Constructing and validating a large-scale velocity-model for the North German Basin in Schleswig-Holstein and Hamburg – A part of the joint project TUNB

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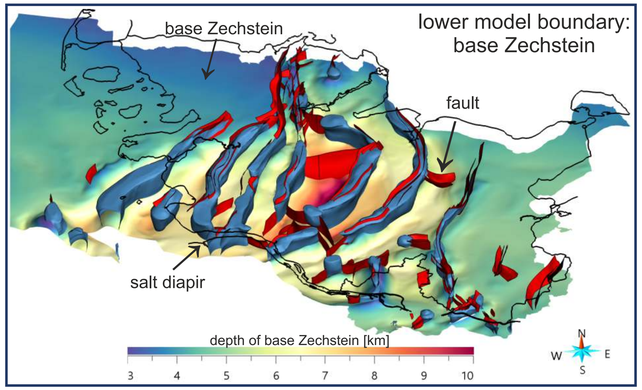
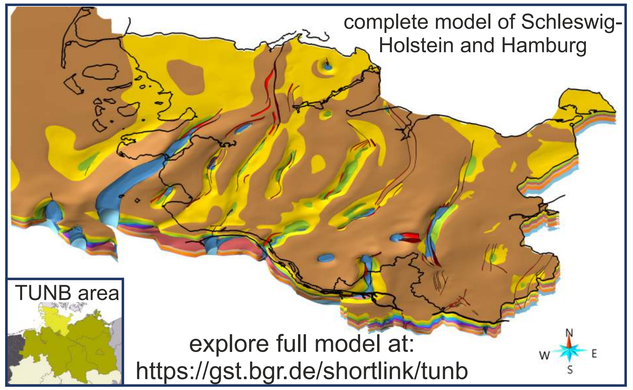
1) TUNB subsurface model

- developed by the Geological Surveys of Northern Germany and the Federal Institute for Geosciences and Natural Resources (BGR) in joint project ‚Subsurface Potentials for Storage and Economic Use in The North German Basin‘
- coherent 3D subsurface model of North German Basin, consisting of 13 horizons between base Zechstein and M. Oligocene, faults and salt diapirs
- western part of model is based on GTA-maps (Tectonic Atlas of Northwest Germany[1]) and updated with well data and seismic surveys from oil and gas industry





2) GTA-velocities after Jaritz et al.[2]

- set in depth domain
- based on well data (sonic-logs / check-shot-velocities)
- used to construct GTA-maps

approach: $v(z)=v_{NN}+g*z$

- v_{NN}: local starting velocities to account for regional variation
- g: different gradients for 10 lithostratigraphic layers

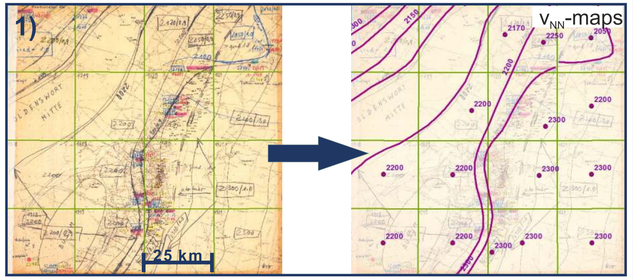
weakness:

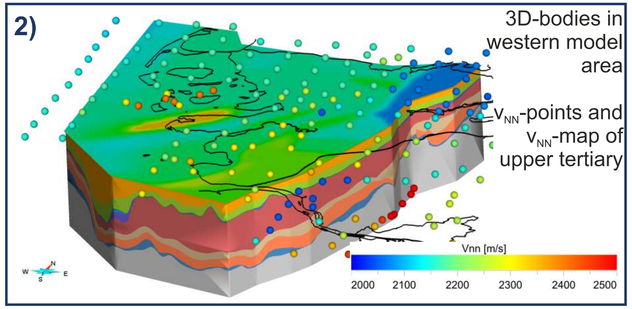
- quality of GTA velocities between wells is unknown

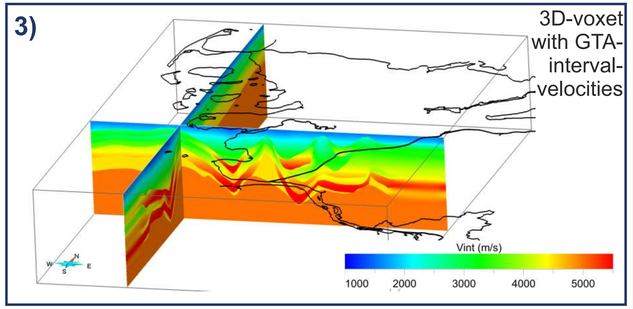
3) constructing GTA-velocity-model in 3D

1. digitize v_{NN}-data-points and gradients g from (hand-written) working-maps
2. calculate interval-velocities v(z) in 3D-bodies of layers
3. transfer velocities to 3D-voxet

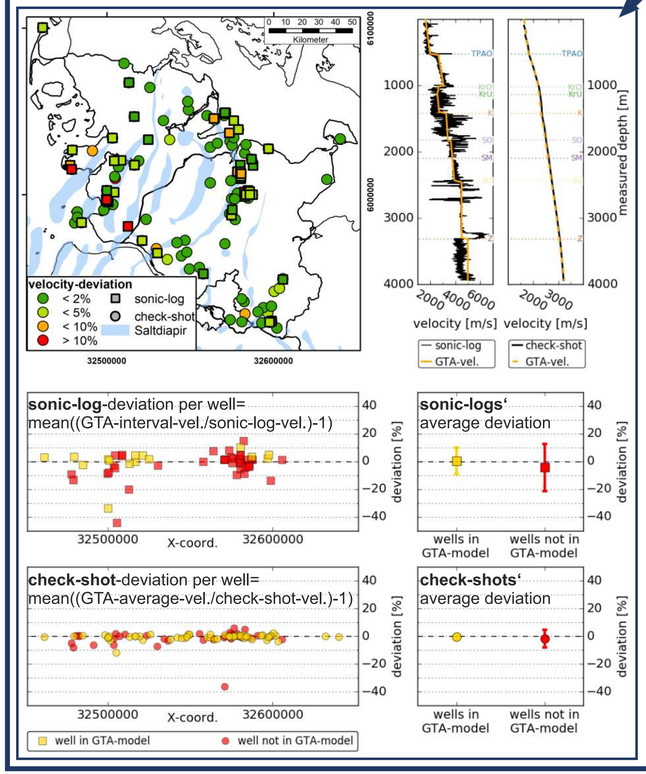
→ 3D-velocity-voxet can be used to convert model units (e.g. horizons, wells) from depth to time domain (and vice-versa)







4) validating GTA-velocity-model...



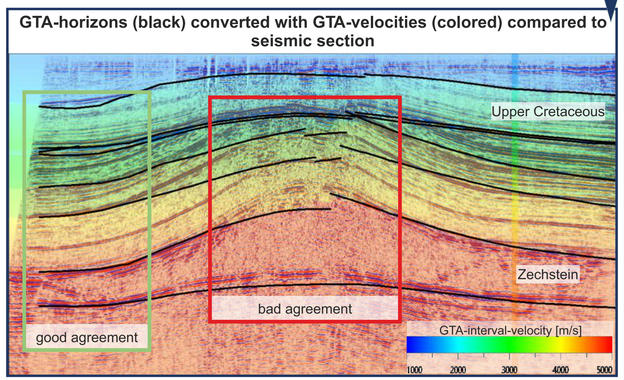
... through well data:

- mean deviations between GTA- and well-velocities show generally good agreement
- better agreements found for check-shot than for sonic-log velocities
- datapoints too sparse to identify local trends/anomalies

... through seismic data:

- first comparisons between converted GTA- and seismic horizons reveal good agreement especially for horizontal layering
- unclear if deviations in structural complex areas are caused by velocity model or GTA-geometries

→ quantitative statewide analysis has to be continued



5) conclusion

- GTA-velocity-model was sucessfully constructed in 3D for the area of Schleswig-Holstein and Hamburg
- velocitiy-model can be used to convert model units from depth to time domain (and vice-versa)
- good agreement found between model- and well-velocities; comparison to seismic surveys needs to be continued
- TUNB 2.0 (planned): velocity-model for full North German Basin; integrate seismic velocities and velocity-approaches from eastern federal states

References: 1 - Baldschuhn, R., Binot, F., Fleig, S., & Kockel, F. (2001). "Geotektonischer Atlas von Nordwestdeutschland und dem deutschen Nordsee-Sektor - Strukturen, Strukturentwicklung, Paläogeographie." Geologisches Jahrbuch A 153: 3-95.;
2 - Jaritz, W., Best, G., Hildebrand, G., & Jürgens, U. (1991). Regionale Analyse der seismischen Geschwindigkeiten in Nordwestdeutschland. Geologisches Jahrbuch E 45:23–57;

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