ÍSOR
Sjálfbærni í verki

22-0162

GEOTHERMAL DISTRICT HEATING IN EYJAFJÖRÐUR, ICELAND

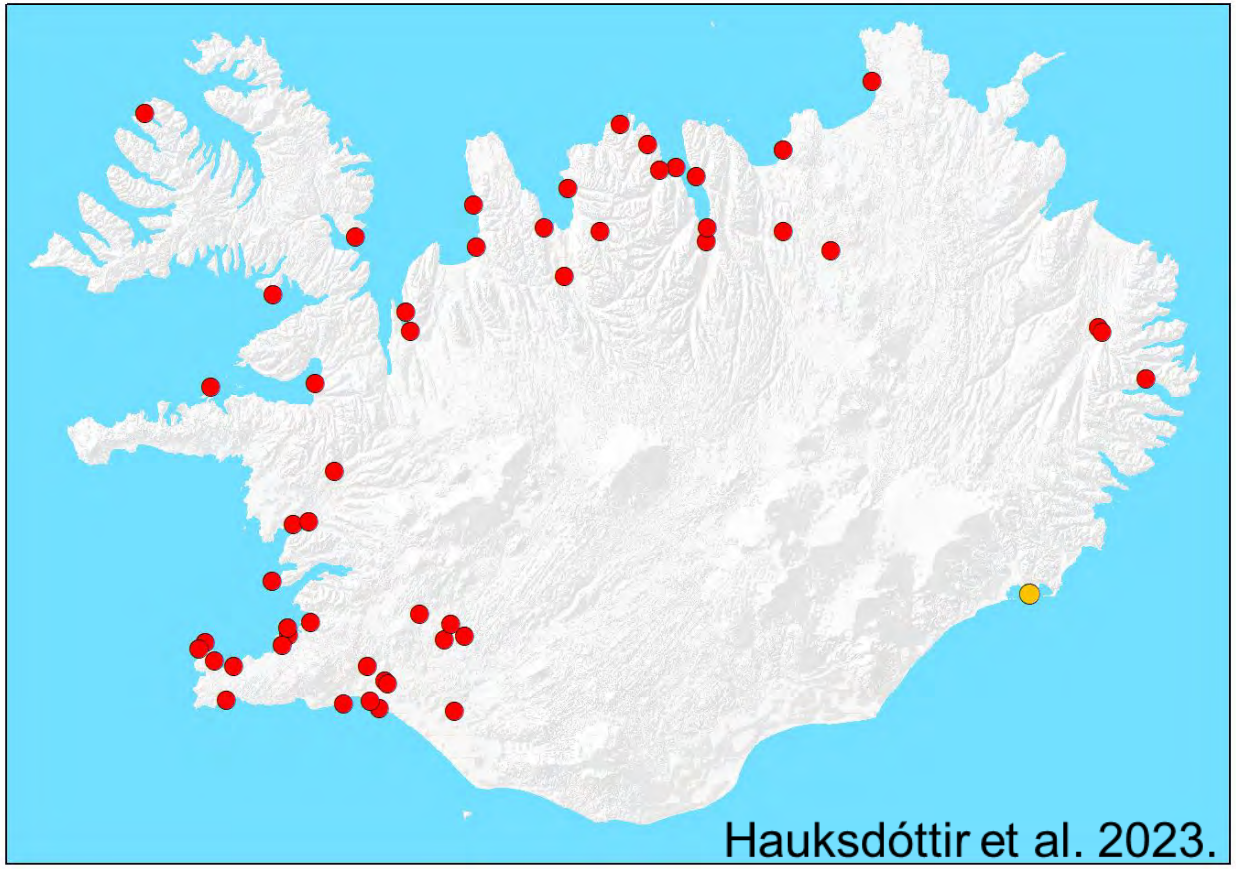
Bjarni Gautason, Sæunn Halldórsdóttir &
Rögnvaldur L. Magnússon

OUTLINE

- District Heating in Iceland
- Akureyri and Norðurorka
- Monitoring of geothermal fields in Eyjafjörður
- General conceptual model
- The Hjalteyri Geothermal Field

ICELAND – DISTRICT HEATING SERVICES

- District heating services in Iceland (53 shown)
- 2/3 of the DHS are not sure how to meet increasing demand
- 7 DHS are in good shape
- 7 DHS are overexploiting their resources



AKUREYRI – CULTURAL DATA

- Akureyri pop. 19,812 as of 1. Jan. 2024
- Surrounding municipalities ~2,300
- Total > 22,000
- Iceland ~383,726 inhab. as of 1. Jan. 2024
- Largest town outside the capital region
- Activities

  Educational center,
  Some industry incl. fishing,
  Tourism (skiing resort),
  Services for surrounding municipalities

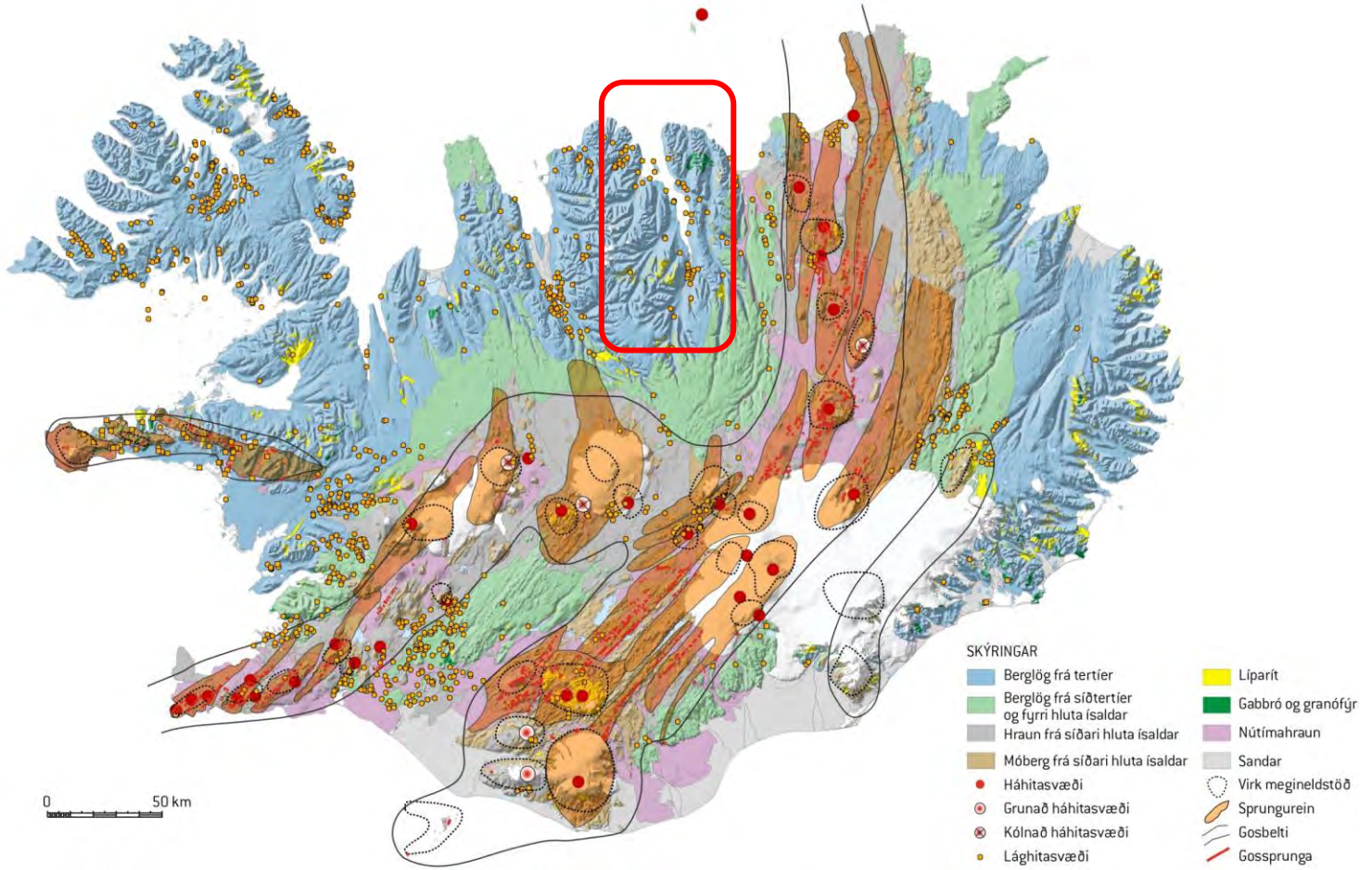
- Norðurorka

  Space heating, waterworks, waste discharge

AKUREYRI – ENVIRONMENT

- Location (Land of the Mid-Night Sun)
  - Lat 65°40’50’’ Long 18°05’22’’
- Temperature
  - January -1.9 °C - Long Term Average
  - July +10.6 °C - Long Term Average
- Precipitation
  - January ~ 55 mm - Long Term Average
  - July ~ 33 mm - Long Term Average

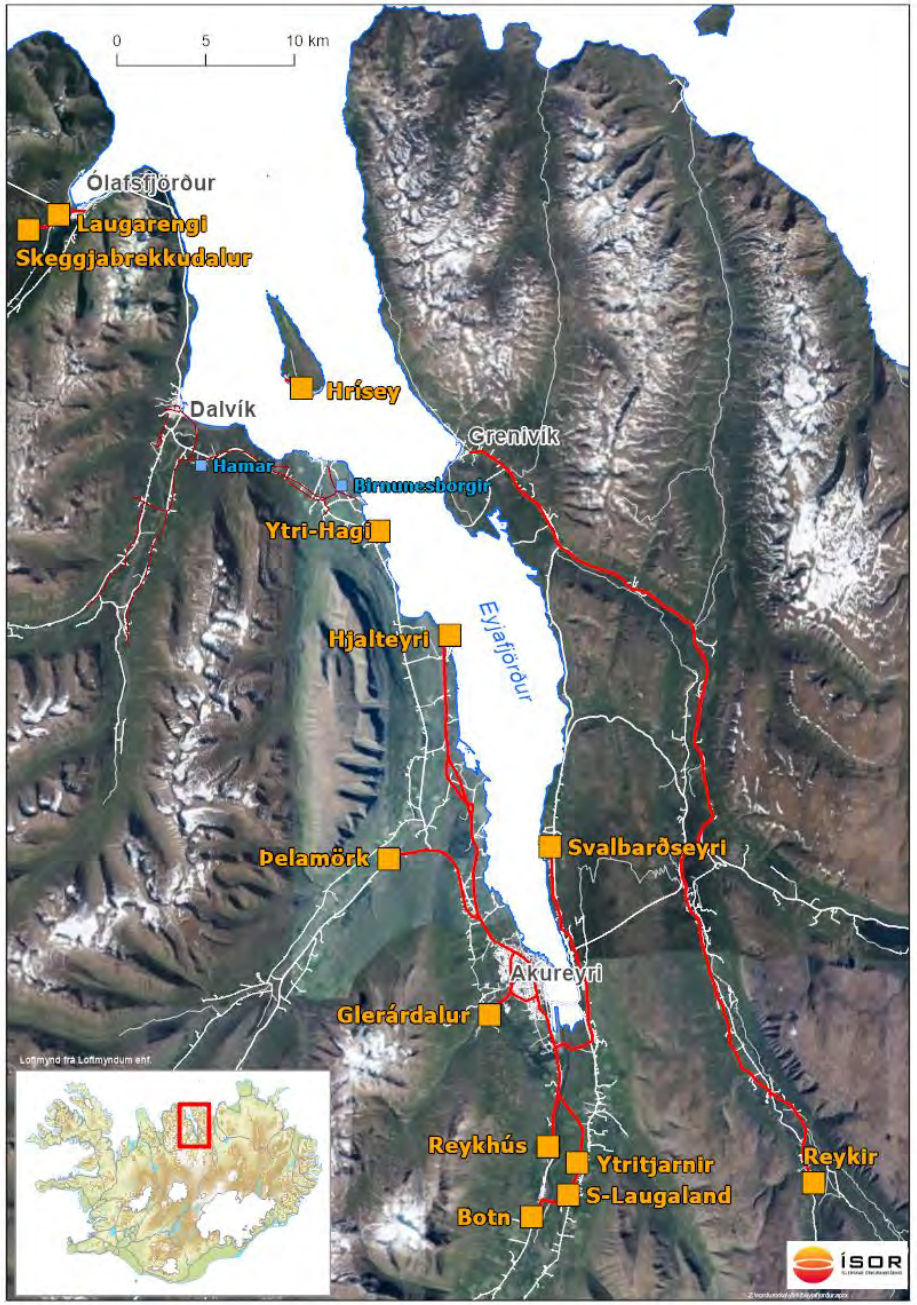
GEOLOGICAL MAP OF ICELAND



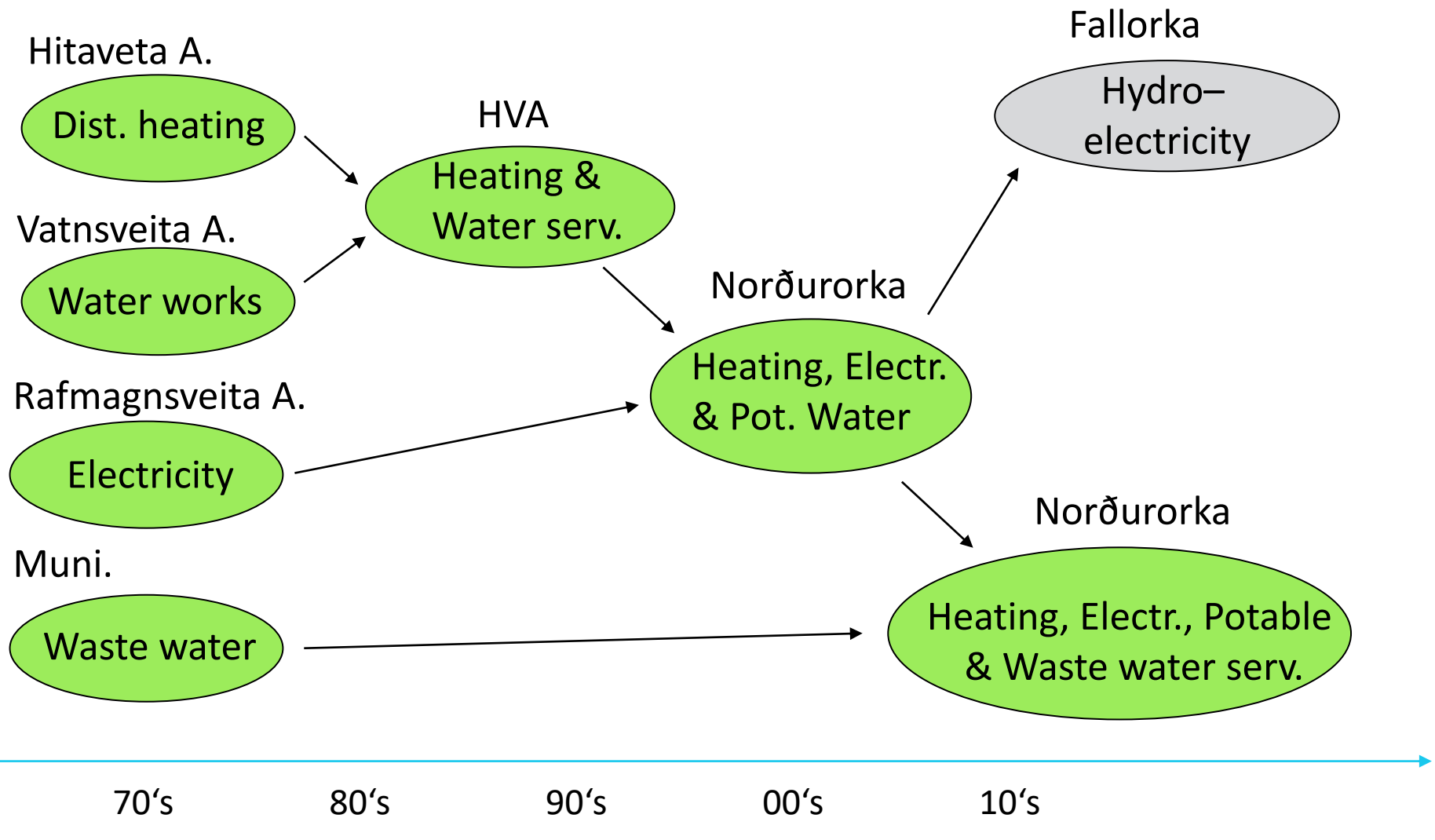
Byggt á jarðfræðikorti Hauks Jóhannessonar og Kristjáns Sæmundssonar 1999. Ísland. 1:1.000.000. Náttúrufræðistofnun Íslands.
Haukur Jóhannesson og Kristján Sæmundsson 1998. Jarðfræðikort af Íslandi. 1:500.000. Berggrunnur. Náttúrufræðistofnun Íslands (2. útg.)
Haukur Jóhannesson og Kristján Sæmundsson 1998. Jarðfræðikort af Íslandi. 1:500.000. Höggun. Náttúrufræðistofnun Íslands.

NORÐURORKA – PRESENT DA

- Seven production fields for Akureyri
- Botn/Hrafnagil, S-Laugaland and Ytritjarnir south of Akureyri
- Glerárdalur west of Akureyri
- Þelamörk and Hjalteyri north of Akureyri
- Two connected fields are not used
- Re-injection
- Electrical boiler; Heat pumps; Oil burner
- Hrísey, Reykir and Ólafsfjörður
- GeoModel: Botn, Laugaland & Hjalteyri

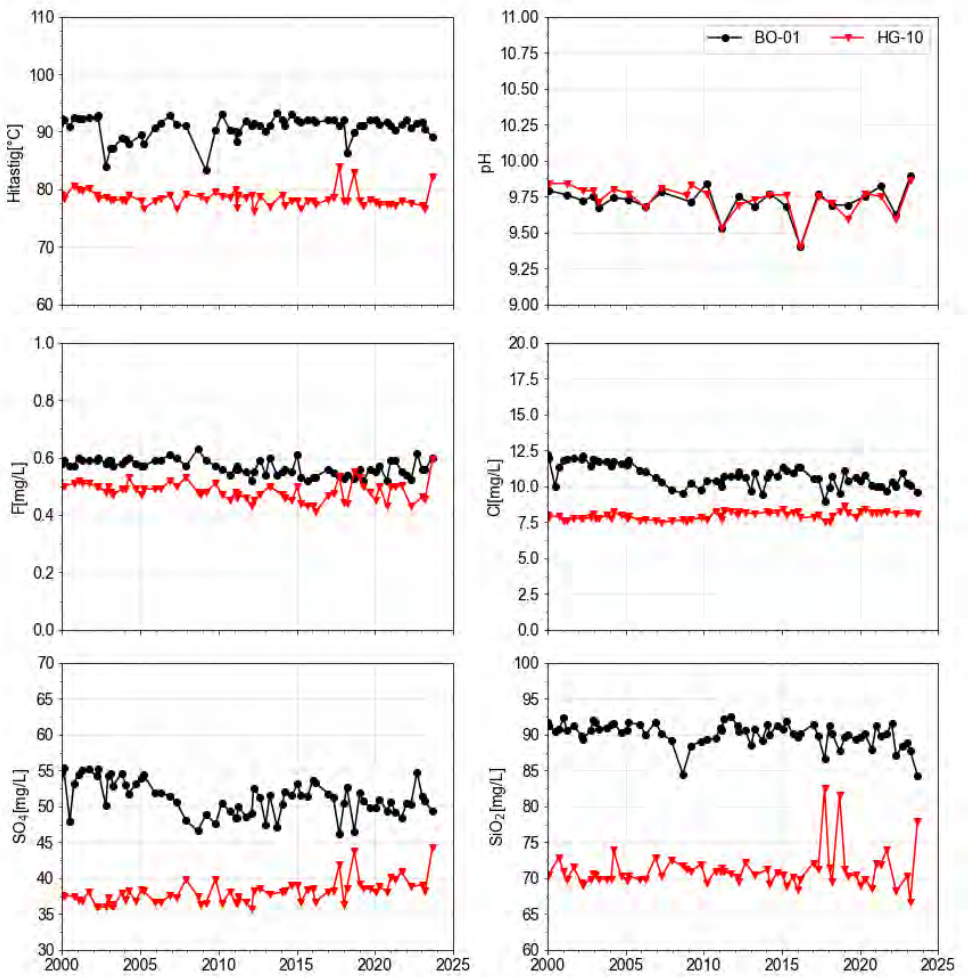


NORÐURORKA – COMPANY HISTORY

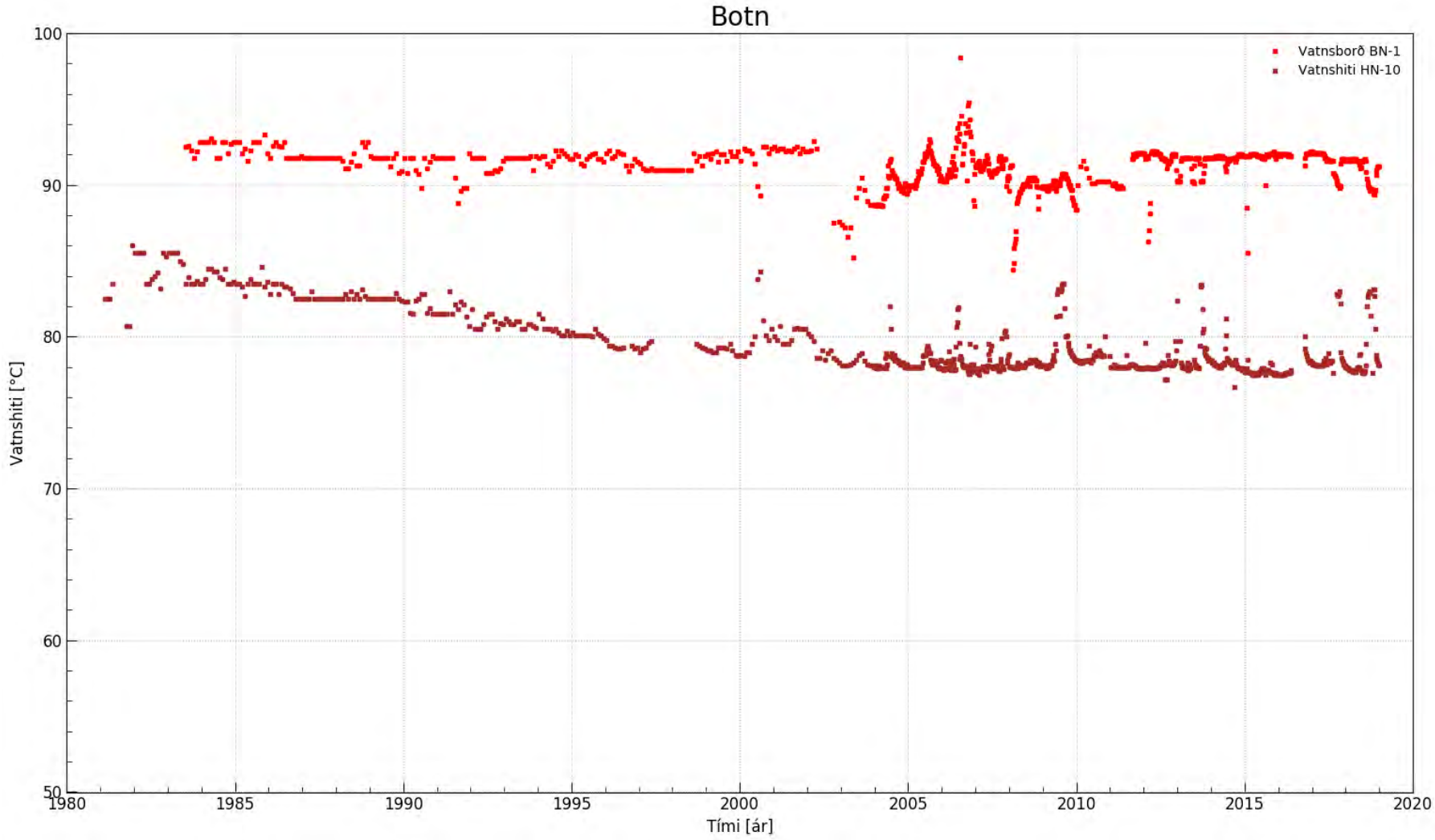


MONITORING - CHEMISTRY

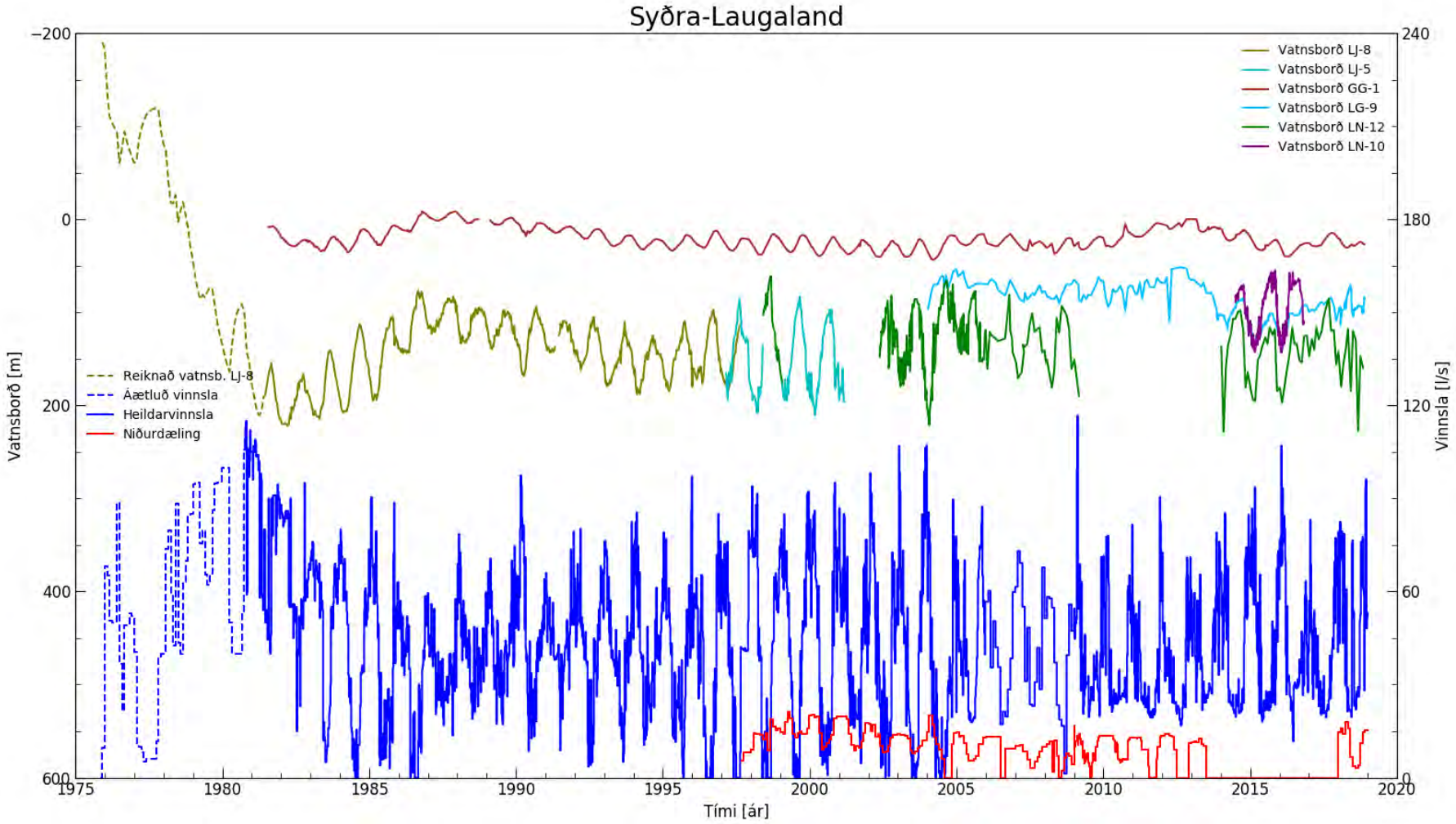
- ÍSOR assists with field monitoring
- Chemistry, temperature, pressure and production
- Chemistry
  - Fluid Low TDS
  - Silica correlates roughly with T
  - pH high (9.0 to 10.0)
  - Cl and F low
  - Mg very low
  - Hydrogen sulfide fairly low
- Hot water very close to being acceptable as potable water



MONITORING - TEMPERATURE

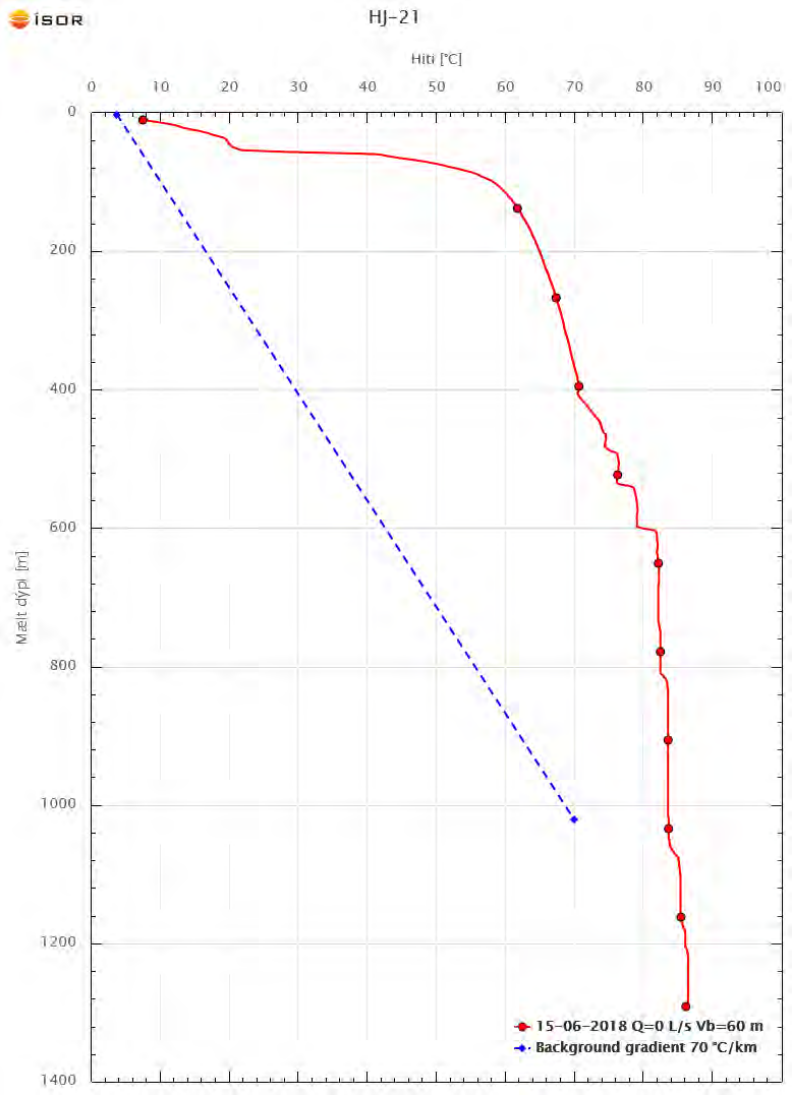


MONITORING – PRESSURE (MASS EXTRACTION)



GENERAL CONCEPTUAL MODEL

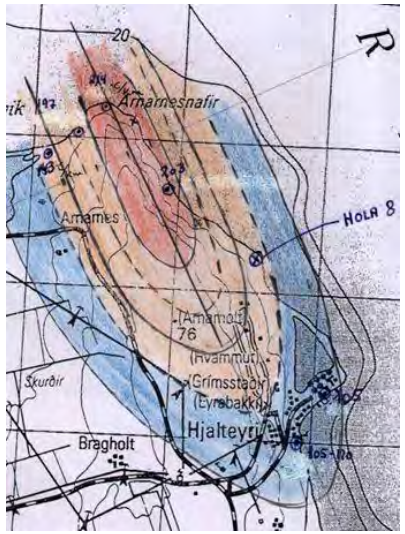
- Low-T geothermal fields
- Associated with deep sub-vertical or vertical fractures or fracture sets
- Convection results in heat mining at depth
- Heat brought to surface in up-flow limbs
- Results in localized gradient anomalies
- T-gradient far above the expected back-ground gradient
- Prospecting with shallow (60-100 m deep) wells has been successful

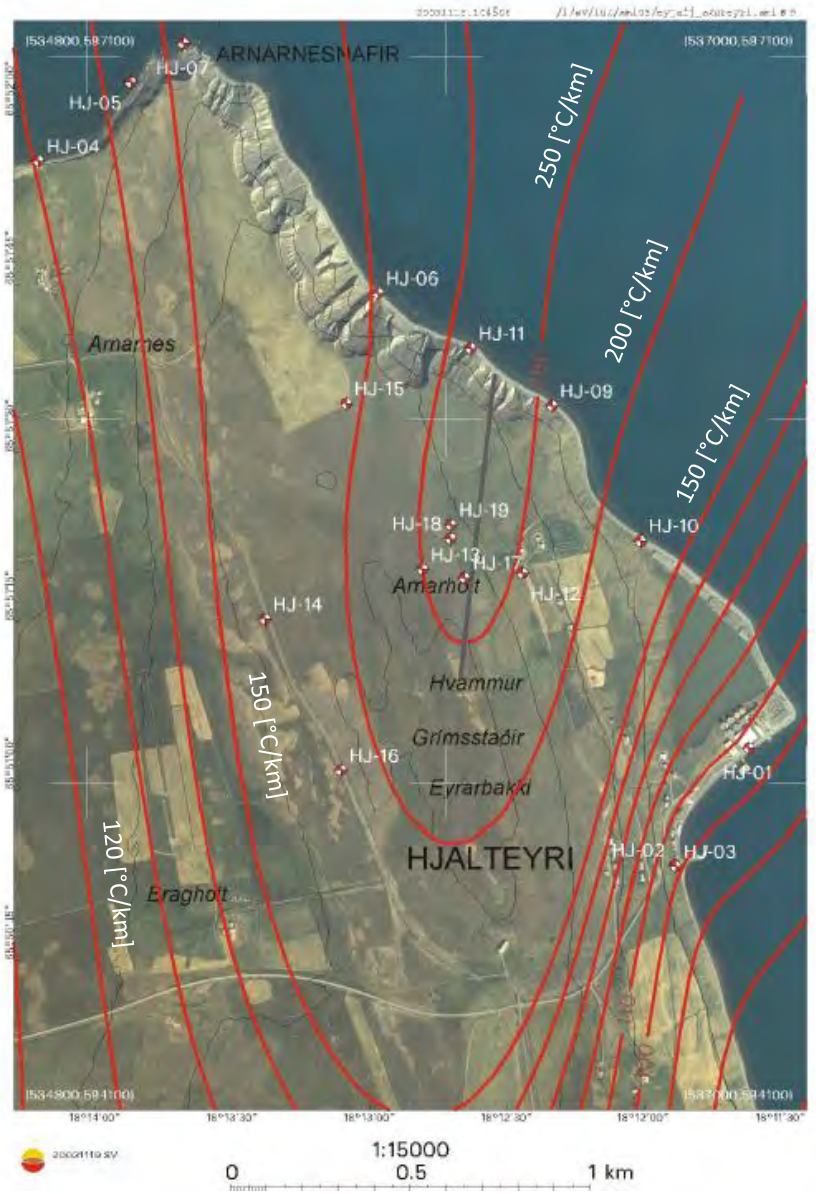


PROSPECTING AT HJALTEYRI

- Prospecting 1999-2002
- 16 temperature gradient wells
- Chemical analysis of warm water from artesian wells
- Borehole-logging & mud-logging
- Magnetic mapping
- Geological mapping
- Seismicity
- Production wells
  - HJ-19 in 2002 – Success!
  - HJ-20 in 2005 – Success!
  - HJ-21 in 2018 – Success!

GENERAL GRADIENT





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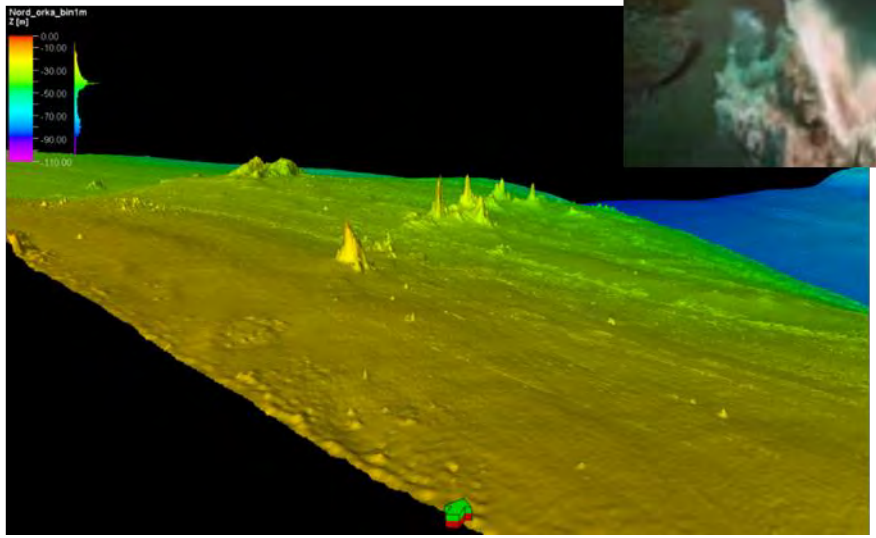
Hjalteyri

Photo: Erlendur Bogason

Photo: Erlendur Bogason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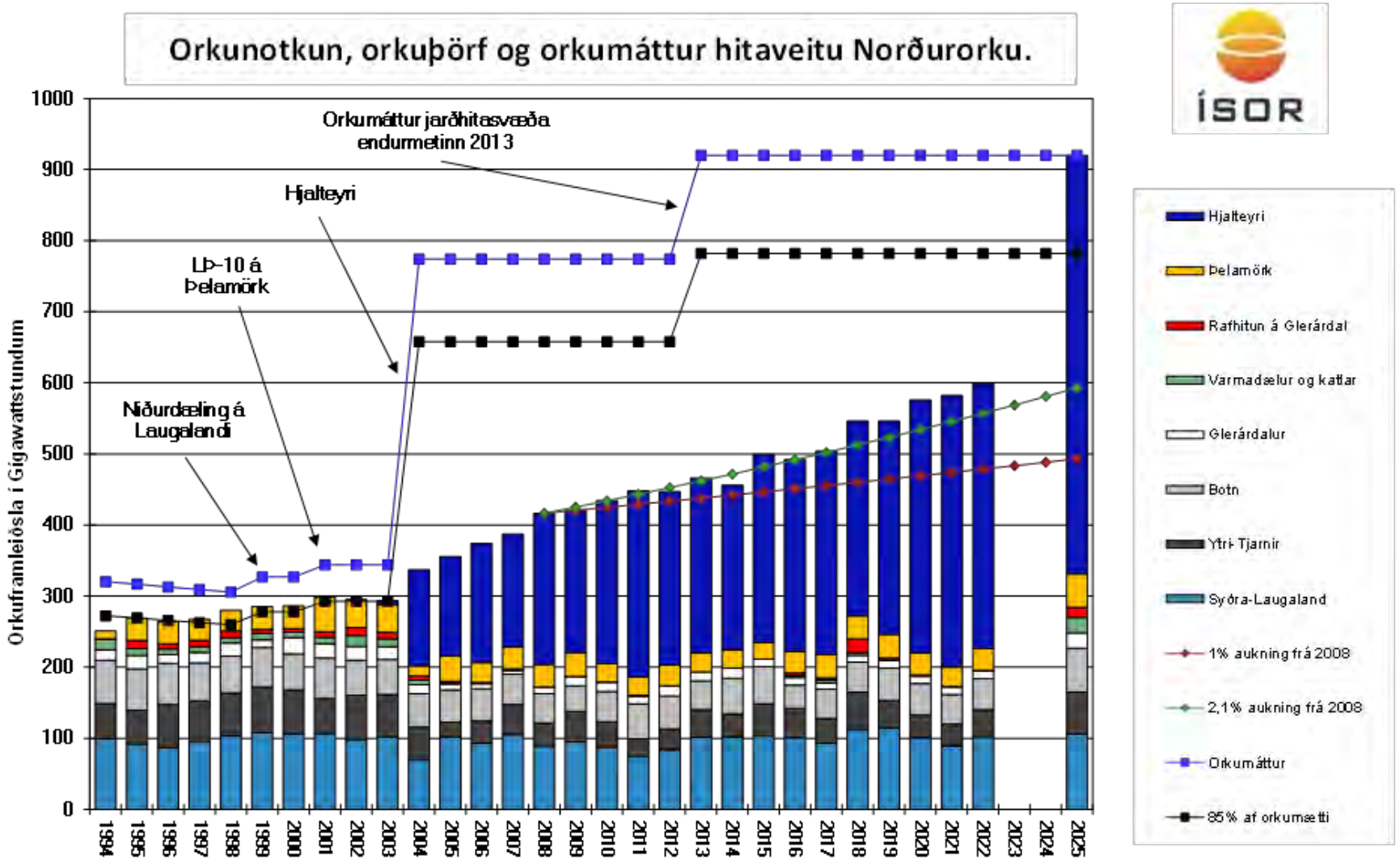
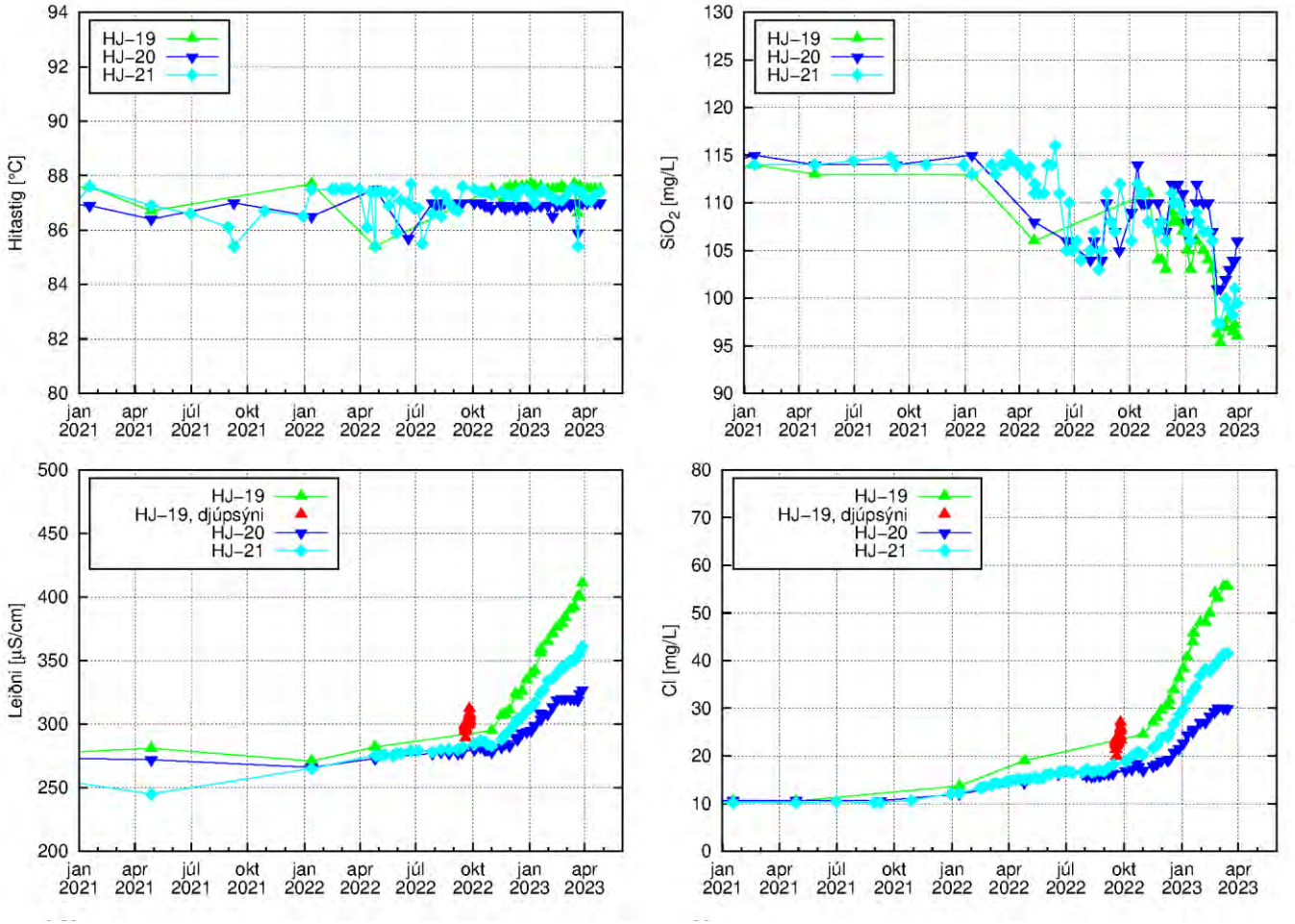
THE IMPORTANCE OF HJALTEYRI



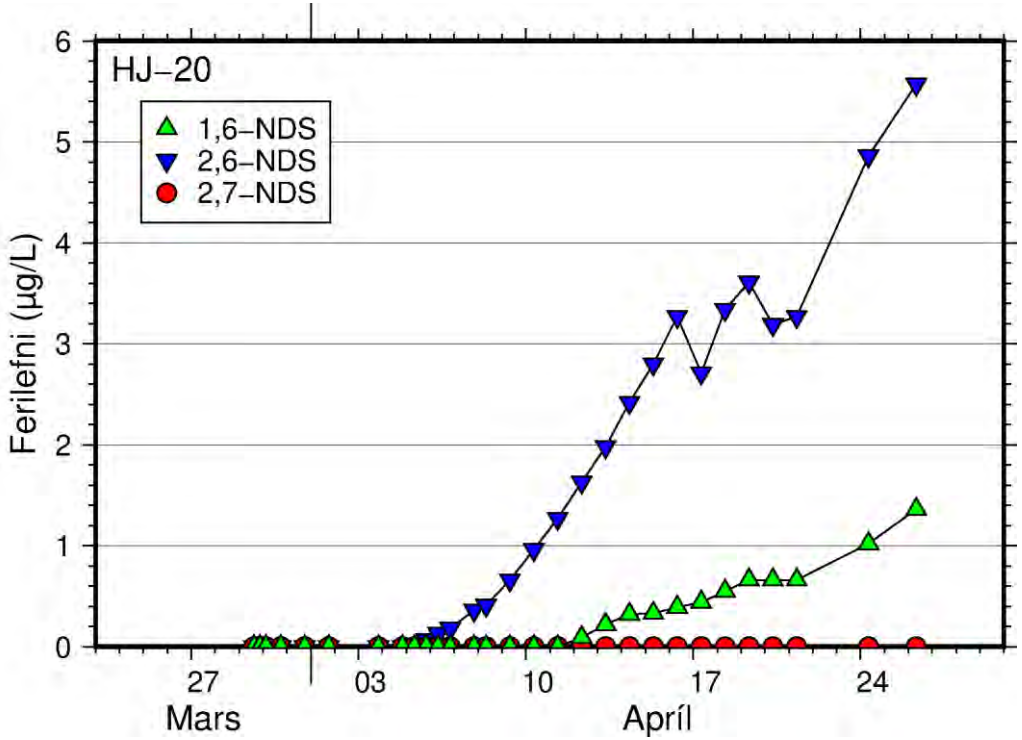
HJALTEYRI SEA-WATER INFILTRATION

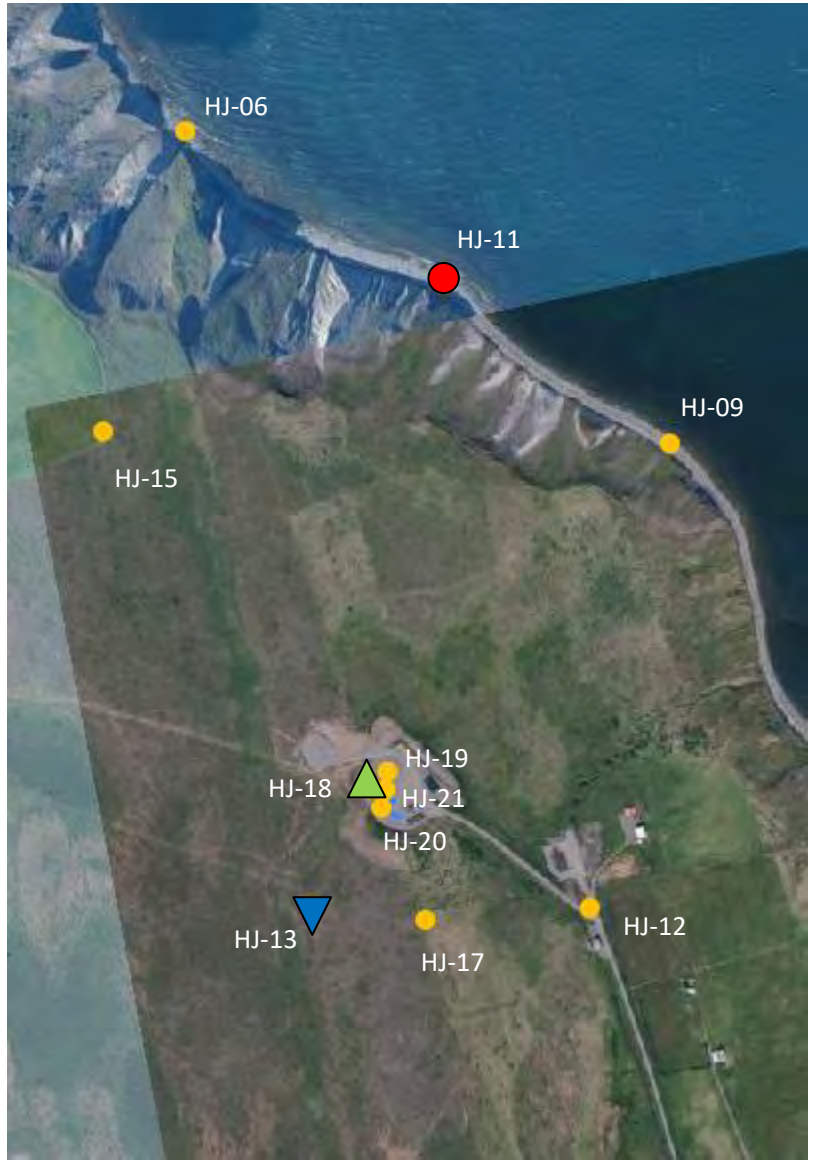
- Late 2021 changes in chemistry
- Continued all through 2022 and 2023
- On-going effort to try to map the flow paths
- Even more detailed chemical monitoring
- Deep sampling and additional logging of wells
- Tracer tests
- Currently ÍSOR is revising the geological model of the system
- Reservoir modelling with Lumpfit++ on-going and with Waiwera on the horizon



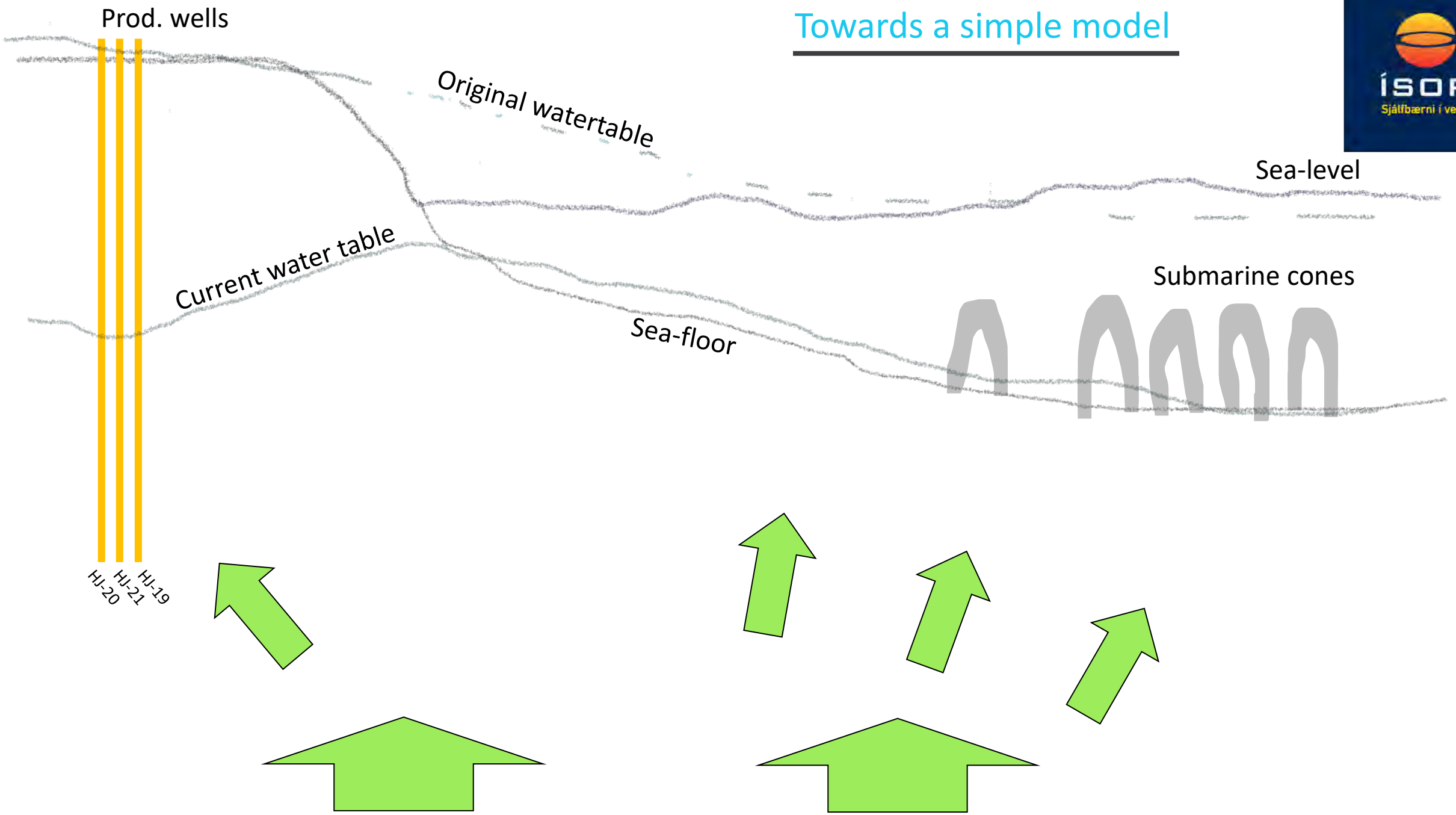
TRACER TESTS

- 1,6-NDS in well HJ-18
- 2,6-NDS in well HJ-13
- 2,7-NDS in well HJ-11





Towards a simple model



Thank You!