



Flow Control Technology for Enhanced Geothermal Wells

TAQA Well Completion

January 2025

Enhanced Geothermal

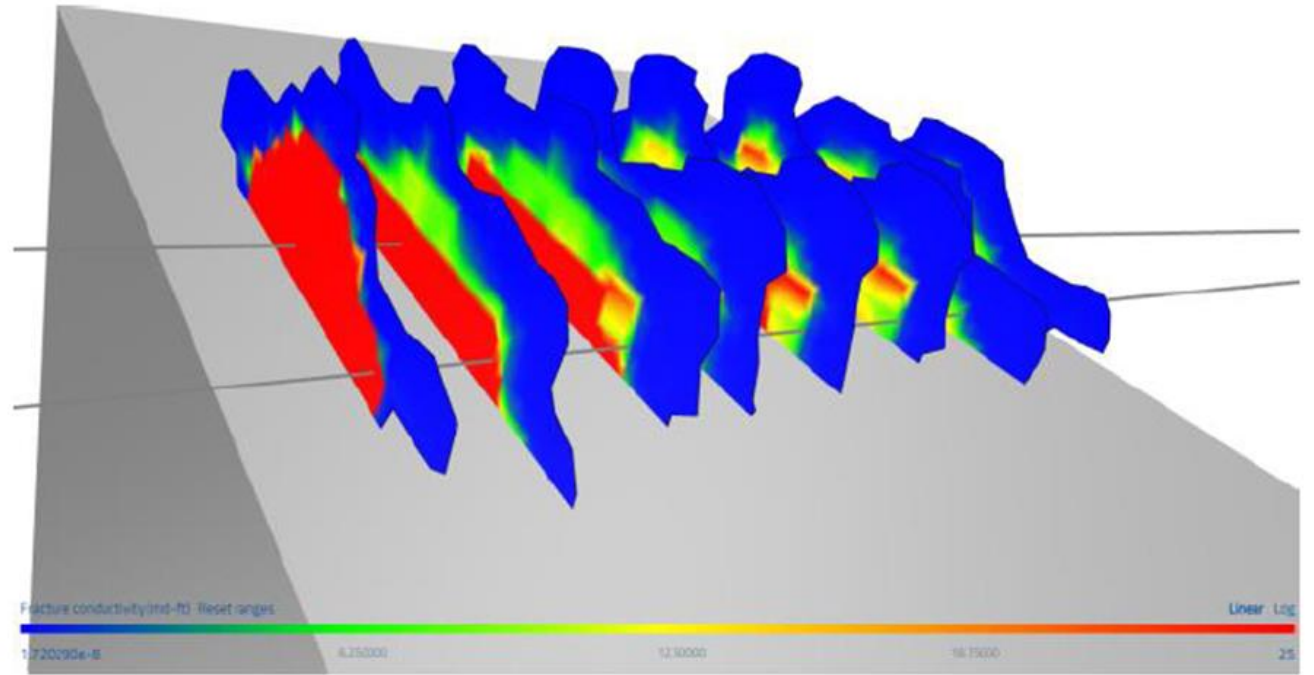
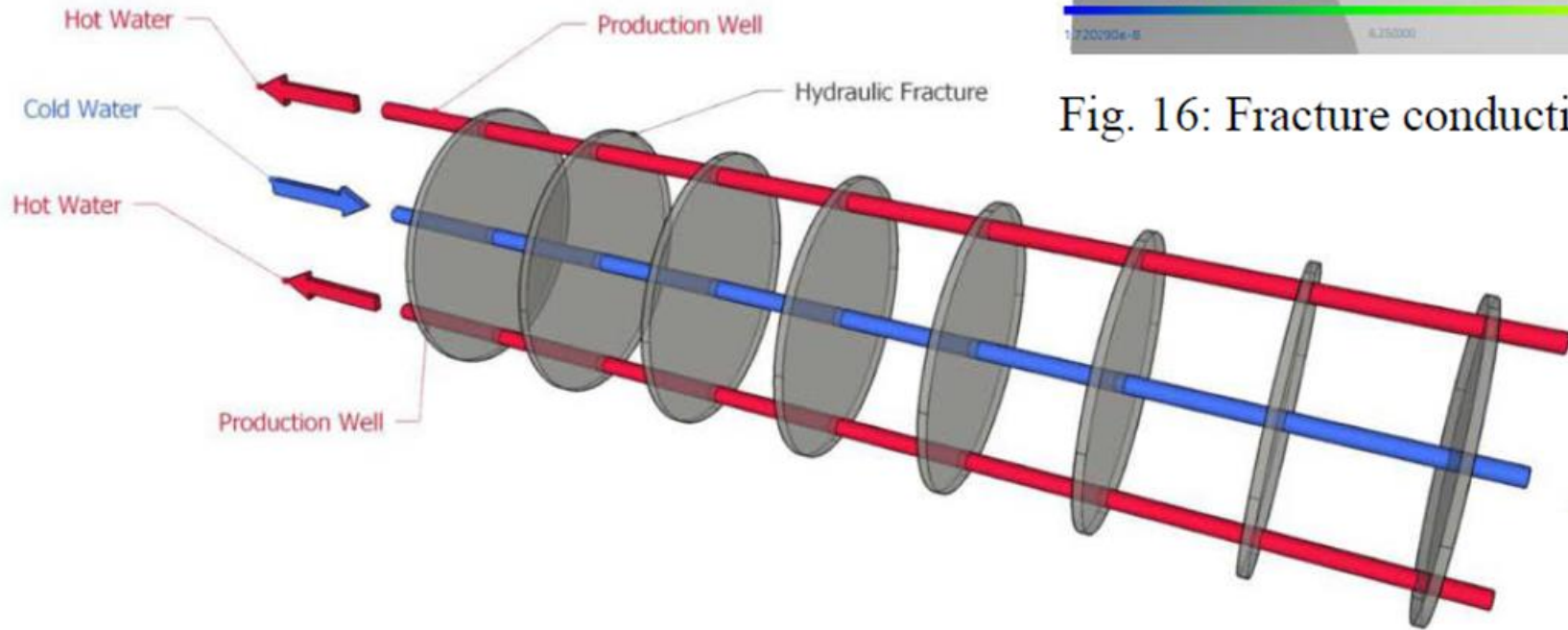
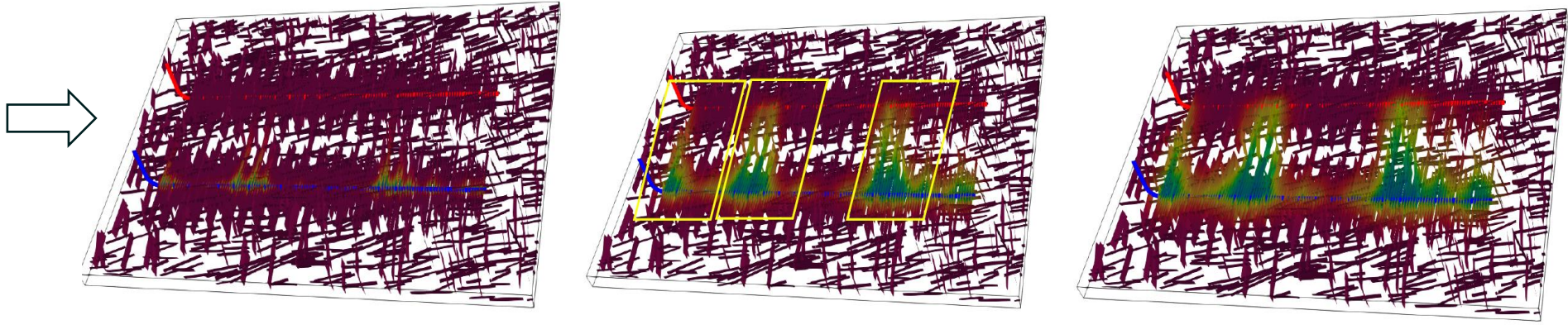
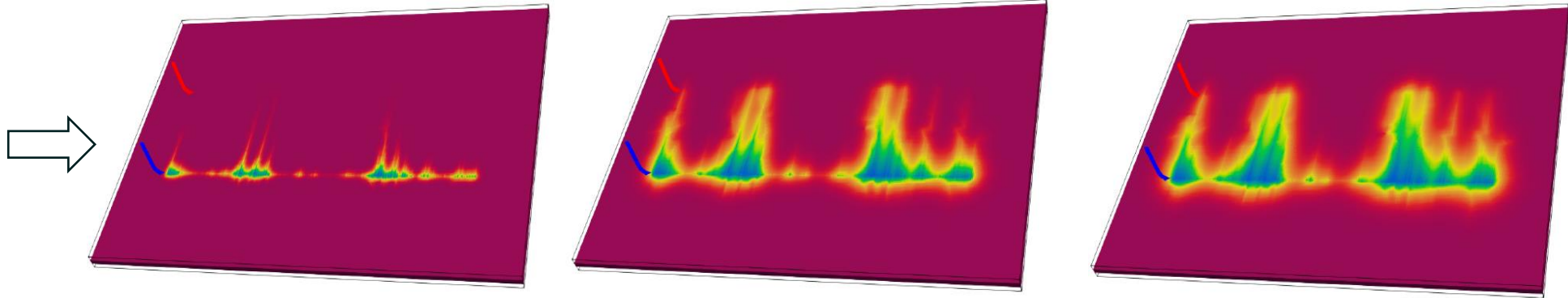


Fig. 16: Fracture conductivity for the 700 ft well spacing case.

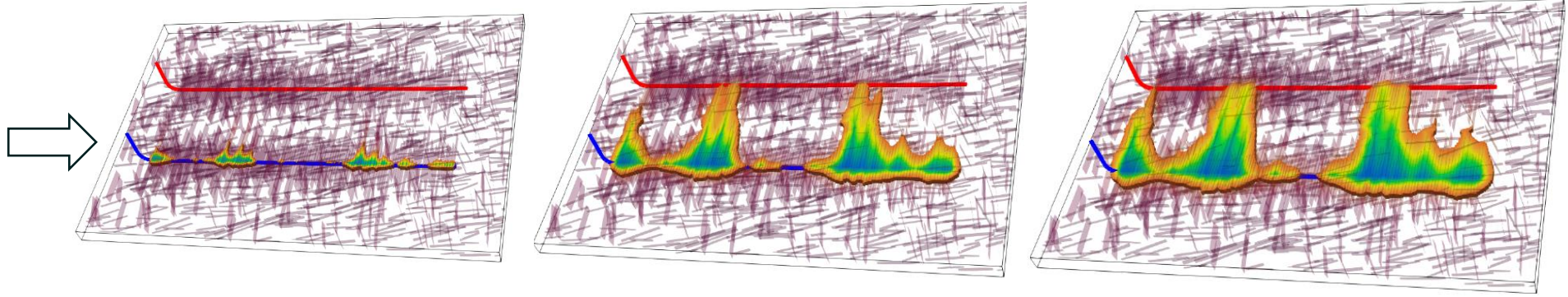
Temperature distribution in fracture network



Temperature distribution in matrix network



Cooling zone propagation



Early Life of the wells
1 year

Mid Life of the wells
15 years

Late Life of the wells
30 years



Advanced Completions and Enhanced Geothermal

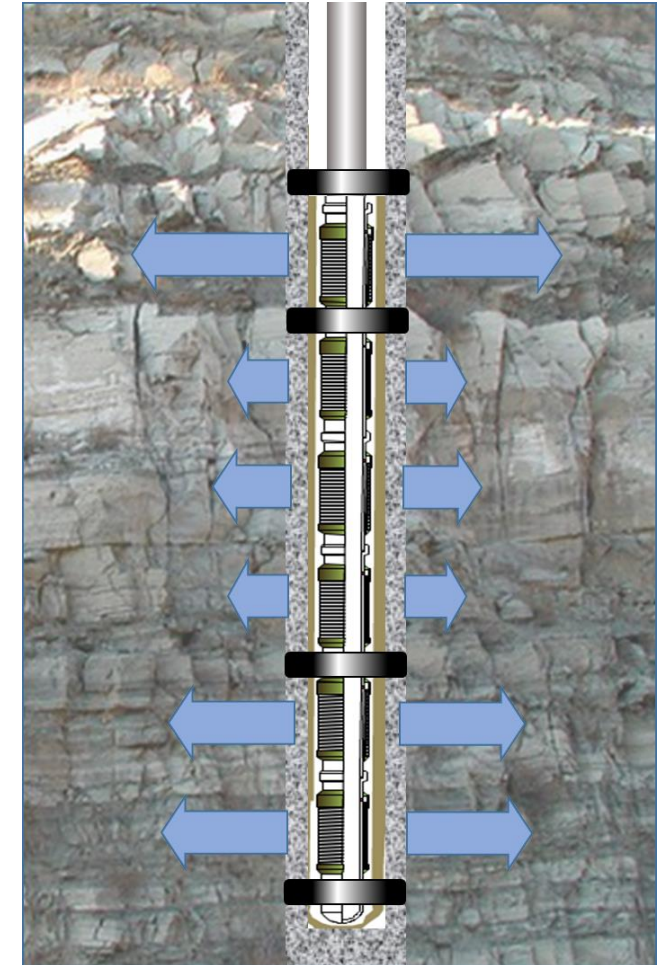
Challenges

- Ensure proportional distribution of water injection and steam production along full length of wellbore to ensure broad areal distribution and maximize enthalpy harvesting
- Mitigate impact of dominant fractures, transmissive faults or thief zones
- Respond to dynamic changes in fluid injection
- Reservoir heterogeneity and anisotropy (stress fields)
- Natural fractures, variable fracture distribution, orientation
- Induced fractures – unequal distribution, orientation, tortuosity
- Variable stress fields
- Unexpected variations in fluid displacement

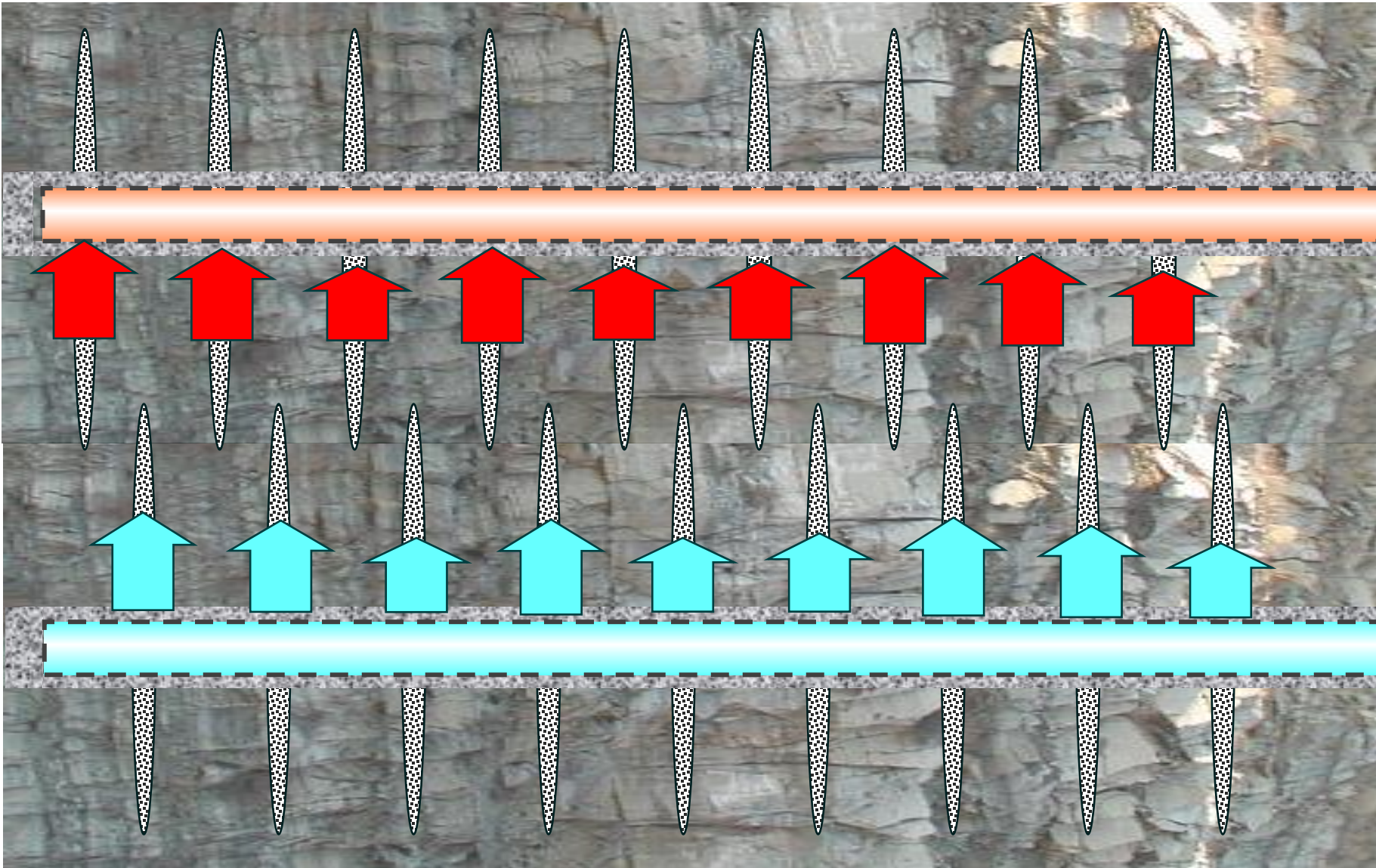
Solutions

Advanced Completions

- Flow Control Devices: FCDs, AFCDs, ICVs
- Sensors: Pressure, temperature, flow, DTS, DAS
- Zonal isolation: Packers, seal bores

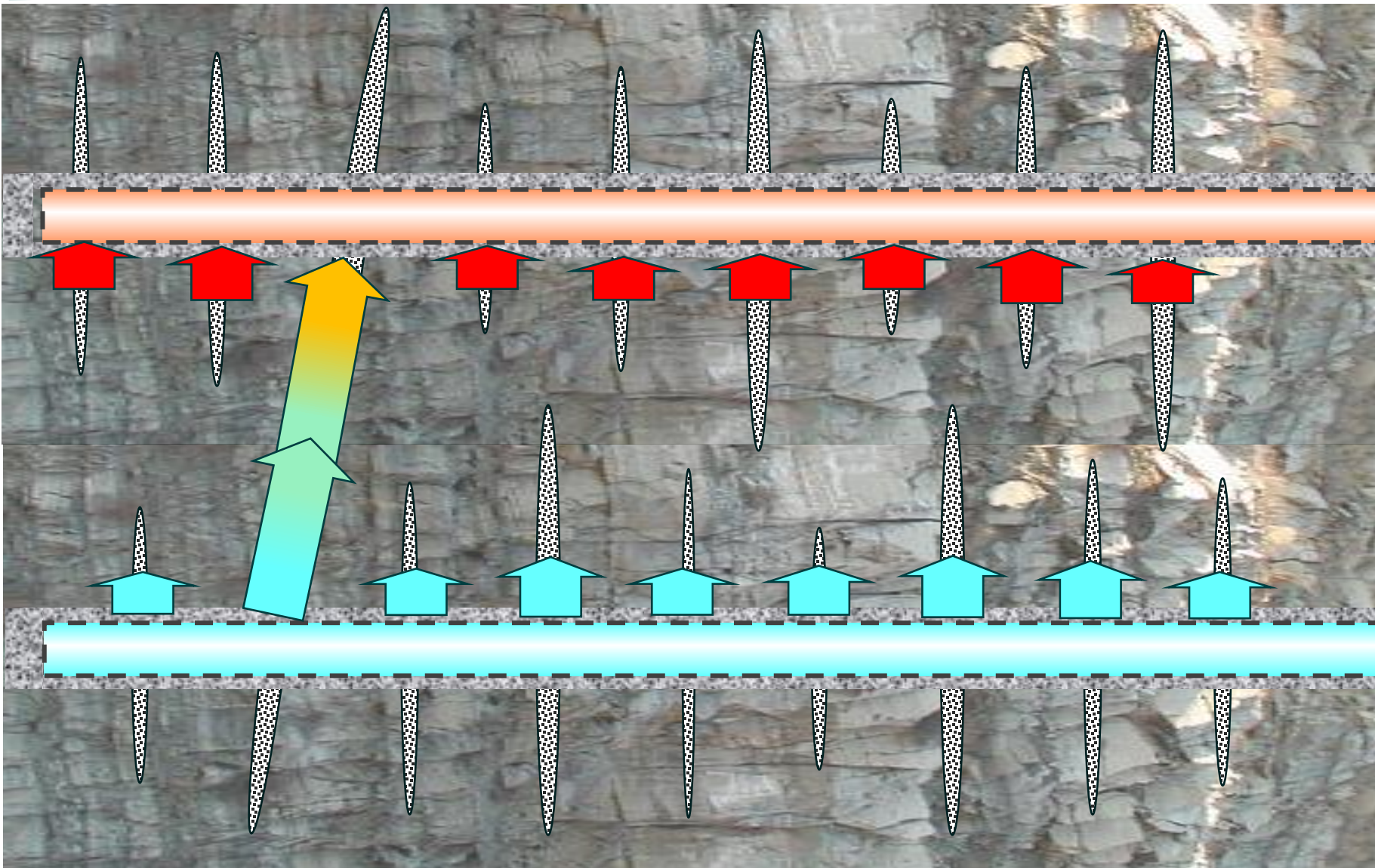


Induced Fracture Enhanced GeoThermal – Ideal Conditions



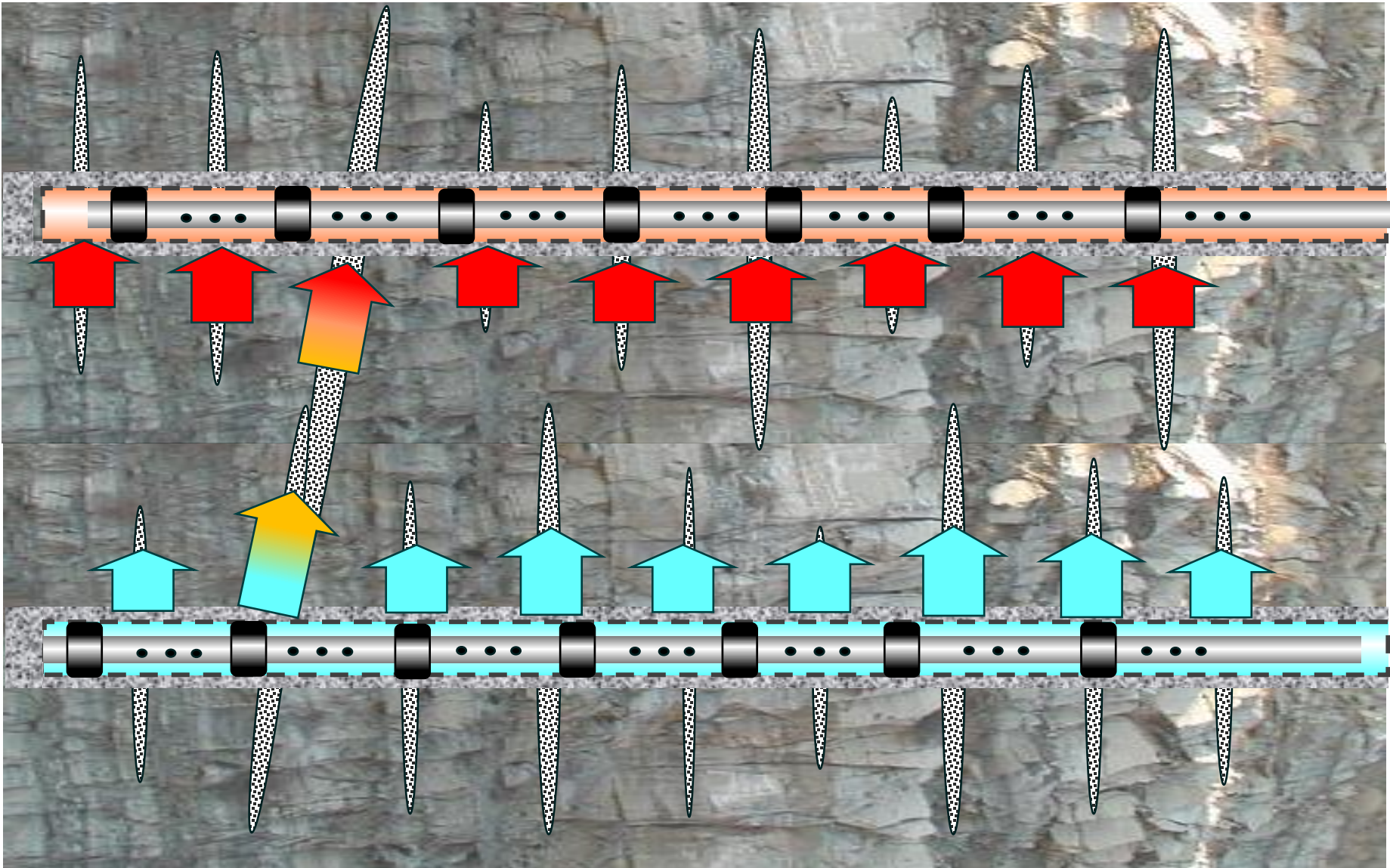
Uniform induced fracture size, distribution and orientation with uniform natural fracture distribution

Induced Fracture Enhanced GeoThermal – Complex



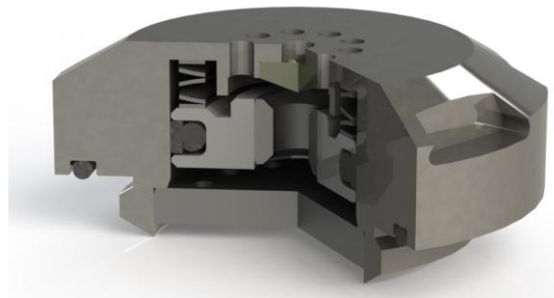
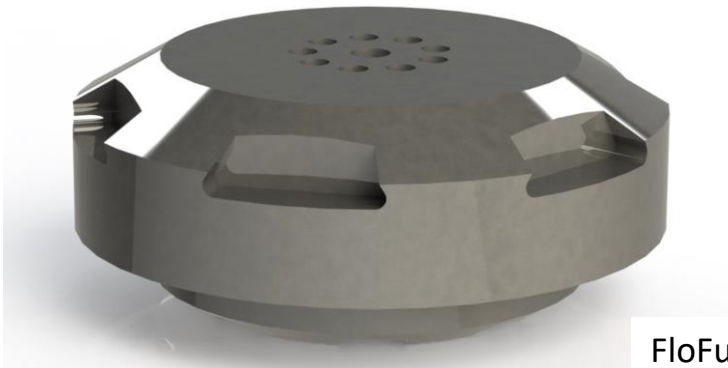
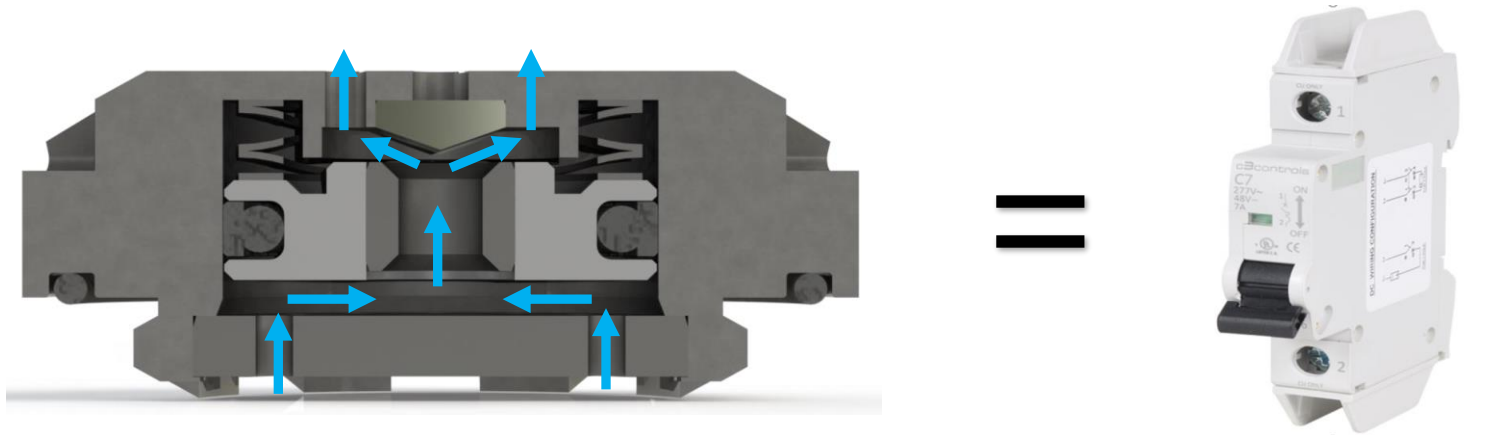
Dominant fracture intersection, natural fault intersection, tortuous fracture paths, concentrated natural fractures, etc. can result in uneven flow distribution and poor enthalpy recovery

Induced Fracture Enhanced GeoThermal – FCD Completion

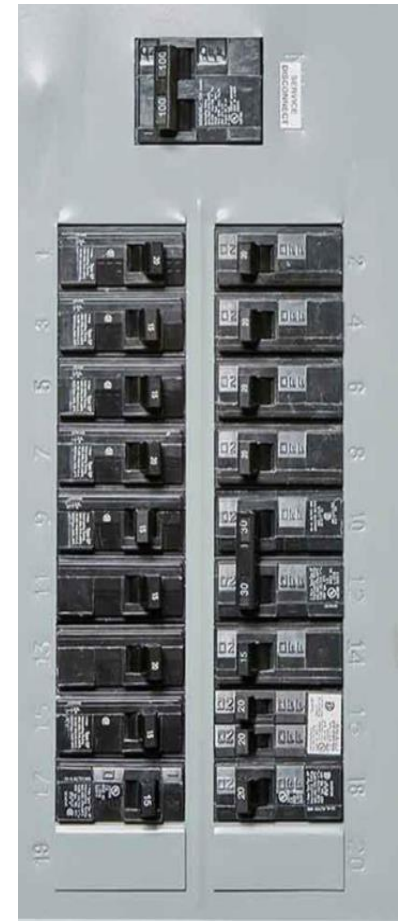
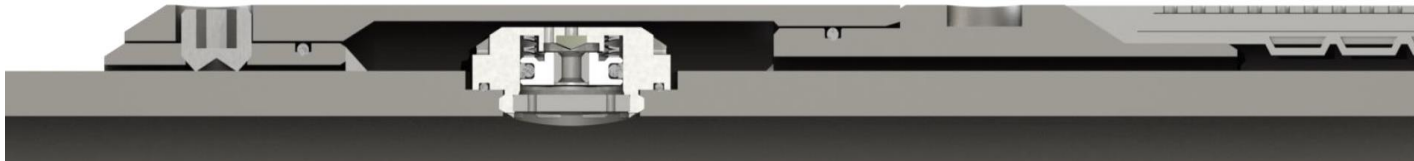


Advanced FCD Completions can mitigate uneven flow distribution as a result of dominant fracture intersection, natural faults, concentrated natural fractures, etc.

FloFuse; Autonomous Rate Limiting Flow Control Device



FloFuse Mounted in Screen



- FloFuse provides a rate limit to prevent excessive fluid injection into the thief/fracture zones thereby enabling balanced distribution of matrix injection.
- The valve is reversible so if the conditions Q , the valve re-opens



Thank You

Any Questions?