ORKUSTOFNUN

Logging and fishing in Húsavík, N-Iceland

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ORKUSTOFNUN
Geosciences Division
May 25, 2000

Short Report
GrB/SSJo/GuH-00/04
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Logging and fishing in Húsavík wells 1, 4 and 5 in May 2000

Introduction

The following report describes logging and fishing activities carried out in Húsavík wells 1, 4 and 5 during May 4 to 5 in the year 2000. The work was carried out upon request by University of Edinburg, Geology and Geophysics division. It is part of a preparation phase for a seismic well to well study to be carried out in the above wells. Figure 1 shows location of the wells and the two major normal faults observed in the area. The wells in question were drilled in 1961 to 1965. Due to slight salinity of the deep reservoir the system was considered non-economical for space heating purposes. The wells have therefore only been used for monitoring except for well 1, where < 1 l/s is pumped for a health spa operation. Table 1 gives GPS coordinates of these wells, collected now in May, only few days after the GPS signal became unscrambled.

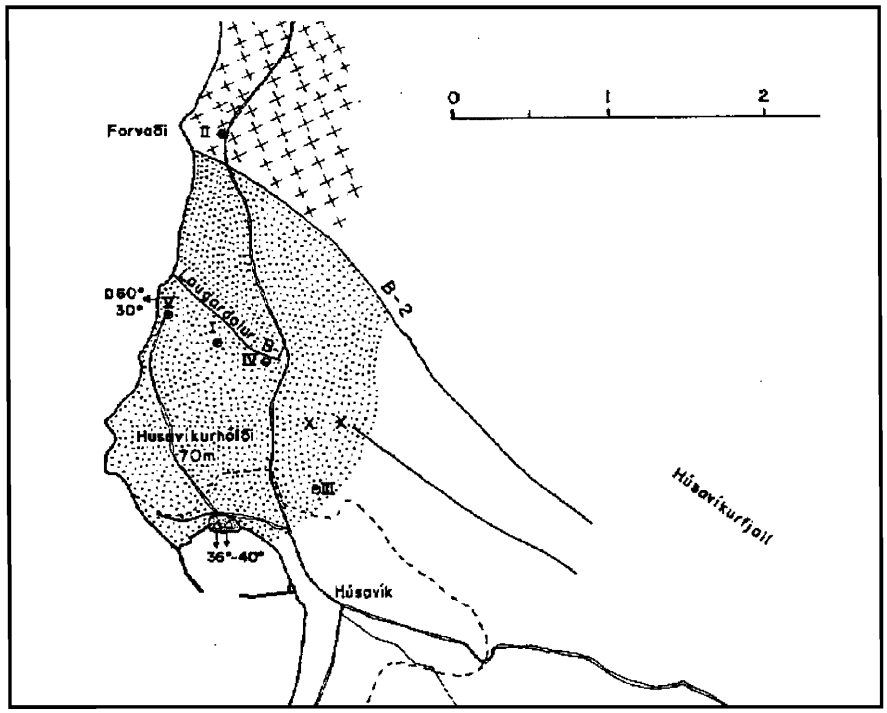

Figure 1: Location map of Húsavík wells. Also shown are the two major faults, B-1 and B-2, location of hot springs, the shoreline and roads. From Tómasson (1969). Scale in kilometers.

Note that for preparing some of the following figures (showing well design), a frequent reference was made to a Orkustofnun report by Jens Tómasson et. al.: *Geothermal studies in Húsavík*, published in March 1969. The Oracle database of Orkustofnun is also used extensively for the making of this report.

Table 1: GPS location of Húsavík wells, measured on May 5, 2000.

Well	ID number	Latitude °N	Longitude °W	Elevation (m)	W-Lambert (m)	N-Lambert (m)
1	51041	66.0554	17.3515	79	470613	617840
4	51031	66.0548	17.3465	55	470388	617776
5	51042	66.0569	17.3568	57	470855	618005

Measurements in well 1

Well 1 was logged on May 4 and 5. The following downhole runs were carried out:

- Waterlevel was measured at 9-10 m depth.
- A 4" go-devil ran to 77 m depth. When pulling out again the tool became mildly stuck at 74 m and easily retrieved.
- Fishing tool hooked on the obstruction also at 74 m depth, after being immersed to 77 m depth. Pulled out slowly, a heavy weight fish. When at surface it became evident that the fish was a slick measuring line, as was expected. It took half an hour hard work to pull it all out of the well, due to the amount of wire. When only 1 m of fish was left in the well, we noticed that some kind of light debris fell out of it and down the well. The sound from the waterlevel indicated that the debris consisted of small particles, possibly rusted metal from inside the casing.
- A 4" go-devil ran to 1065 m where it stopped. By pulling the line softly it went through and continued down to 1157-1160 m depth. Several attempts were made to go deeper without success.
- A 1,5" weightbar made it to 1173 m depth. Several attempts to go deeper were unsuccessful. When back to surface we noticed some grains on the soft end of the led weightbar. These have been checked briefly in a microscope, with the following conclusion: *A sample of fine grained material, adhered to a lead-weight driven to the bottom of a drillhole H-1 in Húsavíkurhöfði, was prepared for analysis by washing out a fairly large portion of the sample. It consisted of a very fine material which was not possible to identify, since individual grains could not be seen. Judging from the nature and appearance of the material, it is most likely that the fine dust is composed of rock flour and possibly some clay minerals. The remaining part of the sample, with a grain size of about 1-3 mm, consists mainly of highly magnetized material, most grains exhibiting considerable oxidation, and on the fracture planes finely vesicular texture can be seen. It can therefore be concluded that most of the courser material is scaling of some sort, most likely from installed parts in the hole, casing or even form the drilling itself or welding or cutting around the wellhead.* From this analysis we suggest that the well obstacle at 1145-1170 m, may be the grains that fell down when the old measuring line was fished out of the wellhead.
- A temperature log was performed down to 1145 m.
- A caliper log was finally performed from the same depth. Only 1,5" diameter, 3 arm tool was used for safety reasons. Running our 4" diameter XY tool was assumed too risky as that diameter is close to the drilled well diameter below 1100 m. We were luckily able to open the 3 arm tool, despite a well temperature exceeding the tool limit.

Figure 2 shows the temperature data collected todate in well 1. The well is presently much hotter at shallow depths than previously. The reason is the hot water pumping, which has been ongoing for years. This high well temperature is to be expected throughout the

seismic project as the spa facility, associated with the well, is most popular in Húsavík and not to be closed down.

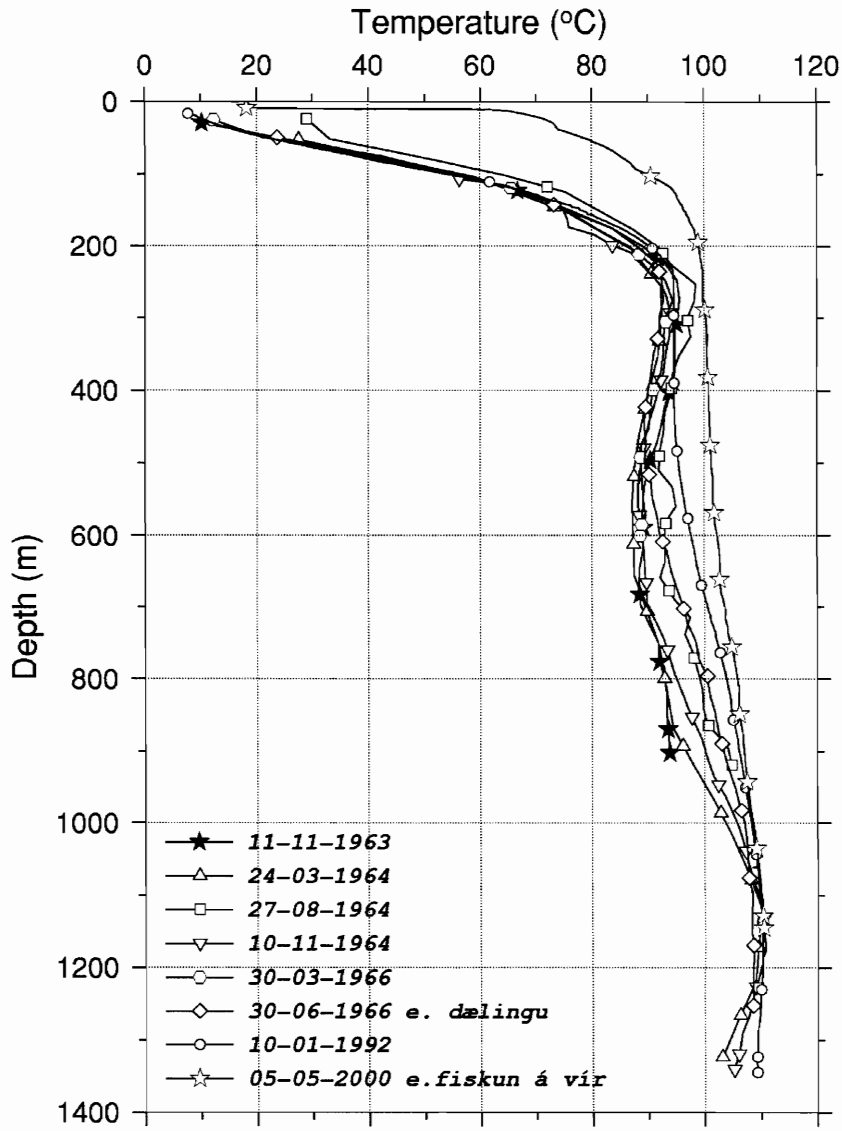

Figure 2: Temperature data from well 1.

Figure 3 shows design and the two caliper logs now available from well 1. From these two calipers and the 4" go-devil run, it is concluded that the well is ready for the 4" tool to be operated in the well during the seismic project. A maximum depth limit is however on the order of 1140-1150 m. Note that there is some difference between the two calipers. The new run appears thus of less quality than the former one, due to higher well temperature. This defect should however not change the overall conclusion that the well is ready for a 4" diameter logging tool.

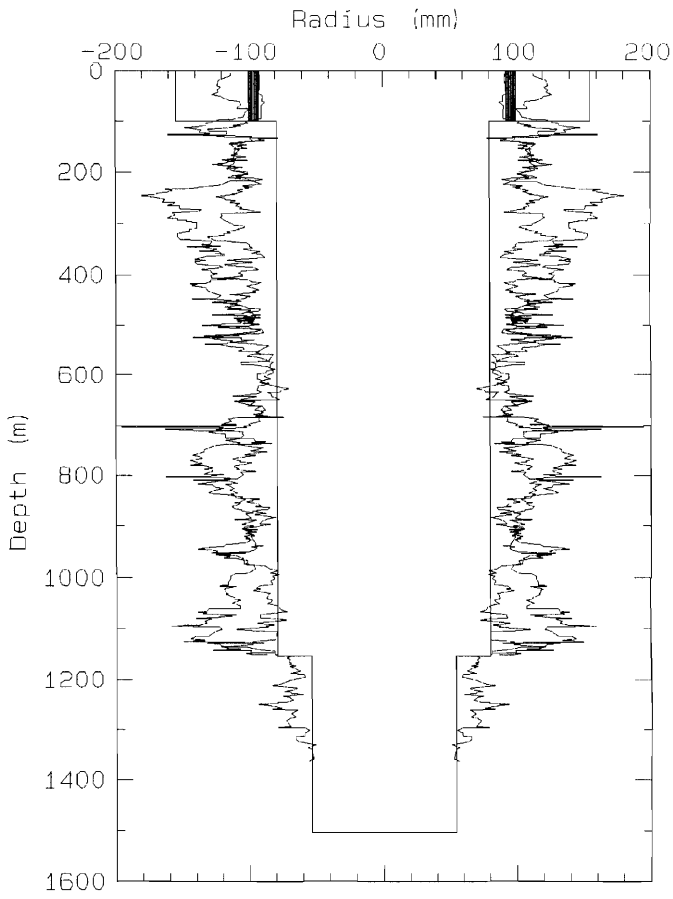

Figure 3: Caliper logs and design of well 1. Straight, narrow lines show the drillbit diameters, thicker vertical lines are casings and the two zigzagged profiles are the caliper runs now collected in the well.

Measurements in well 4

The following is a list of activities carried out in well 4 on May 4, 2000:

- Waterlevel was measured at 15.9 m depth.
- A 1,5" weightbar immersed to a total depth of 483.5 m. Several obstructions were encountered on the way down. Firstly the tool stopped at 343 m, at the same depth where a tool became stuck during logging in 1981. By minor pulling, the weightbar went through and then stopped again at 349, 355 and 478 m depth before reaching a total depth of 483.5 m. This is only 25 m above the drilled depth. During this run we had the feeling that some kind of obstruction was being pushed down the well, or that the well is heavily deviated. When pulling out, the weightbar hooked on to something at 342 m, but was retrieved only by pulling the line by hand.
- The 1,5" weightbar was sent down again to double-check the well depth. This time it became impossible to penetrate the 342 m depth limit. The obstruction was hit hard several times with the weightbar at no success. When pulling out we learned that something hooked on to the weightbar at 325 m depth, but not seriously. The end of the weightbar had been hit several times by an hard object, most likely a piece of cast iron from a submersible pump, as number marks were seen on the led.

- The logging was finalized by sending down a 4" go-devil to 335 m depth. This time obstructions were detected during descent at 325, 329 and 331 m depth.

Figures 4 and 5 show the temperature and the design of well 4. When checking drilling reports we found that the well collapsed at 325-345 m depth. This zone is the best feedzone of the well and may indicate well intersection with the fault B-1 on Figure 1.

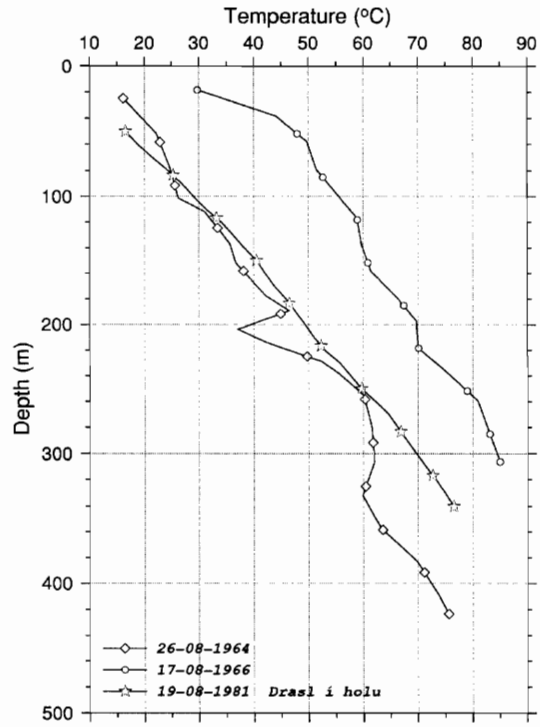

Figure 4: Temperature data from well 4.

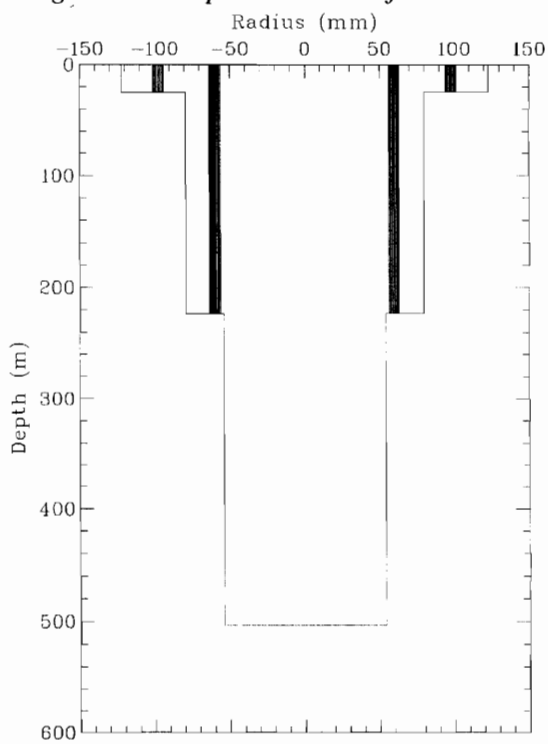

Figure 5: Design of well 4. Same legend as for Figure 3.

Measurements in well 5

The following measurements were carried out in well 5:

- Waterlevel was found at 23.6 m depth.
- A 4" go-devil ran to 544.1 m depth without any obstruction encountered.
- A temperature log was taken to the same depth.

Figures 6 and 7 show the temperature logs collected in well 4 and it's design. No caliper log was carried out this time as the go-devil had no problems going down plus that a reliable caliper log is available from 1981. The shape of the temperature profile shows that well 5 is drilled through a zone of lateral outflow of hot water at 100-150 m depth, presumably coming from the SE and flowing towards the hot springs now present at the shore near well 5.

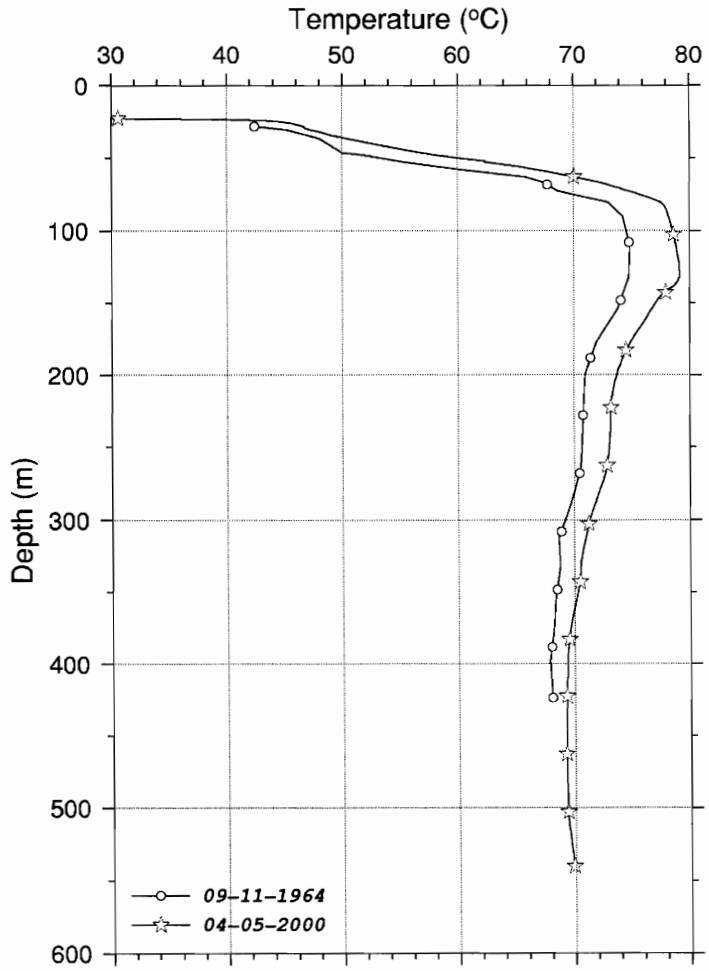

Figure 6: Temperature logs in well 5.

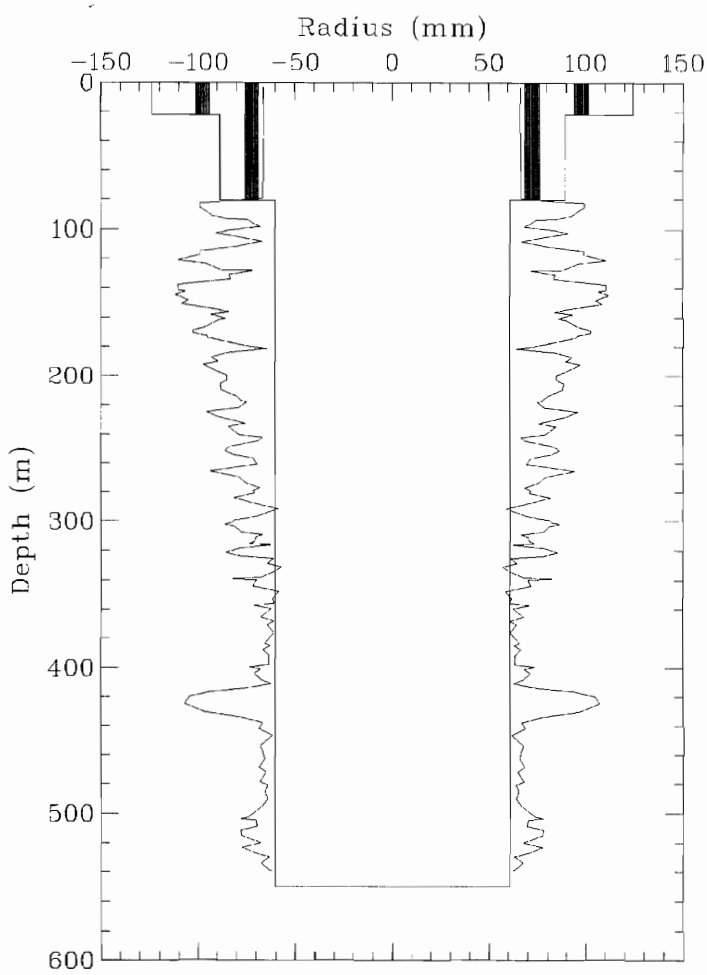

Figure 5: Design of well 5. Same legend as for Figure 3.

Installment of geophones in wells 4 and 5

The logging in Húsavík shows that wells 4 and 5 are suitable for the installment of slim, downhole geophones. We have already discussed this matter with the Húsavík municipal heating company, which is the owner of the wells in question. There are no objections for having a geophone cemented to the bottom of well 5. Furthermore, the drilling engineer of Orkustofnun, Sverrir Thórhallsson (s@os.is), has experience in the cementing of such devices and is available for the job upon request.

Well 4 is, however, a different story. Due to high production potential, a cementing job in the well is out of the question by the owner. If a geophone is to be operated in the well, it has to be non-cemented and retrievable.

Orkustofnun, Iceland on May 25, 2000

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