Wellbore Integrity Monitoring in a Hot Geothermal Well using Fibre Optic Distributed Temperature Sensing

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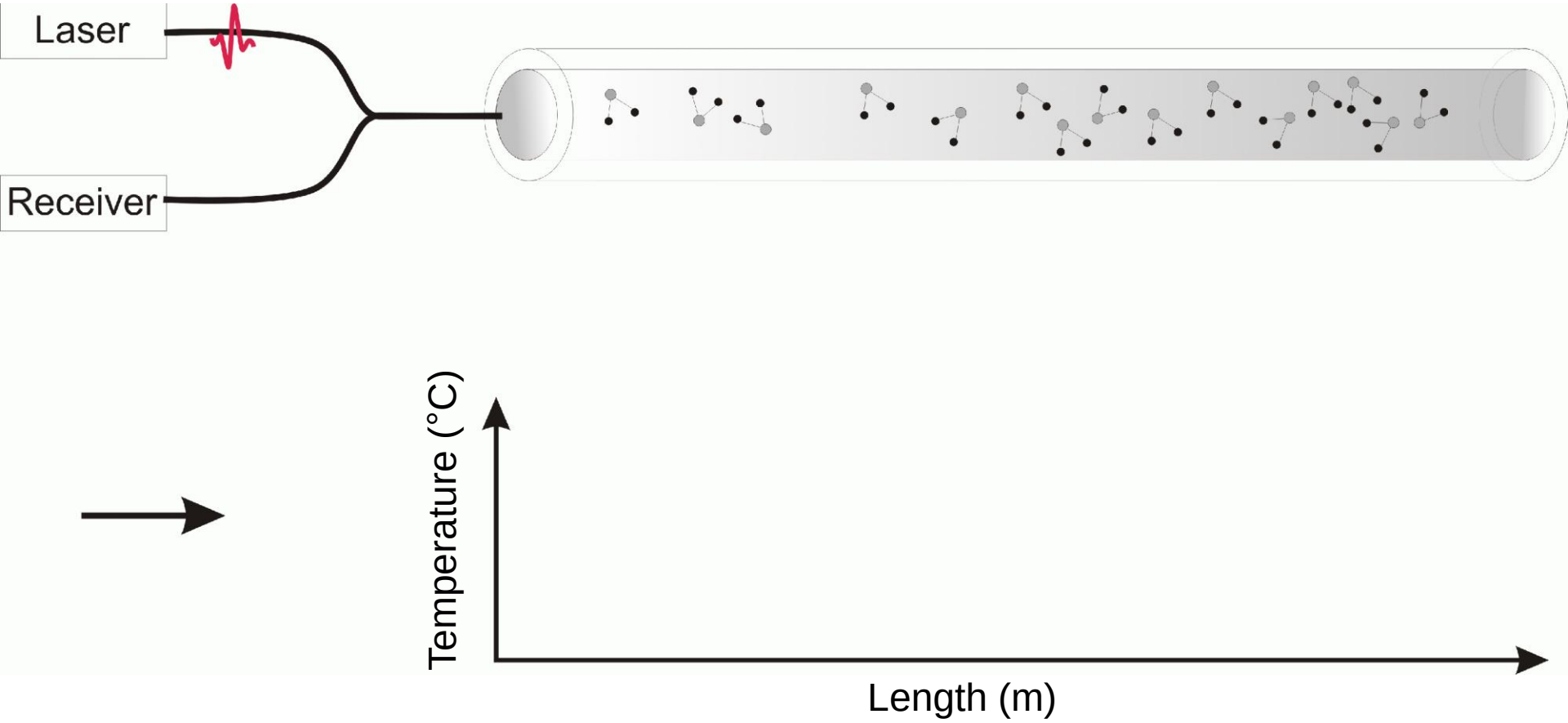
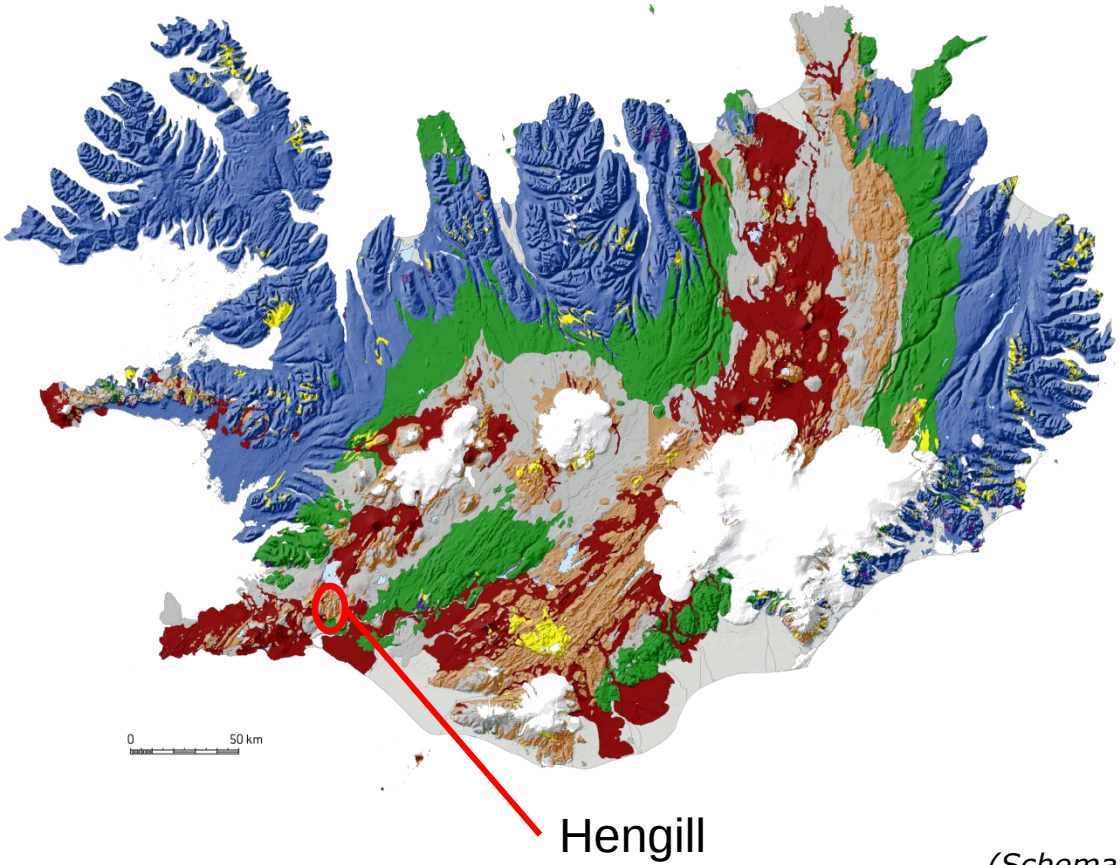
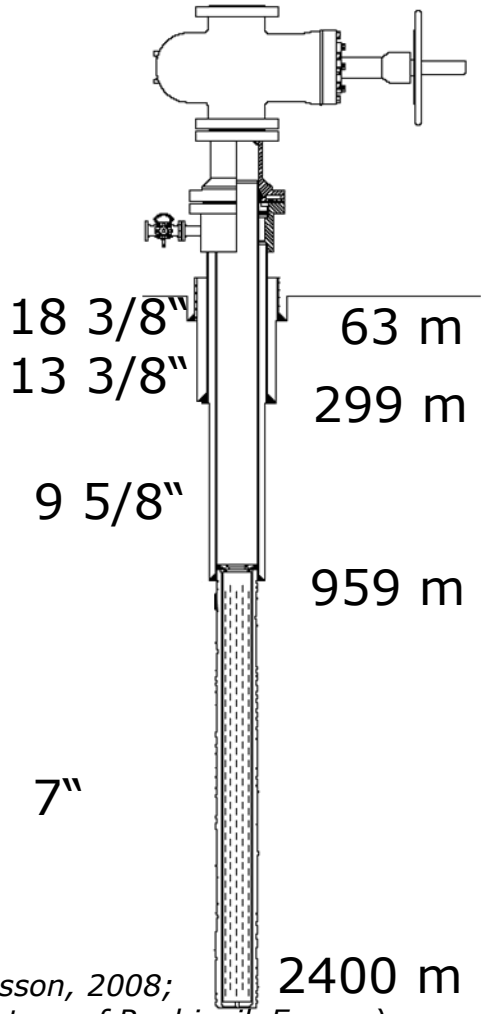
Distributed Temperature Sensing



Iceland – Installation

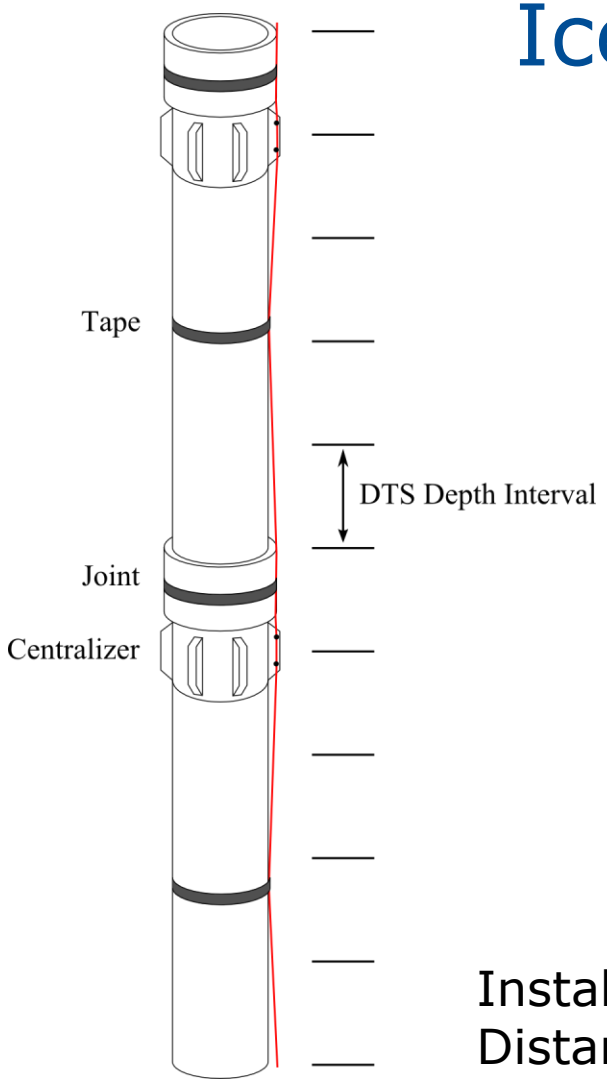


(Jóhannesson and Saemundsson, 1999)



(Schematic: Thorhallsson, 2008;
Well information courtesy of Reykjavik Energy)

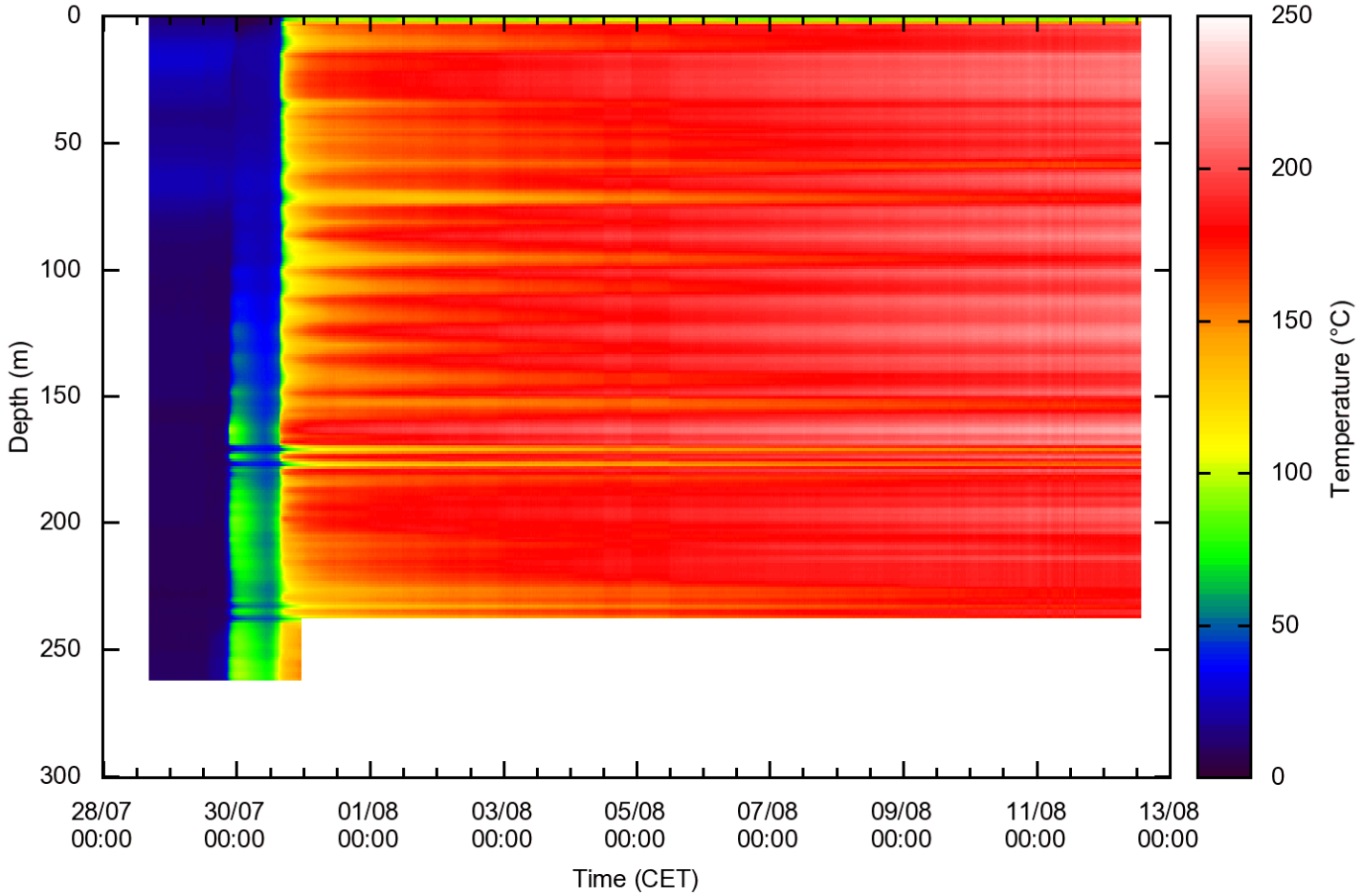
Iceland - Installation



Installation behind anchor casing down to 261.28 m (b.s.)
Distance between cable and casing varies with depth

Site HE-36 and HE-53

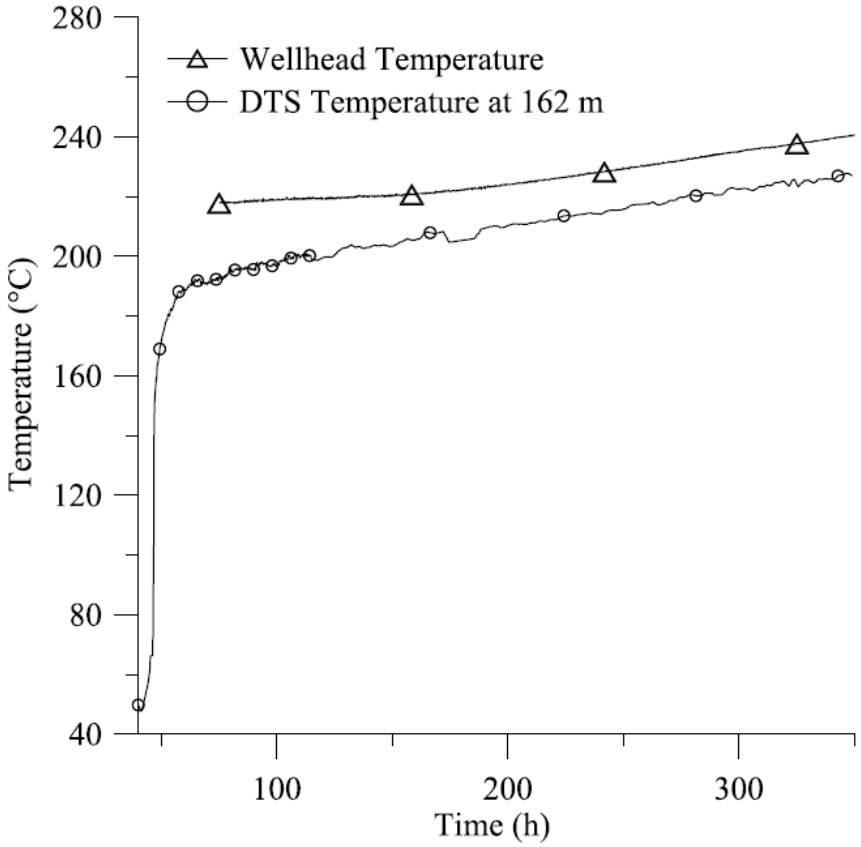
Flow Test – Temperature Evolution



DTS temperatures up to 230°C after two weeks of measurement

Flow Test – Temperature Evolution

Constant temperature difference depending on location of cable in annulus

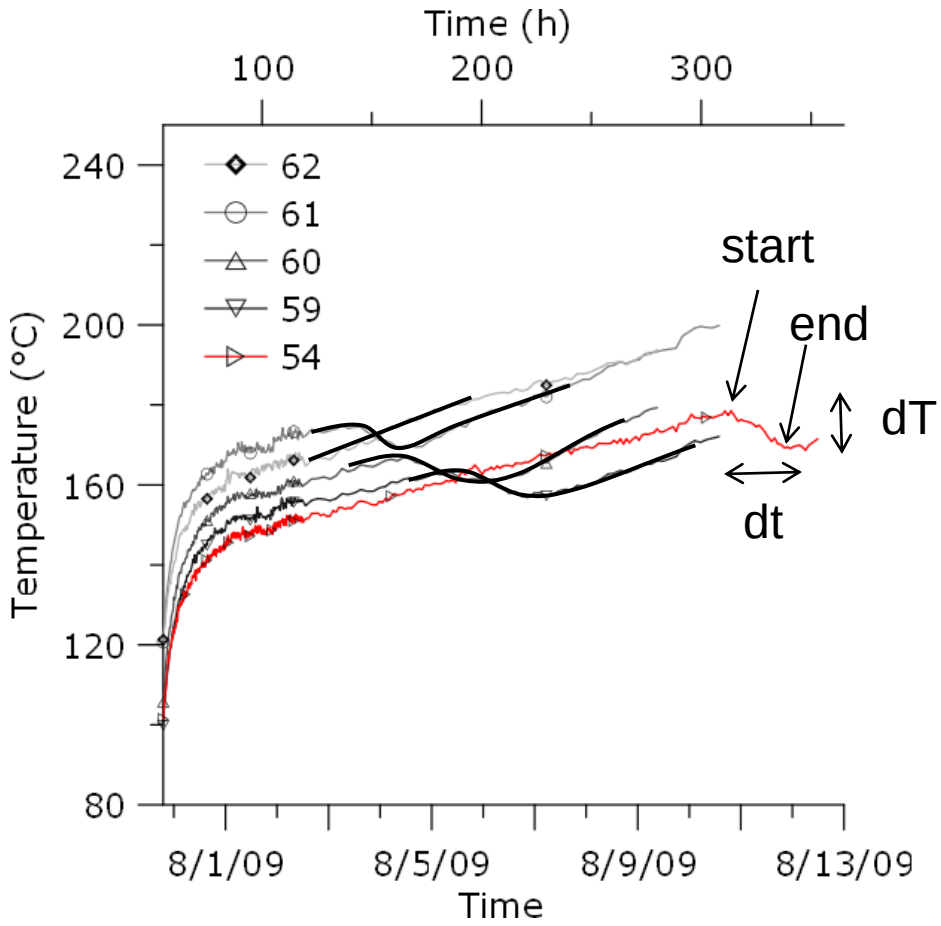


(Wellhead information courtesy of Reykjavik Energy)

Flow Test – Temperature Evolution

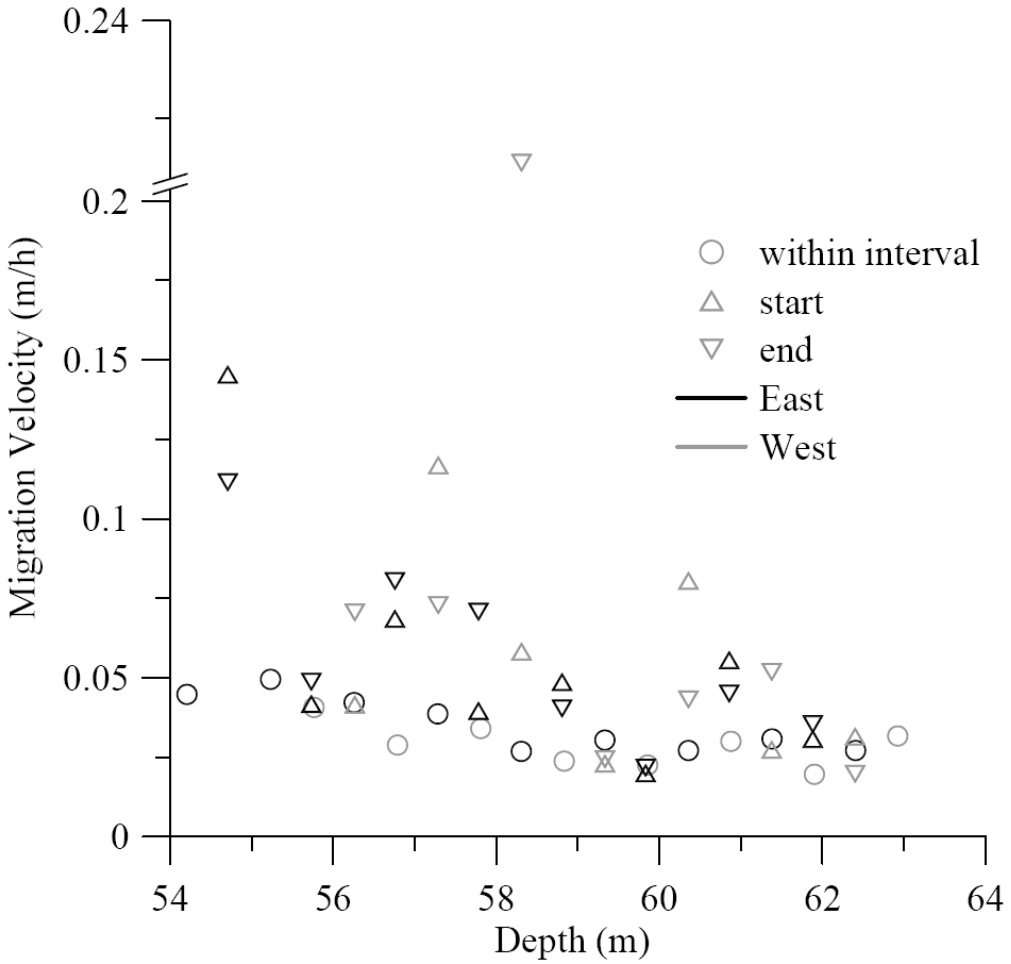
Local temperature decrease in annulus

Migration of temperature anomaly upwards



Flow Test – Temperature Evolution

Constant axial migration velocity of anomaly in annulus

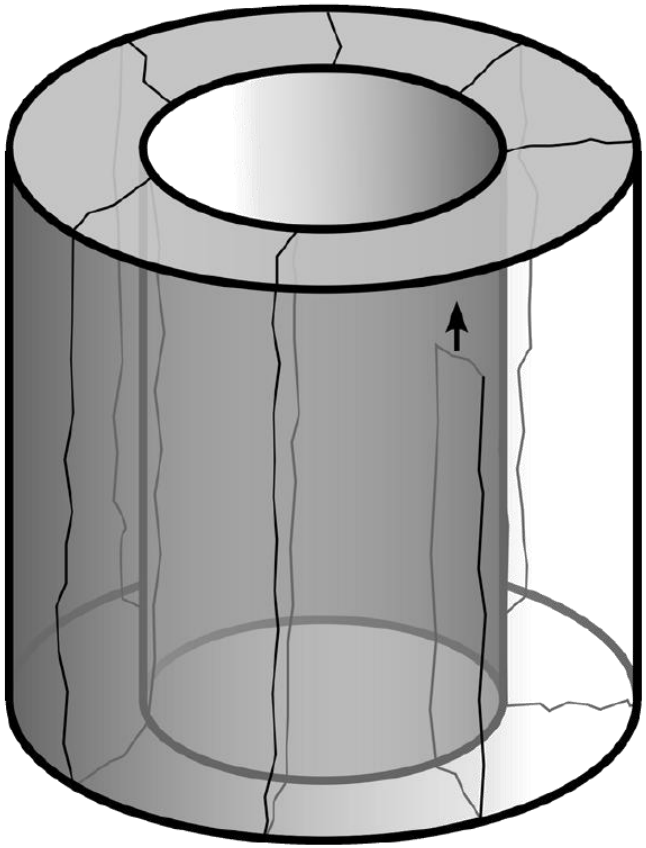


Concept of Fracture Propagation

Concept of fracture evolution in cemented annulus

Fractures evenly distributed around well

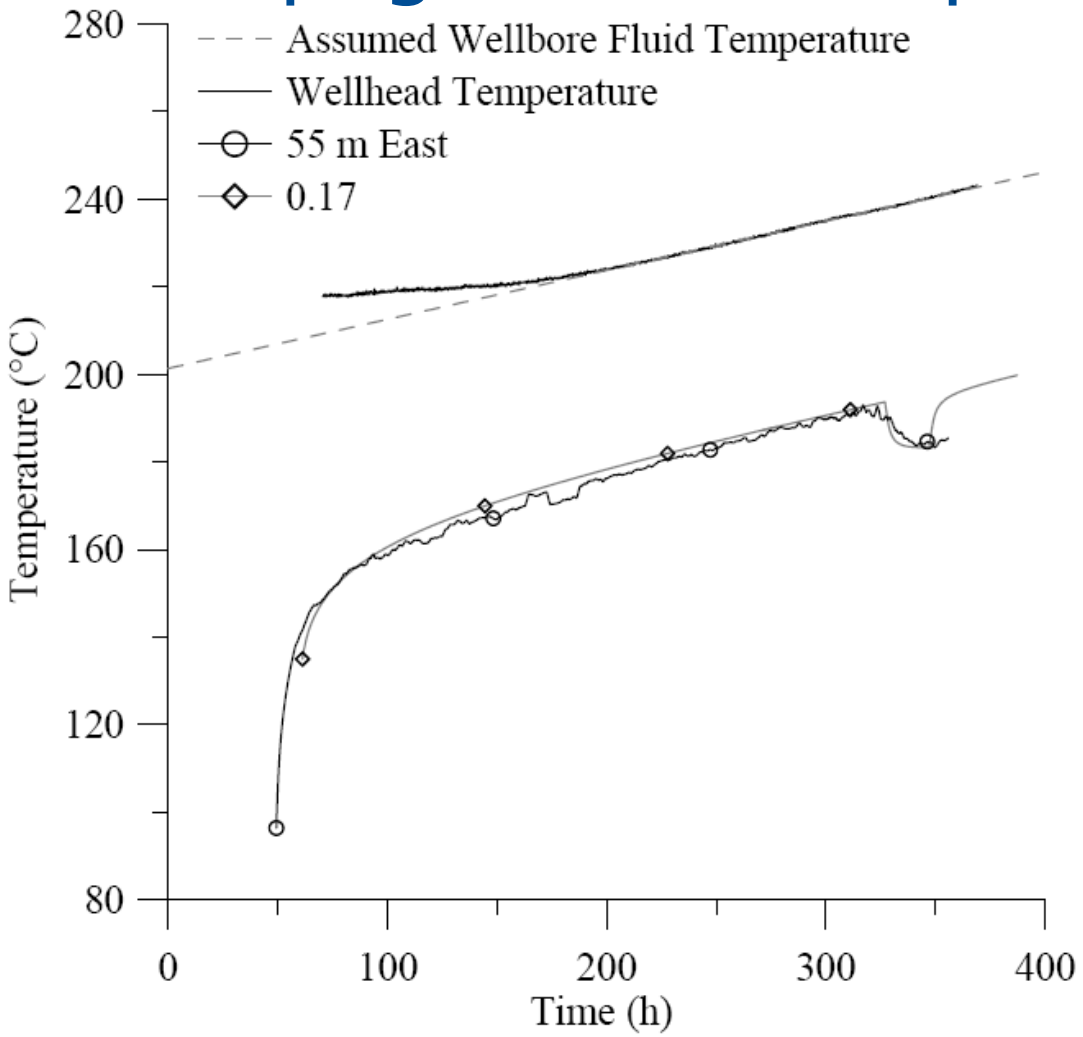
Associated: pore fluid evaporated



Test of Fracture Propagation Concept

1D radial symmetric finite difference model

Heat loss due to evaporation of 40% porosity (weight difference between wet and dry sample)



Summary

- Installation of a fibre optic cable within a hot geothermal well
  - Successful temperature measurements up to 230°C
- Temperature measurements during flow test
  - Online monitoring of thermal processes behind second casing
  - Temperature decrease in annulus although well temperature was increasing
  - Temperature effect migrated upwards
  - Hypothesis: Fracture migration and evaporation of pore fluid
    - Structural integrity monitoring of cemented annulus
    - Loss of zonal isolation

Acknowledgement

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References

- Jóhannesson, H. & Sæmundsson, K. (1998), 'Geological Map of Iceland, 1:500000: Bedrock Geology', Technical report, Icelandic Institute of Natural History
- Thorhallsson, S. (2008), GEOTHERMAL DRILLING AND WELL PUMPS 'Workshop for Decision Makers on Direct Heating Use of Geothermal Resources in Asia', UNU-GTP, unpublished lecture notes


Thank You!