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Pressure modelling in the Hammerfest Basin

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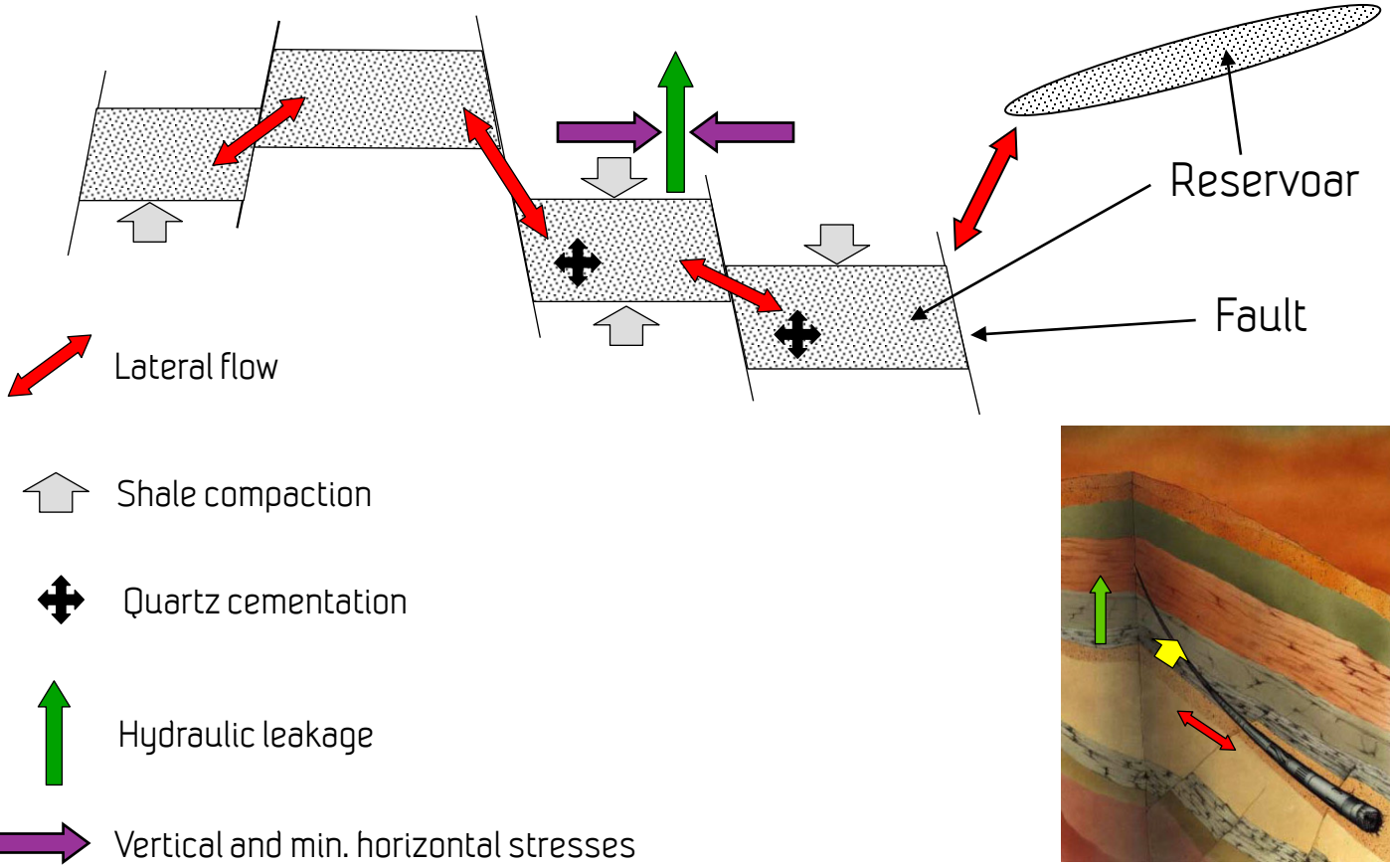
Outline

- Aim: Calculate water fluid pressure in 3D on basin scale
- Methods used: Pressim software
- Study area: Hammerfest Basin
- Results:
  - Pressure distribution maps
  - Pressure vs. time in the Snøhvit area
- Preliminary conclusions
- Further work

pressim

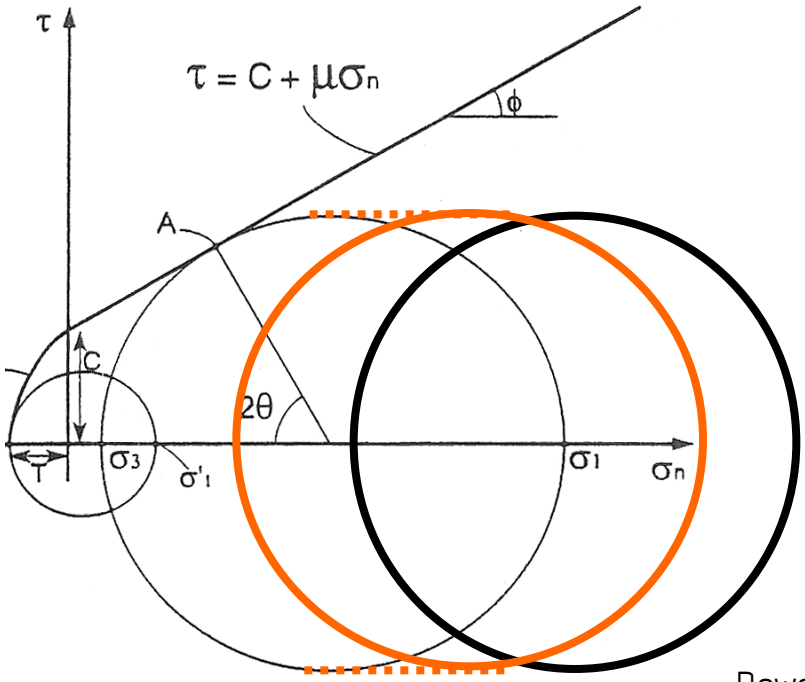


Pressim models all processes for pressure generation and dissipation – *unique features related to modelling of 3D fluid flow*

Failure criteria

Combined Griffith-Coulomb failure criteria

Use a composite failure envelope, which is parabolic in the tensile regime (Griffith) and a straight line in the compressive regime (Coulomb).



High overpressure

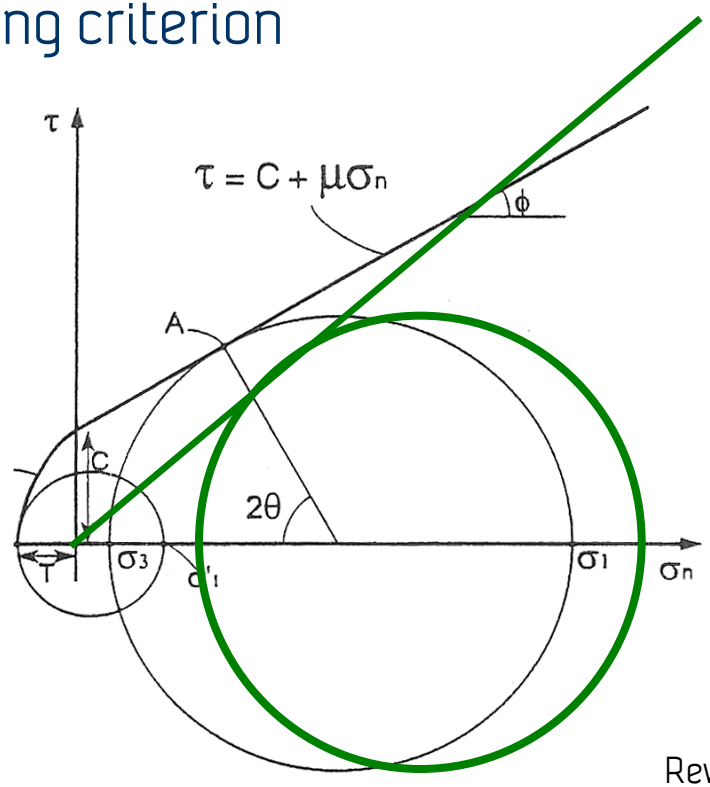
Reworked from Cosgrove (1998)

Failure criteria

- Combined Griffith-Coulomb failure criteria

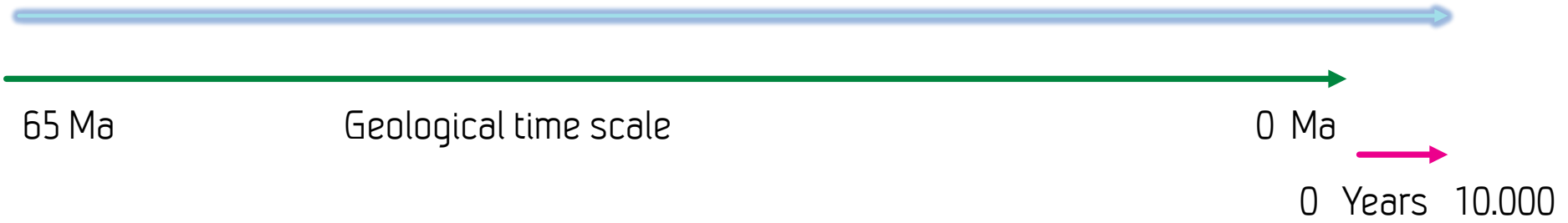
Use a composite failure envelope, which is parabolic in the tensile regime (Griffith) and a straight line in the compressive regime (Coulomb)

- Use frictional sliding criterion



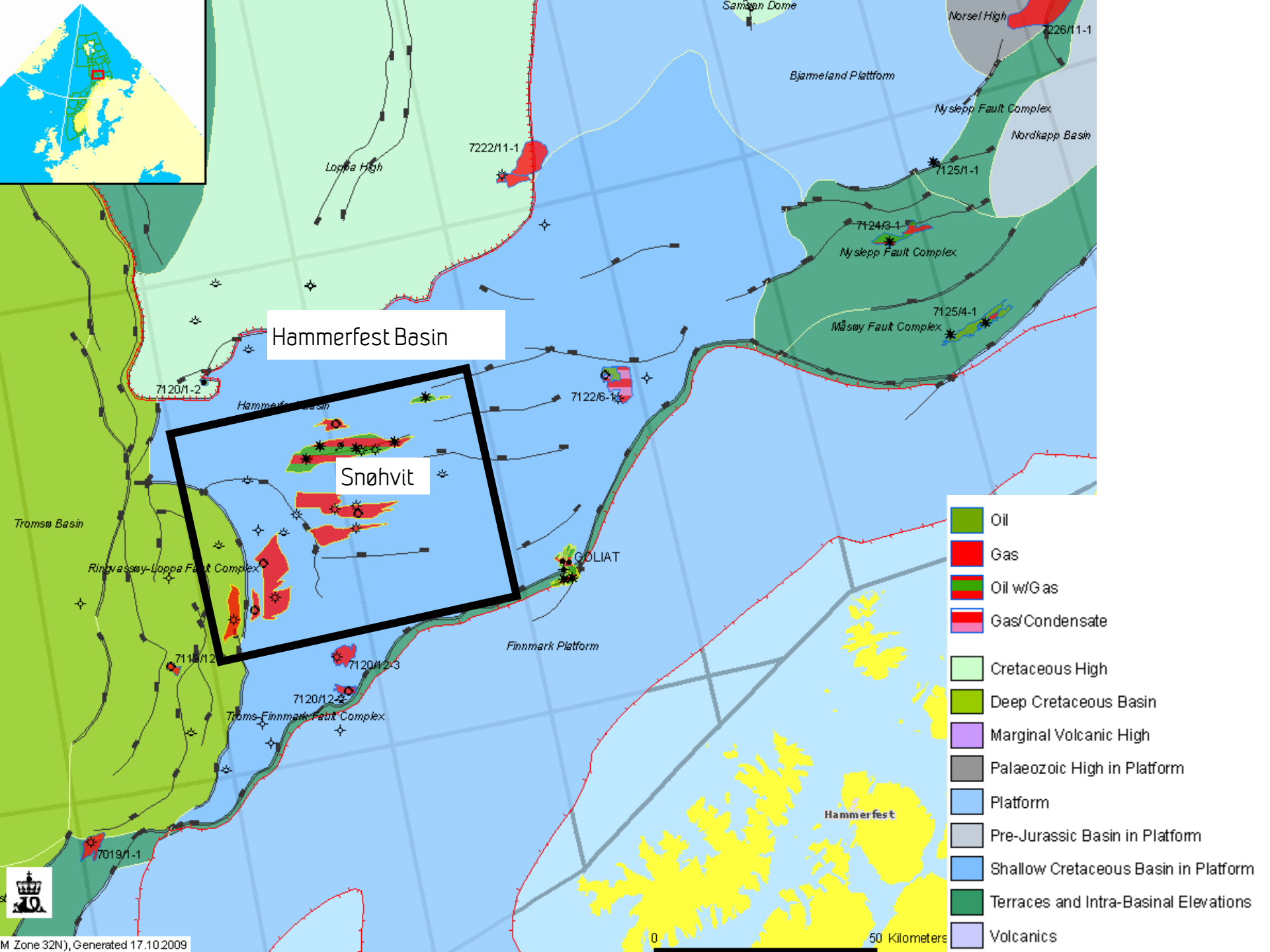
Reworked from Cosgrove (1998)

Simulate water fluid pressure on…

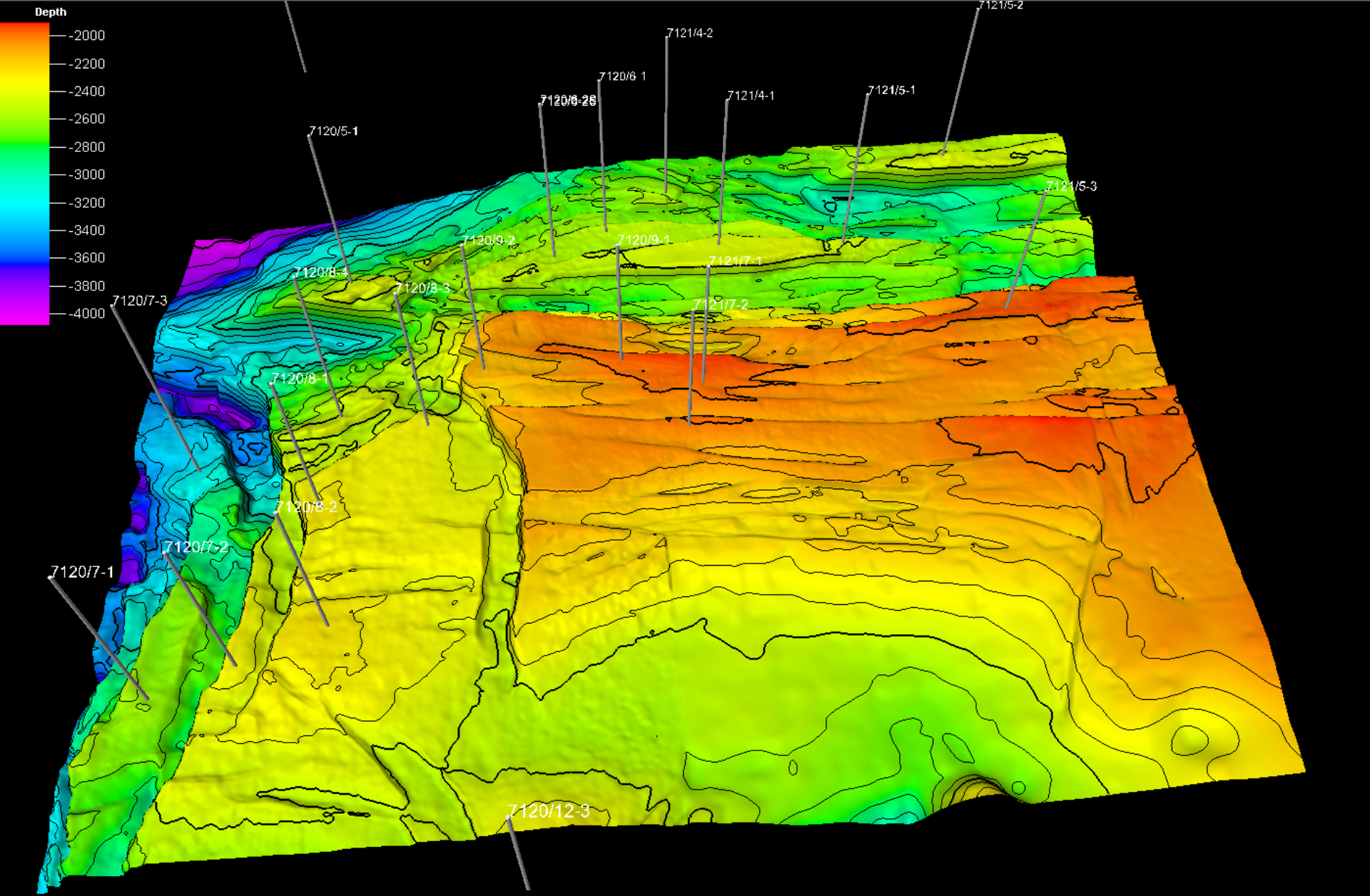


- Use decompacted maps and run forward modelling with burial history, uplift and erosion
- Simulate pressure generation and dissipiation
- Calculate fluid flow every 1000 years
- Calculate hydraulic fracturing and leakage
- Faults are very important!

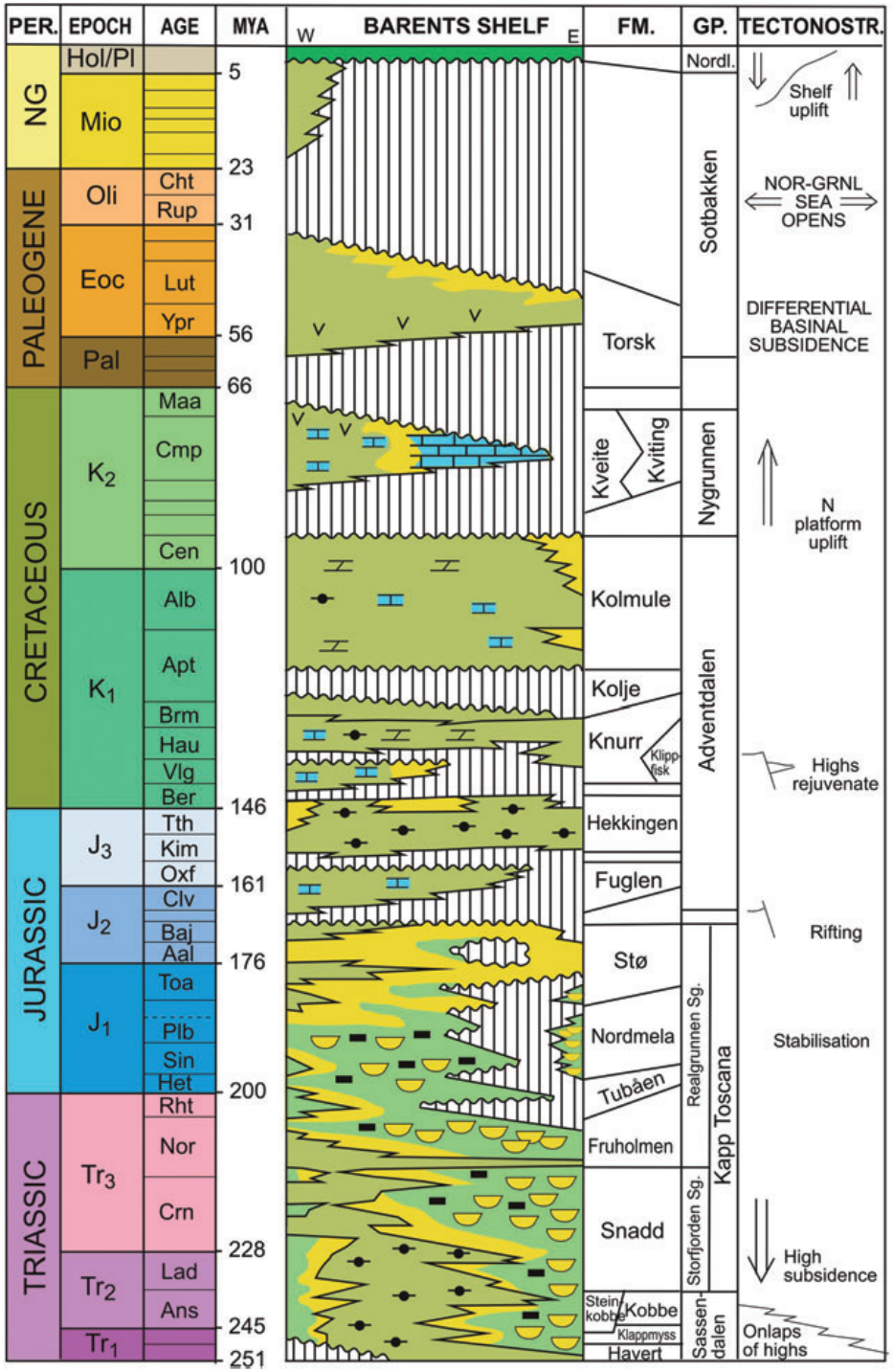
- Use present geomodel with quartz cementation and pressure developed over geological time scale
- No generation due to mechanical burial is assumed
- The major faults will act as barriers to flow
- CO_2 will be injected (localized pressure build-up)
- Potential pressure dissipation through fractures will be simulated



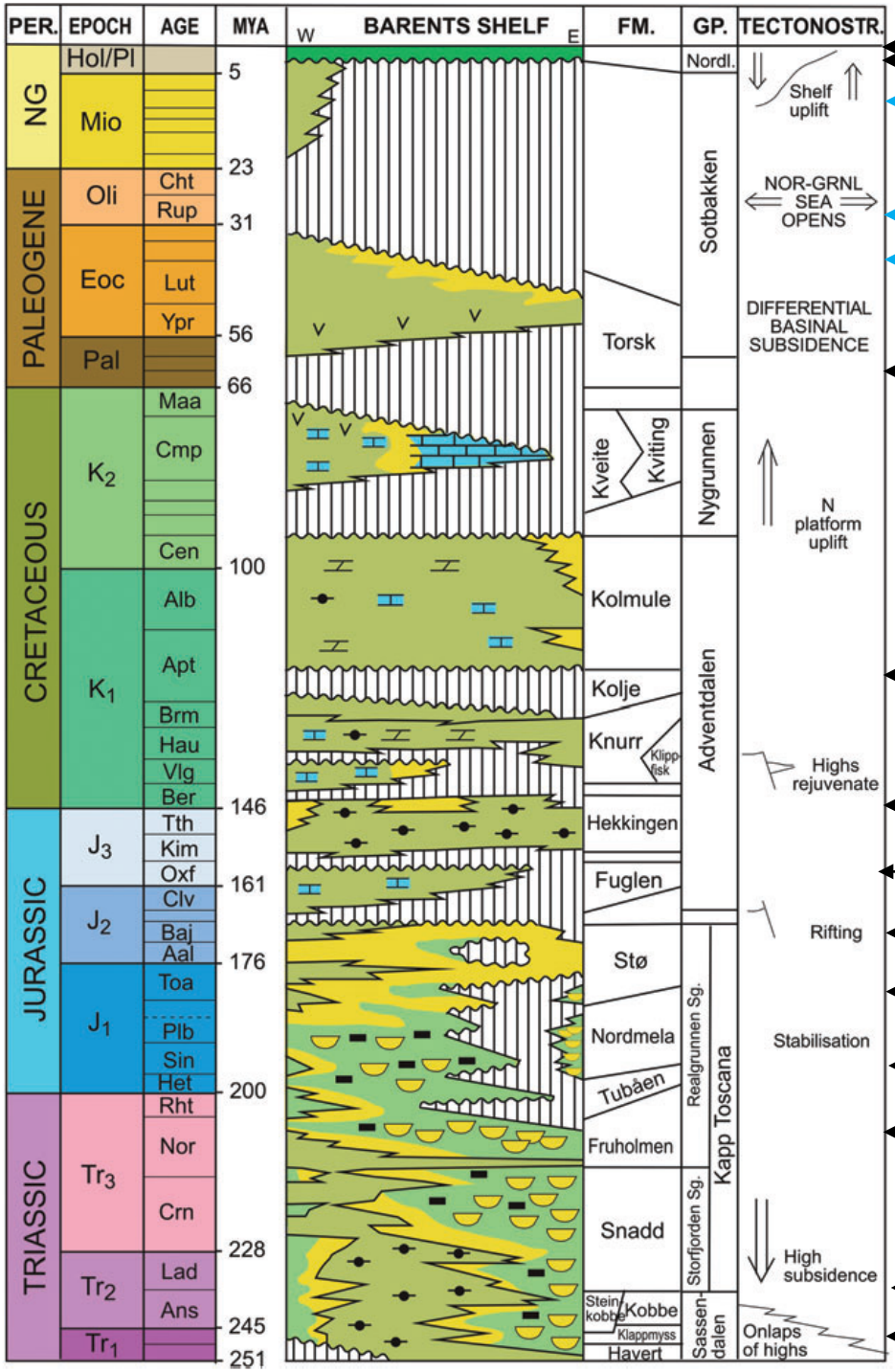
M Zone 32N), Generated 17.10.2009



Study area – depth map top Tubåen Fm



Reworked from Worsley (2008), Nøttvedt et al. (1993), time scale; Gradstein et al. (2004)



Depth maps input to Pressim:

0 Ma Seabed and 2 Ma

10 Ma Intra Sotbakken Fr.

10-2 Ma Erosion

34 Ma Intra Sotbakken Fr.

40-35 Ma Erosion

40 Ma Top Torsk

66 Ma Base Tertiary

125 Ma Top Kolje

145 Ma Top Hekkingen

156 Ma Top Fuglen

168 Ma Top Stø reservoir

186 Ma Top Nordmela

197 Ma Top Tubåen reservoir

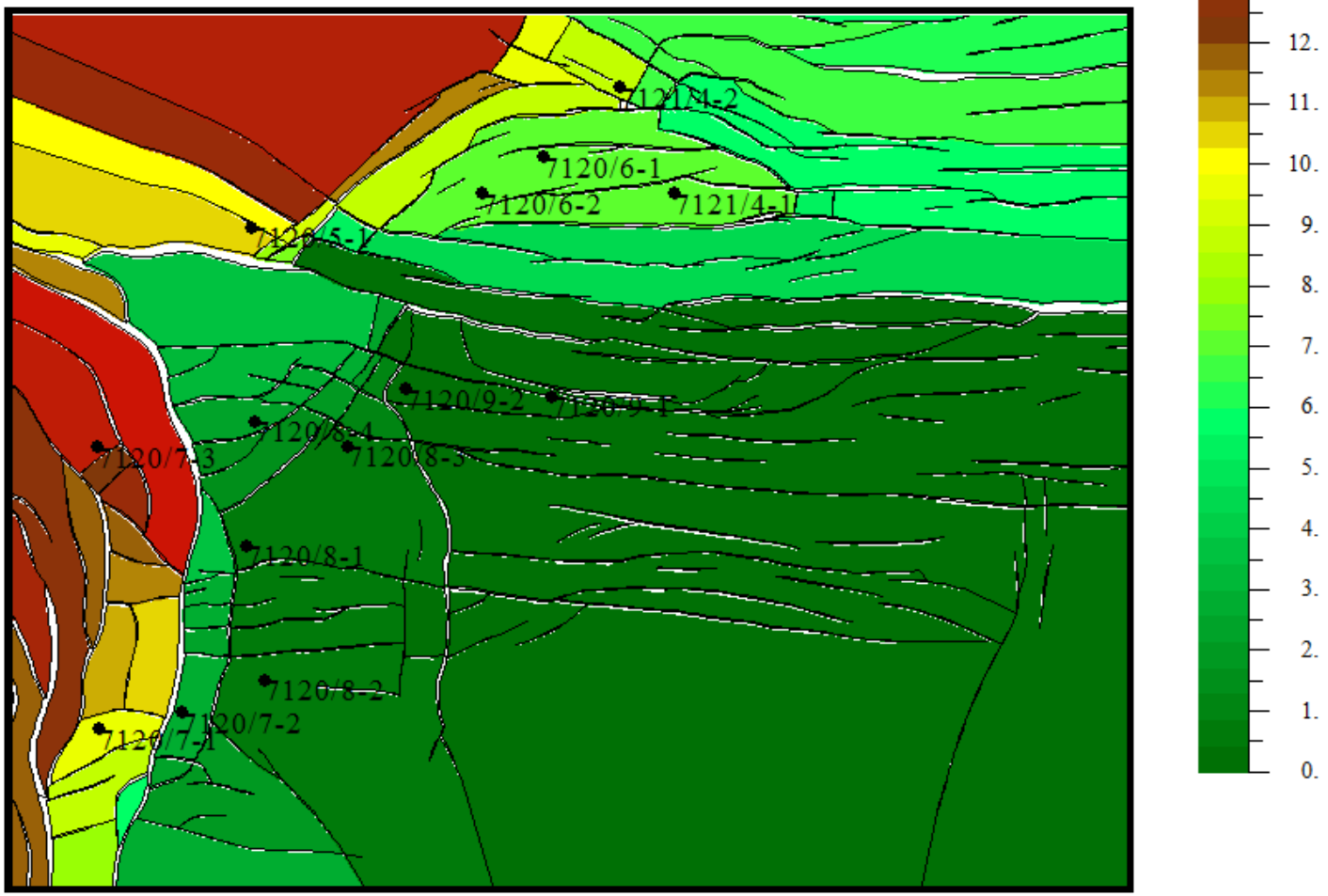
204 Ma Top Fruholmen

237 Ma Top Kobbe

251 Ma Top Permian

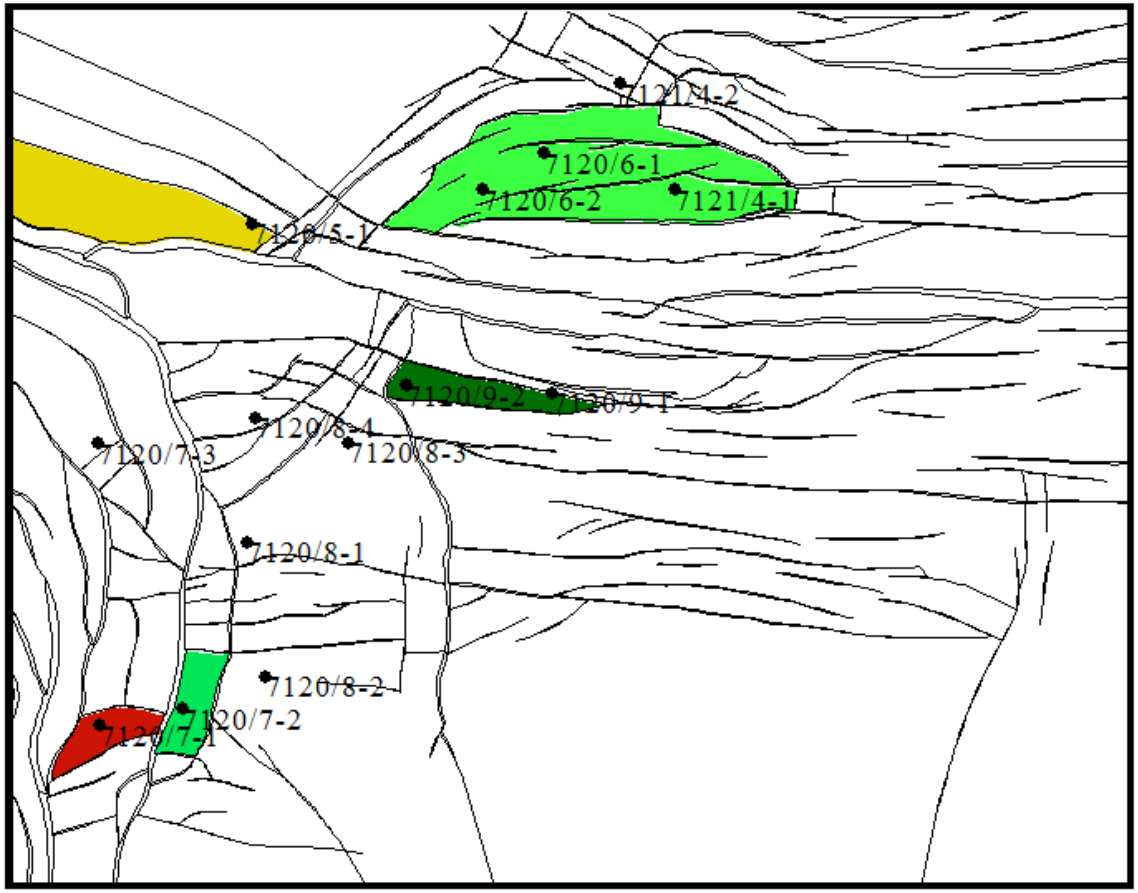
Results – basin modelling set up

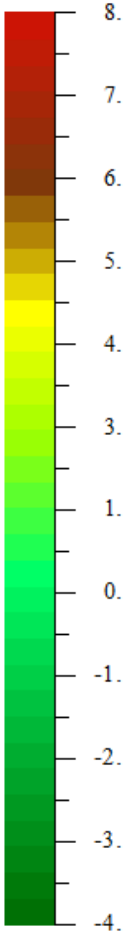
- Simulated overpressure for Tubåen Fm for today in bars



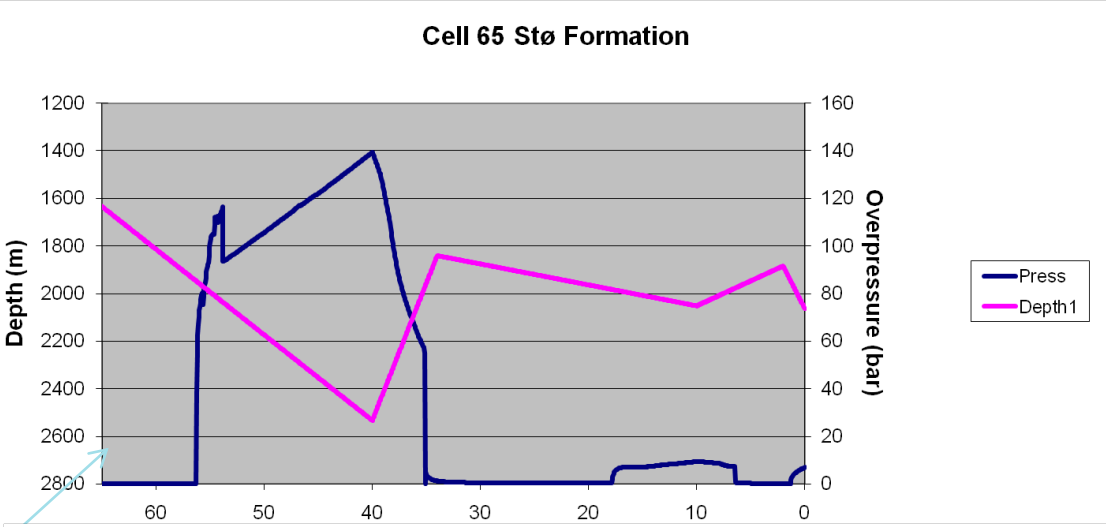
Results – basin modelling set up

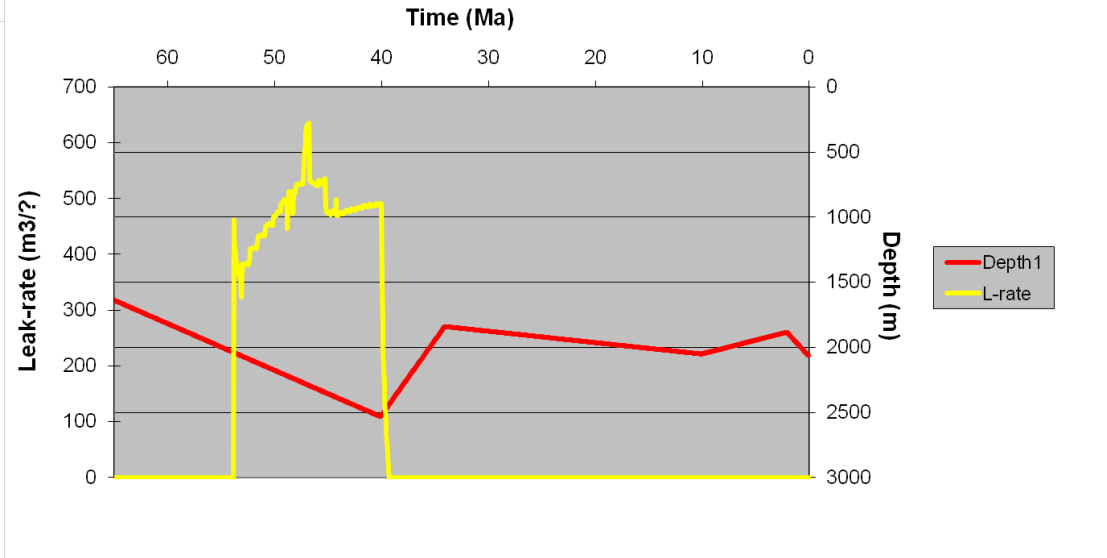
- Deviation between simulated pressure and observed pressures.
- Colour scale in bars
- **Very good match!**



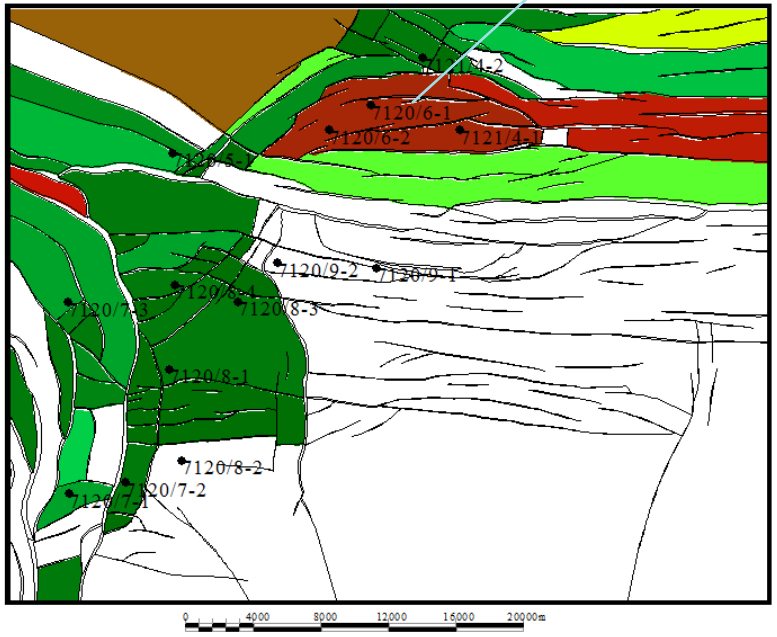


Overpressure vs. Time for Stø Fm,

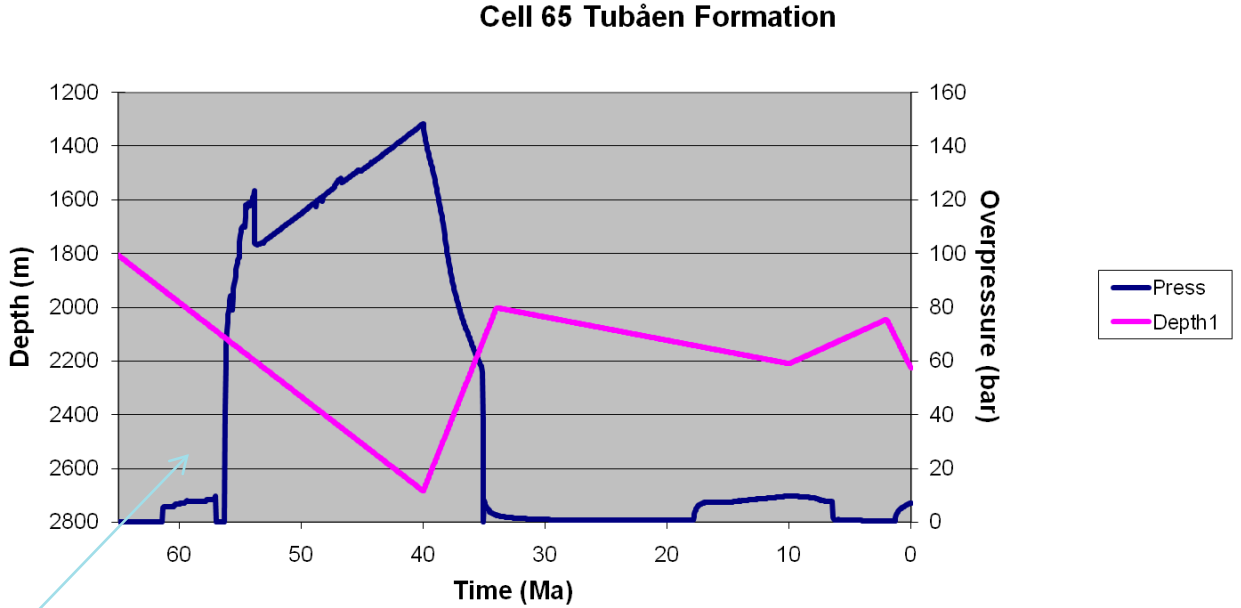


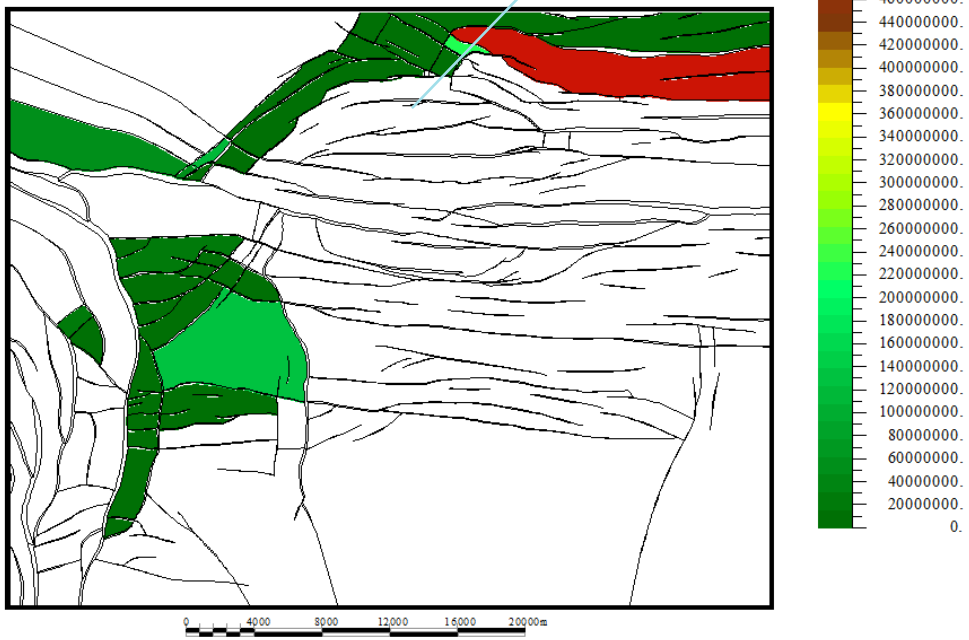


Cum. leakage Stø Fm.



Overpressure vs. Time for Tubåen Fm,

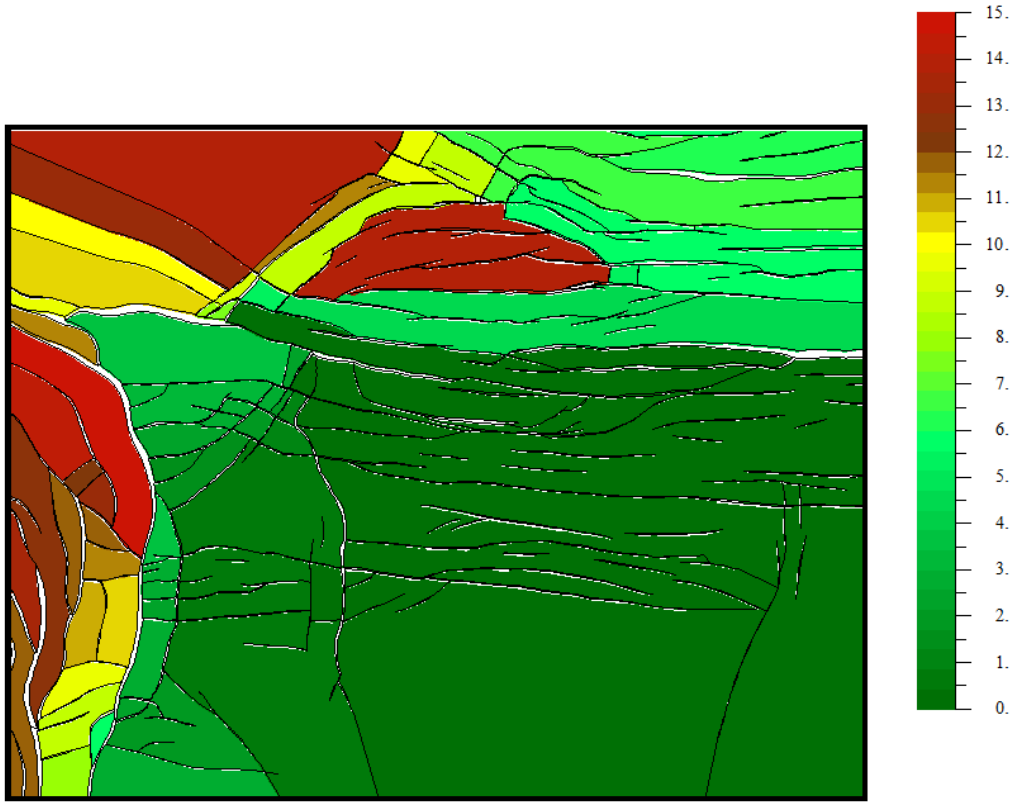




- Leakage from the shallower Stø Fm, prevent leakage from the Tubøen Fm.

Preliminary results – injection in a site – forward modelling

Simulated overpressure (bar)
– after 5 years



Preliminary conclusions

- Can use the geomodel from basin modelling as a starting point
- Benefit: have the effect of erosion and uplift
- Failure criteria for hydraulic fracturing and leakage are inplace

Further work (a lot!)

- Need to introduce gridding internally in the reservoir
- Check effect of varying properties in the reservoir units
- Study effect of injection rate, timing, pressure build up e.g.
- Need to compare results with standard reservoir simulators
- Introduce CO_2 in gas phase (and/or try to combine it with SEMI)