Borehole flow characterization using DTS to monitor discrete in-well heat tracer tests

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Introduction

The use of discrete in-well heat tracer tests to identify geologic characteristics. Results show how well test tools (heat injection)

Methods

1. Methods of heat induction:
   - Abrupt changes in upward flow rate occur at depths of 31 m and 64 m and indicate fractures are present at those depths
   - Method of heat induction: Staining steel perforated shroud
   - Method of temperature measurement: DTS system

Experiment Design

1. Experiment design:
   - Investigating the presence of permeable features such as fractures, the presence of aquitards, and whether flow is upward or downward
   - Method of temperature measurement: Fiber optic cable deployed over full length of well
   - Method of temperature measurement: Distributed Temperature Sensing (DTS) system

Study Location

1. Study Location:
   - Well A: Ice
   - Well B: Ice
   - Well C: Ice

Results

1. Results:
   - Above 47 m, flow appears to come from porous medium
   - Below 47 m, flows are too high to measure with this method
   - The results indicate that DTS monitoring of induced heat pulses is an effective method for detailed borehole flow characterization

Abstract

Heat tracer tests in open wells or boreholes provide valuable information about the adjacent formations, including the presence of permeable features such as fractures, the presence of aquitards, and whether flow is upward or downward. Heat tracer tests in wells are complicated due to the challenges of adding heat to the well and then measuring the response of the water. The results of these tests can be used to identify permeable features and to infer the behavior of the surrounding formations.

Conclusion

DTS is an excellent method of monitoring in-well heat tracer tests, providing real-time data for the length of the borehole without disturbing the water column. It is a non-invasive method that allows for detailed characterization of the flow regime within the borehole. The results indicate that DTS monitoring of induced heat pulses is an effective method for detailed borehole flow characterization.