

Nedmag TR2 brine leakage study

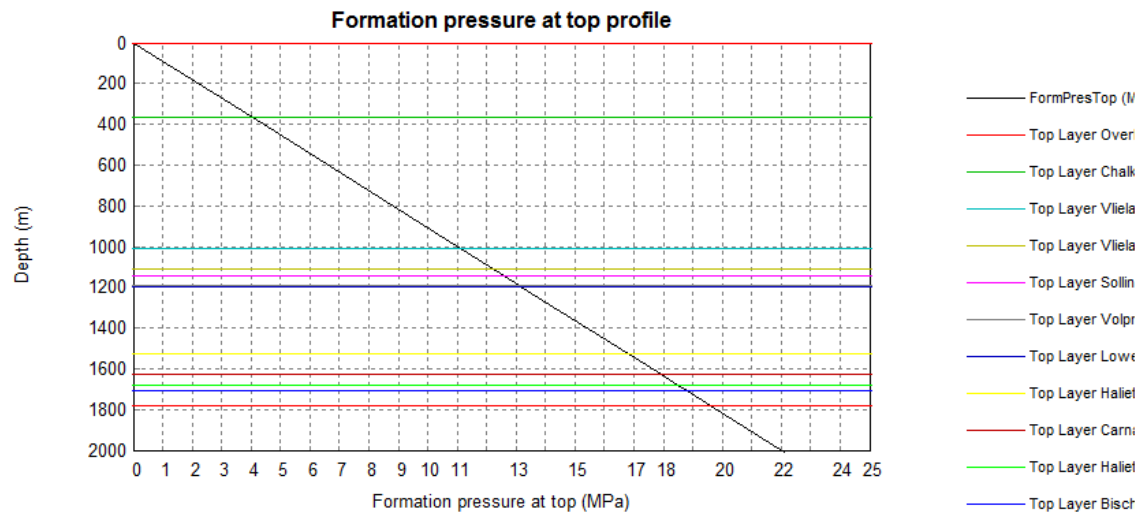


Panterra Geoconsultants

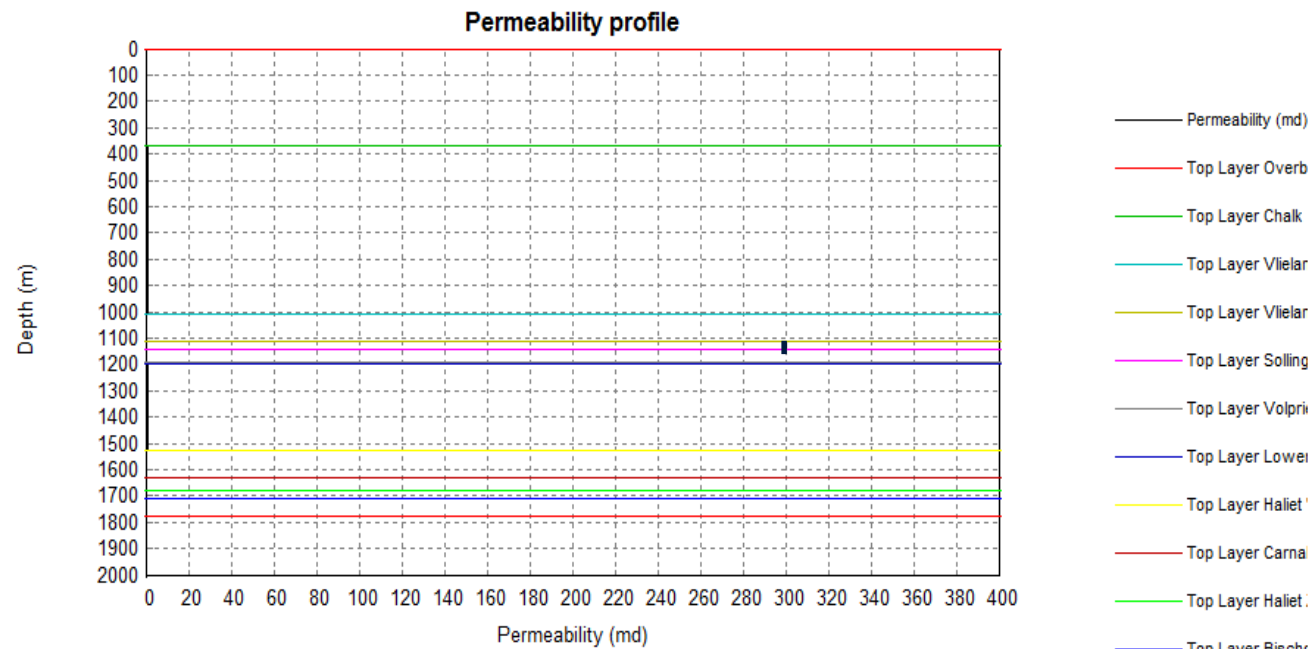
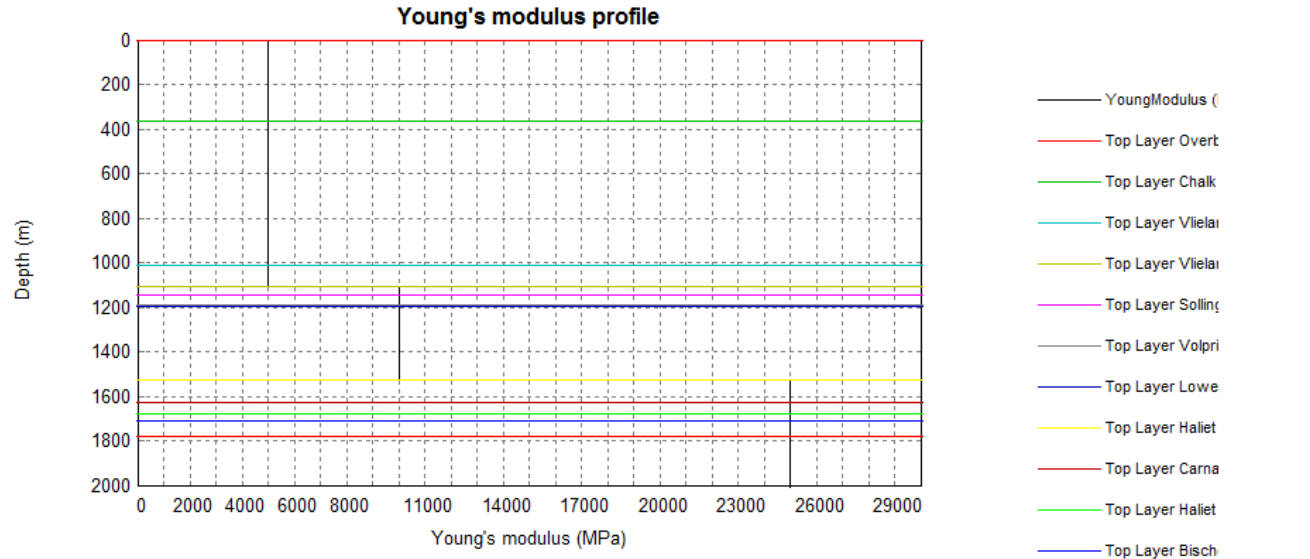
Scope of Work

- Carry out fracture propagation study in order to improve understanding of what happened during leakage event on 20 April 2018

Layers in the model

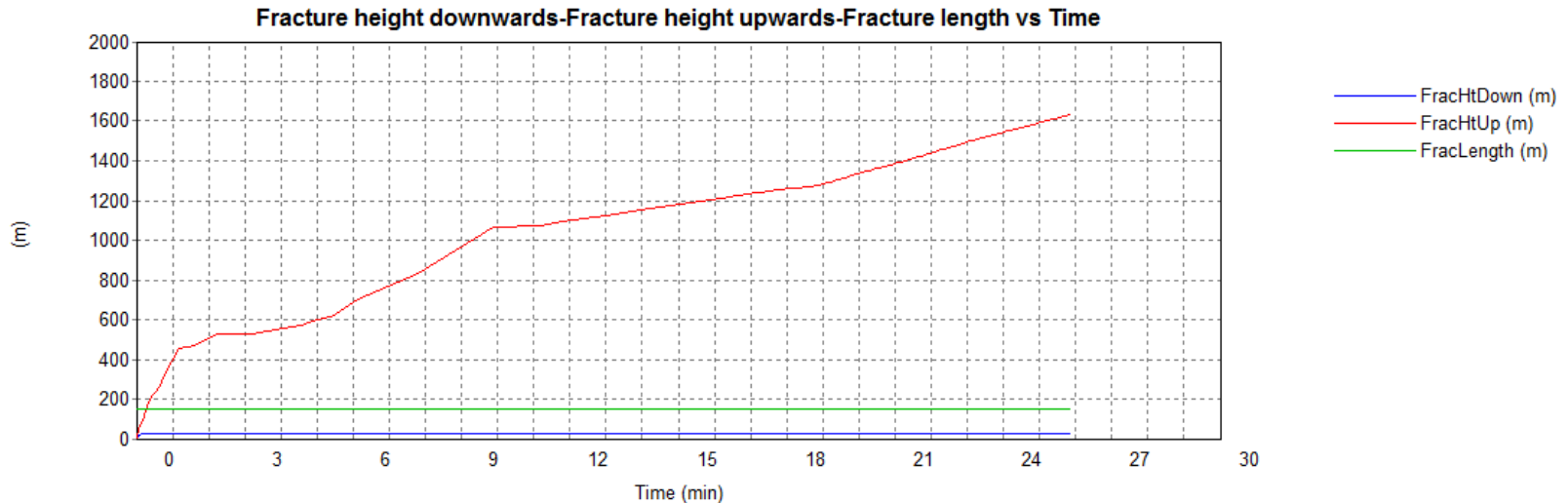
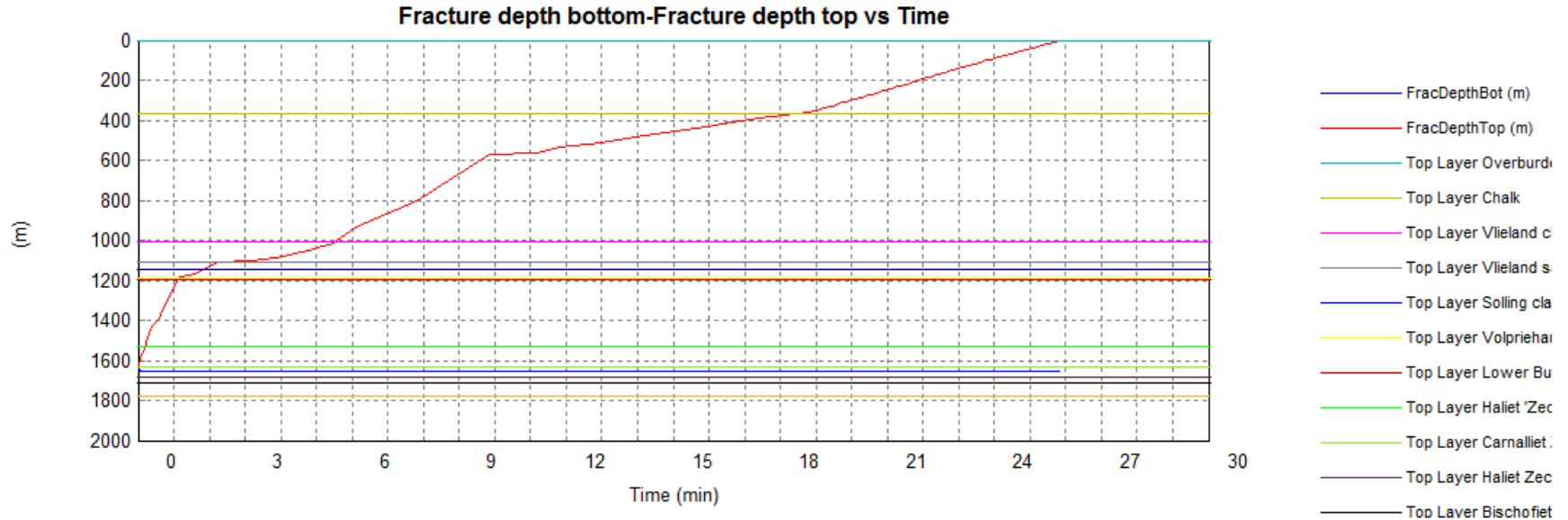


Layers in the model



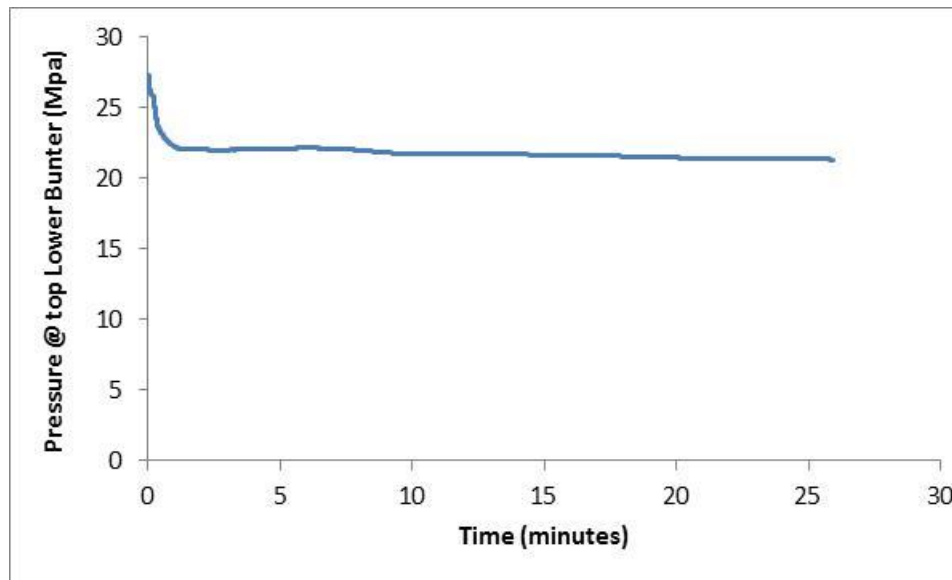
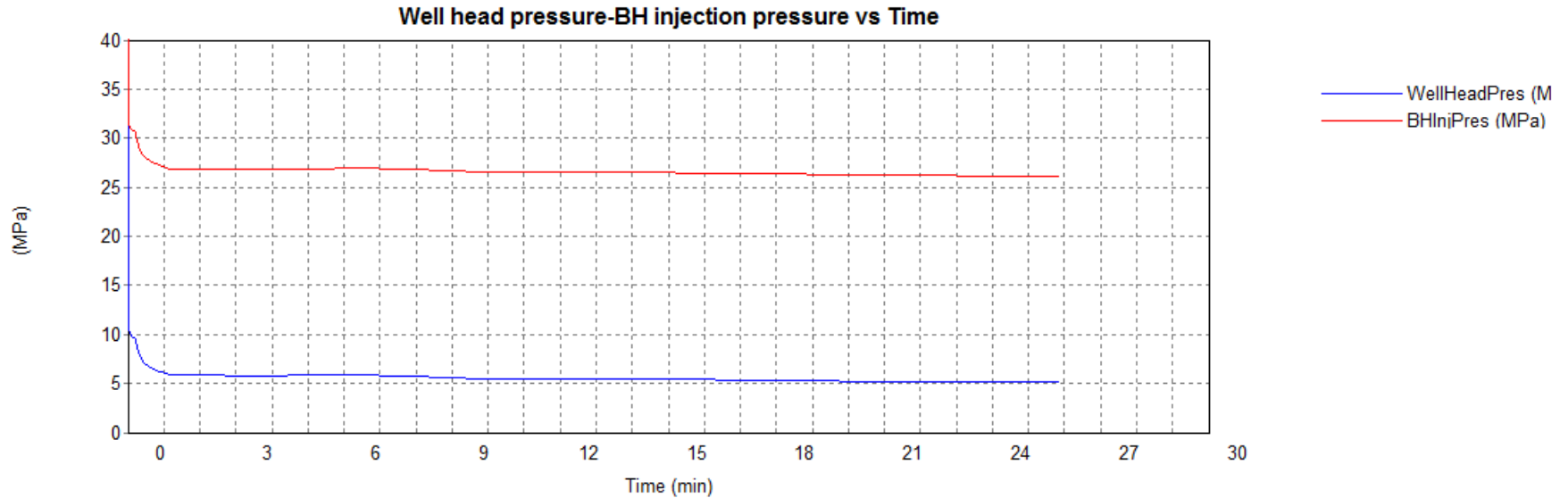
Base case $k_{Vlieland} = 300 \text{ mD}$

First injection cycle @ 1,2 million m³/d



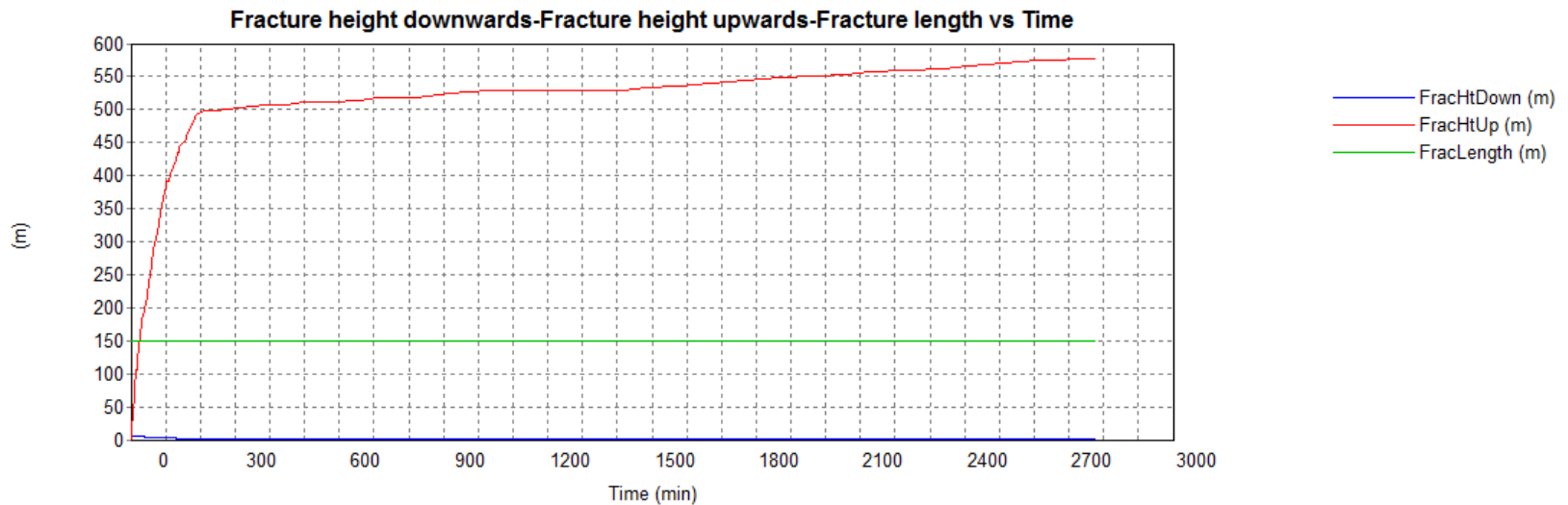
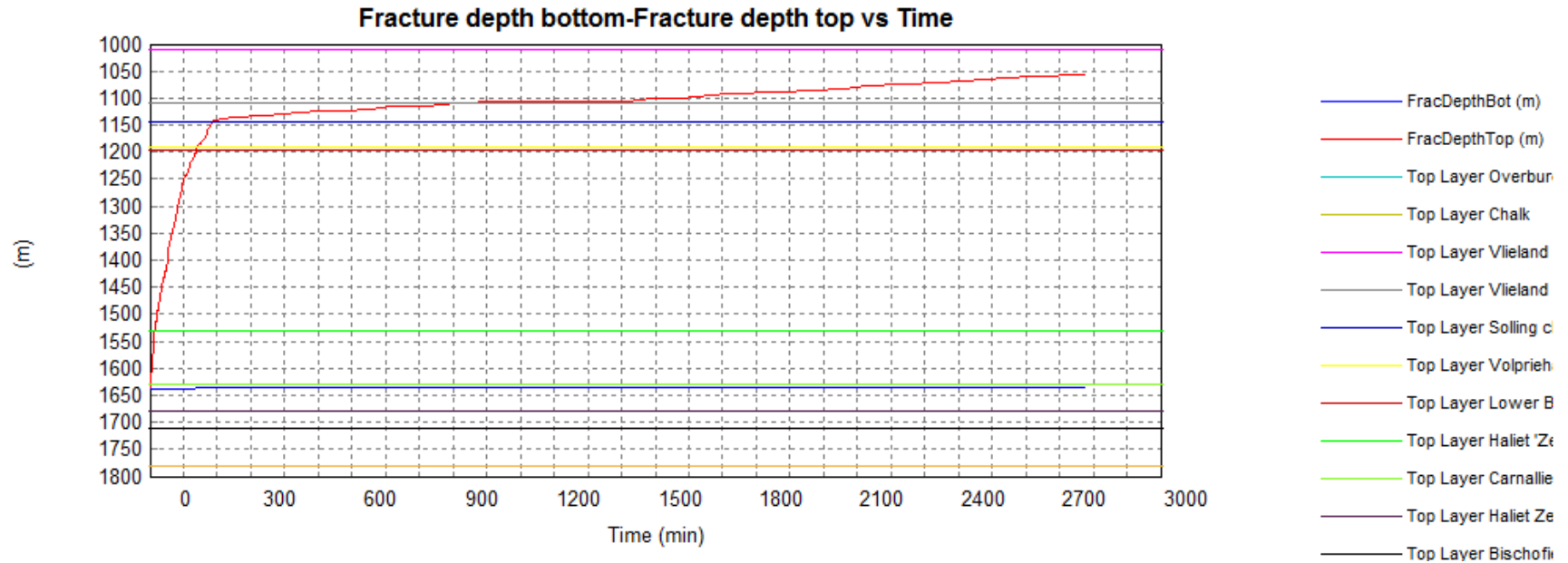
Base case $k_{Vlieland} = 300 \text{ mD}$

First injection cycle @ 1,2 million m³/d



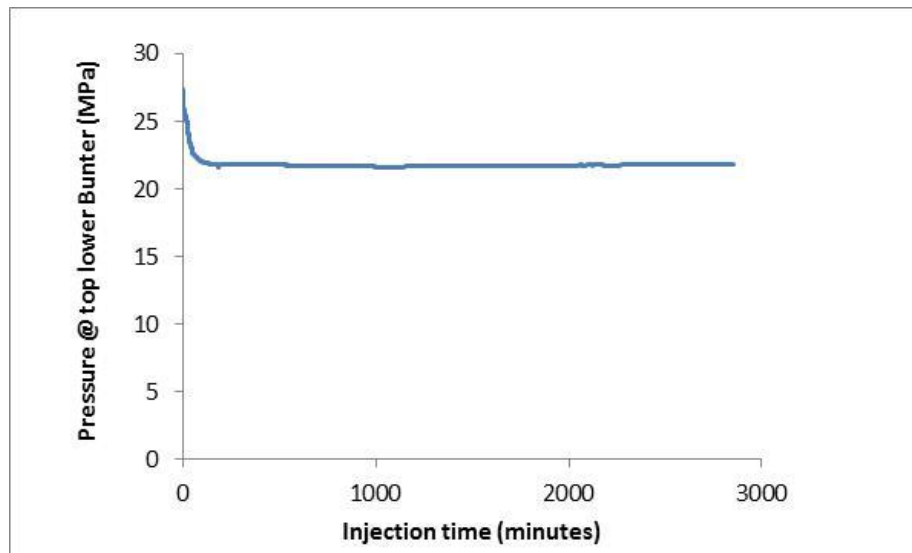
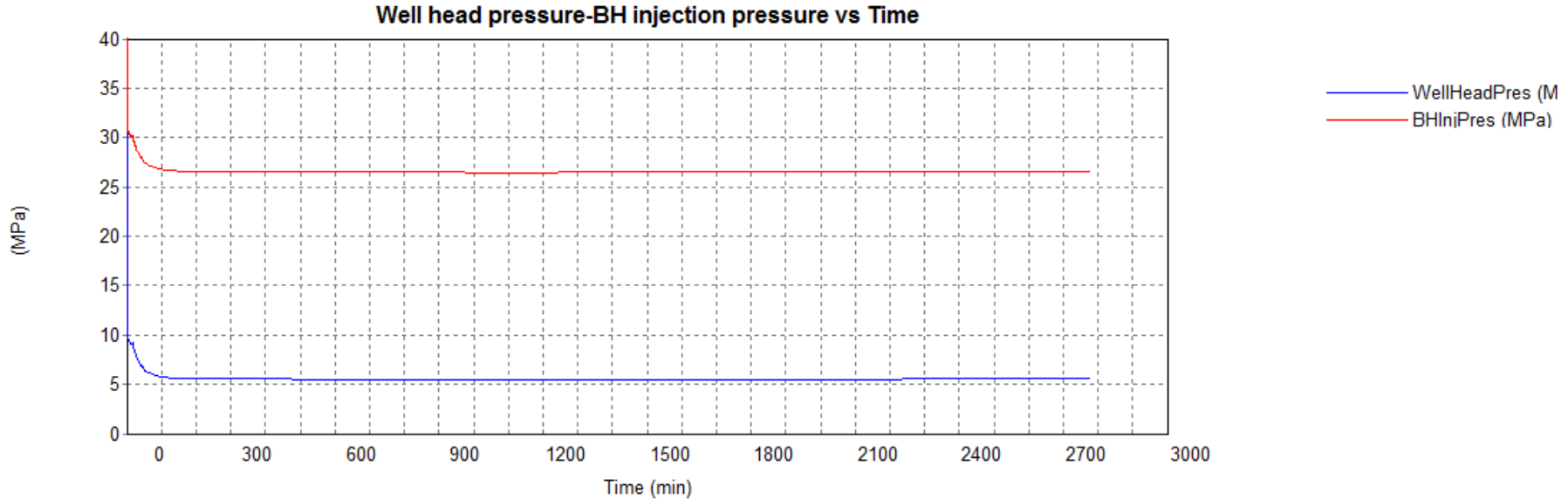
Base case $k_{Vlieland} = 300$ mD

Second injection cycle @ 25200 m³/d for 47,5 hours



Base case $k_{Vlieland} = 300 \text{ mD}$

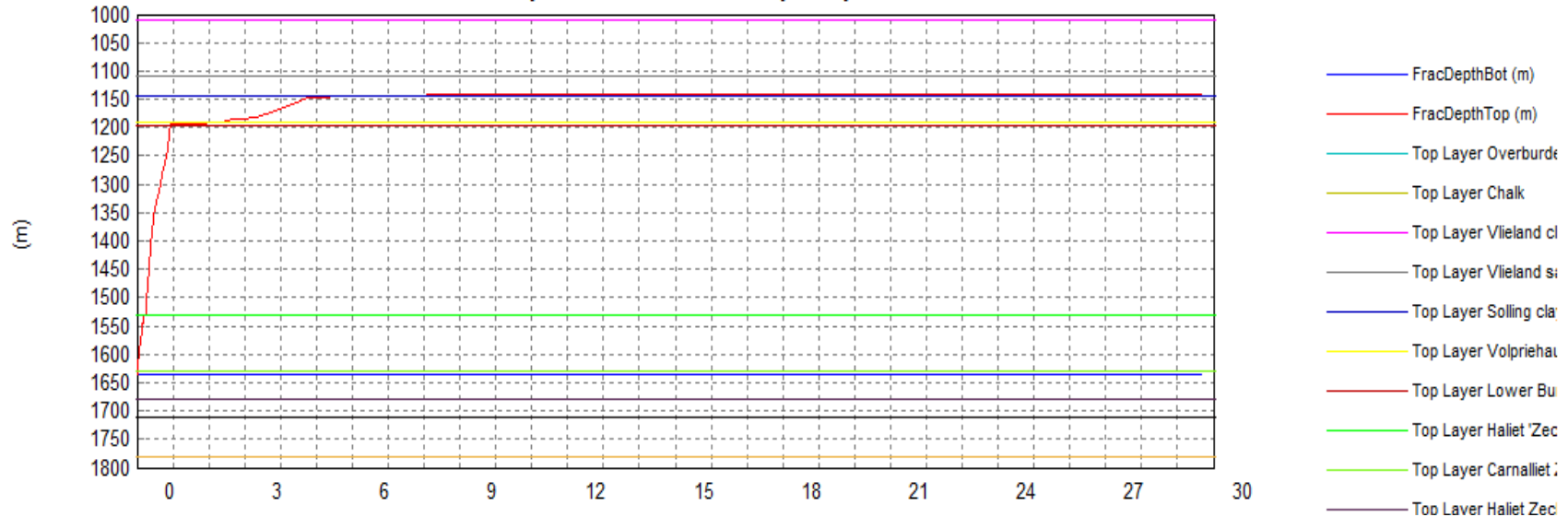
Second injection cycle @ 25200 m³/d for 47,5 hours



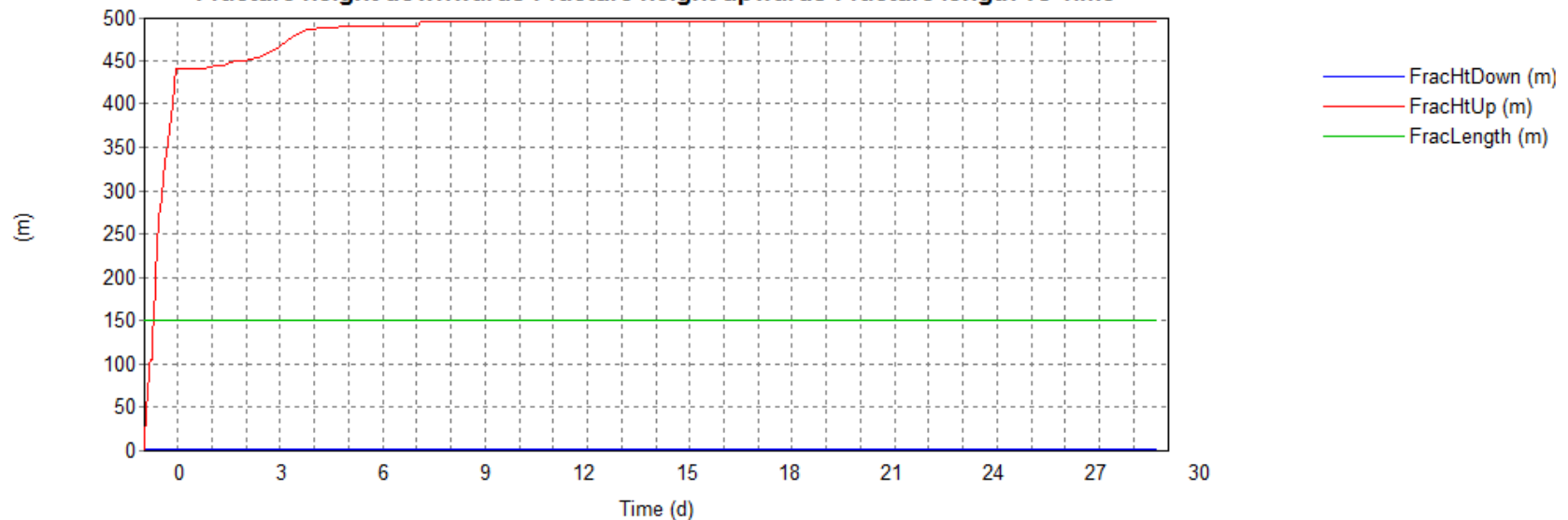
Base case $k_{Vlieland} = 300 \text{ mD}$

Third injection cycle @ 2400 m³/d for one month

Fracture depth bottom-Fracture depth top vs Time

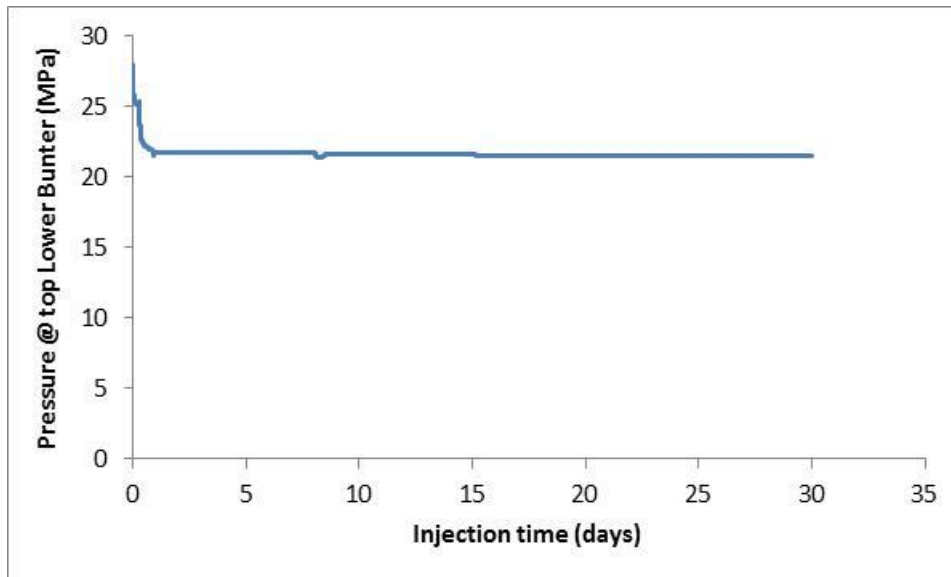
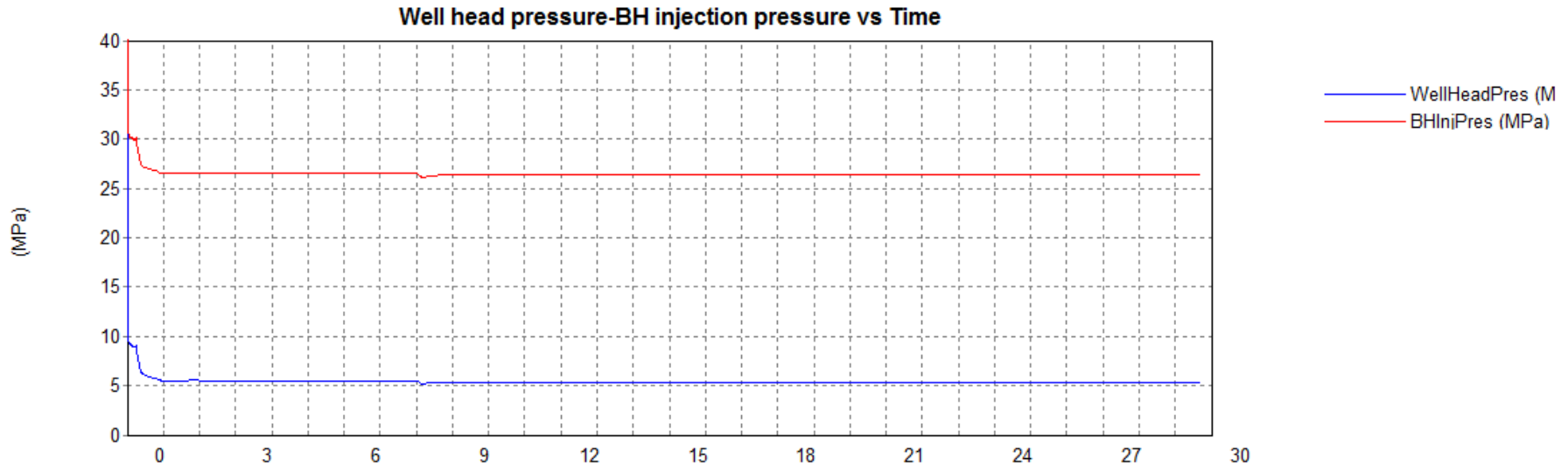


Fracture height downwards-Fracture height upwards-Fracture length vs Time



Base case $k_{Vlieland} = 300 \text{ mD}$

Third injection cycle @ 2400 m³/d for one month



Voorlopige conclusies

- Eenvoudig geologisch model
- Data van Nedmag + schattingen (correlaties, 'ballpark figures')
- Waargenomen trends in injectie THP kunnen redelijk gereproduceerd worden
- Fracture (non-)containment hangt essentieel af van de injection rate en de permeabiliteit(en) in de bovenliggende lagen:
 - *Heel hoge injection rate (1e half uur) & lage permeabiliteit: geen containment*
 - *Heel hoge injection rate (1e half uur) & hoge permeabiliteit: wel containment*
- Voor midden-waardes (rond 25000 m³/d) gedurende 2 dagen na het begin en lage waardes (2400 m³/d) van de injection rate is er altijd containment.
- Bovenstaand is kwalitatief in lijn met veldobservaties elders (bijv. Tordis)
- Verklaring: wanneer de injection rate midden tot laag is, is er voldoende weglek-capaciteit in de overburden-lagen en krijgt de fracture niet de 'kans' om naar de oppervlakte te groeien
- Wanneer de injection rate (erg) hoog is, kan de geïnjecteerde pekkel niet snel genoeg weglekken. Je krijgt dan een situatie die je kunt vergelijken met een ondergrondse 'explosie' of 'blow-out'.
- Gebaseerd op de geologische gegevens die nu bekend zijn (globale NW-ZO richting voor de maximum horizontale in-situ spanning), is de verwachting dat de frac groeit in een verticaal vlak in NW-ZO richting.