

**Geothermal well KN-1 at Kröggólfstaðir.
Pump tests and stimulation attempts**

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GEOHERMAL WELL KN-1 AT KRÖGGÓLFSSTAÐIR
Pump tests and stimulation attempts

Well KN-1 at Kröggólfsstaðir was drilled during the period late July through middle of October 1985 to a total depth of 939 m. The well was planned as a hot water well for Silfurlax hf. Several pump tests were performed during the drilling phase in order to evaluate the production characteristics of the well and attempts were made at stimulating the well.

Well KN-1 was first tested on the 17. of September by air-lift pumping (pump test 1.). The results of the test are presented in Fig. 1. At the time the well was 756 m deep. As can be seen from the figure the production characteristics were poor at that time, pumping of less than 10 l/s resulted in a very great drawdown (150 - 190 m) in the well. Based on the data in Fig. 1. the future response of the well, to a constant production of 5 and 10 l/s, was predicted (Fig. 2.). This prediction is uncertain, but it clearly indicates that as of September 17. well KN-1 could only be produced, for an extended period of time (2 yr.), at a very limited rate (1 - 3 l/s). The prediction also indicates that the drawdown will increase seriously with time, the drawdown after 3 hrs. may double in 2 weeks.

It was then decided, based on this poor result, to continue drilling well KN-1 in the hope of intersecting some hot water aquifers at greater depth. On the 27. of September, when the well was 939 m deep, drilling was stopped. No noticeable aquifers had been encountered.

Well KN-1 was pump tested again, by air-lift pumping, on the 1. of October (pump test 2.). The results are shown in Fig. 3. It can be seen that the drawdown is still considerable. Based on these data the drawdown (for the same production) appears to be about 20 % less during pump test 2. than during pump test 1. The predicted drawdown in Fig. 2. can then be lowered by 20 %. The deepening of well KN-1 does thus not appear to have significantly improved the wells production characteristics.

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It was then decided to attempt to stimulate the well (October 2. and 3.):

(1) A few small explosive charges were detonated at 196 m depth to try to unplug possible aquifers behind the slotted liner at that depth. As expected, a collapse occurred at 240 m depth as a result of the explosions. The yield of the well did, however, not appear to improve or diminish.

(2) The interval between 14 and 240 m depth was then pressurized by pumping about 30 l/s of water under pressure into the well in the hope of opening up fractures/aquifers. The interval was closed off by a packer at 14 m depth. A pressure of up to 27 bar was built up during this stimulation attempt, with no noticeable changes occurring.

The final air-lift pump test of well KN-1 was performed on the 4. of October (pump test 3.). At the same time the well was cleaned from 240 - 270 m. The results of the pump test are shown in Fig. 4. where, however, the pumping is somewhat underestimated (by 2-4 l/s). The results indicate that the production characteristics of well KN-1 did not change significantly during the stimulation attempts.

Well KN-1 is currently being flow tested, i.e. the well is open and the discharge (self-flow) is monitored and will be for several weeks. At the present the output is about 3.5 kg/s of steam and water. Before flashing in the well the water has a temperature (Fig. 5.) of 140 C. The thermal power-output (water and steam) of the well is therefore about 1.8 MW at the present. The output of the well will be monitored for a few more weeks as the output is expected to decline somewhat.

Two representative temperature profiles from the well are presented in Fig. 5. One from the end of the drilling phase and the other measured during the self-flow test.

The results of the pump tests and stimulation attempts can be summarized as follows:

(1) The production characteristics of well KN-1 did not improve significantly by the deepening from 756 to 939 m.

(2) The stimulation attempts did not cause any noticeable changes in the production characteristics of well KN-1.

(3) The collapse in the well below 240 m did not appear to affect the yield of the well. The main inflow into the well appears to be above 240 m depth. Possible aquifers between 450 - 500 m depth are therefore either plugged or have not yielded much during pump tests 1. and 2.

(4) Well KN-1 can not be expected to yield much more than 2 kg/s (of water and steam) in the future (2 yrs.) neither by pumping, with drawdown less than 100 m, nor by self-flow.

(5) The current flow test should enable an estimate of the long term self-flow output of the well. For this estimate to be possible the test needs to be continued for at least a month.

Kröggólfstaðir well KN-1
 Pump test 1. - 85.09.17

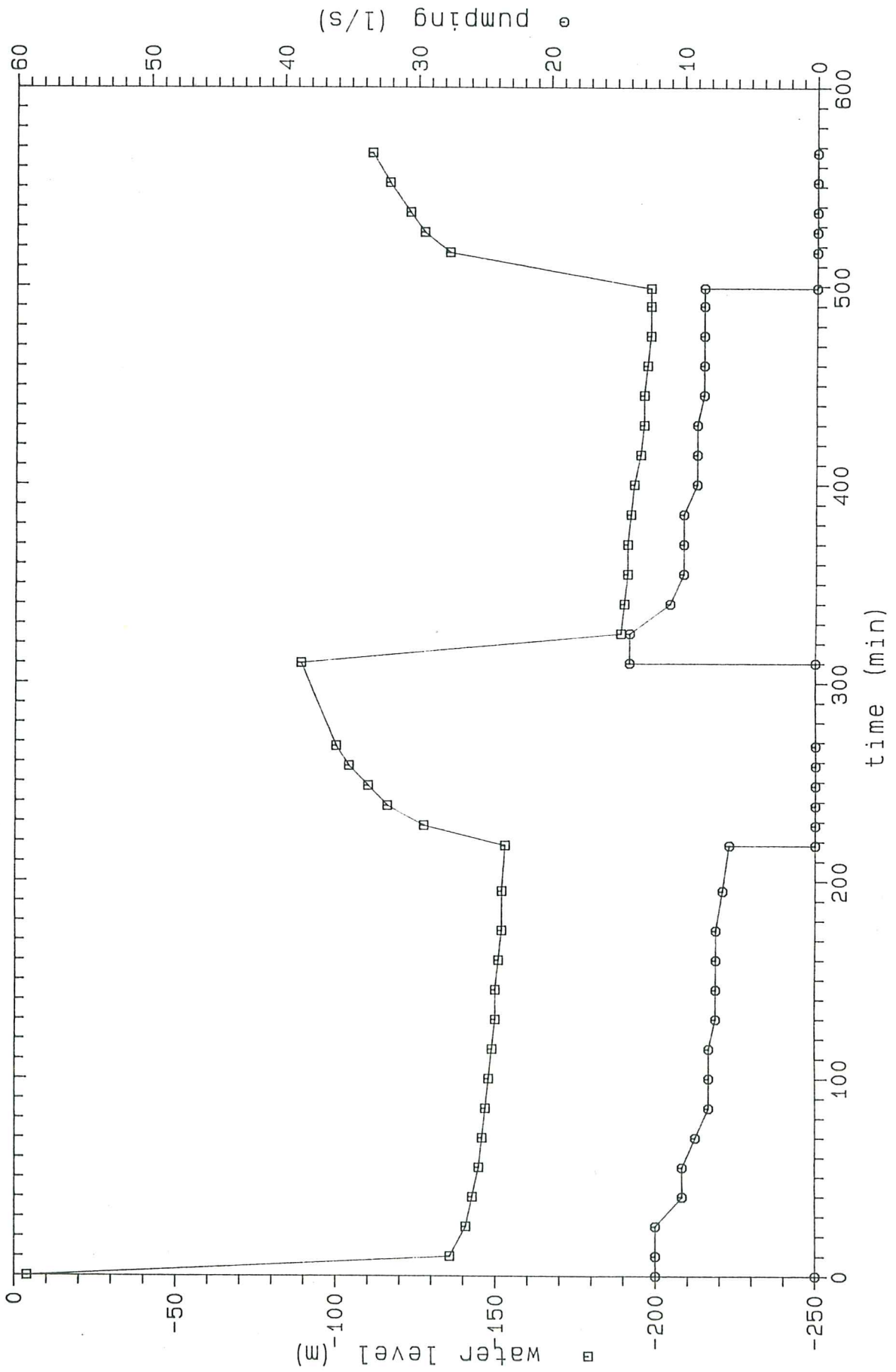


Fig. 1.

Kröggólfstaðir well KN-1
Predicted drawdown

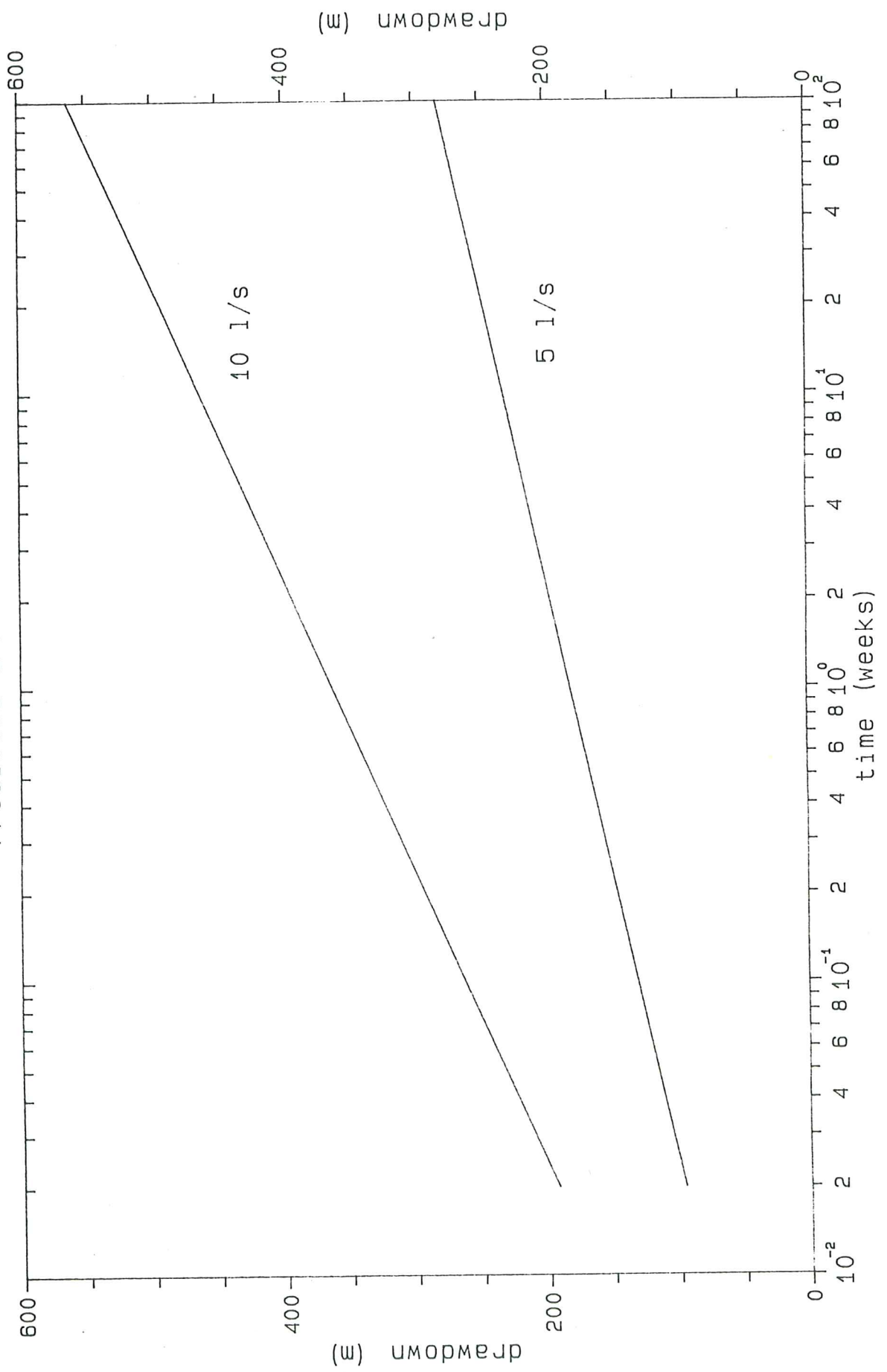


Fig. 2.

Kröggólfstaðir well KN-1
 Pump test 2. - 85.10.01

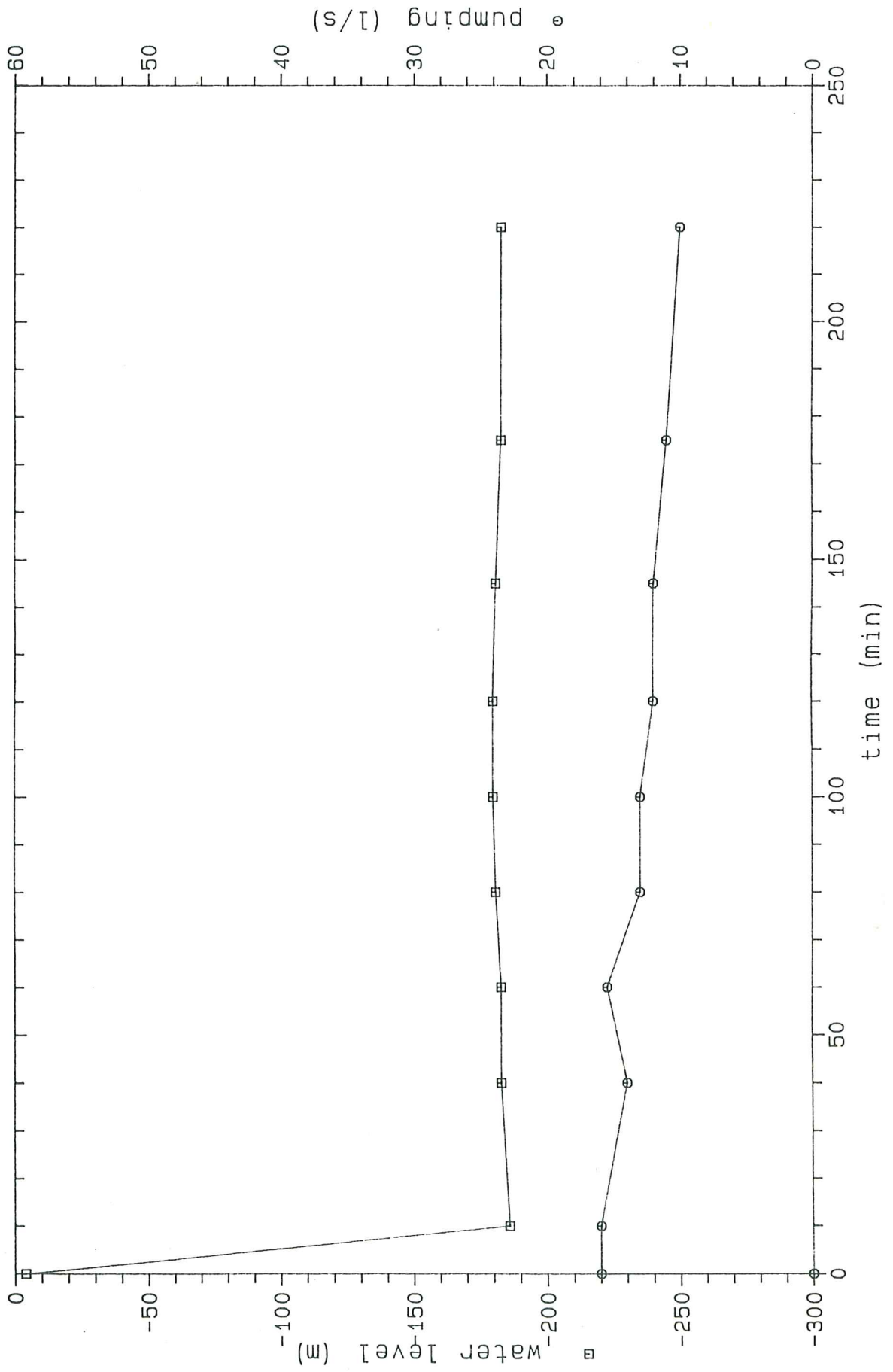


Fig. 3.

Kröggólfstaðir well KN-1
 pump test 3. - 85.10.04

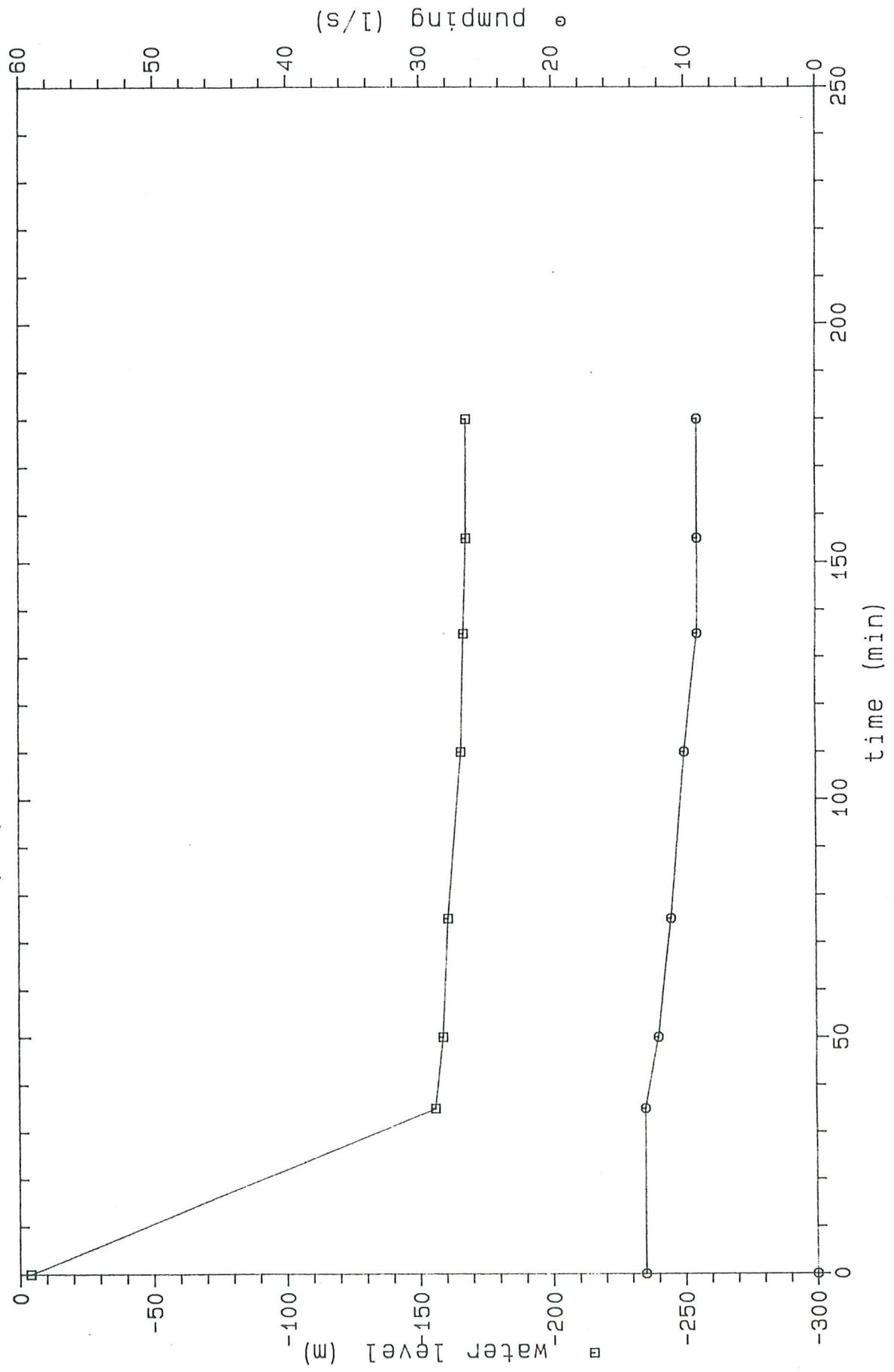


Fig. 4.

Well KN-1 Temperature measurements

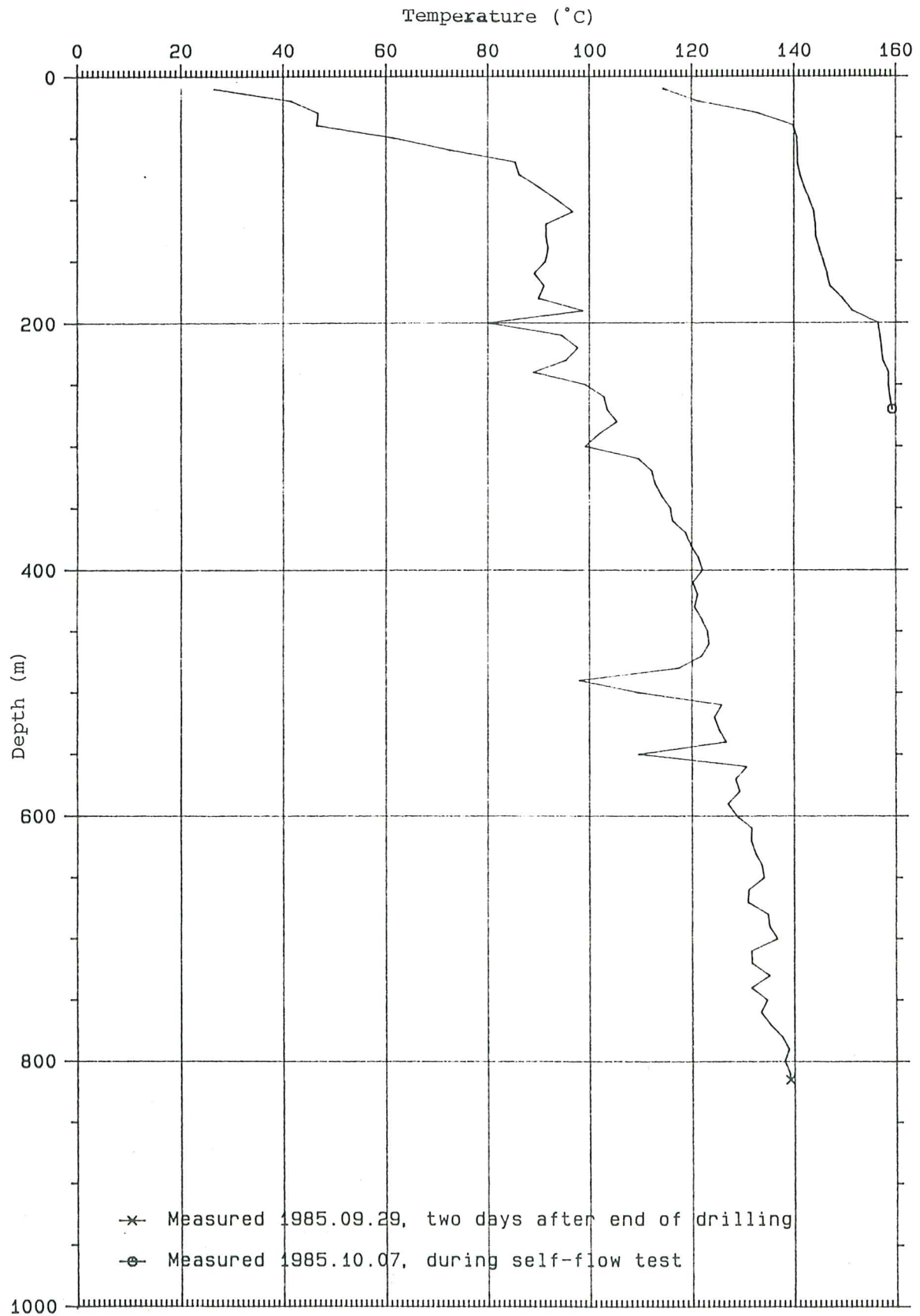


Fig. 5.