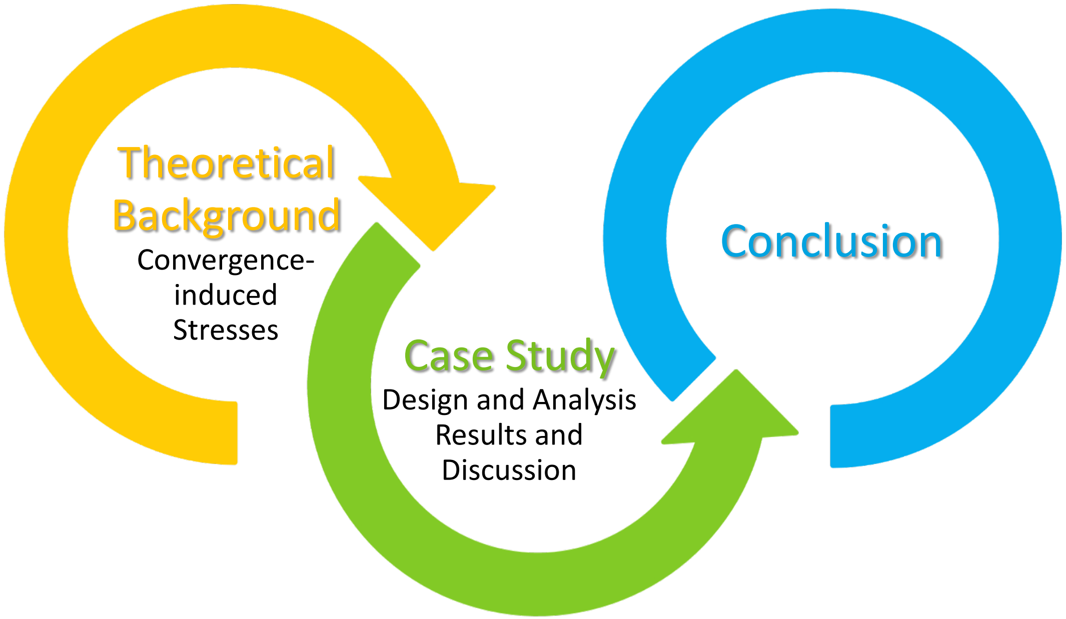
Convergence-induced Stresses on Casing and Cementation due to Salt Cavern Operation

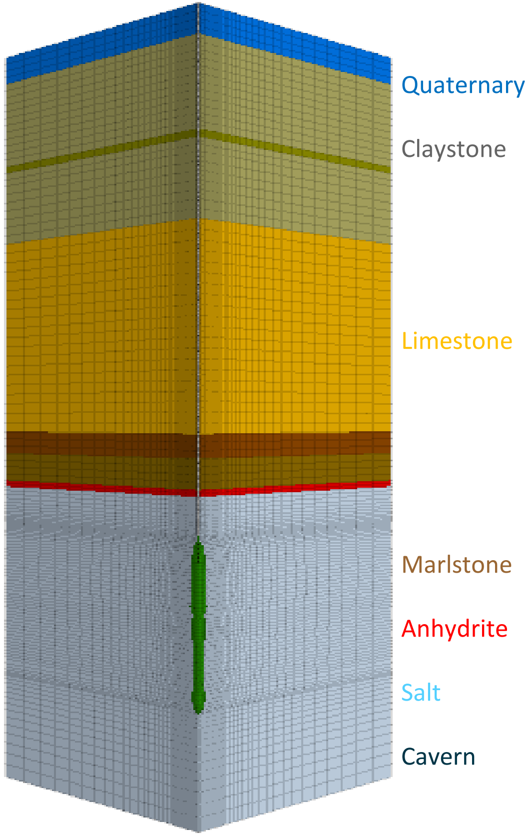
BIRGIT HORVÁTH &
DIRK ZANDER-SCHIEBENHÖFER

5th International Itasca Symposium | Vienna | 19/02/2020

DEEP.KBB

Convergence-induced Stresses on Casing and Cementation due to Salt Cavern Operation

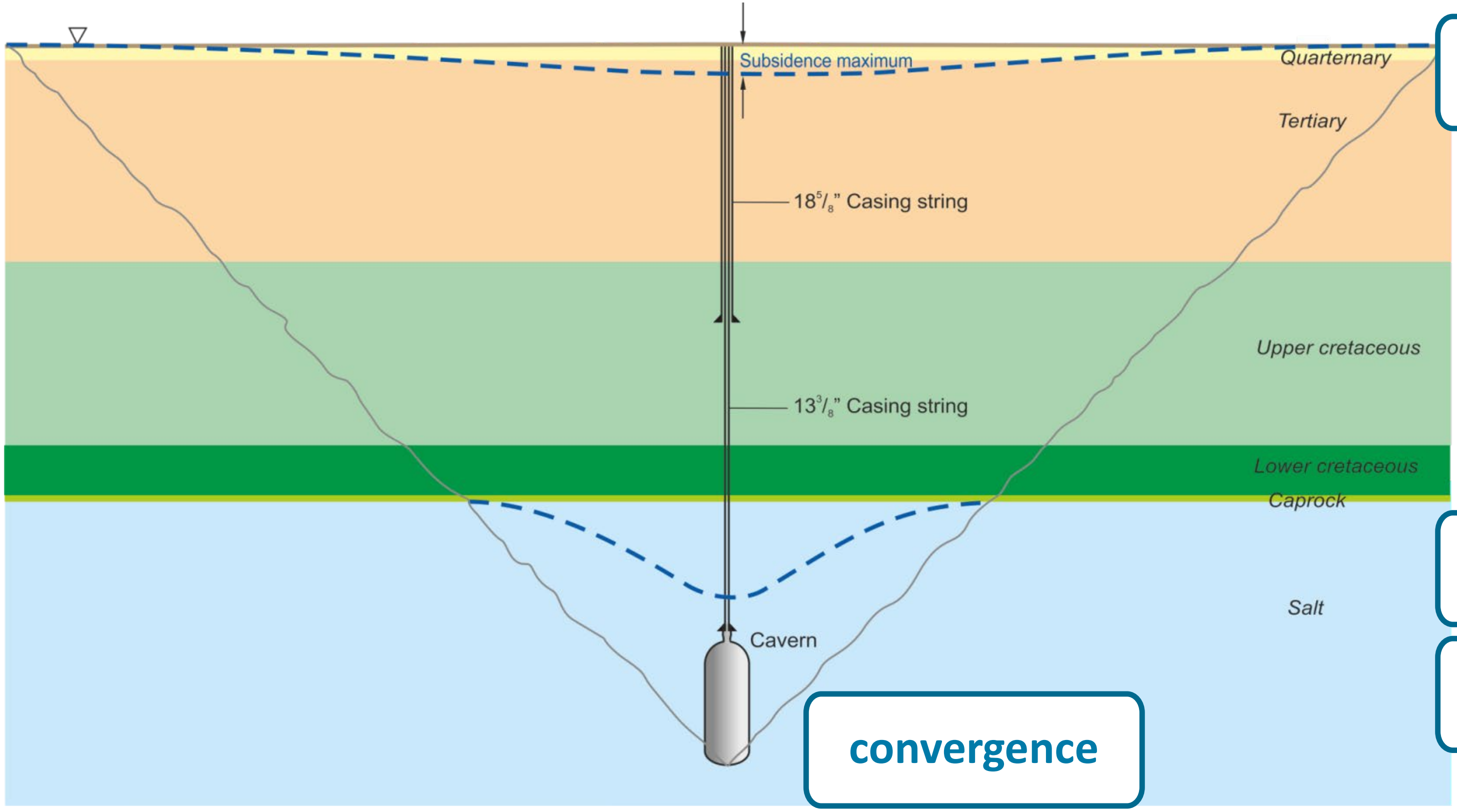




THEORETICAL BACKGROUND

Convergence-induced Stresses

Convergence-induced Stresses



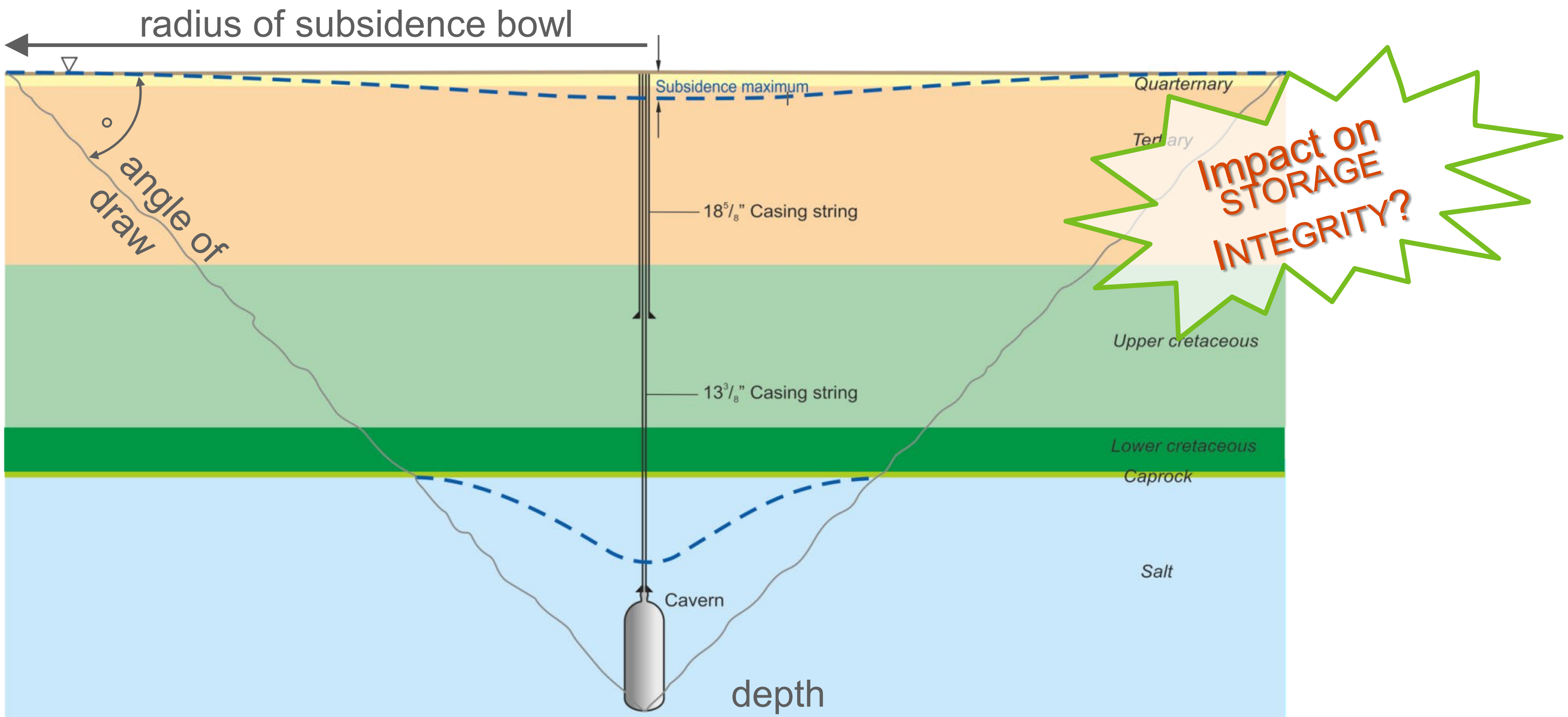
surface subsidence

stressing due to operation

rock mass deformation

convergence

Convergence-induced Stresses

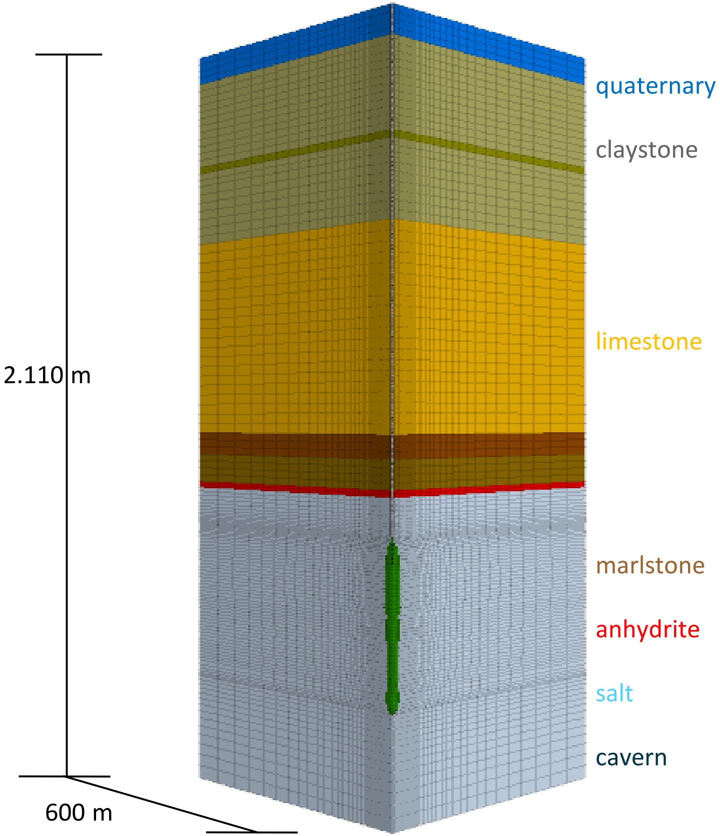


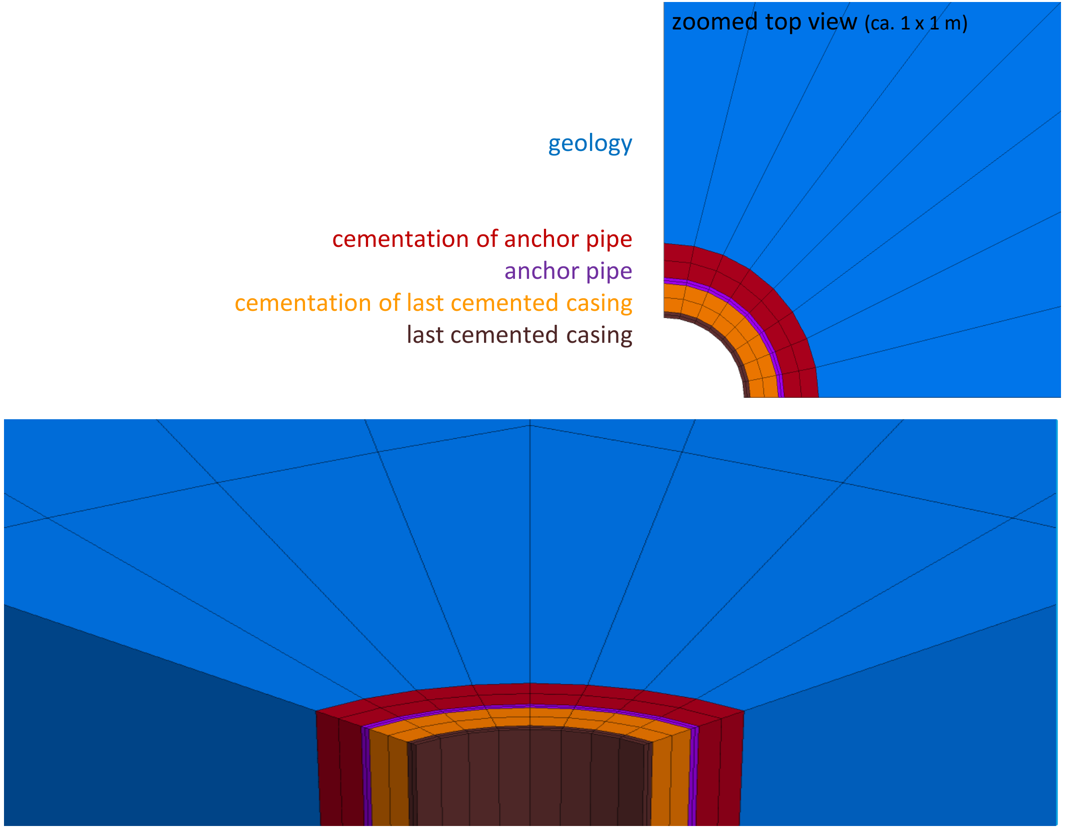
volume of the subsidence bowl = f(convergence volume, time)

Case Study

Design and Analysis

Simulation Model





Calculation Process

geology

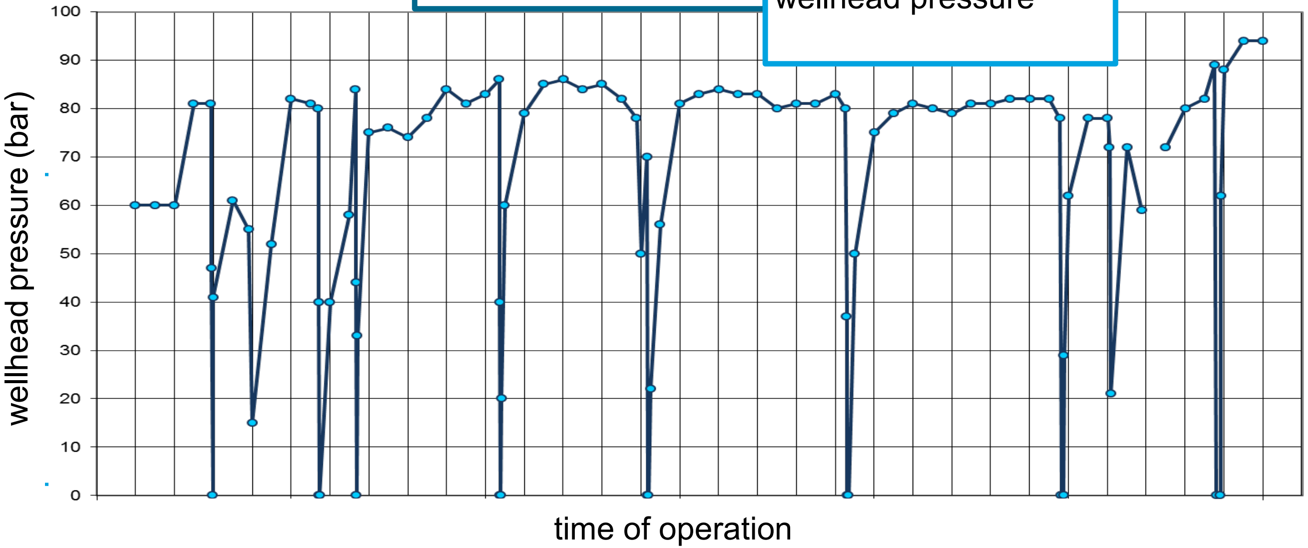
primary state
elastic state

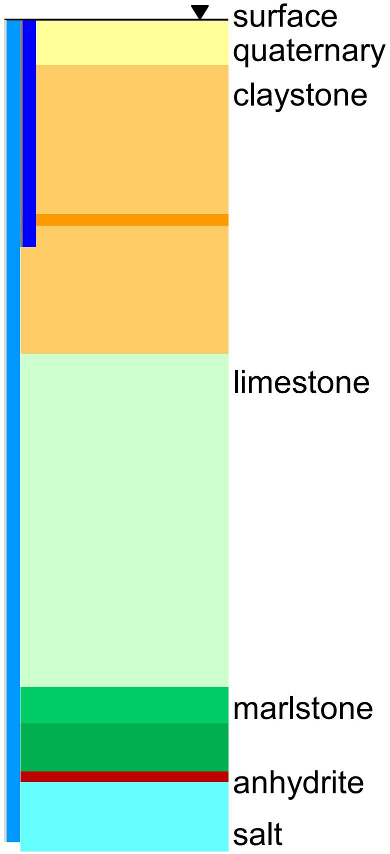
cavern construction

drilling and completion
solution

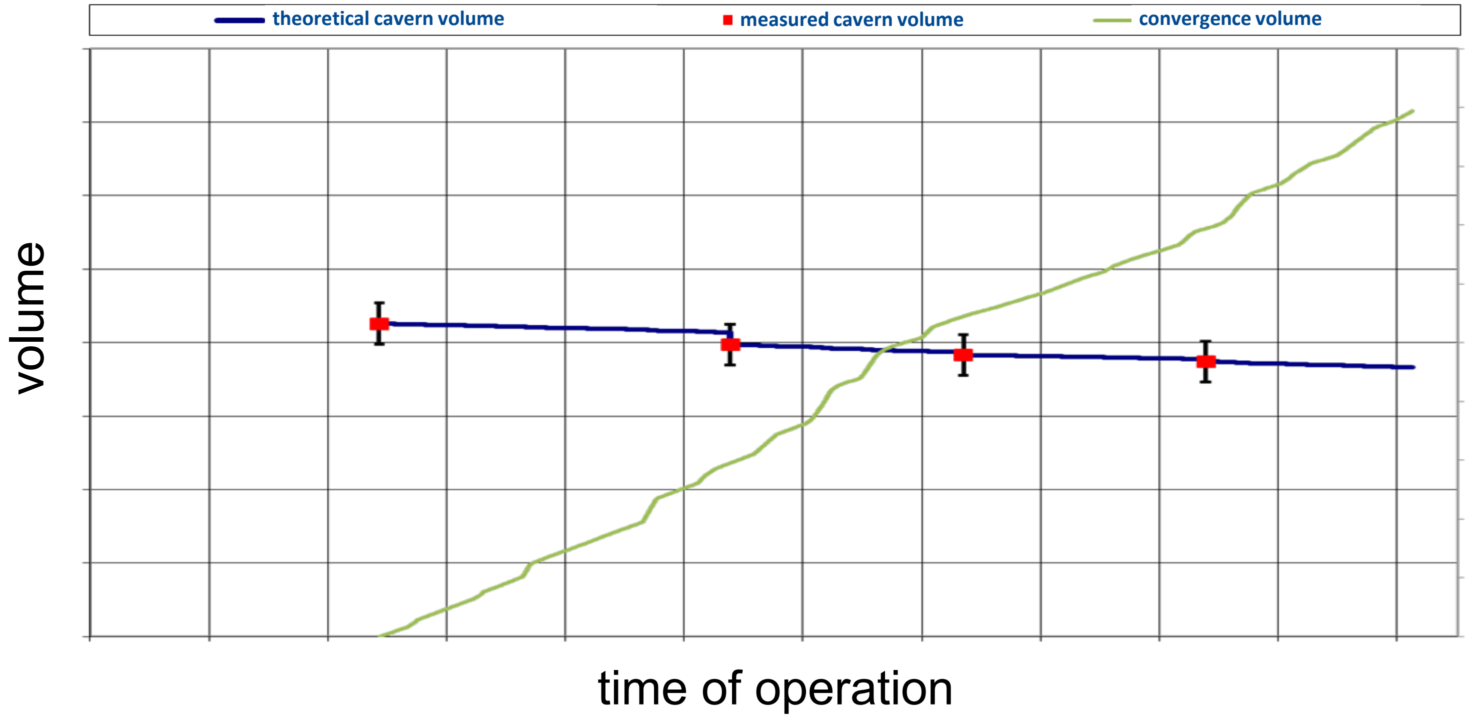
operation phase

oil storage cavern
wellhead pressure





History-Match – Convergence

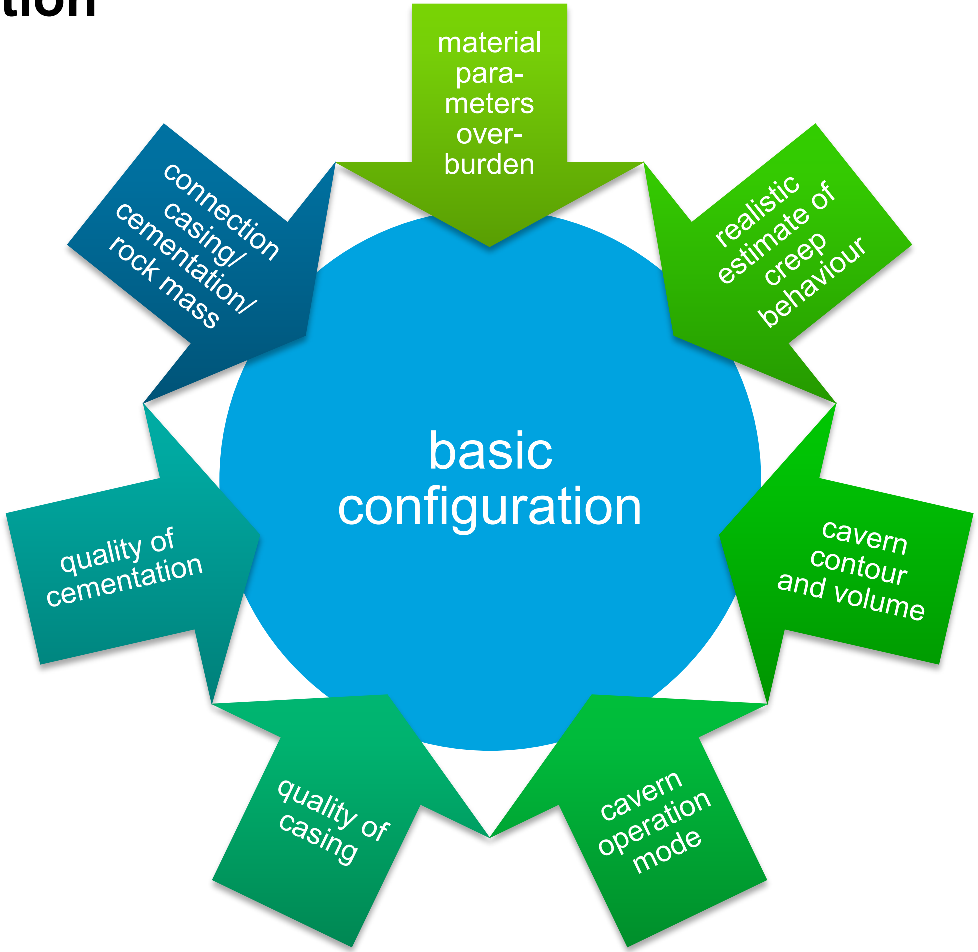


CAVERN VOLUME LOSS

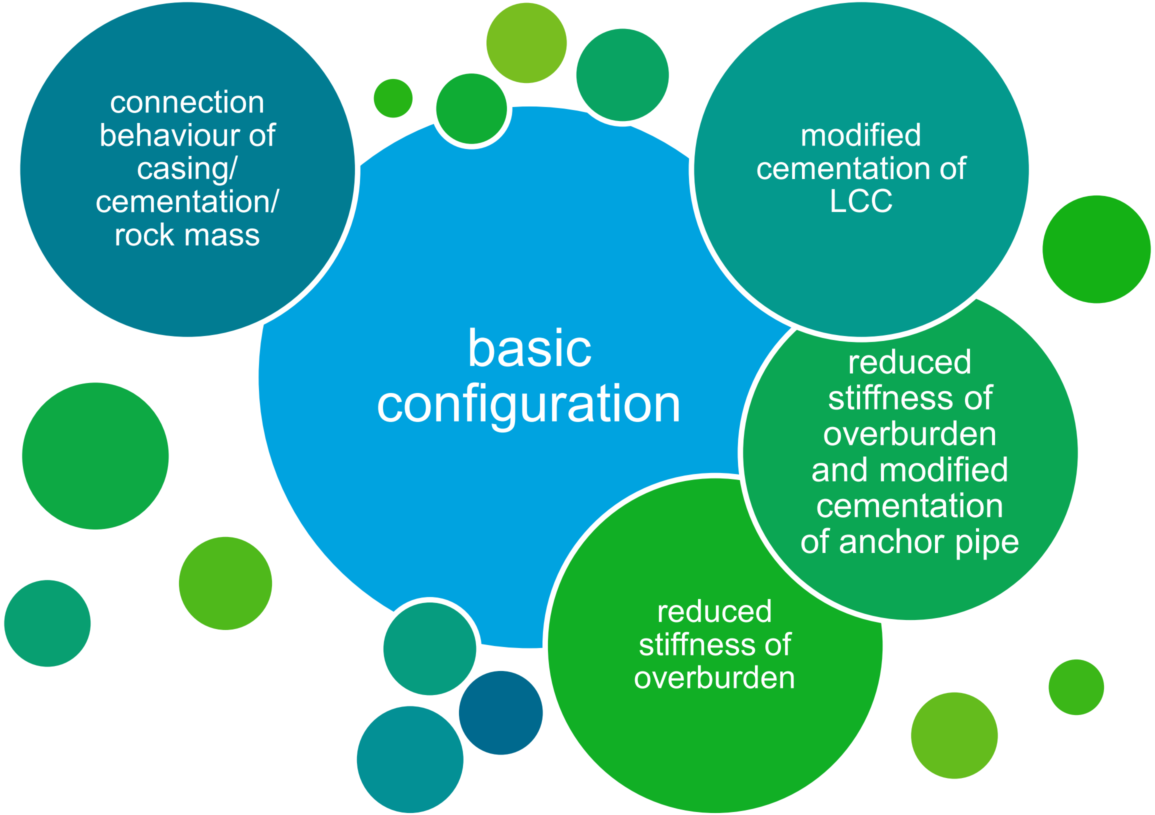
⇨ **operation / stressing**

⇨ **creep of salt**

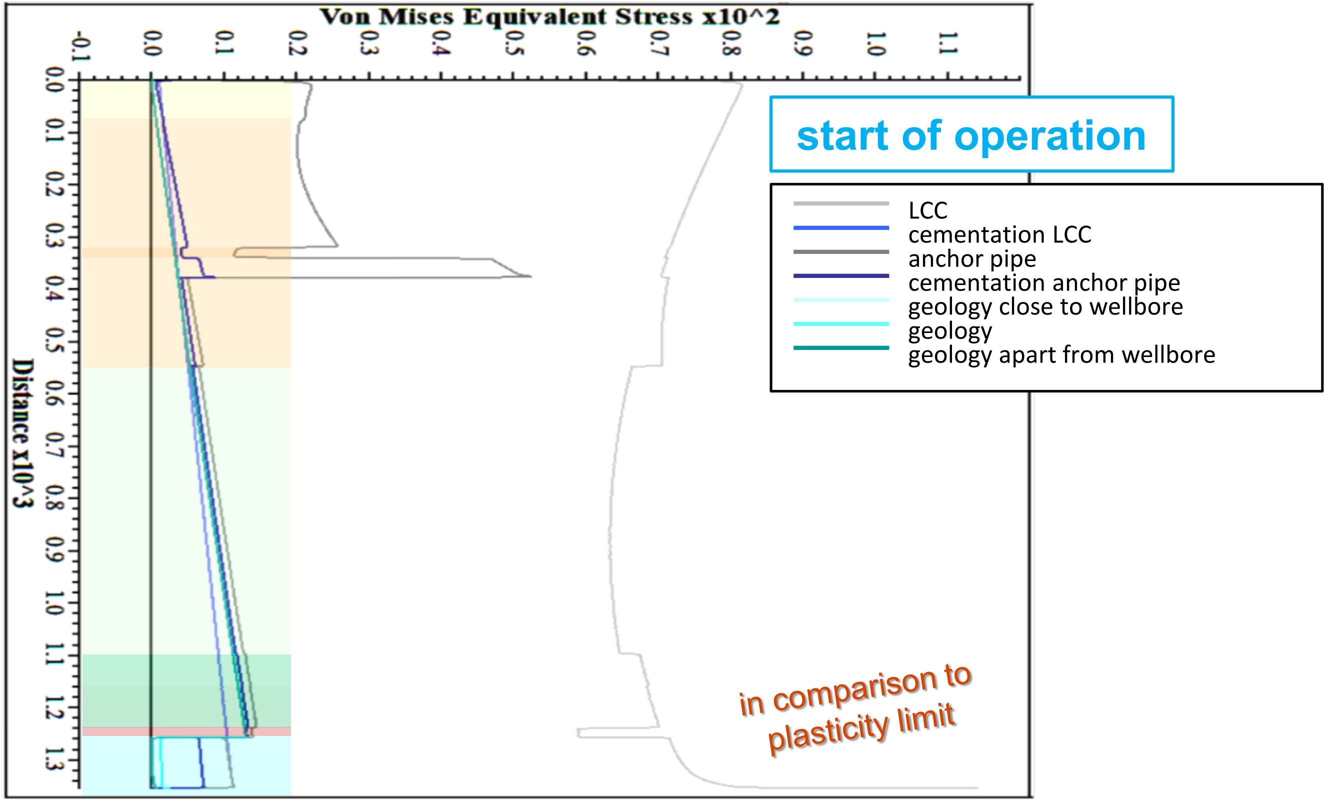
Initial Calculation

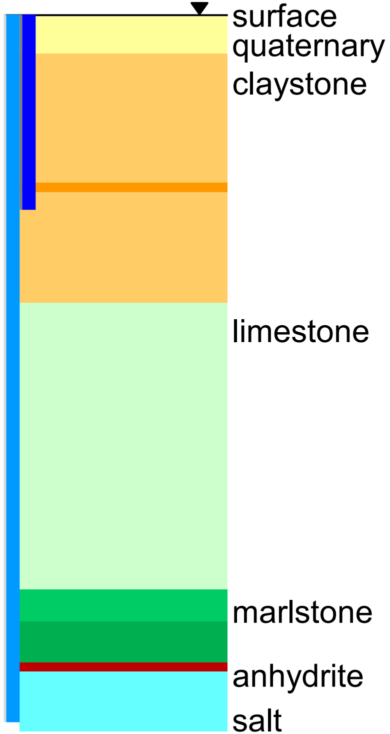


Various Calculations



Basic Configuration
Von Mises Comparative Stress

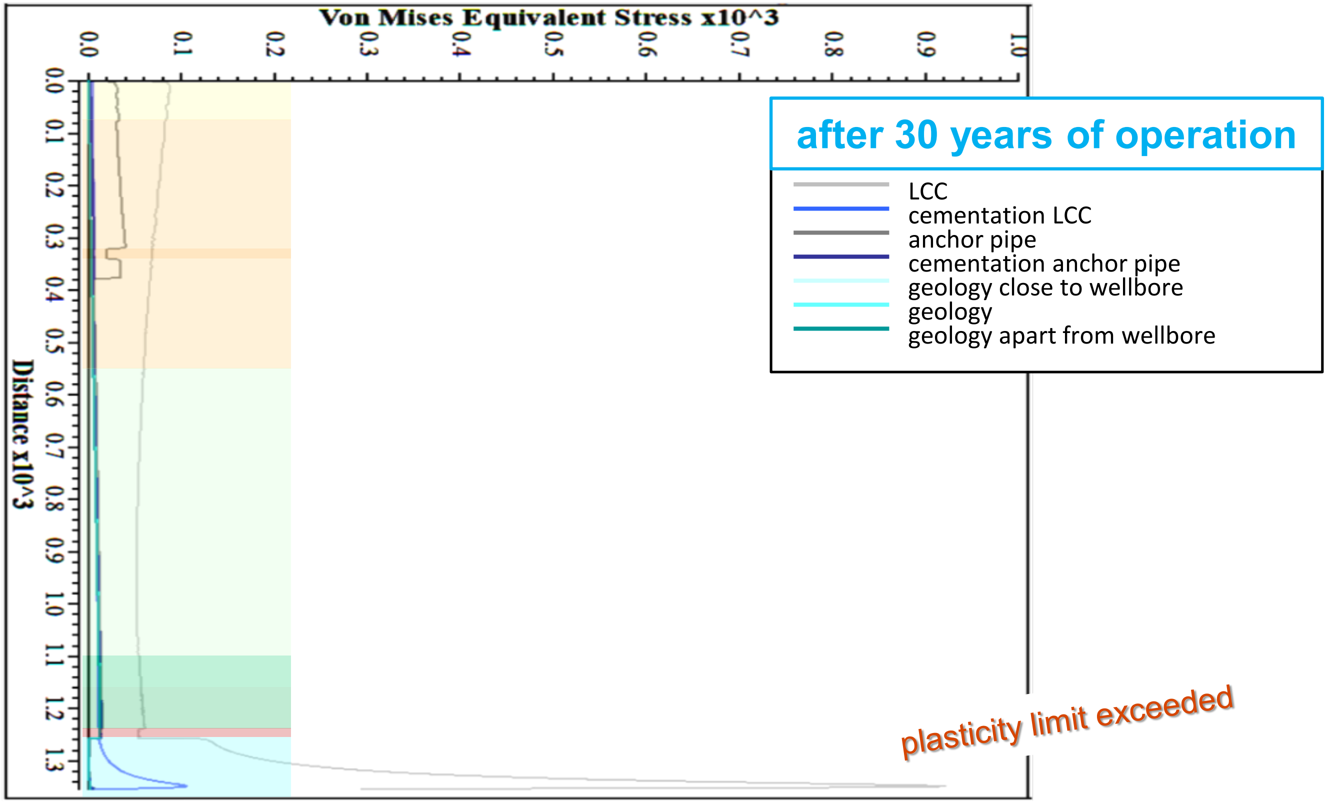


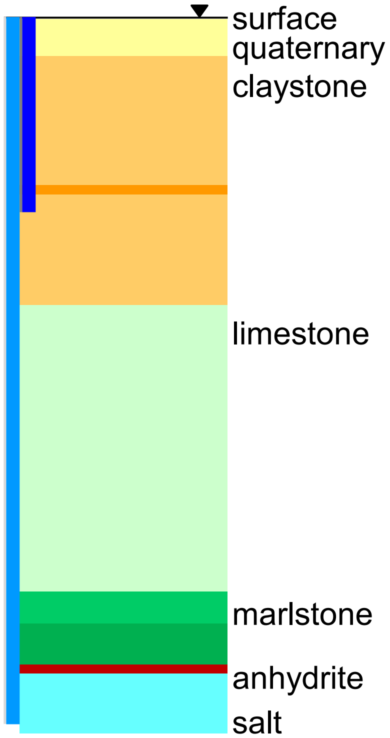


Case Study

Results and Discussion

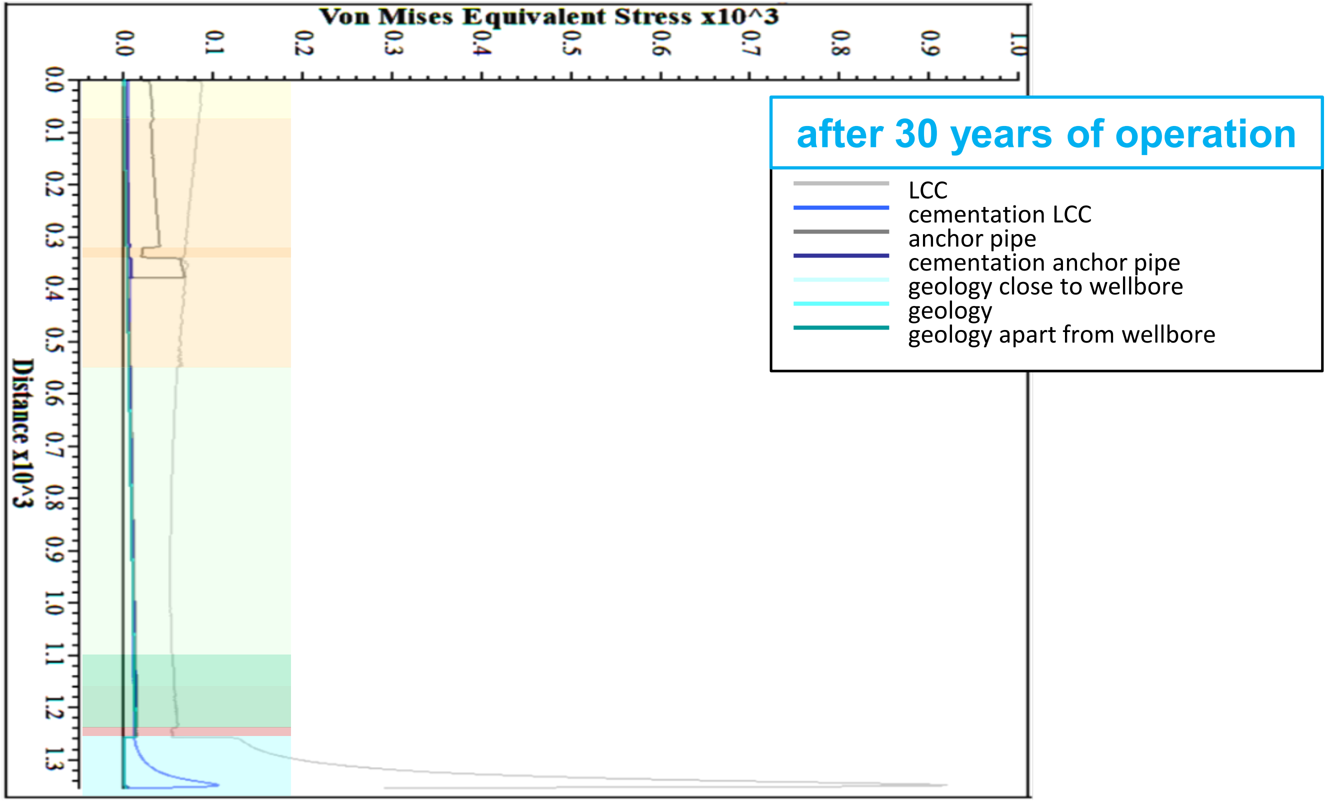
Basic Configuration
Von Mises Comparative Stress

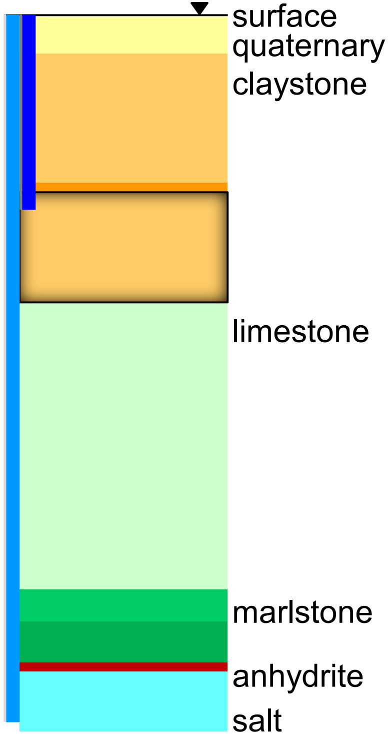




Reduced Stiffness of Overburden

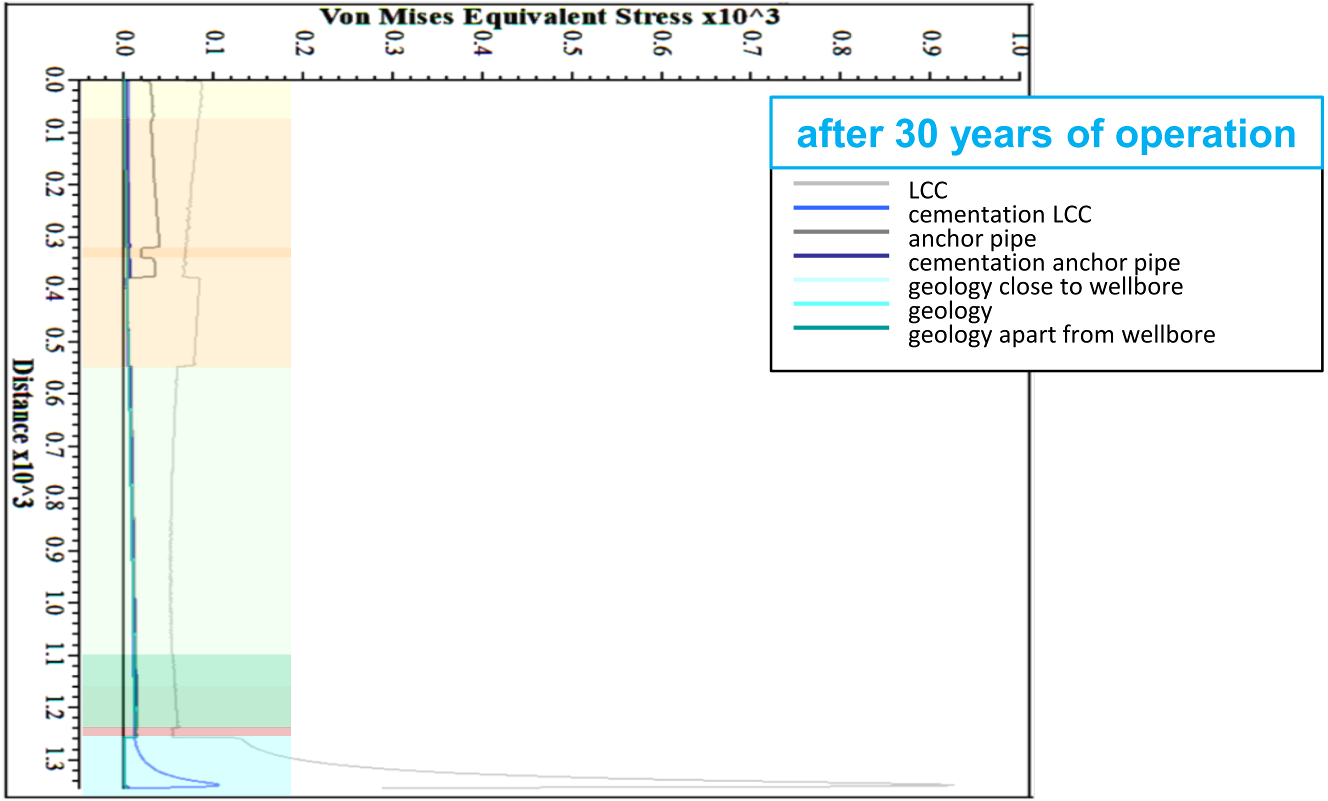
Von Mises Comparative Stress

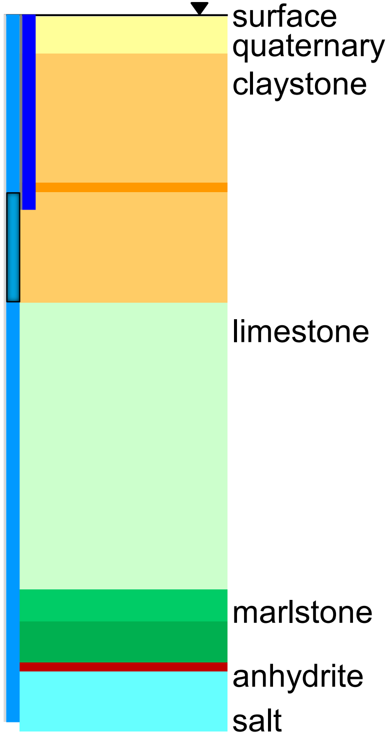




Modified Cementation of LCC

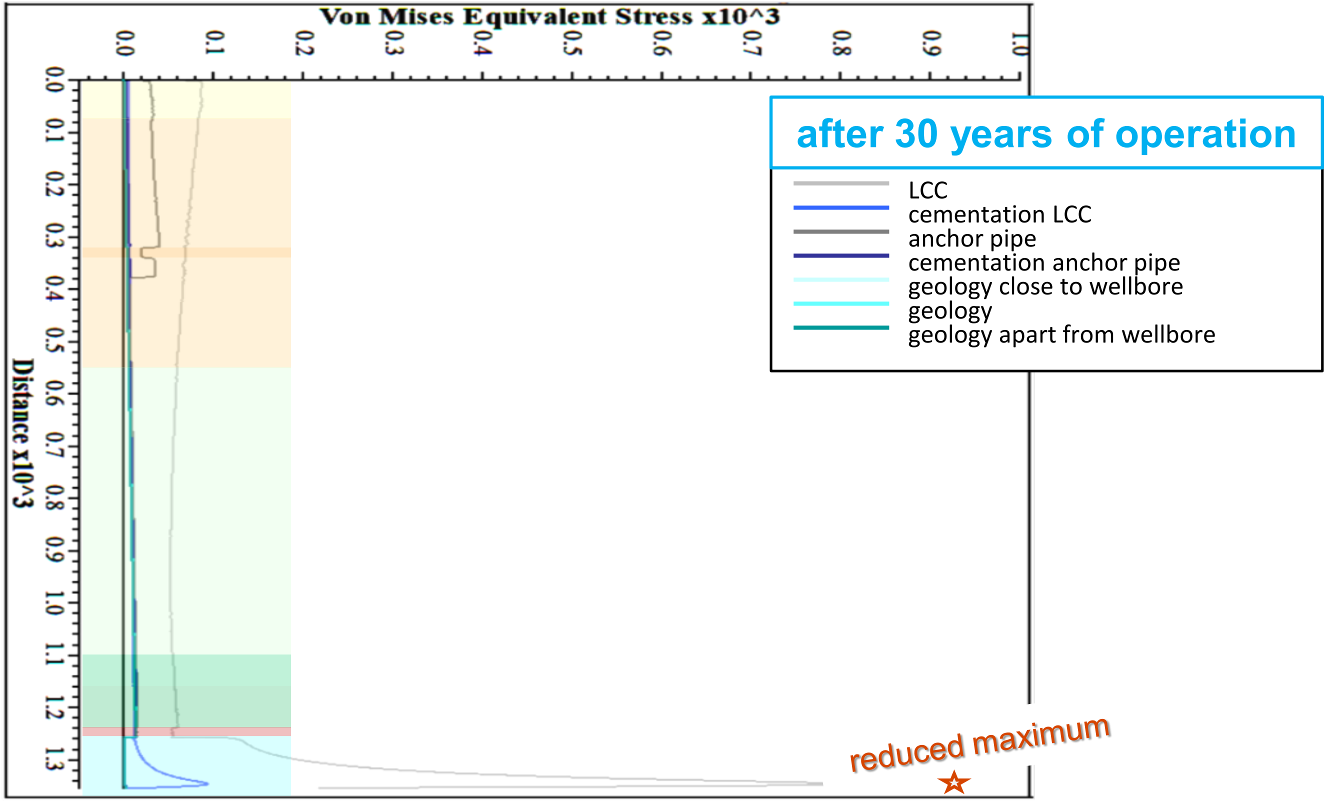
Von Mises Comparative Stress

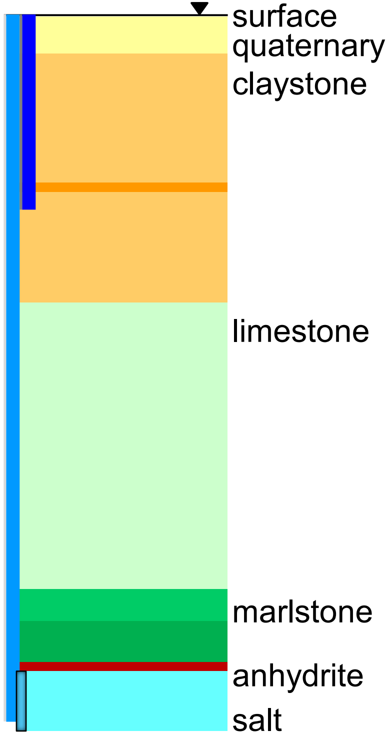




Connection of Casing/Cementation/Rock Mass

Von Mises Comparative Stress





Summary

DEEP.KBB

after 30 years of operation

- ✓ Calculated stressing of cementation remained below assumed ultimate strength.
- ✓ In the overburden section the calculated stressing is below the plasticity limit of steel.
- o Plasticity limit of steel was exceeded in the salt section close to the casing shoe

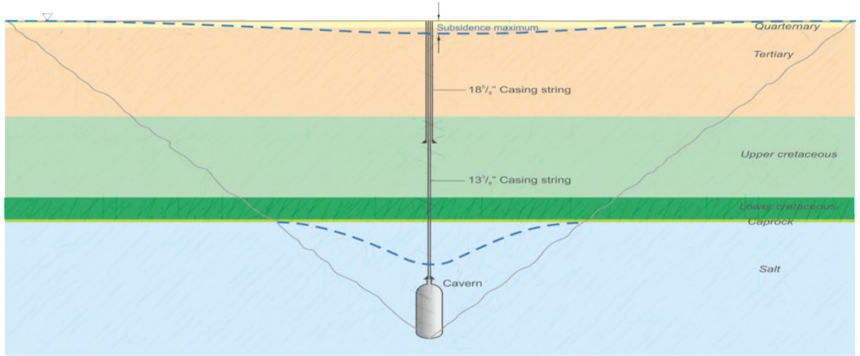
  ⇒ as wireline measurements show
  steel can sustain relative large plastic strains

  no failure criterion

- o Variation of the connection behaviour casing/cementation/rock mass shows a reduction of the casing stressing.

CONCLUSIONS

Conclusion



Convergence-induced stresses

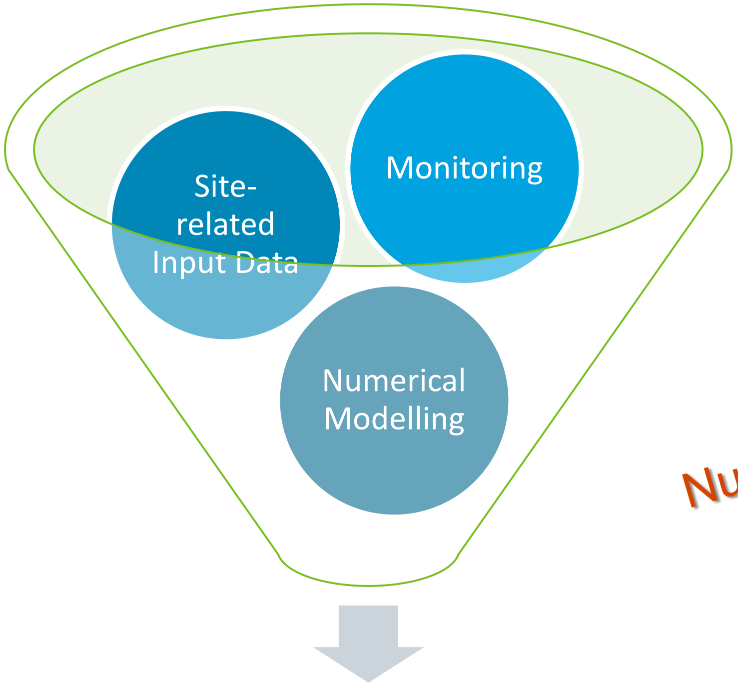
Stressing of LCC
increases over time
⇒ creep of salt

Limited monitoring methods
from surface

⇒ numerical modelling in addition

LCC can withstand the induced stressing
➥ pronounced ability for plastic deformation

Conclusion



Site Specific Assessment

Numerical Modelling

- **Behaviour of complex system casing/cementation/rock mass**
- **Integration of joints of LCC**

Thank you for your attention!
Questions?

BIRGIT HORVÁTH

Birgit.Horvath@deep-kbb.de

Phone: 49 511 542817 - 515
Fax: 49 511 542817 - 11

DIRK ZANDER-SCHIEBENHÖFER

Dirk.Zander@deep-kbb.de

Phone: 49 511 542817 - 43
Fax: 49 511 542817 - 11