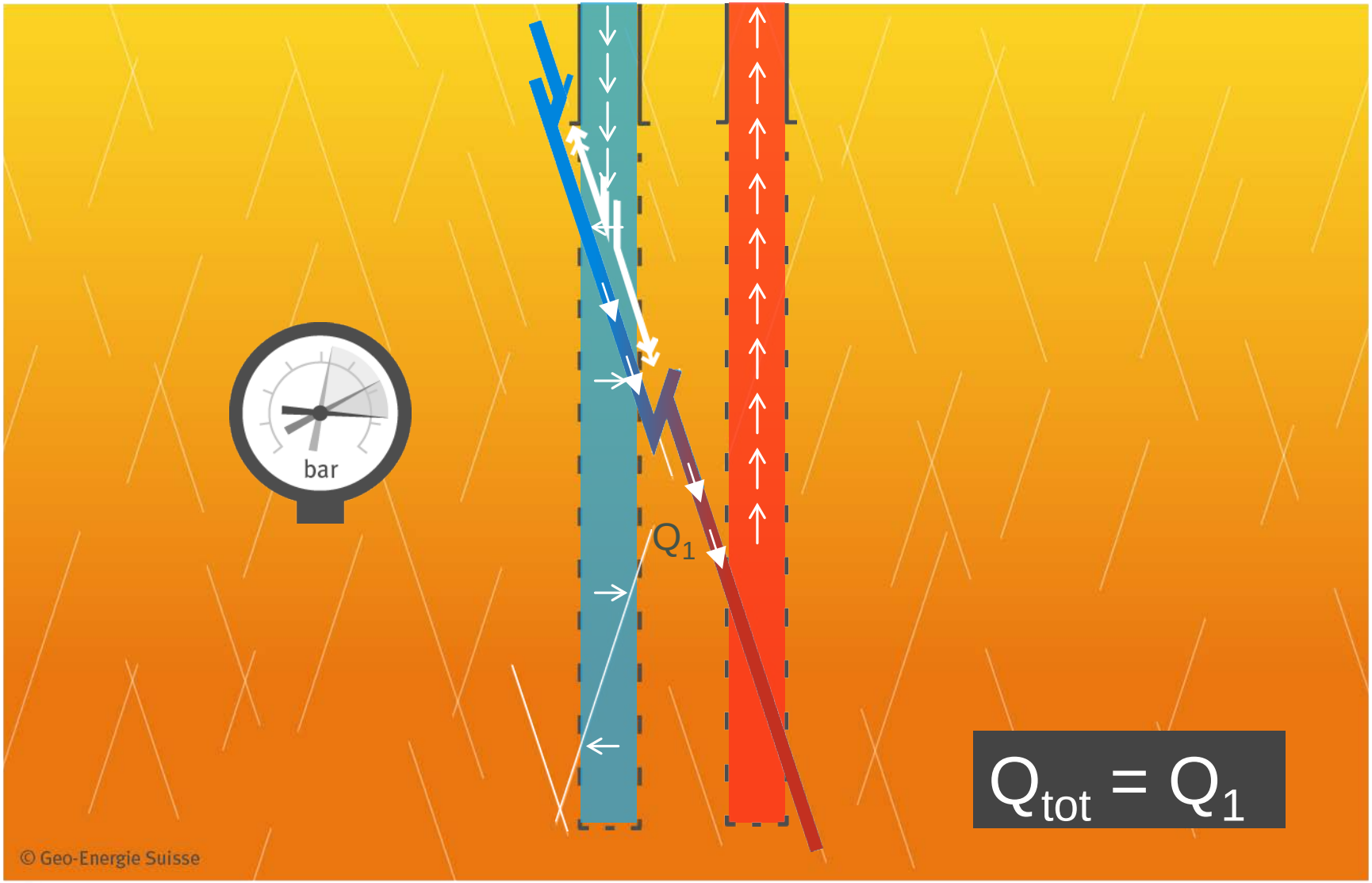
Swiss Centre of Competence for Deep Geothermal Energy for power and heat production

Reservoir engineering for a heat exchanger in Haute-Sorne (or elsewhere)

SCCER-SOE Annual Conference 2018,
Lucern University of Applied Sciences and Arts (HSLU)
14.09.2018, Horw

Dr. Peter Meier & Dr. Dieter Ollinger
Geo-Energie Suisse AG

Stimulation of an open-hole vertical well



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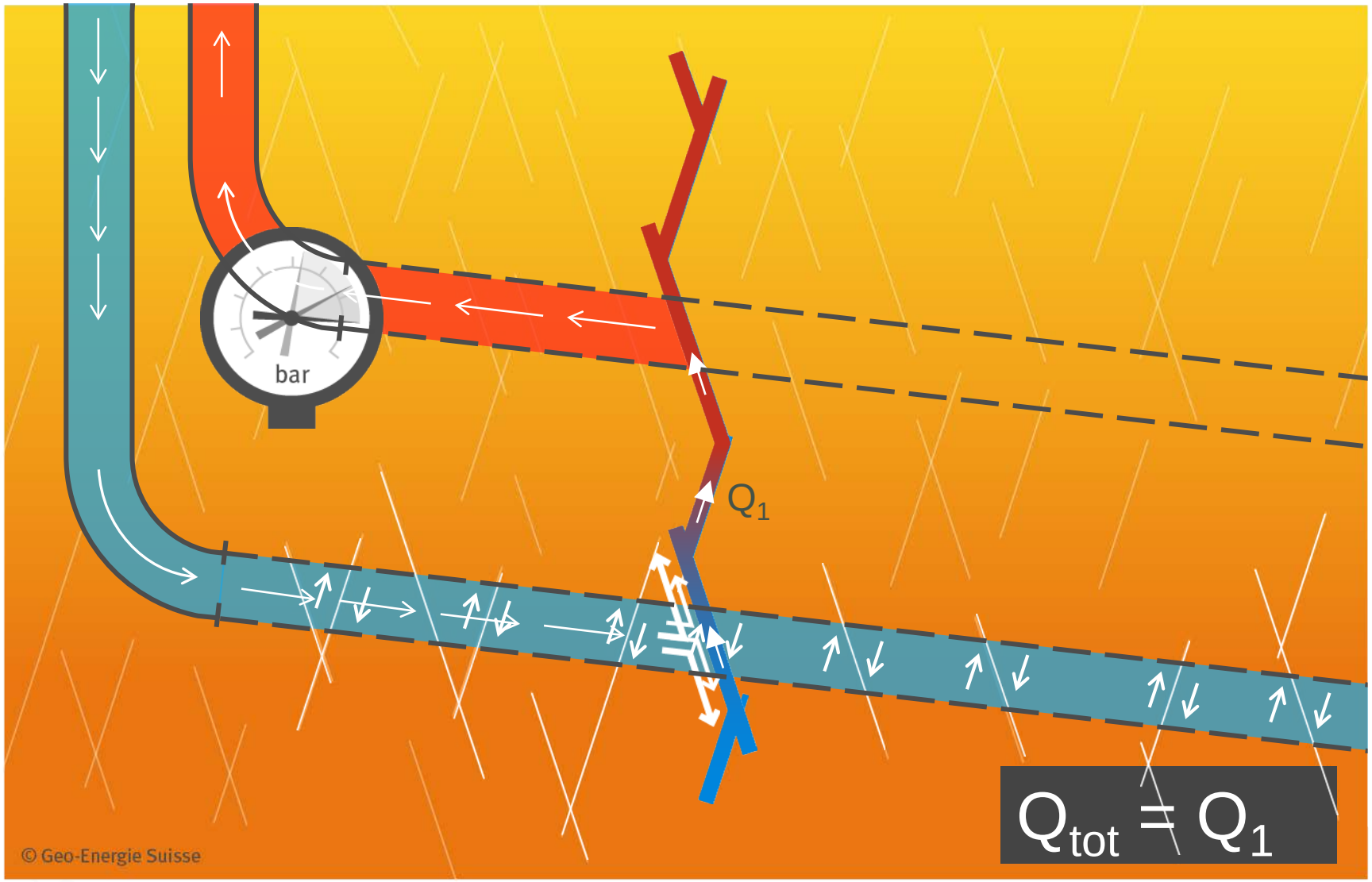
Stimulation of an open-hole deviated well



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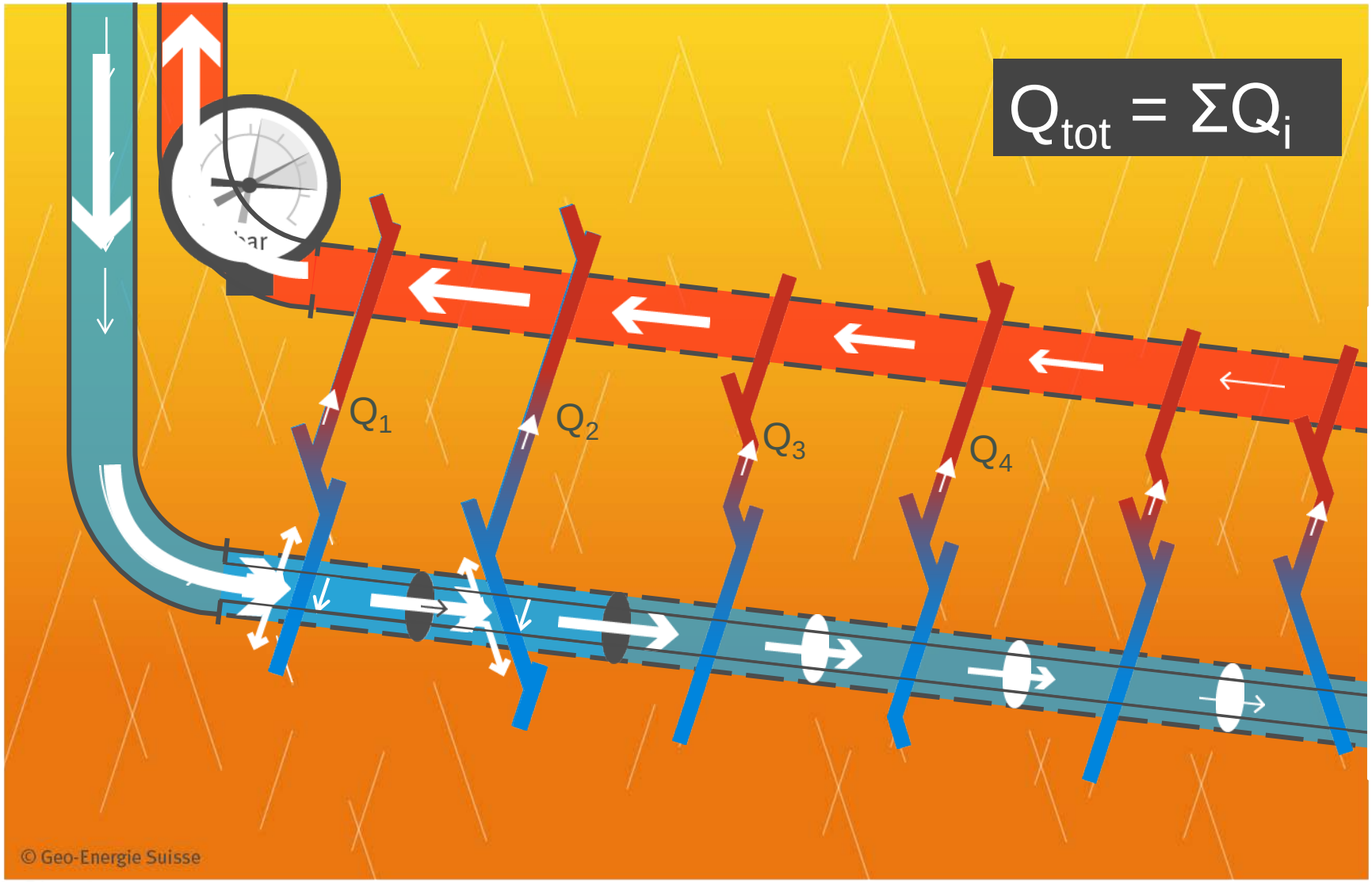
Multi-stage stimulation of isolated segments



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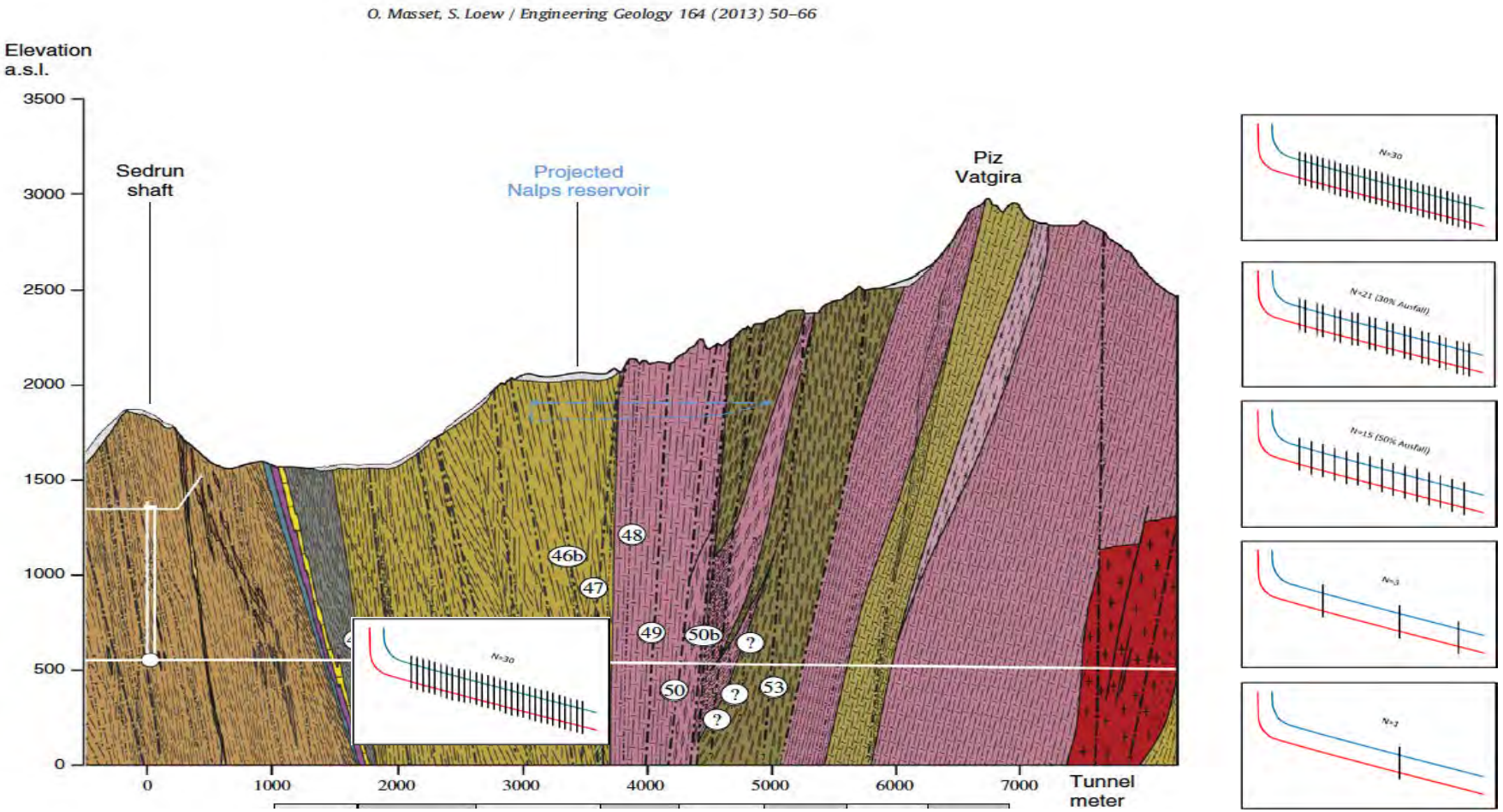
Monte Carlo simulations to estimate the changes of successful flow rates



assuming rock conditions of the Gotthard base tunnel (Masset & Loew, 2013)

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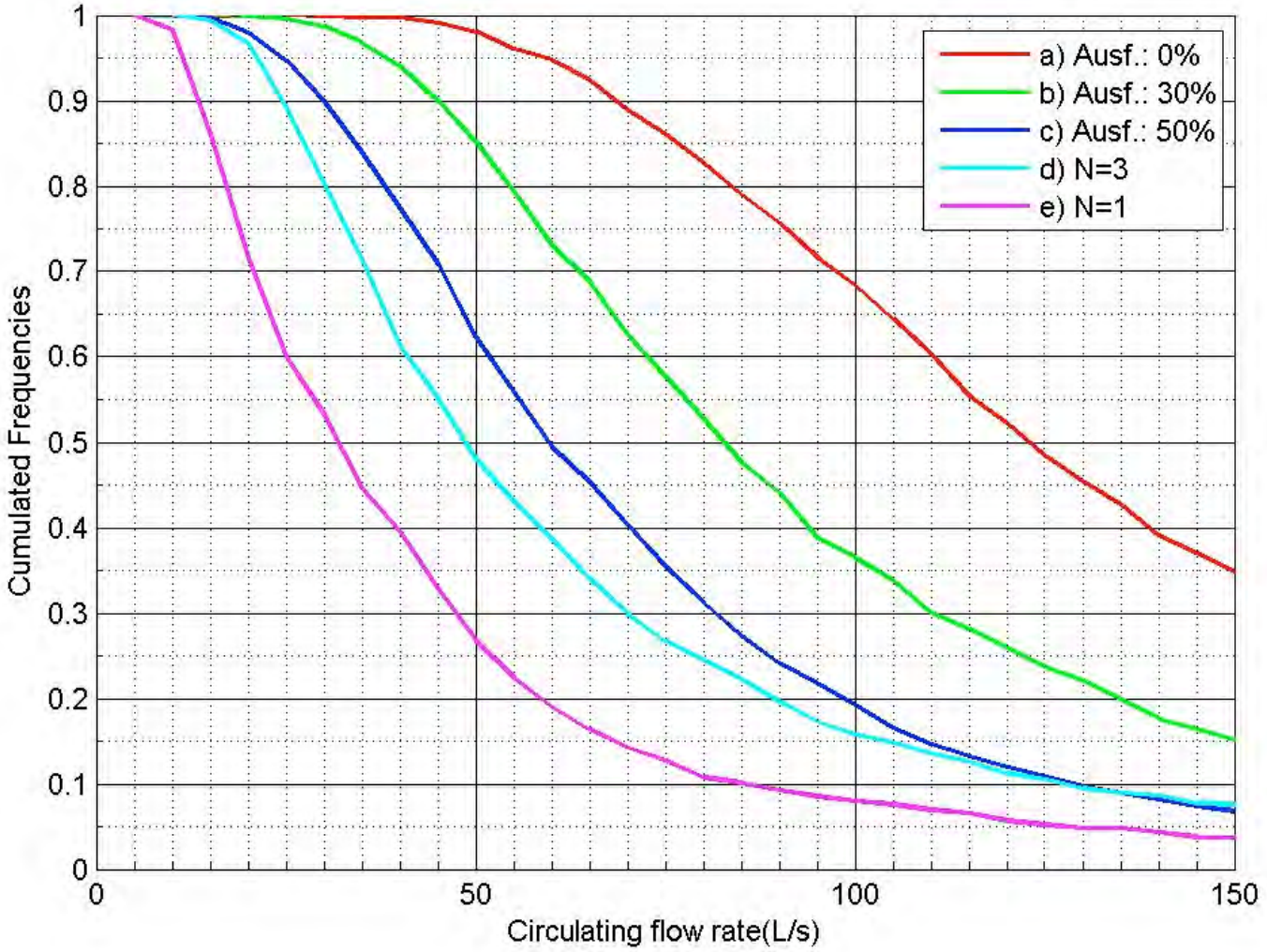
Monte Carlo flow rate simulations for the multi-stage EGS stimulation concept of the Haute-Sorne pilot project

=> Probability of success increases with the number of stages



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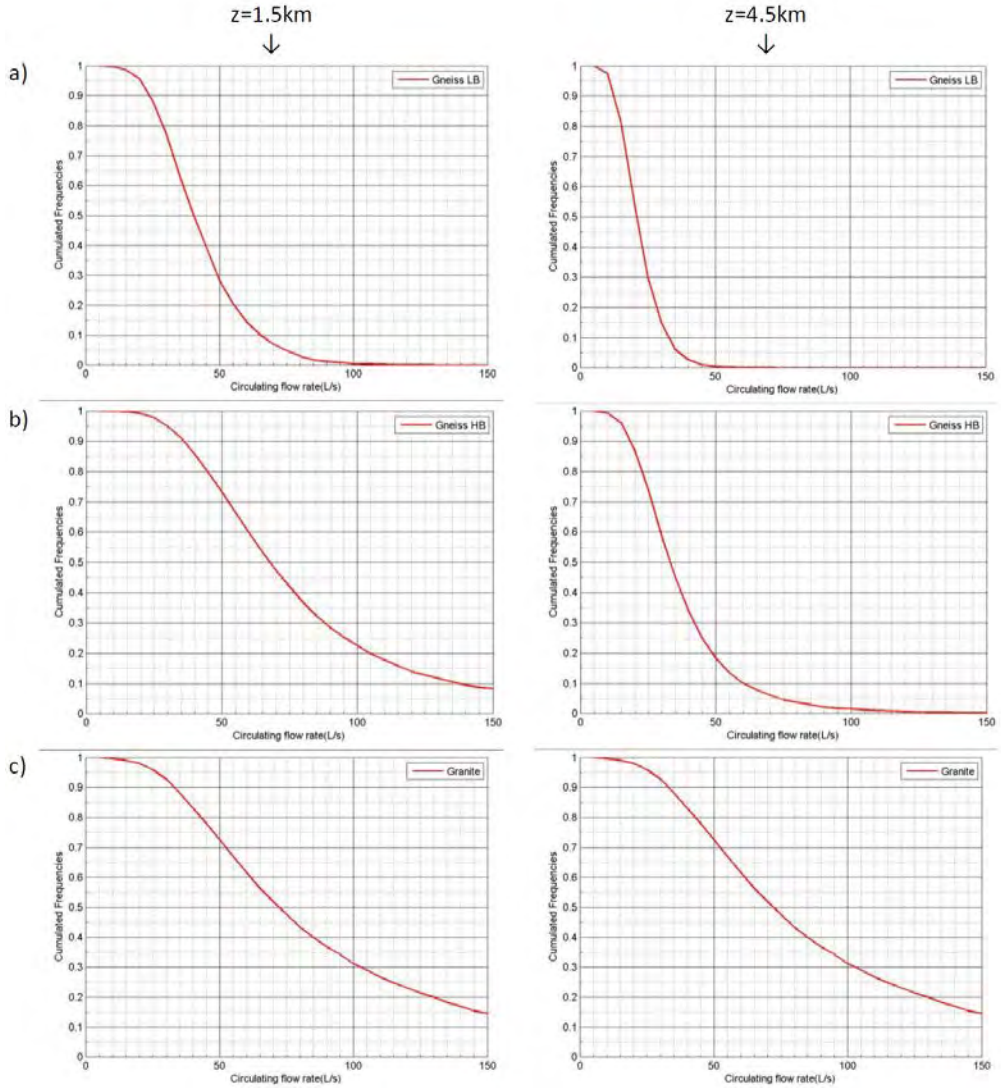
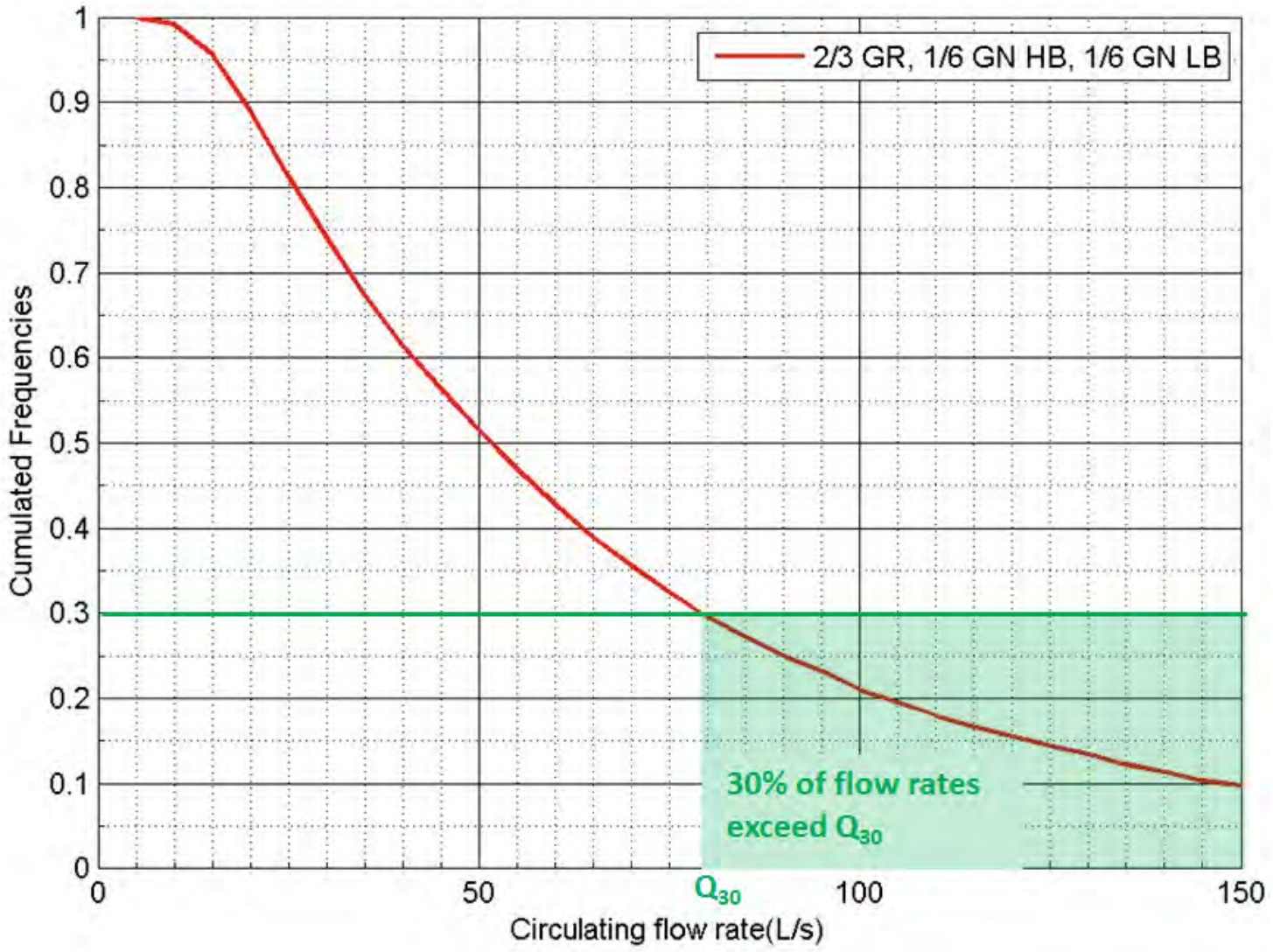
Influence of depth and rock type assuming mean stage failure of 40%



Overall probability assuming a depth of 4500 m, mean stage failure of 40% and 2/3 granite and 1/3 gneiss



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Steps of Monte Carlo modeling

1) Statistical data for transmissivity (T) including spatial correlation along tunnel (borehole) axis
2) Generation of multiple T value-sets
3) Depth correction of T values
4) Multiplication of T values with stimulation factors
5) Correction for stage failure probability
6) Run over 2000 simulations for flow calculation with reservoir model

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Step 1 Statistical data for transmissivity (T) including spatial correlation along tunnel (borehole) axis

Geo-statistical data for transmissivity (T) including spatial correlation along tunnel axis

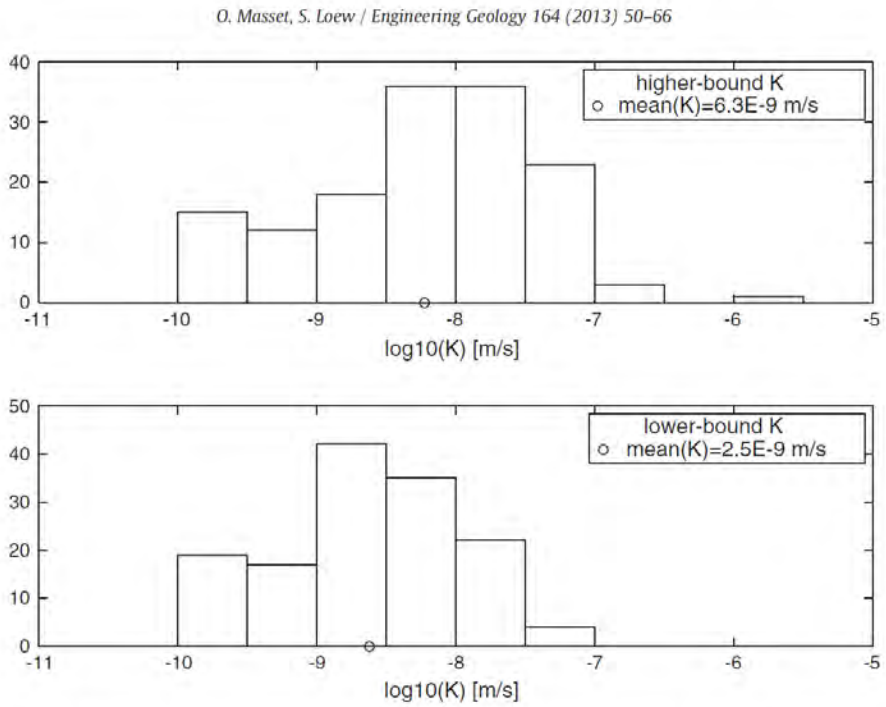
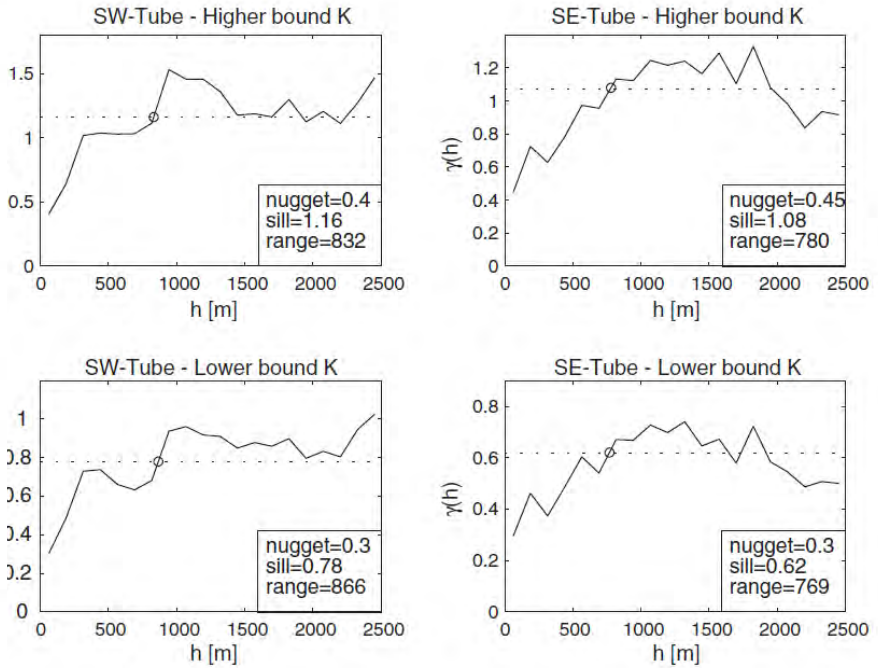


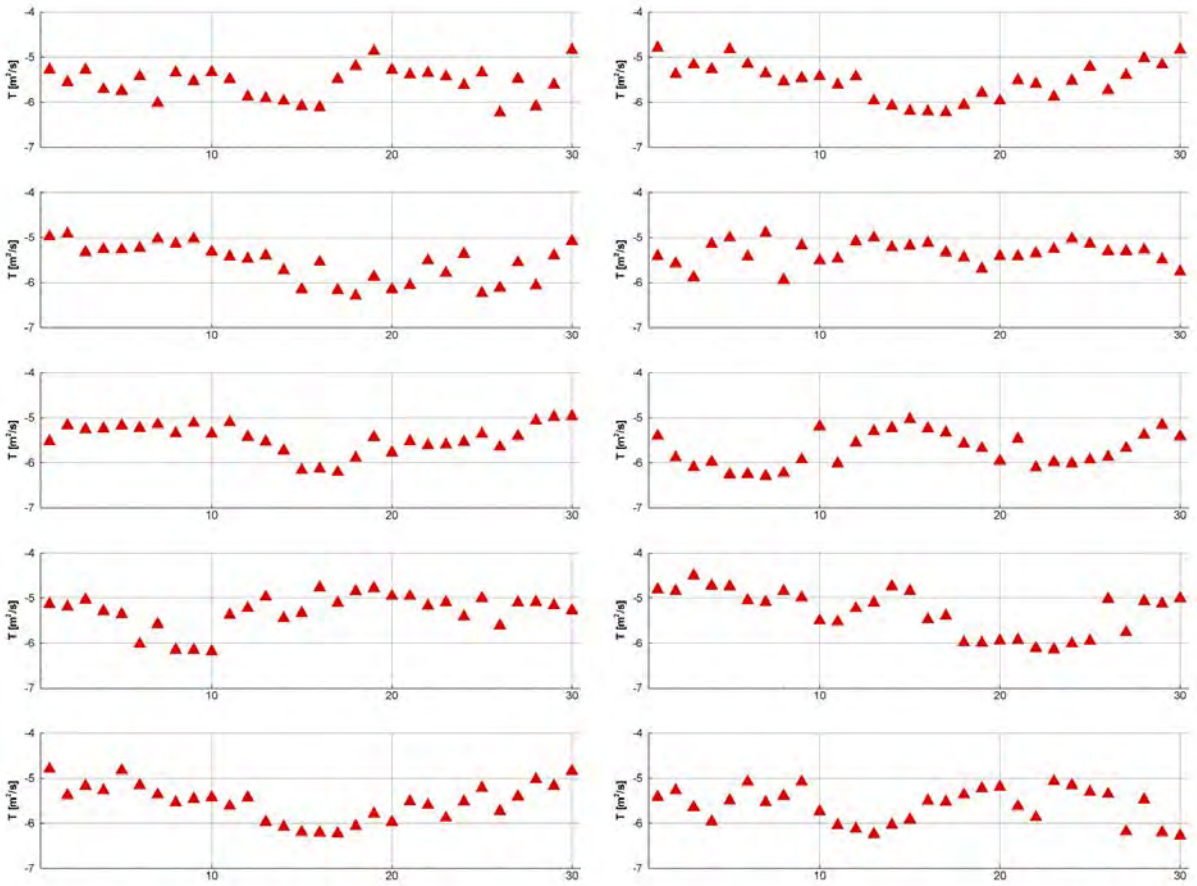
Fig. 14. Histogram distribution of all 50-m hydraulic conductivities (lower and upper bound values).

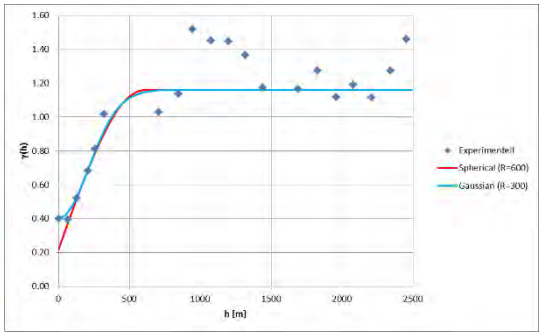


-variograms of 50-m hydraulic conductivities along the two tunnel tubes for higher (HB) and lower (LB) bound values

Step 2: Generation of multiple T value sets for 30 stages along borehole axis

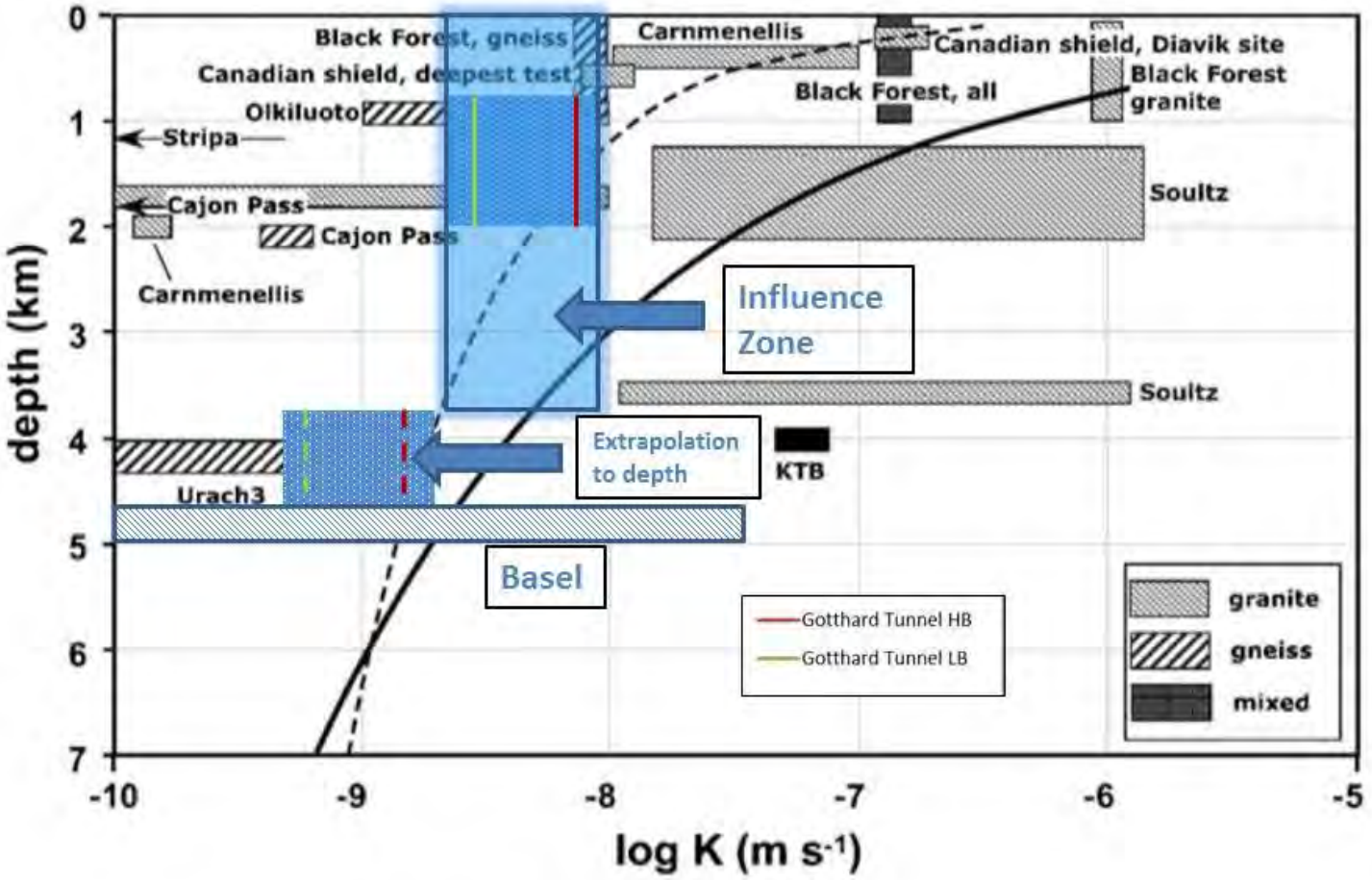
Code SGeMS (Remy et al., 2011)





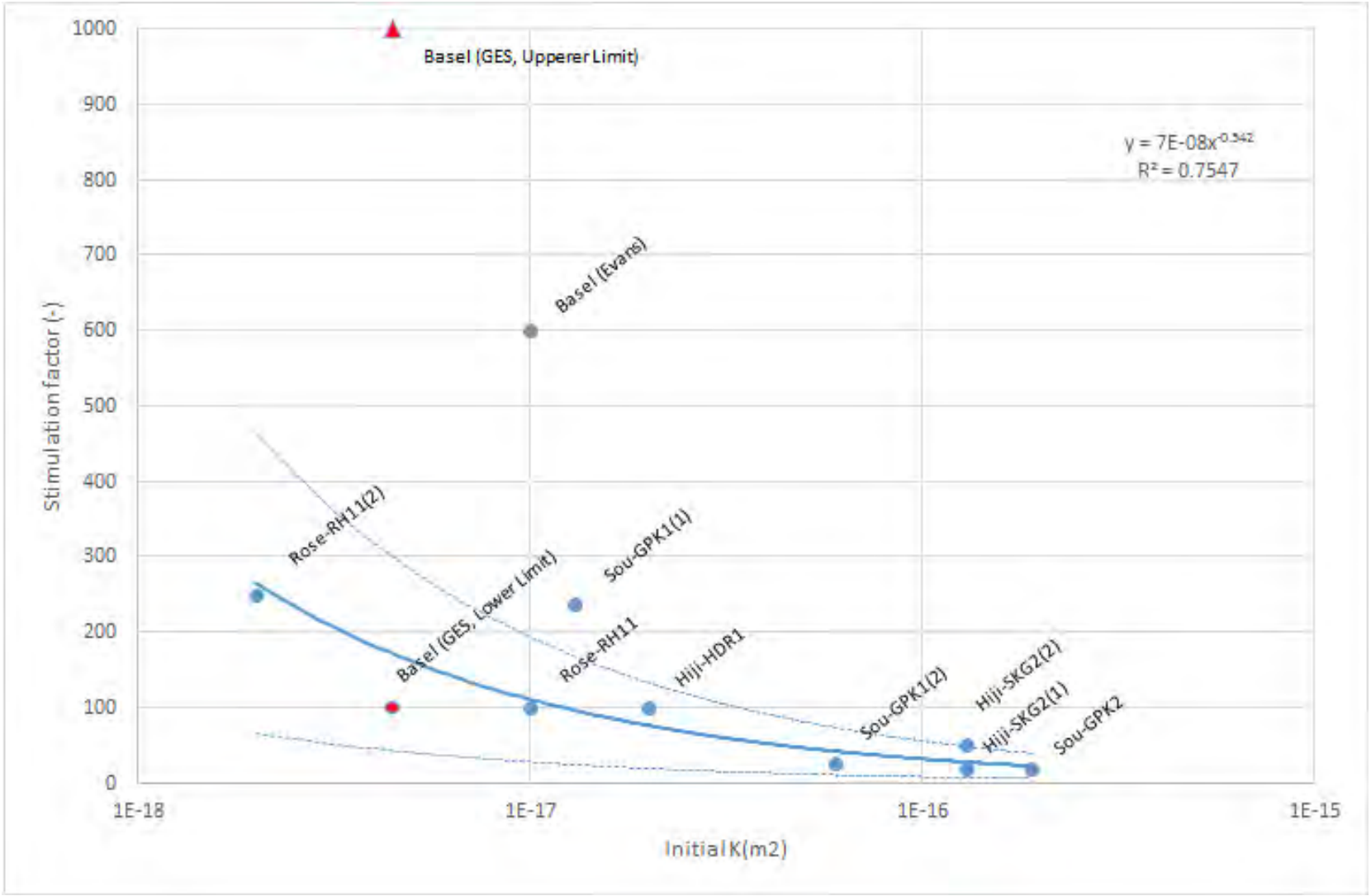
3) Depth correction of T values

Relationship of Stober & Bucher (2007), influence zone deep Gotthard tunnels, Basel borehole data and extrapolation to depth



4) Multiplication of T values with stimulation factors

Modified from Evans (ETH Zürich ZLG short course in deep geothermics, 2013)



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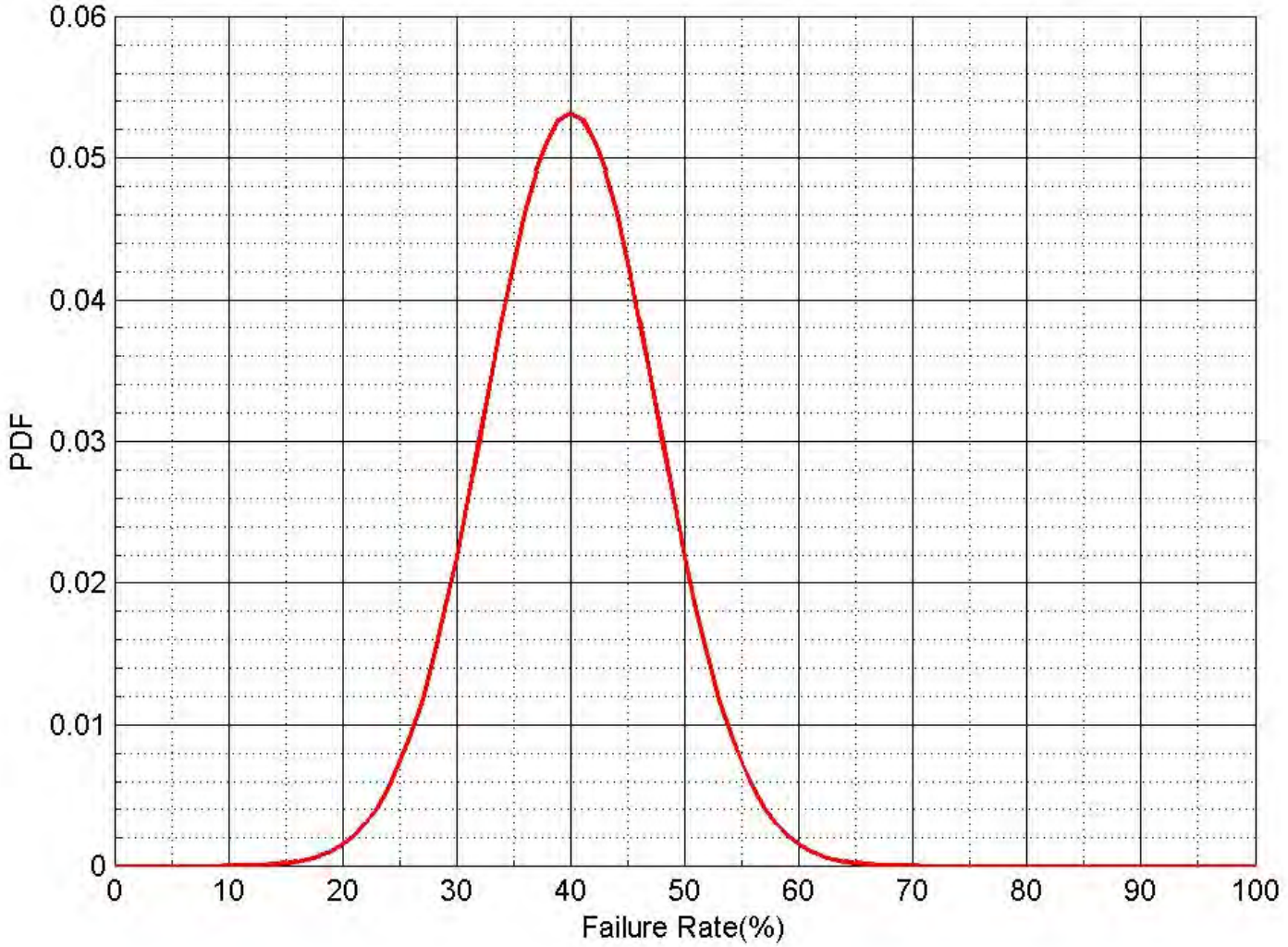
5) Correction for stage failure probability



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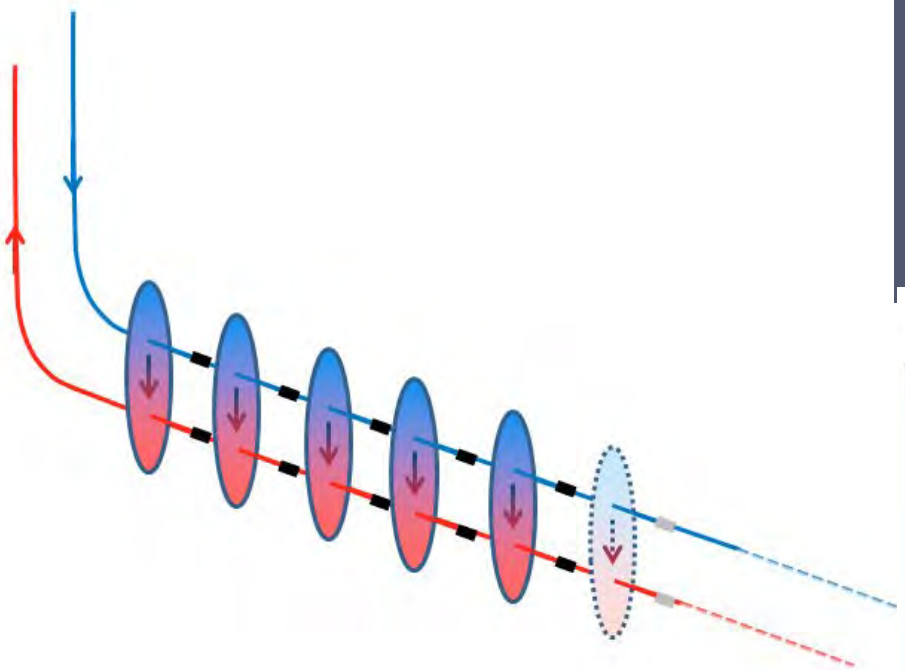
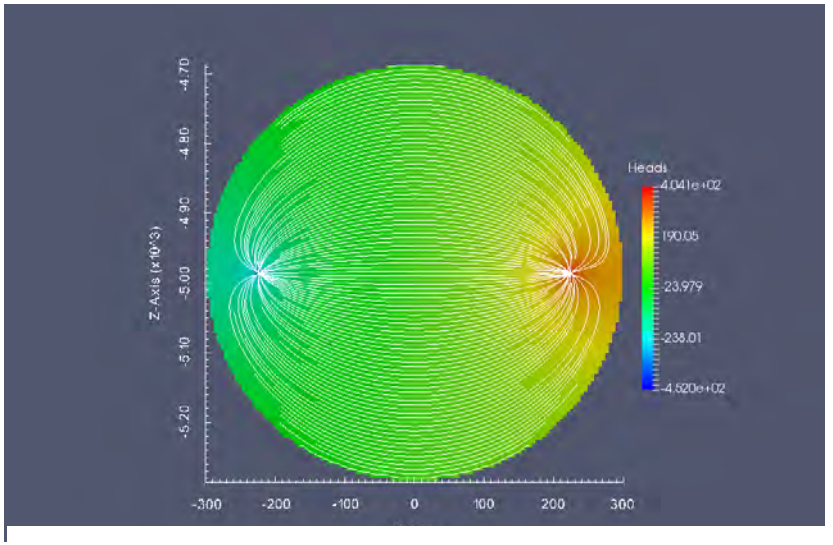
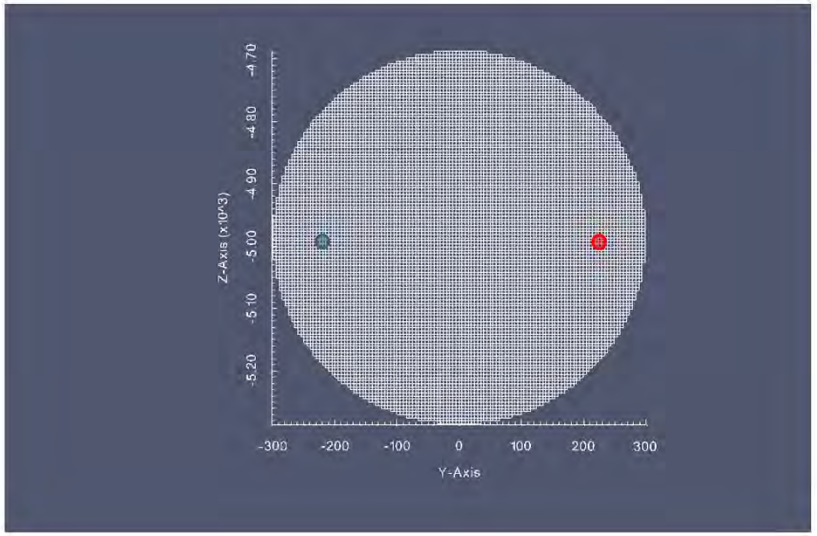
Step 6) Run over 2000 simulations for flow calculation with reservoir model

FE-Code TRANSIN UPC Barcelona







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