This research is funded by the European Union
(EIC, Path nder Programme, G.A. 101046937)

INTRODUCTION AND CO-AXIAL MODEL SIMULATIONS

ANTONIO GALGARO, UNIV. OF PADOVA

RADIATOR MODEL AND COMPARISON WITH CONVENTIONAL TYPE

GIORDANO MONTEGROSSI, CNR-IGG

National Research Council of Italy

Università degli Studi di Padova

Dipartimento di Geoscienze

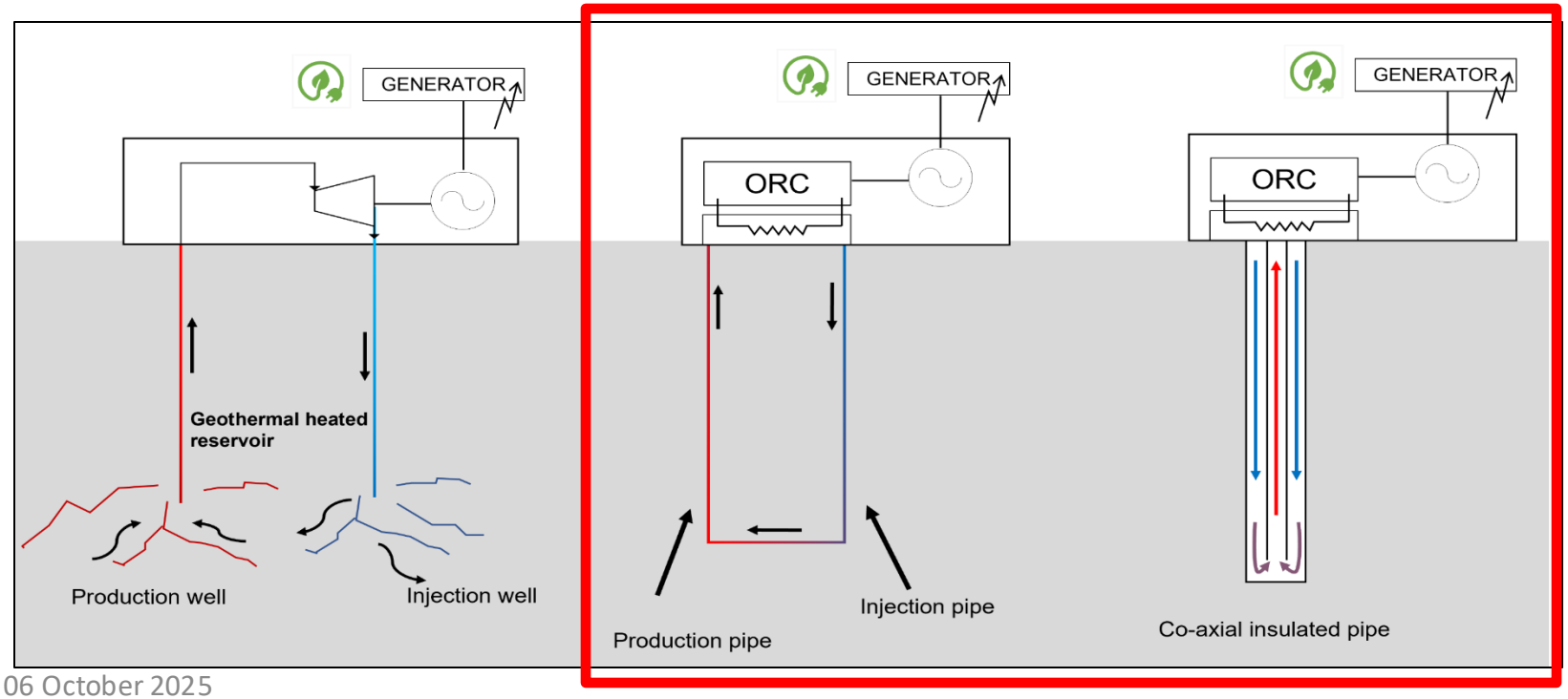
CLOSED LOOP GEOTHERMAL HEAT EXCHANGER SYSTEMS

pro

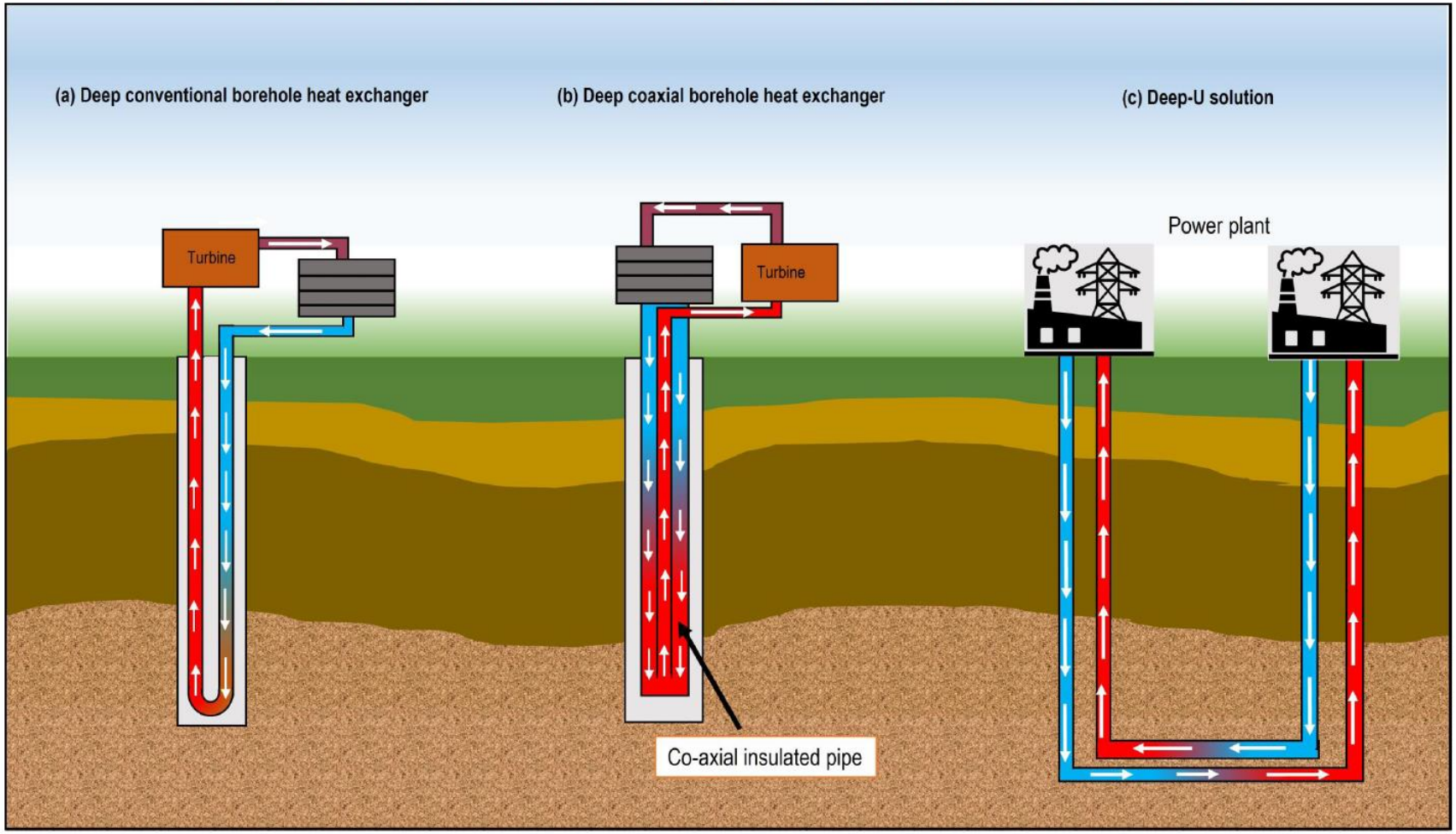
- no geothermal fluids production
- environmental impact and energy for reinjection strongly reduced
- corrosion and scaling problems avoided

cons

- reduction of the heat recovery efficiency



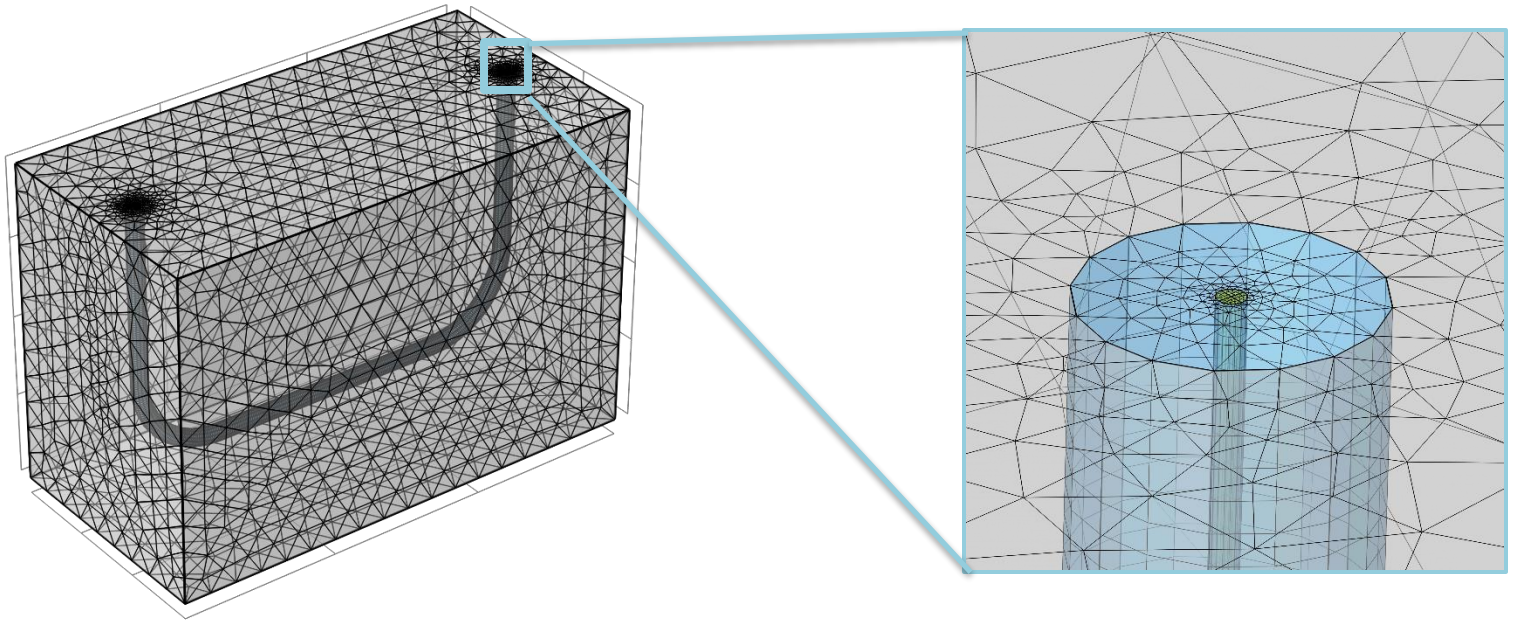
Comparison between different geothermal deep closed solutions



Deep-U Numerical simulation

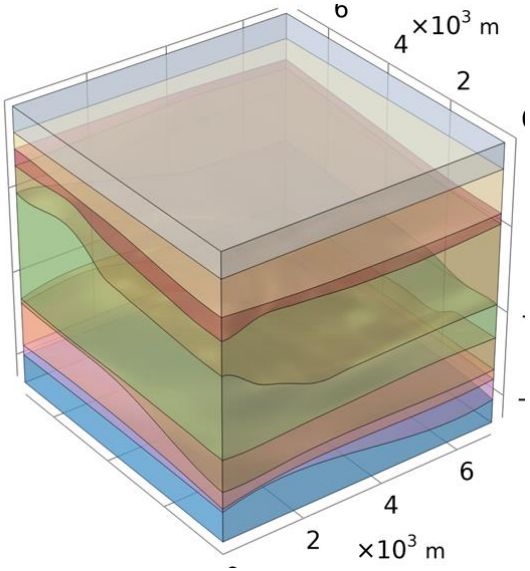
***Case study FEM* modelling**

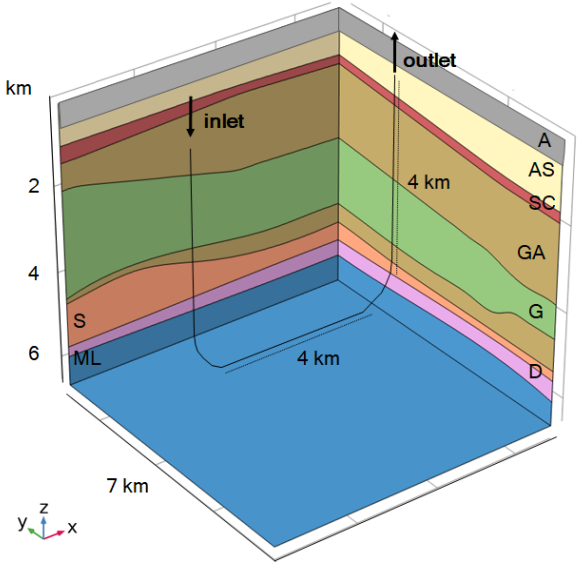
Spatial dimension definition – 2D, 3D → **Physics of the problem** → **Steady state and time-dependent analysis**

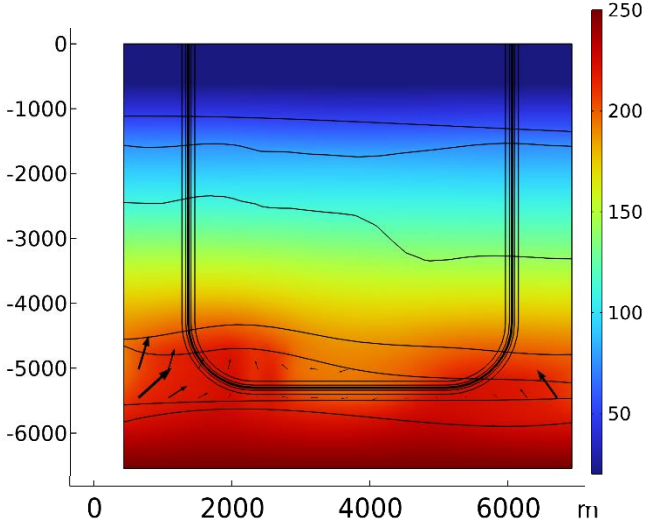


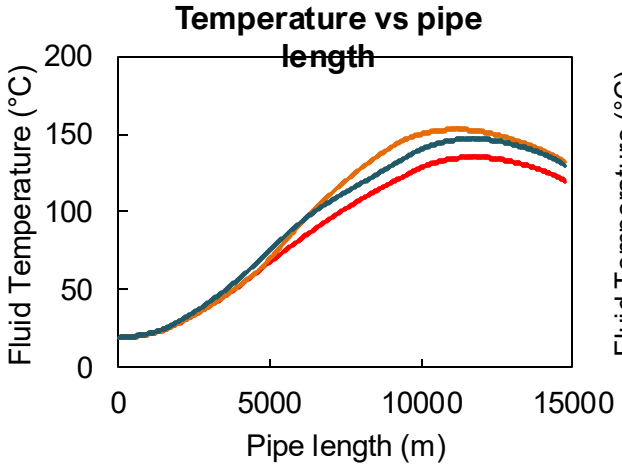
This research is funded by the European Union
(EIC, Path nder Programme, G.A. 101046937)

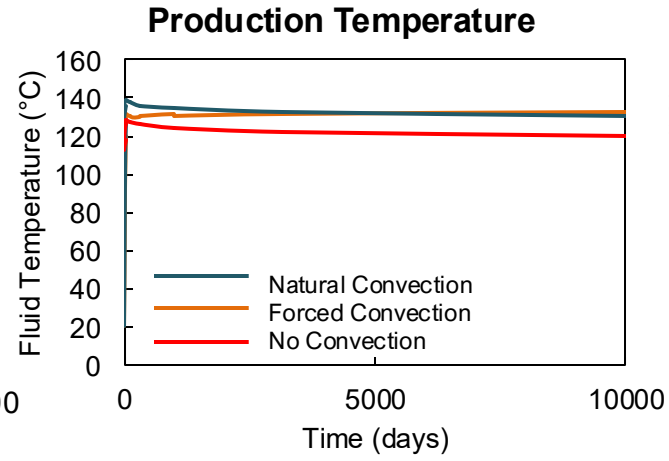
Deep U-tube heat exchanger breakthrough: combining laser and cryogenic gas for geothermal energy exploitation

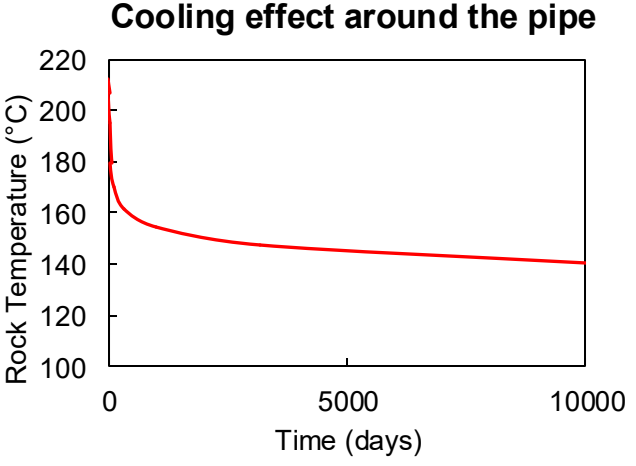




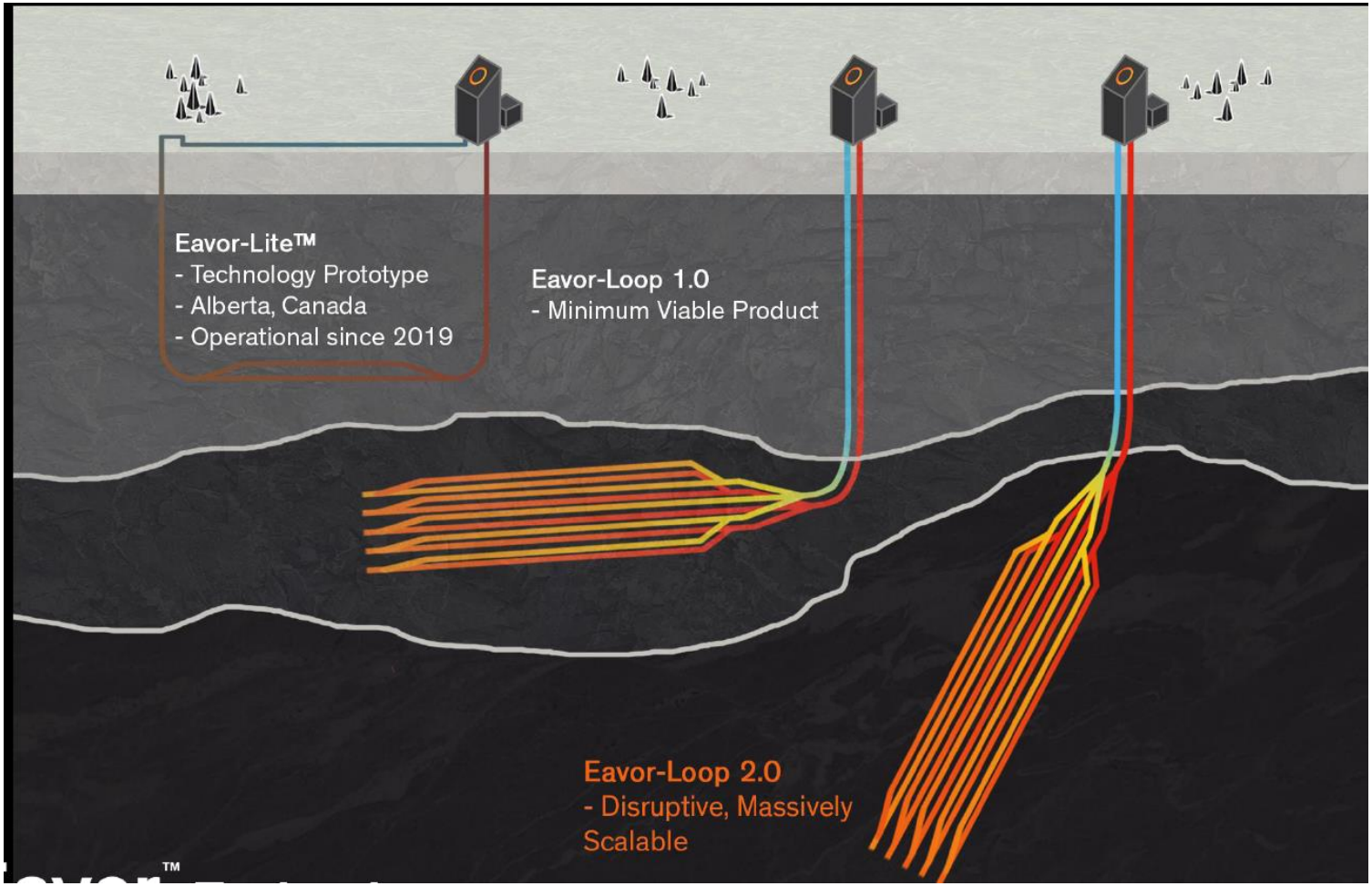








- **The efficiency of closed loop geothermal systems is heavily influenced by the geothermal gradient (and depth)**
- **The energy efficiency can be improved thanks to increasing the depth and carrier fluid time of contact with the deeper surrounding rocks**
- **Alternative deep borehole heat exchangers layouts need to be explored, thanks to new drilling technologies such as Deep-U laser-based solution**
- **This solution could open new opportunities to exploit geothermal solution everywhere**


Eavor-Lite™
- Technology Prototype
- Alberta, Canada
- Operational since 2019
Eavor-Loop 1.0
- Minimum Viable Product
Eavor-Loop 2.0
- Disruptive, Massively Scalable

Introduction

140°C , 6Km deep system (North Italy, North Europe)

300°C , 3Km deep system (Larderello)

145°C , 5.5 Km deep EGS system (Ireland)

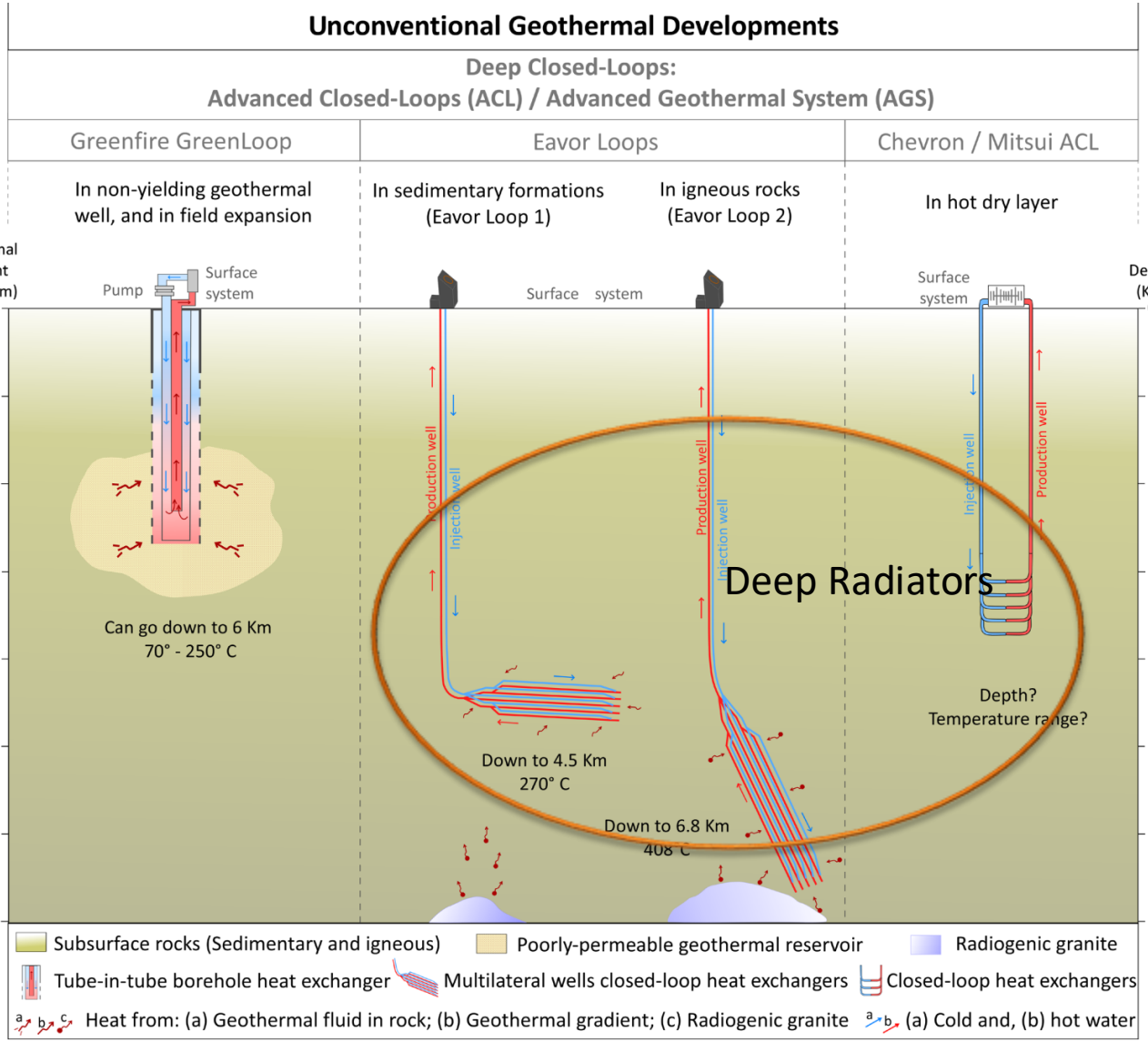
This research is funded by the European Union
(EIC, Path nder Programme, G.A. 101046937)

Deep U-tube heat exchanger breakthrough: combining laser and cryogenic gas for geothermal energy exploitation

Open Journal of Geology, 2024, 14, 196-246
ISSN Online: 2161-7589
ISSN Print: 2161-7570

Conventional Geothermal Systems and Unconventional Geothermal Developments: An Overview

Maryam Khodayar[1], Sveinbjörn Björnsson[2]



National Research Council of Italy

Introduction

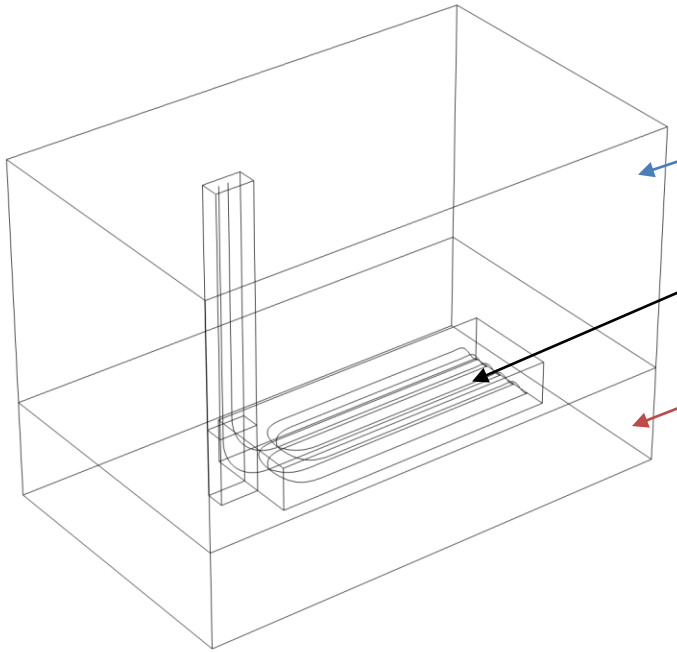
140°C , 6Km deep system (North Italy, North Europe)

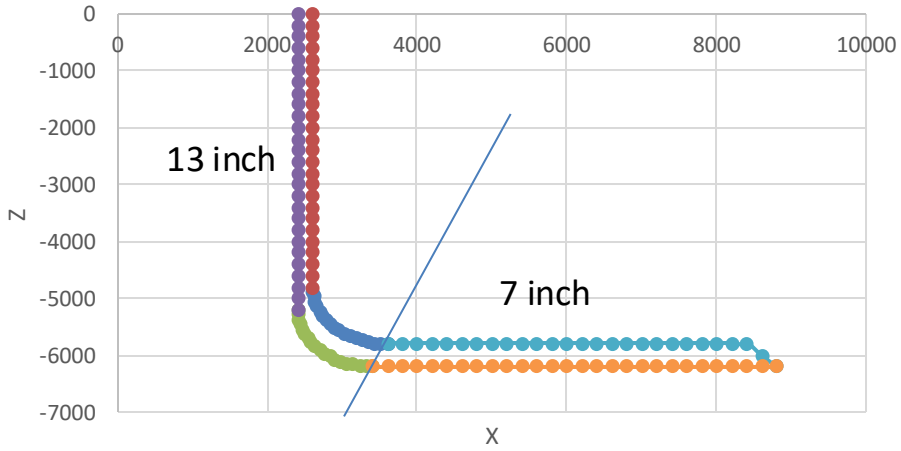
300°C , 3Km depth system (Larderello)

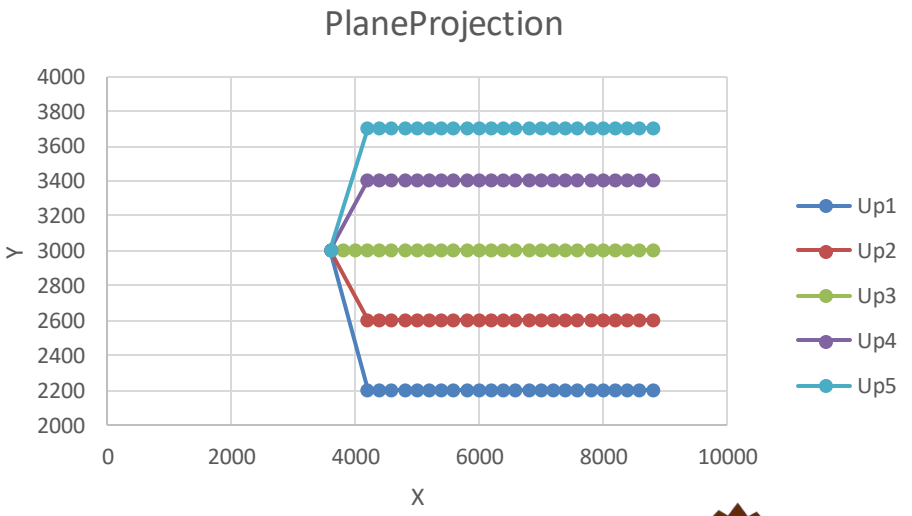
145°C , 5.5 Km deep EGS system (Ireland)

This research is funded by the European Union
(EIC, Path nder Programme, G.A. 101046937)

Deep U-tube heat exchanger breakthrough: combining laser and cryogenic gas for geothermal energy exploitation

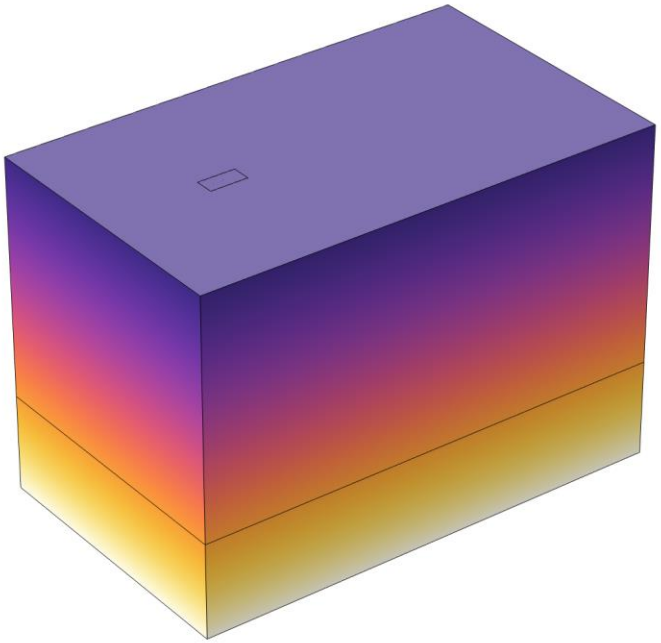




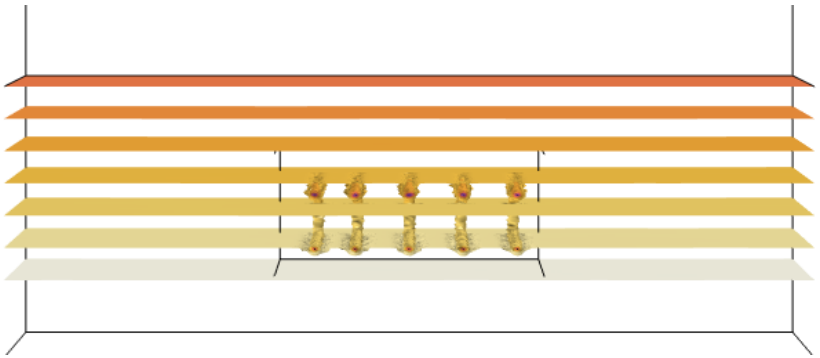


National Research Council of Italy

This research is funded by the European Union
(EIC, Path nder Programme, G.A. 101046937)

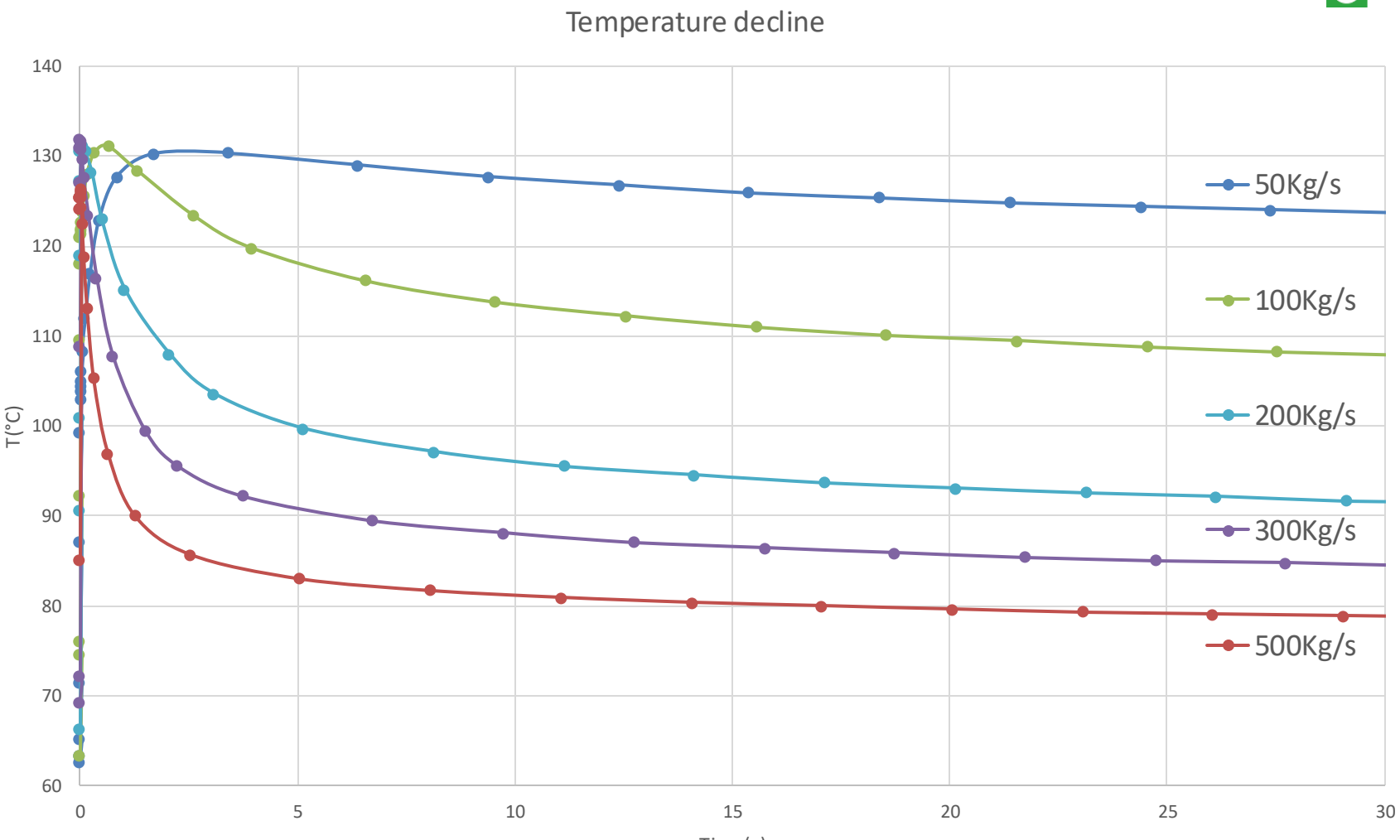


Natural state thermal gradient



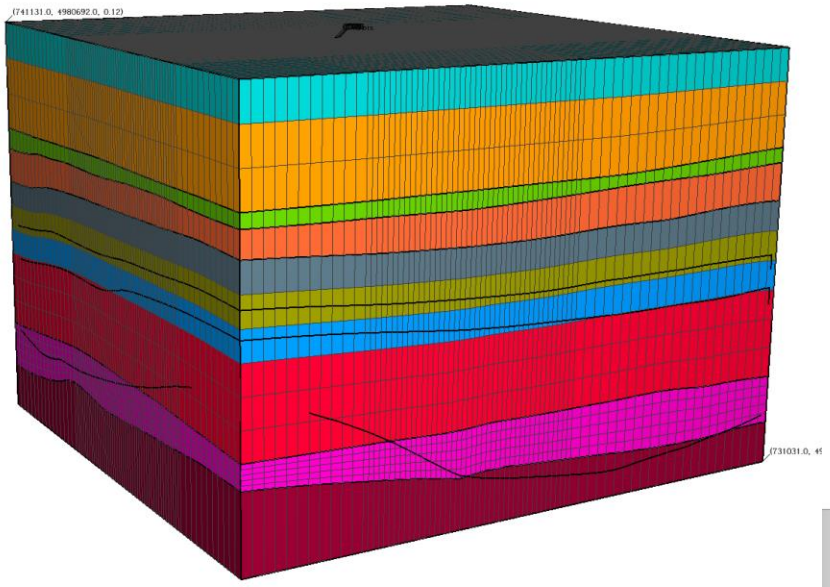
Thermal disturbance after 30 years,
100 Kg/s

This research is funded by the European Union
(EIC, Path nder Programme, G.A. 101046937)



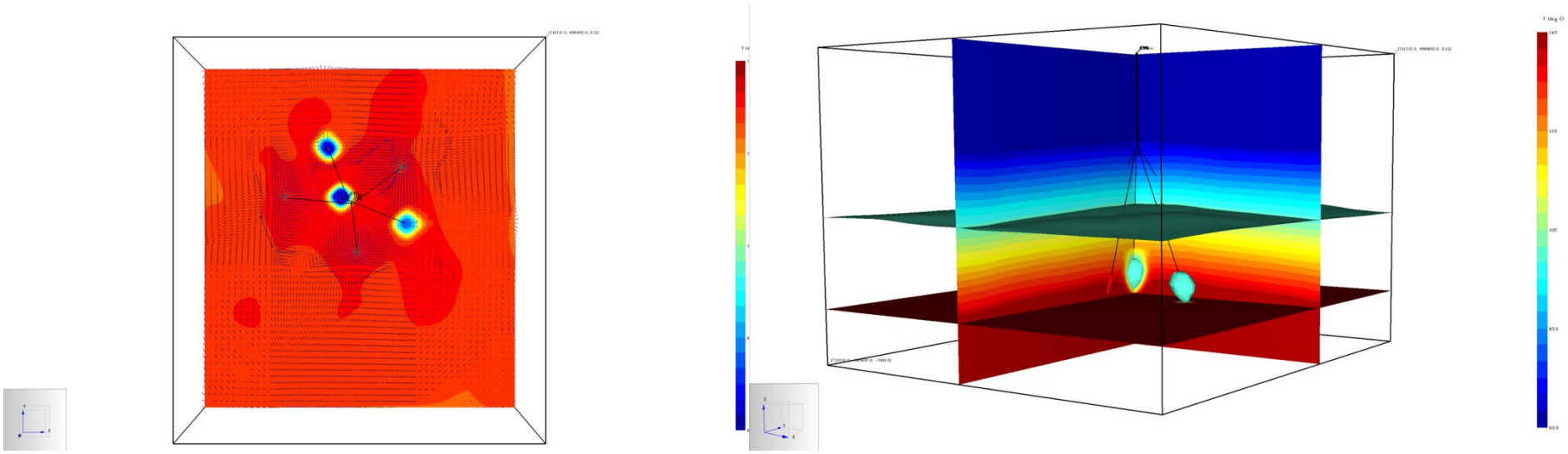
Output Temperature vs time with different flow

Deep U
This research is funded by the European Union
(EIC, Path nder Programme, G.A. 101046937)



Rock type distribution with reservoir (pink) refinement

Well trajectory projection



Temperature distribution after 30 years, blue area evidence reinjection

Total Flow: max. 500 Kg/s (permeability dependent),
Temperature 135°C

Closed Loop

ORC power plant MW for 50 Kg/s 125°C

External pumping station for fluid circulation

Zero emission: no fluid extracted

Drilling cost: 2 x 6.5 Km vertical/deviated plus 50 Km Horizontal

Concerns:
Impermeabilization of the horizontal section
Drilling impact on the rock properties

Open Loop

ORC power plant for 300-500 Kg/s, 135°C, permeability dependent

Submergible pumps (in the 13'' production casing)

Zero emission: Total reinjection (at now not jet realized)

Drilling cost: 6 x 6.5 Km vertical/deviated

Concerns:
Permeability dependent, underground hot fluid presence and quality, scaling and corrosion