



vito

vision on technology



Vlaams
Kenniscentrum
Ondergrond

28/07/2016

3D modeling of the Flemish subsurface using GOCAD

Stijn Bos, Flemish Institute of Technological Research

Partnership

- » VLAKO: Flemish knowledge centre of the subsurface
 - » Collaboration of ALBON and VITO
 - » ALBON: Land and Soil Protection, Subsurface and Natural Resources Division of the Flemish Government

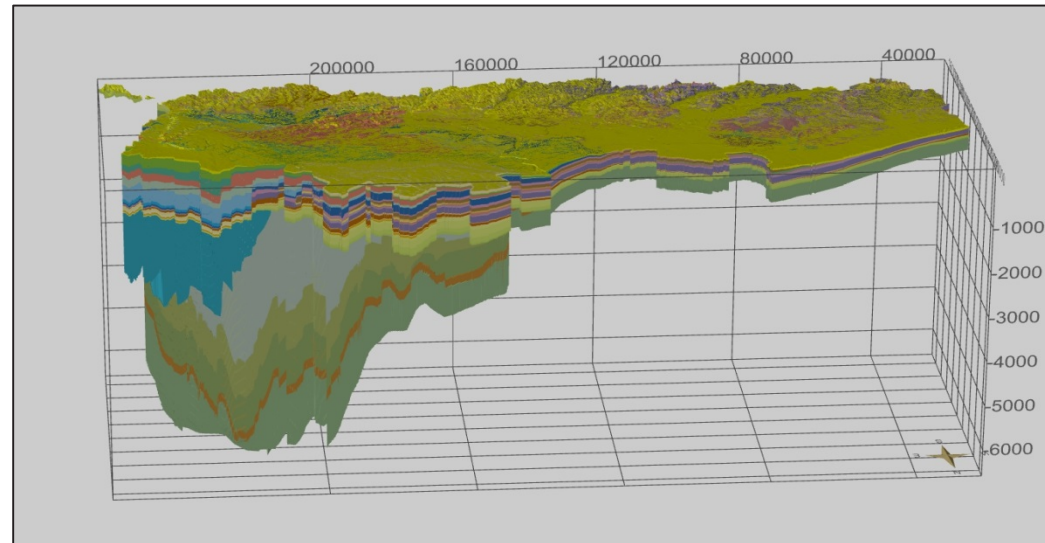
- » VITO: Flemish Institute of Technological Research

- » Delivering subsurface information into public domain through the DOV-website (<http://dov.vlaanderen.be>)



Status of the Flemish subsurface model

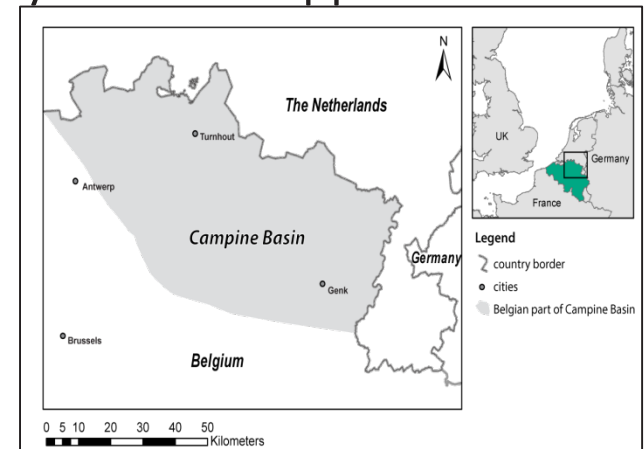
- » 2013: First full 3D model finalized consisting of mapped 2D horizons from the Quaternary up to the Paleozoic basement.
 - » The third dimension is given via arbitrary fault dips.
 - » No actual fault planes available.



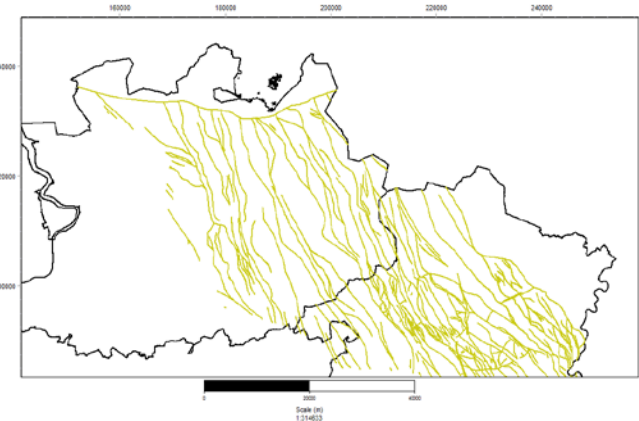
G3Dv2 model visualized using the 3DSubsurfaceViewer®

Need for a solid structural model

- » Main goal of VLAKO to deliver detailed voxel models of the natural resources in the Flemish subsurface
 - » Primary target are the coal and sandstone layers of the Upper Carboniferous
 - » Only present in the NE of Flanders (Campine Basin)

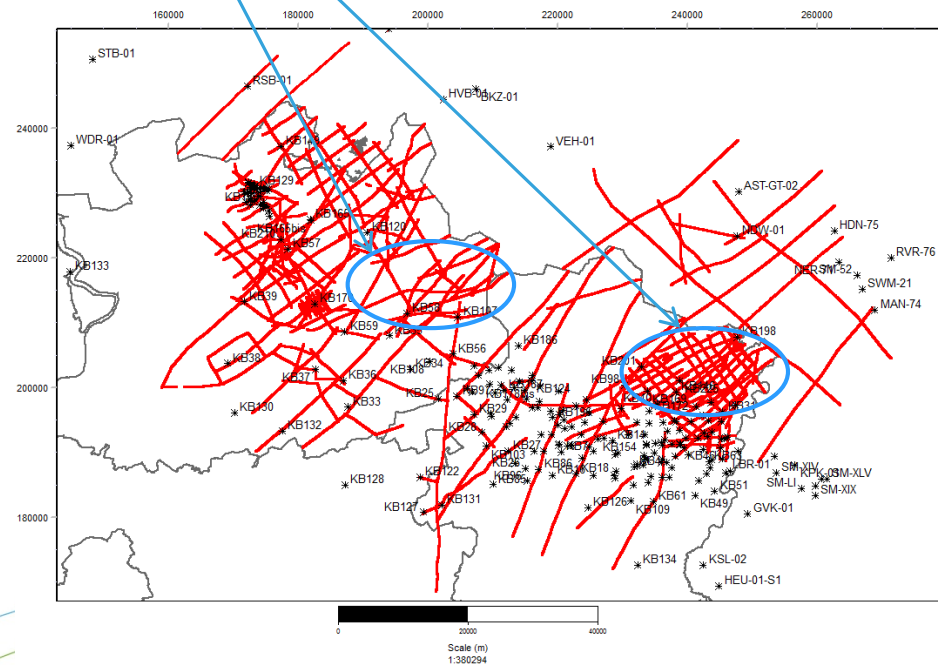


- » Need to include 3D fault planes as part of the reservoir grid
- » Existing palaeozoic fault maps are ambiguous and not conceptual/pragmatic



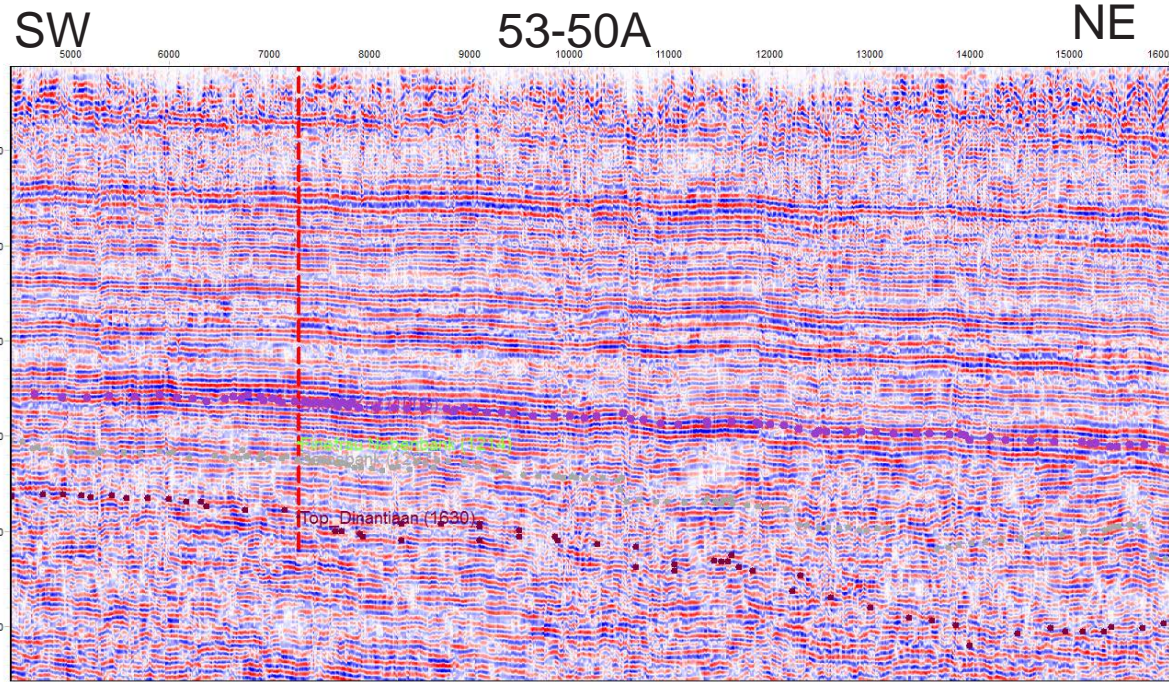
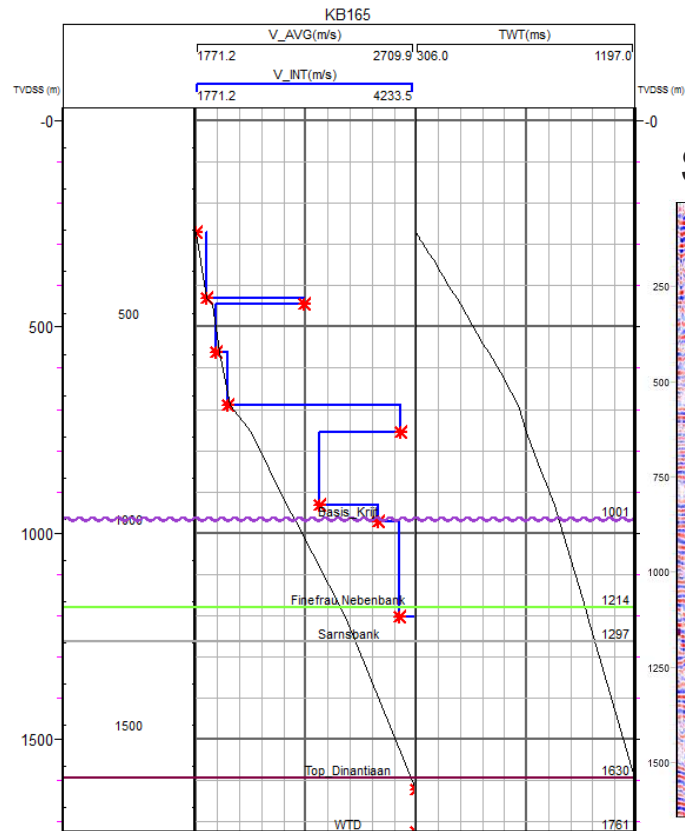
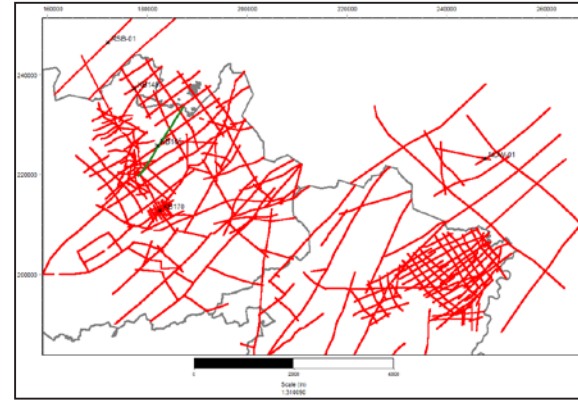
(Seismic) data inventory

- » Since latest interpretation round of all seismic data (late 90's)
 - » new seismic data available in two regions
 - » 80% of all seismic data has been digitized and loaded into an interpretation software package (GOCAD)



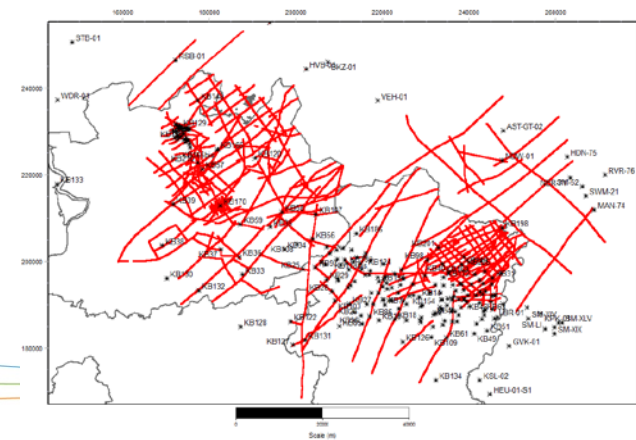
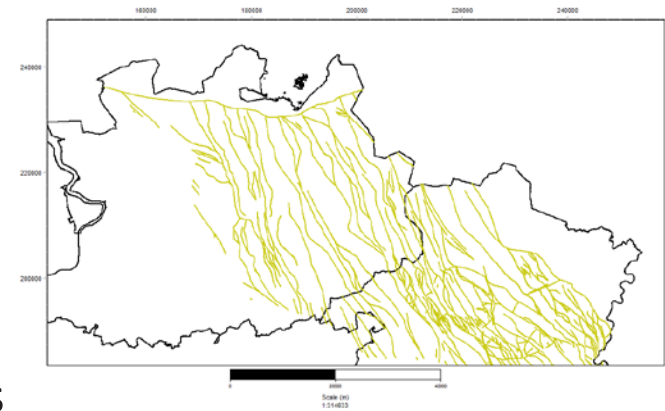
Horizon interpretation

» Integration of well data



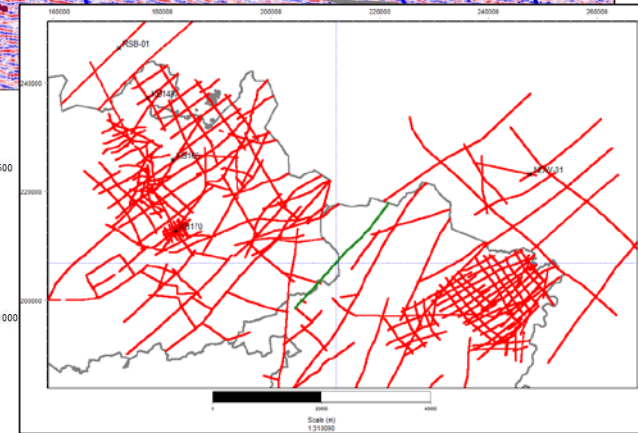
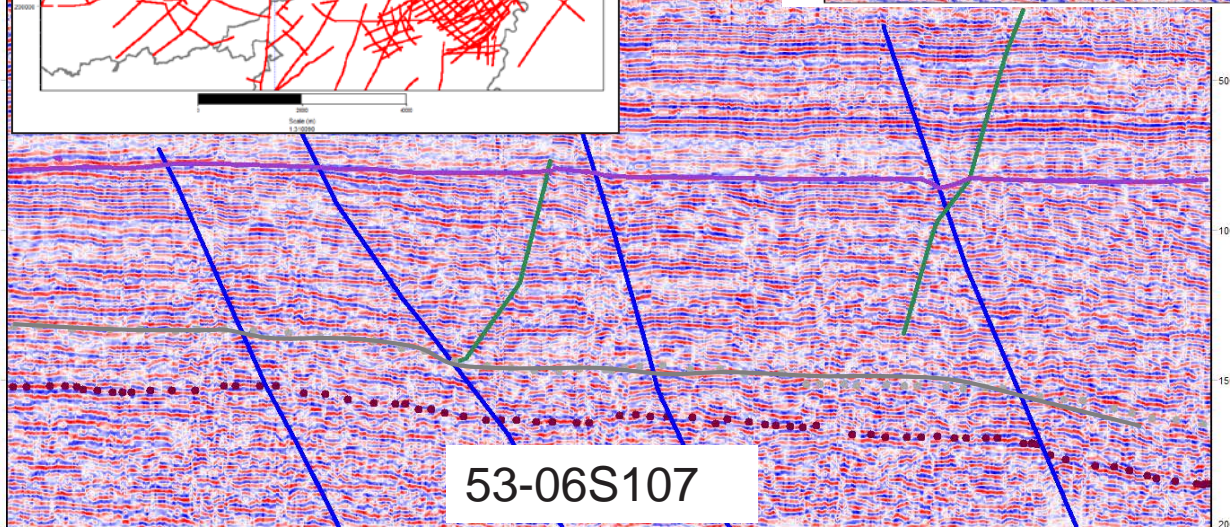
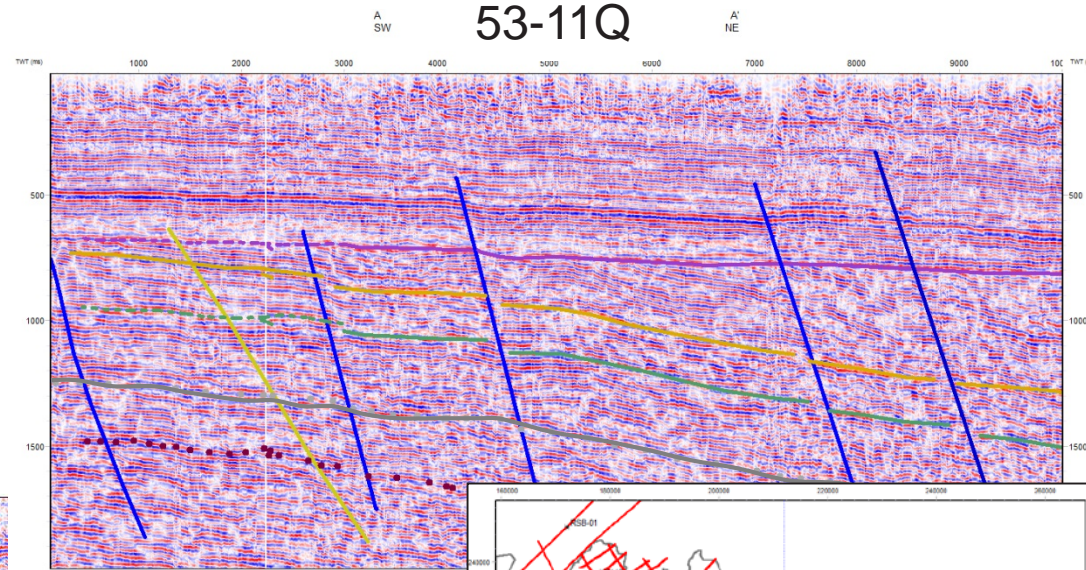
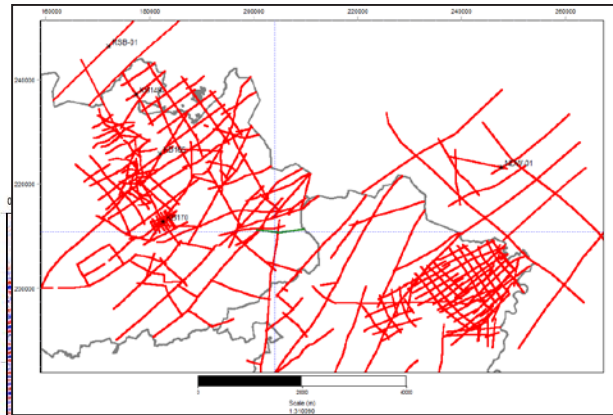
Fault interpretation rationale

- » Find confirmation of NW-SE oriented Carboniferous graben structures on NE-SW oriented seismic lines and test continuity towards the south and the north
- » Find solution for the 'unique' feature called Hoogstraten fault
- » Bridge the gap between high data density areas in NW and SE
- » Create a pragmatic and conceptual fault model that can be used as input for regional structural modeling purposes



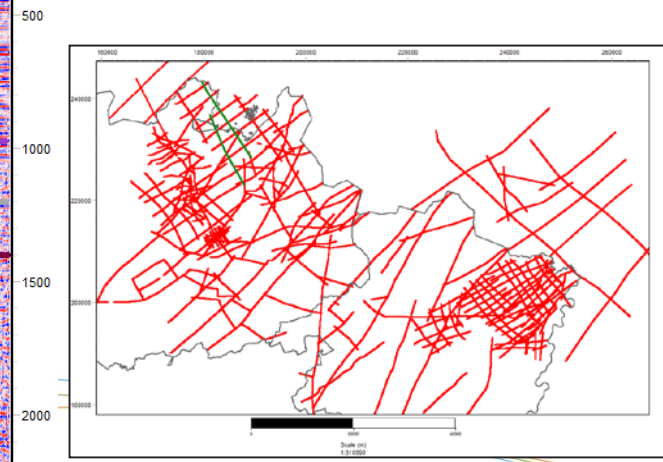
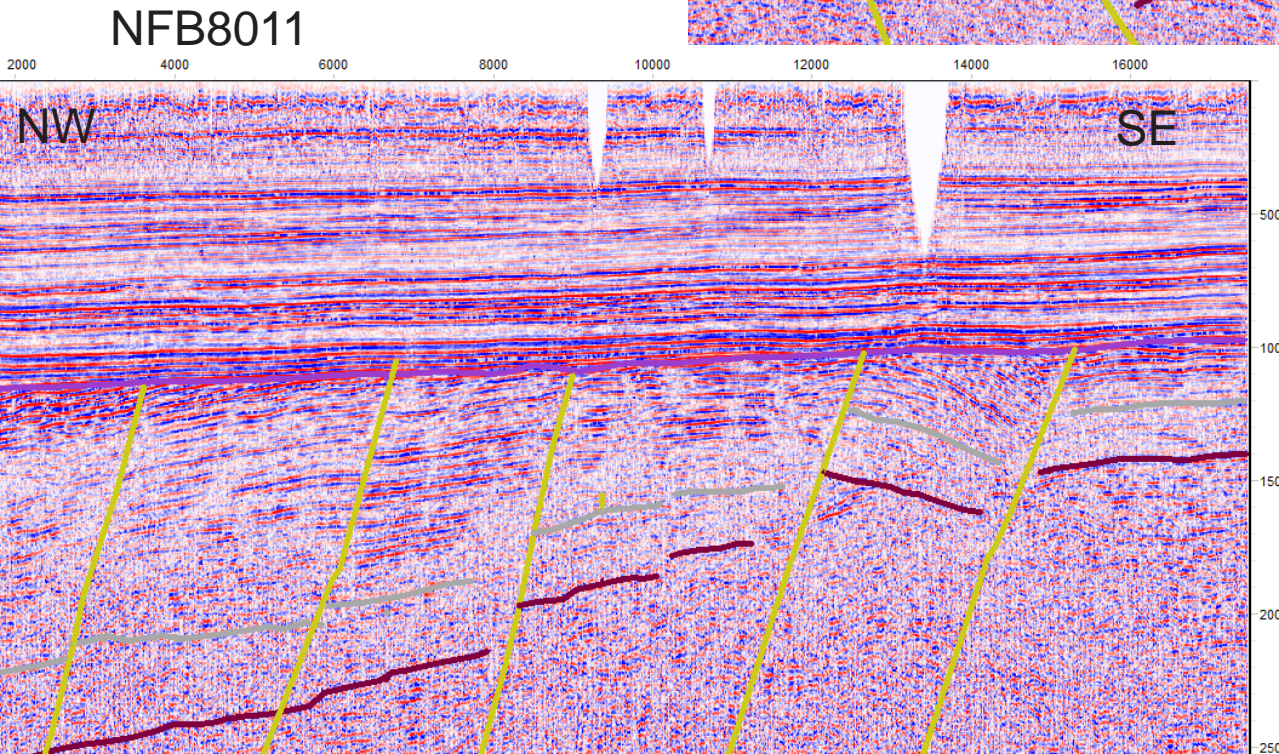
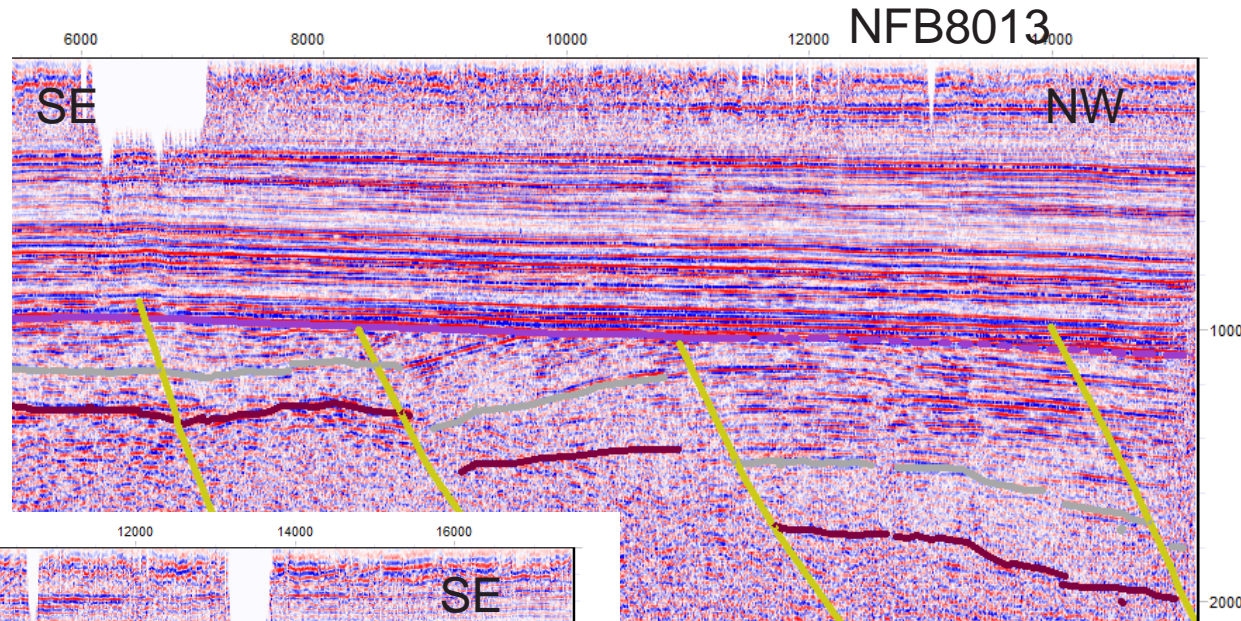
NW-SE faults

» Structures visible on NE-SW to EW oriented lines



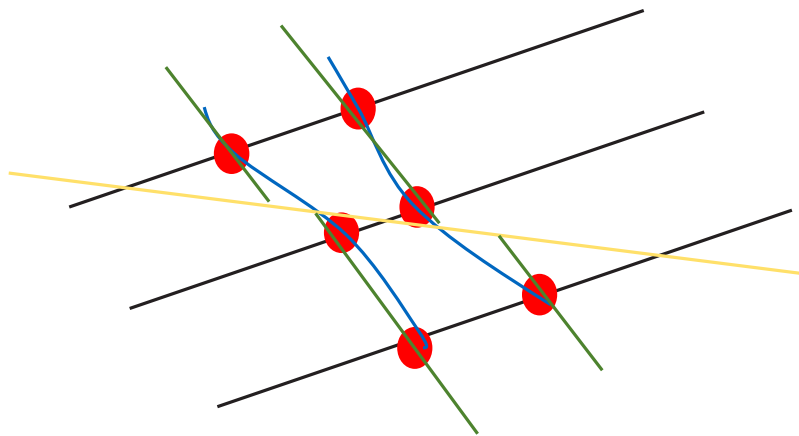
E-W faults

- » Structures visible on NW-SE to N-S oriented lines



Identification of fault step-overs using 2D data

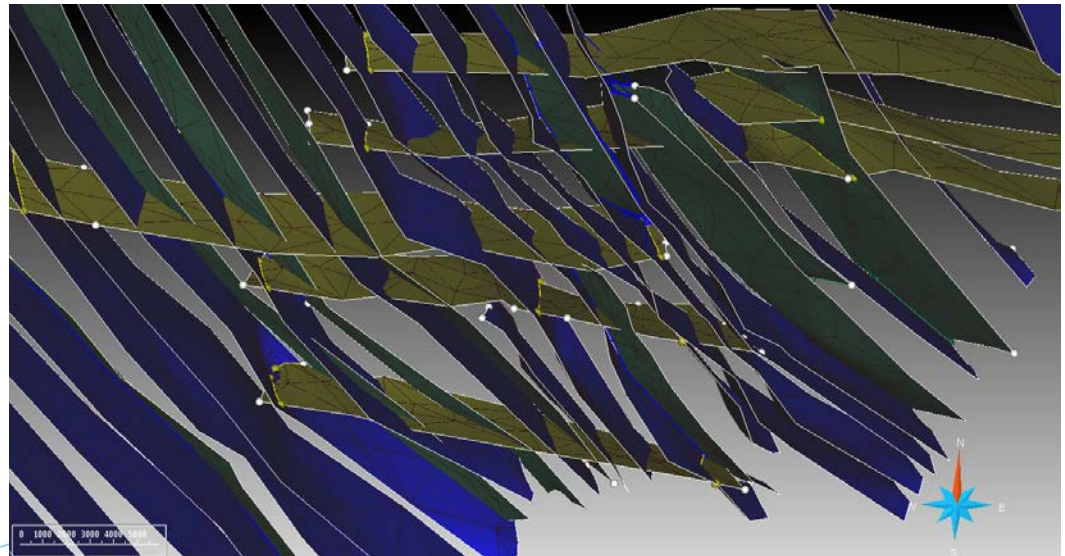
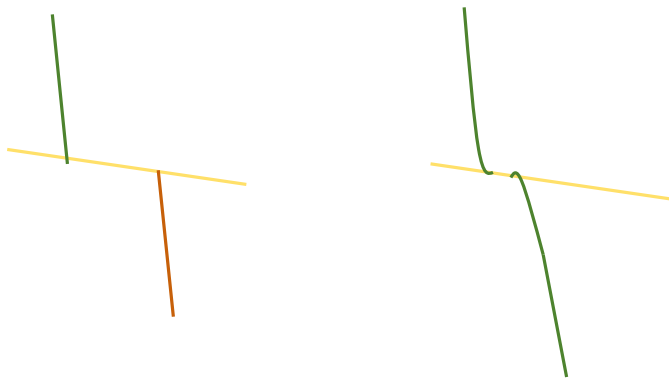
- » Comparison of classical fault plane connection and a fault plane connectivity with the prior knowledge of an influencing oblique structure



- 2D seismic lines
- **Fault interpretation**
- WNW-ESE lineament known to be present from regional evaluation
- **Classical fault plane connection**
- **New fault plane connection**

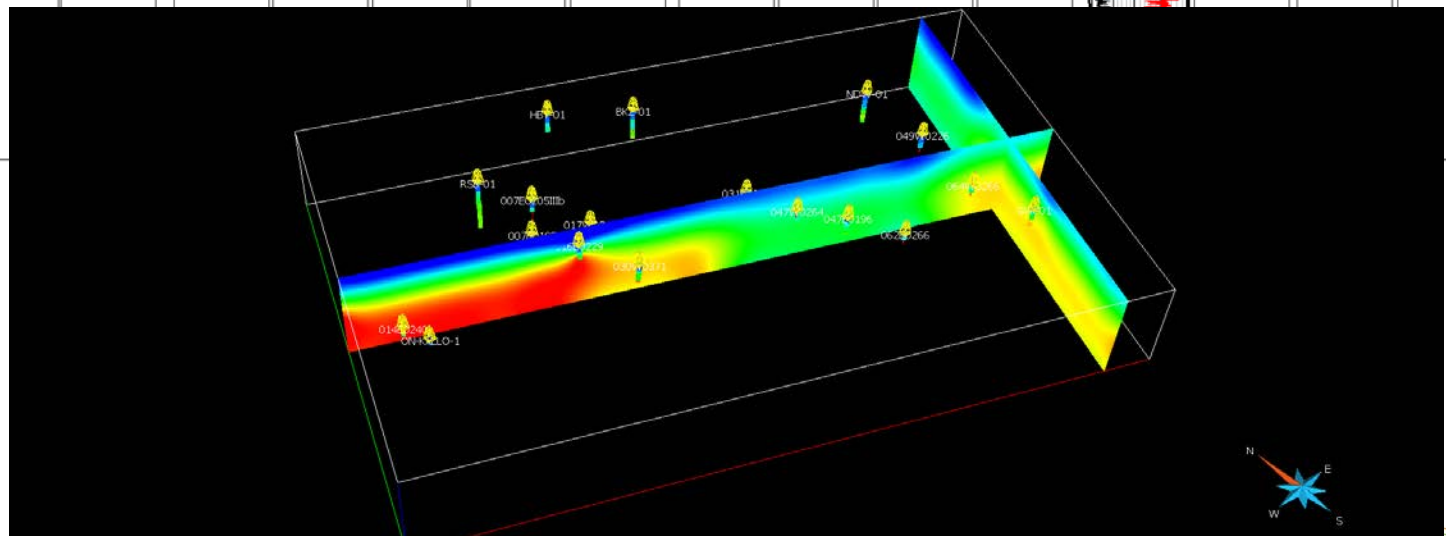
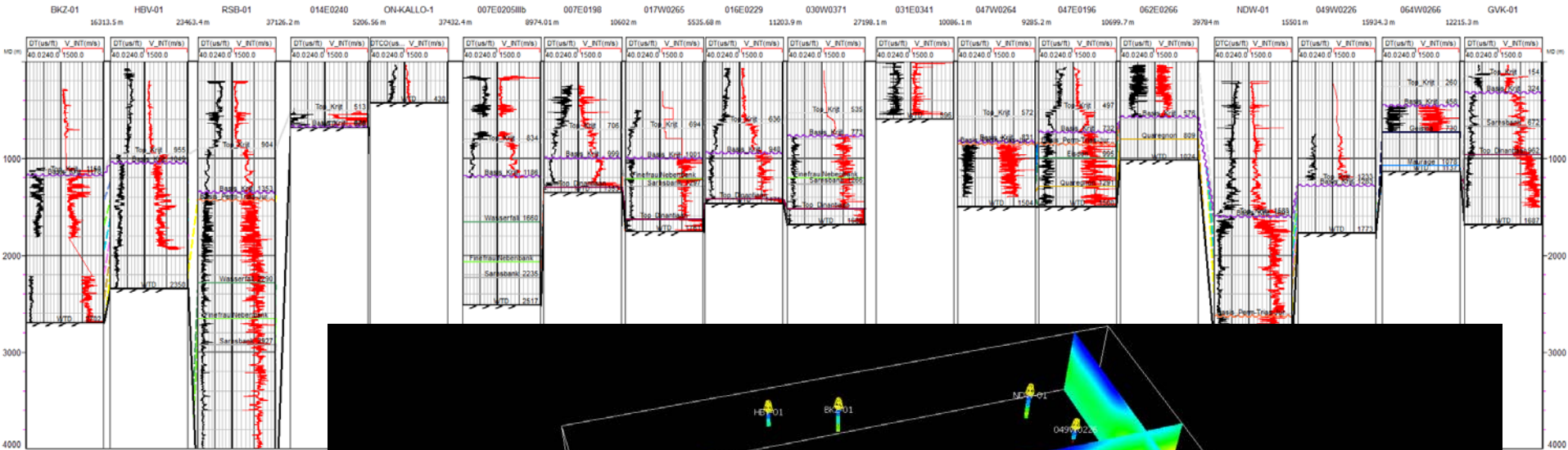
Modeling fault-fault contacts in GOCAD

- » Concept: WNW-ESE lineaments are the main faults that have resulted in step-overs of the NW-SE faults
 - » Make separate faults N and S of each lineament and branch the faults
- OR*
- To be solved!**
- » Tear long-distance NW-SE faults along the WNW-ESE lineaments



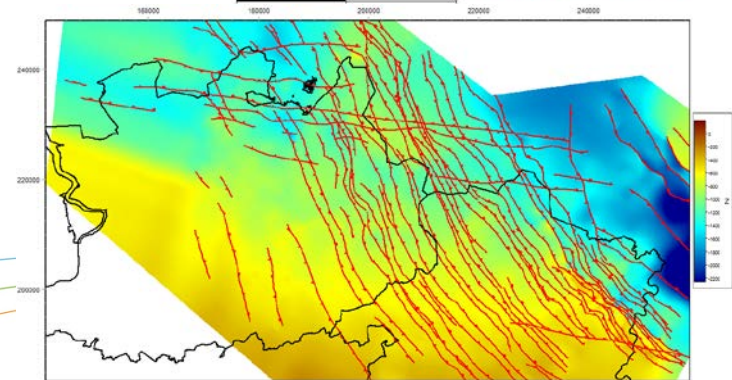
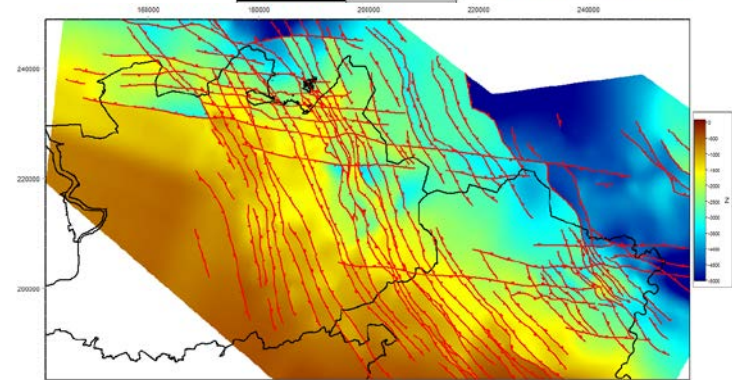
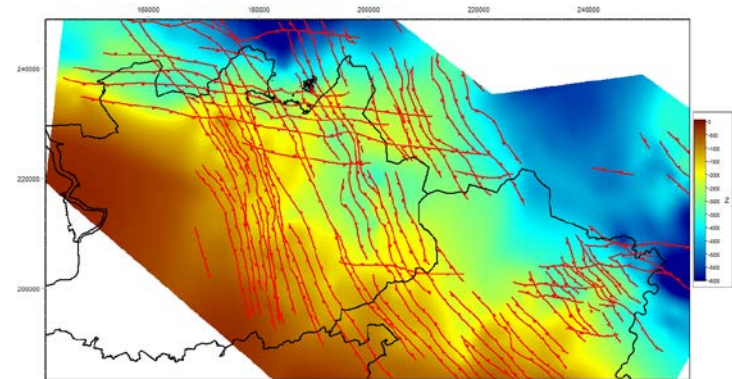
Velocity model

» 18 wells with (seismic) velocity information



Faulted depth maps of paleozoic strata

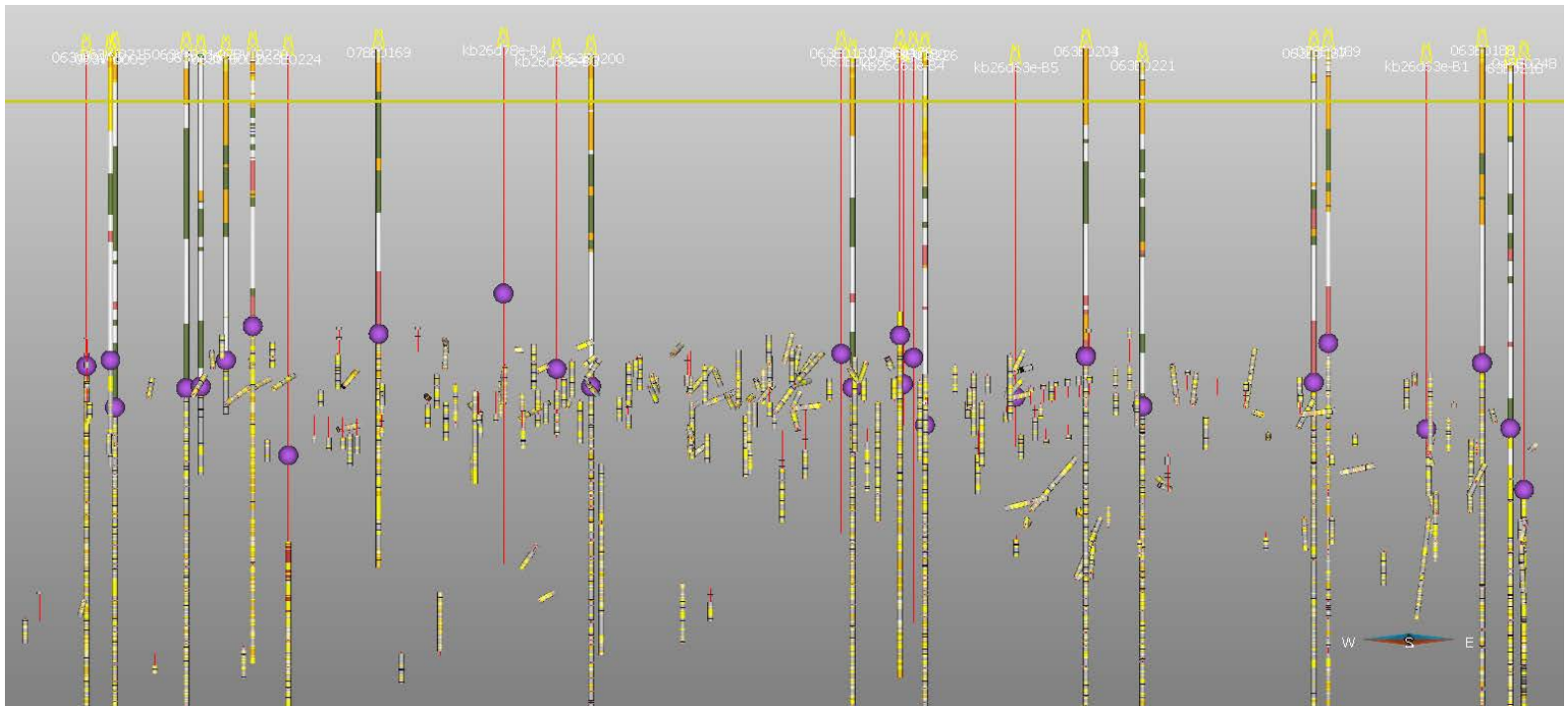
- » Base Namurian (Serpukhovian) stage
 - » WNW-ESE lineaments strongly present
 - » Lack of deep seismic results in 'unmodeled zone'
- » Base Westfalian (Bashkirian) stage
 - » WNW-ESE lineaments strongly present with large throws
 - » NW-SE faults with large throws stepping-over from E to W
- » Base Cretaceous period
 - » WNW-ESE lineaments less present and without significant throws



Integration of mining data in 3D grid

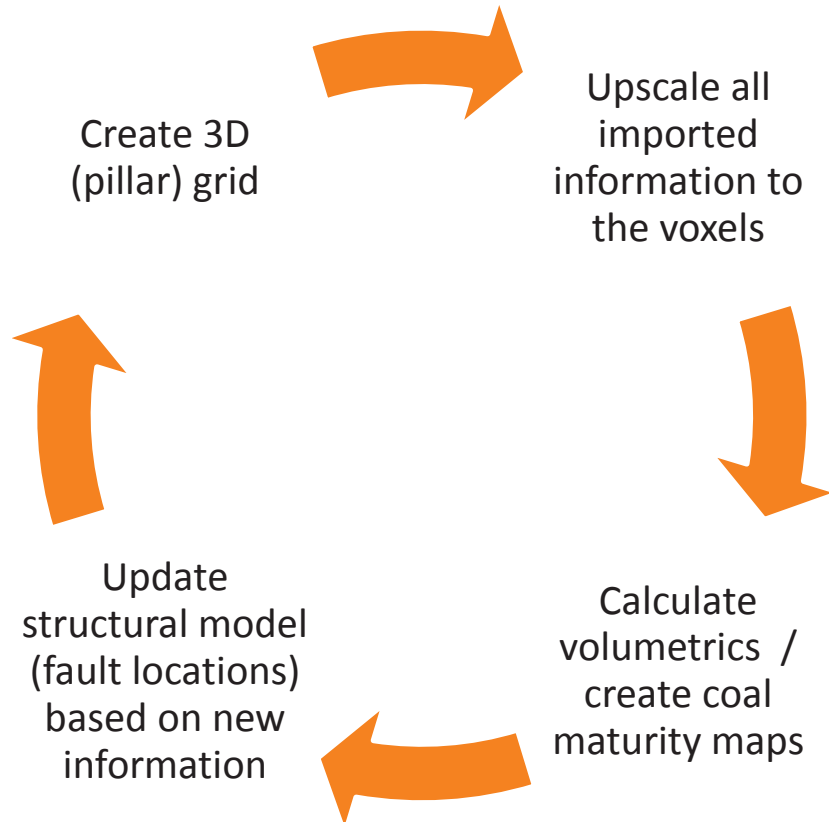
- » 841 subsurface wells (mining wells) with core descriptions resulting in high density lithofacies input for upscaling

Sea level



Ongoing work

» Iterative process

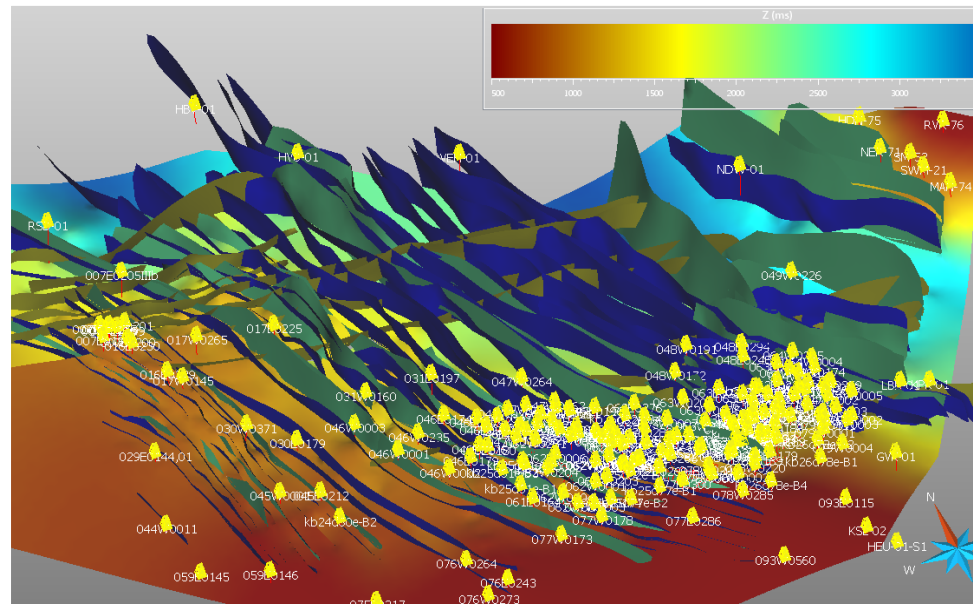


Conclusions

- » Pragmatic structural model created that has several advantages
 - » Fault model gives insight in connectivity of sandstone and coal layers of the Westphalian
 - » Acts as input for 3D restorations/ basin modeling → maturity of coals
- » Issues still exist on how to exactly model the fault-fault contacts (step-overs, e.g.)
- » A lot of mining data imported in the software to be upscaled into the grid
- » More knowledge from neighbouring countries should be combined for the general picture, more specific on the late Palaeozoic structural development
 - » Sedimentological features and structural interpretations in NE-England, Dutch southern offshore and onshore and Nordrhein-Westfalen (Germany)

Research collaborations?

Acknowledgements



Vlaanderen
verbeelding werkt