

*40<sup>th</sup> Anniversary*

# Model Simulations of the Svartsengi Geothermal System, SW Iceland

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# Outline of Presentation

- Introduction
- Subsurface Geology
- Resistivity Structure
- Production History
- Subsidence Monitoring
- Previous Models
- Current Numerical Model
- Conclusions

# Introduction

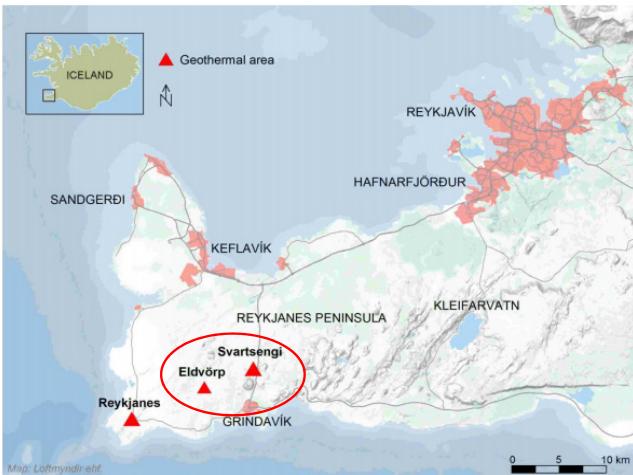


FIGURE 1: Map of the Reykjanes Peninsula (Vatnaskil, 2012)

- Svartsengi-Eldvörp region lies within the active volcanic zone of the outer Reykjanes Peninsula.
- Reservoir characterised by:
  - Uniform pressure conditions
  - High permeabilities
  - Reservoir temperature of 240°C

## Objective:

To develop a numerical model of the entire Svartsengi geothermal system, incorporating subsidence as an additional calibration data set

# Resistivity Structure

- Resistivity profile is synonymous with that of a high temperature geothermal field.
- TEM revealed a common reservoir extending from Eldvörp to Svartsengi with clearly defined boundaries.

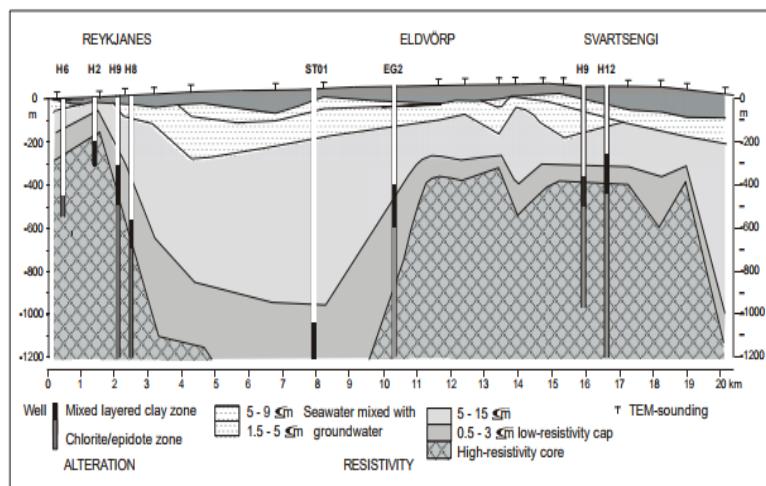


FIGURE 2: ESE-WNW trending TEM resistivity cross section along the outer Reykjanes Peninsula (Karlsdóttir, 1998)

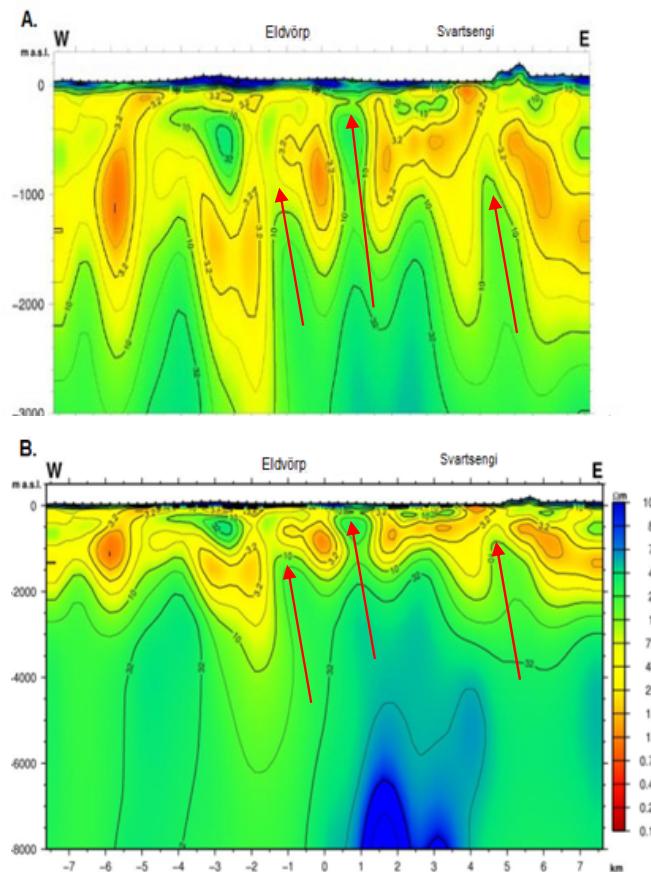


FIGURE 3: MT ESE-WNW trending cross section, modified from Karlsdóttir and Vilhjálmsdóttir (2015)



# Production History

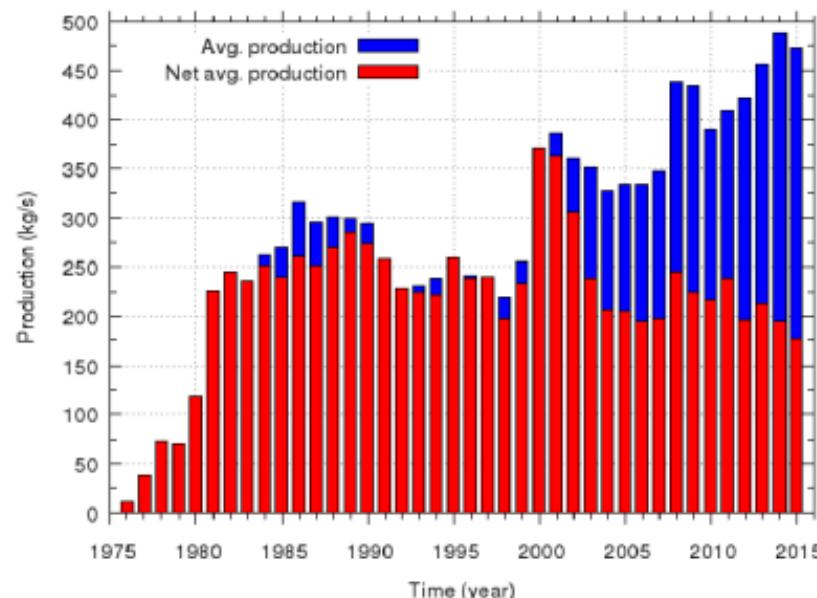


FIGURE 4: Production history at Svartsengi for the period 1975-2015 (Gudmundsdóttir, 2016)

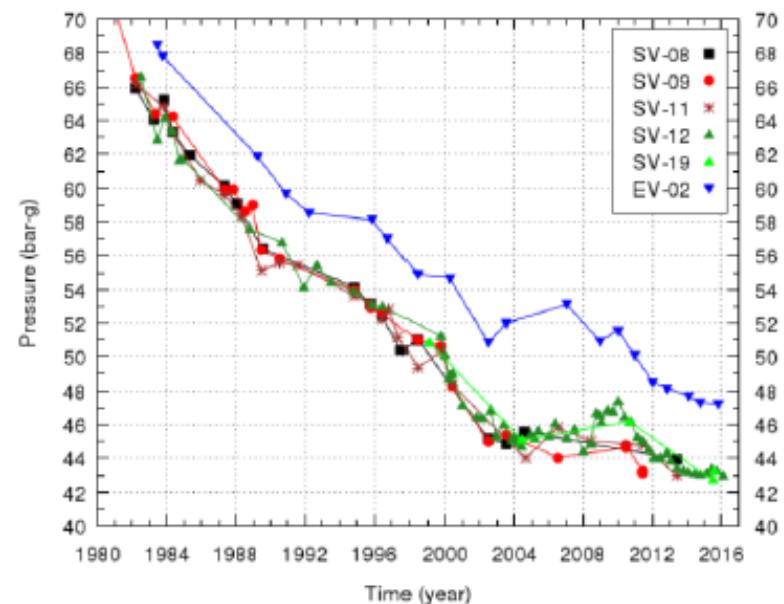


FIGURE 5: Pressure history at Svartsengi and Eldvörp for the period 1980-2016 (Gudmundsdóttir, 2016)

# Subsidence Monitoring

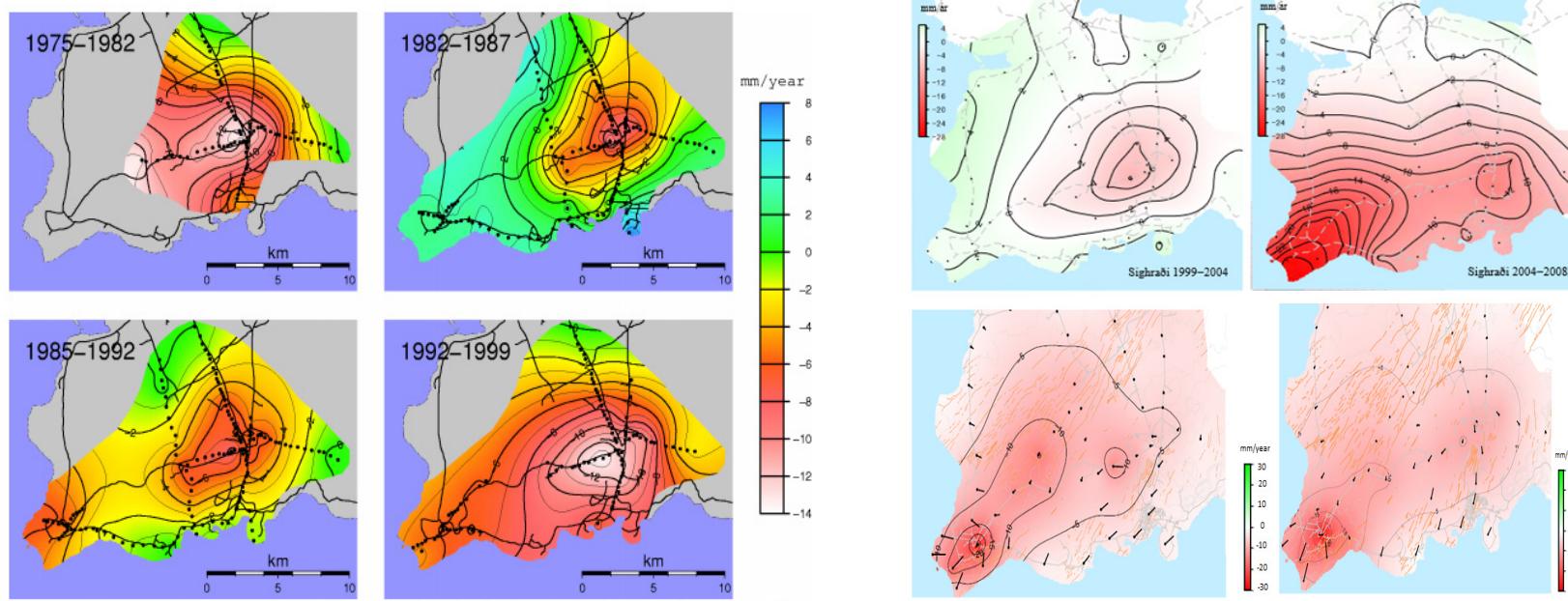


Figure 6: The subsidence rate in the Reykjanes Peninsula from 1975-2014 from Eysteinsson 2000; Magnússon 2009, 2013, 2015

# Conceptual Model (1991)

- Liquid dominated reservoir at depths exceeding 600 m.
- A two phase chimney in the NE portion of the field.
- Temperature anomaly near well 4 was interpreted as the main up-flow to the Svartsengi system.

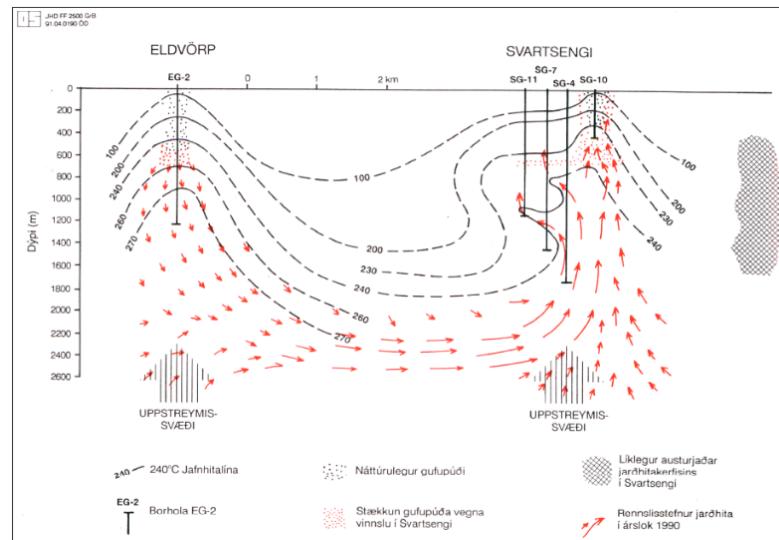


FIGURE 7: Temperature model of the Svartsengi reservoir (Björnsson & Steingrímsson, 1991)

# Current Numerical Model

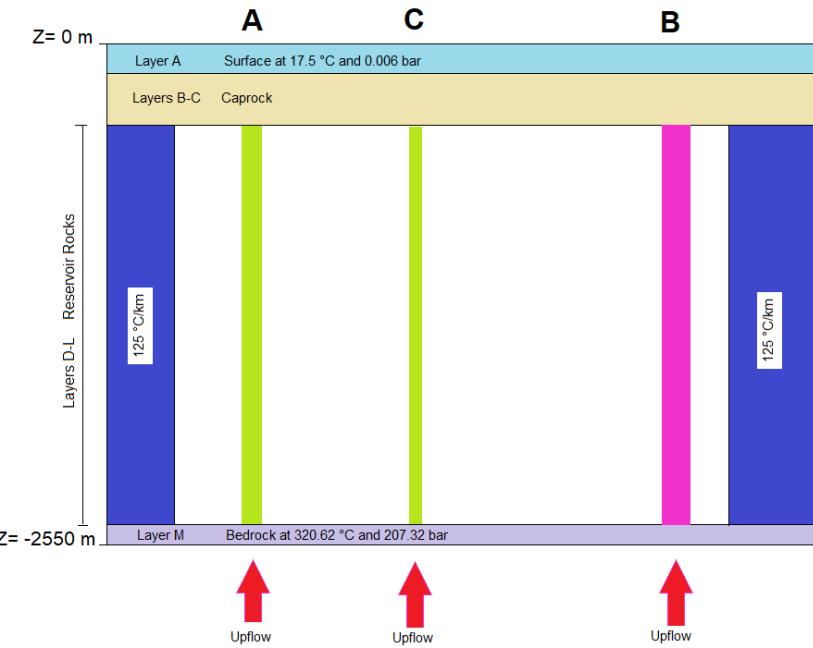


FIGURE 8: Vertical cross section, depicting boundary conditions and location of mass heat sources A, B and C

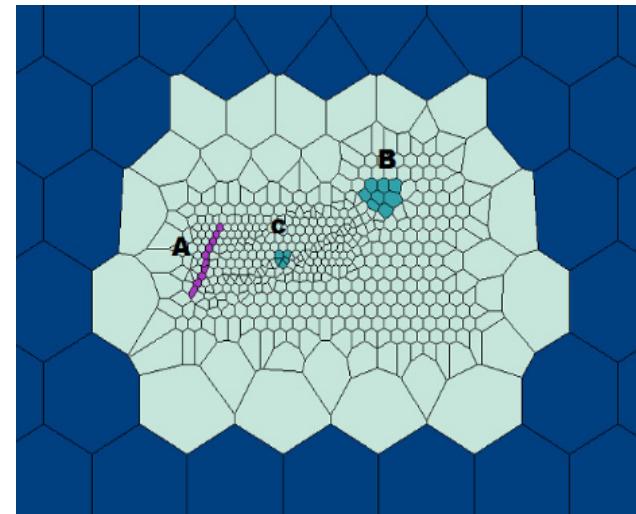
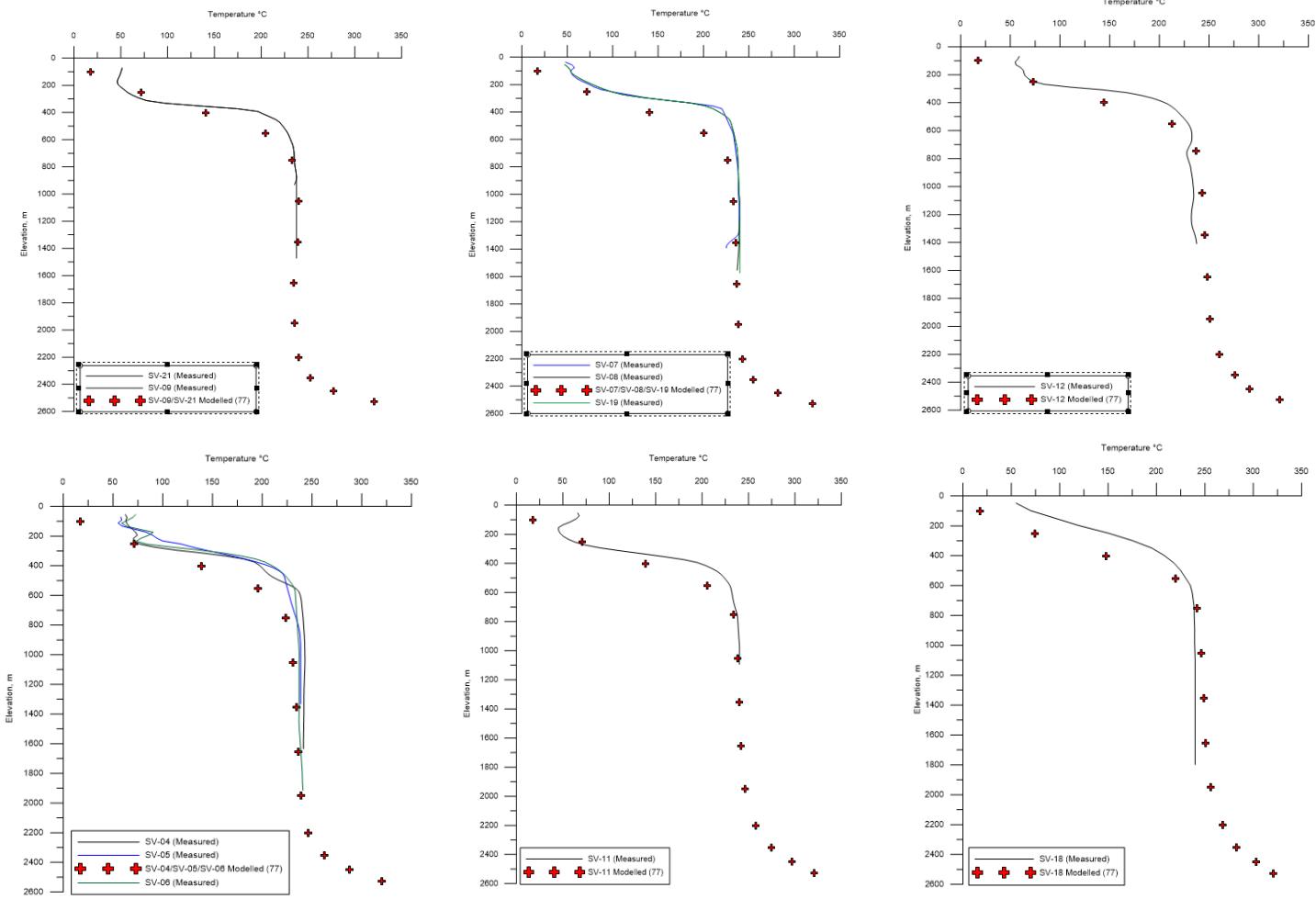


FIGURE 9: Horizontal mesh showing up-flow zones A, B and C, modelled as mass heat sources

# Preliminary Results



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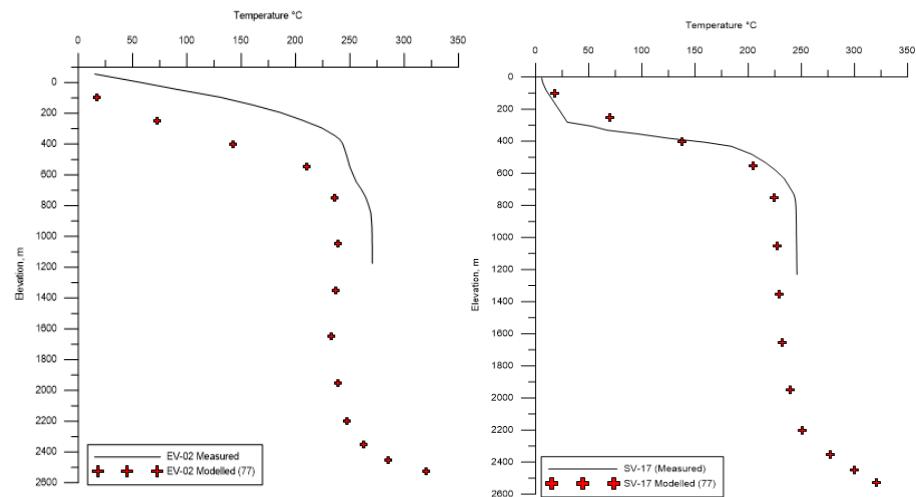


TABLE 1: Up-flow zone parameters

Source	Total Area (km <sup>2</sup> )	Total Flow (kg/s)	Flow/Area (kg/m <sup>2</sup> .s)	Enthalpy (kJ/kg)
A	0.60	215	$3.57 \times 10^{-4}$	1350
B	0.75	137	$1.84 \times 10^{-4}$	1300
C	0.18	95	$5.18 \times 10^{-4}$	1300

# Next Steps

Further calibration to be done to model:

- Production and pressure decline
- Mass changes
- Subsidence

# Acknowledgements

Special thanks to HS Orka for granting permission to utilise and publish well data from the Svartsengi System

# Thank you