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Fljótsdalur Hydro Project. Recovery in core holes after air lift testing

Ómar Sigurðsson

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FLJÓTSDALUR HYDRO PROJECT
Recovery in core holes after air lift testing

General

Eight core holes were pumped from different depths by use of air lift. After the pumping was stopped the water level recovery was measured. The core holes are slim holes with average diameter of about 0.076 cm. Some of the holes were pumped with the drill string in the hole which can affect the results of those tests. Furthermore, the drawdown observed in the holes during the air lift testing indicates high pressure losses at the walls of the drill holes. These additional pressure losses are caused by non-Darcy flow effects i.e. turbulent flow.

The water level recovery was fitted with analytical models and one should keep in mind that the estimated values for transmissivity, storage and skin factor are model dependent to some degree. For most of the holes a model assuming a constant pressure production prior to the shut-in was sufficient to fit the data. In some of the drill holes, especially those that showed a rapid recovery, the numerical simplification of the analytical functions does not fully hold at all times. This could be clearly seen in the fitting process of data from hole FS-33, but in that case the fully expanded analytical equation for that model had to be used.

In general the coefficient of transmissivity (T) obtained from the tests is low ranging between $(0.06\text{-}6.0)10^{-6}$. The storage coefficient (S) is, however, high indicating that the water feed zones in the holes have pressure connection to the regional groundwater system (system with a free water table). In that case the storage coefficient is a function of the average porosity and the drainage area for the holes. As the transmissivity is low, the pumping time generally on the order of one hour per step and the holes can be assumed to drain a circular area, then the radius of the drainage area can be estimated to be on the average about 1.5 m. The storage coefficient could therefore be used to estimate the average formation porosity for the main water feed zones in some of the drill holes. For most of the holes the skin factor is around zero.

In the following paragraphs the main results of the water level recovery after the air lift testing is presented for each of the core holes.

Core hole FS-31

The fit with the water level recovery data in this hole gives the highest estimates for the coefficients of transmissivity and storage. For a known thickness of the main feed zones the average permeability could be obtained from the transmissivity. The high storage further indicates that the main feed zones have a good communication to the local groundwater system

Core hole FS-32

For hole FS-32 only the latter recovery step is fitted as the early data is missing from the former step. The analytical model used assumes a constant circular head at some distance from the hole. The coefficients for the transmissivity and storage are about the average as can be expected from these holes. Estimated average porosity from the storage coefficient is about 3 %.

Core hole FS-33

Three recovery steps were obtained after pumping at three different depths. All the steps show a very rapid recovery so the only model that could fit the data assumes a constant pressure head at some distance from the hole. Temperature profiles indicate that the main feed zone is the bottom of the hole. That feed zone has therefore permeabiliy in the upper range for these holes. Further the feed zone is in a relatively good aquifer as the constant pressure boundary is estimated at a distance of less than 0.5 m from the hole.

Core hole FS-34

The estimates for the transmissivity coefficient are below average in this hole indicating relatively low formation permeability. From the storage coefficient the average porosity is estimated about 4 %.

Core hole FS-35

Three recovery steps were obtained in this hole after pumping was stopped at three different depths. The coefficients of transmissivity estimated are above average for this hole. The coefficients of storage are also in the upper range indicating a relatively good pressure connection to the local groundwater system. Estimated average porosity would be about 8 %.

Core hole FS-36

Two recovery steps were obtained in hole FS-36 after pumping was stopped at two different depths. A widely different estimates for the coefficients of transmissivity and storage is obtained form the fit to each of the steps. Here the latter step is considered to be more representative for this hole. The transmissivity is therefore below average, but the storage is high. As before, the high storage can indicate a good communication to the local groundwater system.

Core hole FS-37

Two recovery steps were obtained in hole FS-37. Both steps were obtained after pumping had been stopped at about 110 m depth. Here only the latter step is considered as the early data is missing from the former step. The fit to the recovery data of the latter step indicates a very low transmissivity for this hole. The storage estemated is also in the lower range.

Core hole FS-38

Here a double porosity model was used to fit the water level recovery data. An adequate fit was not obtained, but the behavior of the recovery strongly indicates a fracture flow. The estimated transmissivity shown on the figure for this hole is therefore to low. The fracture related transmissivity is expected to be about ten (10) times higher than that shown on the figure.

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Ómar Sigurðsson

JHD-BM-760-Omar
90.11.0623 T

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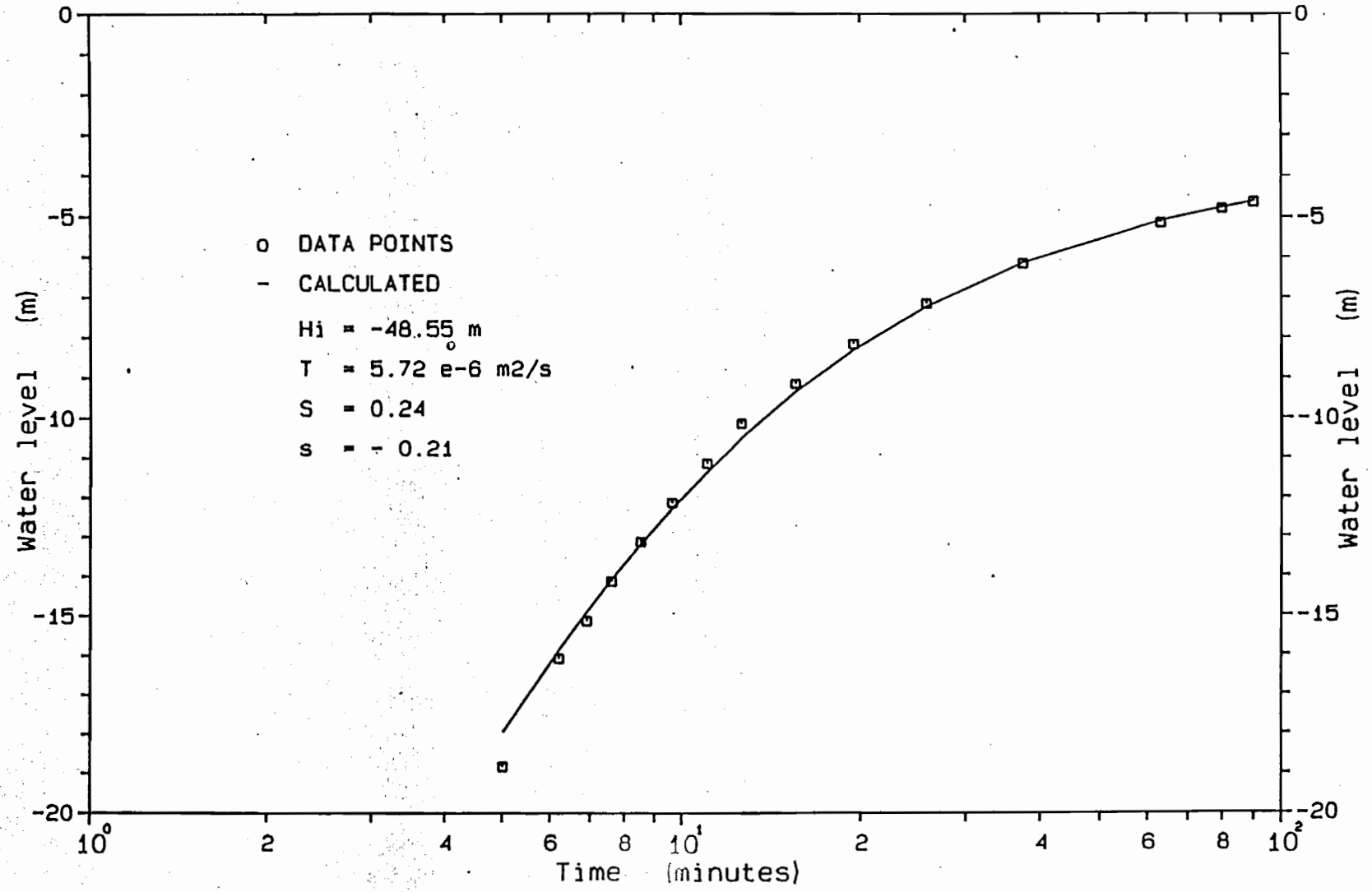
Air lift test in core hole FS-31



JHD-BM-760-Omar
90.11.0632 T

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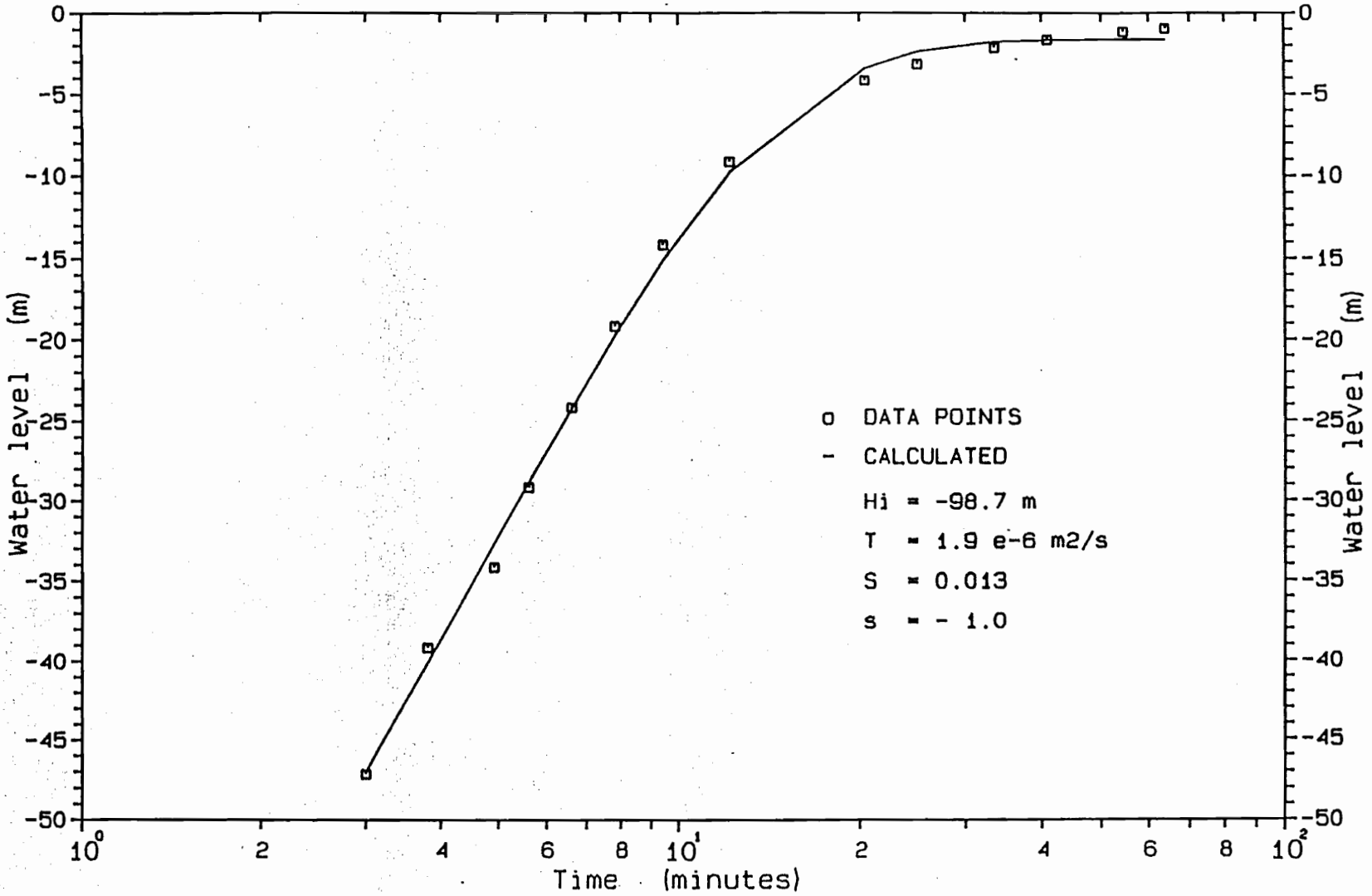
Air lift test in core hole FS-32



JHD-BM-760-Omar
90.11.0625 T

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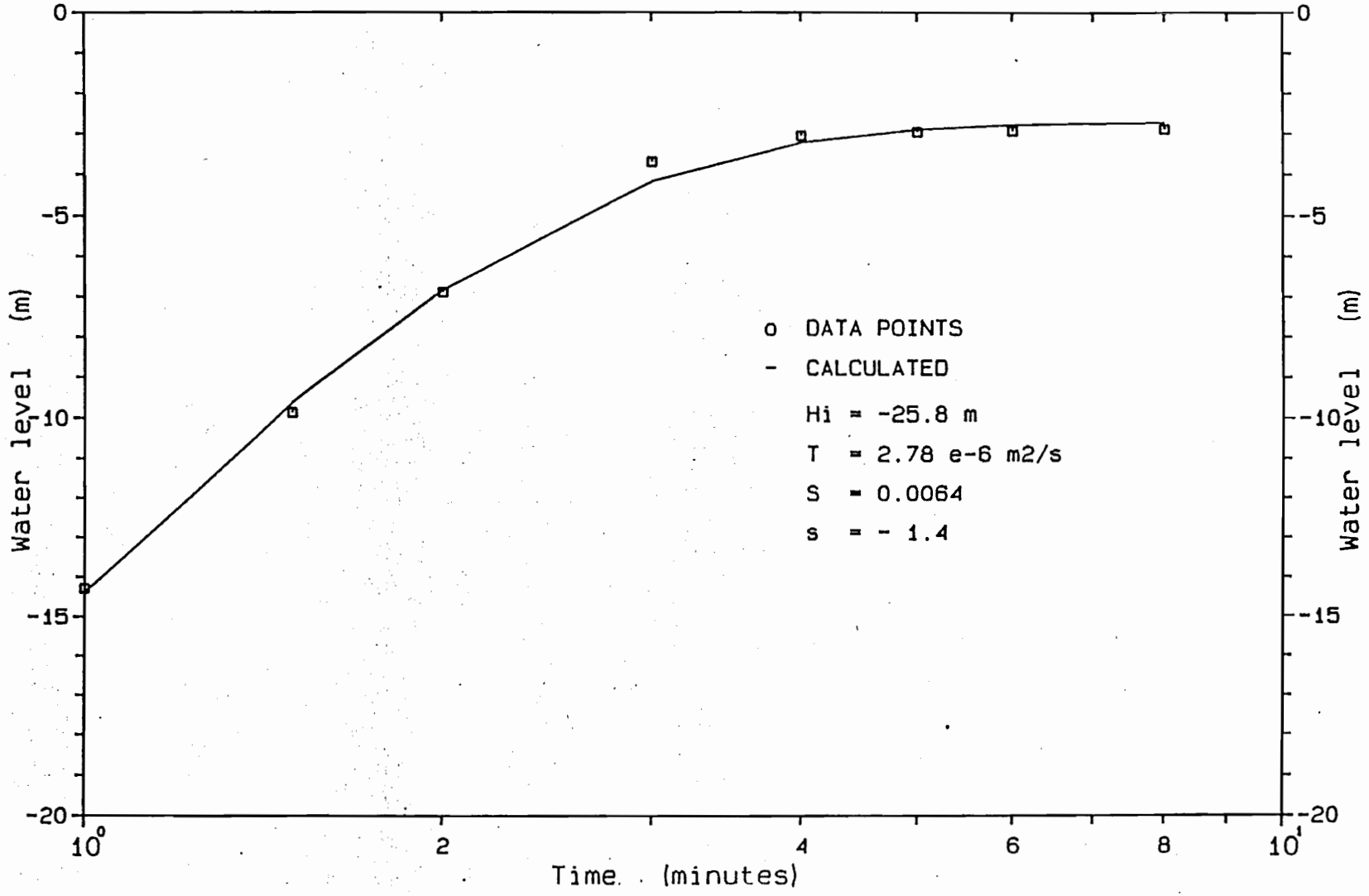
Air lift test in core hole FS-33



JHD-BM-760-Omar
90.11.0626 T

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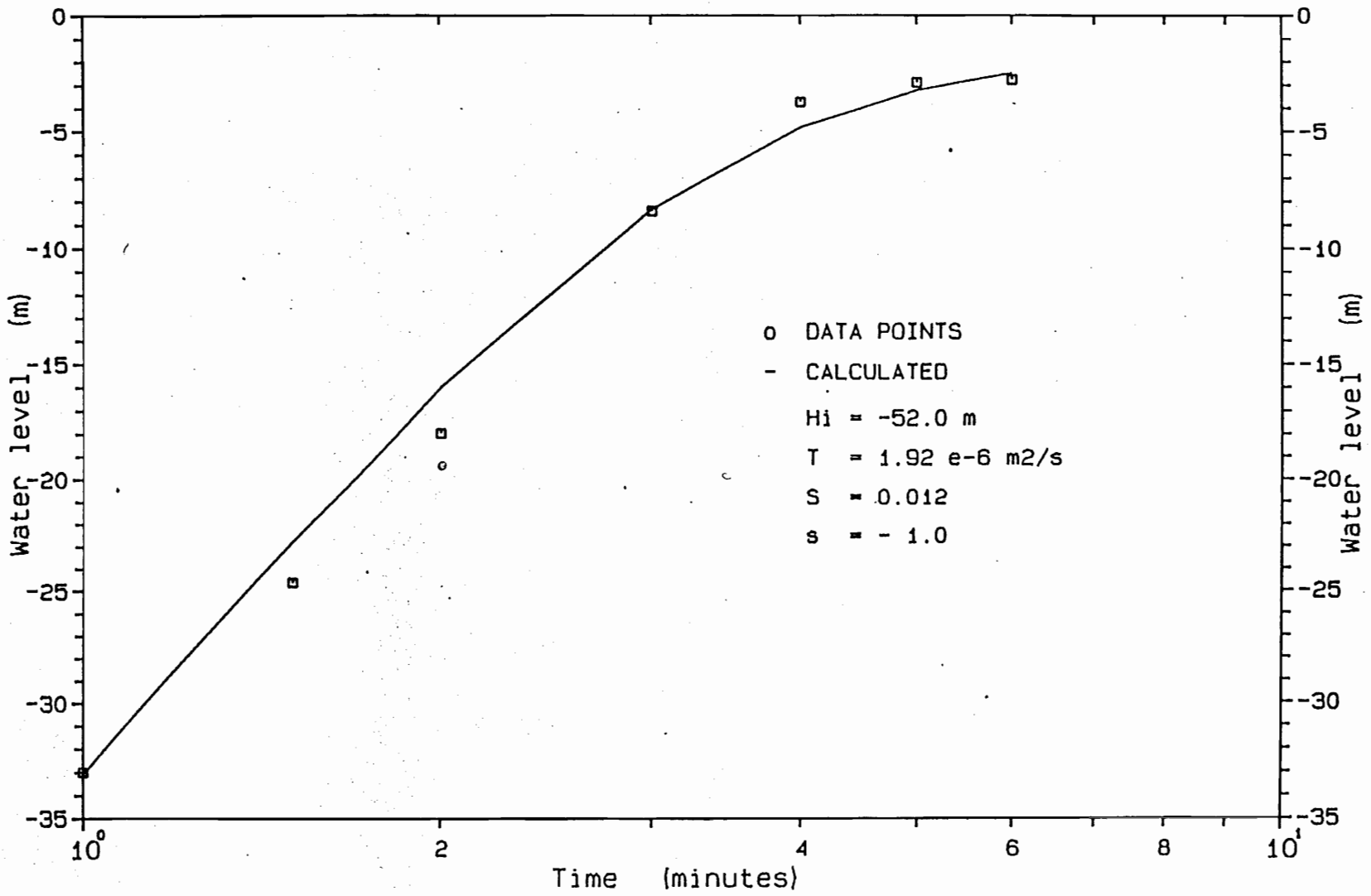
Air lift test in core hole FS-33



JHD-BM-760-0mar
90.11.0627 T

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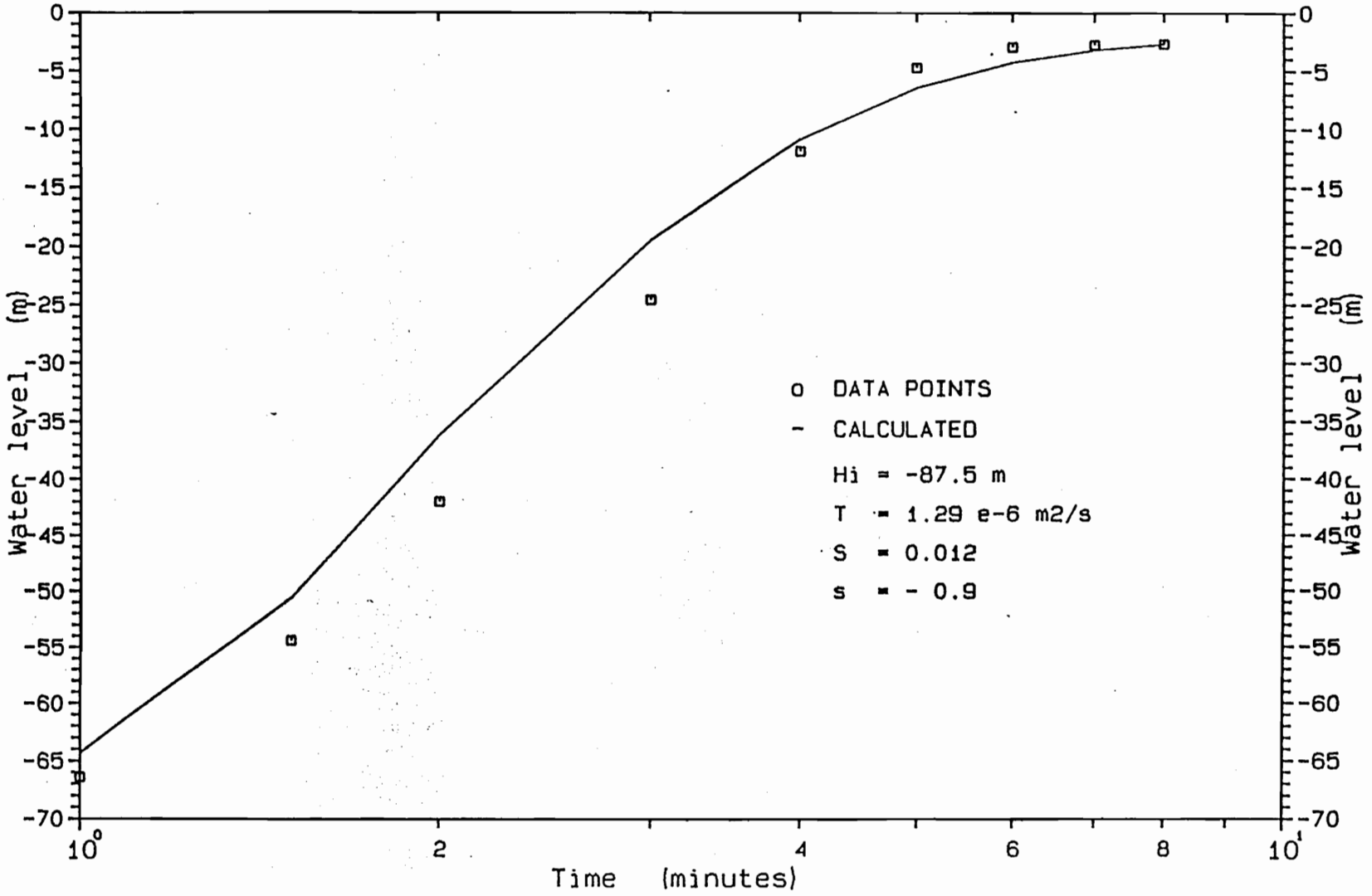
Air lift test in core hole FS-33



JHD-BM-760-Omar
90.11.0628 T

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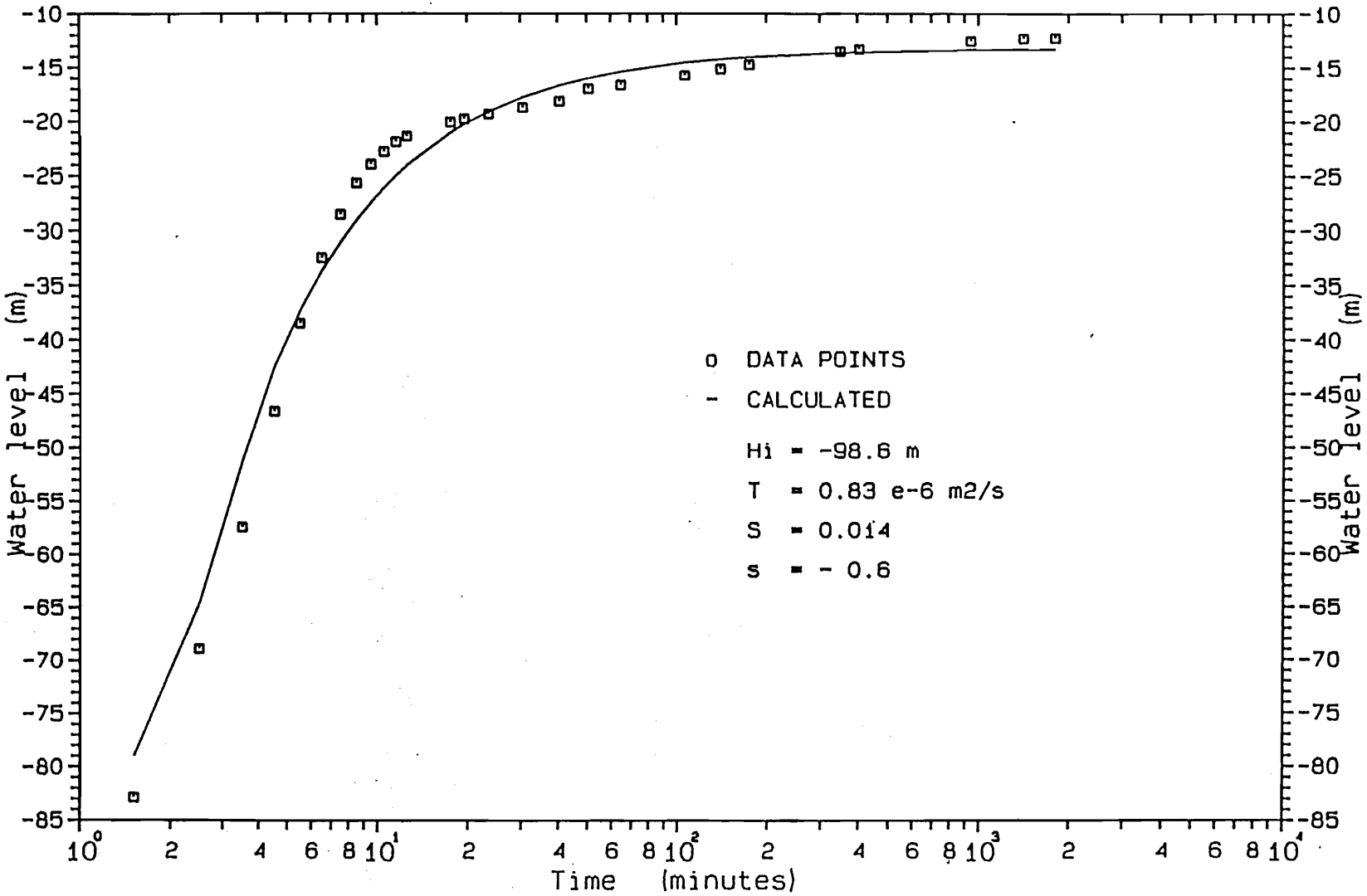
Air lift test in core hole FS-34



JHD-BM-760-0mar
90.11.0634 T

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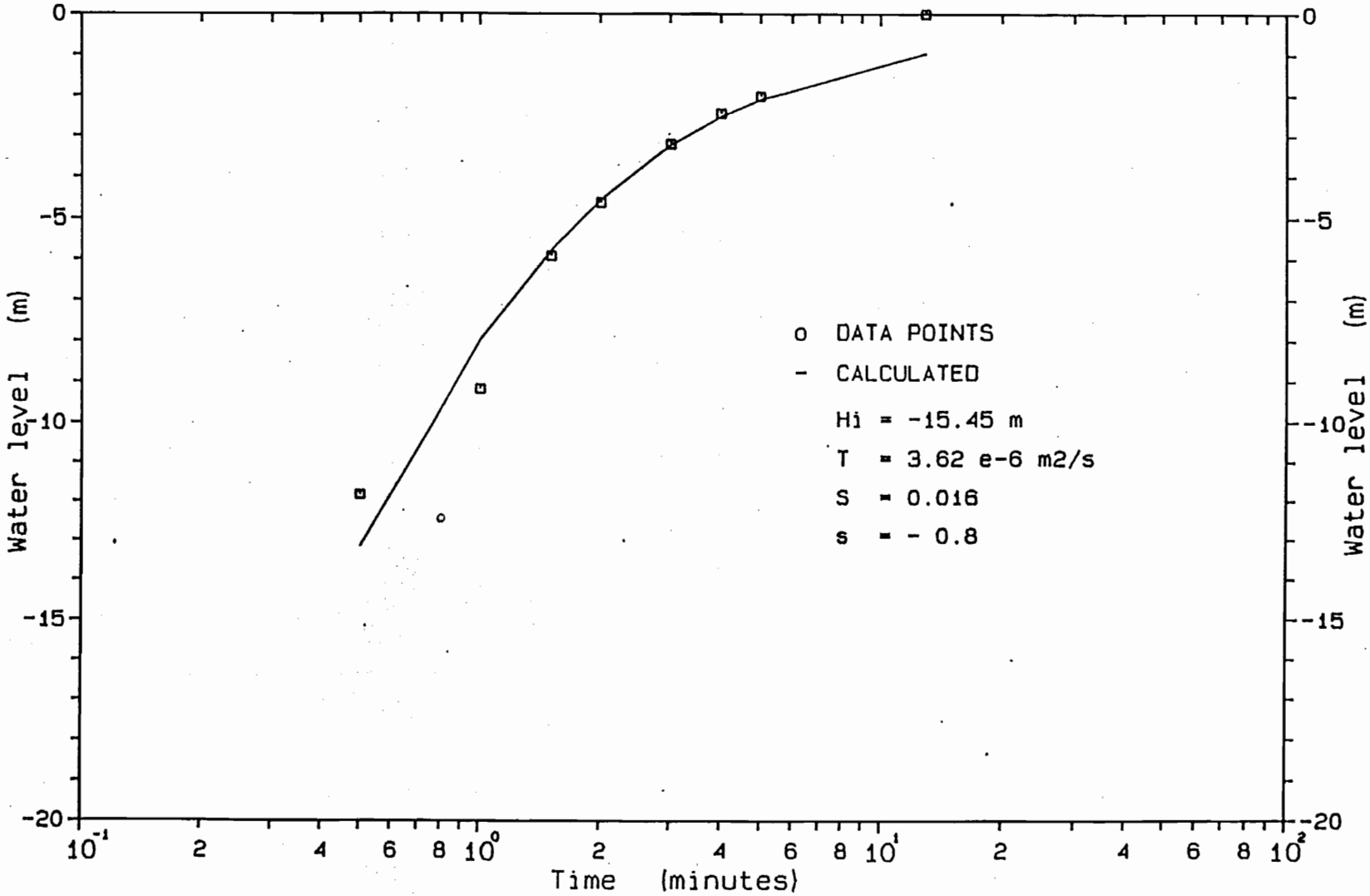
Air lift test in core hole FS-35



JHD-BM-760-Omar
90.11.0635 T

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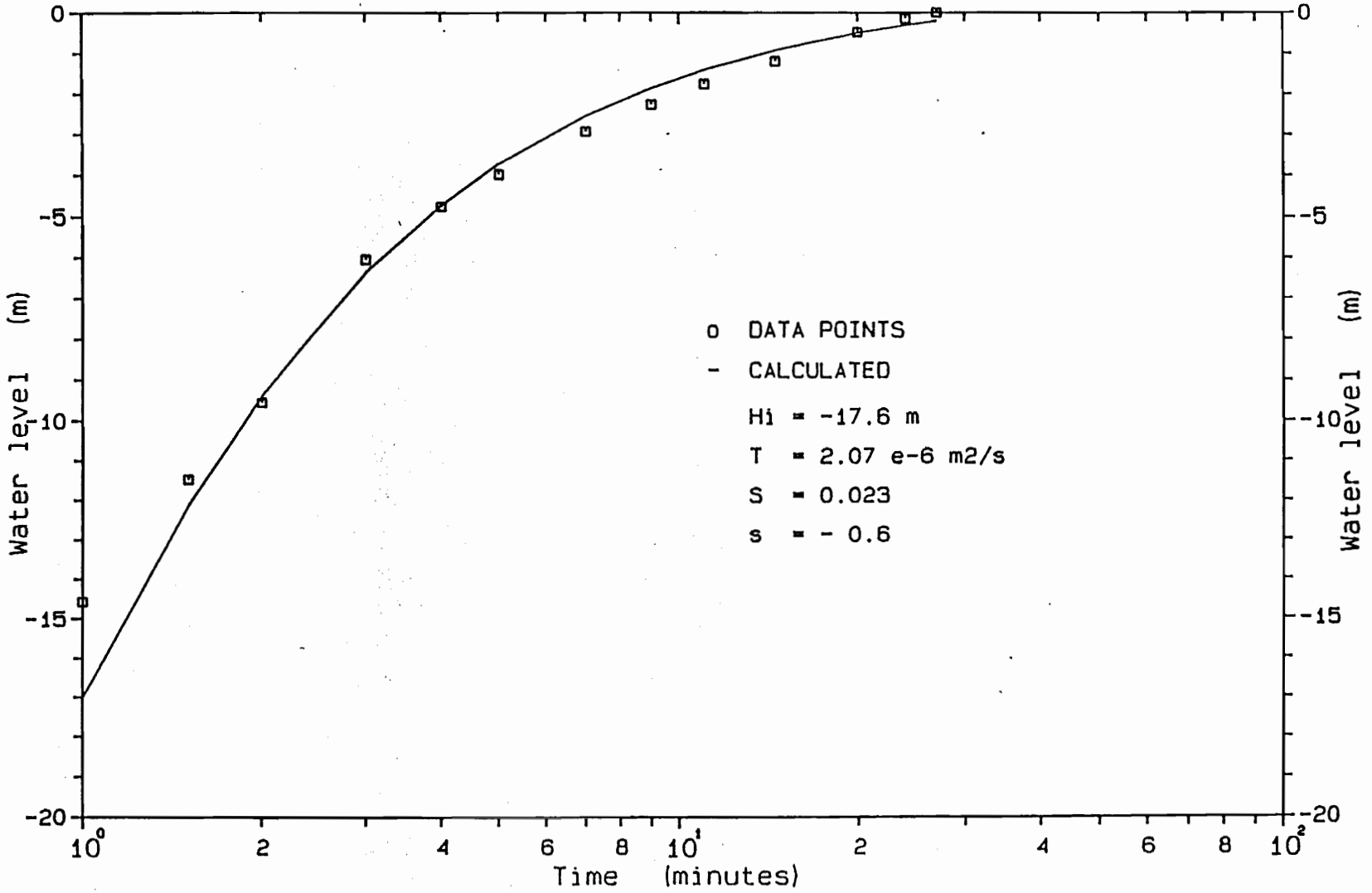
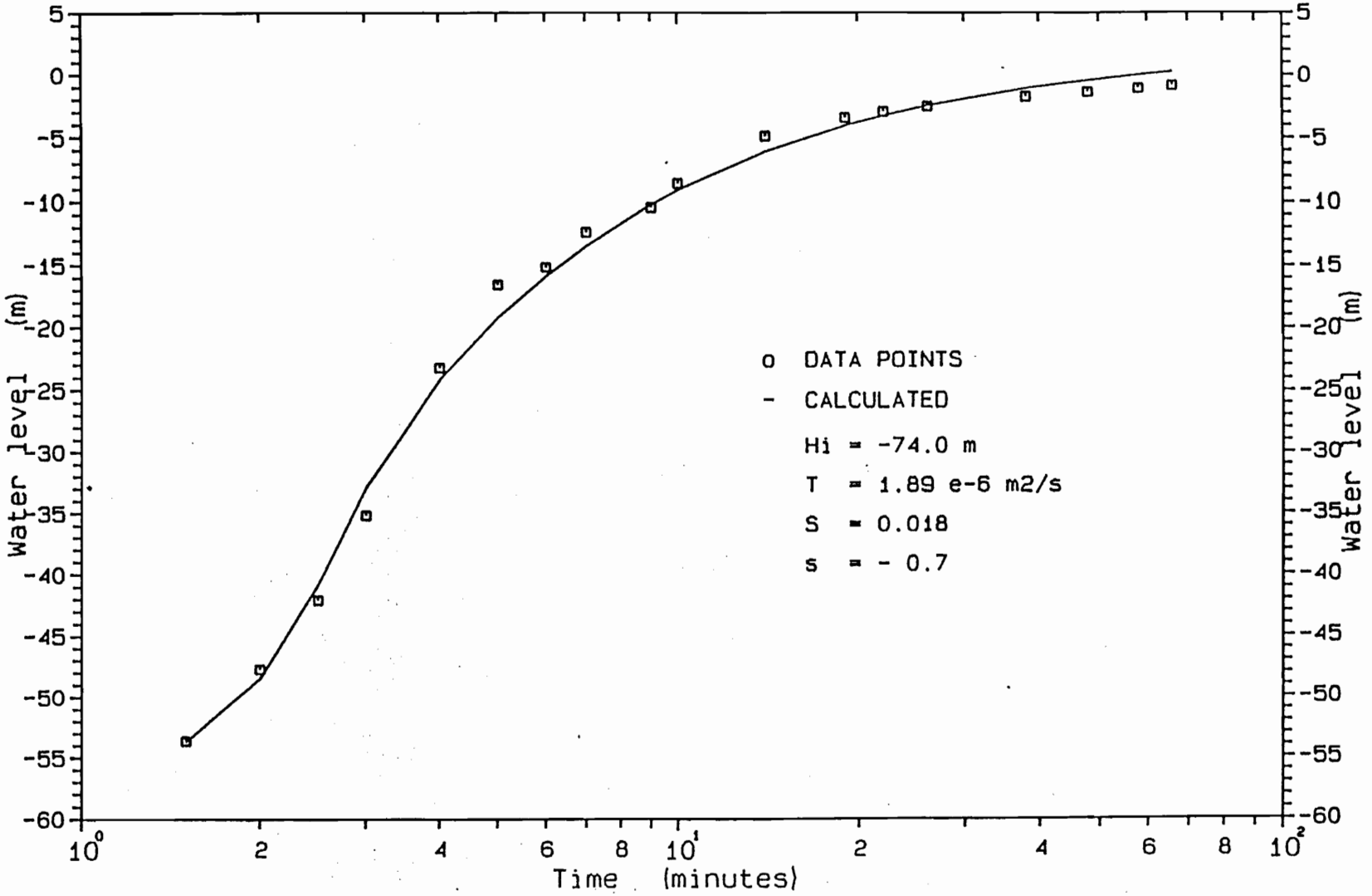
Air lift test in core hole FS-35



JHD-BM-760-Omar
90.11.0633 T

FLJÓTSDALUR HYDRO PROJECT

Air lift test in core hole FS-35



JHD-BM-760-Omar
90.11.0629 T

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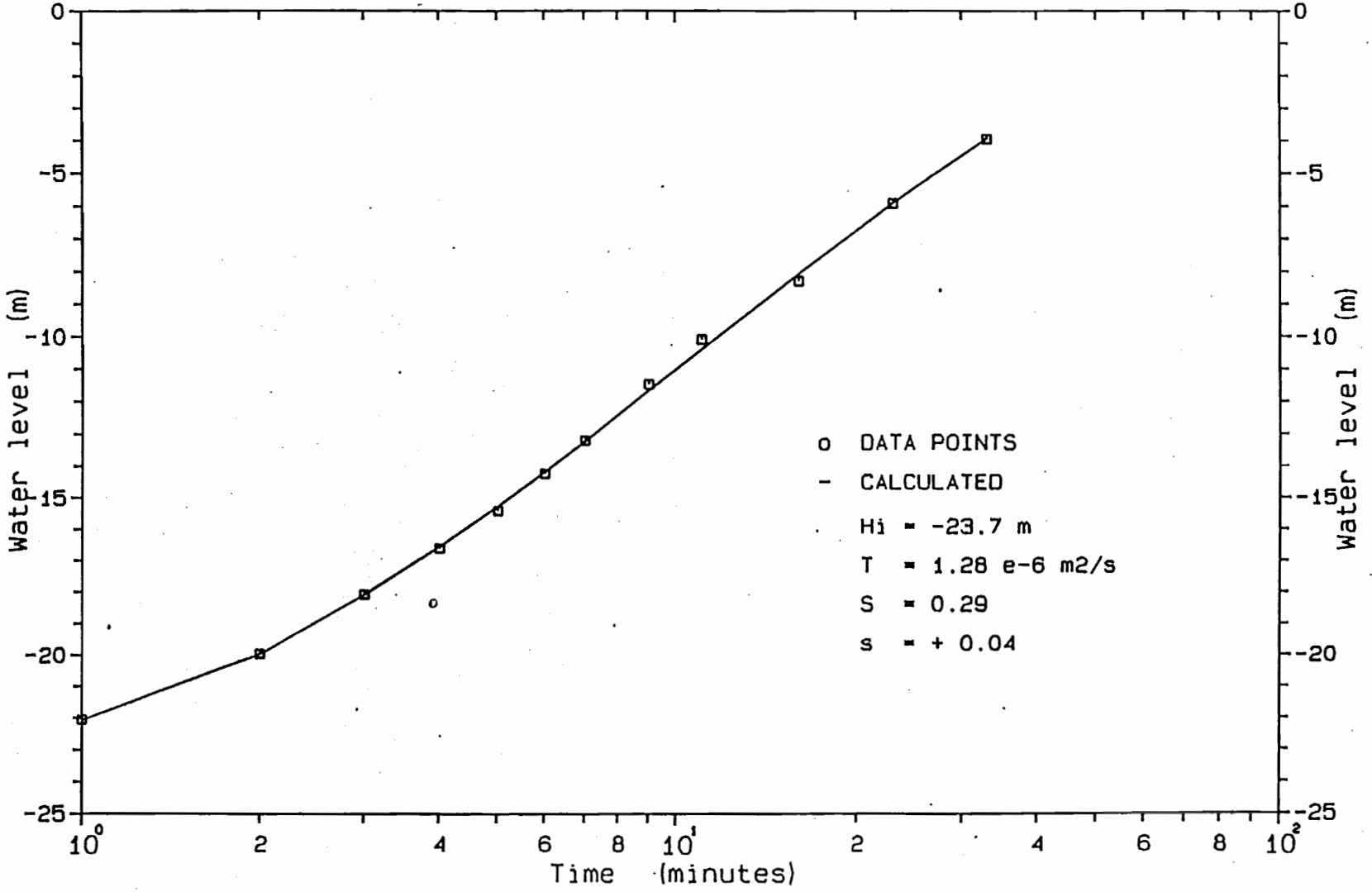
Air lift test in core hole FS-36



JHD-BM-760-Omar
90.11.0630 T

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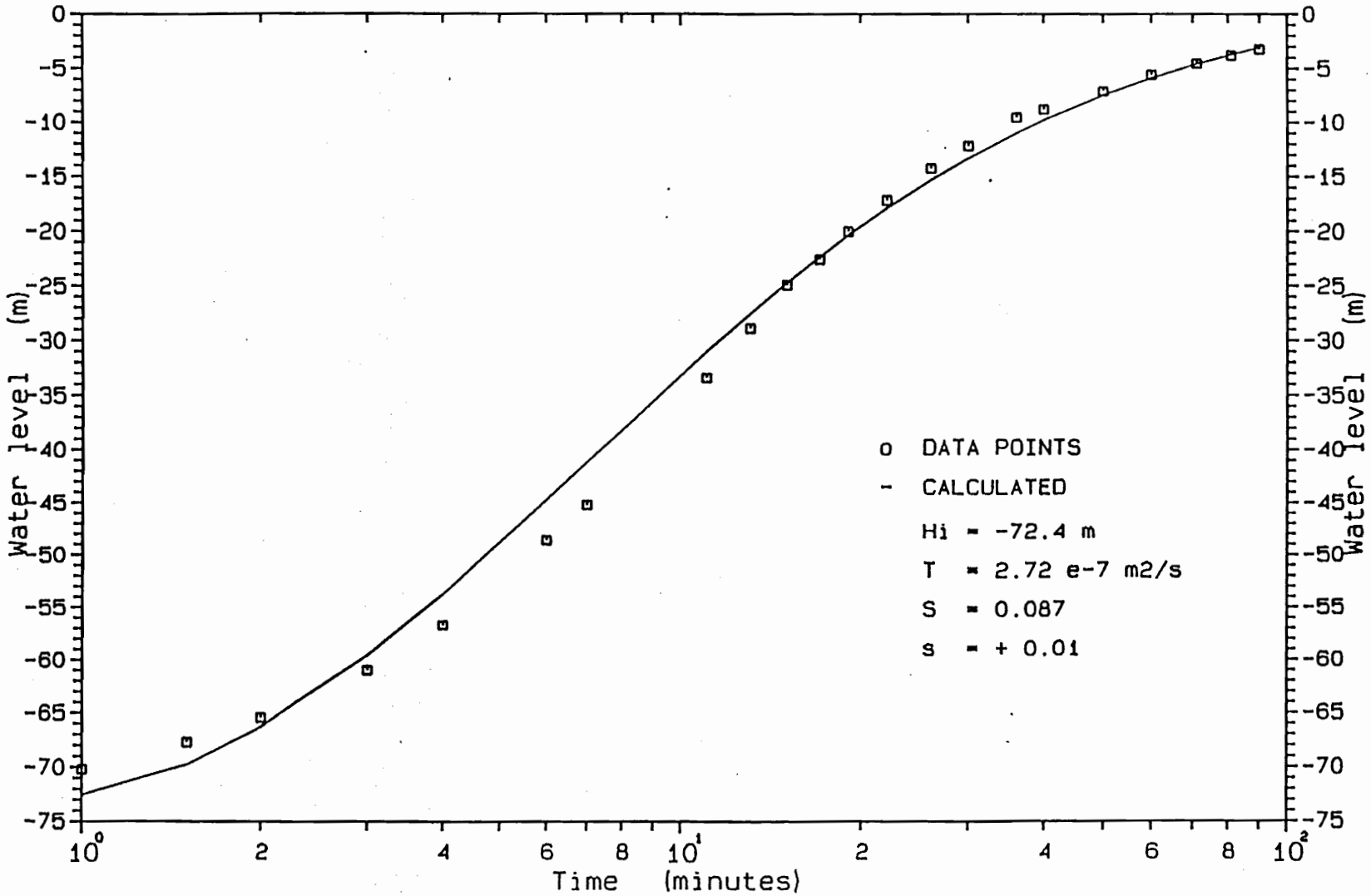
Air lift test in core hole FS-36



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90.11.0624 T

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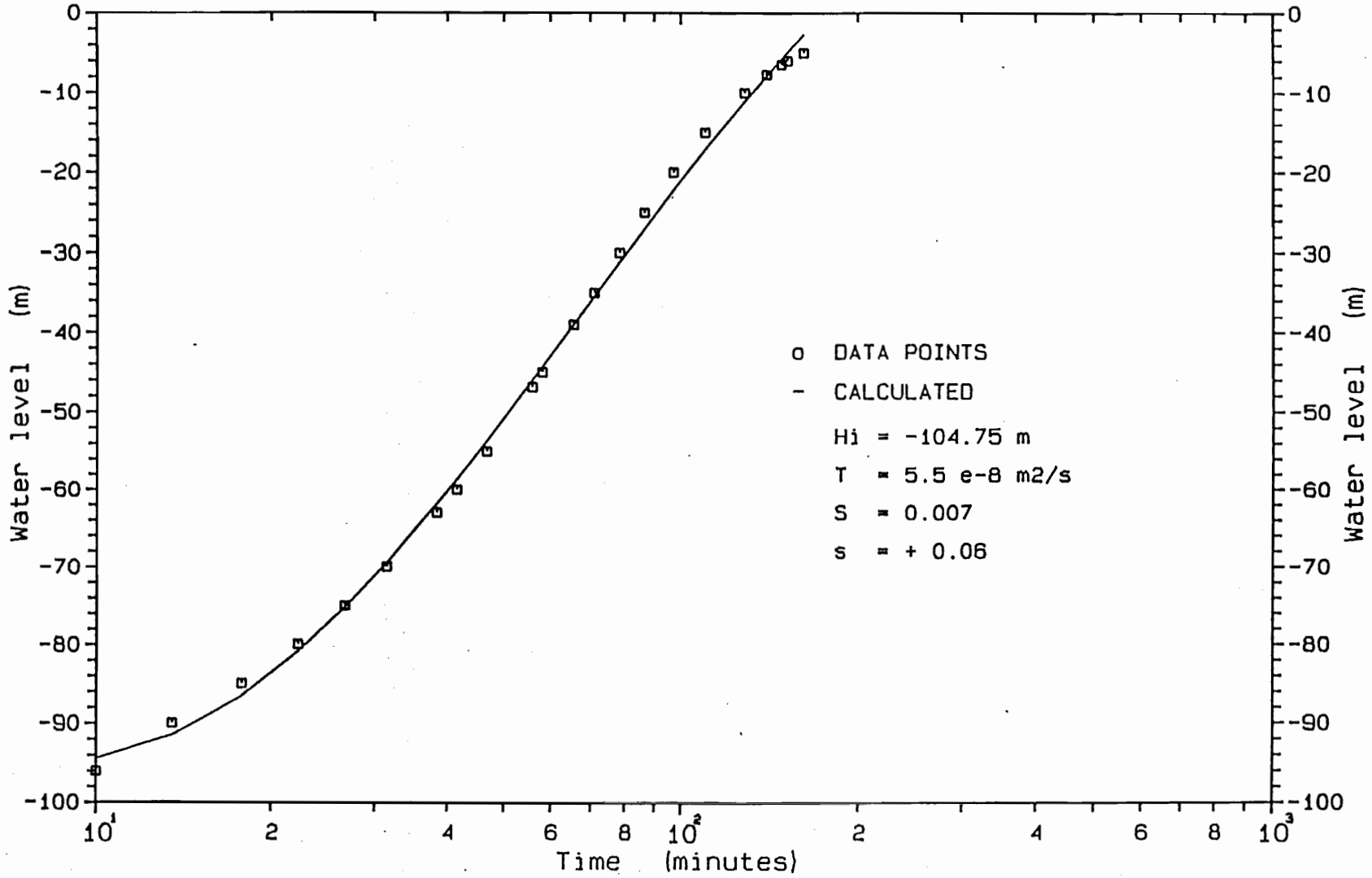
Air lift test in core hole FS-37



JHD-BM-760-Omar
90.11.0631 T

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Air lift test in core hole FS-38