



IGG
Institute for Geomechanics
and Geotechnics



TRANSDISZIPLINÄRE FORSCHUNG ZUR ENTSORGUNG
HOCHRADIOAKTIVER ABFÄLLE IN DEUTSCHLAND

Uncertainties in regard to the geological and geotechnical Barriers

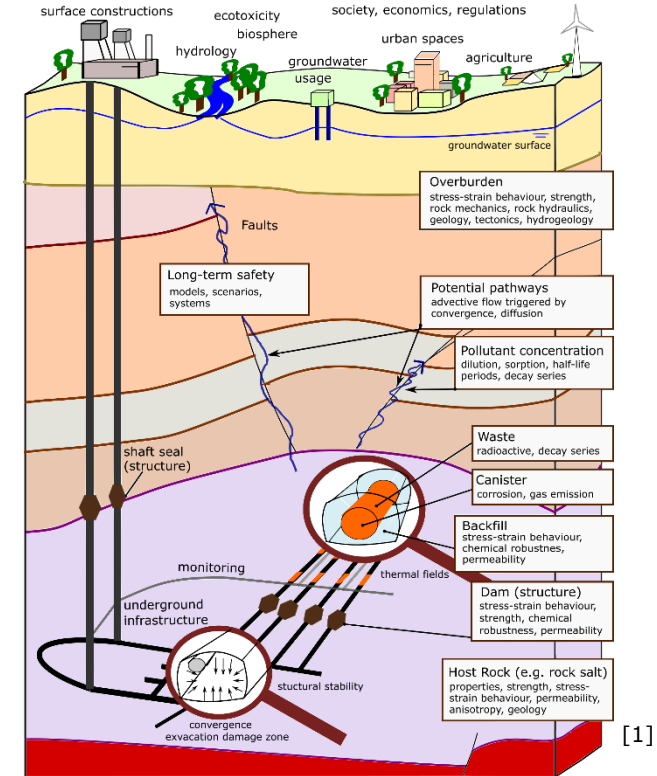
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Institute for Geomechanics und Geotechnics

SafeND – Workshop WS5, Berlin, 10.-12.11.2021



Complexity of HAW-repositories

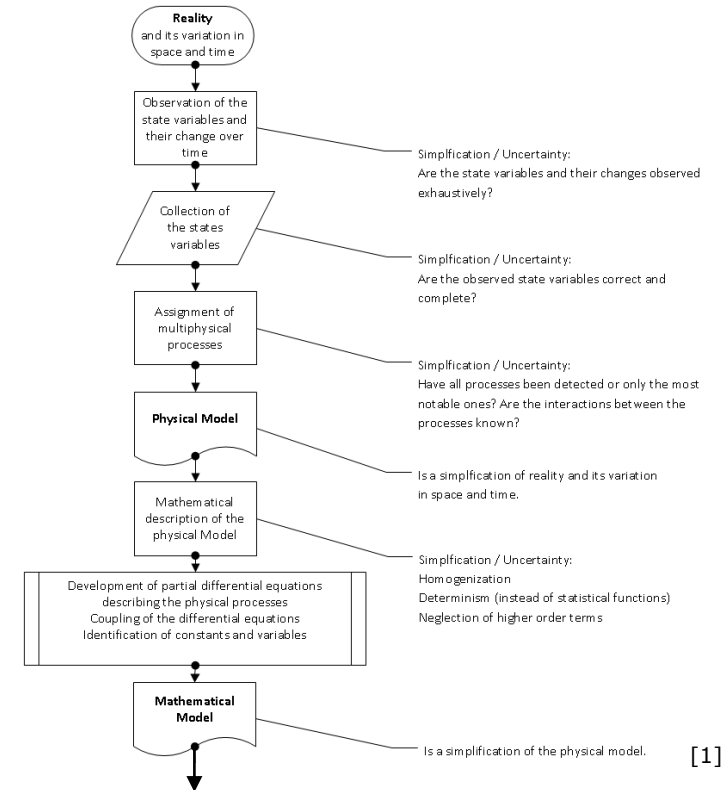
- Thermal, mechanical, hydraulic and chemical processes and their interaction
- Multi-barrier system
- Uniqueness of each repository
 - No experience with the entire system
 - Experience available with parts in
 - Underground laboratories
 - Low-level Waste Disposal Sites
 - Laboratory testing, etc....



[1]

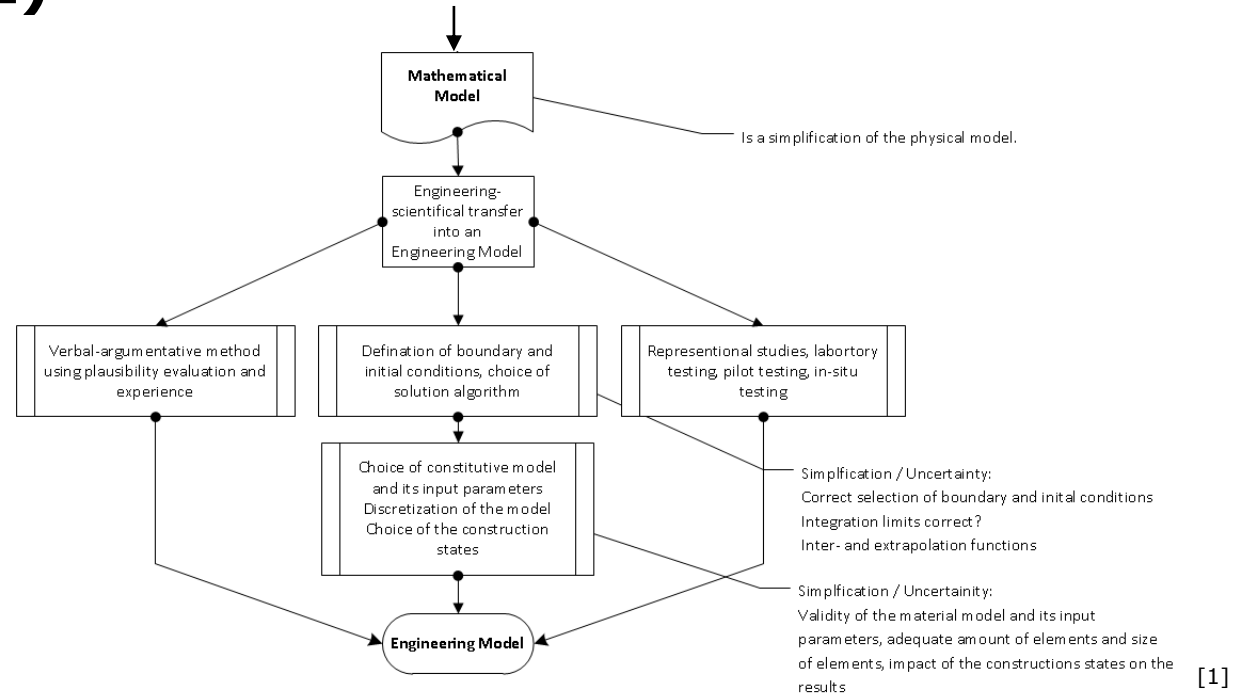
Uncertainties caused by modelling (1/2)

- Reality is simplified by modeling
- Reality
 - physical model
 - mathematical model
 - engineering model
- Simplification due to the model's objective



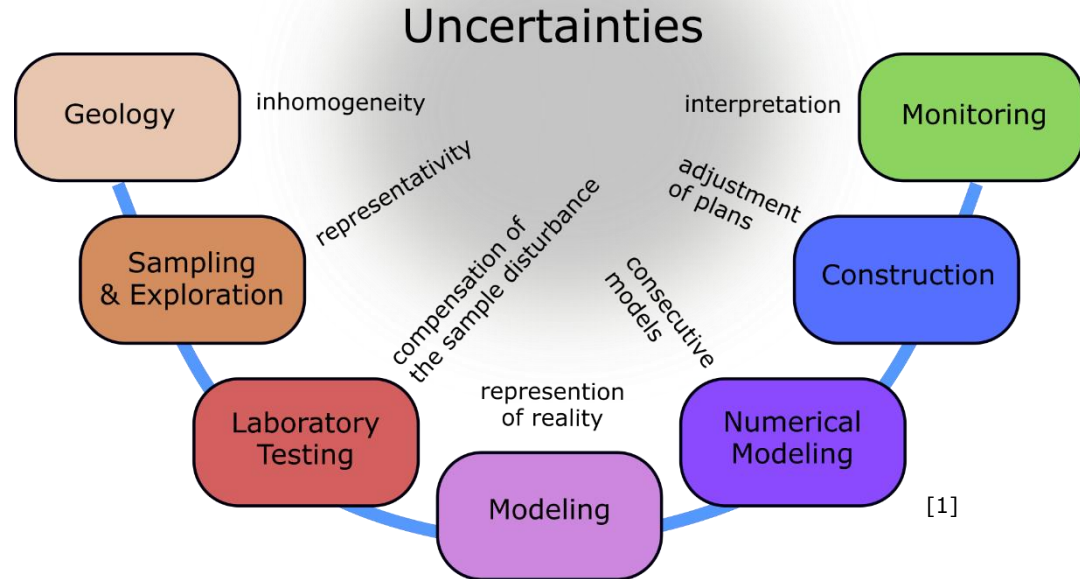
Uncertainties caused by modelling (2/2)

- The resulting engineering model is optimized for its purpose



Regimes of Uncertainties

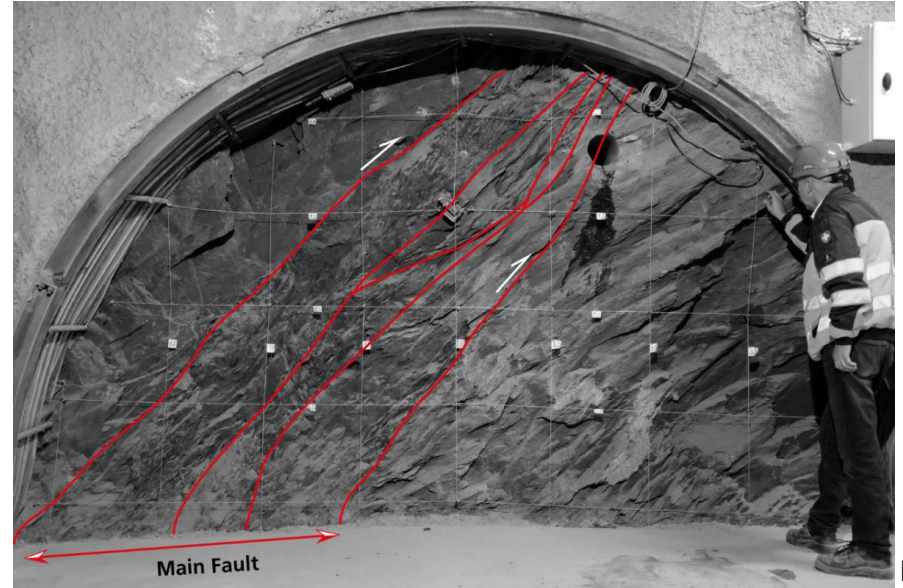
- Overview of various uncertainties fields addressed in the report
- For example: fault zones



Scenario: Undetected Fault Zone



- Sometimes detecting faults is difficult
- Faults can be orientated in the same direction as the drift and can not be detected from inside the drift



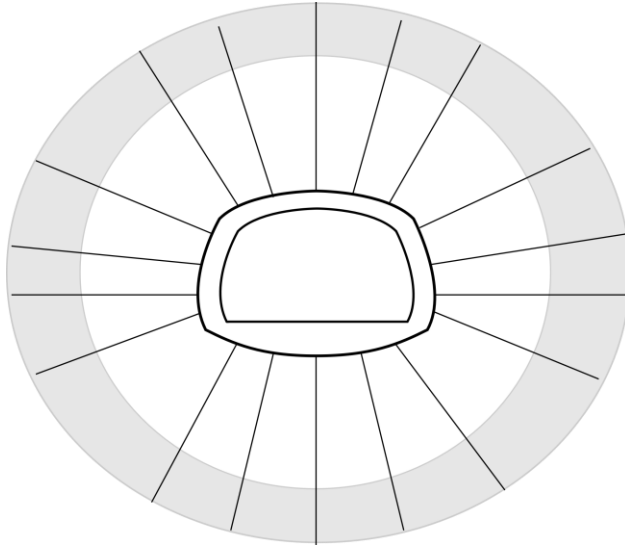
[2]

Example: Main Fault in Mont Terri (CH)

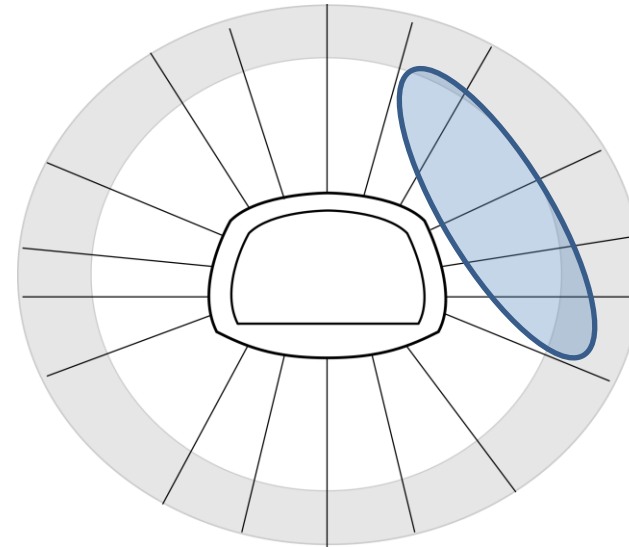
Scenario: Failure of the lining



Repository in clay rock, infrastructure drift, 40 years operational time required



Lining with rock bolts

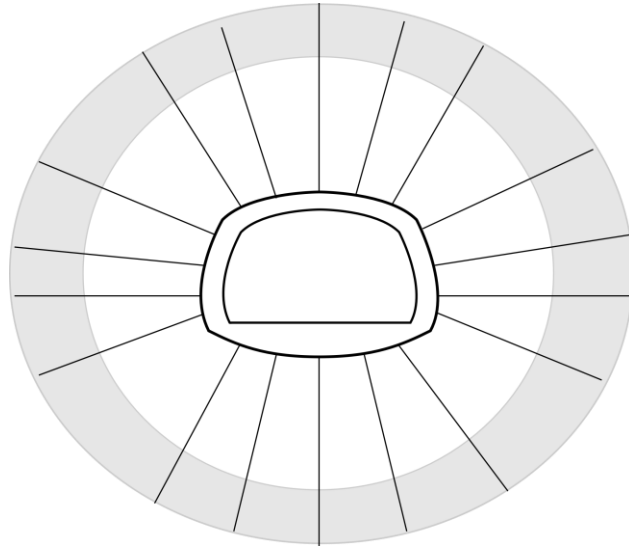


Rock bolt failure

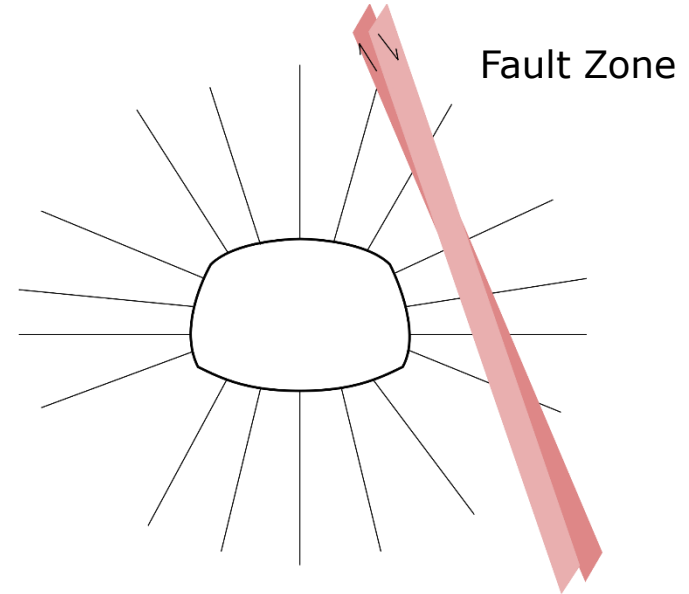
Cause: Undetected Fault Zone



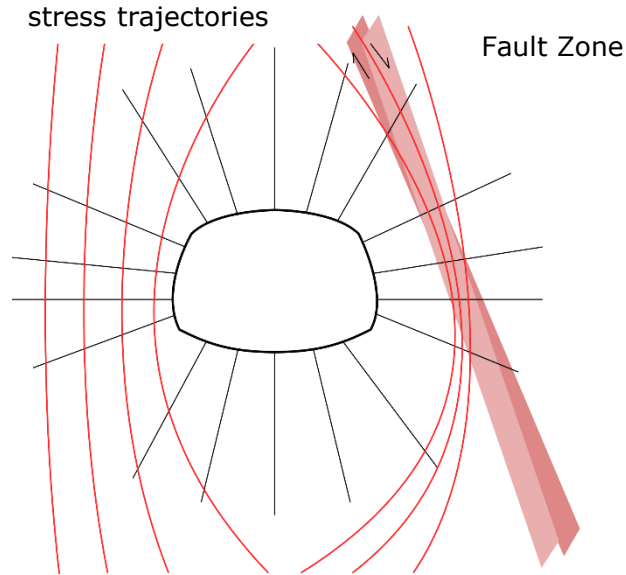
Repository in clay rock, infrastructure drift, 40 years operational time required



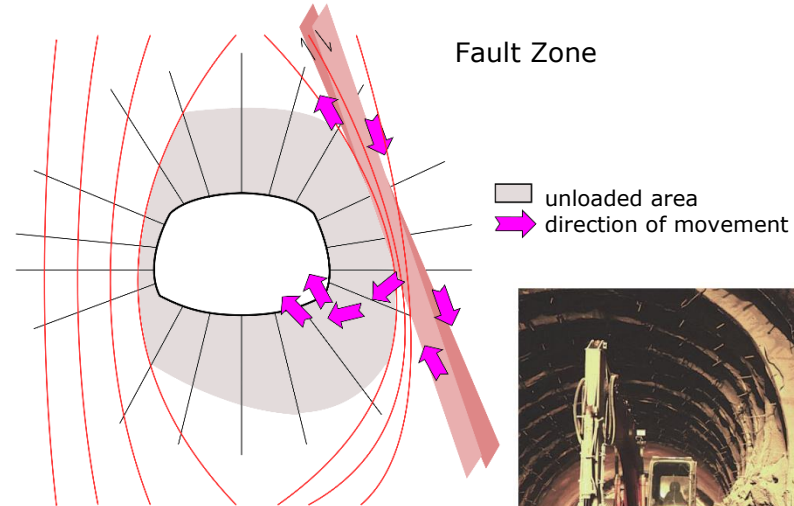
Lining with rock bolts



Scenario: Undetected Fault Zone



Stress redistribution due to the
infrastructure drift and fault zone



Resulting displacements



Conclusion

- Dealing with uncertainties in underground engineering requires flexibility: „it is dark in front of the pickaxe“

- A conflict field can be identified:

Binding regulations by laws, standards, plans, etc.

vs.

Requirement for adaption because of differences between model
and the observed development of the repository

- If an adaption of the plan is needed, one can not conclude that the selected site is not suitable as repository site

„There is nothing certain, but the uncertain“
- proverb -

The report will be available shortly! →



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[1] Hassel, T.; Mintzlaff, V.; Stahlmann, J.; Röhlig, K.-J.; Eckhardt, A.: Sicherheitsrelevante Barrieren bei der Endlagerung: Ungewissheiten aus der Perspektive der Ingenieurwissenschaften. TRANSENS-Bericht-4 [in review]

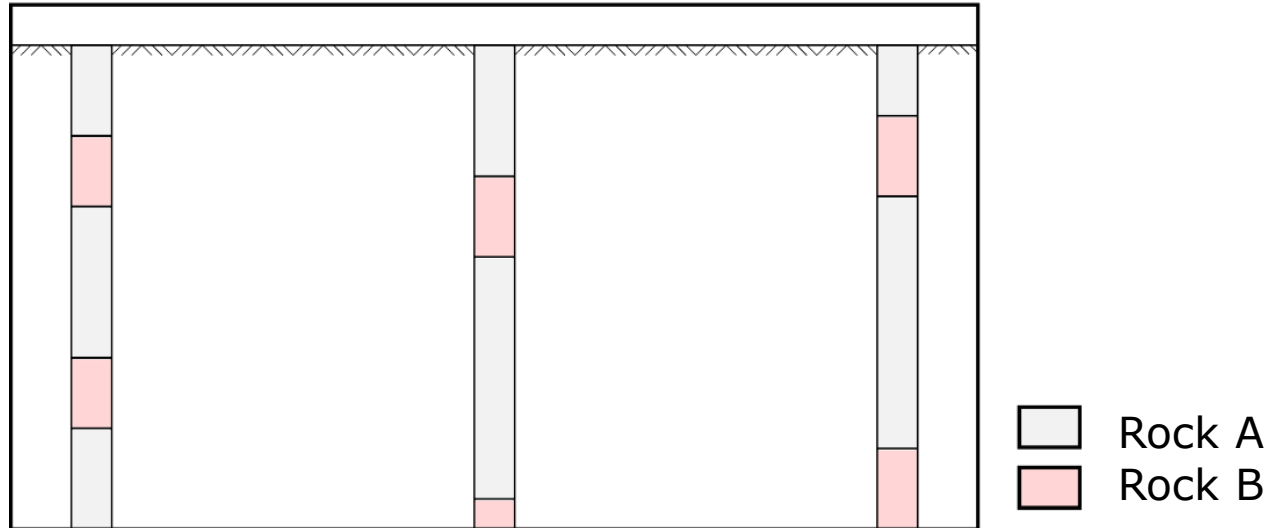
[2] <https://www.mont-terri.ch/de/geologie/geologische-strukturen.html>

[3] Schubert, P.: Thirra Tunnel Albanien – mit einem klaren Konzept zum Erfolg. Geomechanics and Tunnelling 6 (2013), No. 1

Interpolation: Geological Model



There are three drillings with alternating layers of two rocks.
How would you interpolate?

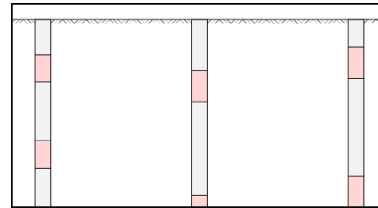
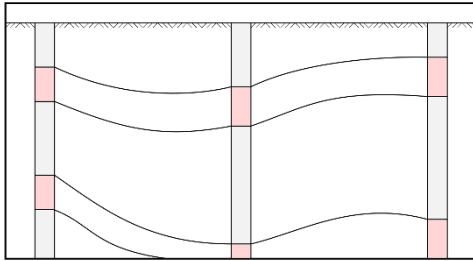


Interpolation: Geological Model



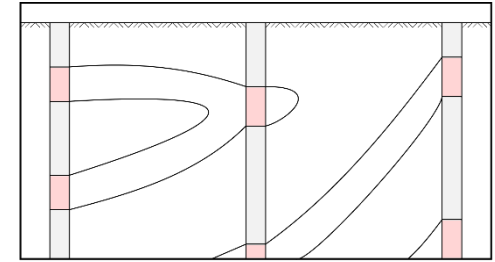
Four fast interpolations:

a) Layers

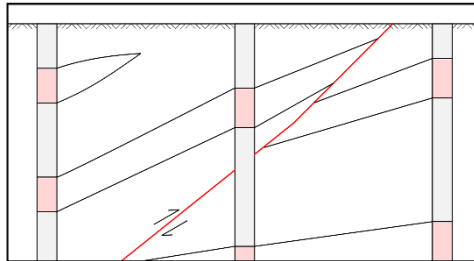


□ Rock A
□ Rock B

d) over-tilted fold...



b) The reverse fault



c) Lenticles of rock B

