581,85	blocked	"		
23.6.71	575,79	577,04	587,15	571,38	560,96	"	585,20	579,28	564,26			
08.7.71	575,21	578,07	587,10	571,15	560,15	"	584,95	581,35	563,34			
17.7.71	575,9	577,65	587,26	571,34	565,11	"	585,15					
25.7.71	575,13	577,80	587,52	572,28	560,48	"	585,39					
7.8.71	575,59	578,52	586,49	572,98	560,32	"	582,92					
22.8.71	575,50	578,51	586,54	573,18	560,26	"	585,32					
15.9.71	570,01	578,22	587,89	573,52	562,79	"	585,74					

TABLE 5
TAFLA

MÆLINGAR TVÍ- OG ÞRÍVETNIS
MEASUREMENTS OF DEUTERIUM AND TRITIUM

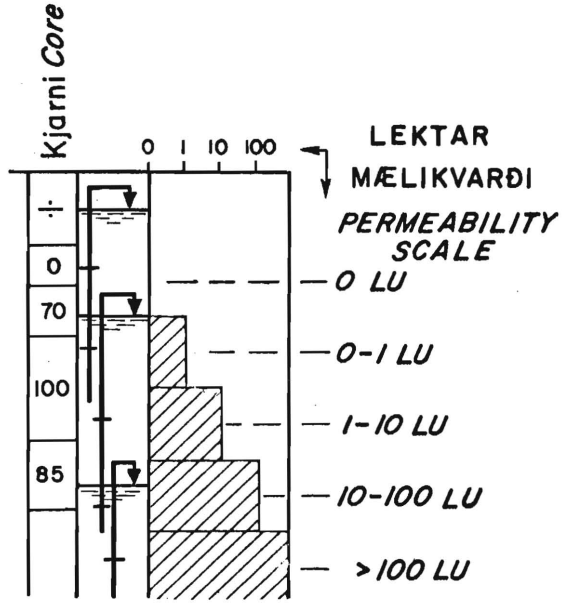
Staður Location		Hnit Coordinates Y		X		Tvívetni Deuterium δ	Þrívetni Tritium T.U.
Svartá		442	510	541	810	- 79,1	96
Borehole Drillhole	NA-10	440	968	545	816	- 78,2	53
Lind Spring		440	605	544	595	- 80,2	47
Þjórsá		440	910	543	490	- 84,3	

TABLE
TAFLA 6

HITAMÆLINGAR
TEMPERATURE MEASUREMENTS °C

Dagsetn.mæl. Date of measurement	Þjórsá	lind spring	lofthiti air temp.
19.9 '70	3,0	3,5	2,6
20.9 '70	2,2	3,2	0,0
21.9 '70	2,0	3,2	1,0
22.9 '70	4,2	3,2	8,5
23.9 '70	4,5	3,2	9,6
24.9 '70	5,0	3,2	8,0
28.9 '70	3,0	3,2	2,5
29.9 '70	2,6	3,2	0,4
2.10 '70	3,8	3,2	6,0
3.10 '70	3,6	3,2	5,2
4.10 '70	2,3	3,3	0,2
7.10 '70	1,4	3,2	0,5

MYND *Exh.* 0.00	ORKUSTOFNUN Raforkudeild KJARNA-, LEKTAR OG JARÐVATNSÚTSKÝRING *NOTE ON CORE PERMEABILITY AND GROUND WATER*	18/9'70 HT/EK Tnr. 204 B – Ým. Fnr. 9586



LEKTAR-OG JARÐVATNSÚTSKÝRING
NOTE ON PERMEABILITY AND GROUND WATER

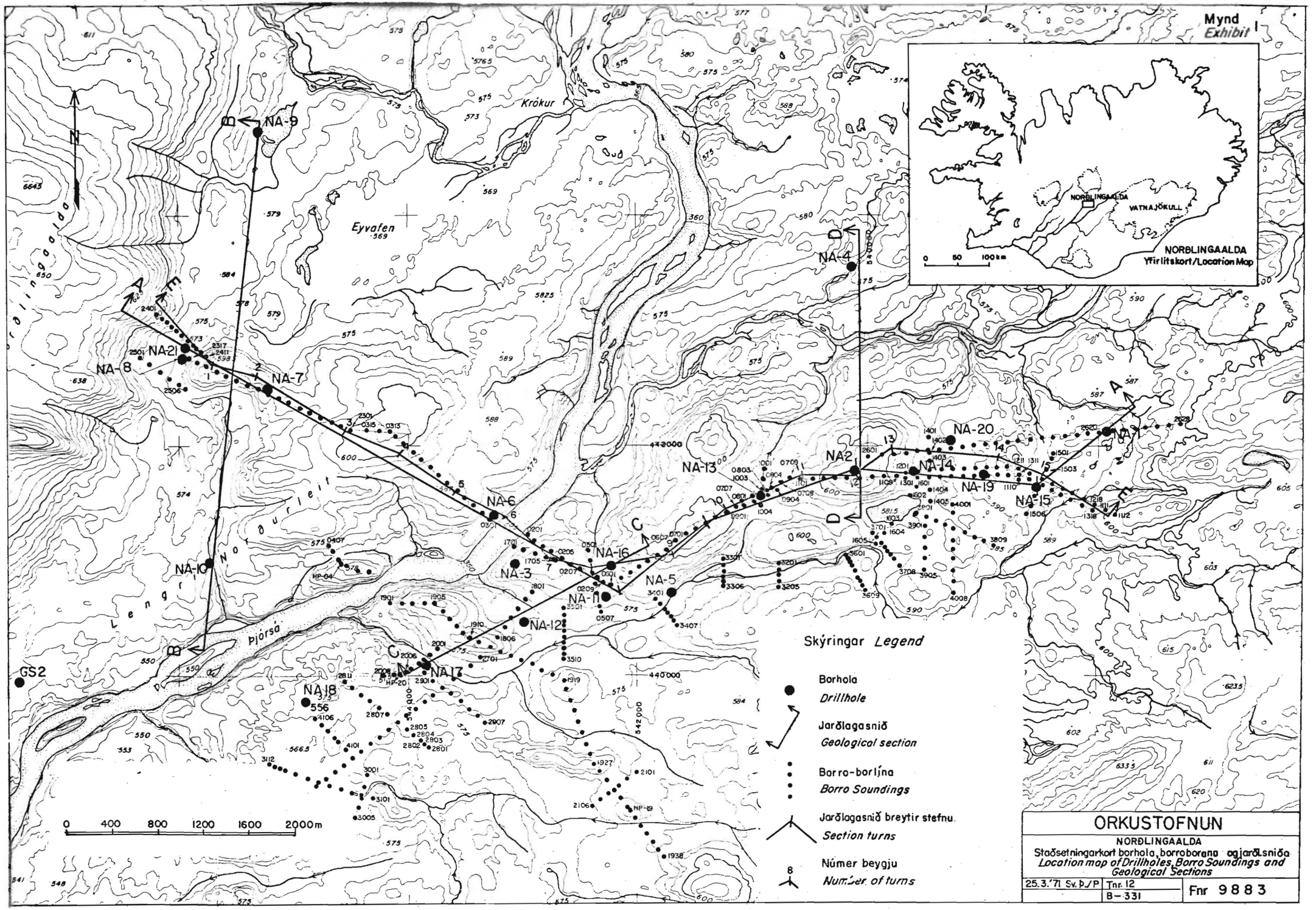
Jarðvatnsborð er sýnt með örvum. Neðri endi örvarinnar og þverstrikin sýna holudýpið, þegar jarðvatnsborðið var mælt. Ef jarðvatn breytist ekkert í borun, nær örin í botn.
Ground water levels are shown by arrows. Base of the arrows and the horizontal bars indicate the hole depth when the water level 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/cm^2
1 LU = Lugeon Unit = 1 l/min/m in 76mm Ø hole at pressure 10 kg/cm^2

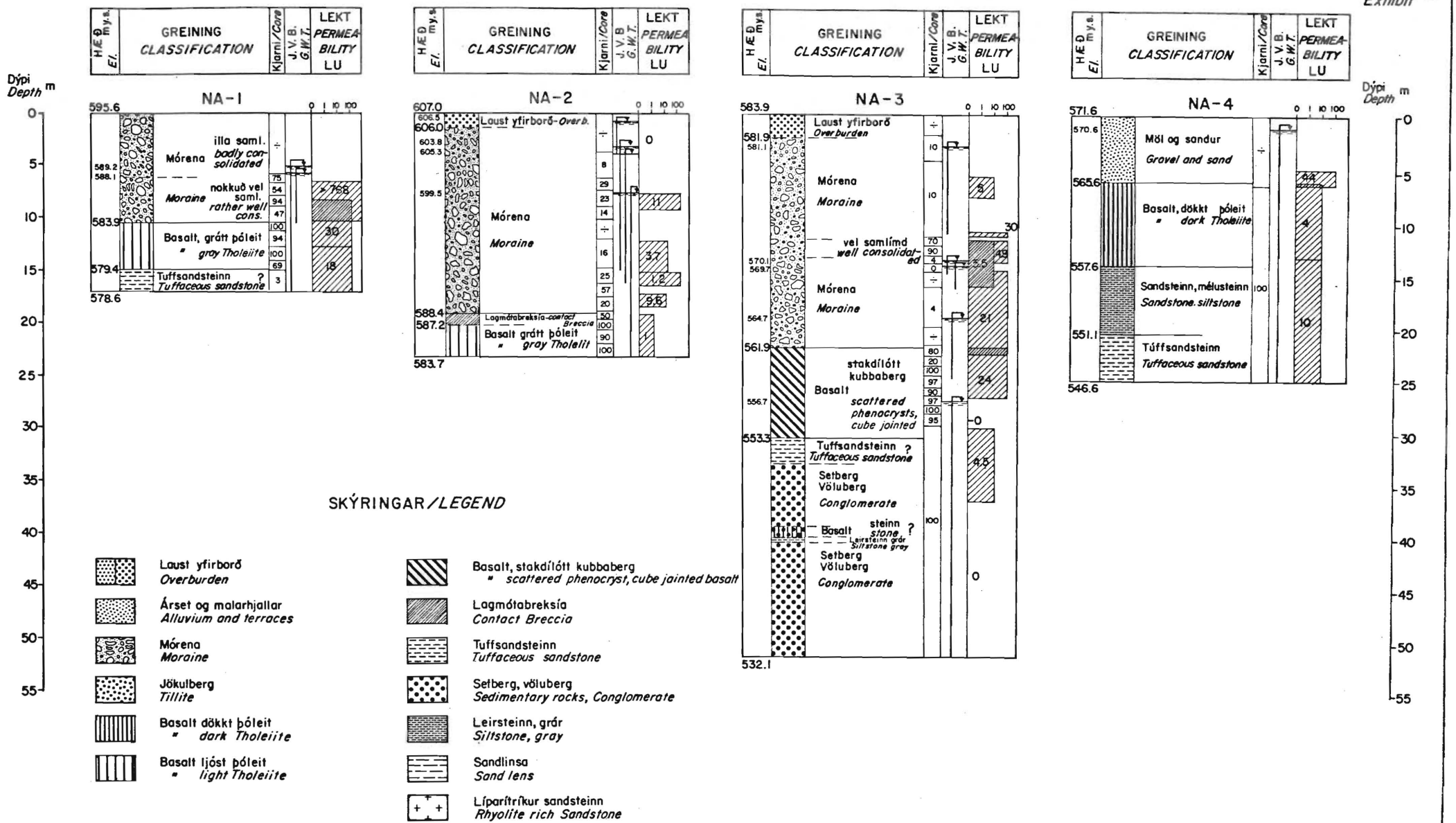
Hæðartölur jarðvatns eru ritaðar smærra letri en hæðartölur bergs, á borholusniðum.
Figures for ground water levels are shown with smaller lettering on graphic core logs.

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

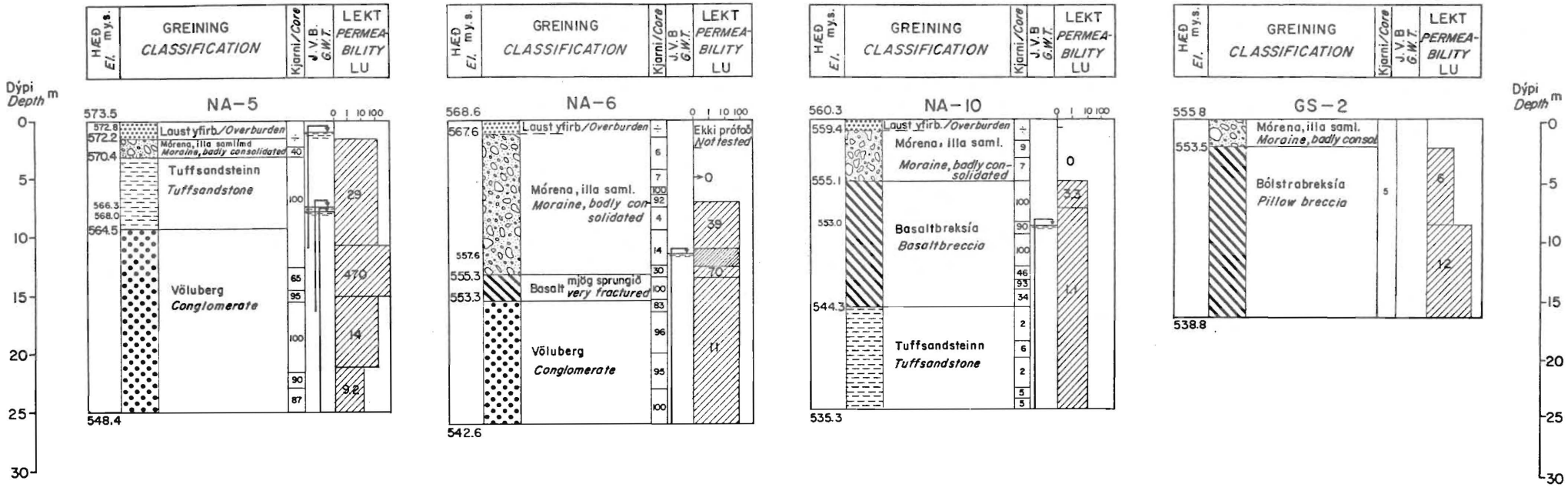
Core: Numbers indicate % core recovery
÷ core sampling not attempted.


Mynd
Exhibit 1
NORÐLINGAALDA
VATNAJÖKULL
0 50 100 km
NORÐLINGAALDA
Yfirlitskort/Location Map
Krókur
Eyvafen
Leirdalsöldu
Lengri Norðurleið
Þjórsá
NA-1
NA-2
NA-3
NA-4
NA-5
NA-6
NA-7
NA-8
NA-9
NA-10
NA-11
NA-12
NA-13
NA-14
NA-15
NA-16
NA-17
NA-18
NA-19
NA-20
NA-21
GS2
HP-04
HP-19
HP-20
0 400 800 1200 1600 2000m
Skýringar Legend
Borhola
Drillhole
Jarðlagasnið
Geological section
Borro-borlína
Borro Soundings
Jarðlagasnið breytir stefnu.
Section turns
Númer beygju
Number of turns
ORKUSTOFNUN
NORÐLINGAALDA
Staðsetningarkort borhola, borroborana og jarðlagsniða
Location map of Drillholes, Borro Soundings and Geological Sections
25.3.'71 Sv. Þ./P
Tnr. 12
B-331
Fnr 9883

Mynd *Exhibit* 2



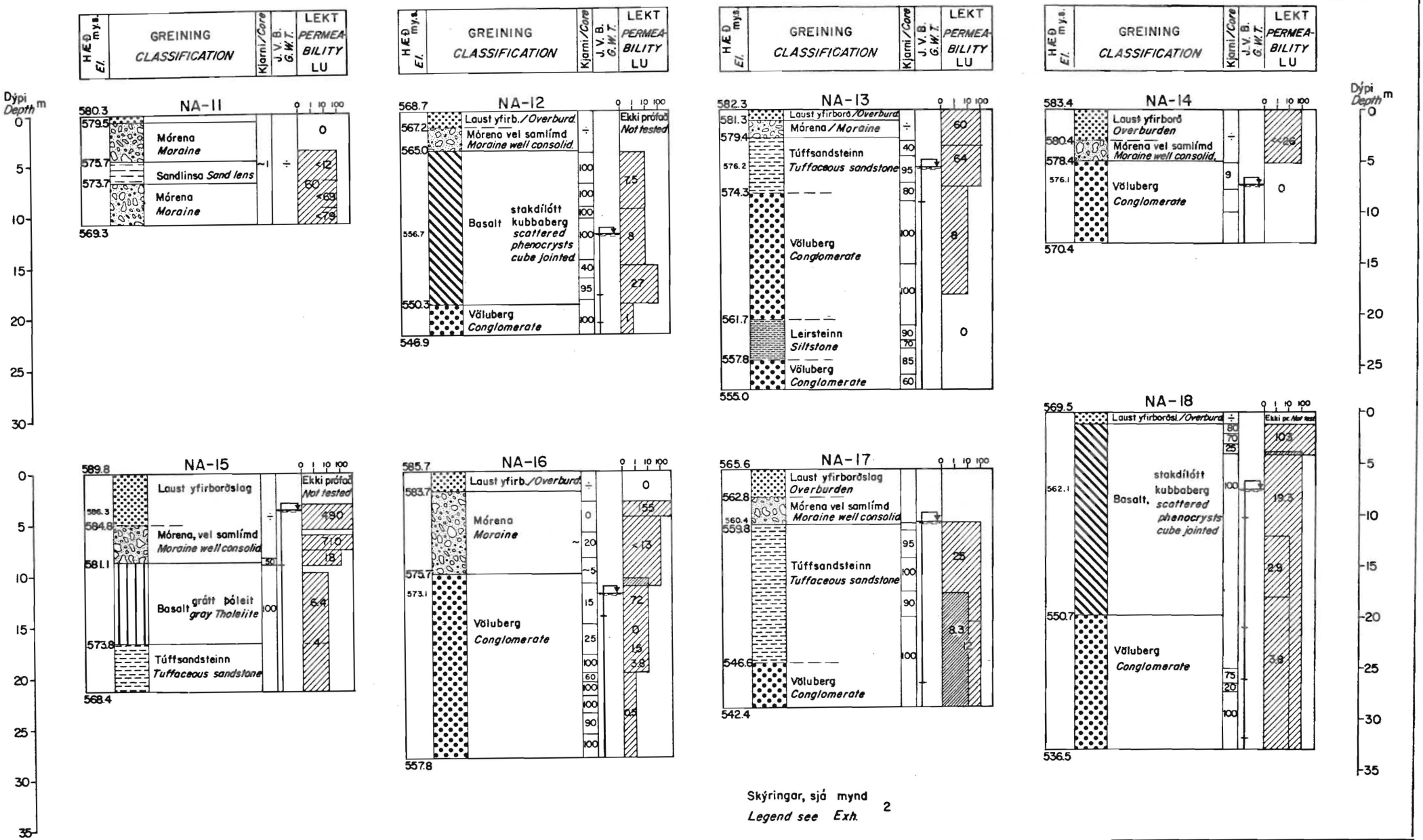
ORKUSTOFNUN		
NORÐLINGAALDA		
Borholusnið NA-1–NA-4		
GRAPHIC CORE LOGS " "		
25.6'71 Sv.Þ/EK	Tnr. 23	Fnr. 9973
Bl. 1 af 20	B - 331	



Skýringar, sjá mynd 2
Legend see Exh. "

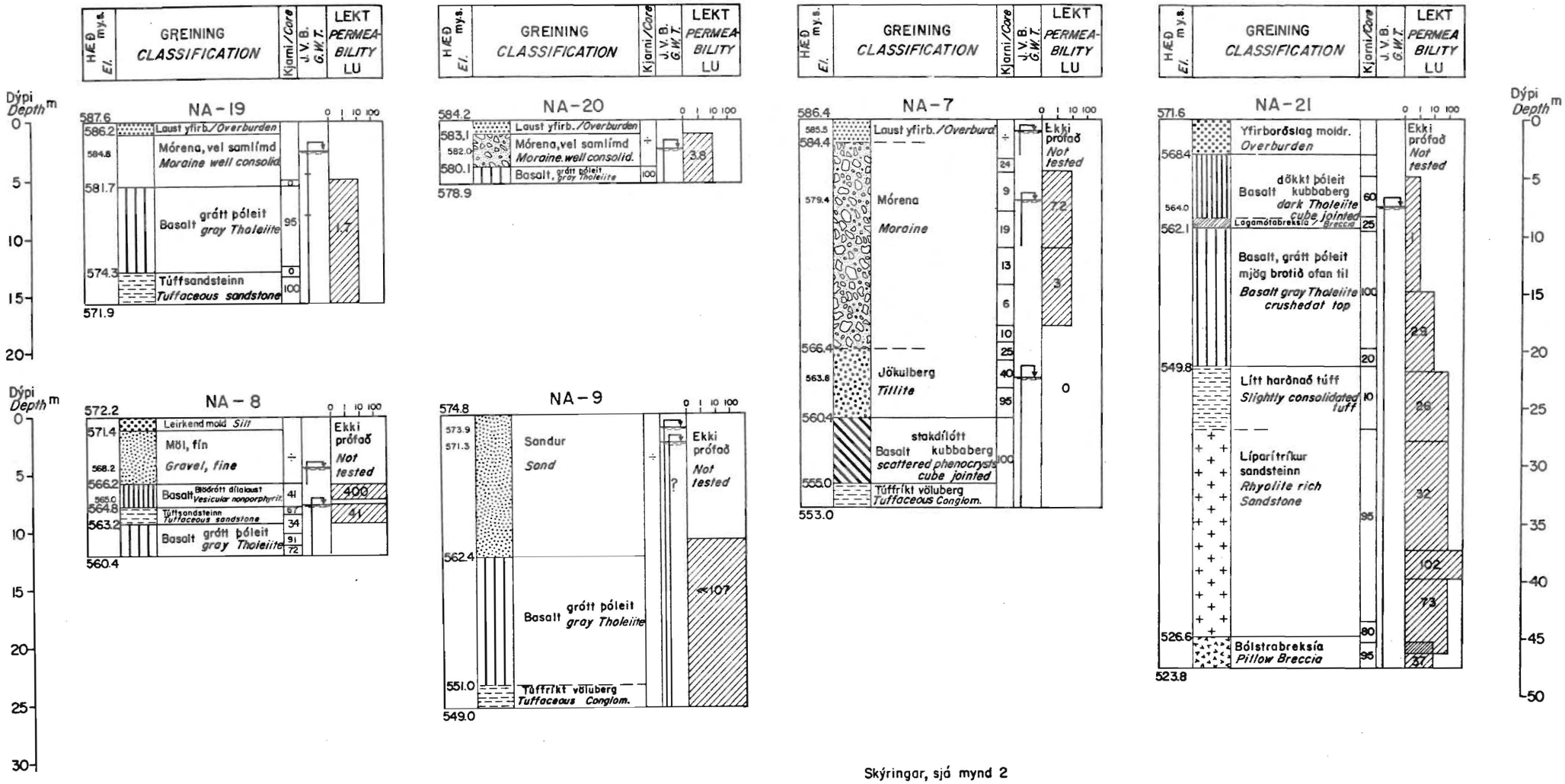
ORKUSTOFNUN		
NORÐLINGAALDA		
Borholusnið NA-5-6-10 og GS-2		
GRAPHIC CORE LOGS " " "		
22.6'71 Svþ/EK	Tnr. 24	Fnr. 9974
Bl. 2 af 20	B-331	

Mynd *Exhibit* 4



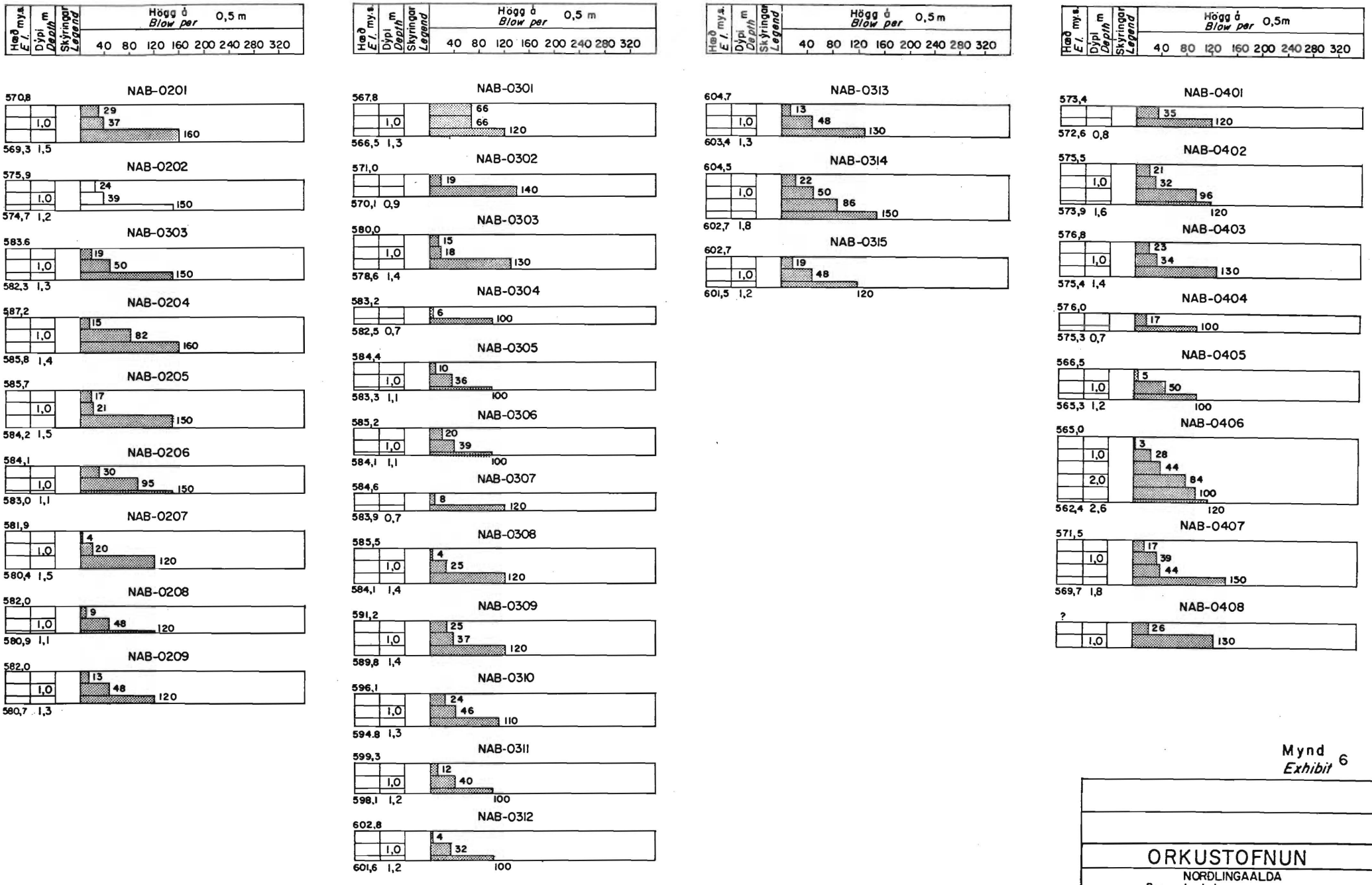
Skýringar, sjá mynd 2
Legend see Exh.

ORKUSTOFNUN		
NORÐLINGAALDA		
Borholusnið NA-11–NA-18 *GRAPHIC CORE LOGS* " "		
10.7.'71 Sv.þ/EK	Tnr. 25	Fnr. 9975
Bl. 3 af 20	B-331	



Skýringar, sjá mynd 2
Legend see Exh. "

ORKUSTOFNUN		
NORÐLINGAALDA		
Borholusnið NA-7-9 NA-19-21 *GRAPHIC CORE LOGS* " " "		
8.7'71 Sv.Þ/EK	Tnr. 26	Fnr. 9976
Bl. 4 af 20	B-331	



Mynd
Exhibit 6

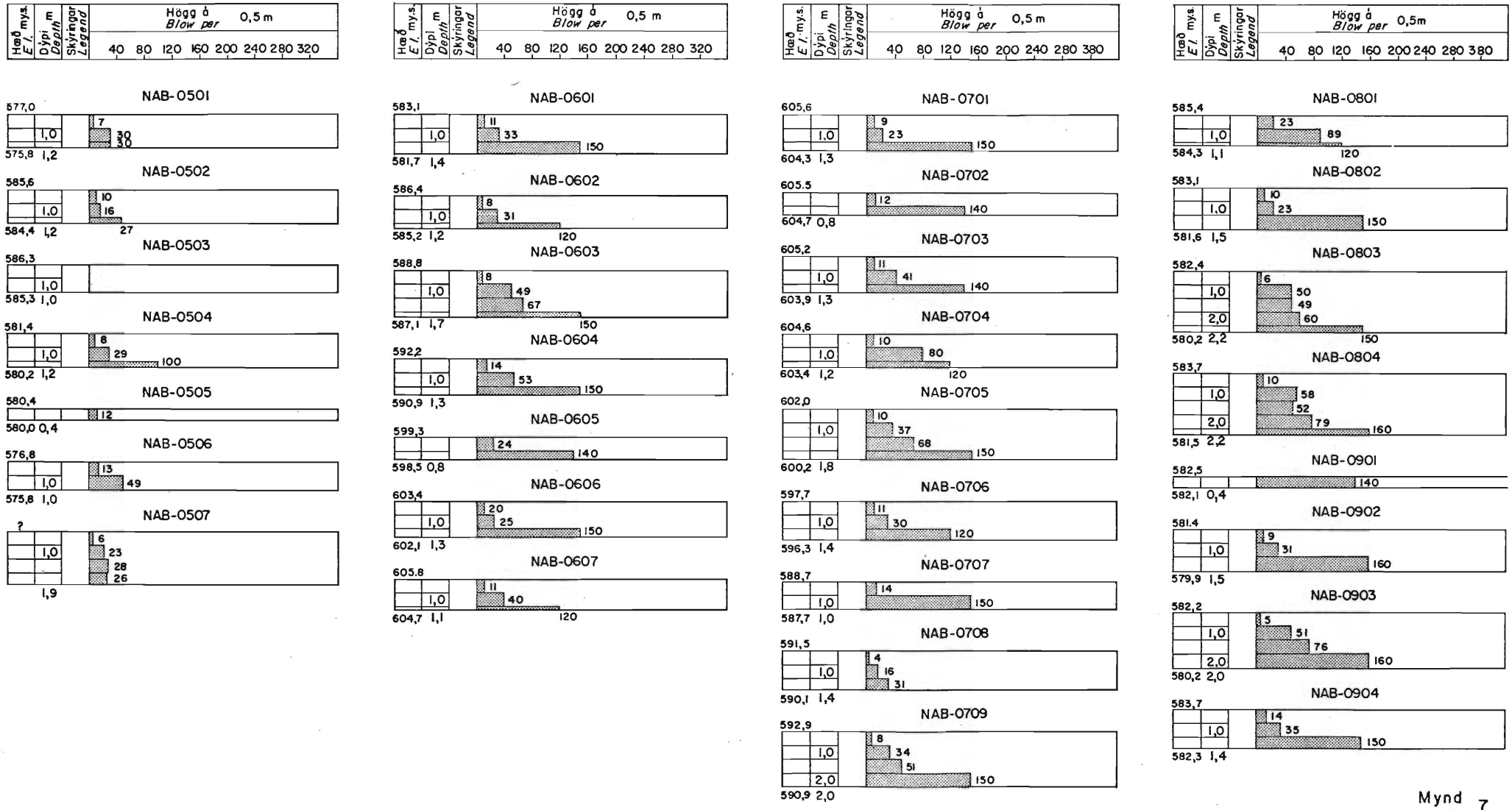
ORKUSTOFNUN

NORÐLINGAALDA

Borro - borholur NAB - 0201-0408

Borro - Soundings

20.11'70 H.T/O	Tnr.19 Tnr.107	Fnr. 9890
Blað 5 af 20	B-331 Borro-b	



Mynd 7
Exhibit

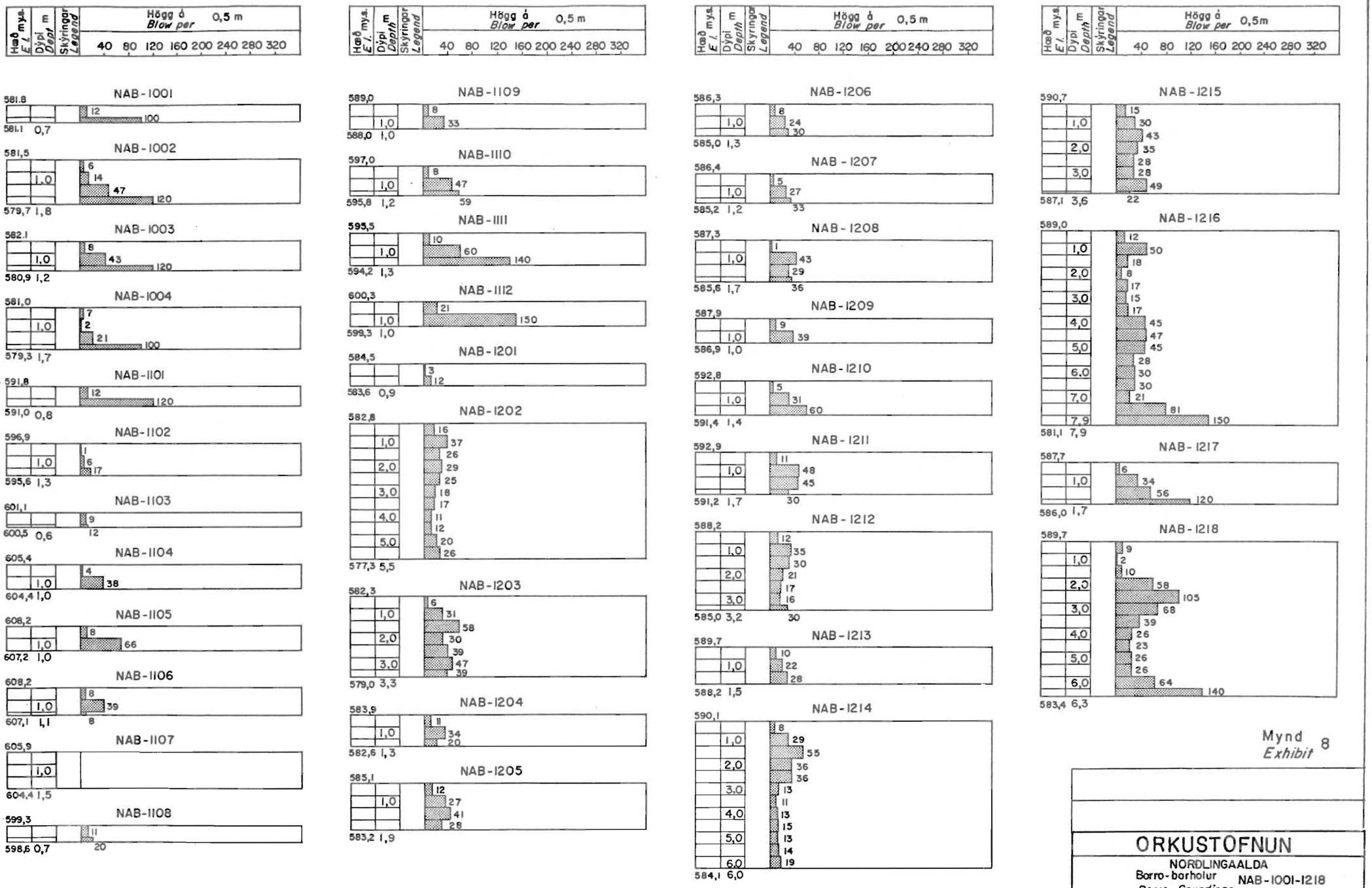
ORKUSTOFNUN

NORÐLINGAALDA

Borro - borholur NAB - 0501-0904

Borro - Soundings

26.11'70 H.T/O	Tnr. 19 Tnr. 107	Fnr. 9890
Bl. 6 of 20	B-331 Borro-b.	



Mynd 8
Exhibit

ORKUSTOFNUN

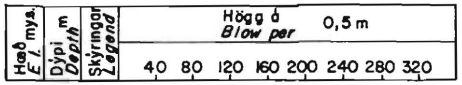
NORÐLINGAALDA

Borro-borholur NAB-1001-1218

Borro-Soundings

29.10'70 H.T/O	Tnr. 107 Tnr. 1
Blað 7 af 20	Borrob. B-331

Fnr. 9890



NAB-1301

584,5
1,0
3 37 59 120
582,8 1,7

NAB-1302

582,1
1,0
2,0
3,0
8 17 20 45 34 25 160
578,6 3,5

NAB-1303

582,6
1,0
13 40 39 100
581,0 1,6

NAB-1304

584,3
1,0
2,0
3,0
3 21 84 47 44 46
581,1 3,2 110

NAB-1305

585,5
1,0
8 60 100
584,2 1,3

NAB-1306

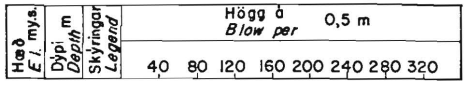
586,2
1,0
2,0
3,0
6 37 66 57 47 32 150
582,8 3,4

NAB-1307

585,1
1,0
10 70 75 120
583,3 1,8

NAB-1308

586,9
1,0
22 77
585,7 1,2 150



NAB-1309

587,8
1,0
4 33 89
586,2 1,6 100

NAB-1310

591,2
1,0
2 150
590,2 1,0

NAB-1311

595,4
1,0
43 105
594,3 1,1 100

NAB-1312

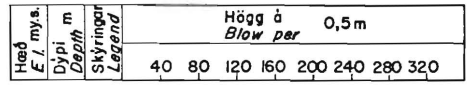
598,1
1,0
2,0
3,0
4,0
5,0
14 35 38 45 67 96 86 55 67
593,0 5,1 150

NAB-1313

589,5
1,0
2,0
3,0
4,0
5,0
6,0
4 33 50 26 25 28 19 21 35 63 86 92
583,4 6,1 150

NAB-1314

589,0
1,0
2,0
3,0
4,0
5,0
6,0
7,0
7 30 28 26 28 22 14 11 7 8 7 9 12 13 30 150
581,2 7,8



NAB-1315

588,8
1,0
2,0
6 73 82 84 120
586,5 2,3

NAB-1316

587,9
1,0
2,0
7 49 59 50 88 120
585,2 2,7

NAB-1317

588,6
1,0
2,0
3,0
4,0
5,0
6,0
7,0
8,0
4 76 17 8 12 21 47 37 41 49 52 42 46 25 24 36 59 150
579,9 8,7

NAB-1318

591,0
1,0
2,0
13 37 45 11 36 120
588,2 2,8

NAB-1401

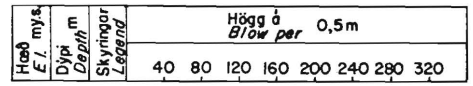
581,5
581,2 0,3 12

NAB-1402

582,5
1,0
6 30 54
581,0 1,5

NAB-1403

582,5
1,0
2,0
9 23 49 40 26 28
579,6 2,9



NAB-1404

584,2
1,0
2,0
9 22 31 27 32
581,9 2,3

NAB-1405

584,4
1,0
2,0
17 46 35 24 21 48
581,5 2,9

Mynd
Exhibit 9

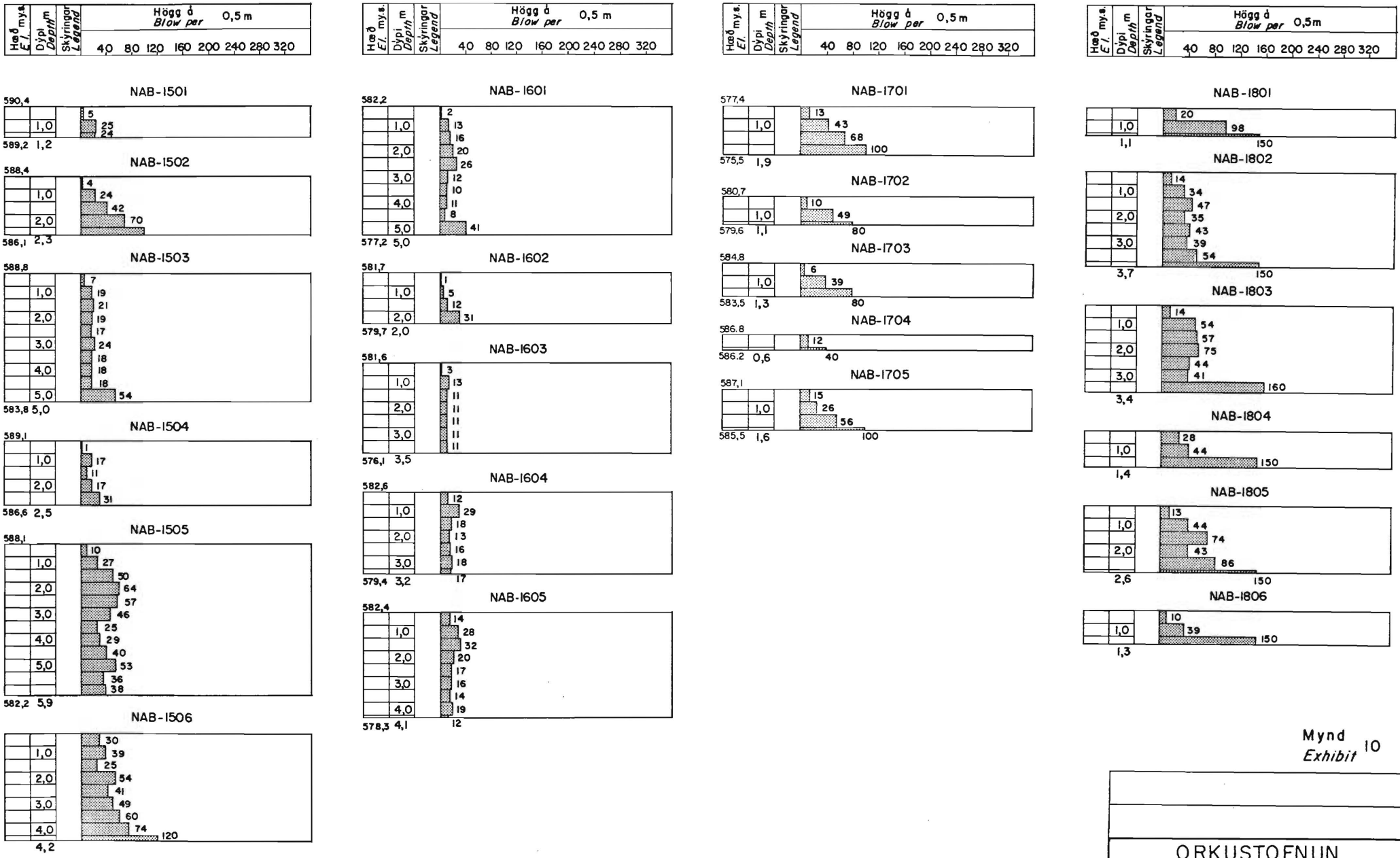
ORKUSTOFNUN

NORÐLINGAALDA

Borro - borholur NAB - 1301 - 1405

Borro - Soundings

2.12'70 H.T/O	Tnr.19 Tnr.107	Fnr. 9890
B1.8 af 20	B-331 Borro-b.	



Mynd
Exhibit 10

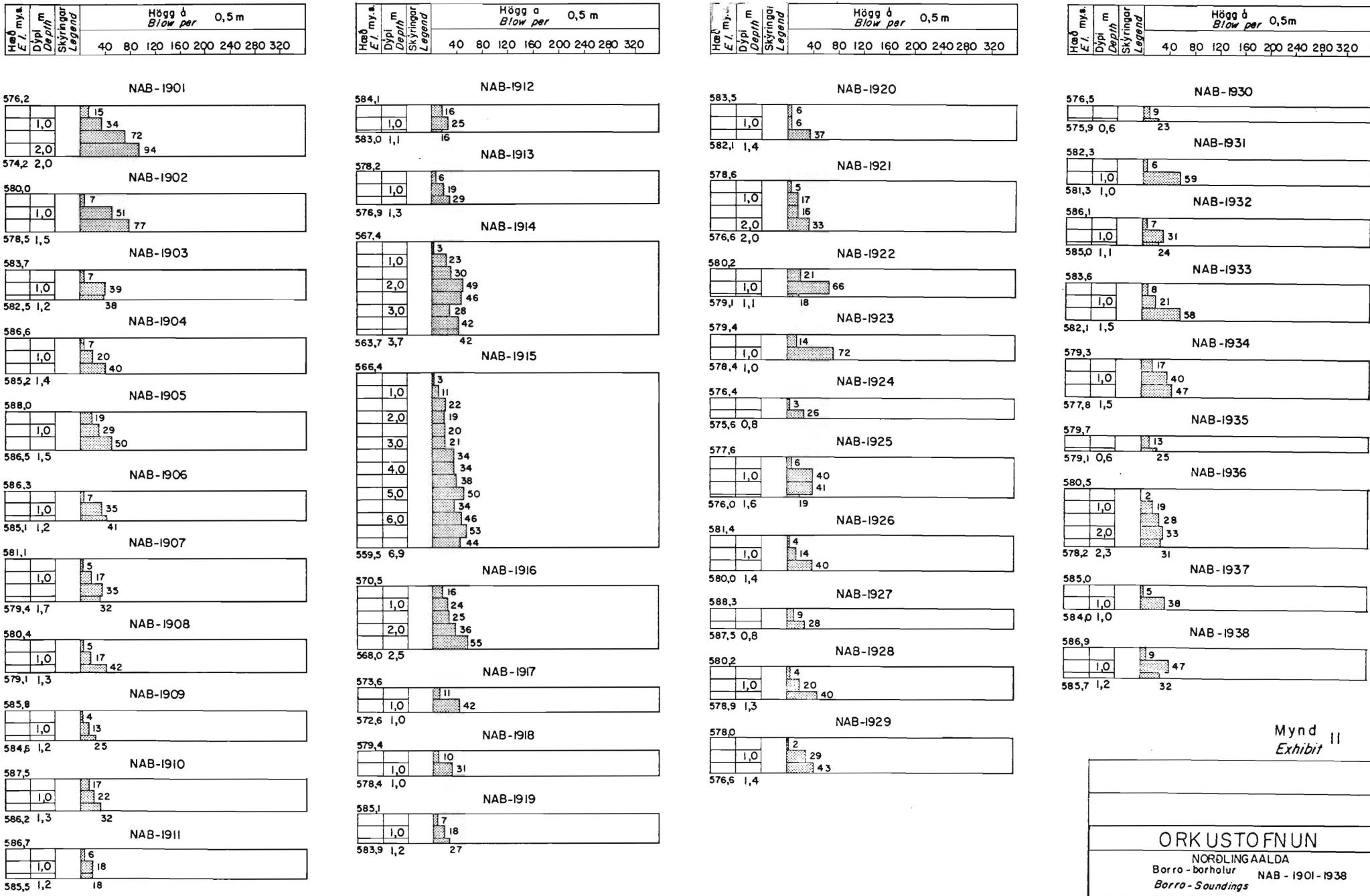
ORKUSTOFNUN

NORÐLINGAALDA

Borro-borholur NAB - 1501 - 1806

Borro-Soundings

14.12'70 H.T./O	Tnr.19 Tnr.107	Fnr. 9890
Blað 9 af 20	B-331 Borro-b.	



Mynd 11
Exhibit

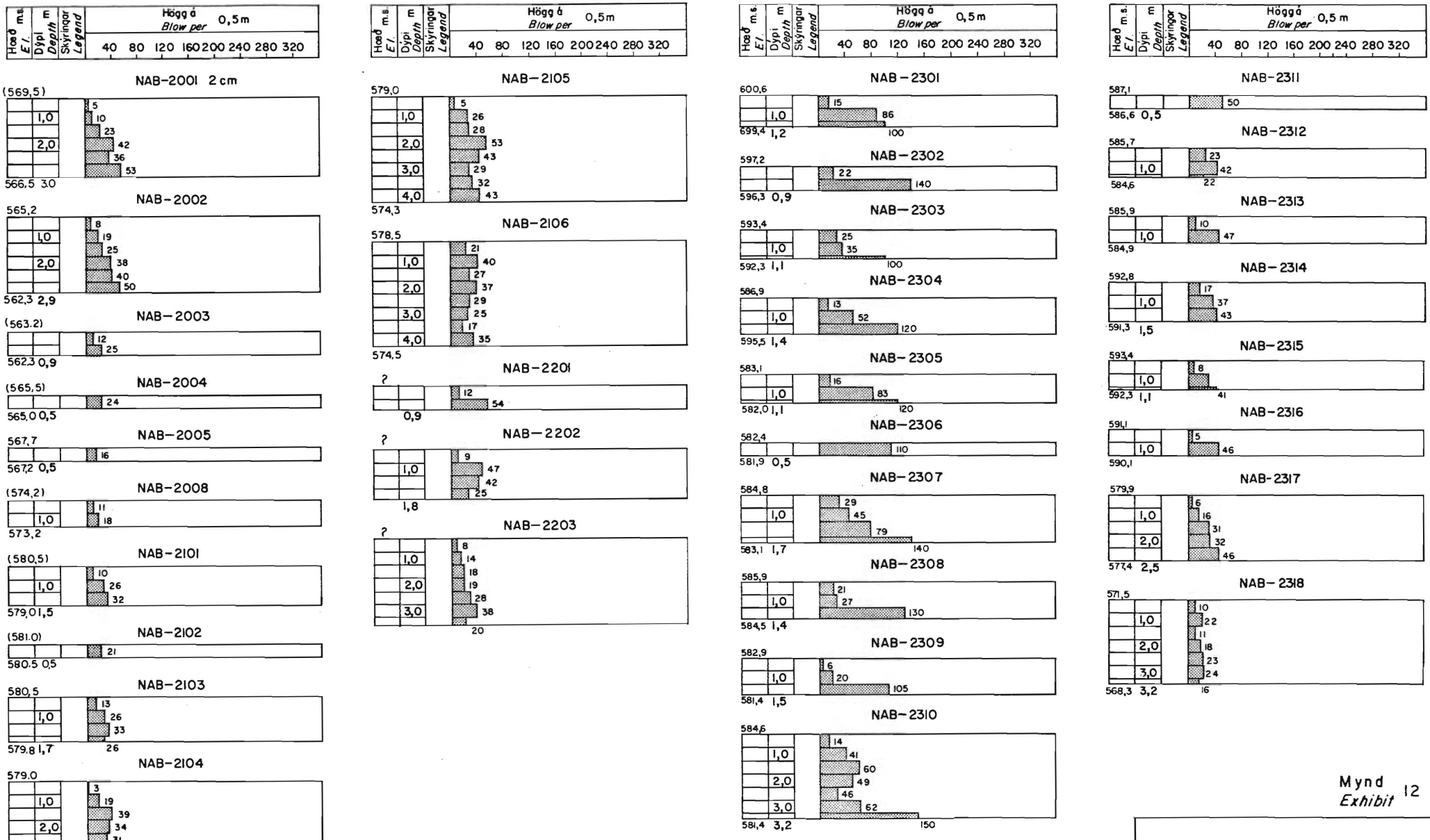
ORKUSTOFNUN

NORÐLINGAALDA

Borro - borholur NAB - 1901 - 1938

Borro - Soundings

20.11'70 H.T/O	Tnr. 19 Tnr. 107	Fnr. 9890
Blað 10 of 20	B-331 Borro-b.	



Mynd 12
Exhibit

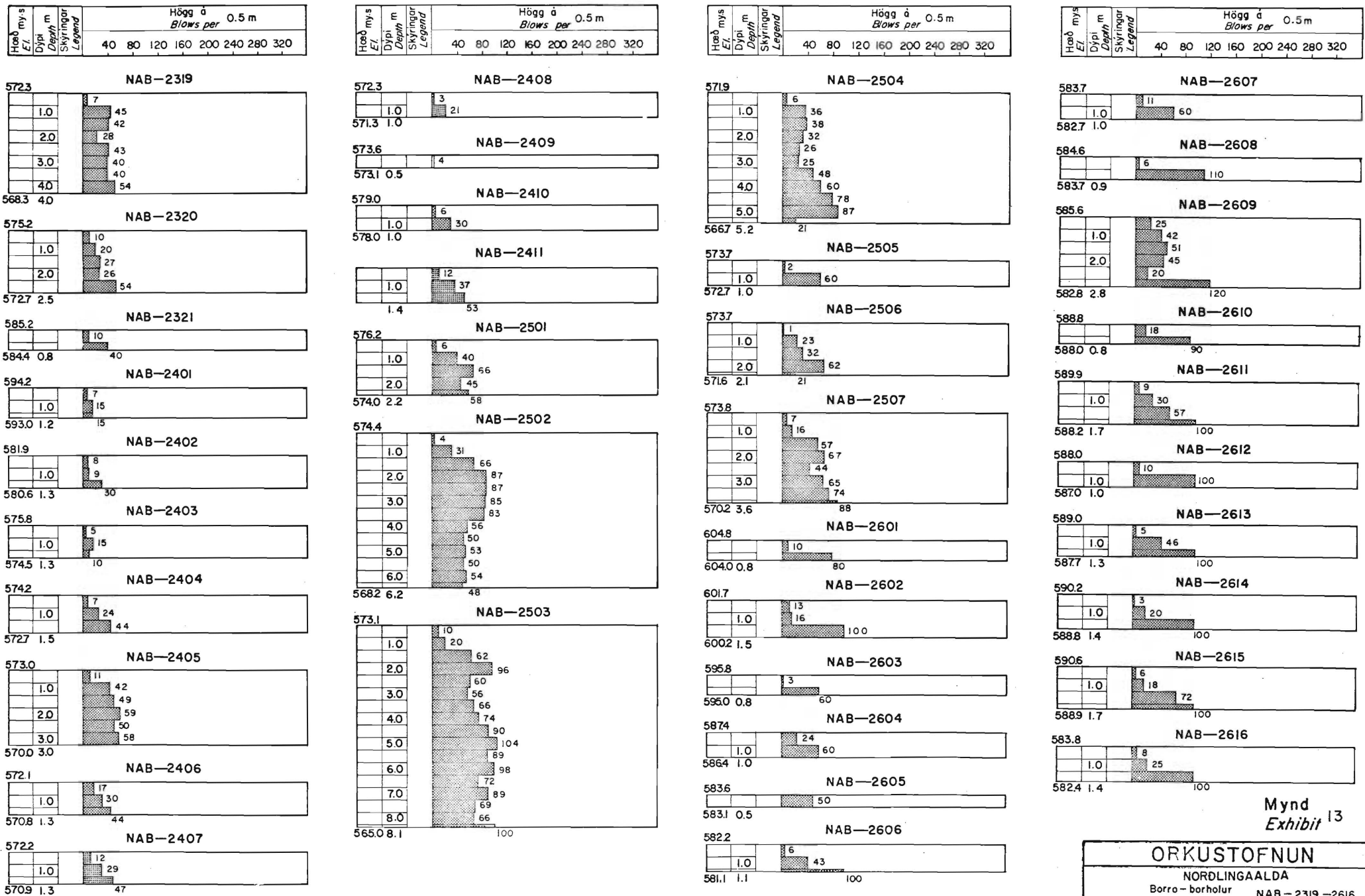
ORKUSTOFNUN

NORÐLINGAALDA

Borro-borholur NAB-2001-2318

Borro-Soundings

25.5.'71 Sv.p./HE	Tnr. 19 Tnr.107	Fnr. 9890
Blað 11 af 20	B-331 Borro-b.	



Mynd
Exhibit 13

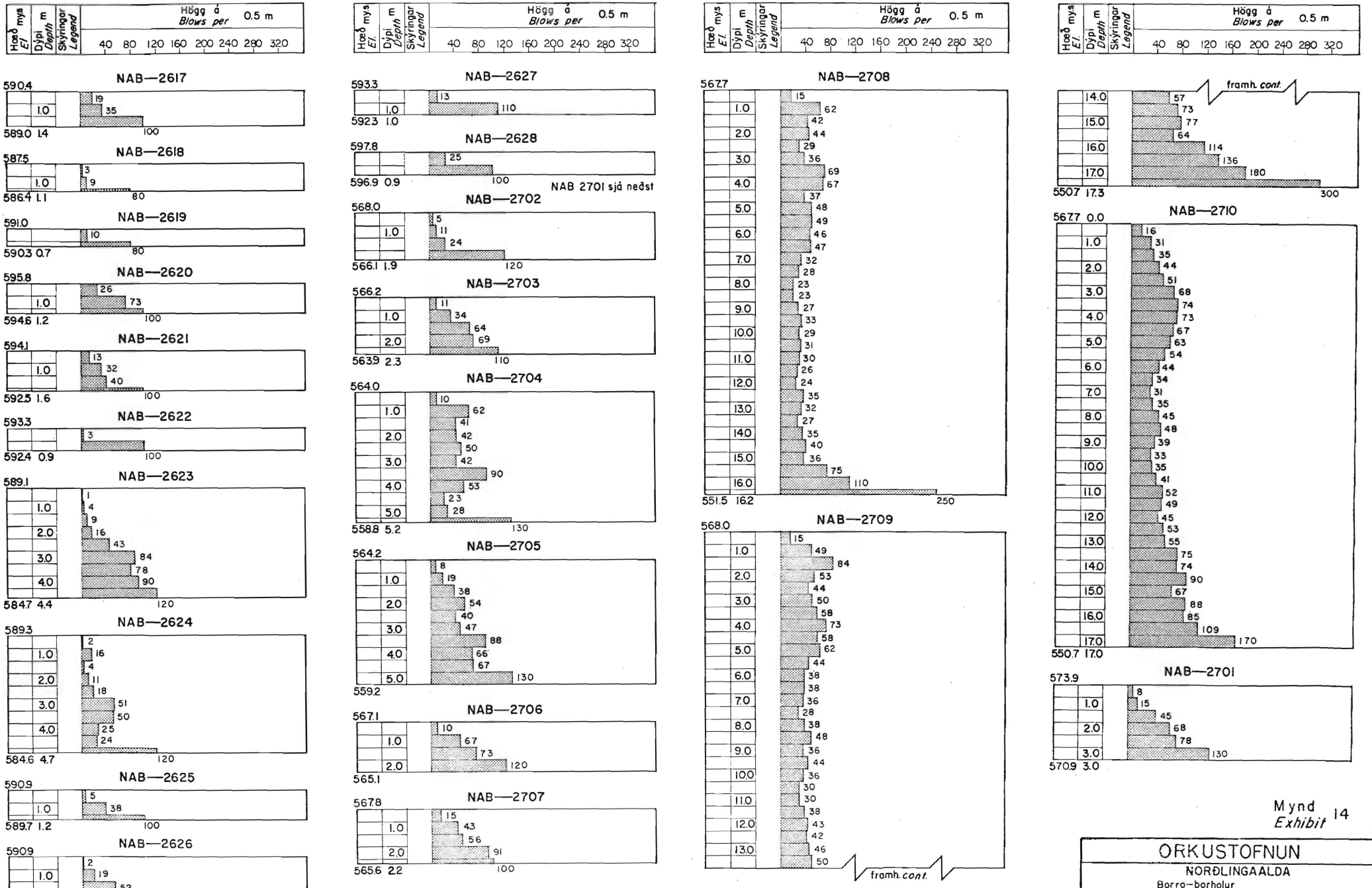
ORKUSTOFNUN

NORÐLINGAALDA

Borro – borholur NAB – 2319 – 2616

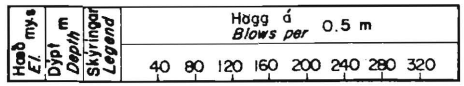
Borro – Soundings

27.10.'71 Svþ/B	Tnr. 19 Tnr. 107	Fnr. 9890
Blað 12 af 20	B – 331 Borro-b	



Mynd 14
Exhibit

ORKUSTOFNUN			
NORÐLINGAALDA			
Borro-borholur *Borro-soundings*		NAB—2617–2710	
3.11.'71 Svþ/BH	Tnr. 19	Tnr. 107	Fnr. 9890
blað 13 af 20	B-331 Borro-b		



NAB—2711

567.7

Dýpt Depth m	Högg á Blows per 0.5 m
	18
1.0	45
	45
2.0	34
	36
3.0	54
	58
4.0	65
	59
5.0	55
	54
6.0	58
	58
7.0	67
	65
8.0	45
	35
9.0	33
	36
10.0	40
	50
11.0	60
	64
12.0	64
	56
13.0	61
	69
14.0	70
	68
15.0	90
	96
16.0	86

551.4 16.3 250

NAB—2712

567.7

Dýpt Depth m	Högg á Blows per 0.5 m
	17
1.0	32
	35
2.0	50
	38
3.0	42
	58
4.0	61
	43
5.0	45
	43
6.0	42
	50
7.0	40
	39
8.0	42
	34
9.0	29
	33
10.0	32
	36
11.0	41
	38
12.0	43
	60
13.0	48
	46
14.0	50

framh. cont.

framh. cont.

Dýpt Depth m	Högg á Blows per 0.5 m
	49
15.0	52
	68
16.0	80
	112
17.0	75
	60
18.0	50
	72

548.8 18.9 300

NAB—2713

566.4

Dýpt Depth m	Högg á Blows per 0.5 m
	11
1.0	53
	26
2.0	69
	39
3.0	25
	29
4.0	34
	51
5.0	43
	37
6.0	40
	42
7.0	47
	46
8.0	44
	44
9.0	44
	34
10.0	33
	38
11.0	59
	78
12.0	76
	86
13.0	88
	103
14.0	148
	320

551.9 14.5

NAB—2714

564.3

Dýpt Depth m	Högg á Blows per 0.5 m
	3
1.0	5
	31
2.0	25

561.9 2.4 100

NAB—2715

566.4

Dýpt Depth m	Högg á Blows per 0.5 m
	19
1.0	31
	40
2.0	31
	36
3.0	28
	53
4.0	38
	31
5.0	32
	34
6.0	37
	28
7.0	24
	22
8.0	20
	17
9.0	18
	24
10.0	25
	23
11.0	24
	24
12.0	25
	25
13.0	25
	28
14.0	32
	34
15.0	33
	34
16.0	36
	36
17.0	52
	49
18.0	37
	48
19.0	54
	78
20.0	63
	77
21.0	100

545.1 21.3 250

NAB—2716

566.6

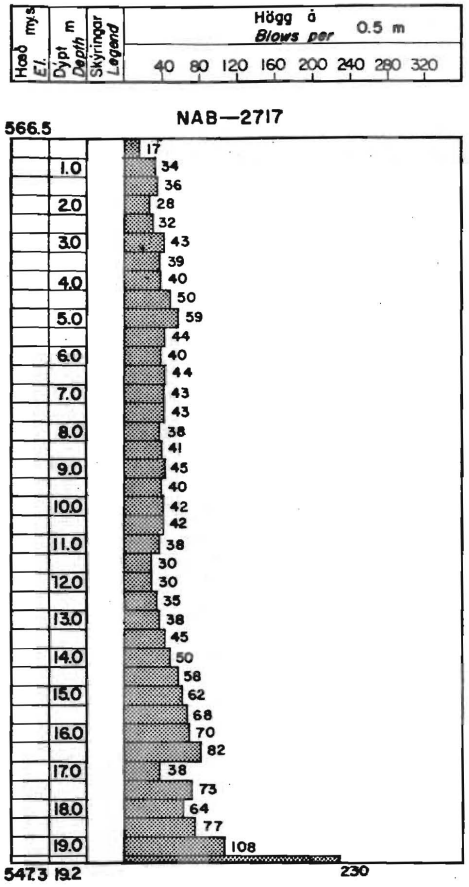
Dýpt Depth m	Högg á Blows per 0.5 m
	17
1.0	21
	28
2.0	30
	36
3.0	32
	21
4.0	22
	20
5.0	24
	30
6.0	20
	24
7.0	20
	15
8.0	15
	20
9.0	23
	18
10.0	17
	20
11.0	19
	22
12.0	24
	27
13.0	27
	29
14.0	32
	35
15.0	32
	39
16.0	43
	47

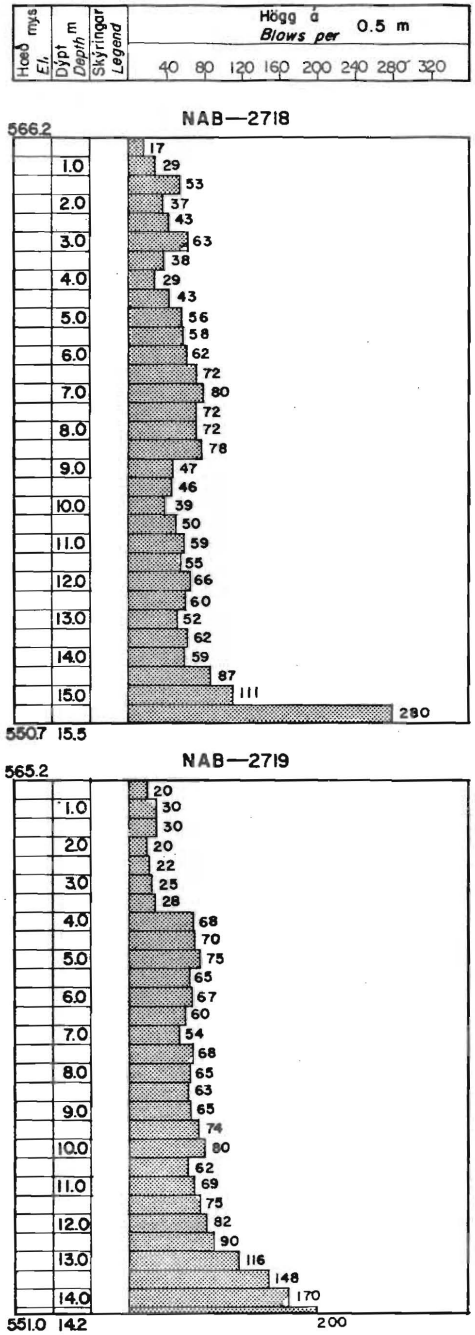
— Borun hætt —

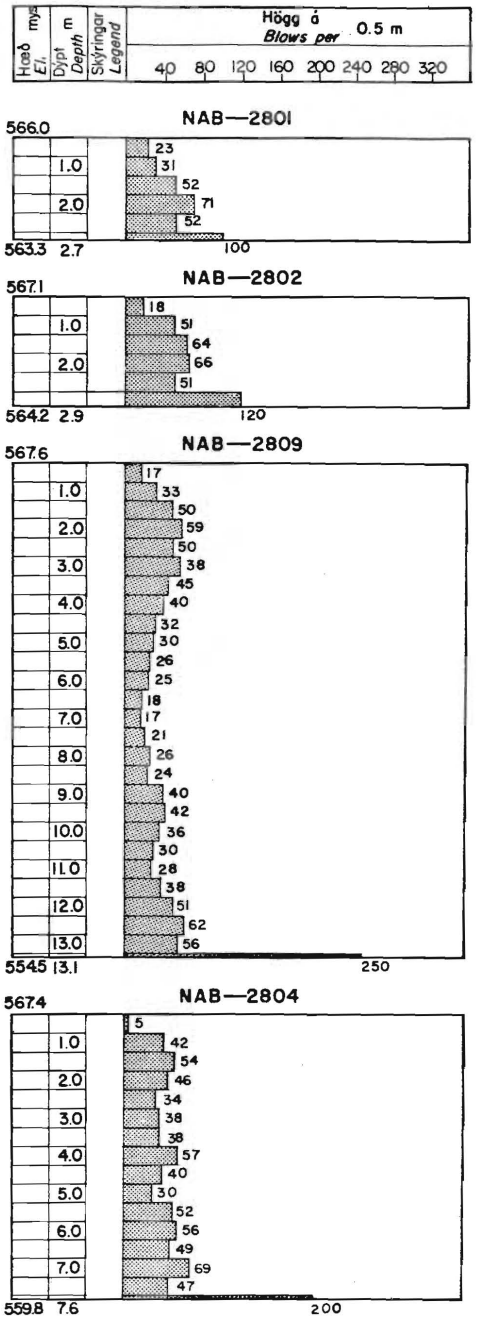
560.1 16.5

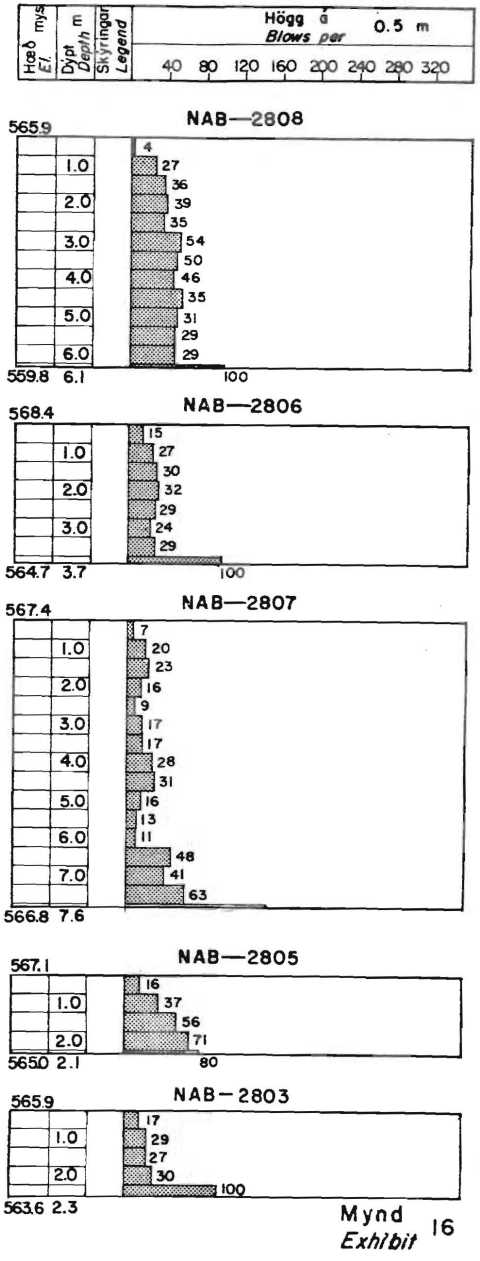
Mynd
Exhibit 15

ORKUSTOFNUN			
NORÐLINGAALDA			
Borro—borholur *Borro—soundings*		NAB—2711—2716	
5. 11. '71 Sv.þ/B	Tnr. 19	Tnr. 107	Fnr. 9890
blað 14 af 20	B-331	Borro-b	



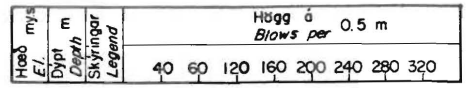


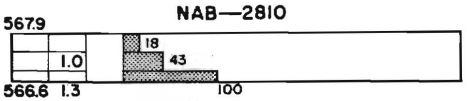


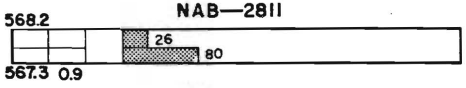


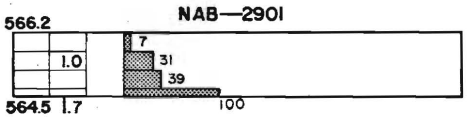
Mynd 16
Exhibit

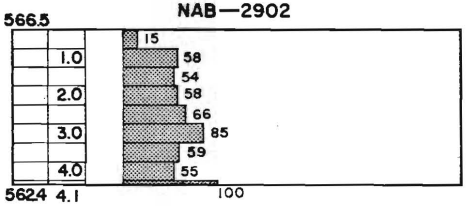
ORKUSTOFNUN		
NORÐLINGAALDA		
Borro—borholur *Borro—soundings*		NAB-2717—2808
9.11.'71 Svþ/BH	Tnr.19	Tnr.107
blað 15 af 20	B-331 Borro-b	Fnr. 9890

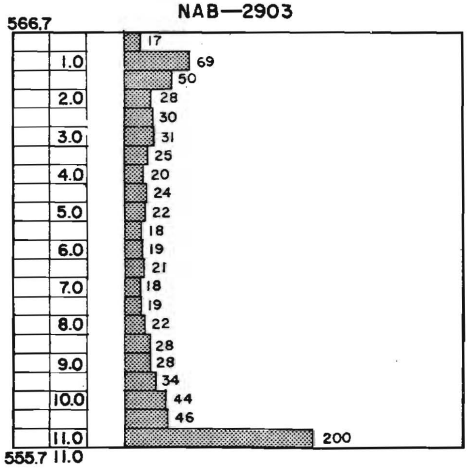


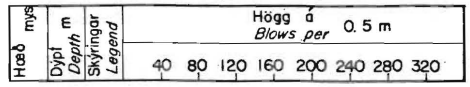


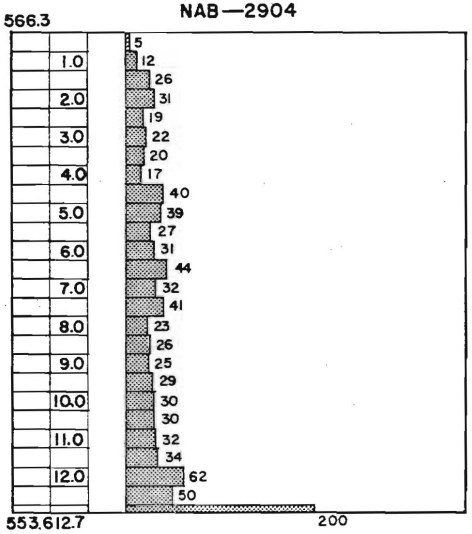


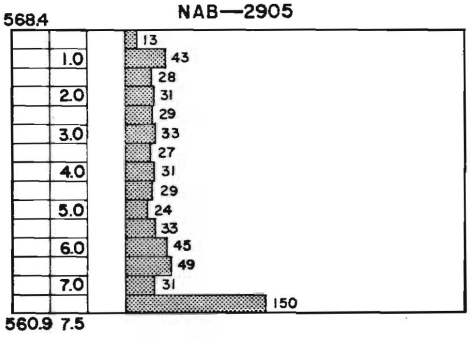


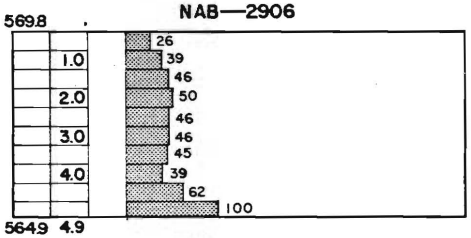


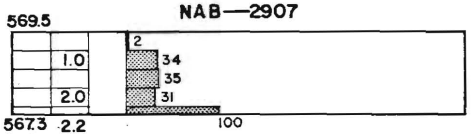


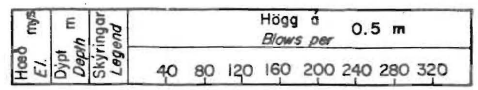


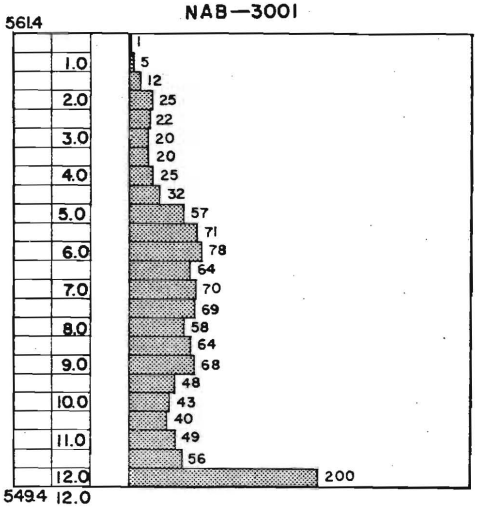


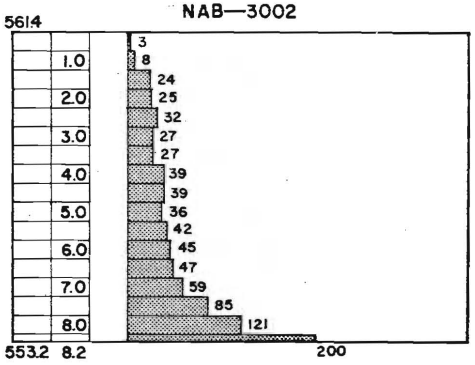


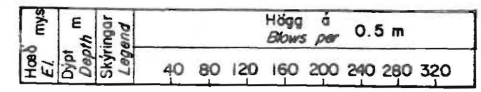


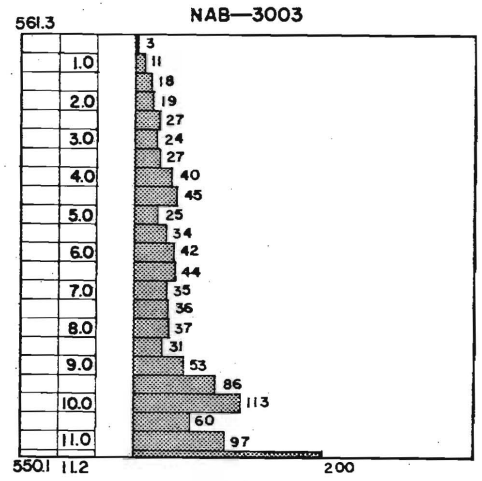


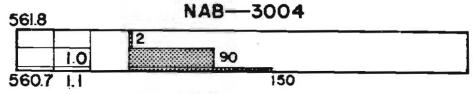


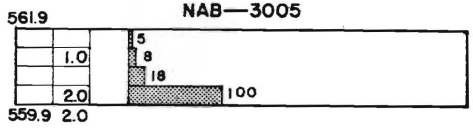












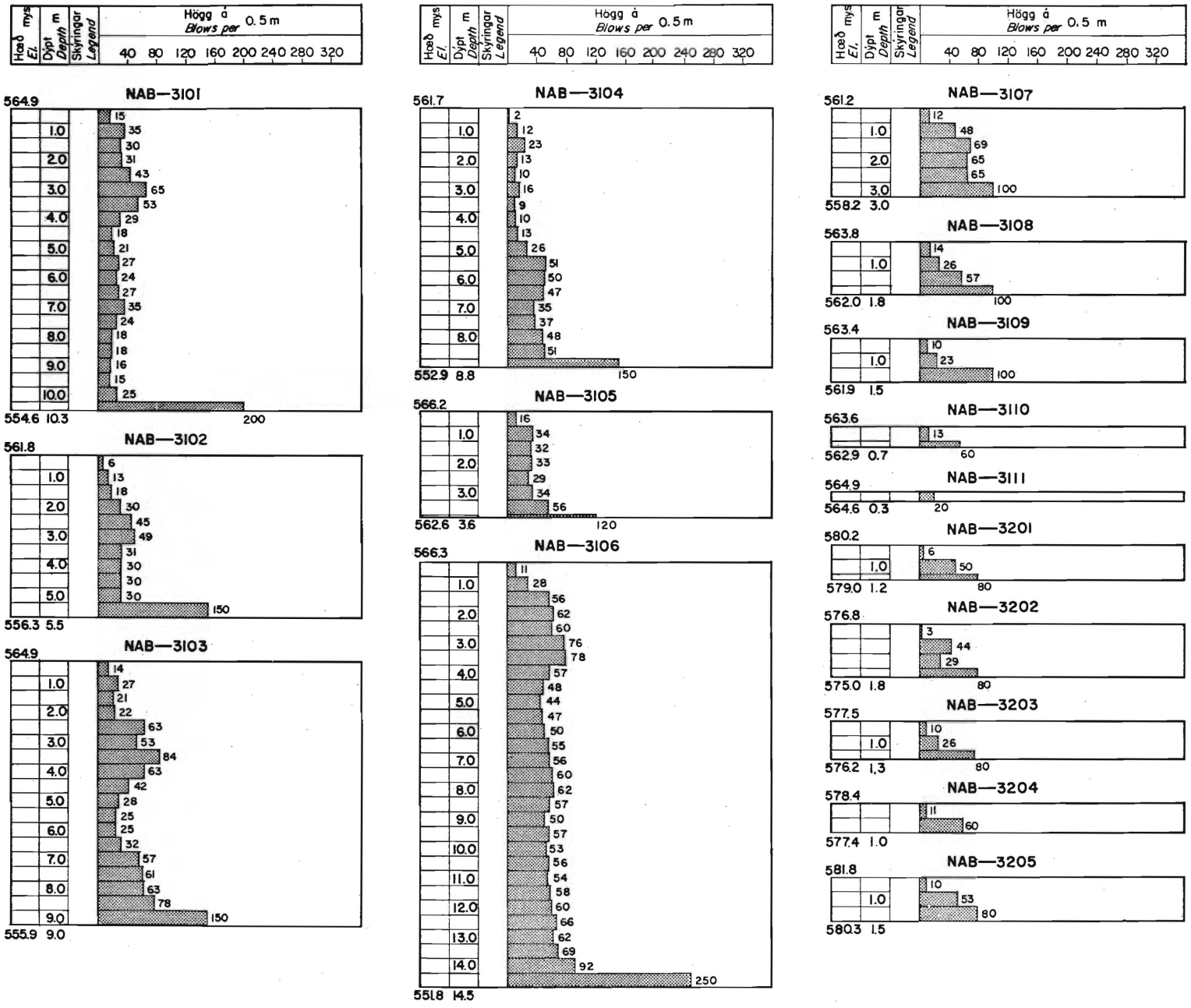
Mynd
Exhibit 17

ORKUSTOFNUN

NORÐLINGAALDA

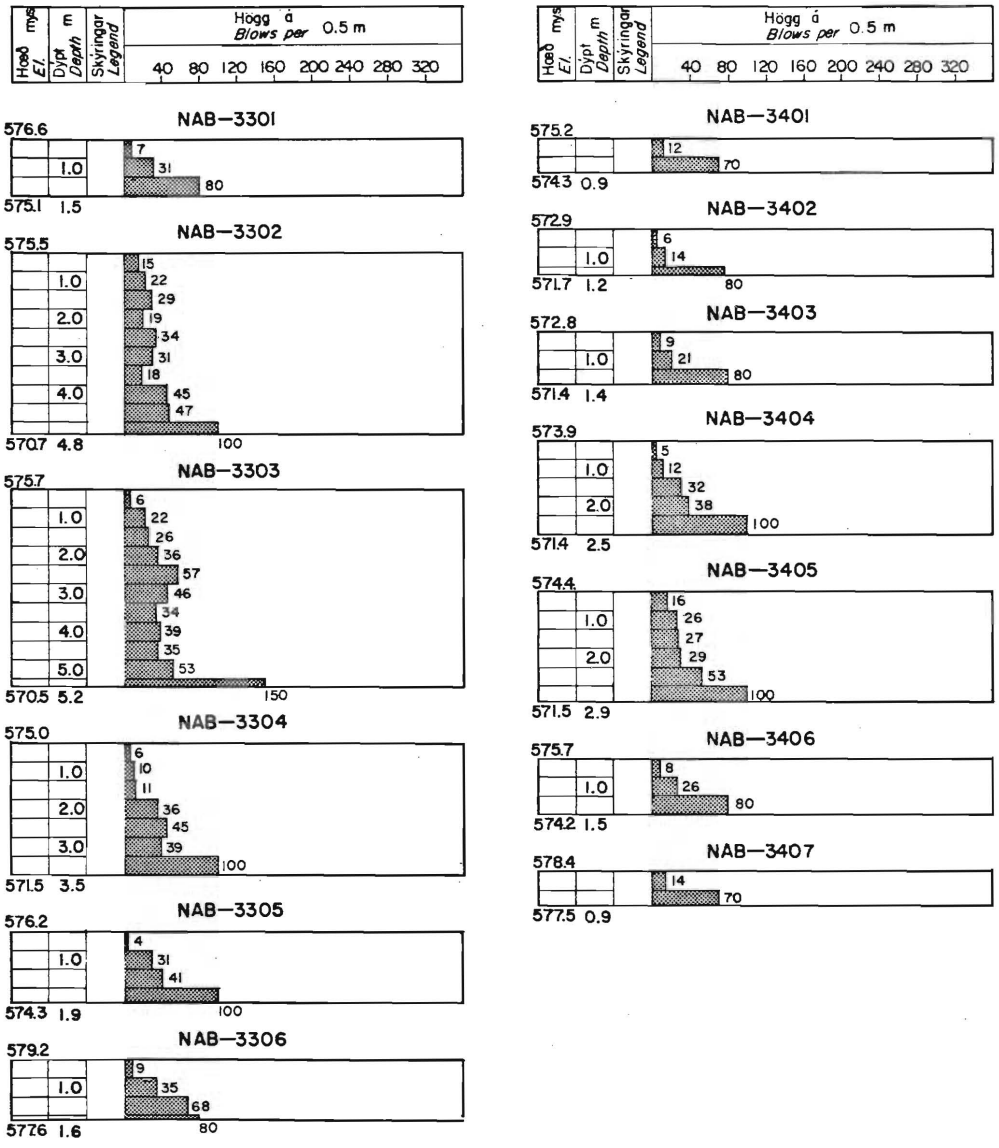
Borro-borholur NAB—2810—3005
Borro-soundings

12.11.'71 Svb/B	Tnr.19 Tnr.107	Fnr. 9890
blað 16 af 20	B-331 Borro-b	



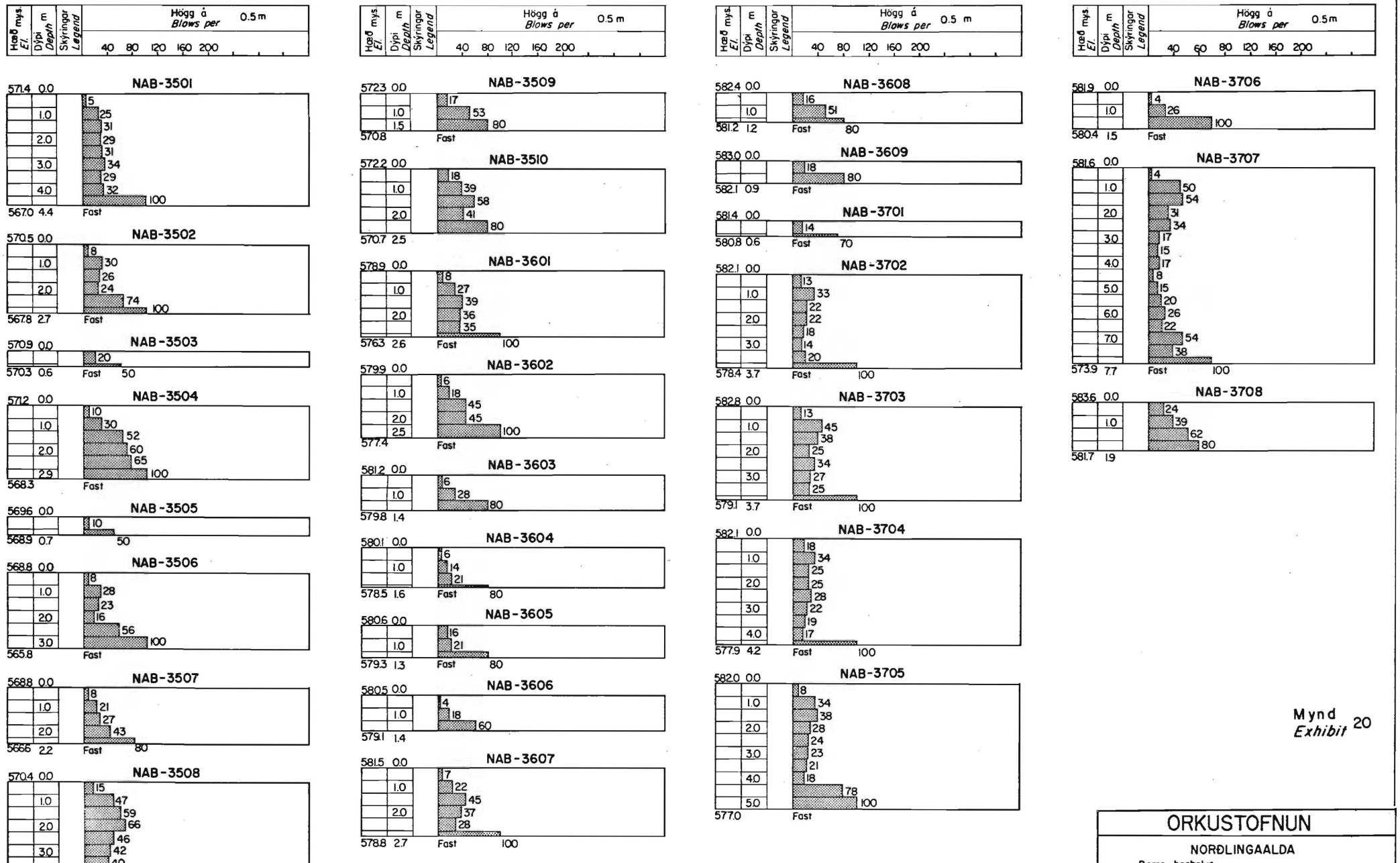
Mynd
Exhibit 18

ORKUSTOFNUN			
NORÐLINGAALDA			
Borro-borholur *Borro-soundings*	NAB-3101-3205		
16. 11. '71 Svb/BH	Tnr. 19	Tnr. 107	Fnr. 9890
blað 17 af 20	B-331	Borro-b	



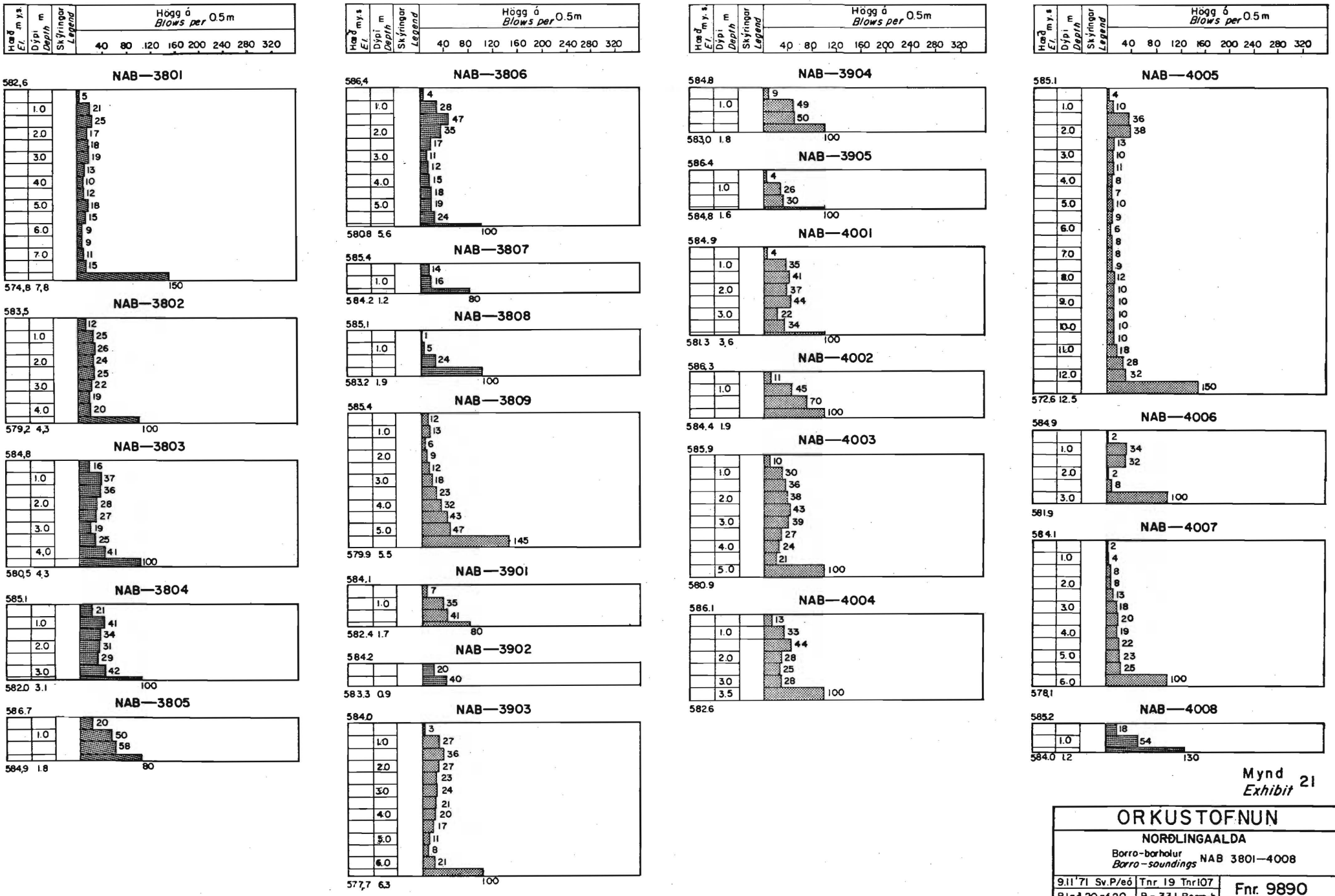
Mynd 19
Exhibit

ORKUSTOFNUN			
NORÐLINGAALDA			
Borro—borholur *Borro—soundings*		NAB—3301—3407	
18.11.'71 Svþ/BH	Tnr. 19	Tnr. 107	Fnr. 9890
blað 18 af 20	B-331	Borro-b	



Mynd *Exhibit* 20

ORKUSTOFNUN			
NORÐLINGAALDA			
Borro - borholur *Borro - soundings*		NAB - 3501-3708	
9.11.'71 Sv.D./eó	Tnr. 19	Tnr. 107	Fnr. 9890
Blað 19 af 20	B-331	Borro-b	



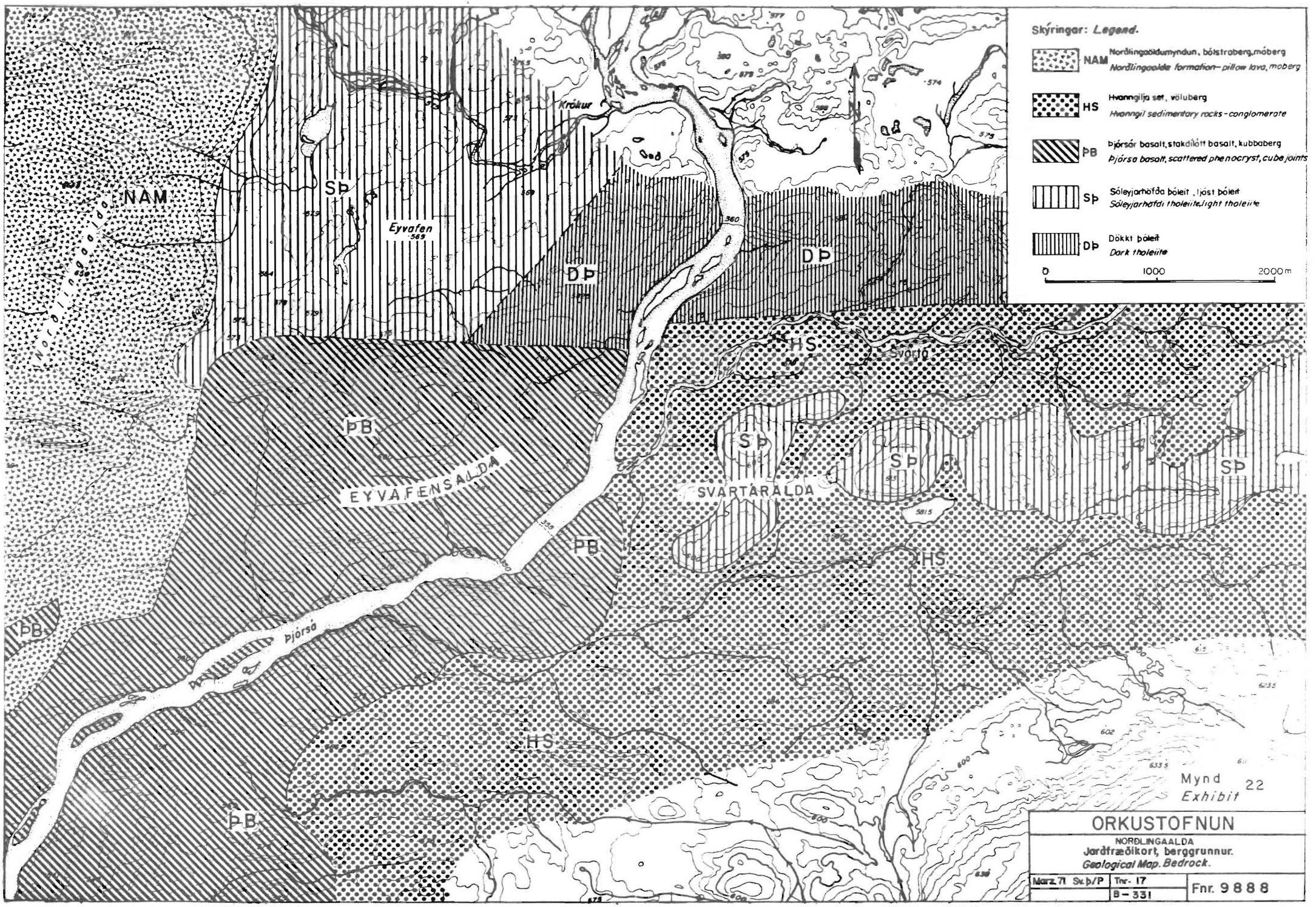
Mynd
Exhibit 21

ORKUSTOFNUN

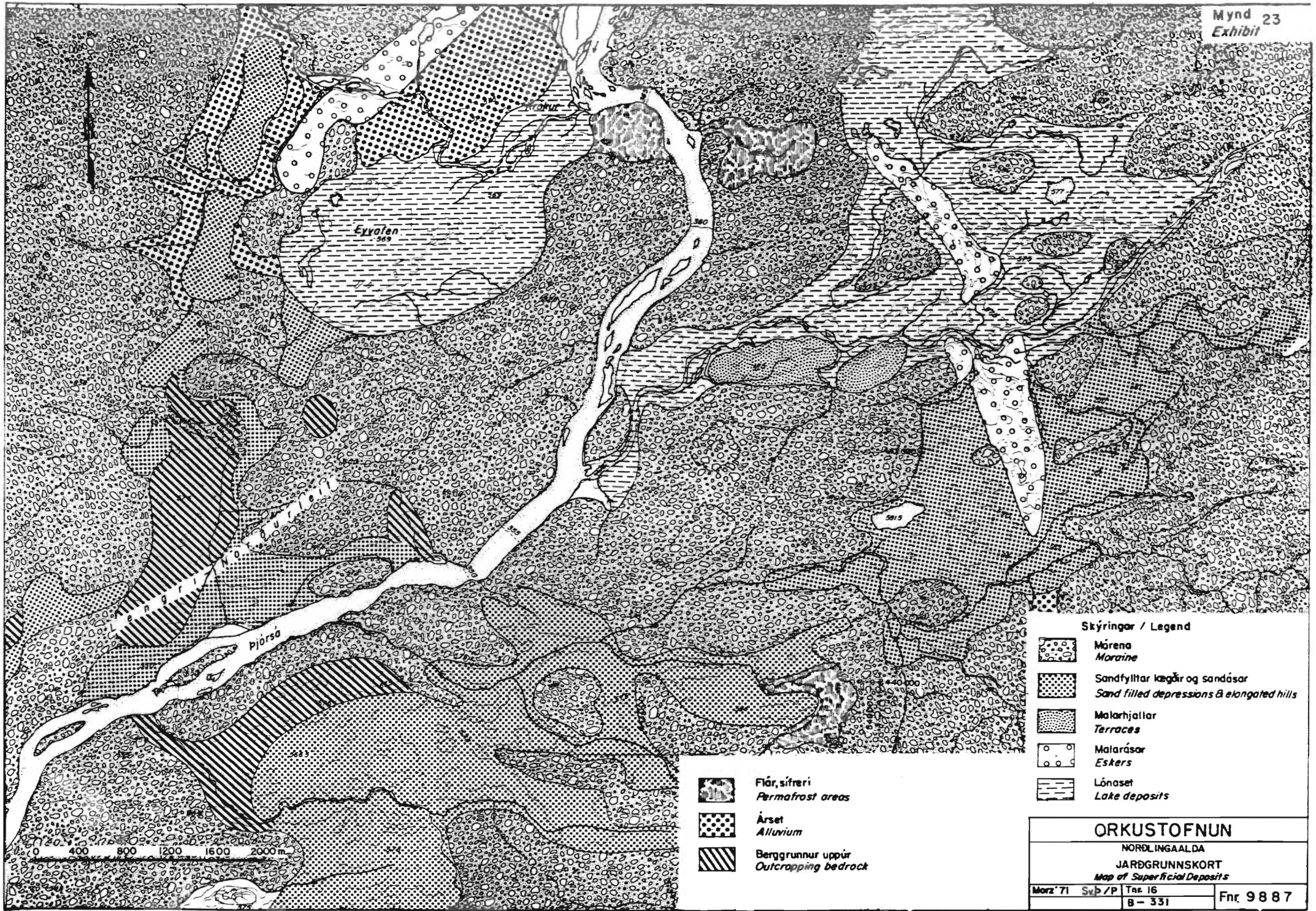
NORÐLINGAALDA

Borro-borholur
Borro-soundings NAB 3801—4008

9.11'71 Sv.P/eó	Tnr 19 Tnr107	Fnr. 9890
Blað 20 af 20	B - 331 Borro-b	


Skýringar: Legend.
NAM Norðlingaöldumyndun, bólstraberg, móberg
Norðlingaalda formation – pillow lava, moberg
HS Hvanngilja set, völuberg
Hvanngil sedimentary rocks – conglomerate
ÞB Þjórsár basalt, stakdílótt basalt, kubbaberg
Þjórsá basalt, scattered phenocryst, cube joints
Sþ Sóleyjarhöfða þóleít, ljóst þóleít
Sóleyjarhöfði tholeiite, light tholeiite
Dþ Dökkt þóleít
Dark tholeiite
0 1000 2000 m
NAM
Króki
Eyvafen
Sþ
DÞ
ÞB
EYVAFENSALDA
HS
Svörtu
SVARTÁRALDA
Þjórsá
Mynd 22
Exhibit
ORKUSTOFNUN
NORÐLINGAALDA
Jarðfræðikort, berggrunnur.
Geological Map. Bedrock.
Marz 71 Sv.þ/P
Tnr- 17
B – 331
Fnr. 9888

Mynd 23
Exhibit



Skýringar / Legend

- Mórena — *Moraine*
- Sandfylltar lægðir og sandásar — *Sand filled depressions & elongated hills*
- Malarhjallar — *Terraces*
- Malarásar — *Eskers*
- Lónaset — *Lake deposits*
- Flár, sífreri — *Permafrost areas*
- Árset — *Alluvium*
- Berggrunnur uppúr — *Outcropping bedrock*

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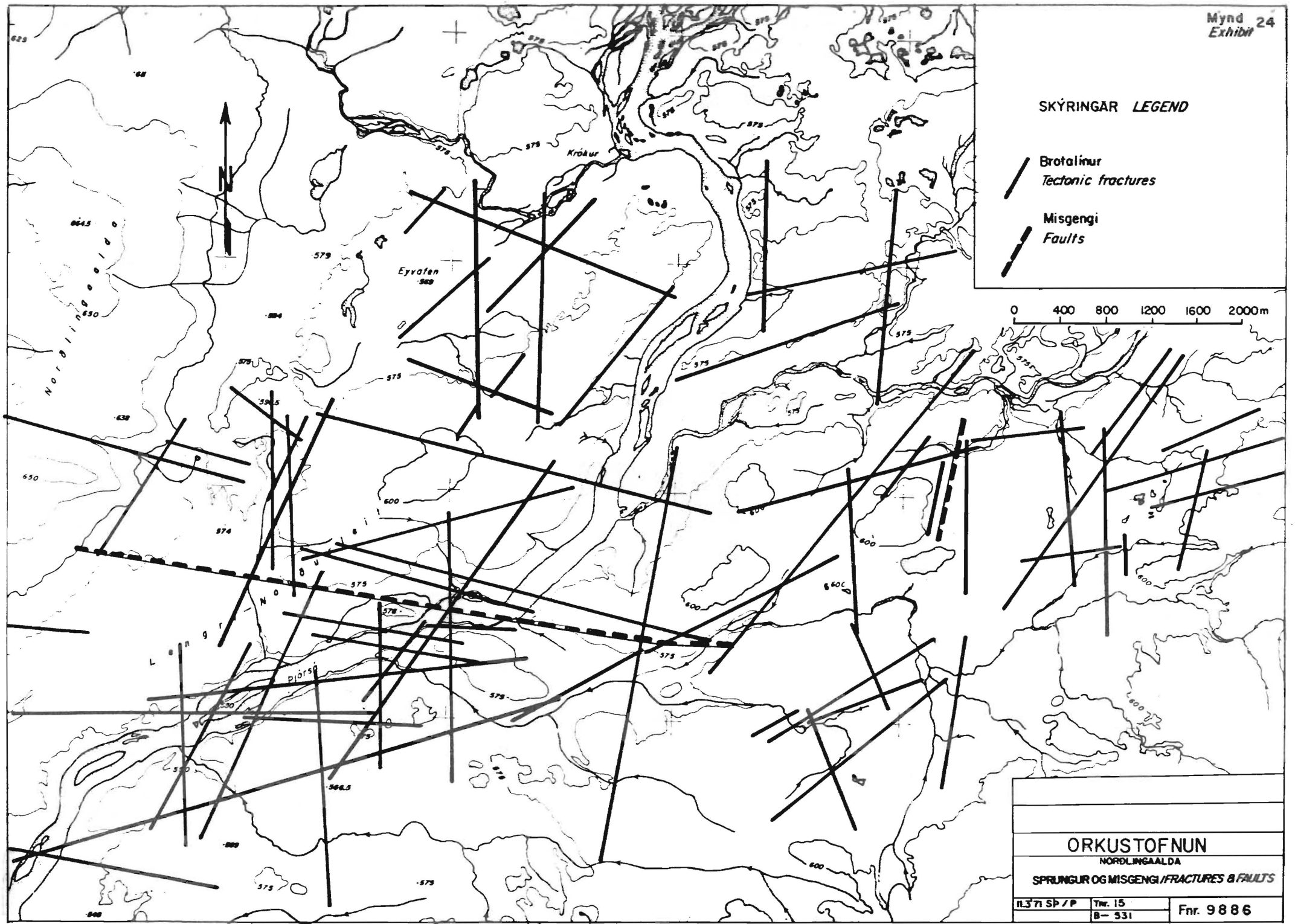
NORÐLINGAALDA

JARÐGRUNNSKORT

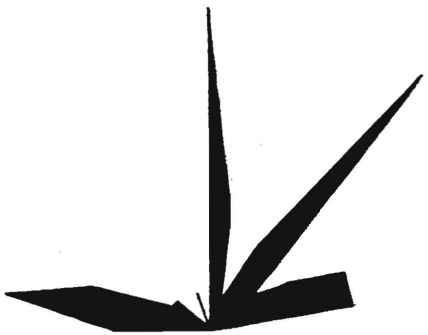
Map of Superficial Deposits

Morz'71 SvÞ/P	Tnr. 16 B – 331	Fnr. 9887


Mynd 24
Exhibit
SKÝRINGAR LEGEND
Brotalínur
Tectonic fractures
Misgengi
Faults
0 400 800 1200 1600 2000m
N
Króáur
Eyvafen
Norðlingaalda
Langi
Piðrá
ORKUSTOFNUN
NORÐLINGAALDA
SPRUNGUR OG MISGENGI/FRACTURES & FAULTS
11.3'71 SÞ/P
Tnr. 15
B— 931
Fnr. 9886

Mynd 25
Exhibit

SPRUNGURÓSIR
ROSE DIAGRAMS

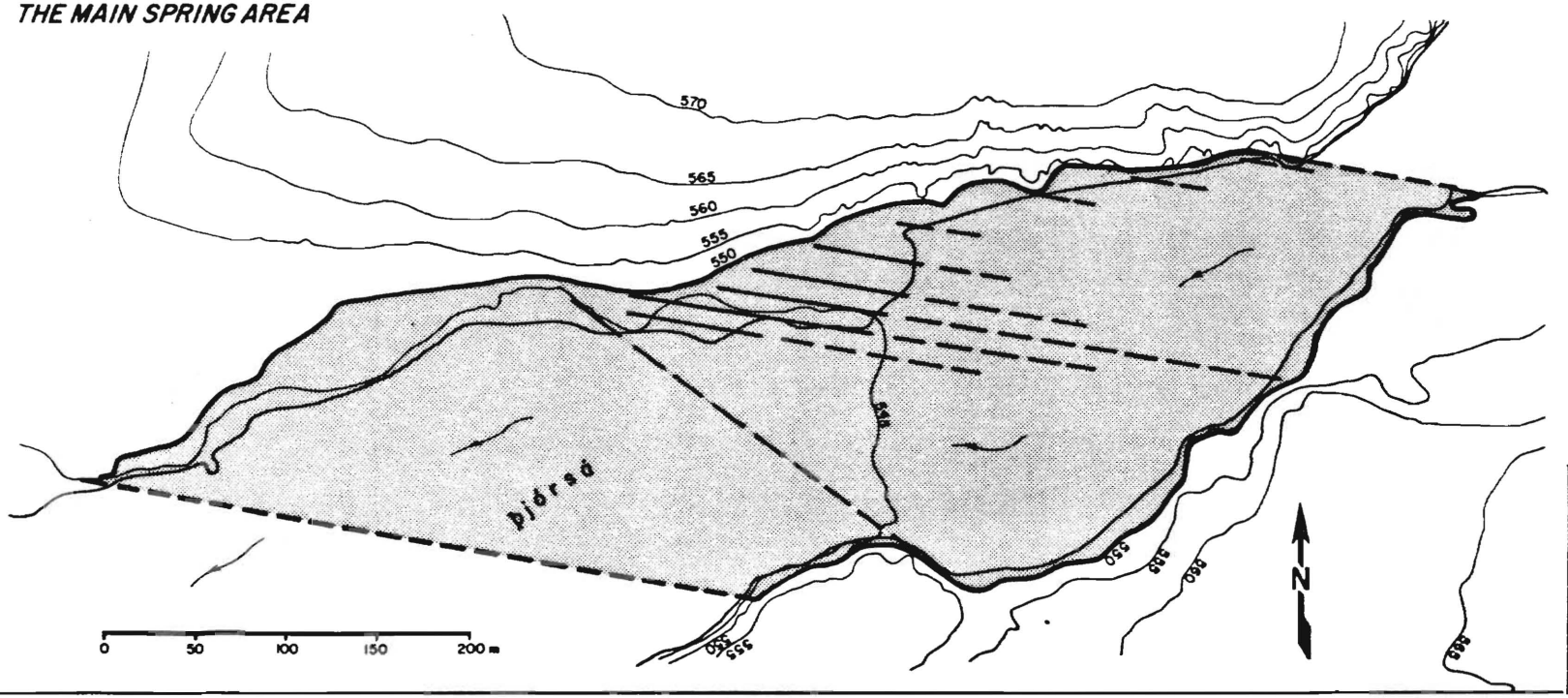


Stefna sprungna á öllu svæðinu (mælt eftir loft ljósmyndum)
Direction of fissure trends of the whole area (from Aerial Photographs)

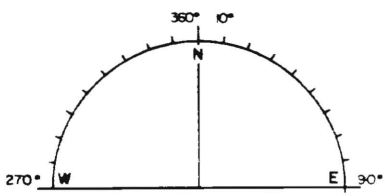
Stefna sprungna a lindasvæðinu
Direction of joints in Spring Area

0 5 10%
2% = 0.5 cm

AÐAL LINDASVÆÐIÐ
THE MAIN SPRING AREA



SKÝRINGAR / *LEGEND*



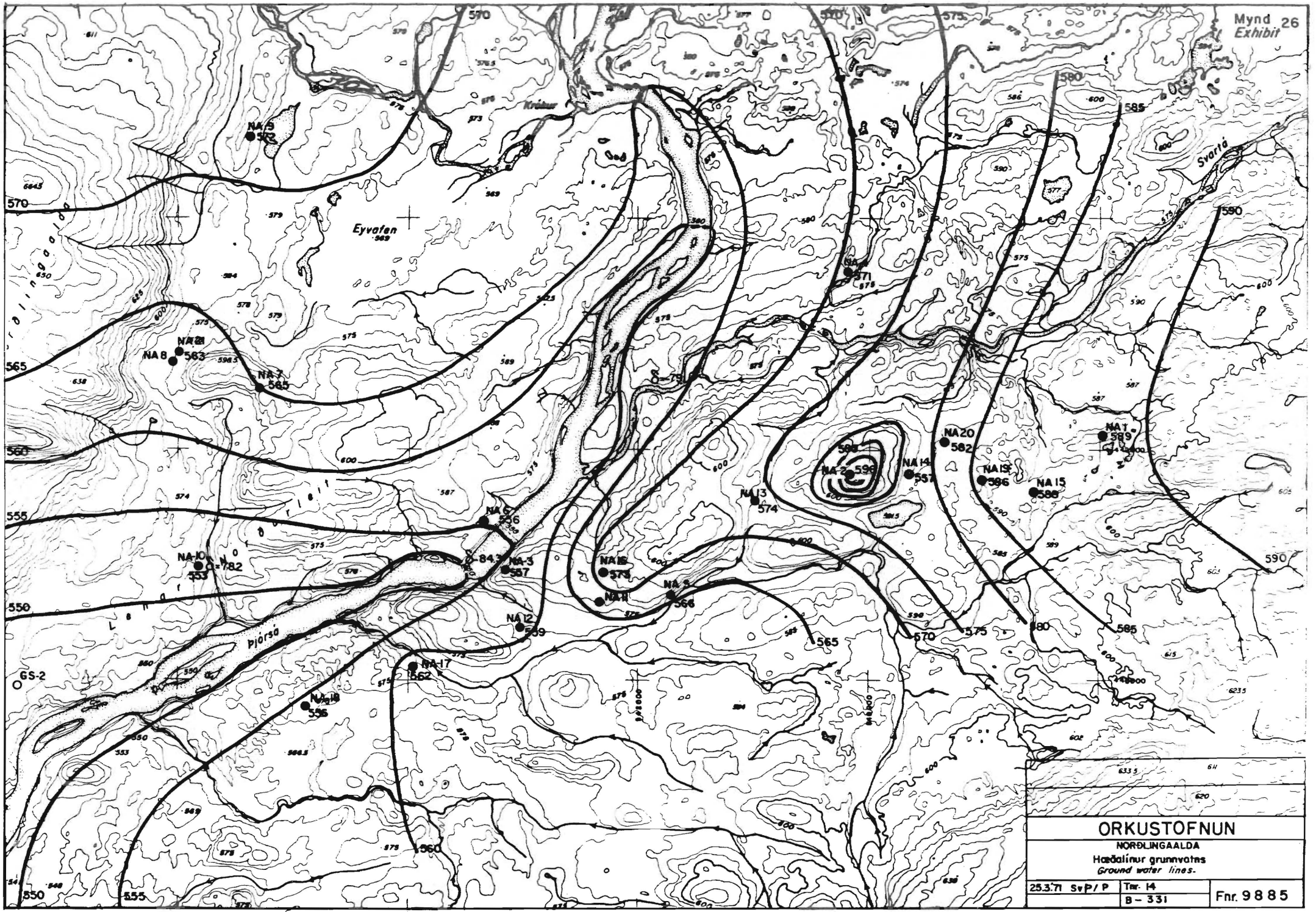
Stefnur settar inn fyrir hverjar 10°
(±5° frá uppgefinni stefnu)
Plotted for every 10°
(±5° from plotted direction)

Takmörk aðal lindasvæðisins
Boundary of main Spring Area

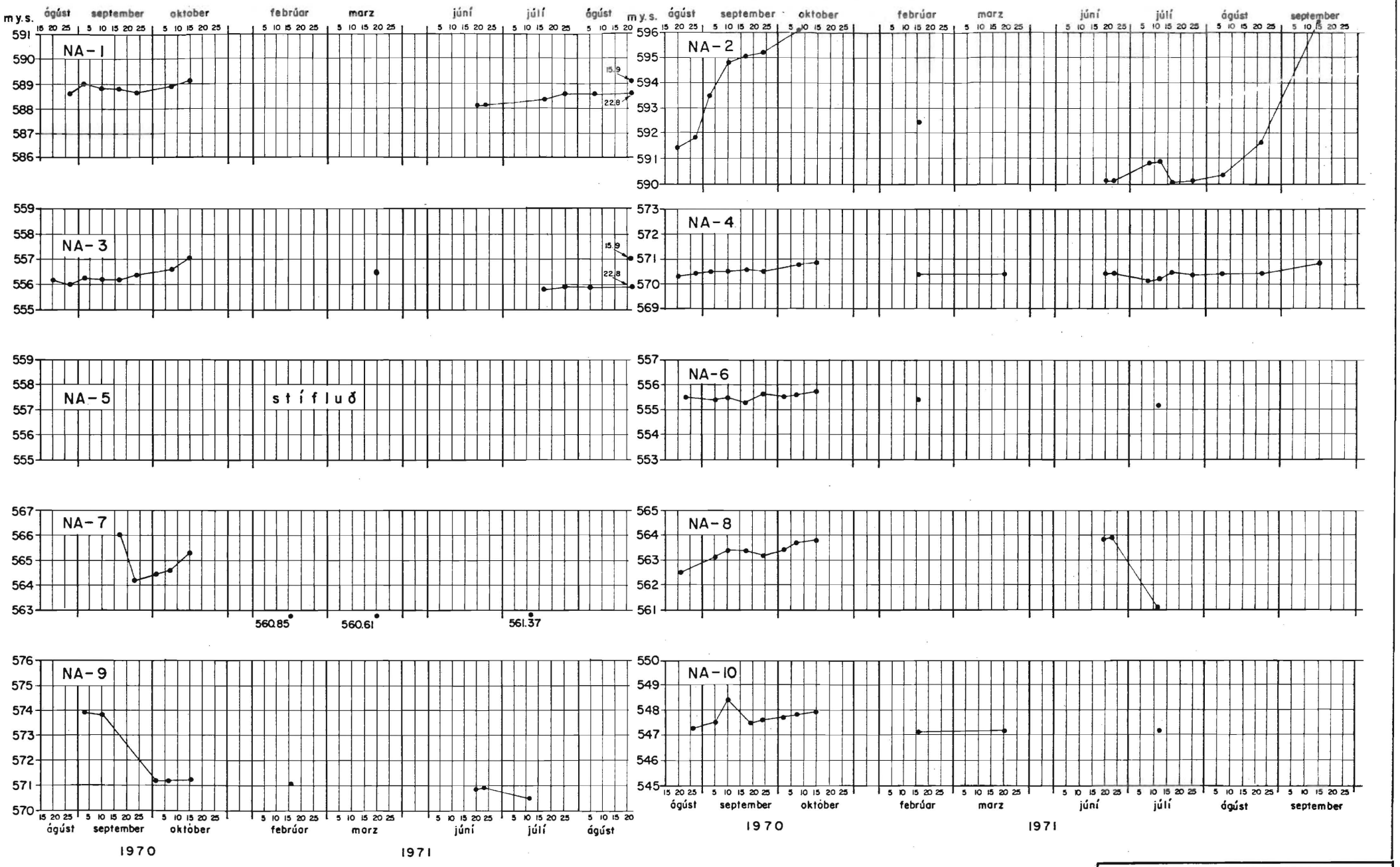
Stefna vatnsgefandi sprungna
Direction of yielding fissures

ORKUSTOFNUN
NORÐLINGAALDA
Aðal lindasvæðið og sprungurósir
THE MAIN SPRING AREA AND ROSE DIAGRAMS

18.5.'71 Sv. Þ/VEK	Tnr. 18 B-331	Fnr. 9889


Mynd 26
Exhibit
Kráká
Eyvafen
Svartá
Pjórsá
NA-1
NA-2
NA-3
NA-4
NA-5
NA-6
NA-7
NA-8
NA-9
NA-10
NA-11
NA-12
NA-13
NA-14
NA-15
NA-16
NA-17
NA-18
NA-19
NA-20
NA-21
GS-2
ORKUSTOFNUN
NORÐLINGAALDA
Hæðalínur grunnvatns
Ground water lines.
25.3.71 SvP/P
Tnr. 14
B - 331
Fnr. 9885

Mynd 27
Exhibit



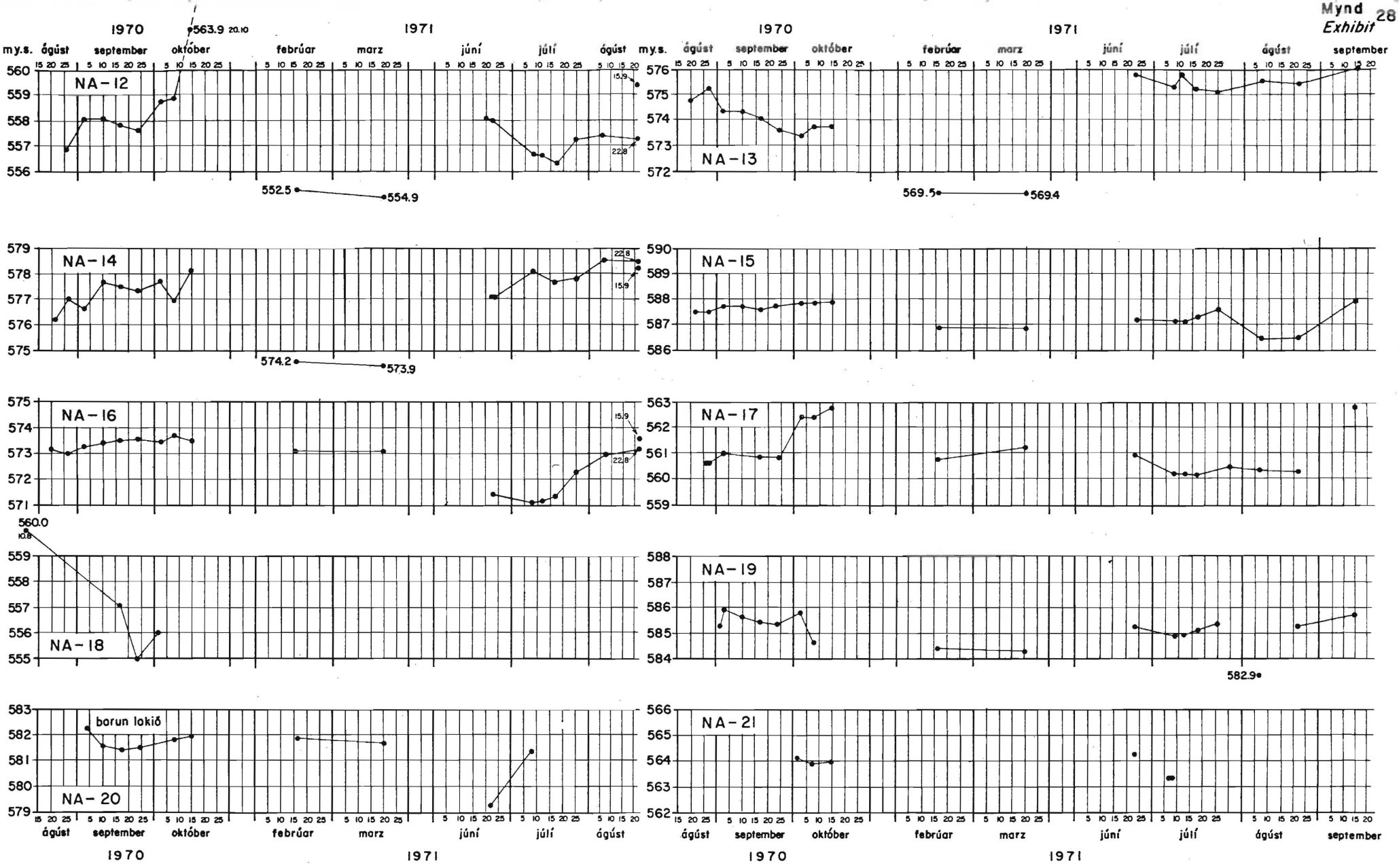
ORKUSTOFNUN

NORÐLINGAALDA

Breytingar á jarðvatnsstöðu í borholum

Ground water level fluctuation in Boreholes

24.8.'71 SvÞ/EK	Tnr.17 Tnr. 27	Fnr. 10044
Blað 1 af 2	B-Grunnv.B-334	



ORKUSTOFNUN		
NORÐLINGAALDA		
Breytingar á jarðvatnsstöðu í borholum *Ground water level fluctuation in Boreholes*		
30.8 Sv.þ/EK	Tnr. 18 Tnr 28	Fnr. 10044
Bl. 2 af 2	B-Grunnv. B-331	

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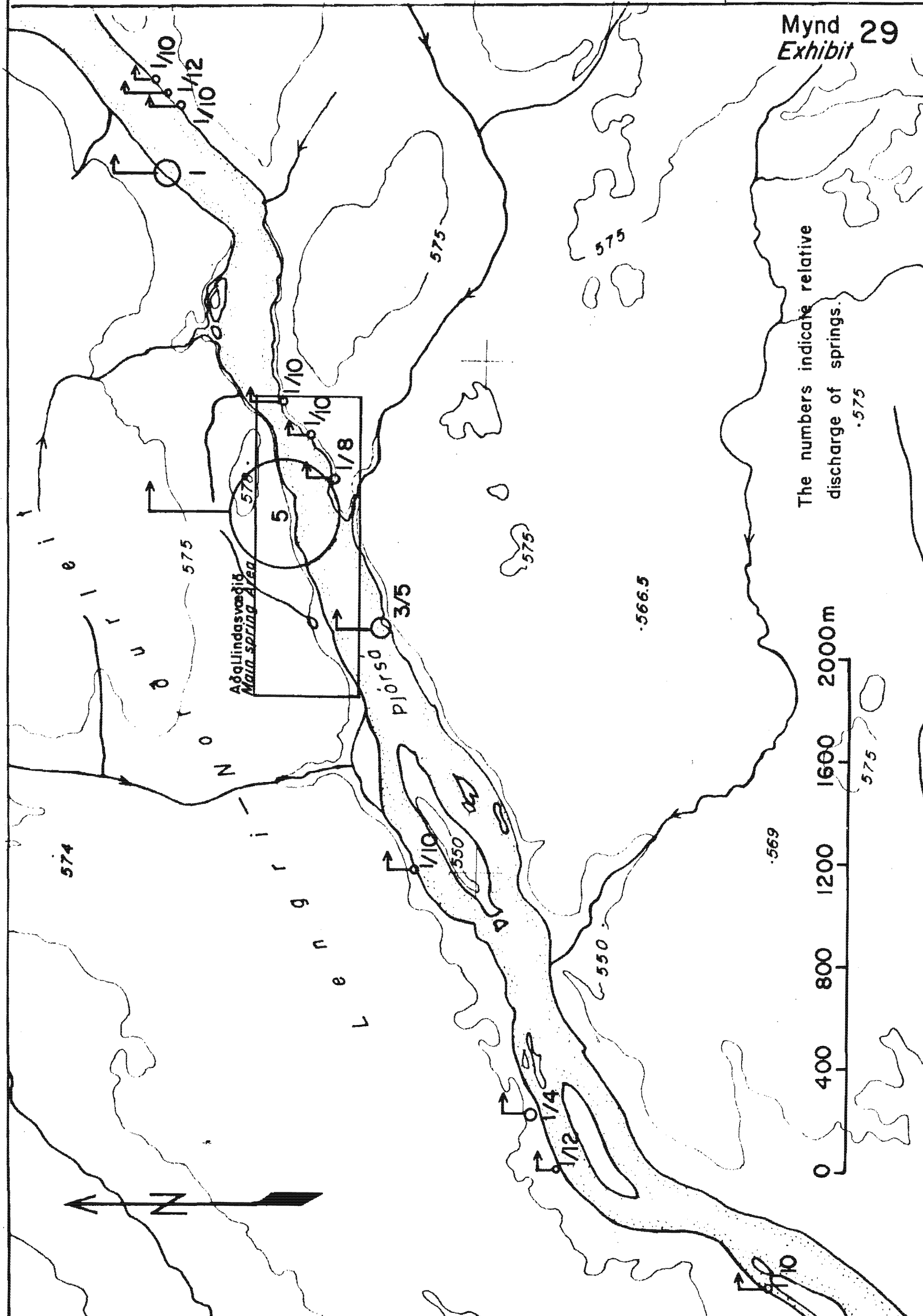
NORÐLINGAALDA

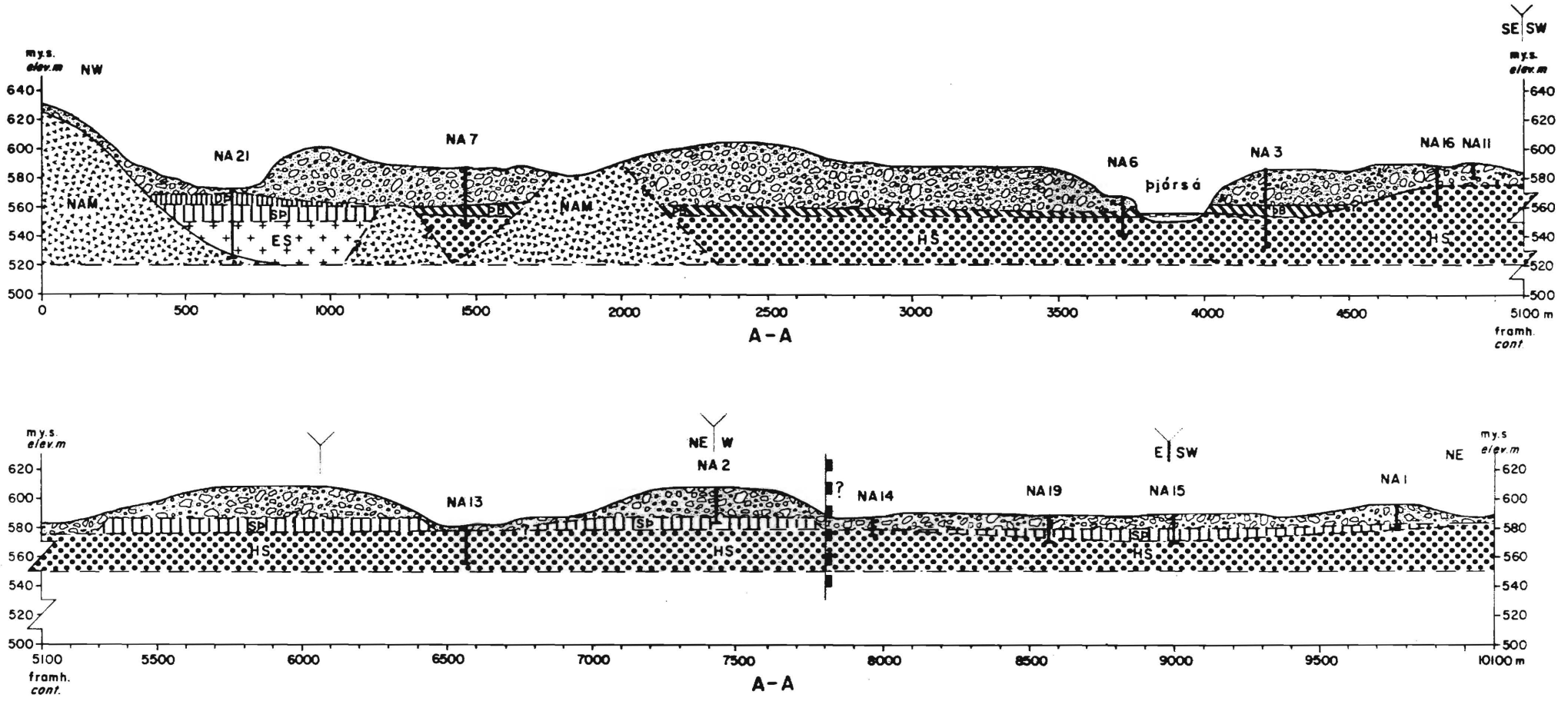
Lindasvæði

Location of springs

20.3.'71 Sv Þ / P
Tnr. 13
B — 331
Fnr. 9884

Mynd 29
Exhibit





SKÝRINGAR / *LEGEND*:

- NAM — Norðlingaöldumyndun – bólstraberg, móberg
  Nordlingaalda formation – Pillow Lava, Moberg
- HS — Hvanngilja set – völuberg
  Hvanngil sedimentary-rocks. Conglomerate
- ÞB — Þjórsár basalt – stakdílótt basalt, kubbaberg (breksía)
  Thjorsa Basalt – scattered phenocrysts cube joints (somet. Breccia)
- SP — Sóleyjarhöfða þóleit – ljóst þóleit
  Sóleyjarhöfdi Tholeiite – light Tholeiite
- DP — Dökkt þóleit
  Dark Tholeiite
- ES — Eyvafensset – sandsteinn
  Eyvafen sedimentary-rocks. Sandstone
- Mórena – jökulberg
  Moraine – Tillite
- Laus yfirborðslög – sandur, möl
  Overburden – Sand, Gravel
- Árset og malarhjallar
  Alluvium and Terraces
- Misgengi
  Faults

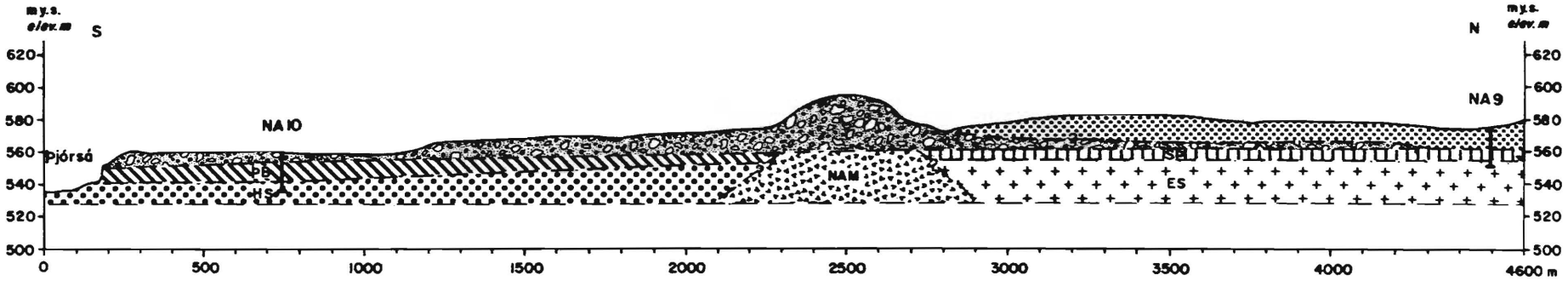
Mynd 30
Exhibit

ORKUSTOFNUN

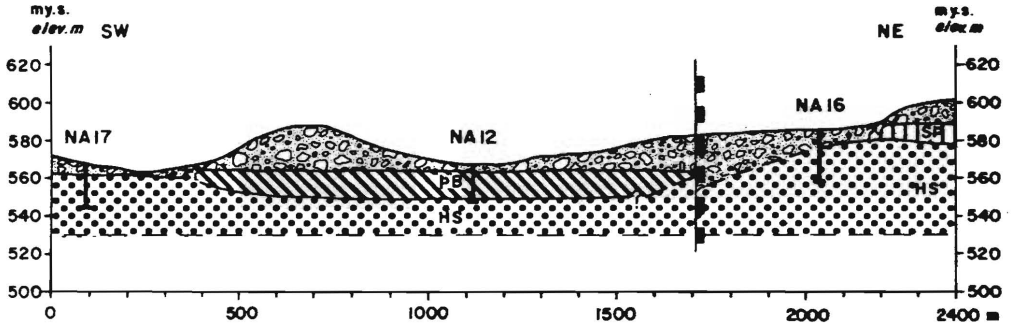
NORÐLINGAALDA
Jarðlagasnið A-A
Geological section

10.6'71 SkP/ÆK	Tnr. 20 B-331	Fnr. 9891

Mynd 31
Exhibit

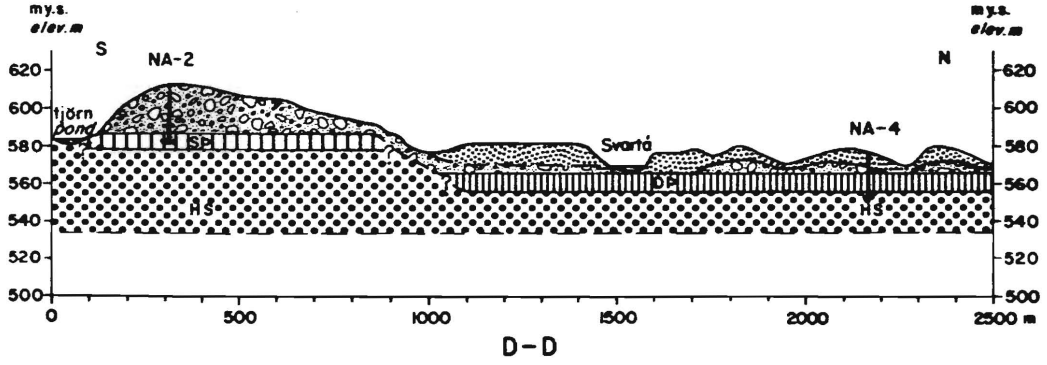


B-B



C-C

Skýringar sjá mynd 30
Legend see Exh. "



D-D

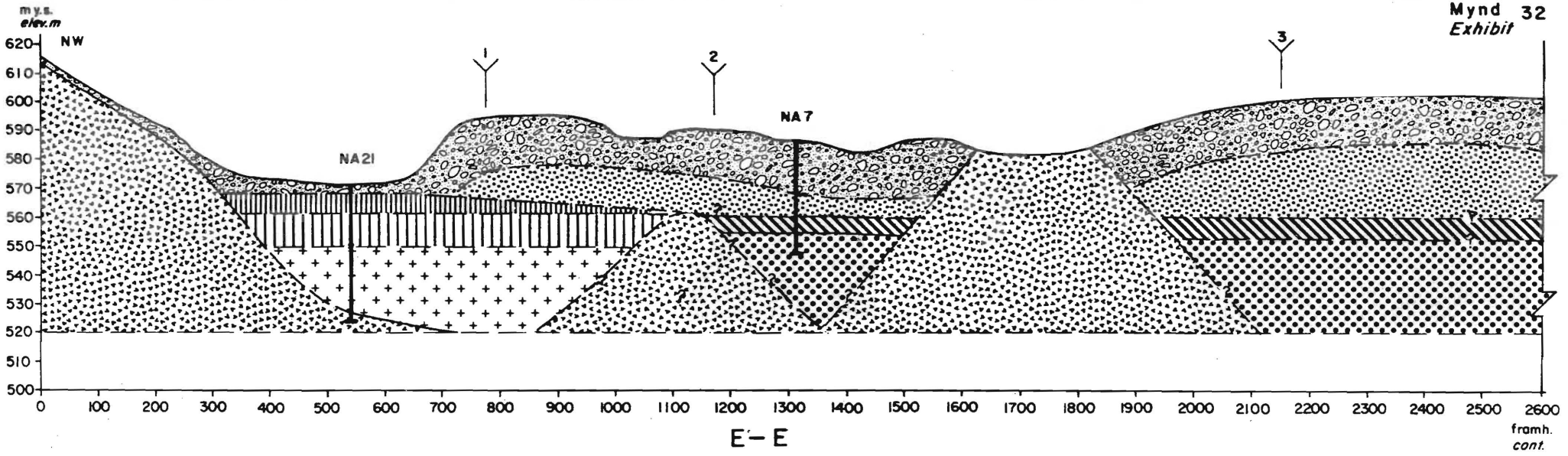
ORKUSTOFNUN

NORÐLINGAALDA

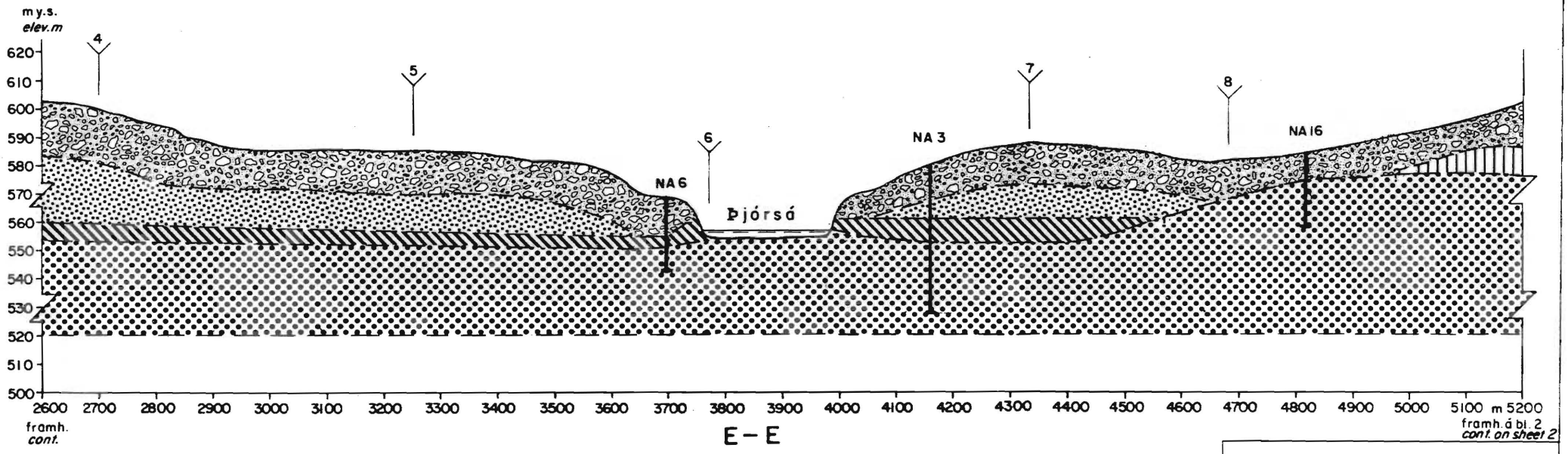
Jarðlagasnið B-B, C-C, D-D.
Geological sections

14.6'71 Sv.Þ/EK | Tar. 21 | B-331 | Fnr. 9892

Mynd 32
Exhibit



E – E

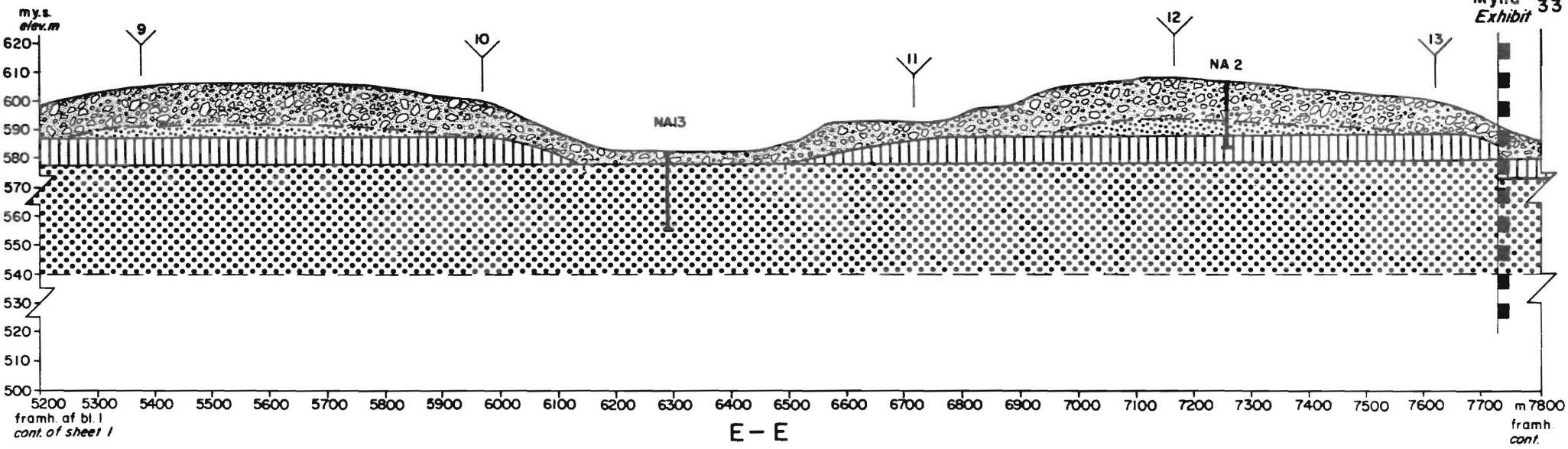


E – E

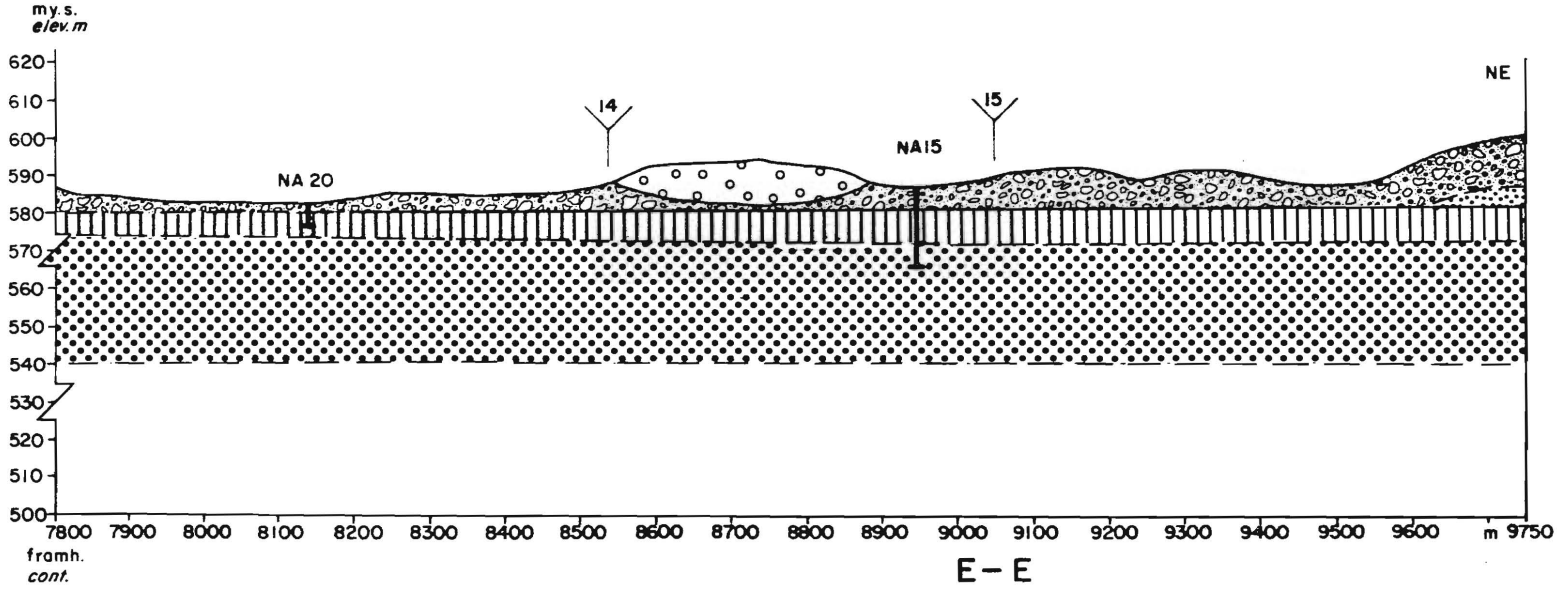
Skýringar sjá mynd 30
Legend see Exh. "

ORKUSTOFNUN	
NORÐLINGAALDA Jarðlagasnið *Geological section*	E-E
10.6.'71 SvP/EK	Tnr. 22
Bl. 1 af 2	B-331
Fnr. 9893	

Mynd 33
Exhibit



E – E



E – E

Skýringar sjá mynd 30
Legend see Exh. "

ORKUSTOFNUN	
NORÐLINGAALDA Jarðlagasnið E-E *Geological section*	
10.6.'71 SvP/EK	Tnr. 22
Bl. 2 af 2	B-331
	Fnr. 9893