

## Projekt-Betreiber:

HeideGeo GmbH

## Projekt-Management:

HeideGeo GmbH & GeoDienste GmbH

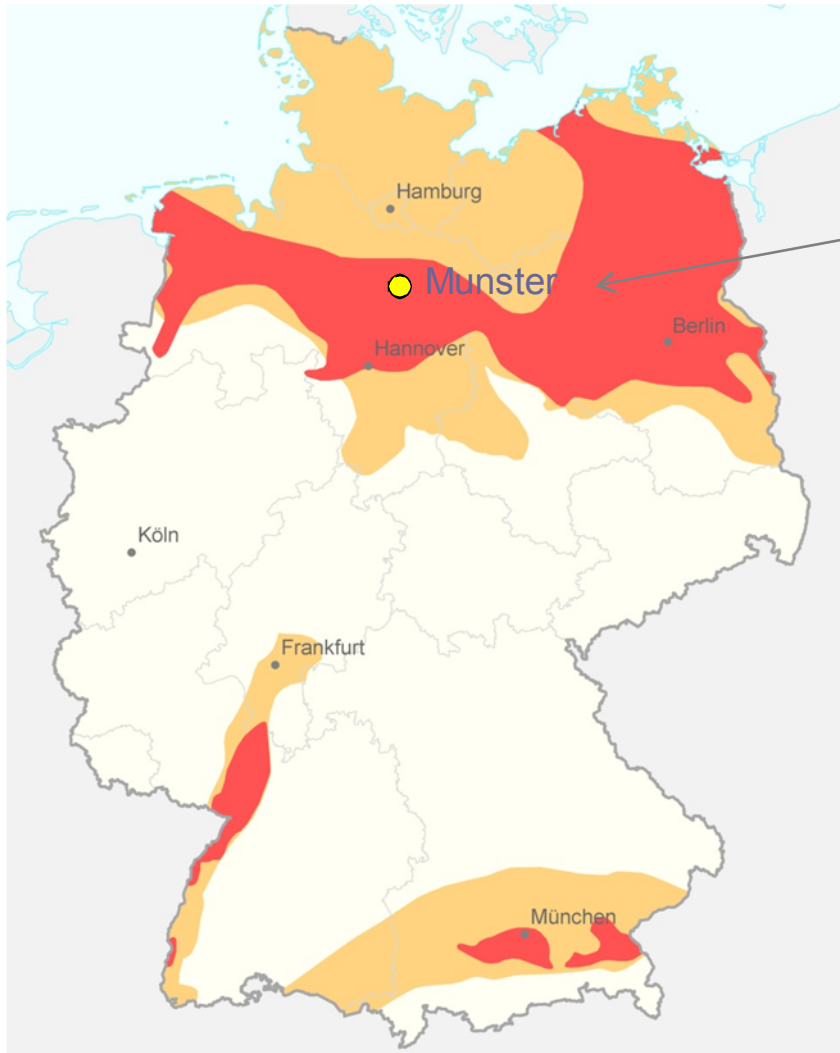
## Eckdaten:

Wärme: 14,7 MW<sub>th</sub>

Strom: 1,2 MW<sub>el</sub>

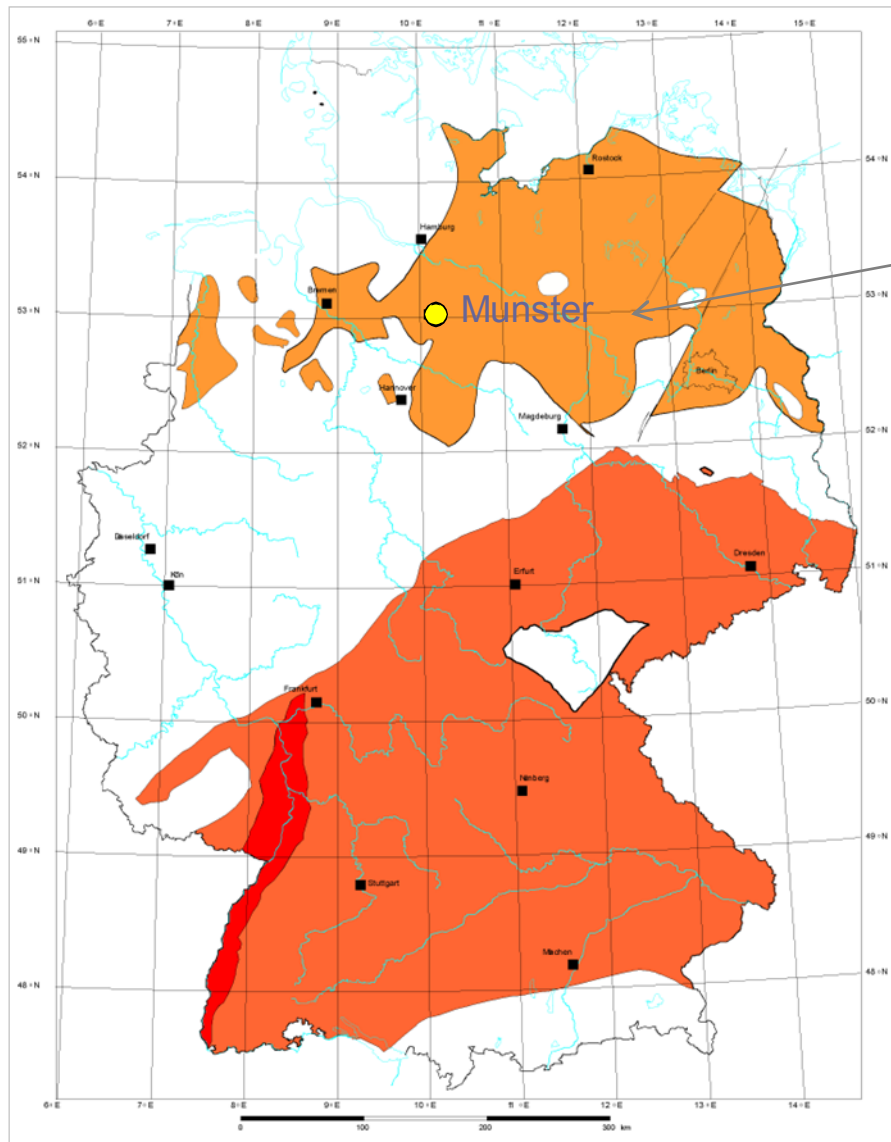


Quelle: LIAG-Hannover



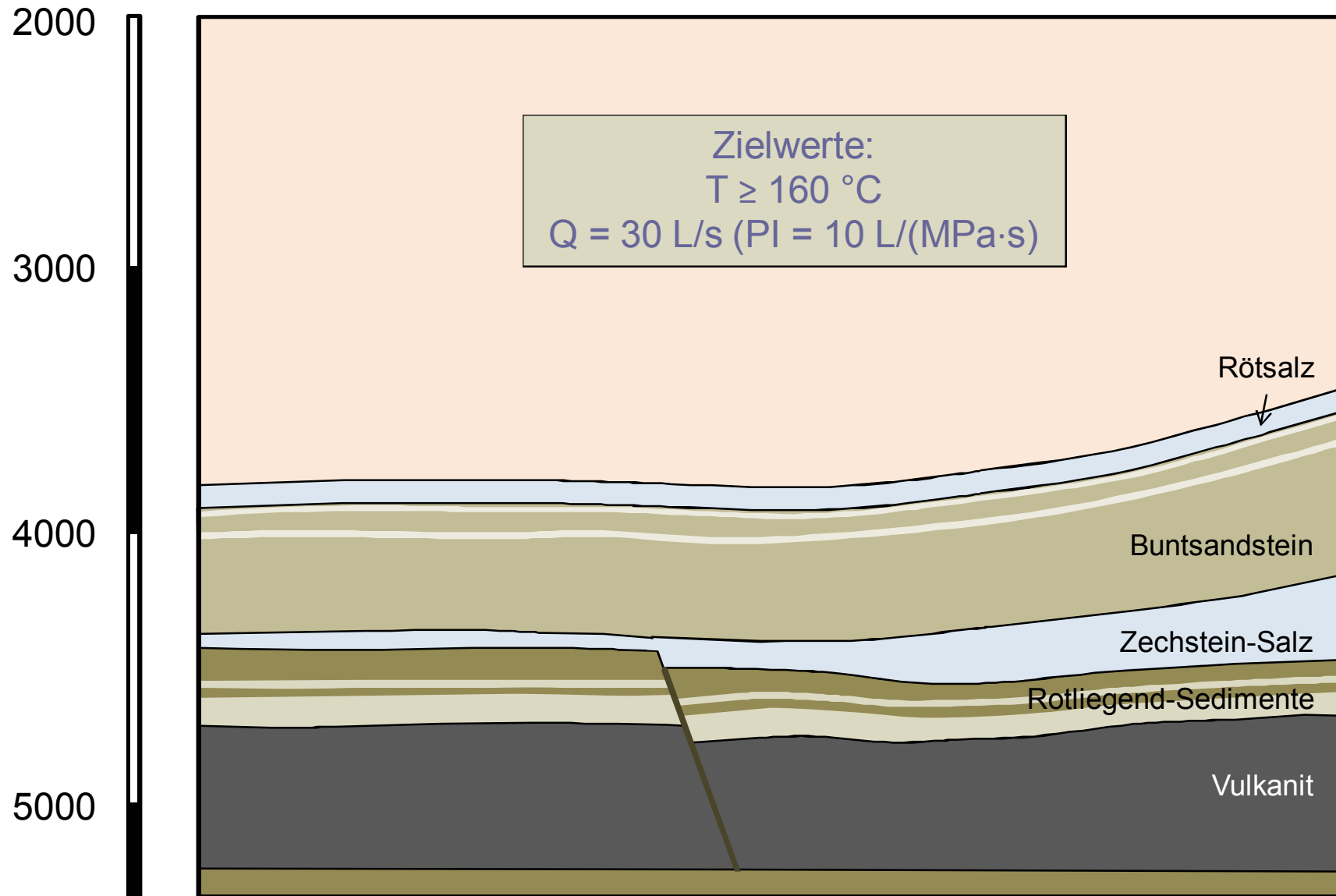
Rotliegend Sandsteine ( $T > 100\text{ °C}$ )

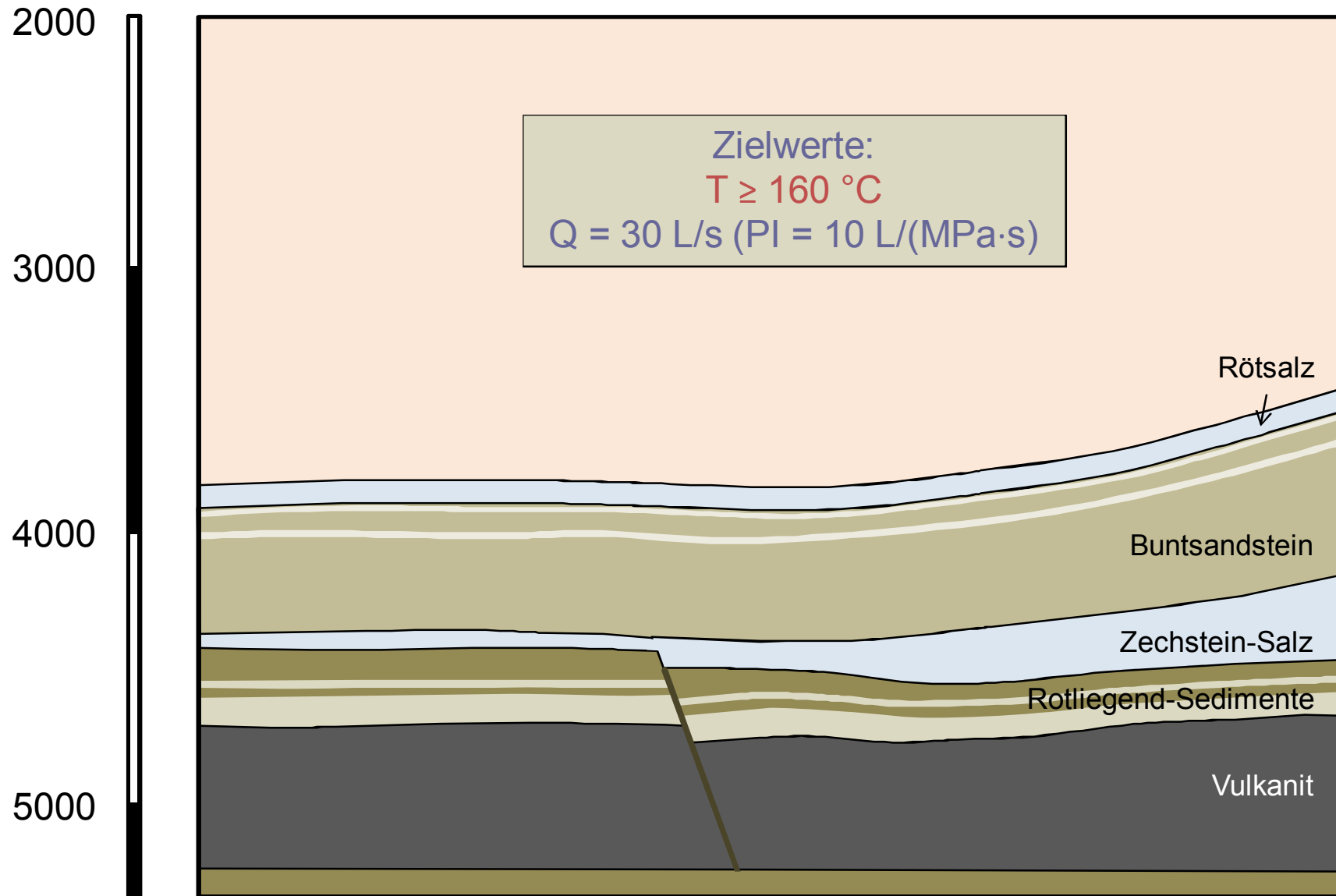
Quelle: LIAG-Hannover

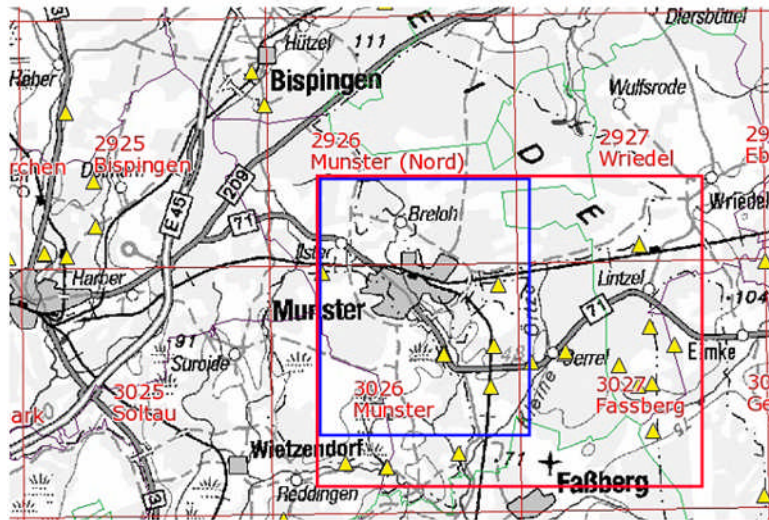


Rotliegend Vulkanite

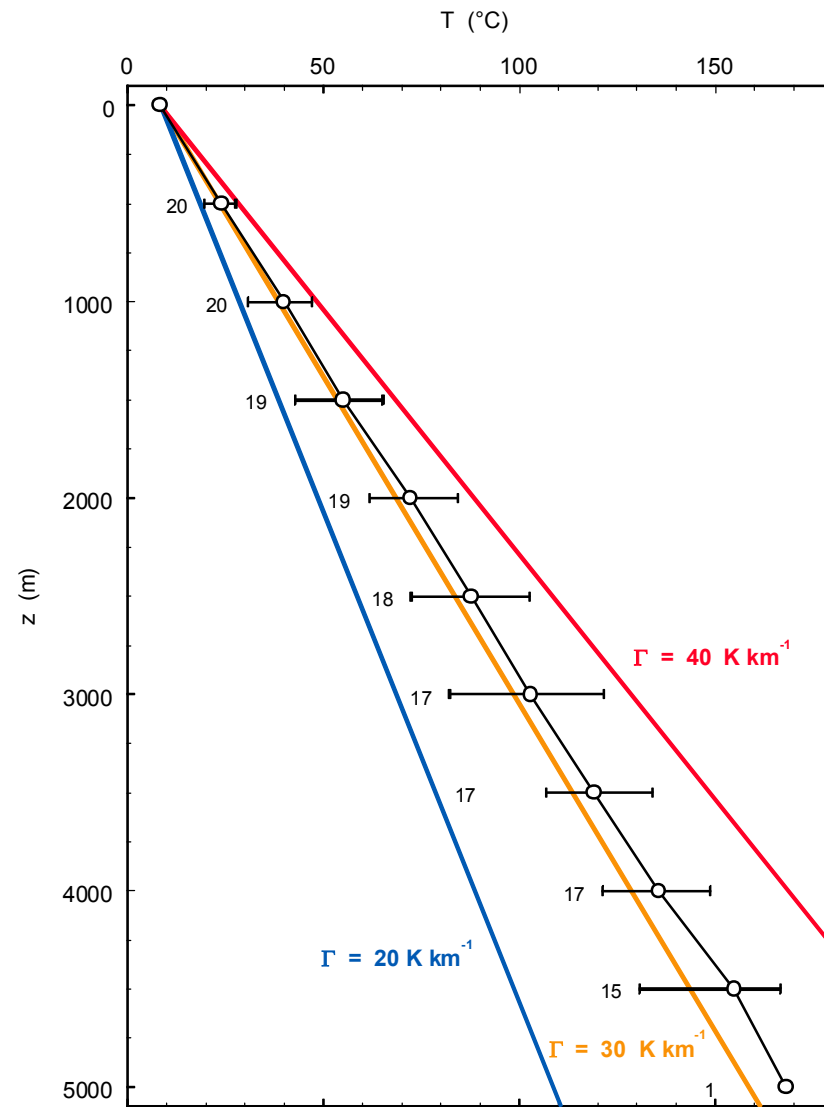
Quelle: Jung et al., 2002



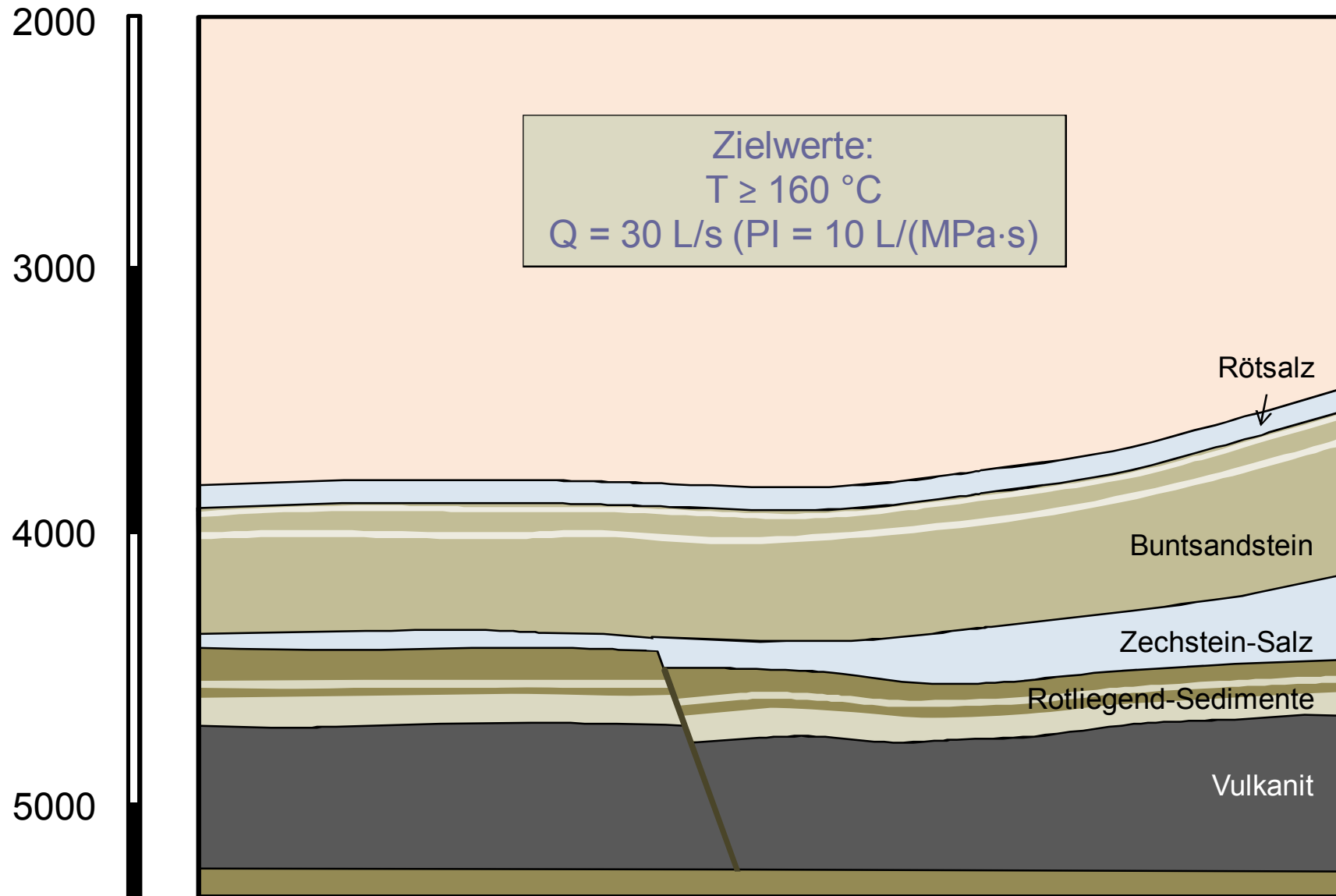


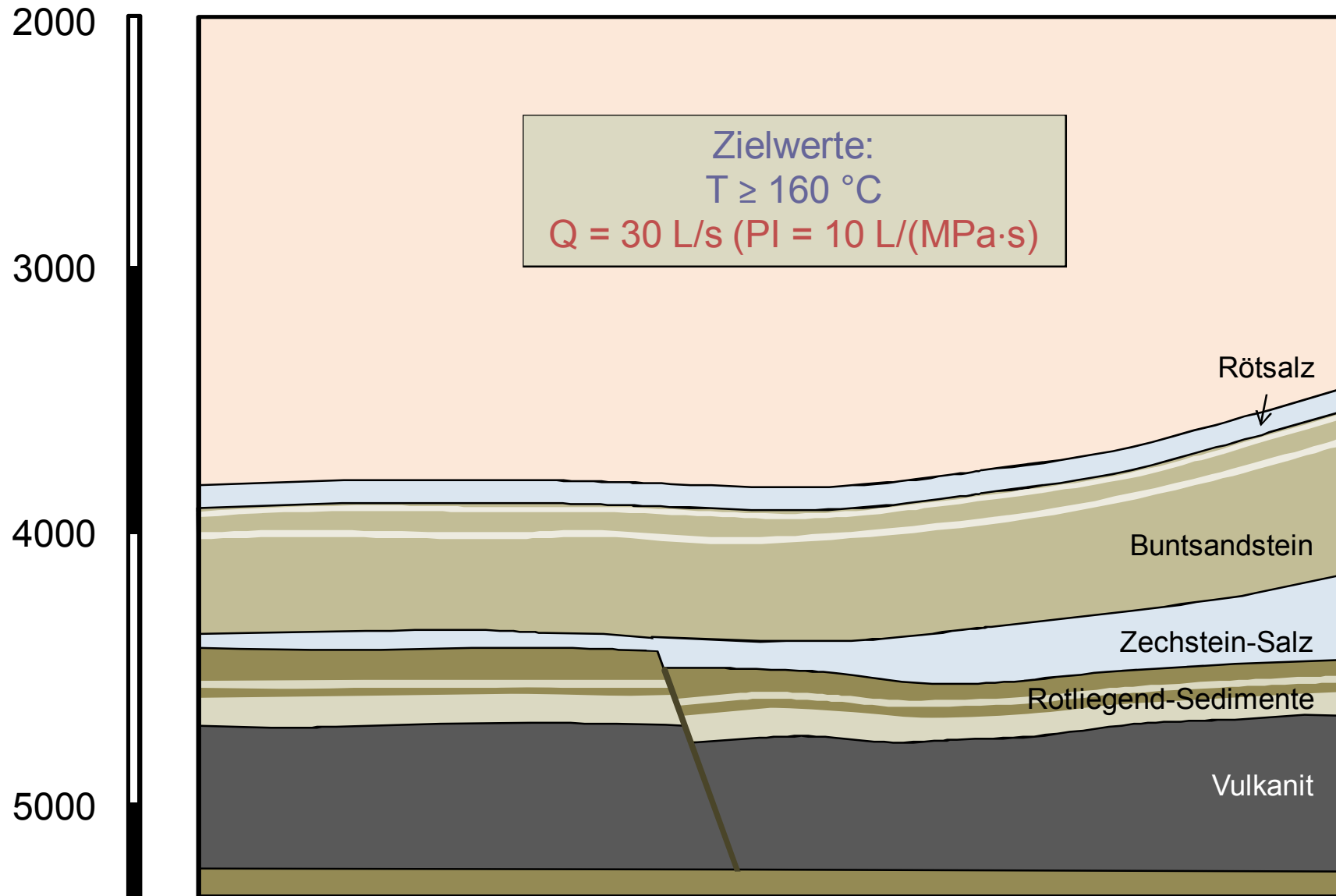


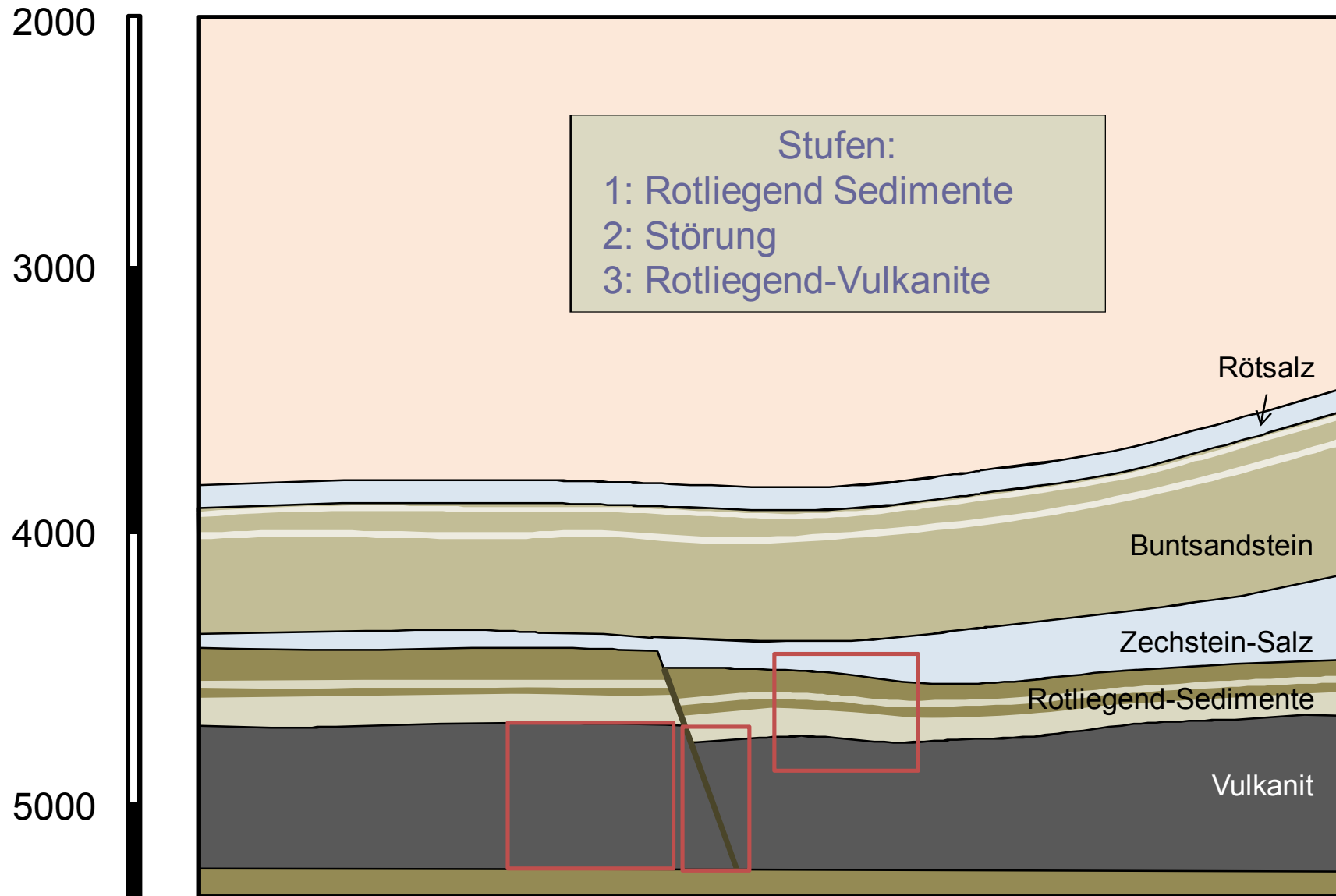
Quelle: Schellschmidt et al., 2009

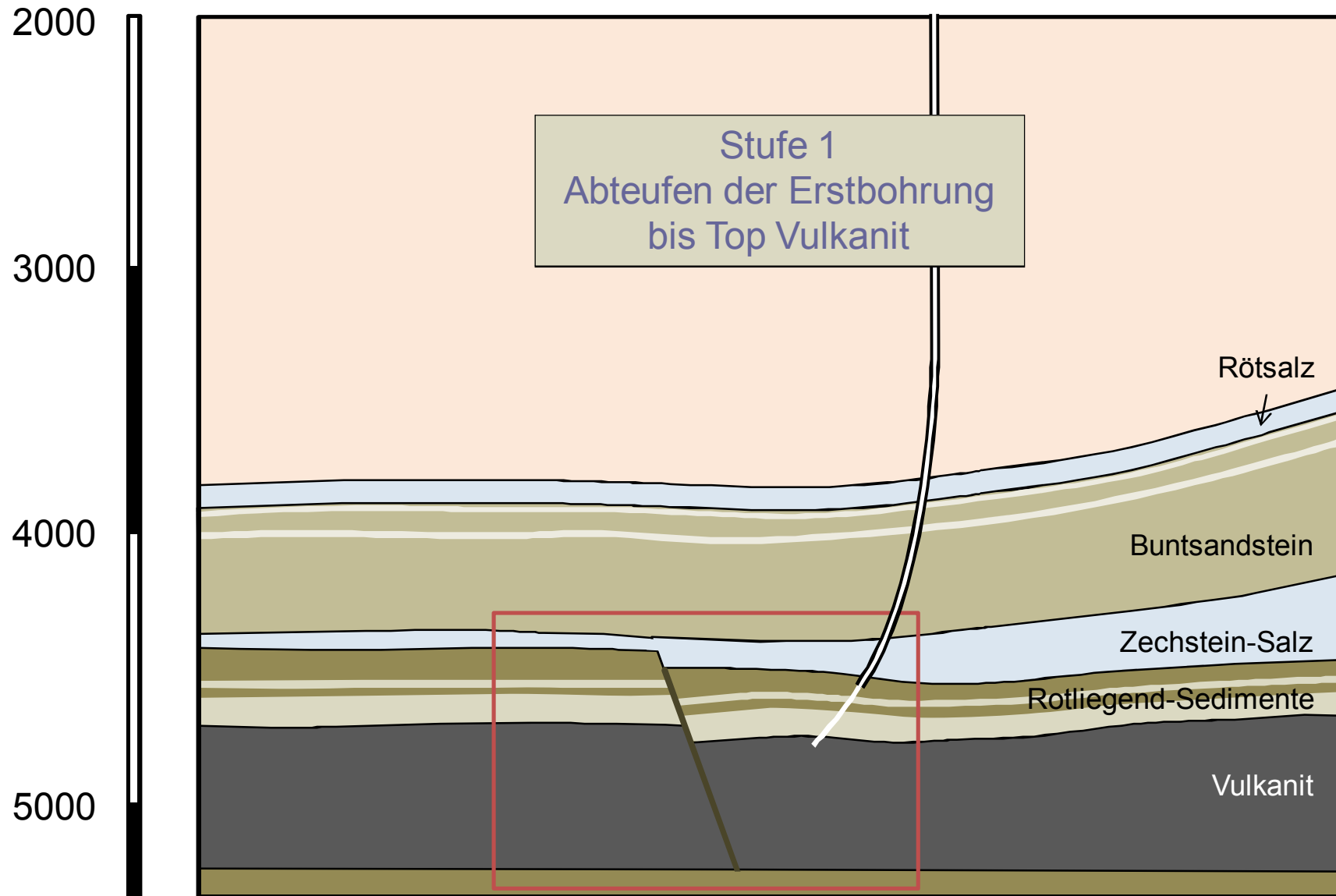




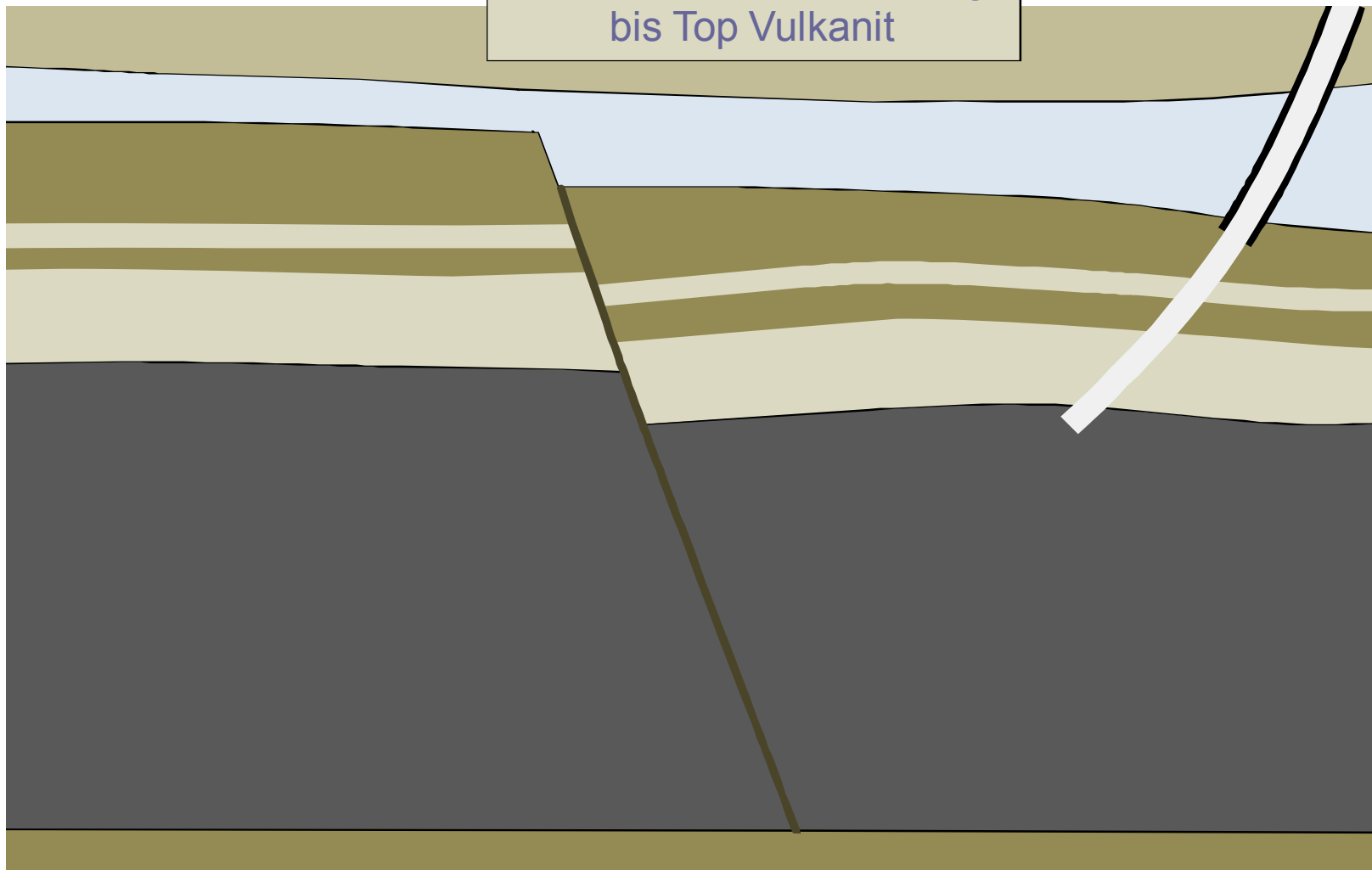




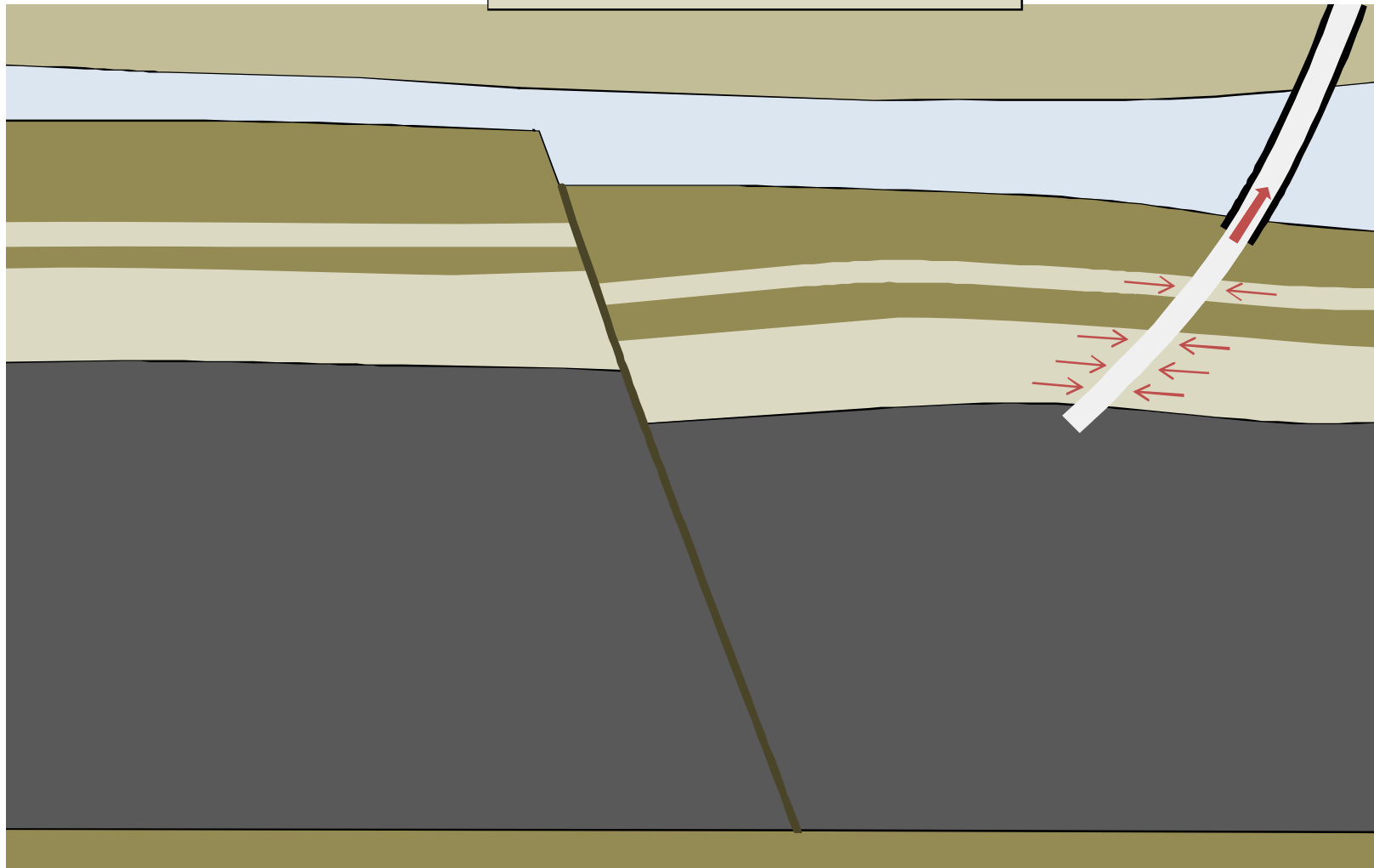




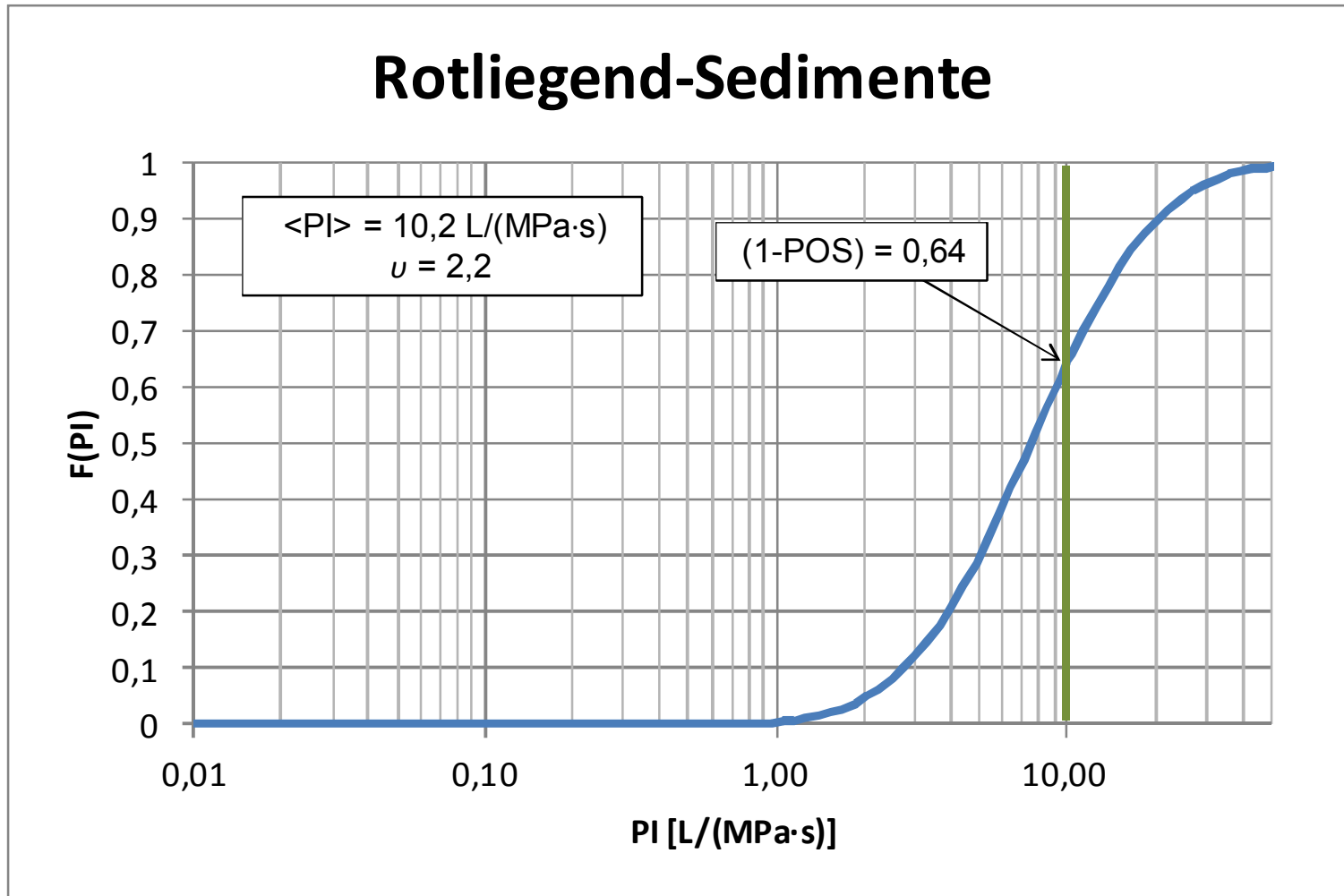
Abteufen der Erstbohrung  
bis Top Vulkanit



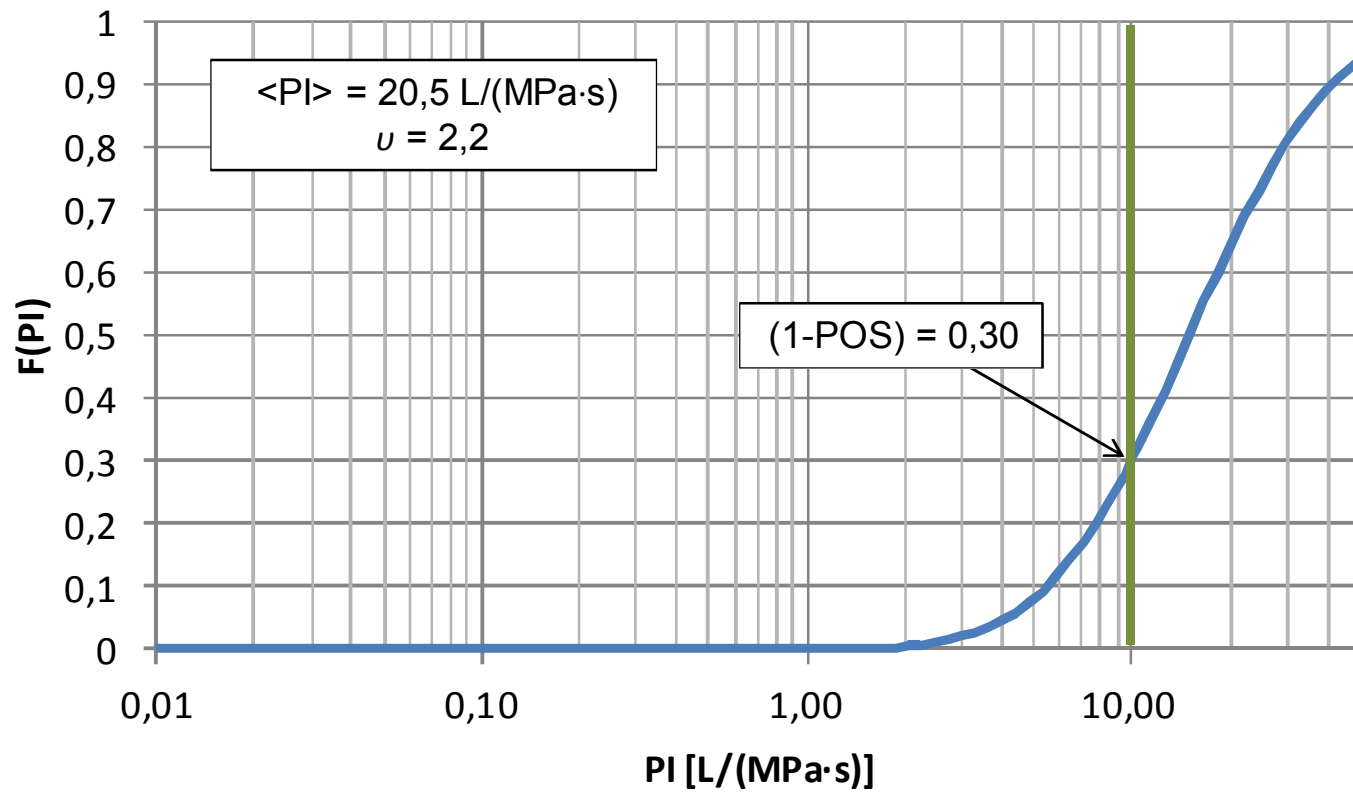
## Hydraulischer Test



# Rotliegend-Sedimente

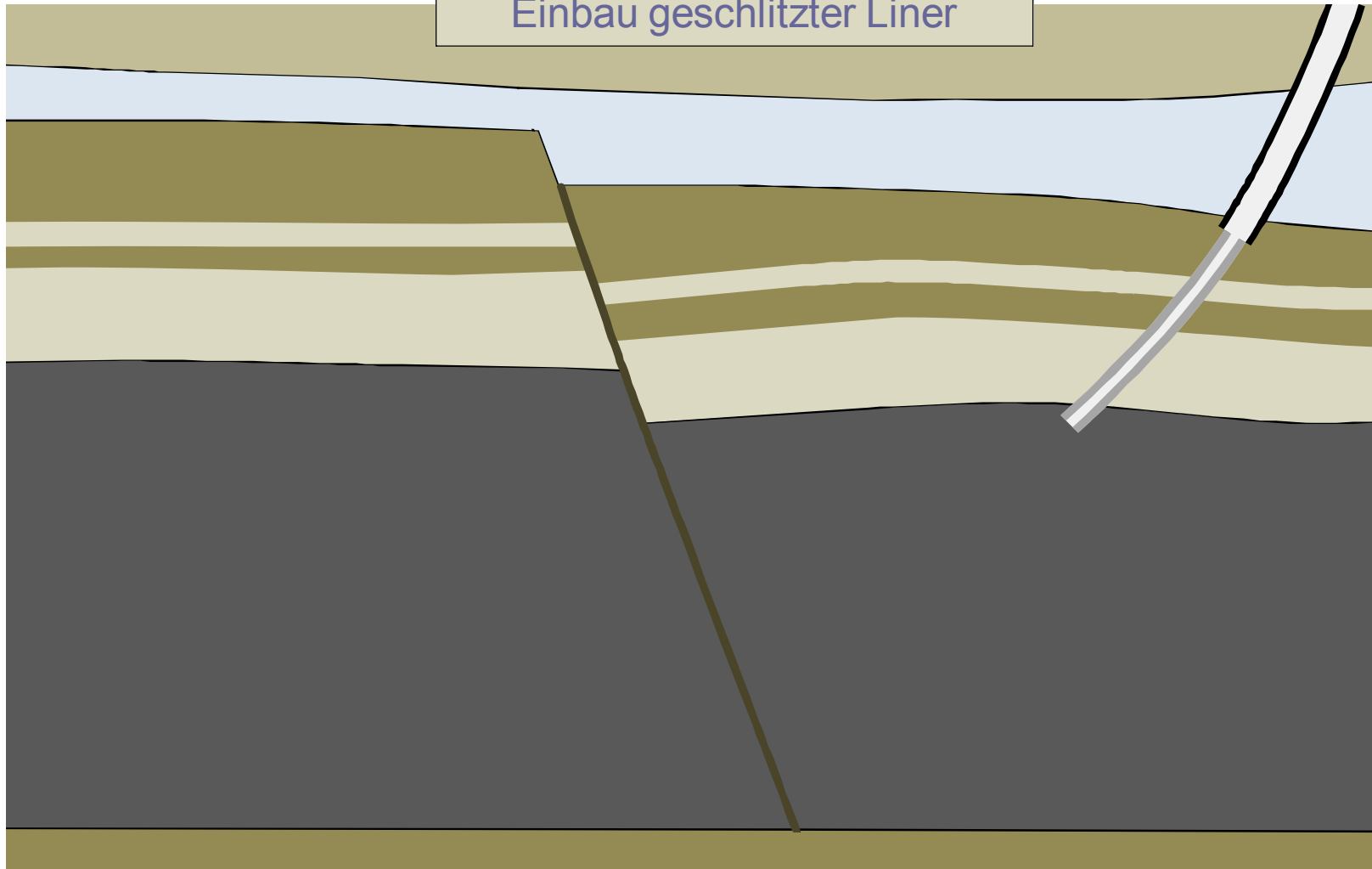


## Rotliegend-Sedimente Post-Frac

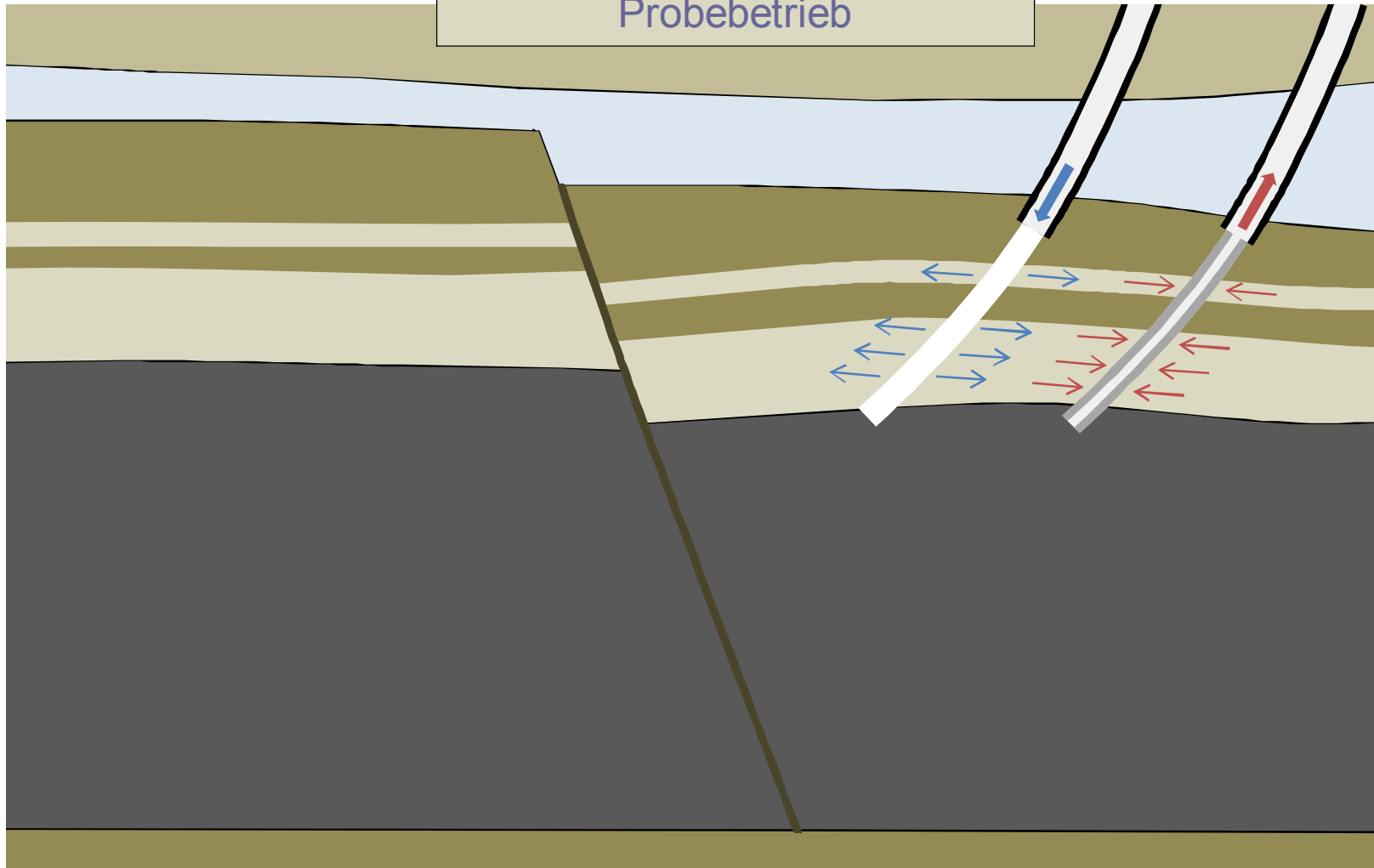




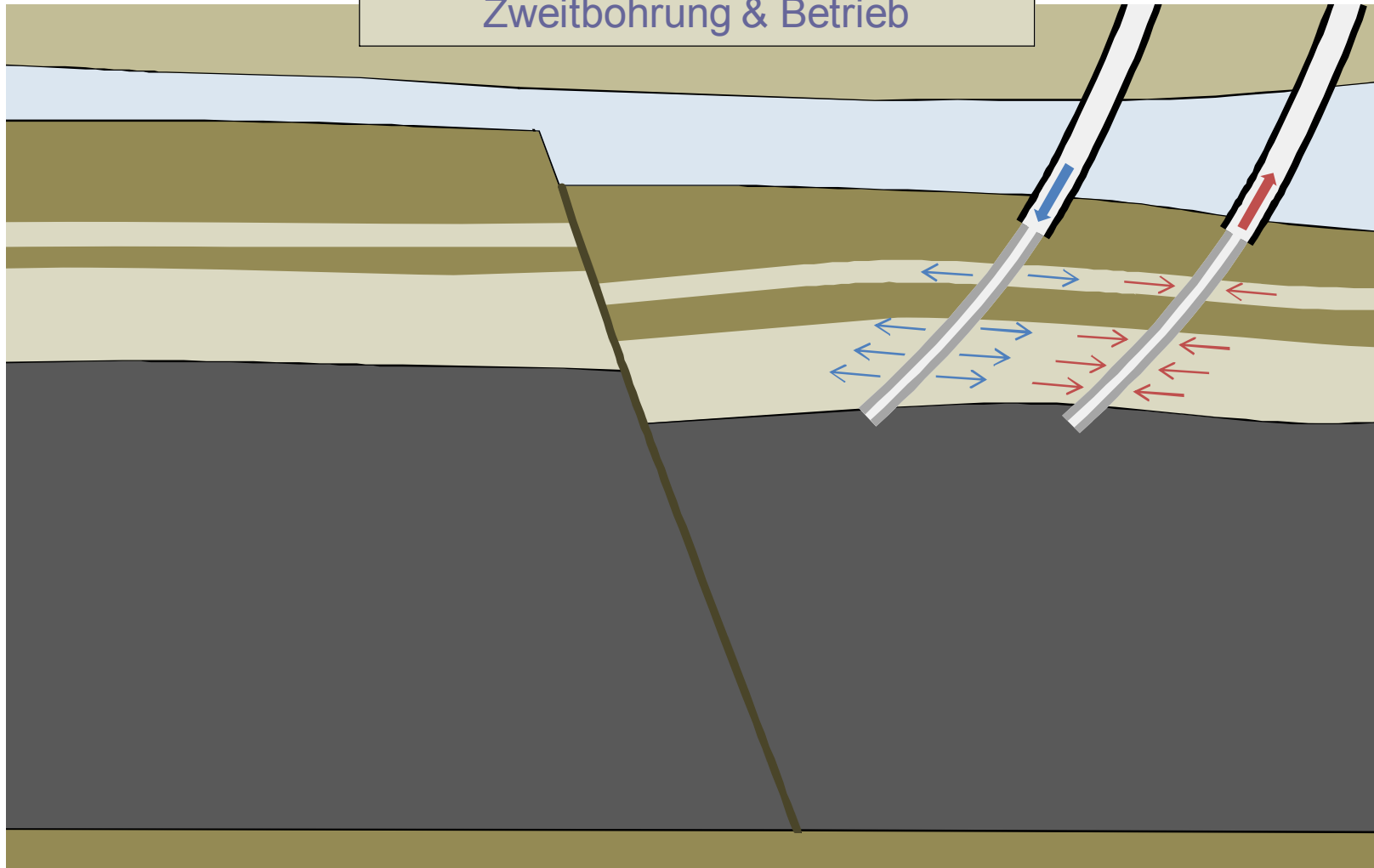
$PI > 10 = L / (MPa \cdot s)$   
Einbau geschlitzter Liner



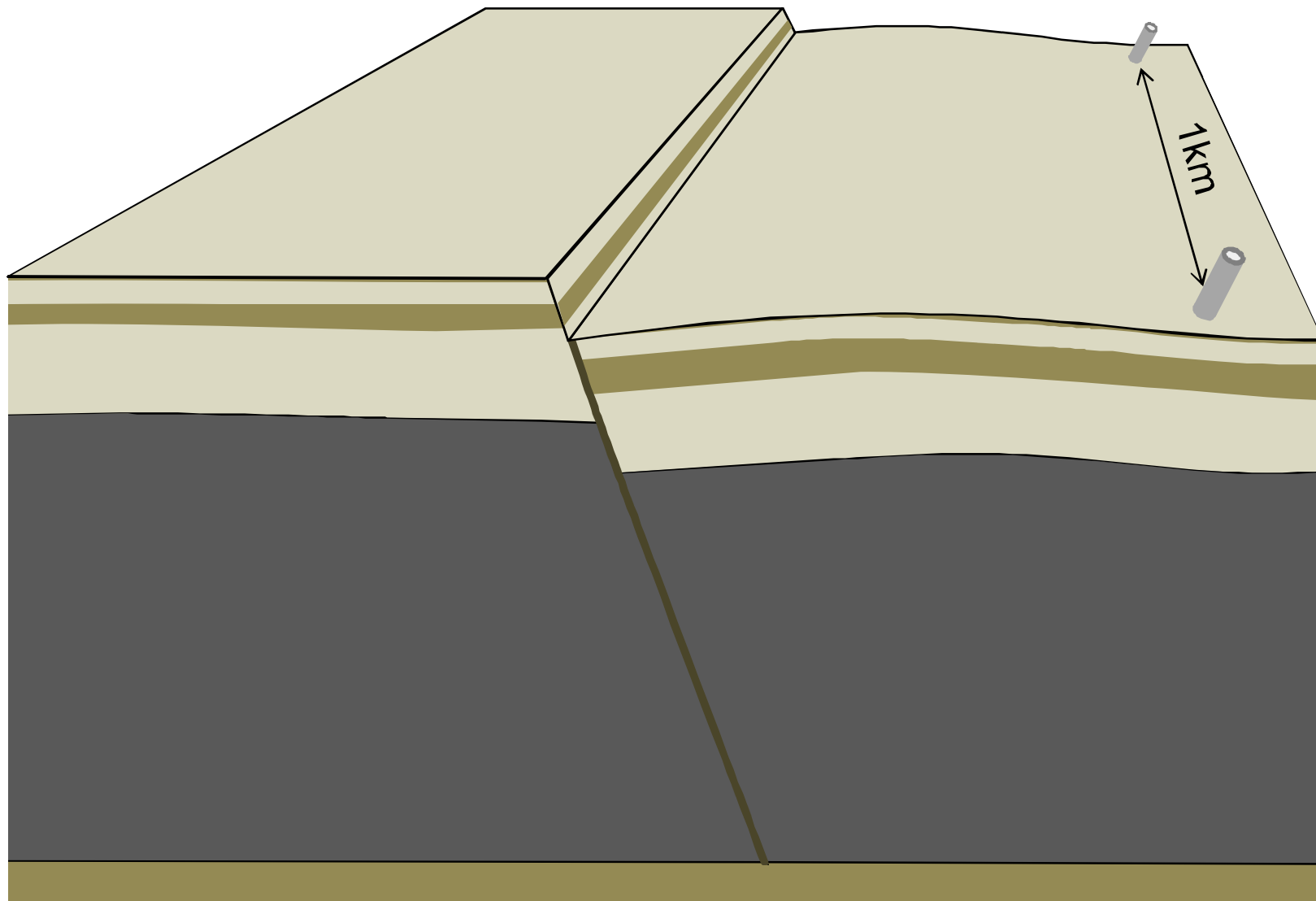
Abteufen Zweitbohrung & Probetrieb



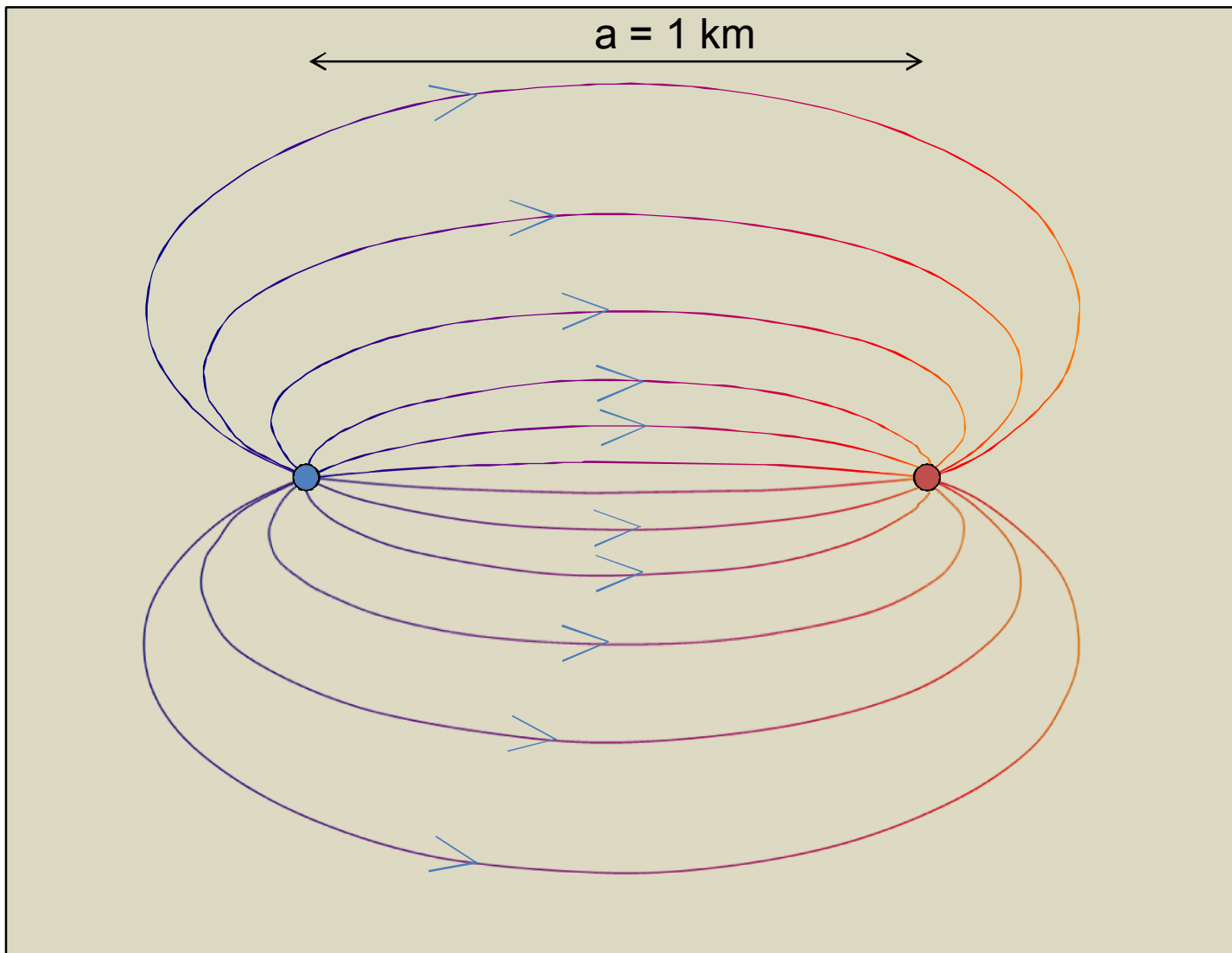
Einbau geschlitzter Liner in  
Zweitbohrung & Betrieb



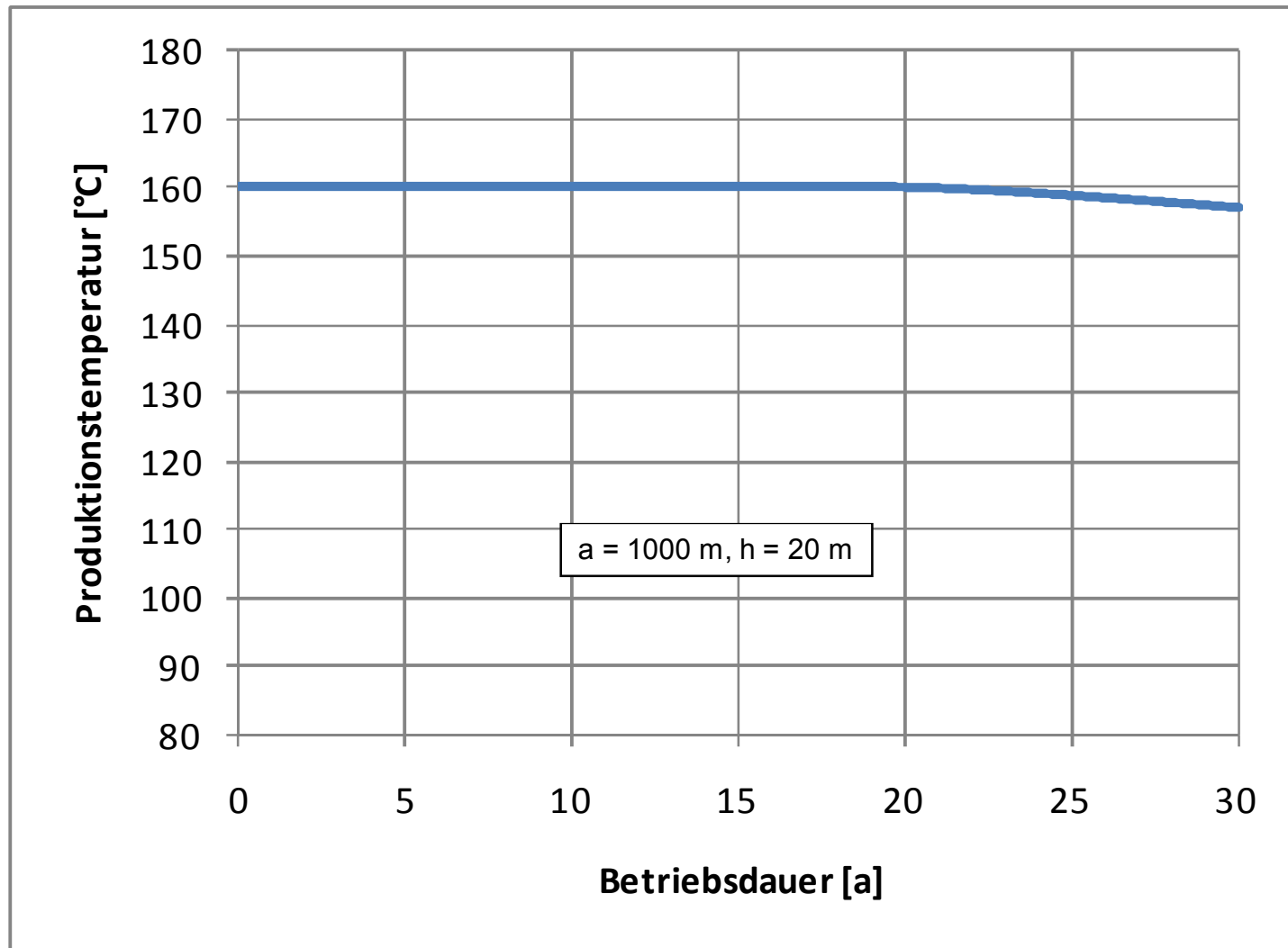
Nutzungsdauer?

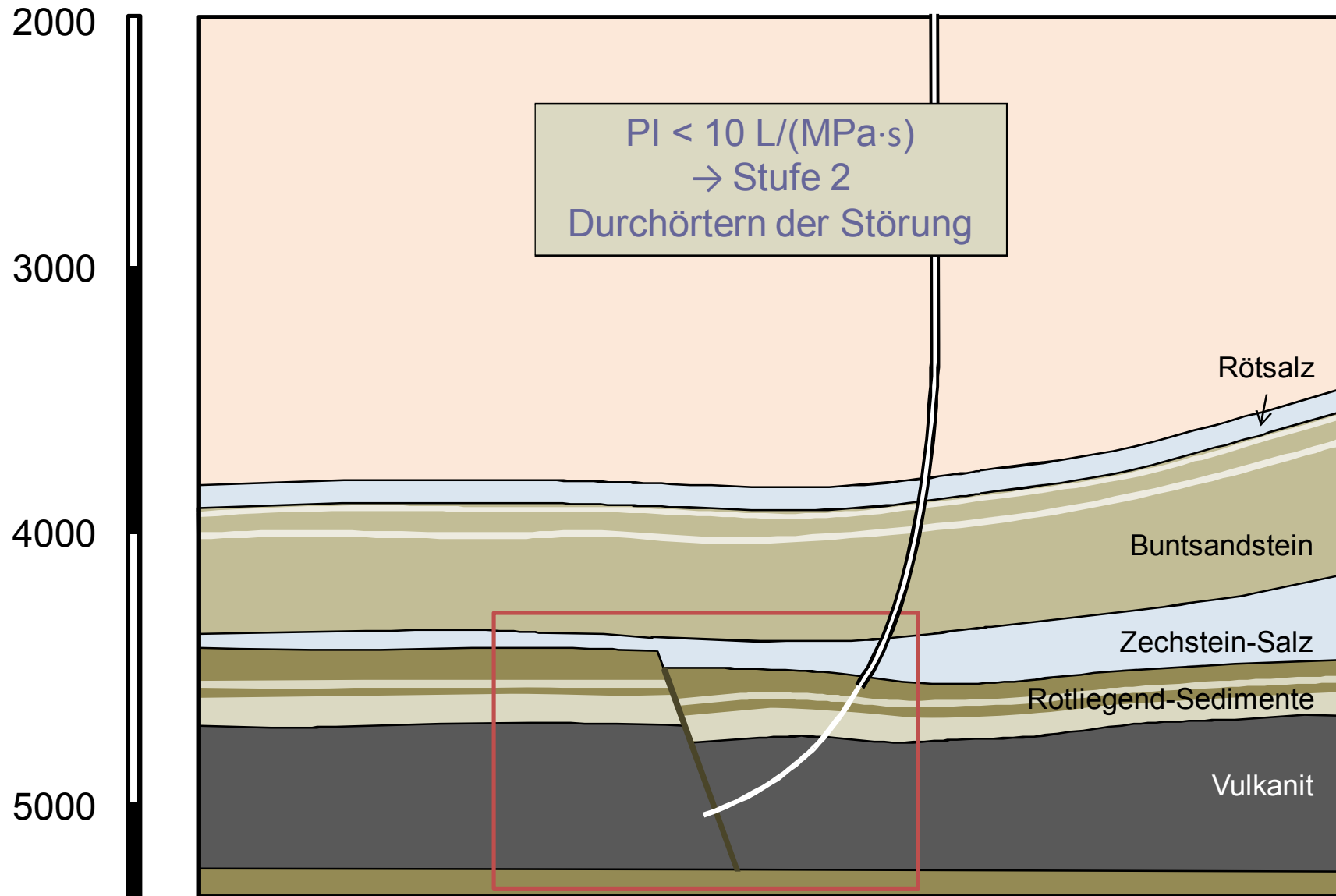


Nutzungsdauer?

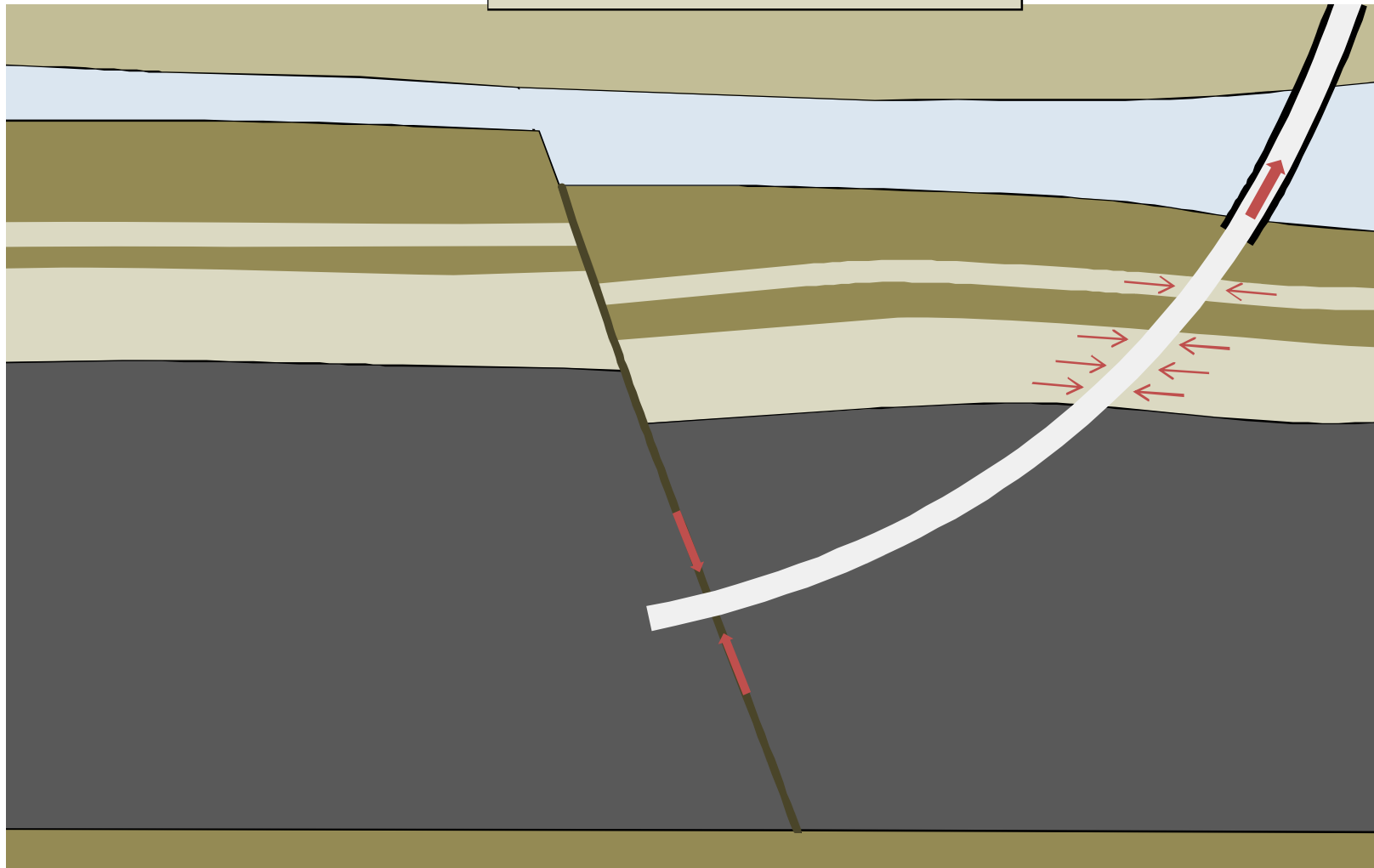


## Nutzungsdauer



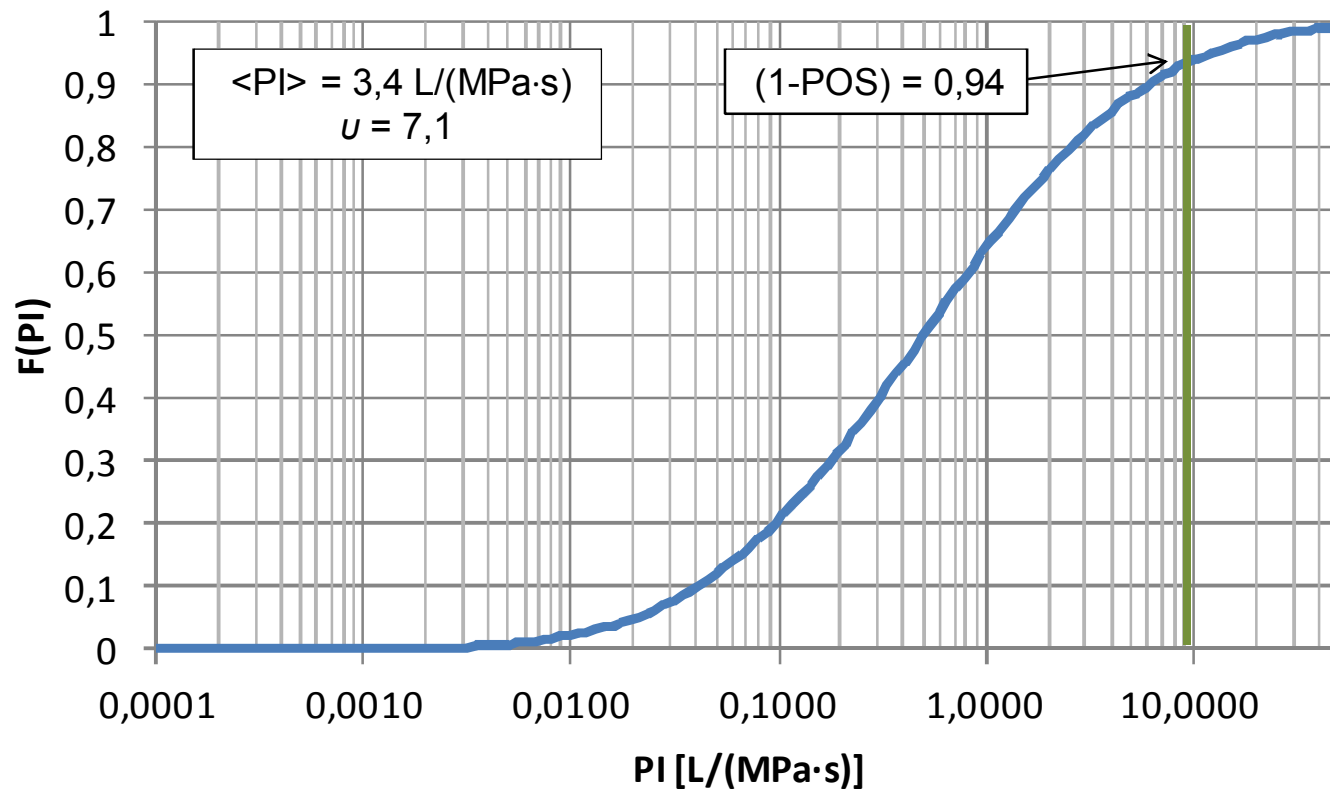


## Hydraulischer Test

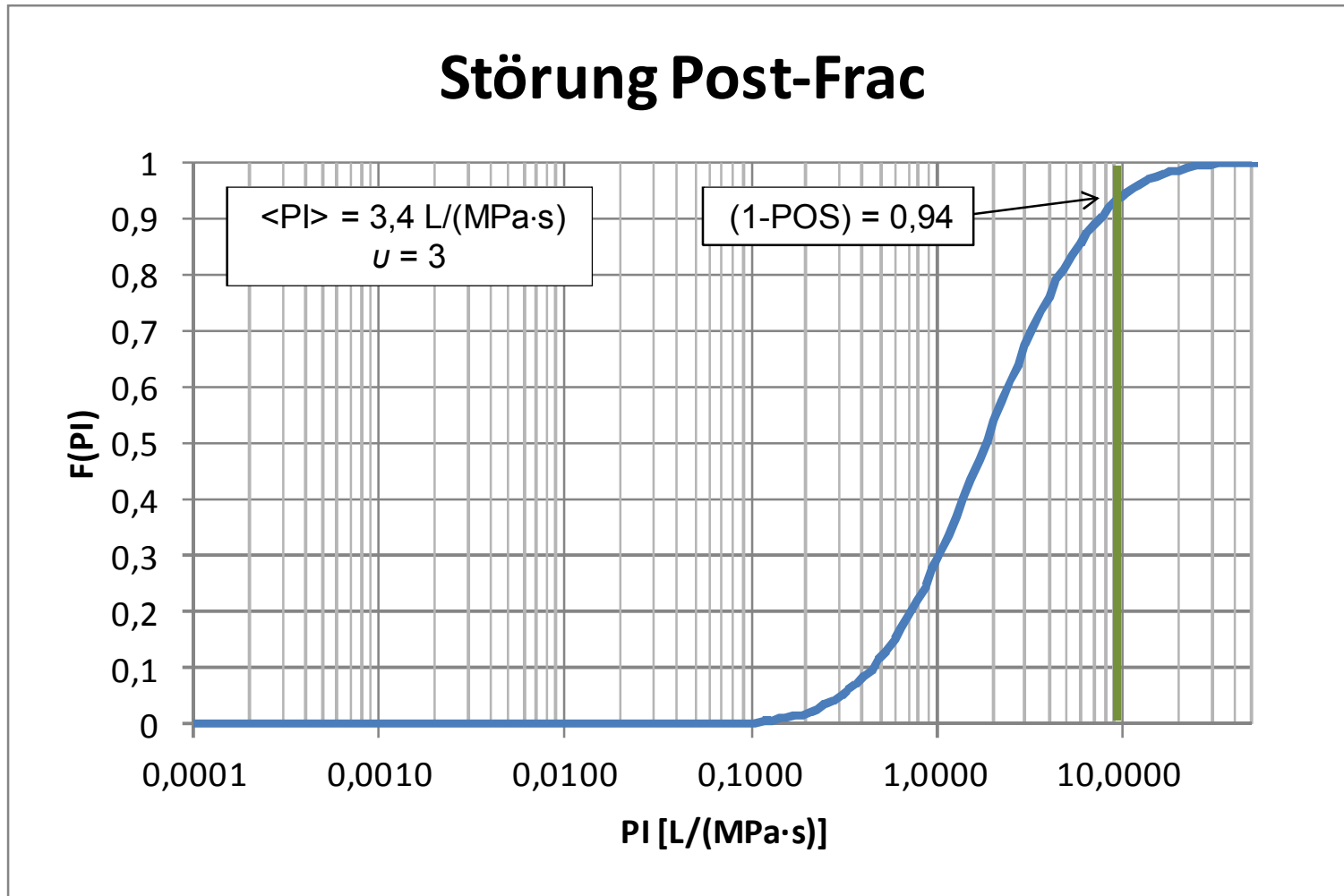


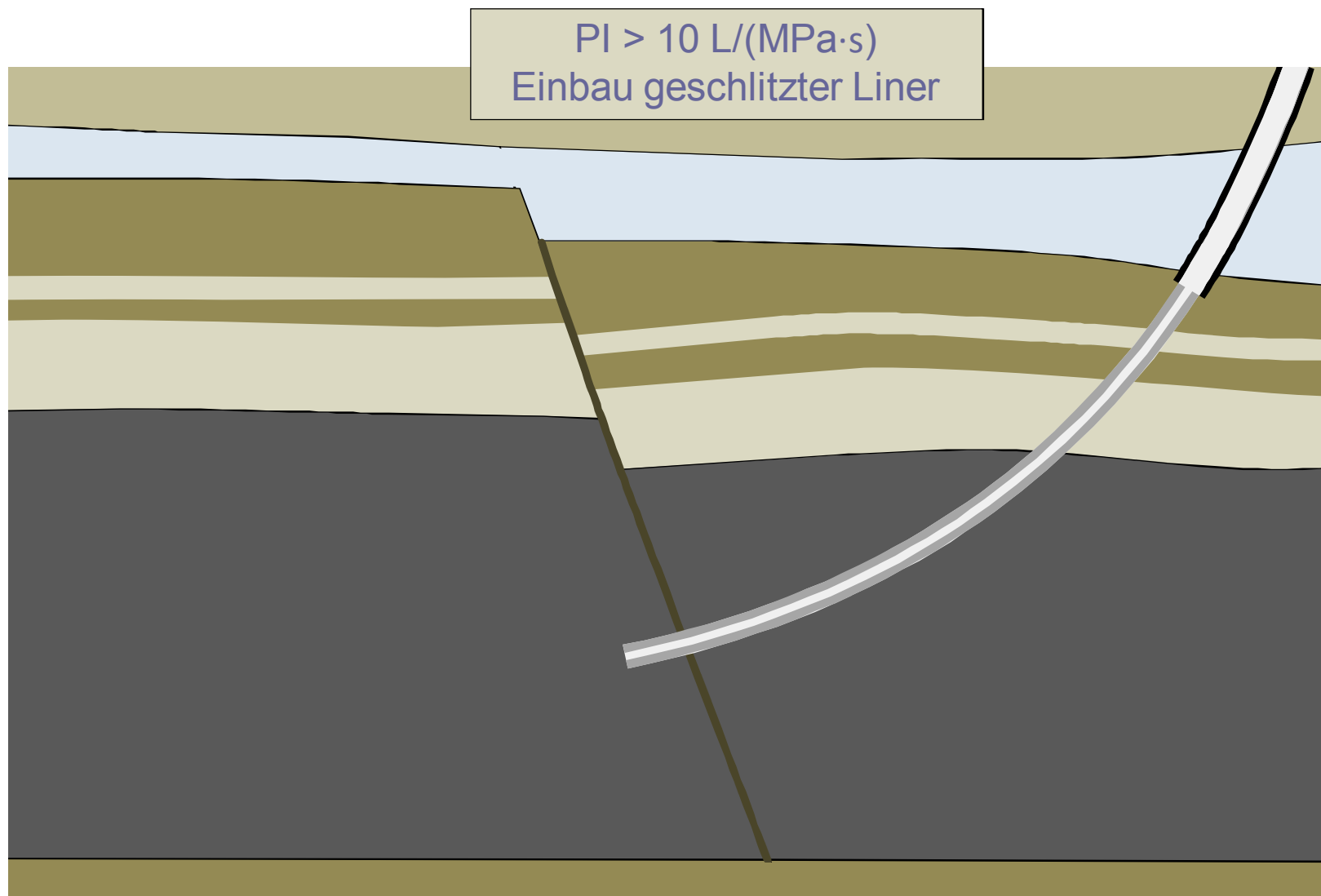


# Störung-Produktivitätsindex

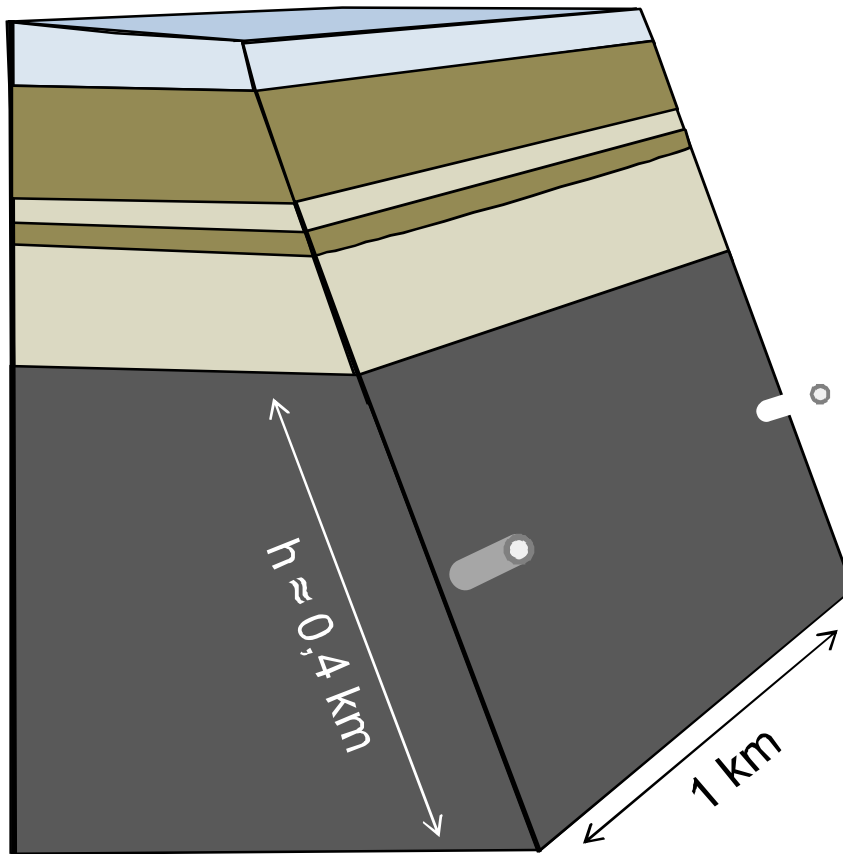


# Störung Post-Frac

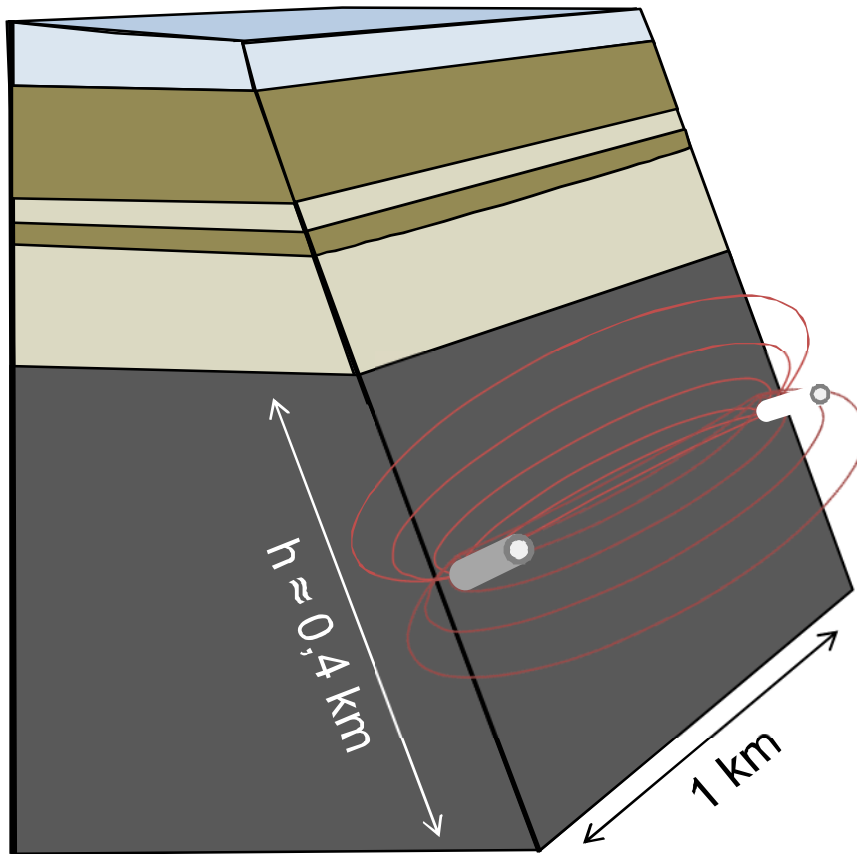




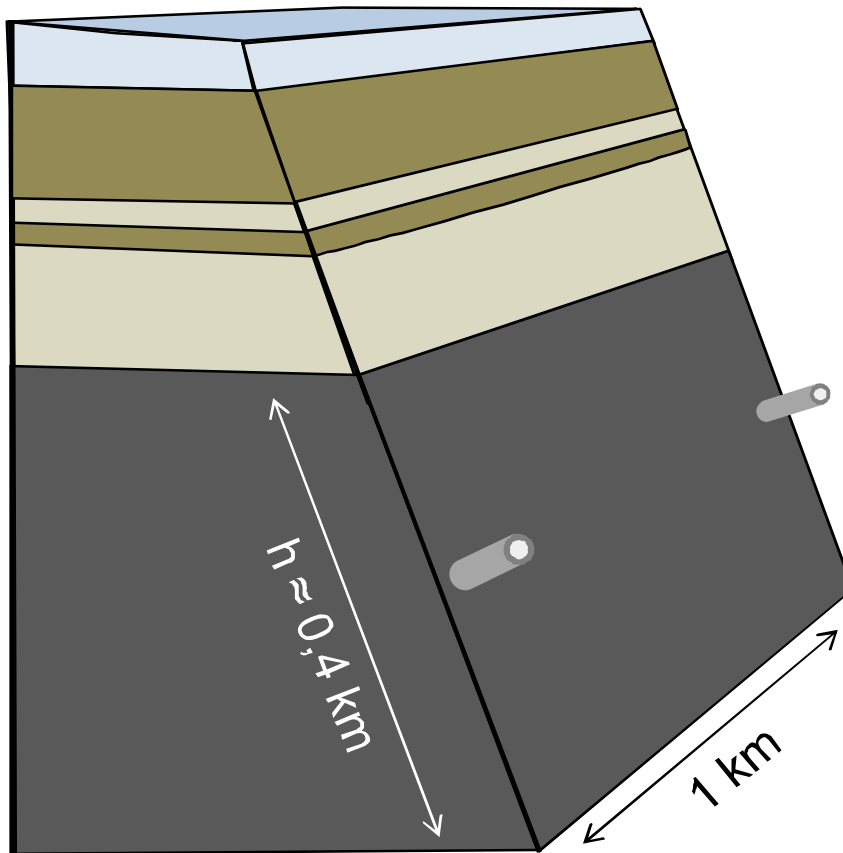
## Durchhörtern der Störung mit Zweitbohrung



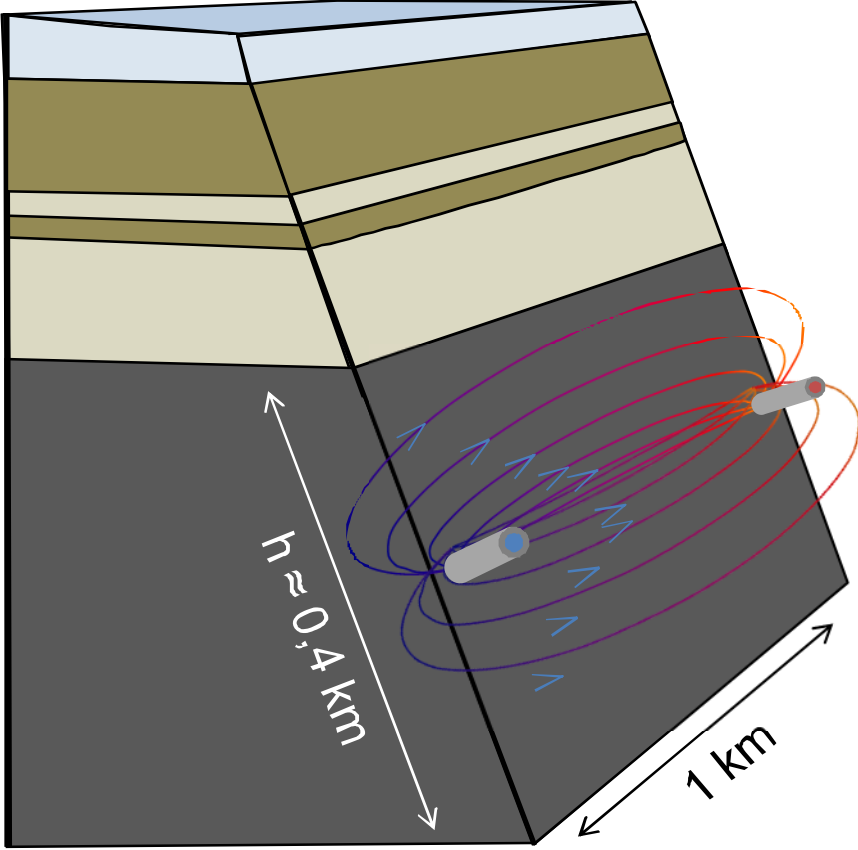
## Zirkulationstest



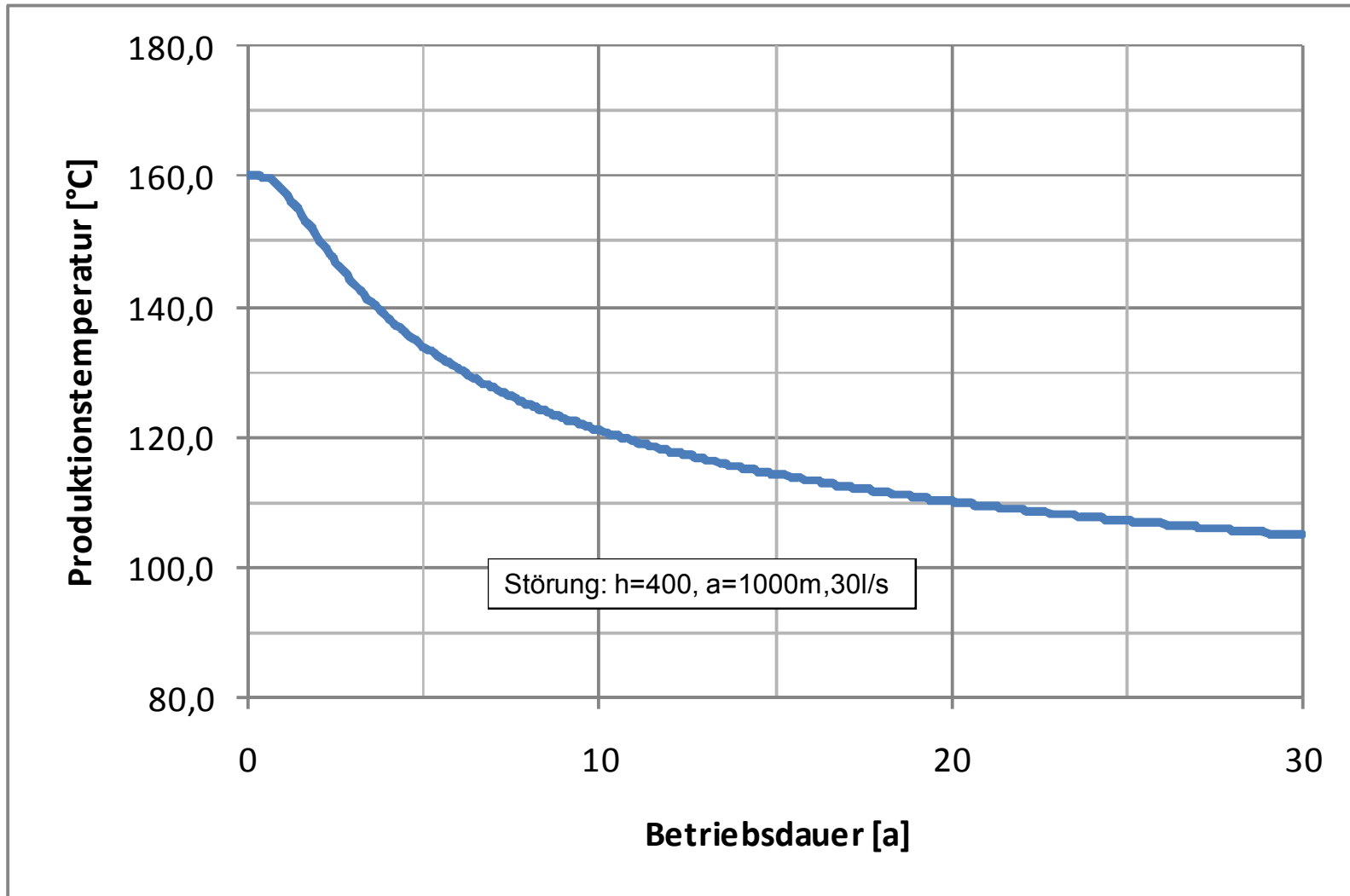
$PI > 10 \text{ L}/(\text{MPa}\cdot\text{s})$   
Einbau geschlitzter Liner in Zweitbohrung



Betrieb: Nutzungsdauer?

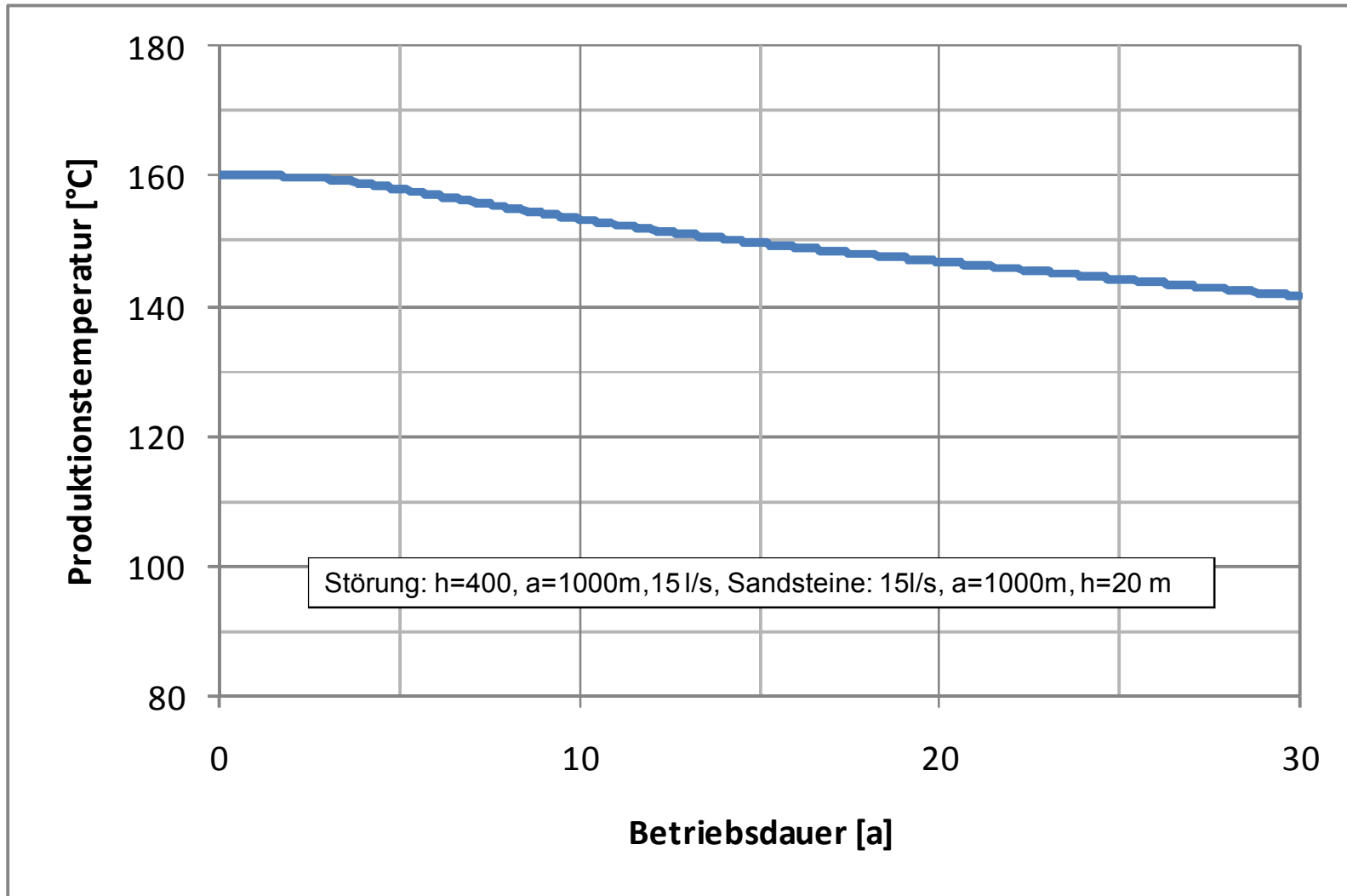


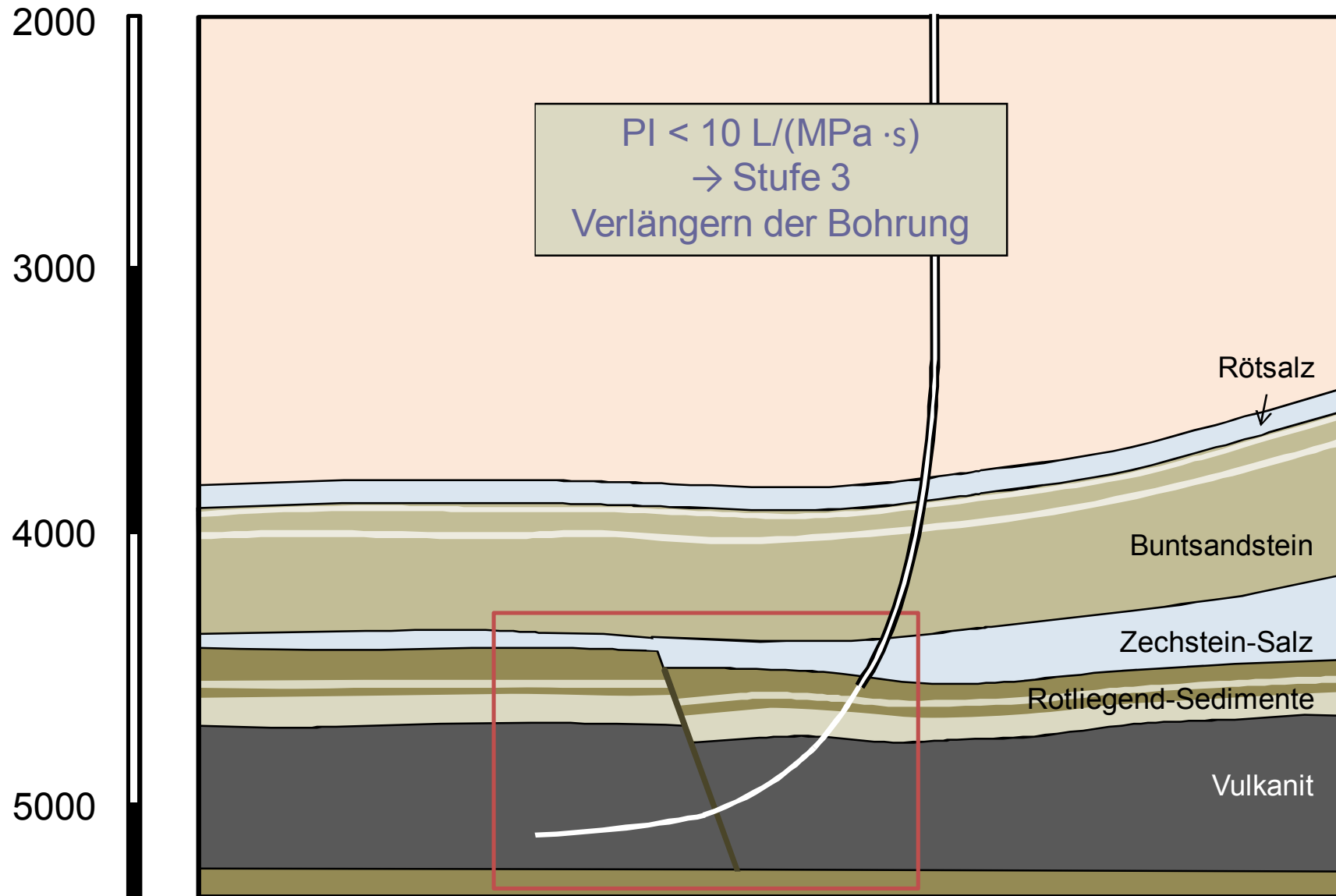
Nur Störung



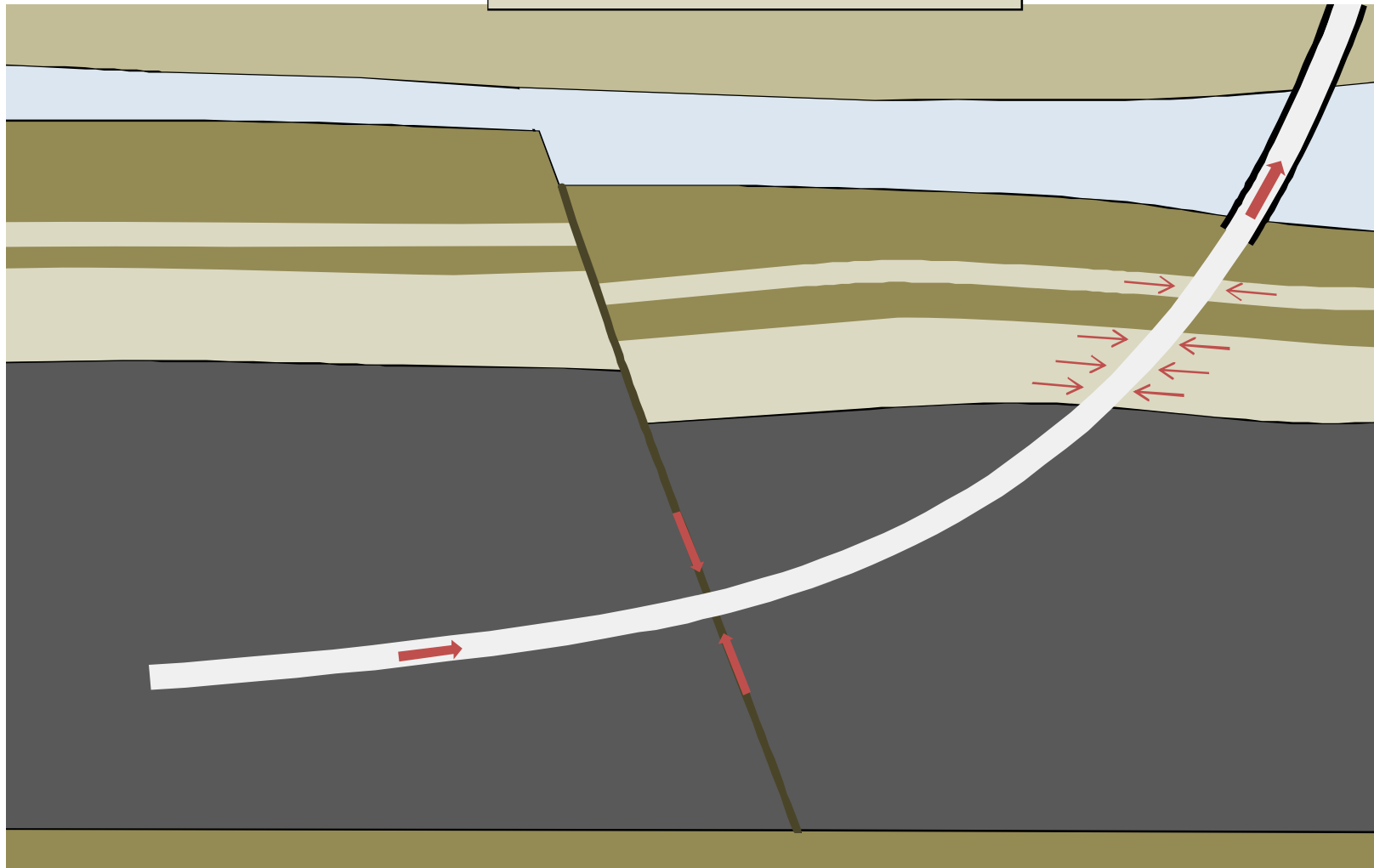


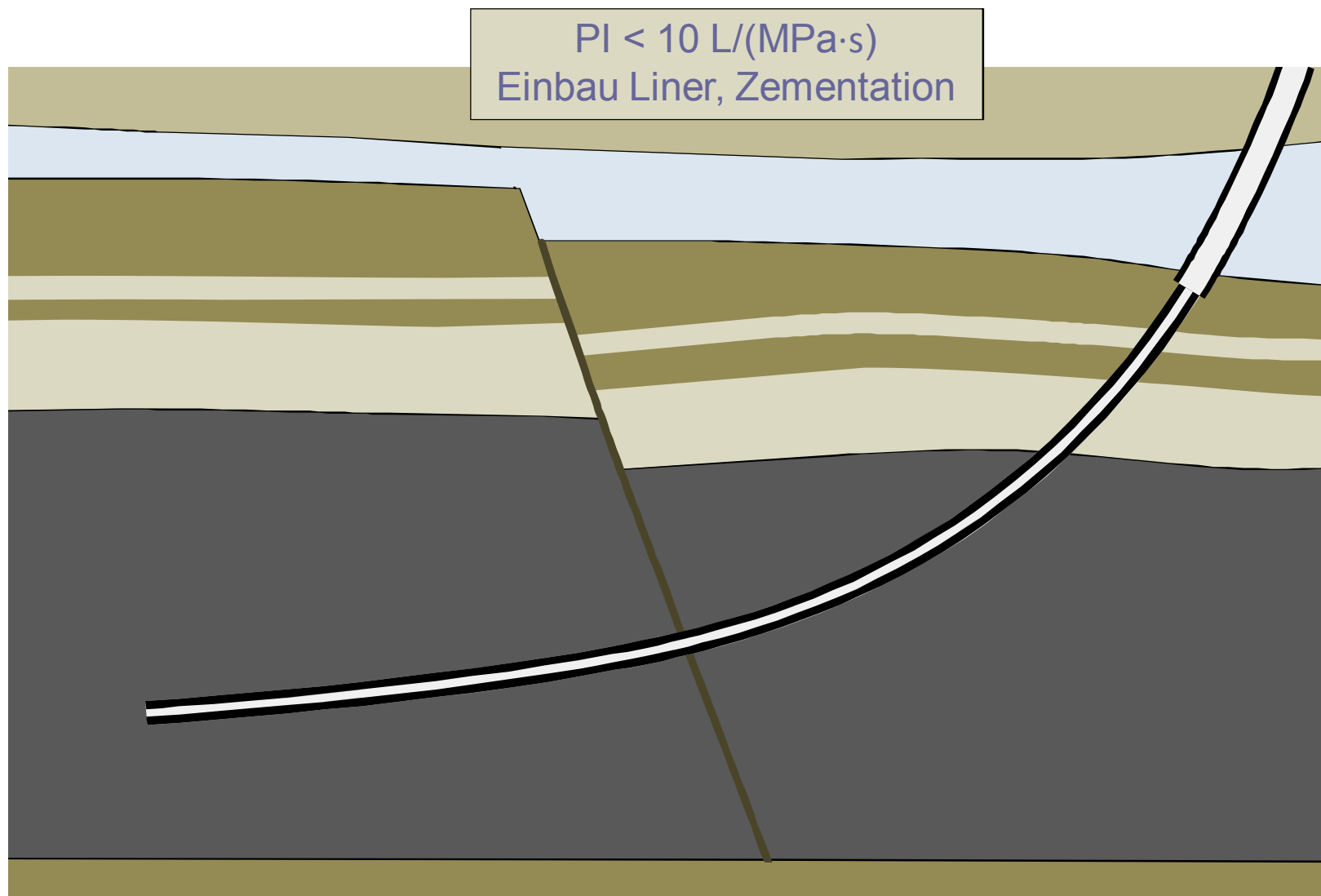
## Rotliegend-Sedimente & Störung

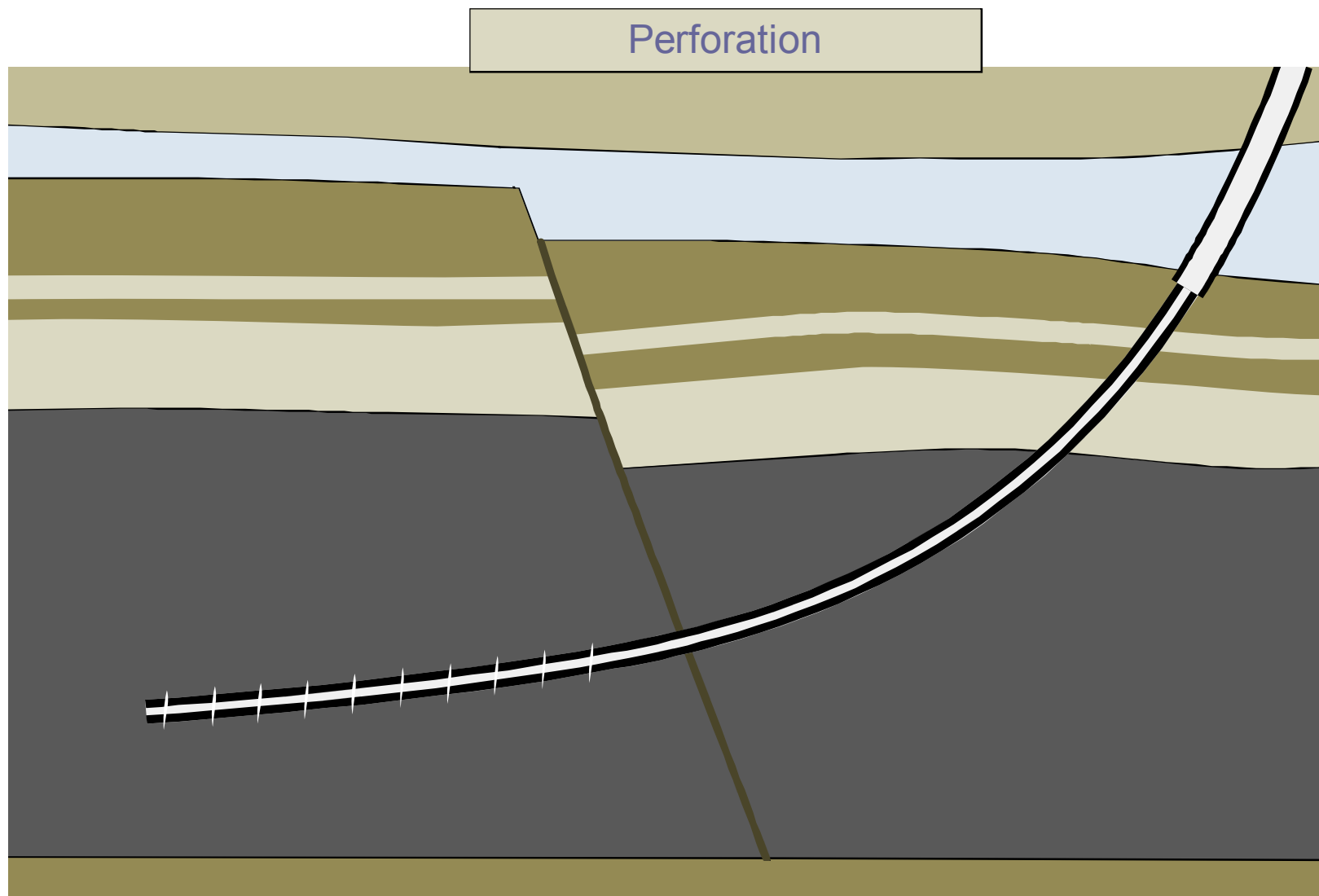




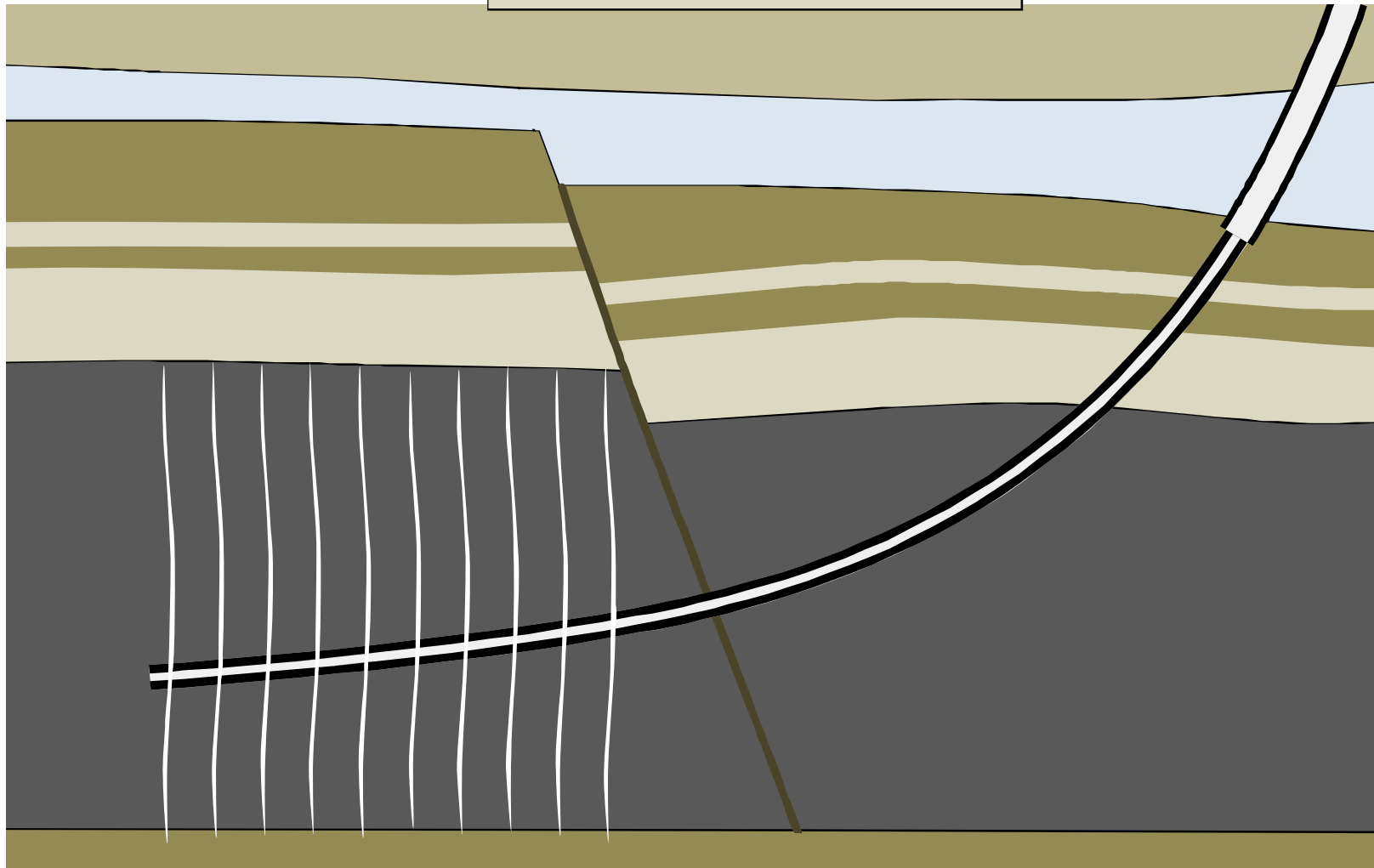
## Hydraulischer Test



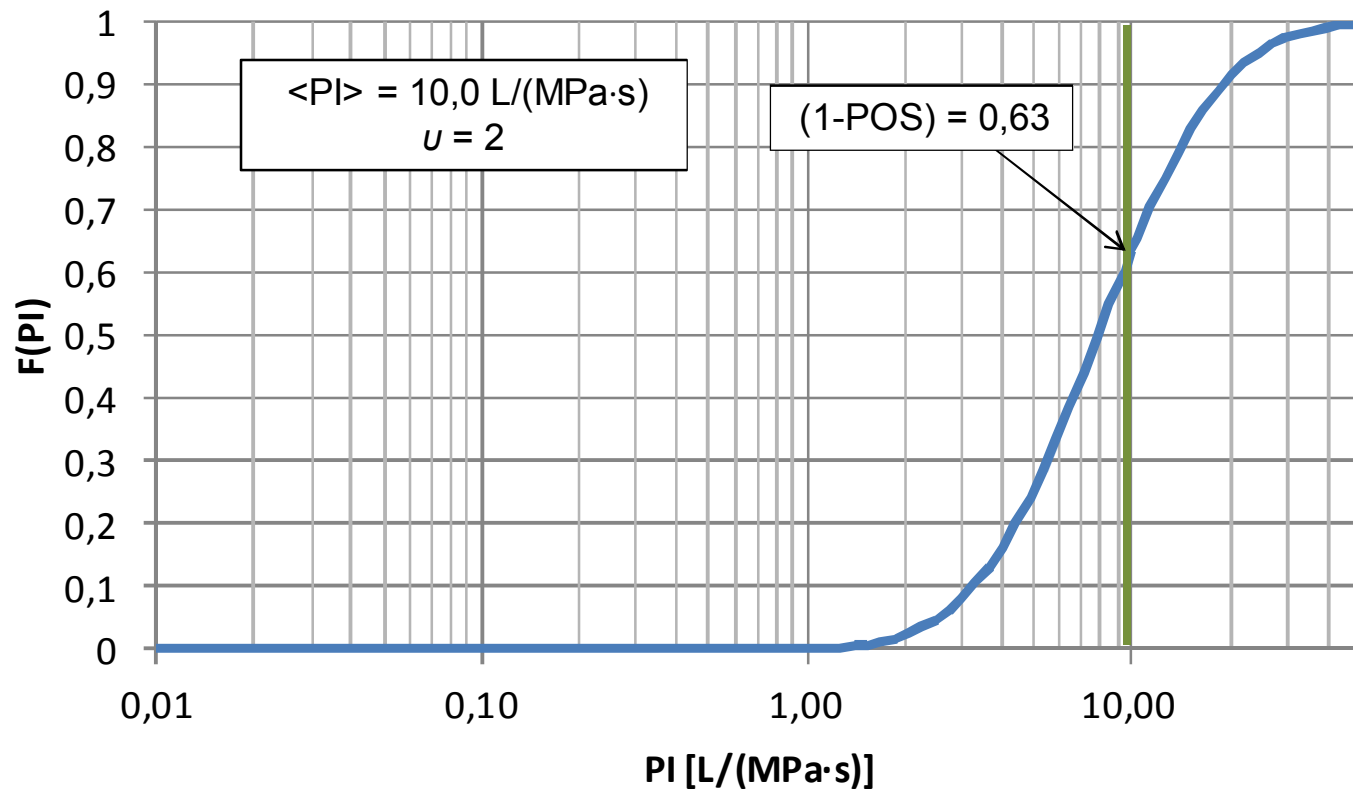




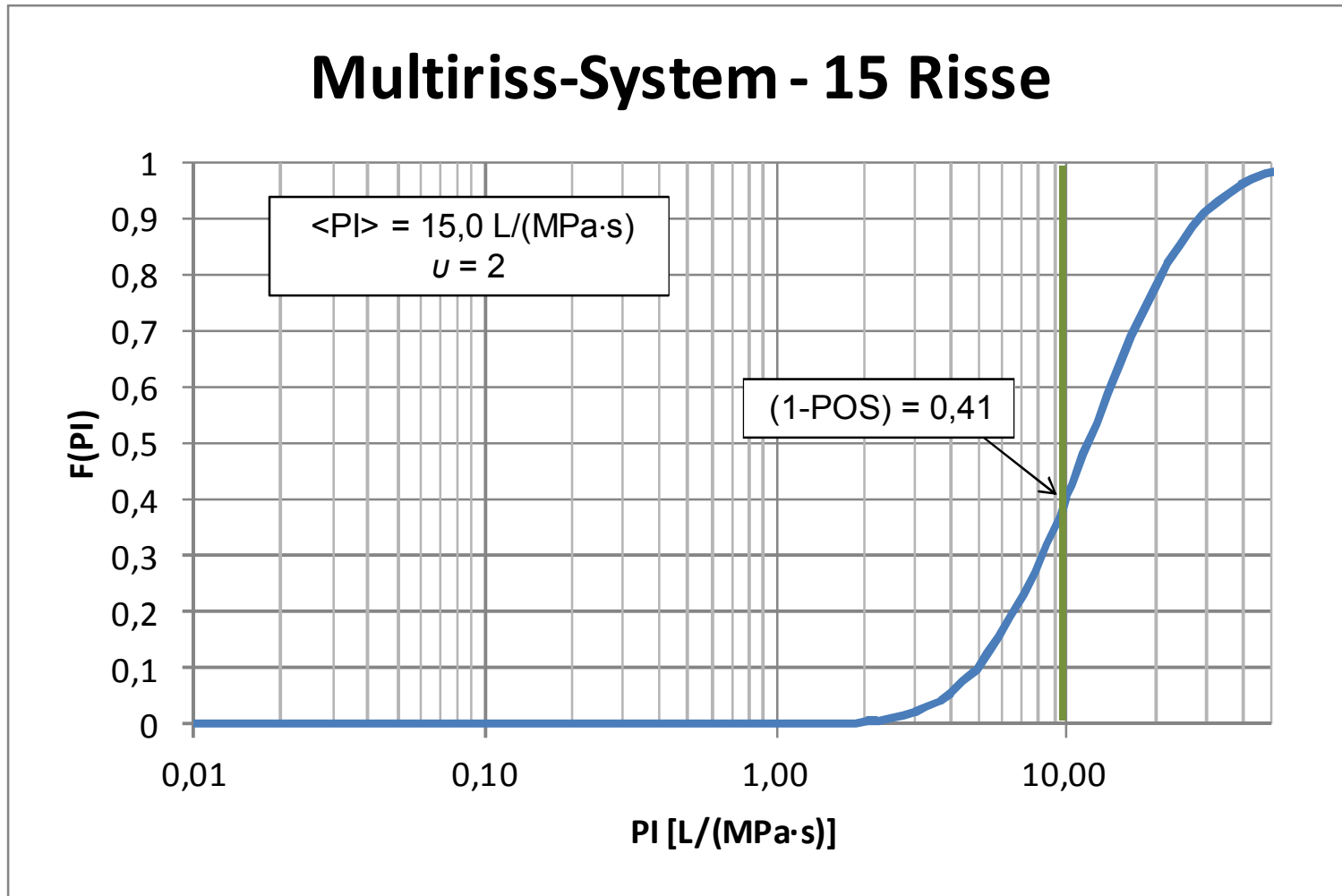
## Frac-Tests



# Multiriss-System - 10 Risse

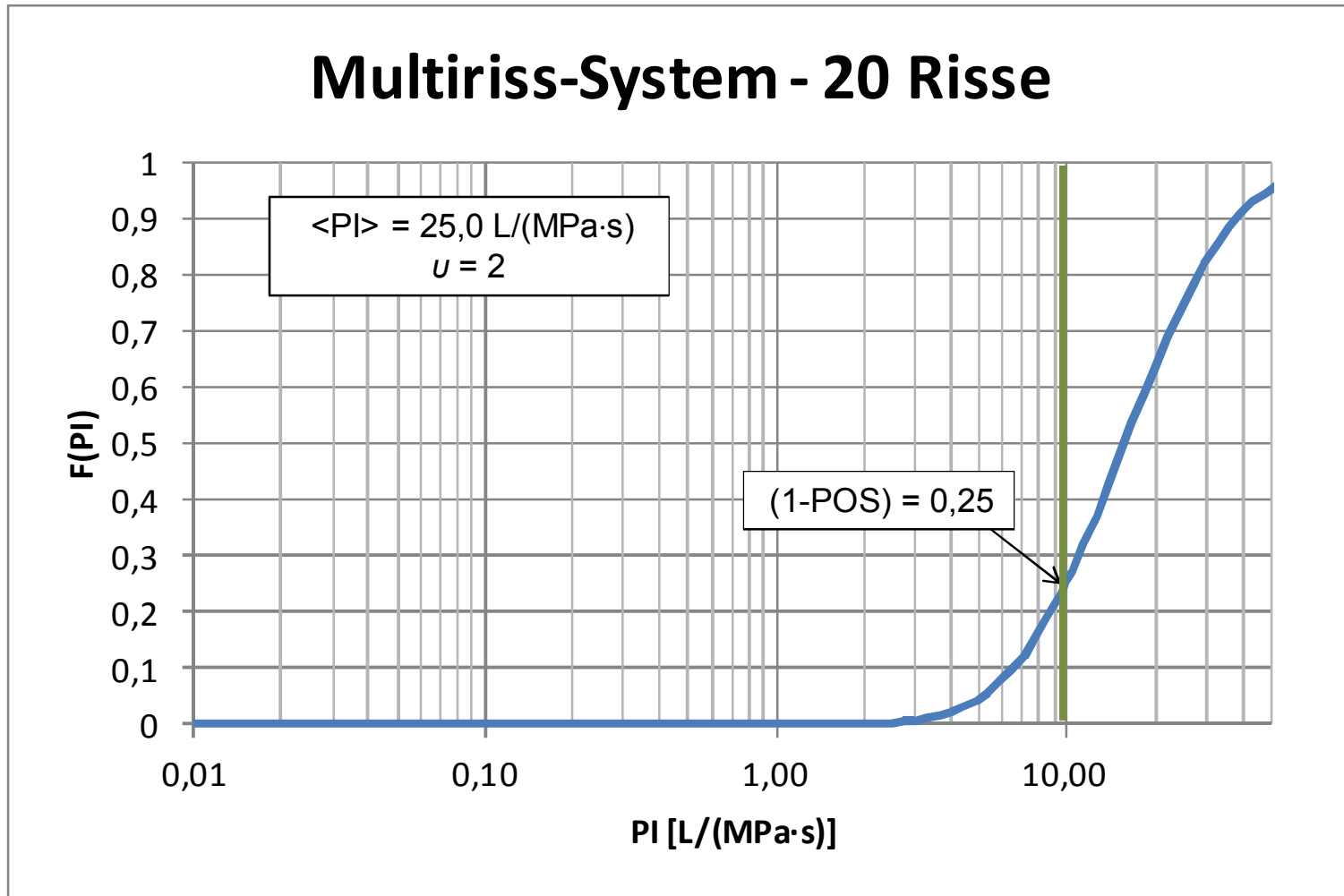


## Multiriss-System - 15 Risse

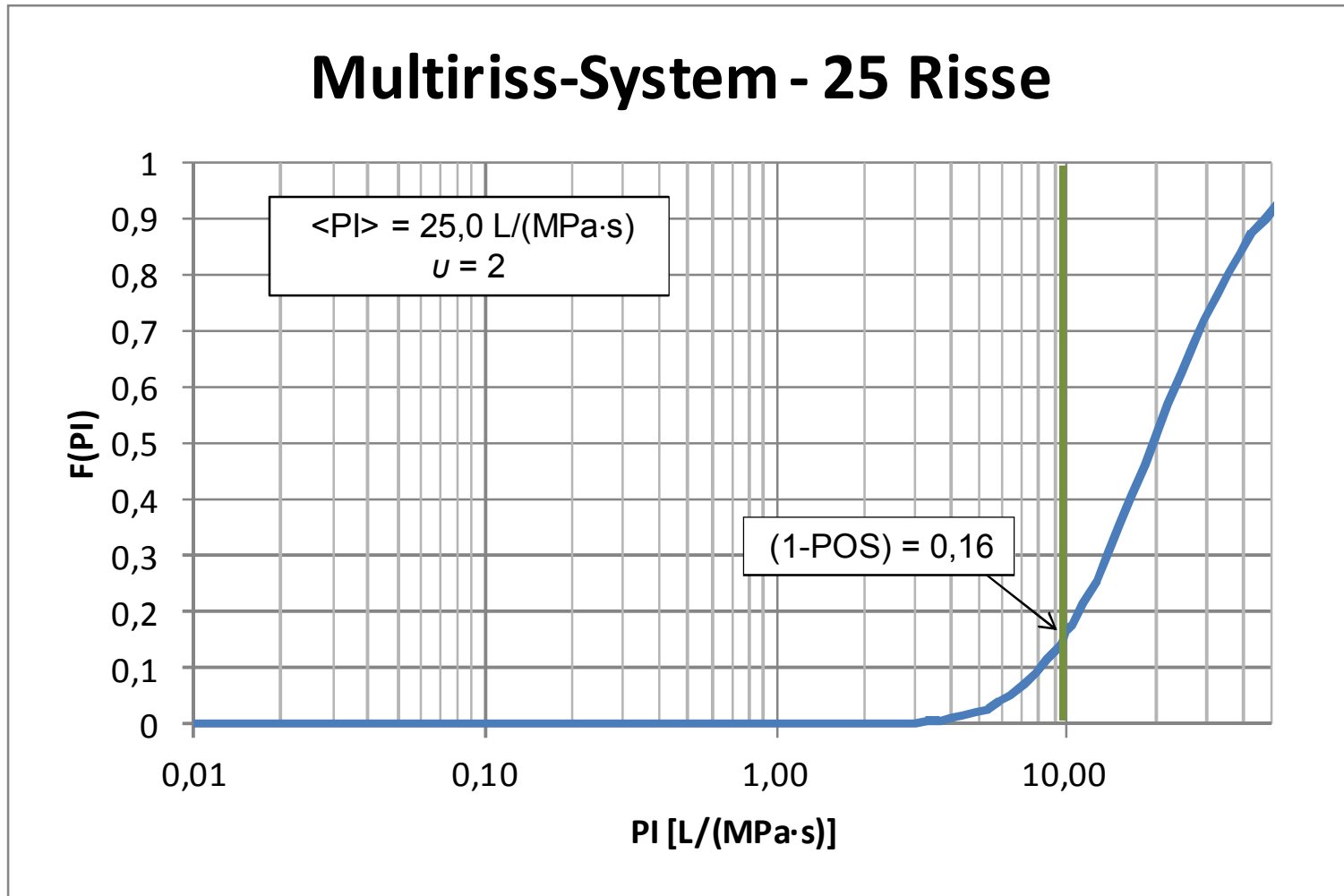




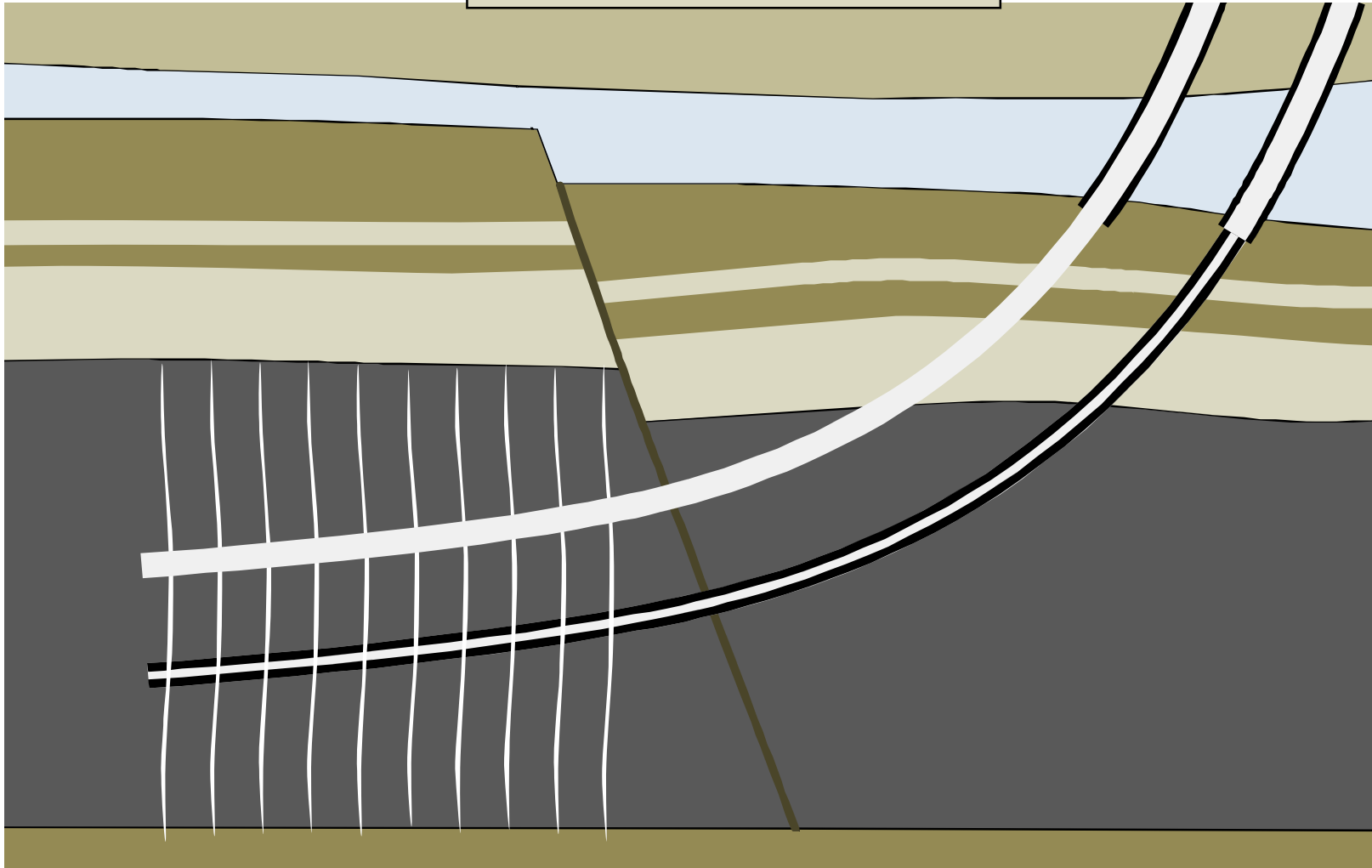
# Multiriss-System - 20 Risse

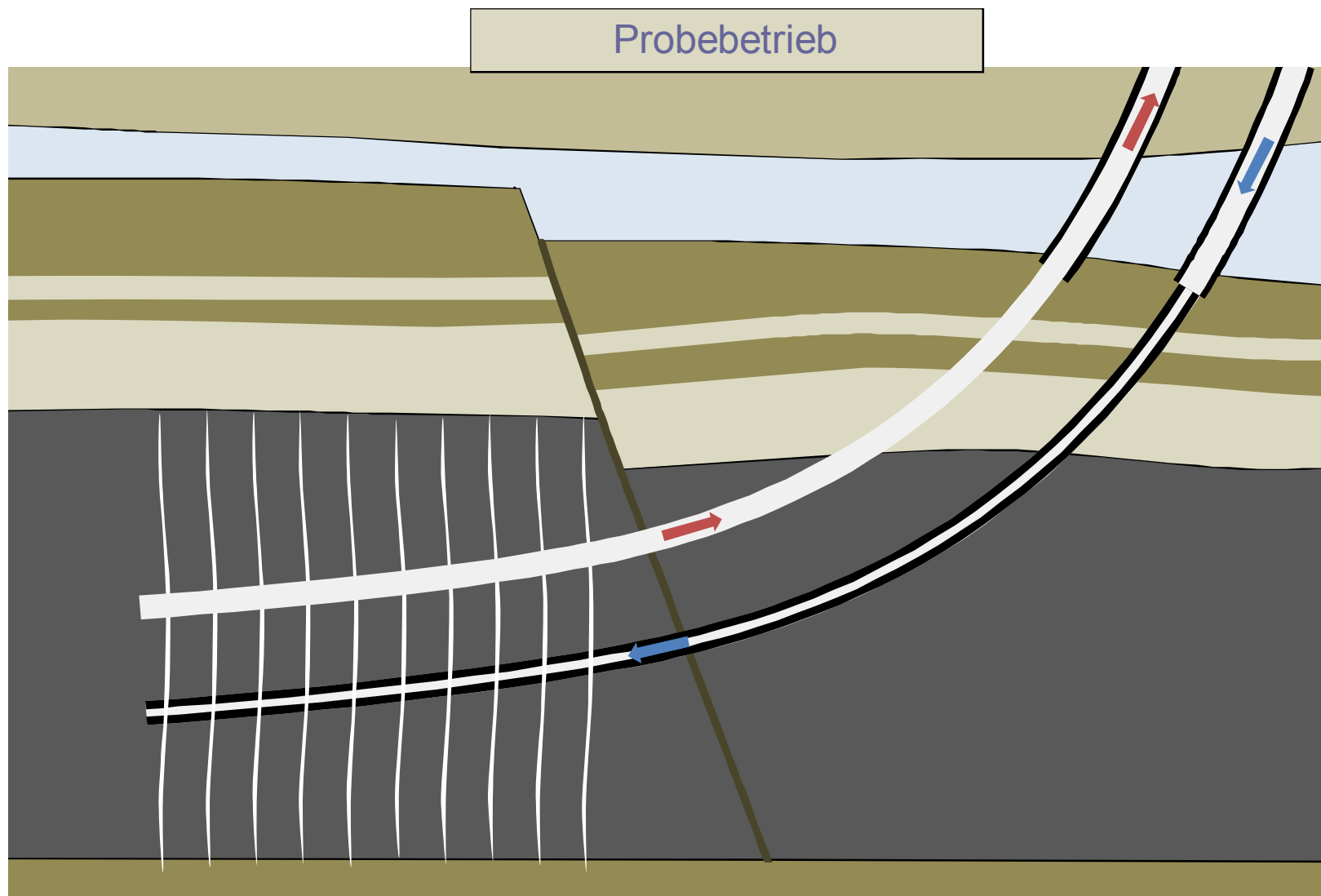


# Multiriss-System - 25 Risse

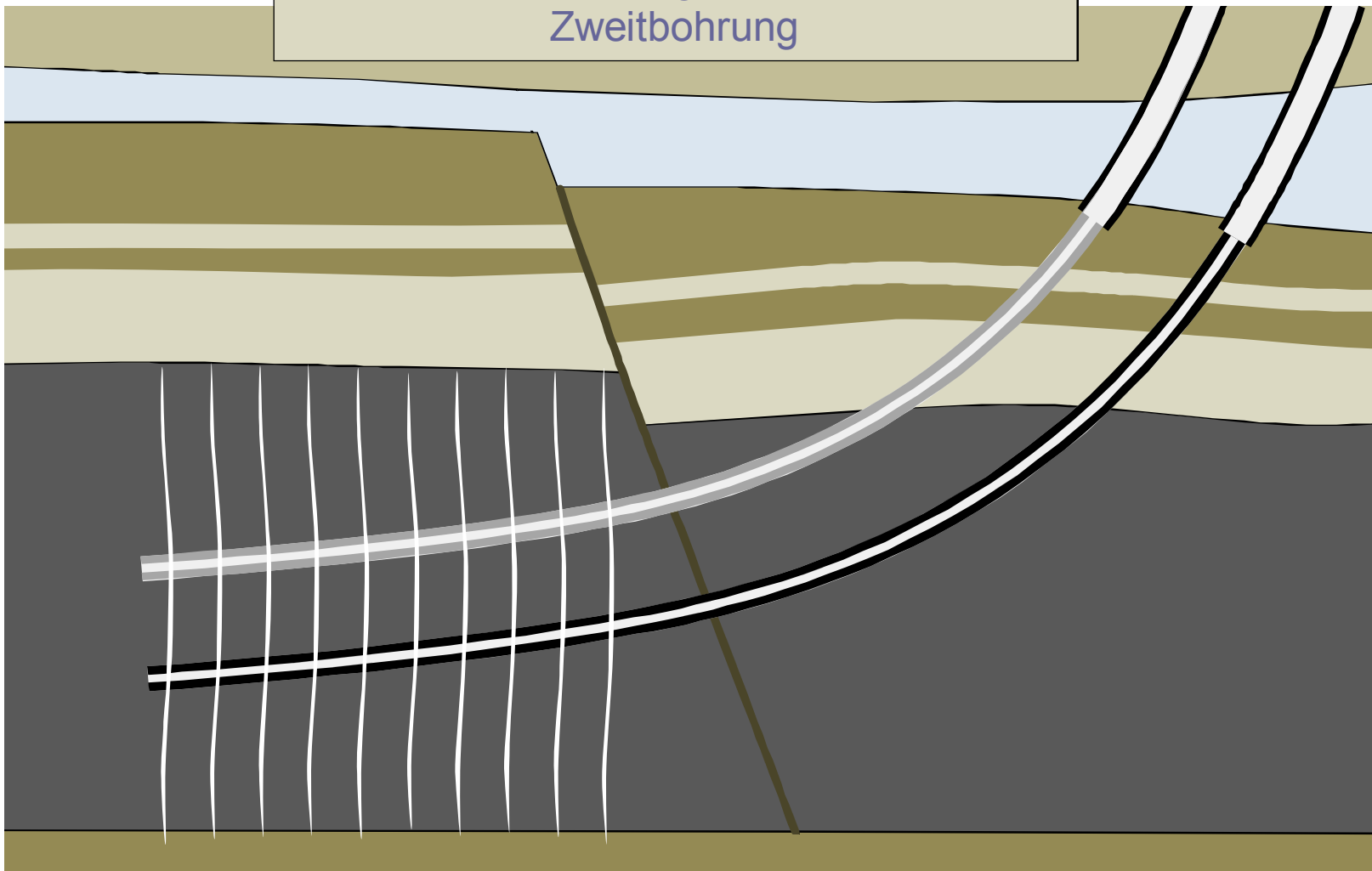


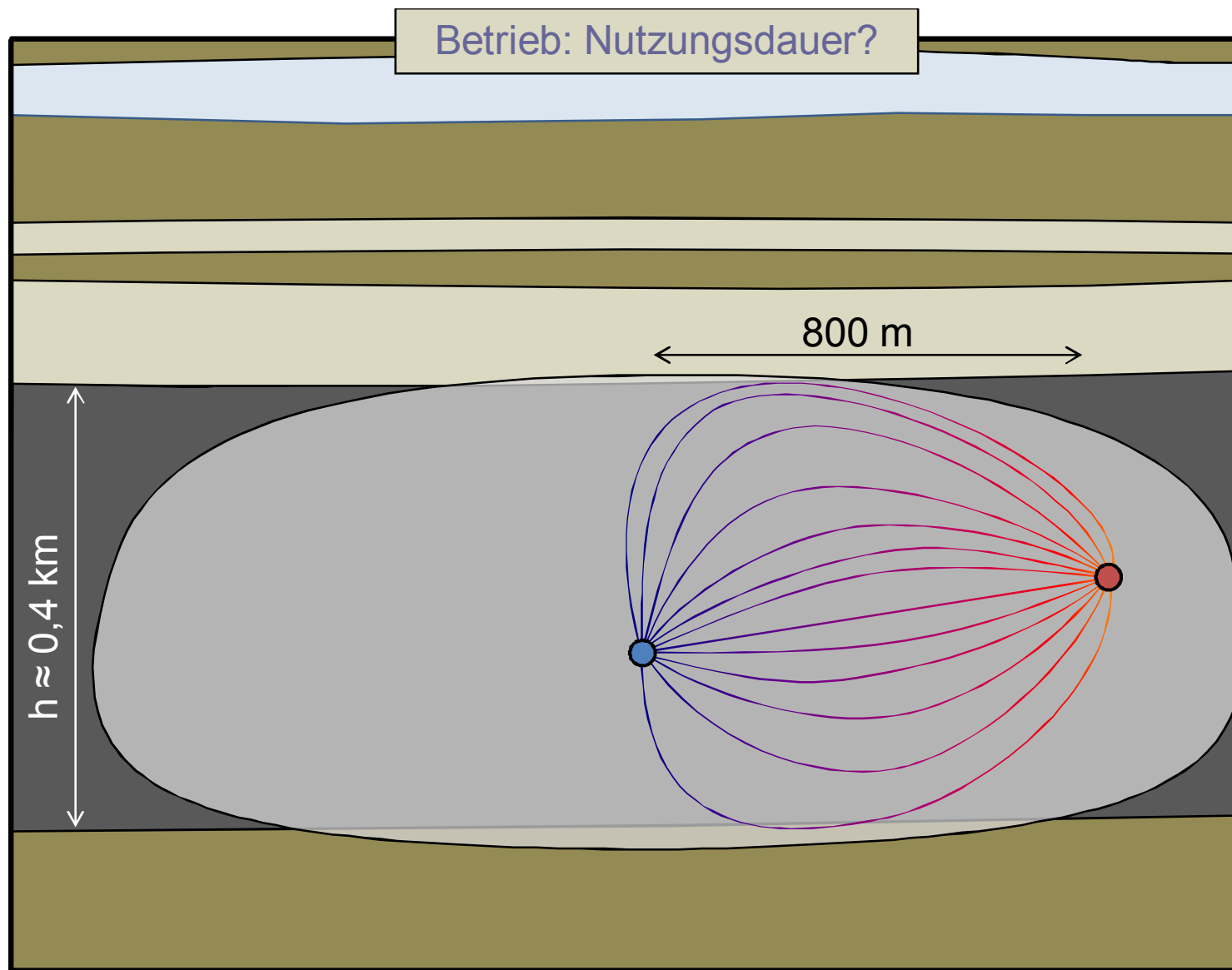
Abteufen Zweitbohrung



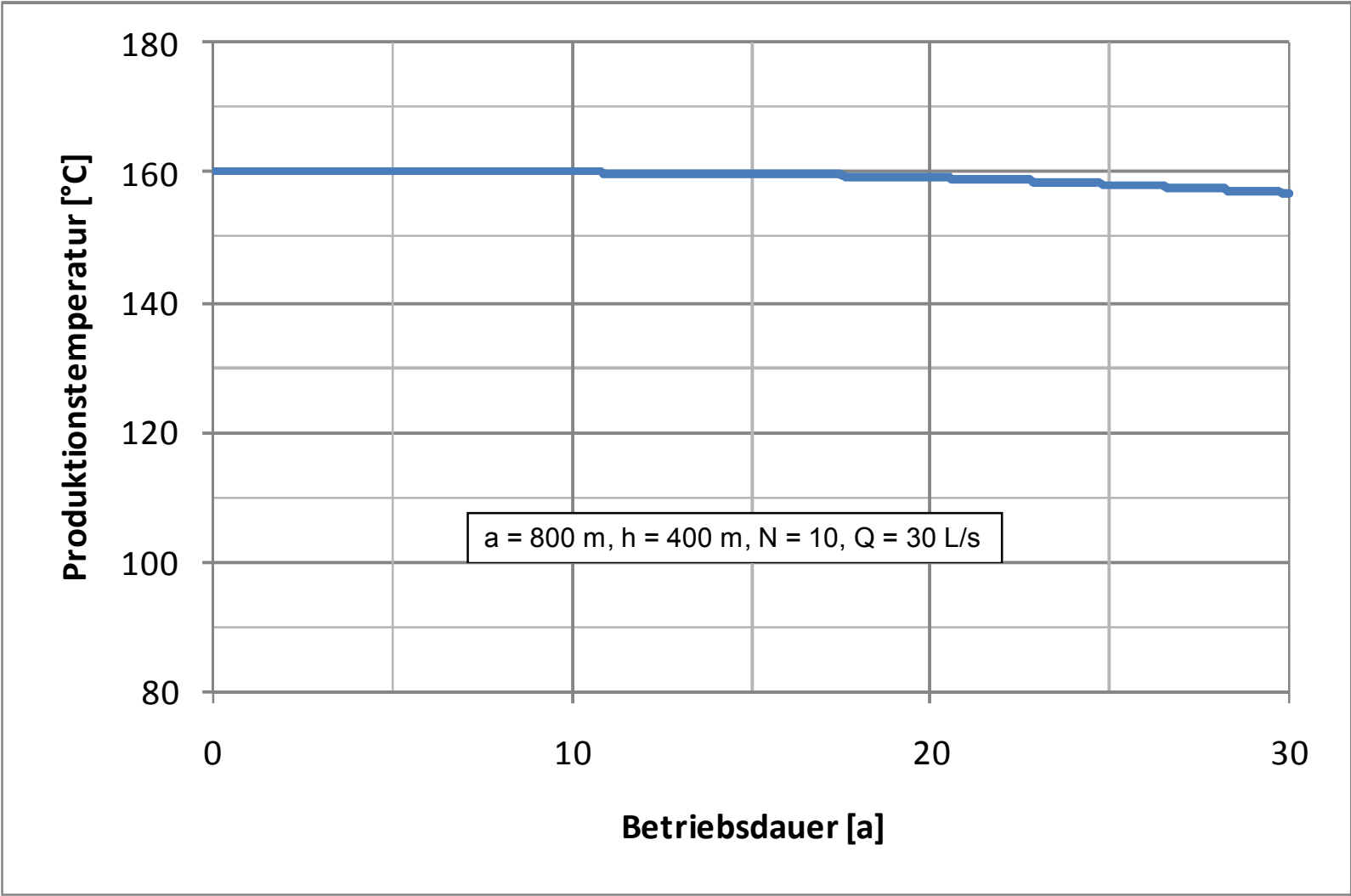


$Q > 30 \text{ L/s}$ : Einbau geschlitzter Liner in  
Zweitbohrung





Nur Multiriss-System



# Besondere Herausforderungen

Lagerstättendruck & Gasgehalt

Richtbohren im Vulkanit

Zementation

Risserzeugung

Offenhalten der Risse

Parallelität der Risse



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## Probleme:

Starker Verschleiß: Meißel, Räumler, Gestänge  
Starke Vibration: Ausfall der Steuerelektronik

## Abhilfe:

### “Rotary Steerable Systems” mit Motor

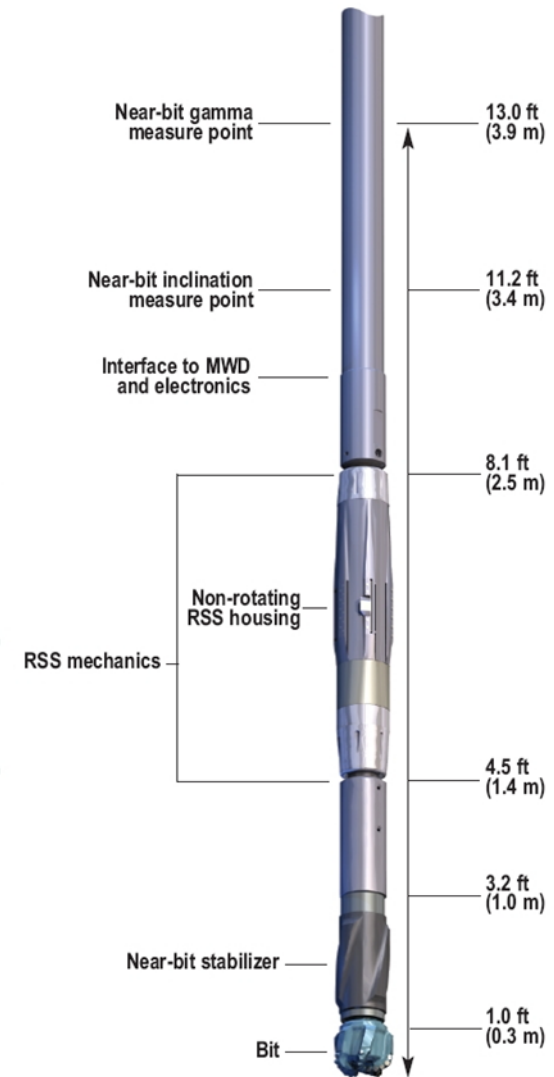
nicht rotierender äußerer Gehäuseteil  
Bohrstrang rotiert langsam



links: „AutoTrak“ (Copyright: Baker Hughes)

rechts: „RSS“ (Copyright: Weatherford)

Quelle: Jung & Sperber, 2009



# Resultate aus vergleichbaren Bohrprojekten im Ausland

## Azurite-Ölfeld in Vietnam (Granit)

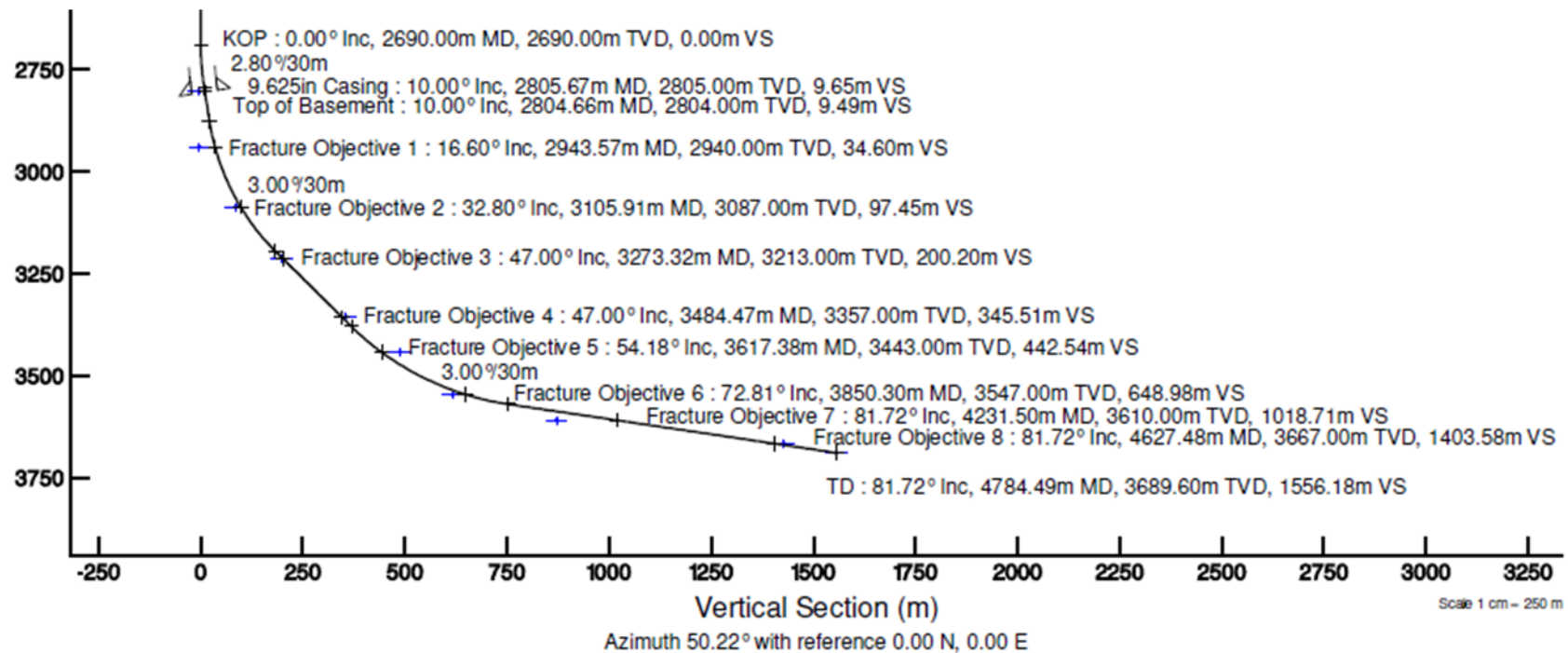


Abb.: Beispiel einer Horizontalbohrung im Granit im Azurite-Feld, Vietnam (SPE 122690)

Quelle: Jung & Sperber, 2009

# Besondere Herausforderungen

Lagerstättendruck & Gasgehalt

Richtbohren im Vulkanit

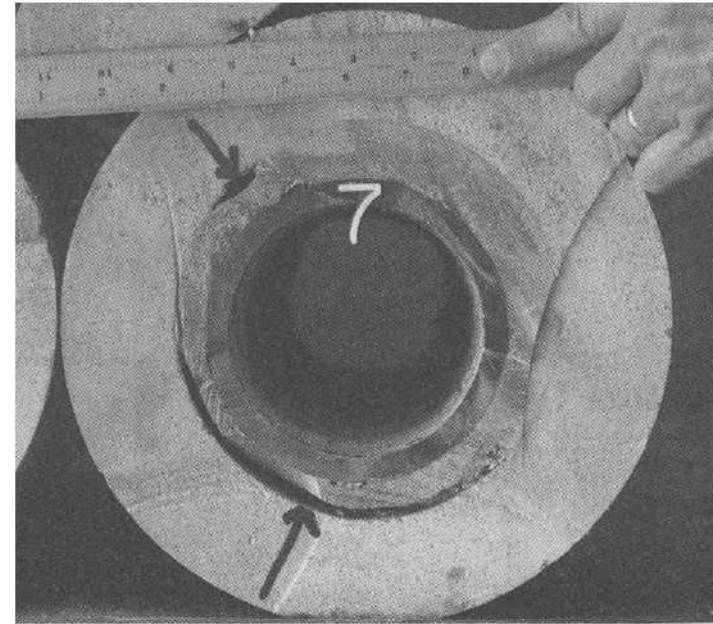
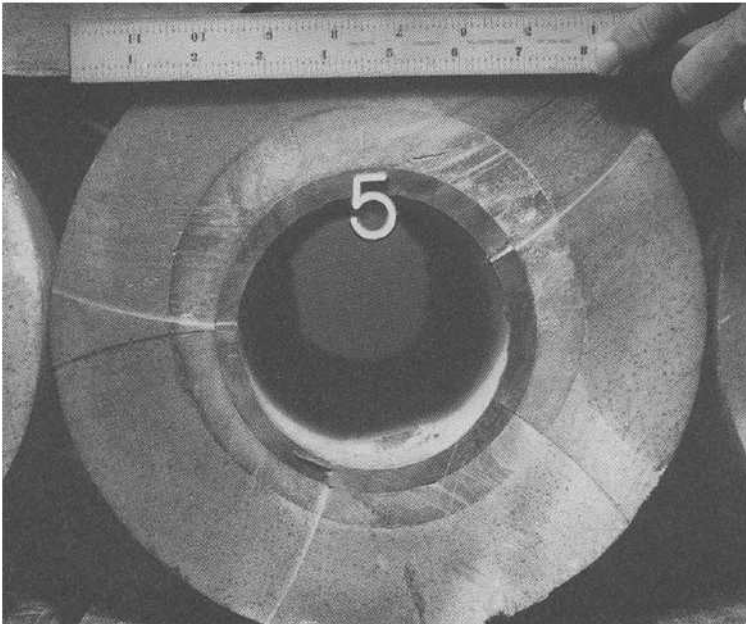
Zementation

Risserzeugung

Offenhalten der Risse

Parallelität der Risse

## Problem: Kanalbildung

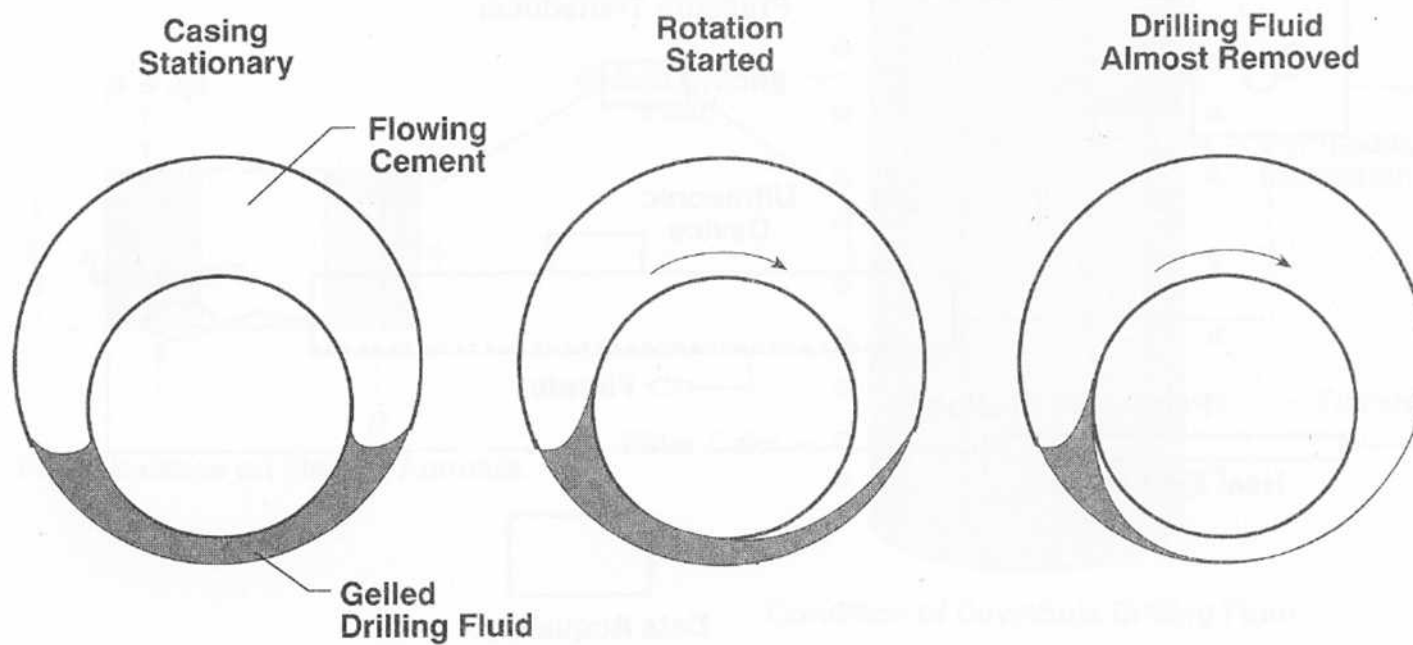


(Economides et al., 1998)

*Quelle: Jung & Sperber, 2009*

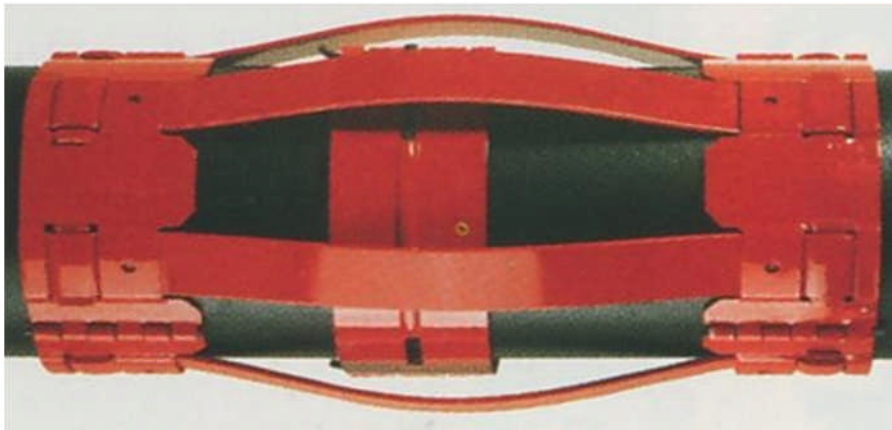
Gegenmaßnahmen:

1. Rotation und Rückziehen des Gestänges beim Zementieren



Einfluss der Strangrotation auf die Spülungsverdrängung im Ringraum (Economides et al., 1998)

## 2. Gute Zentrierung der Verrohrung



Centraliser mit Stahlfederbögen  
(Copyright: Weatherford)



„Spiraglider“  
(Copyright: Weatherford)



# Besondere Herausforderungen

Lagerstättendruck & Gasgehalt

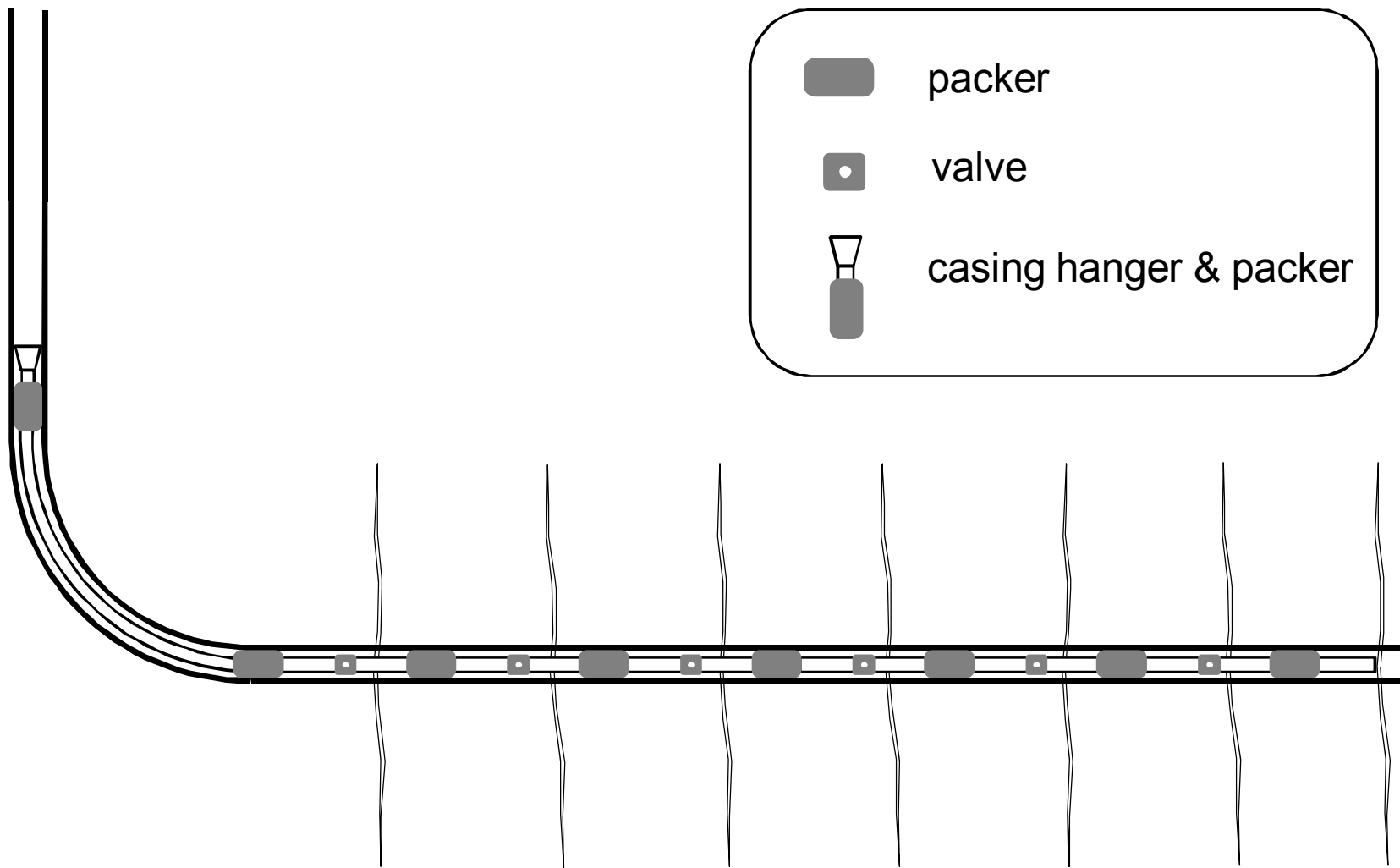
Richtbohren im Vulkanit

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30 Abschnitte  
160 °C

# Besondere Herausforderungen

Lagerstättendruck & Gasgehalt

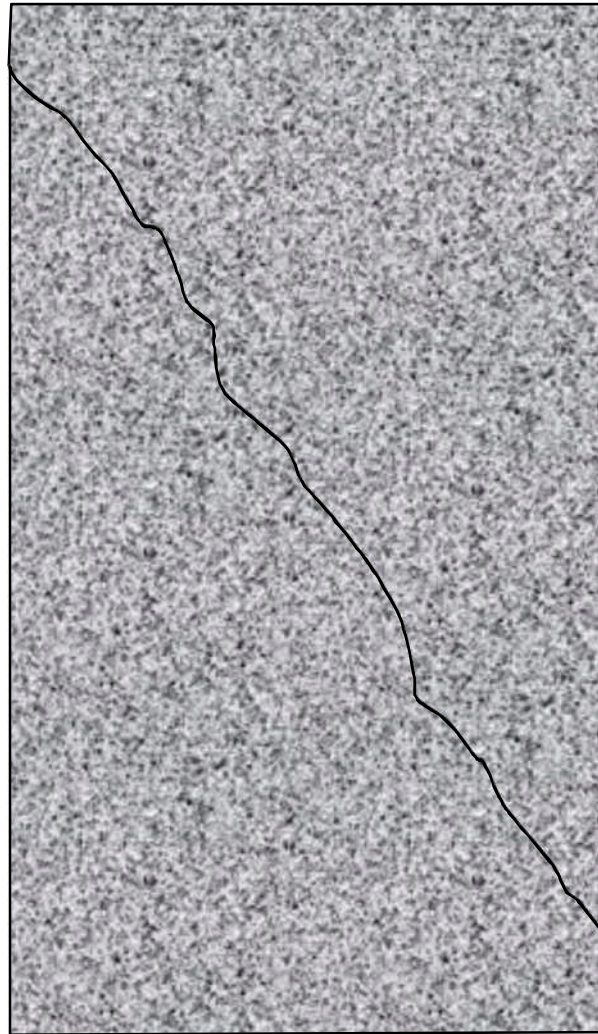
Richtbohren im Vulkanit

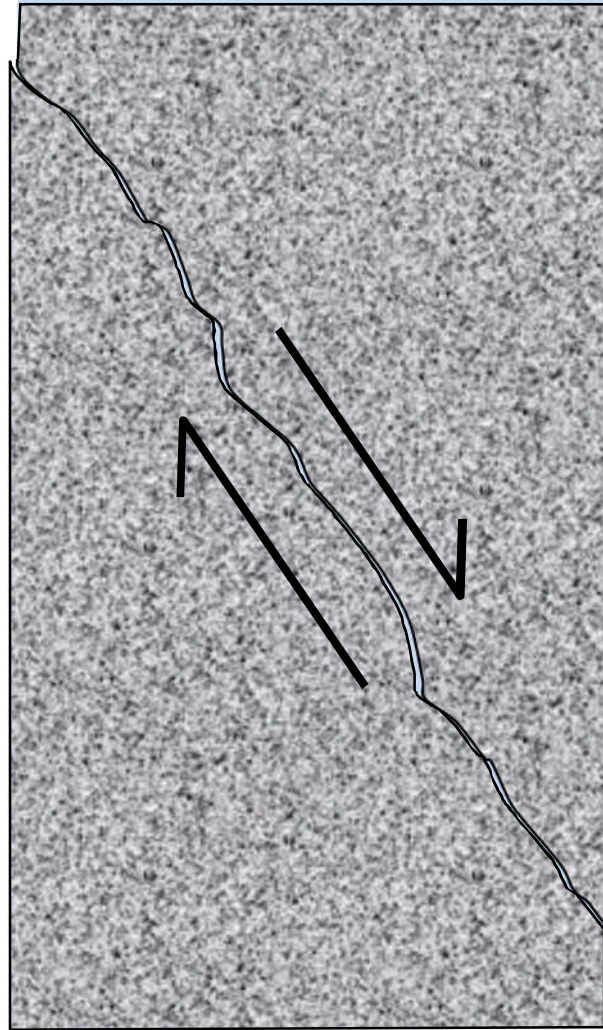
Zementation

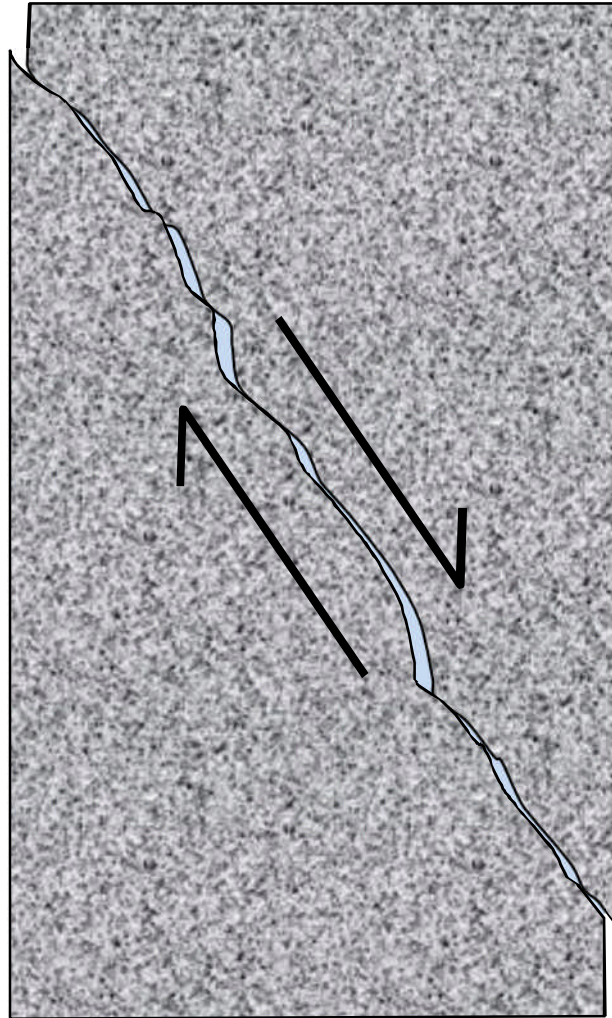
Risserzeugung

Offenhalten der Risse

Parallelität der Risse







Transmissibilität

selbstgestützte Fracs:

$$T_f > 1 \text{ D}\cdot\text{m}$$

Stützmittel-Fracs

$$T_f < 1 \text{ D}\cdot\text{m}$$

# Besondere Herausforderungen

Lagerstättendruck & Gasgehalt

Richtbohren im Vulkanit

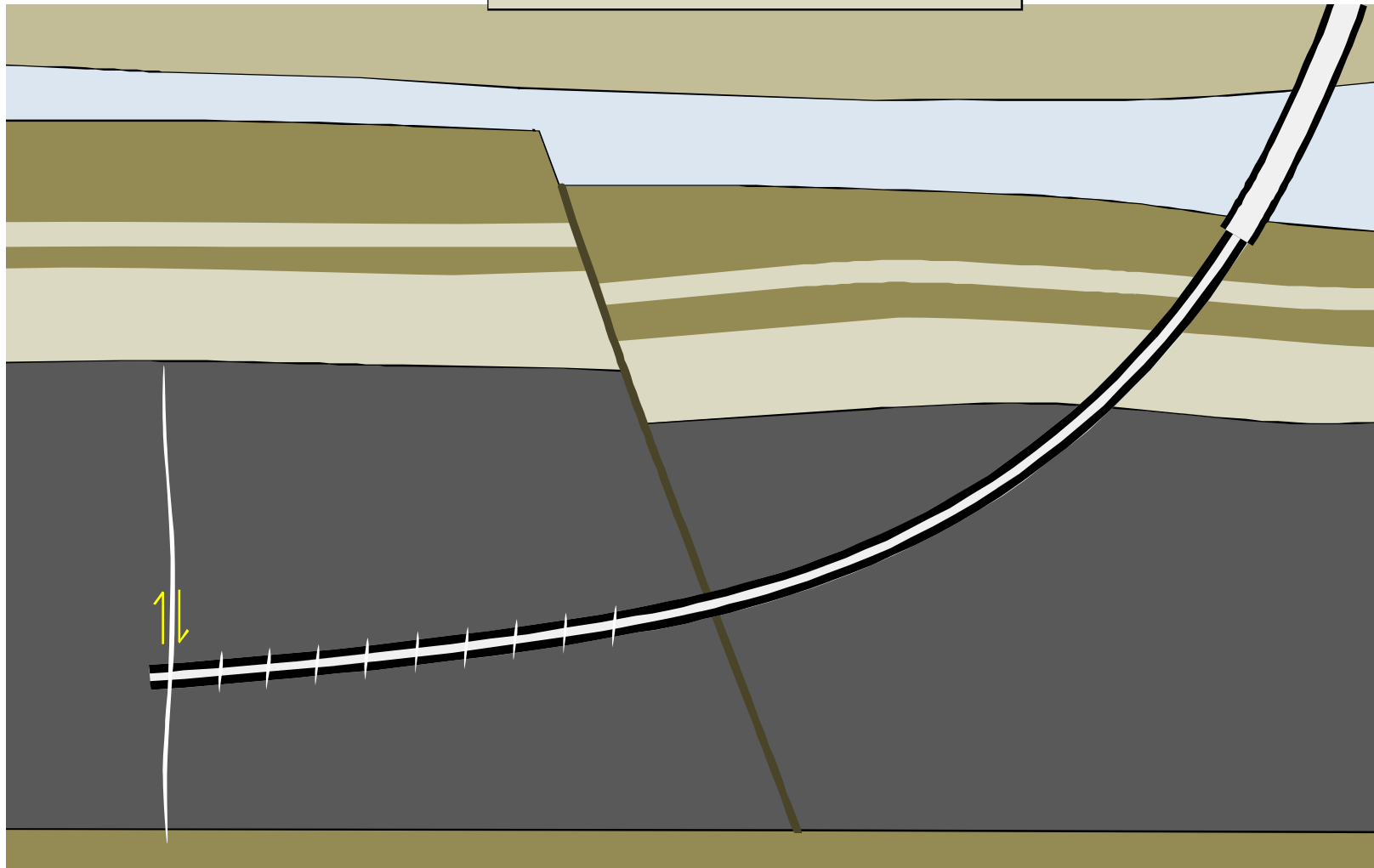
Zementation

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Offenhalten der Risse

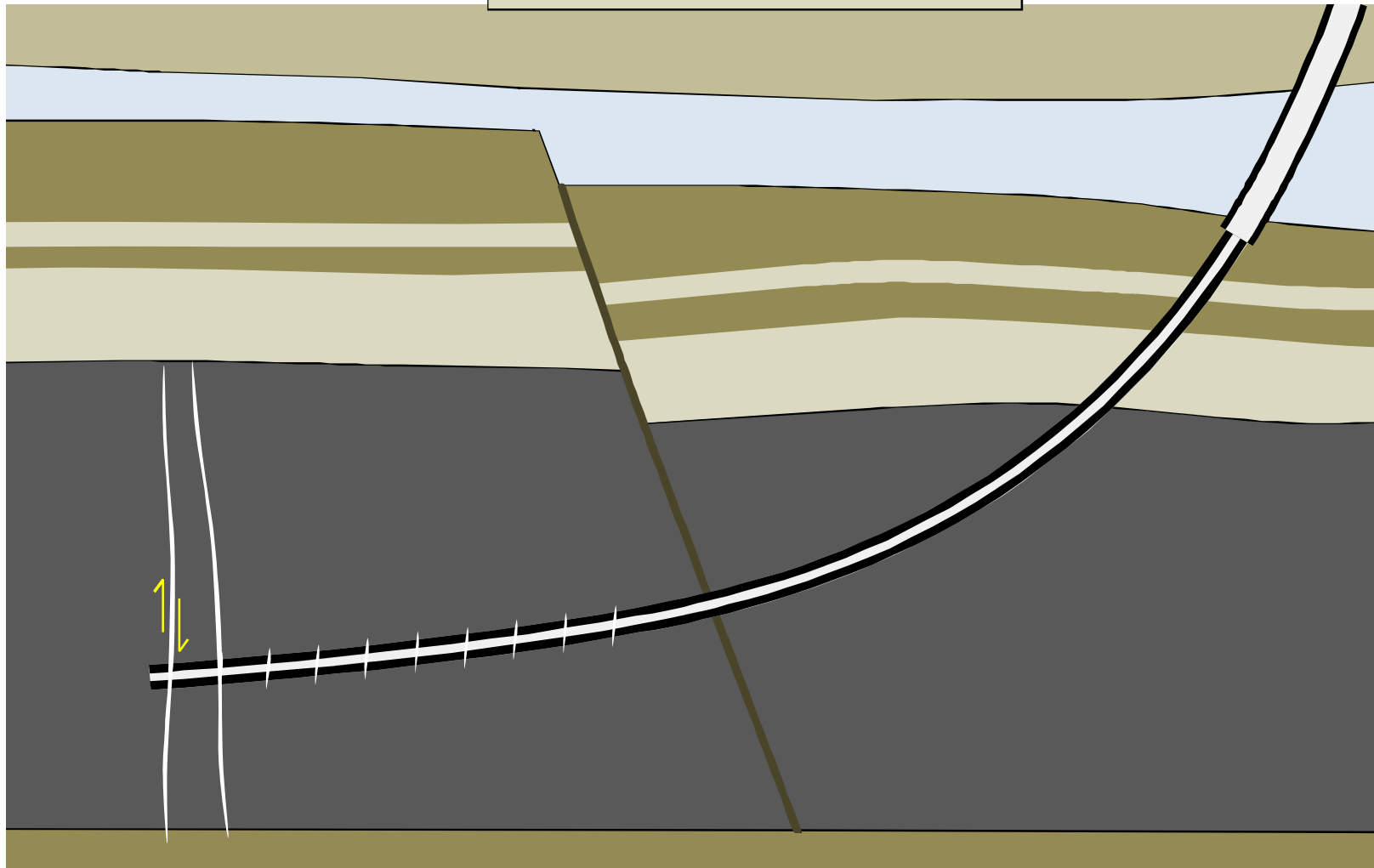
Parallelität der Risse

## Frac-Tests

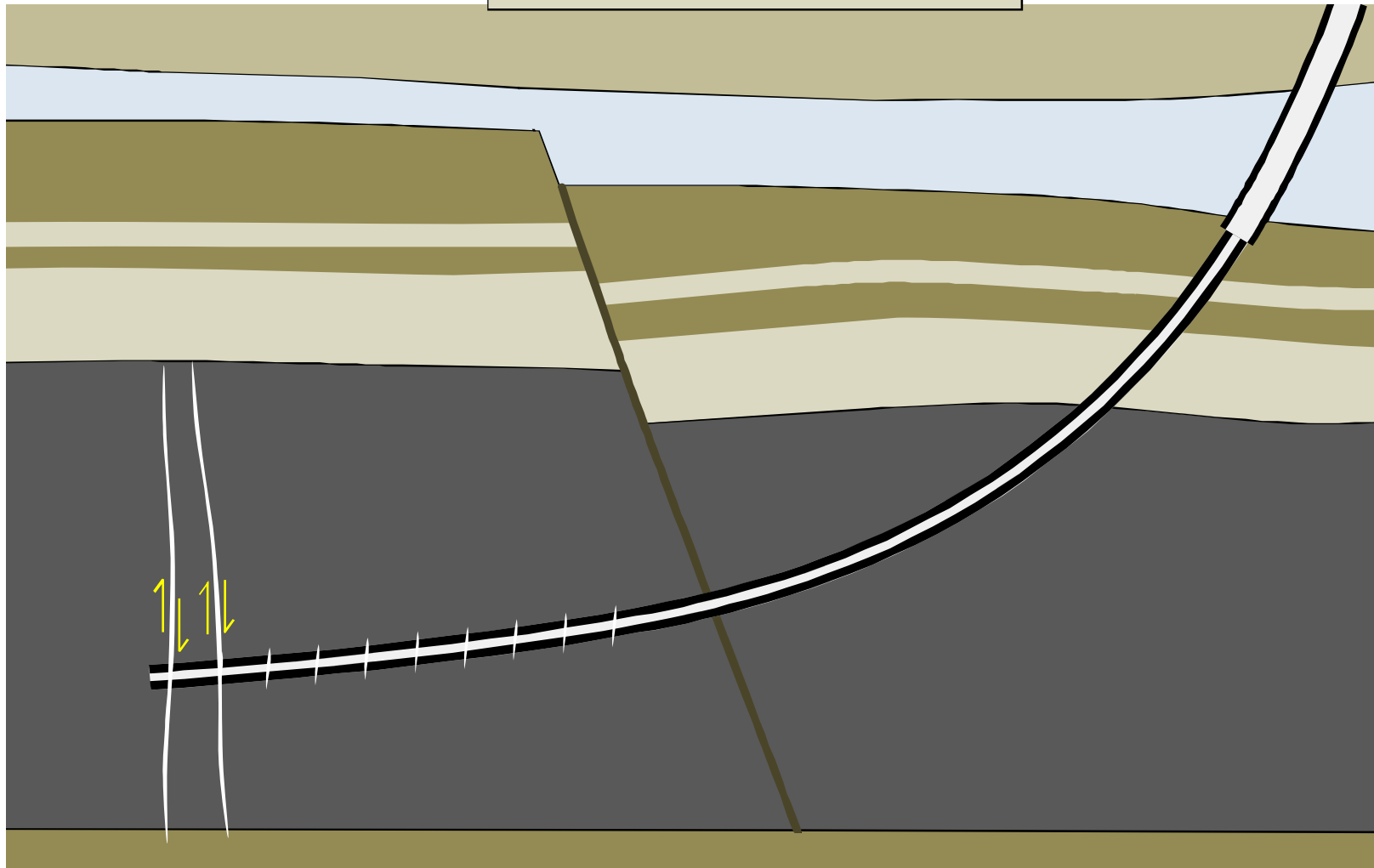




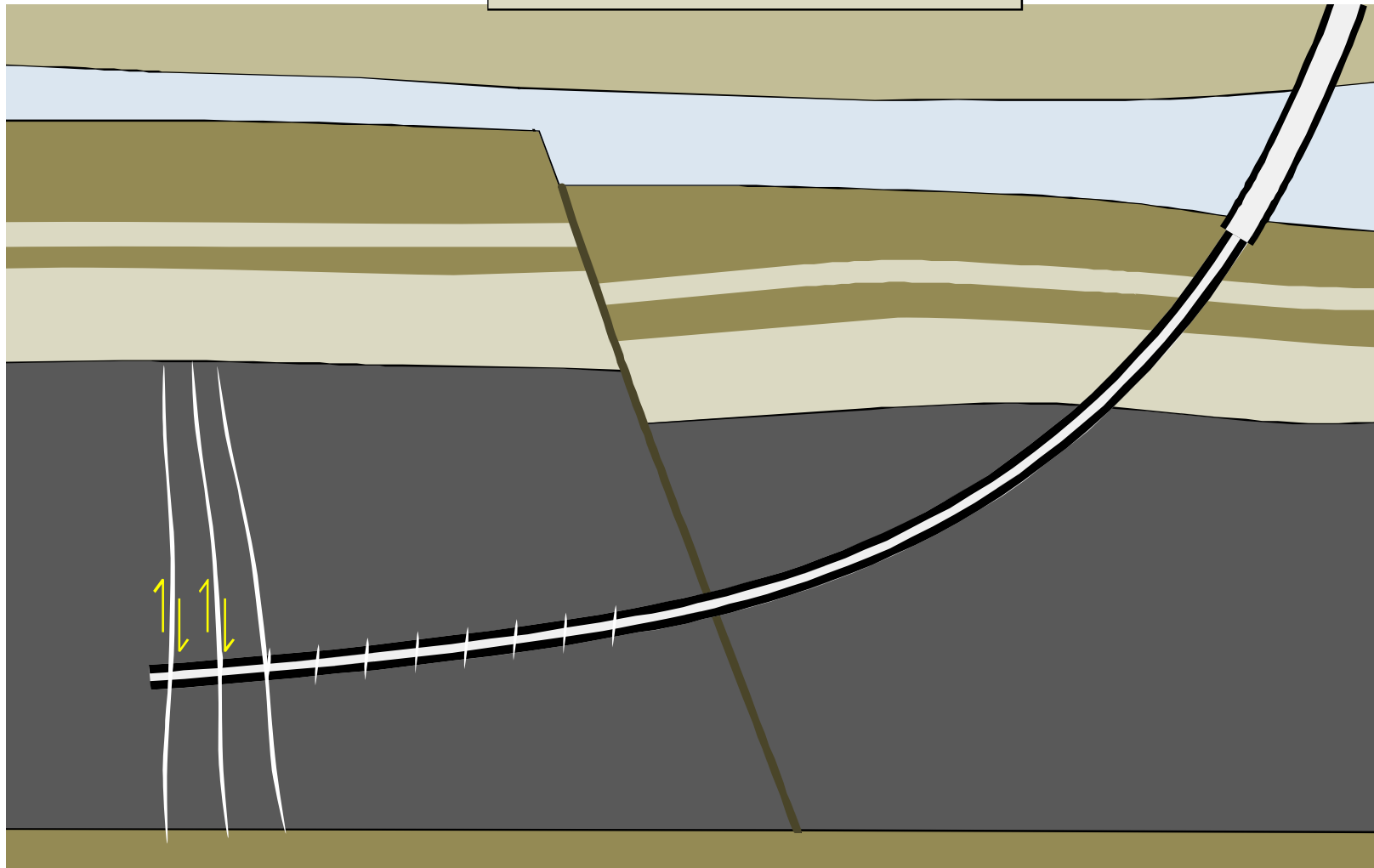
## Frac-Tests



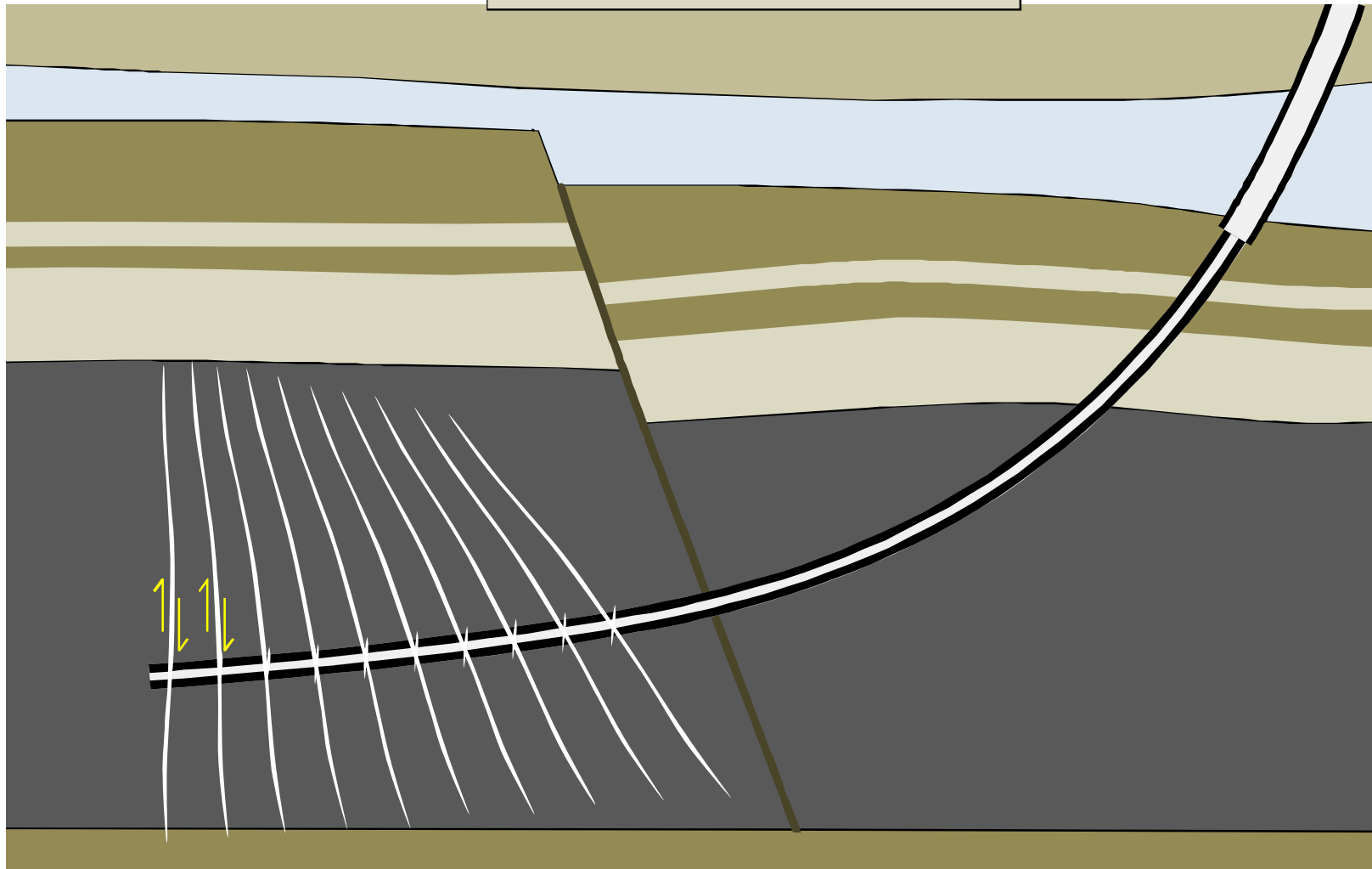
## Frac-Tests



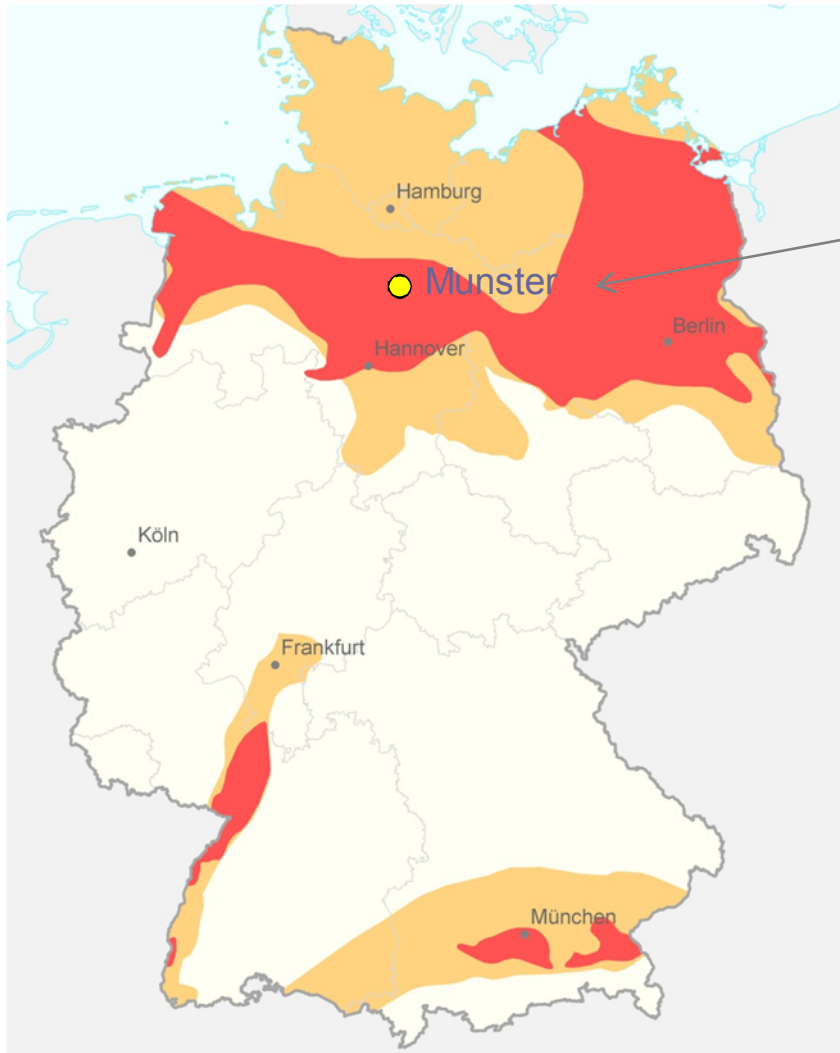
## Frac-Tests



## Frac-Tests



# Ausblick



Rotliegend Sandsteine ( $T > 100 \text{ }^\circ\text{C}$ )

Strompotenzial: 7 EJ

Wärmepotenzial: 90 EJ

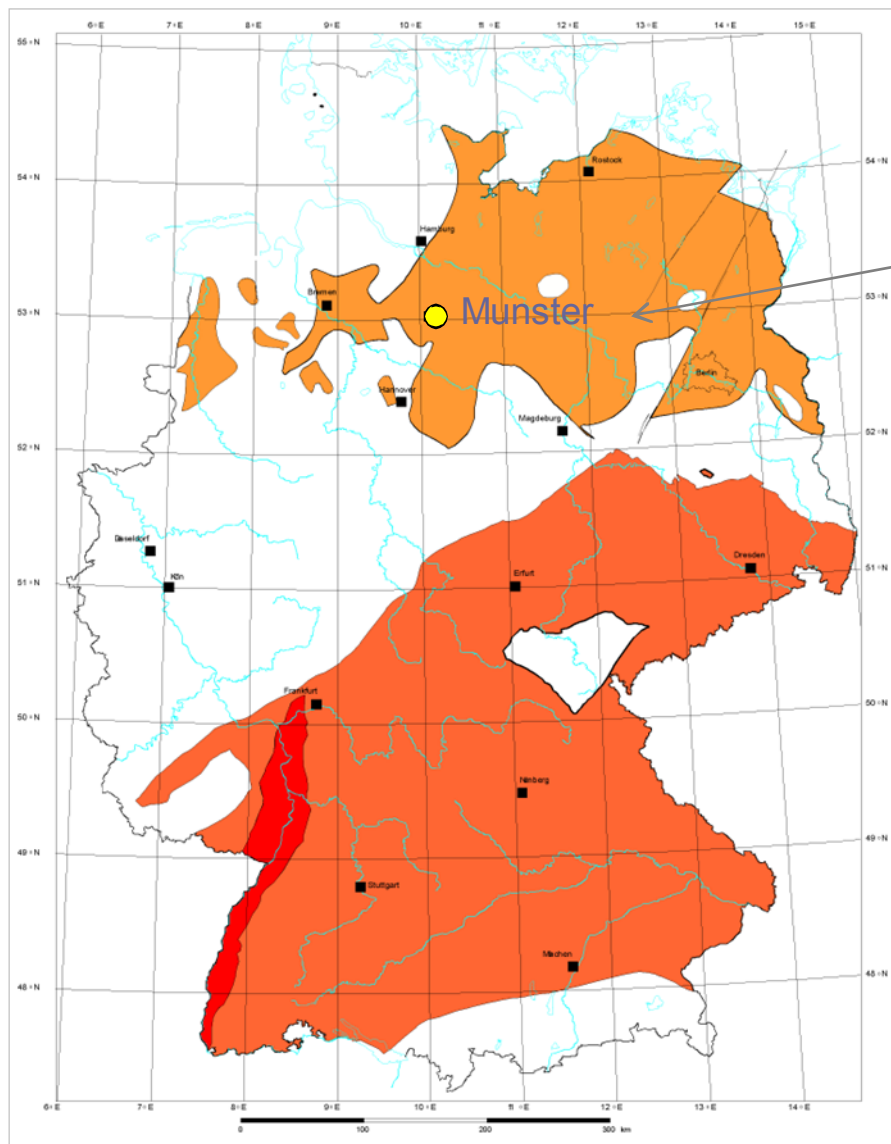
KW-Reserven De: 6 EJ

nach LBEG 2012

Jahreswärmebedarf De: 5 EJ

Jahresstrombedarf De: 2 EJ

Quelle: LIAG-Hannover



Rotliegend Vulkanite ( $T > 100\text{ °C}$ )

Strompotenzial: 66 EJ

Wärmepotenzial: 700 EJ

KW-Reserven De: 6 EJ

nach LBEG 2012

Jahreswärmebedarf De: 5 EJ

Jahresstrombedarf De: 2 EJ

Quelle: Jung et al., 2002