Exploring deep subsurface: Techniques, workflow, data processing and status of the GeORG-project

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Agenda

- **Introduction GeORG-project**
- **Geological setting**
- **Workflow of the project**
  - input data
  - 3d-modeling
- **Summary**

GeORG – project objectives:

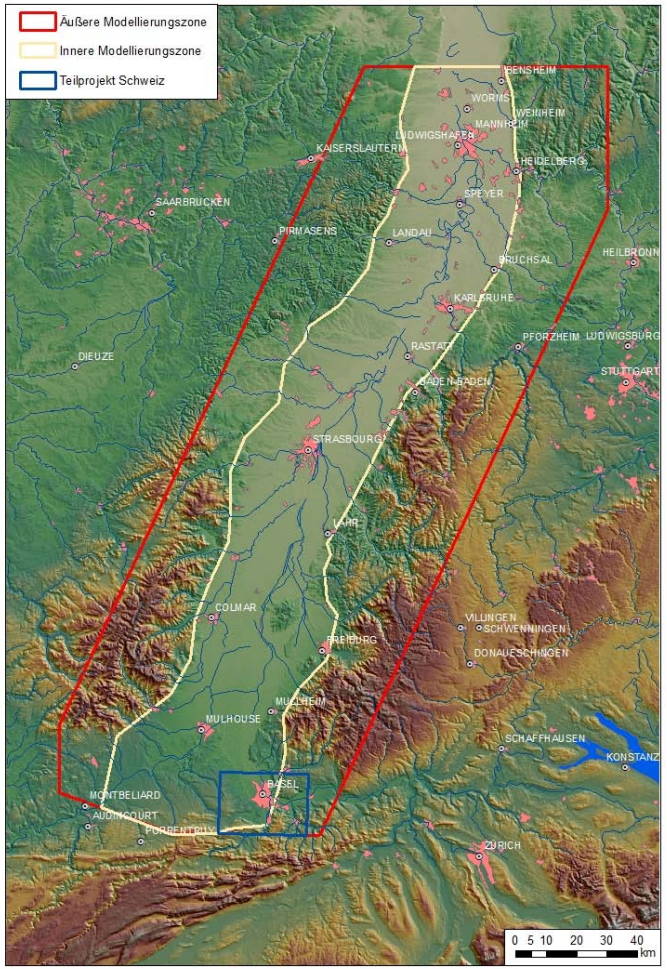
- geological model as a tool for the description of the 3d-configuration of the Upper Rhine Graben
- digital, consistant, transnational data set, open for further developments
- basic principles for availability of deep geopotentials:

  - deep geothermal energy

  - deep aquifers

  - CO_2 sequestration, storage of compressed air
- Basel region:

  - better understanding of the principles of induced seismicity



GeORG – project organisation

- **project partners with work participation:**
  - Landesamt für Geologie, Rohstoffe und Bergbau Baden-Württemberg LGRB-RPF (project executing organisation)
  - Landesamt für Geologie und Bergbau Rheinland-Pfalz
  - Service Géologique Régional Alsace (BRGM)
  - Universität Basel (Abteilung Angewandte und Umweltgeologie)

- **cofinancing partners:**
  - Région Elsass (F)
  - Conseil Général du Bas-Rhin, Conseil Général du Haut-Rhin
  - Agence de l'Environnement et de la Maîtrise de l'Energie
  - Kanton Basel-Stadt, Amt für Umwelt und Energie (CH)
  - Kanton Basel-Landschaft, Amt für Militär und Bevölkerungsschutz und Amt für Umweltschutz und Energie (CH)
- **non-cofinancing partner:**
  - Kommission Klimaschutz der Oberrheinkonferenz (D,F,CH)

Project team

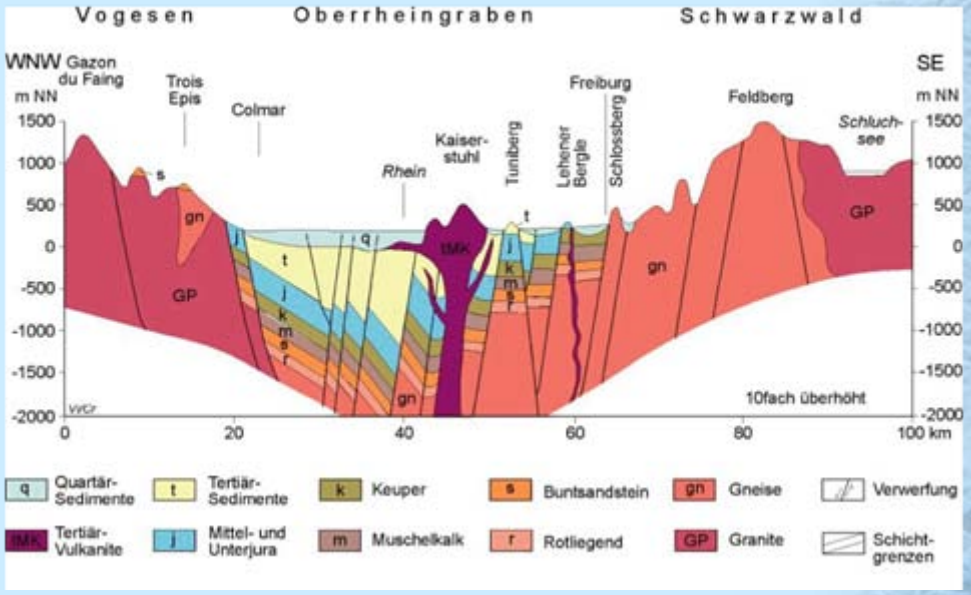
project workers:

4 project workers (full time)

ca. 20 other persons (permanent staff, part time)

run time: 3 years (1. october 2008 to 30. september 2011)

Geology – lithostratigraphic record

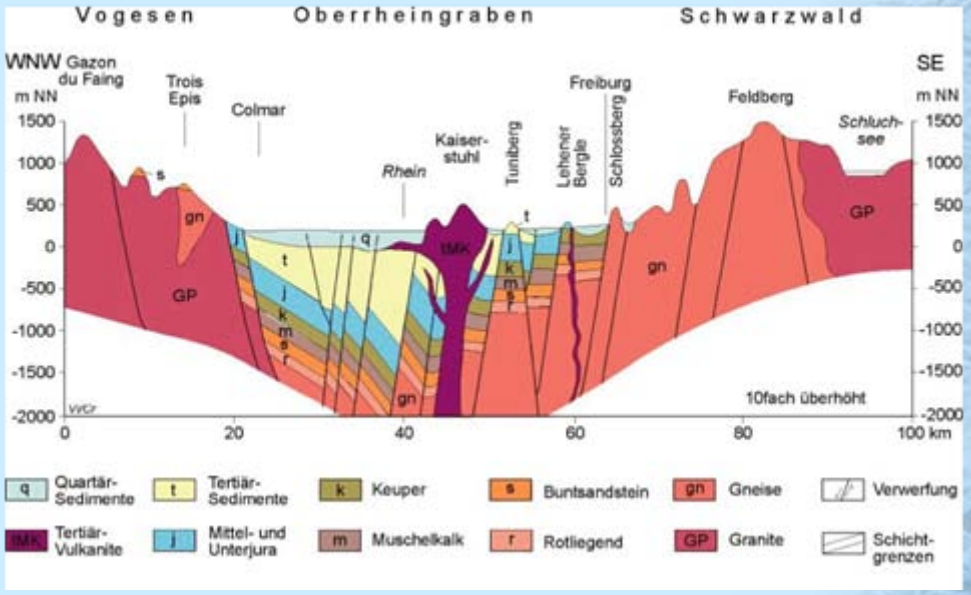


Cenozoic rift and wrench basin

- Thickness of Cenozoic graben fill: up to 3.5 km (sediments including salts)
- local volcanic activity (diatremes, Miocene effusives)
- Mesozoic and Posthercynian sediments (Permian – Upper Jurassic)
- crystalline basement: hercynian deformed metamorphic and magmatic rocks

Geopotentials can be found in every depositional complex!

Geology – tectonic structures



Cenozoic rift and wrench basin

- closely spaced Cenozoic fault systems
- 4-5 km extension, 30-40 km sinistral strike slip offset
- normal faults, transtensional and transpressional structures
- Mesozoic and Hercynian faults

Tectonic structures are essential for geopotentials!

Project workflow

data acquisition

harmonization

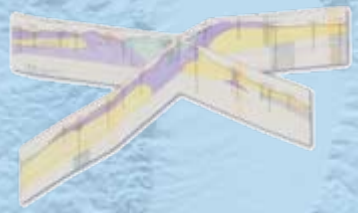
velocity modeling

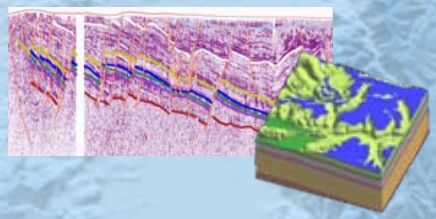
seismic interpretation & geometric 3d-modeling (Gocad)

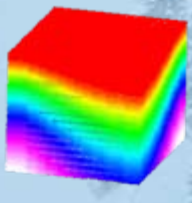
temperature modeling

model parametrization with hydrogeological & geothermal properties

derivation of geopotentials & geohazards





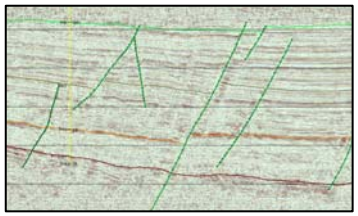


Input data & harmonization

wells

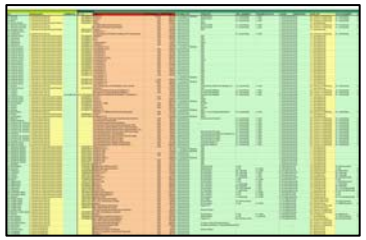
- lithology
- various sources
- interchange format
- nomenclature harmonization

seismic profiles



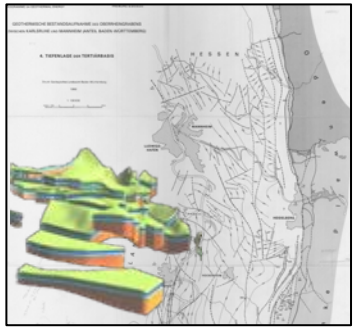
- structural architecture
- oil industry
- digitization
- homogenisation
- migration

parameter sets



- hydraulics
- hydrochemistry
- poroperm
- temperatures
- heat conductivity
- various sources
- unit harmonization
- corrections etc.

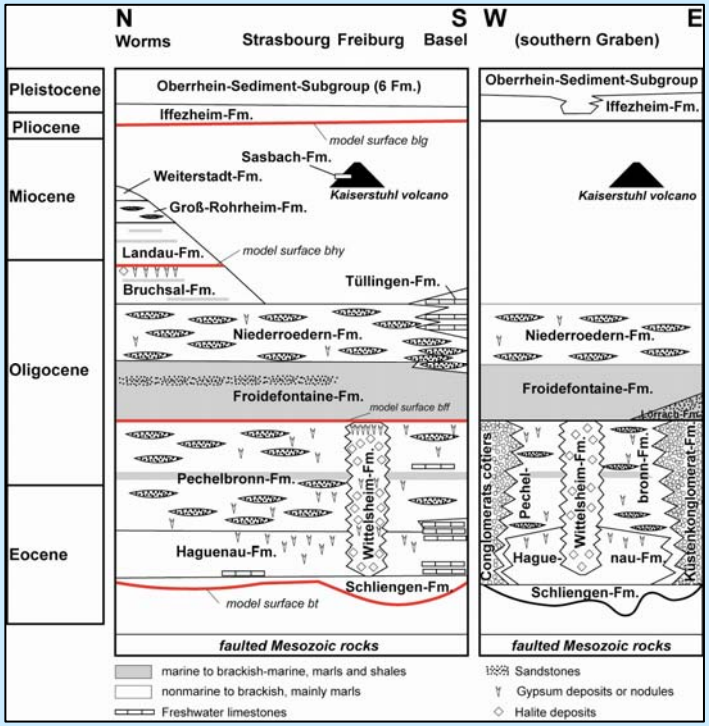
previous projects

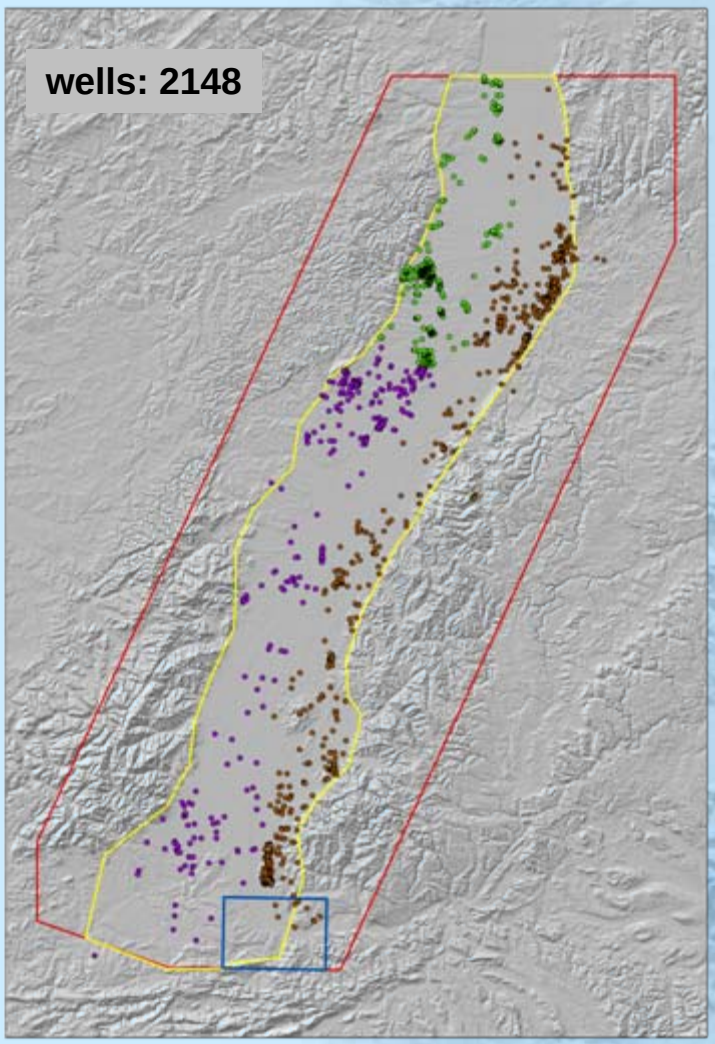


- structural architecture
- various sources
- technical harm.
- nomenclature

coordinate transformation

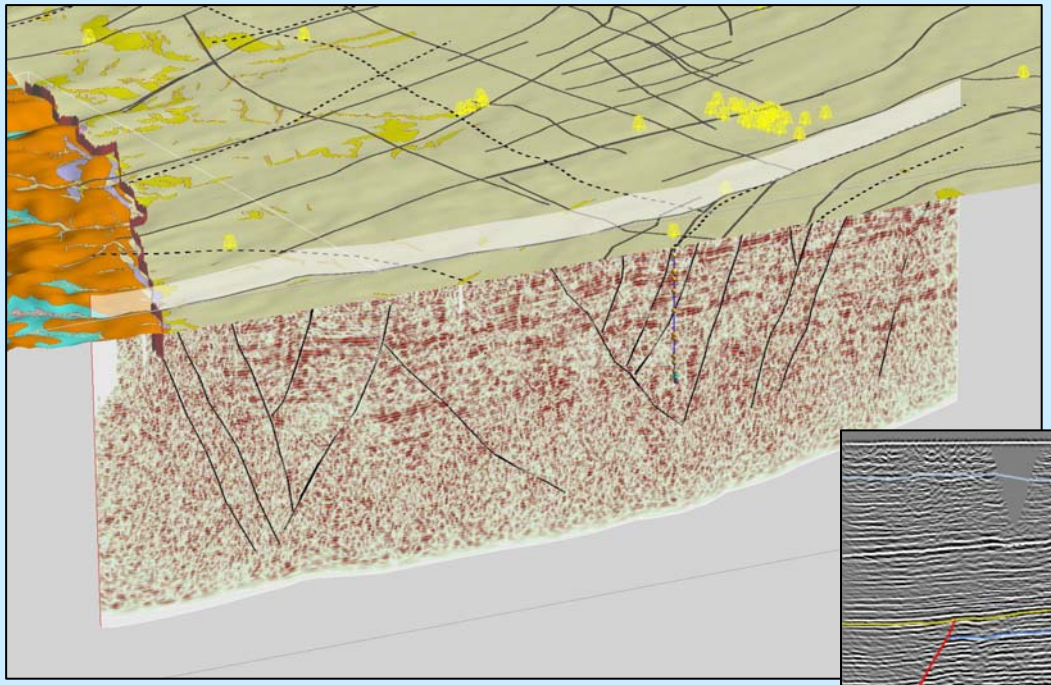
Input data: wells

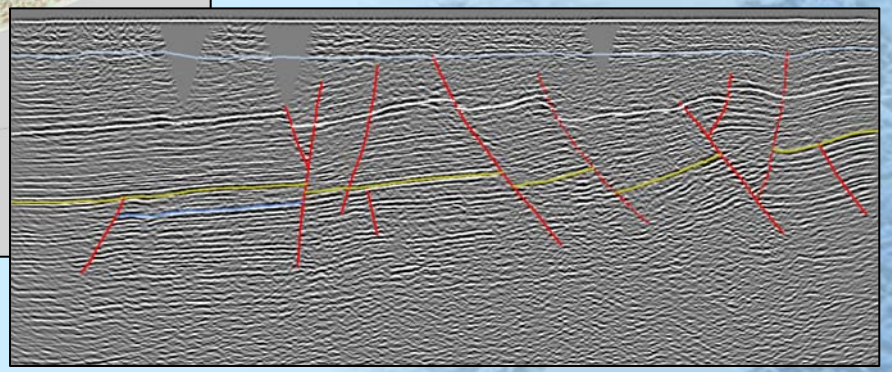




- metadata check
- harmonization of stratigraphy
- new nomenclature for Cenozoic deposits

Seismic interpretation



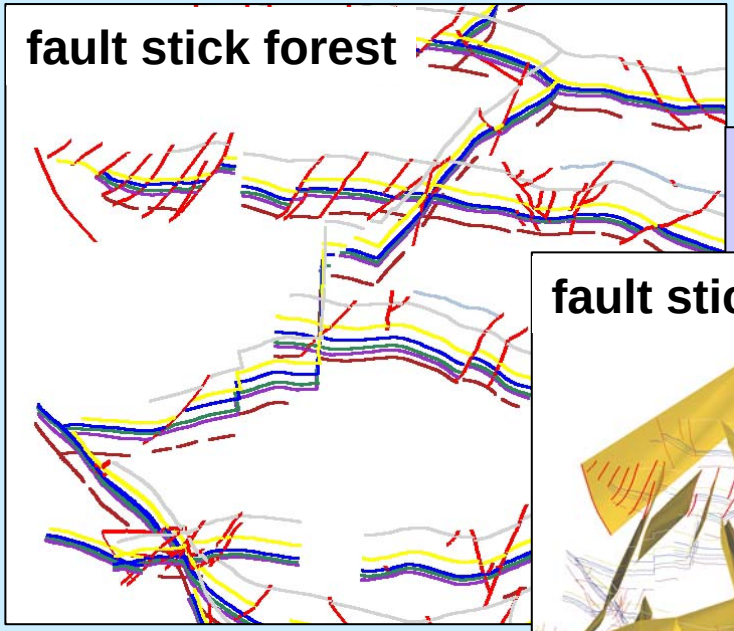


picking of faults and horizons...

... is a topic of the next presentation

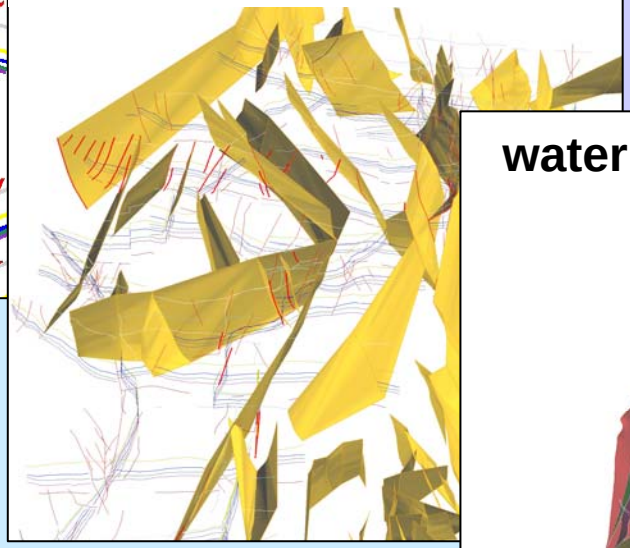
Fault modeling

fault stick forest

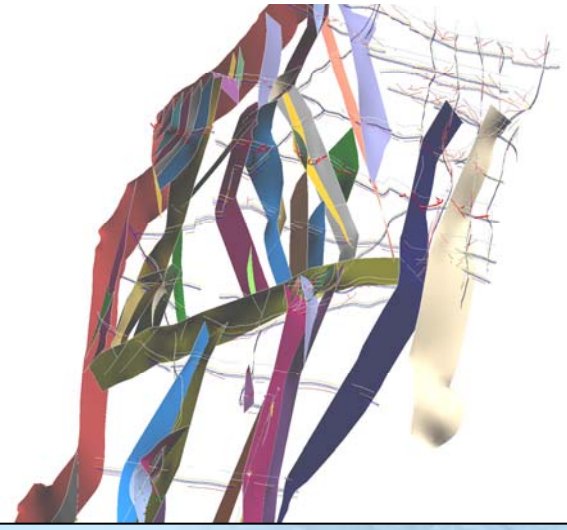


genetic model

fault stick correlation



waterproof fault network



Horizon modeling

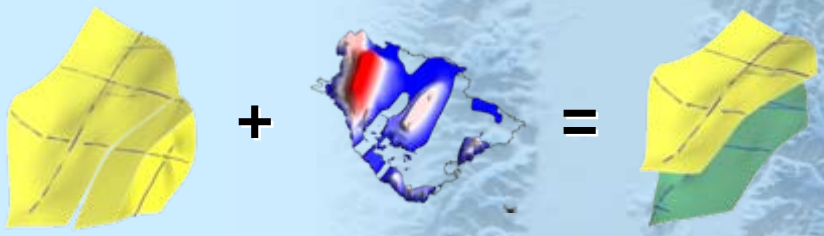
Cenozoic Horizons

base unconsolidated rocks (blg)
base Landau-Formation (bhy)
base Froidefontaine-Formation (bff)
base Tertiary (bt)

- **synsedimentary tectonics**
- **direct modeling from seismics**
- **modeling in time domain**

Mesozoic & Paleozoic Horizons

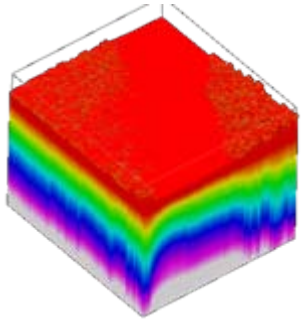
base Upper Jurassic (bjo)
top Hauptrogenstein (thr)
base Keuper (bku)
top Muschelkalksalinar (tms)
base Muschelkalk (bmu)
top crystalline basement (tkr)



- **minor synsedimentary tectonics**
- **reference horizons: direct modeling (time)**
- **thickness distributions (depth domain)**
- **derivative horizons: modeling in depth**

Velocity Modeling

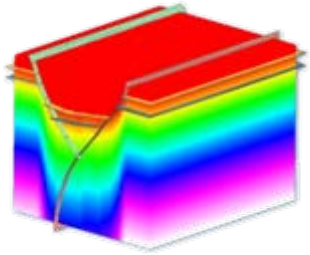
velocity model 1



done!

- depth - time conversion
- conversion of input data
- source: check shots (88)
- no geological structures (!)

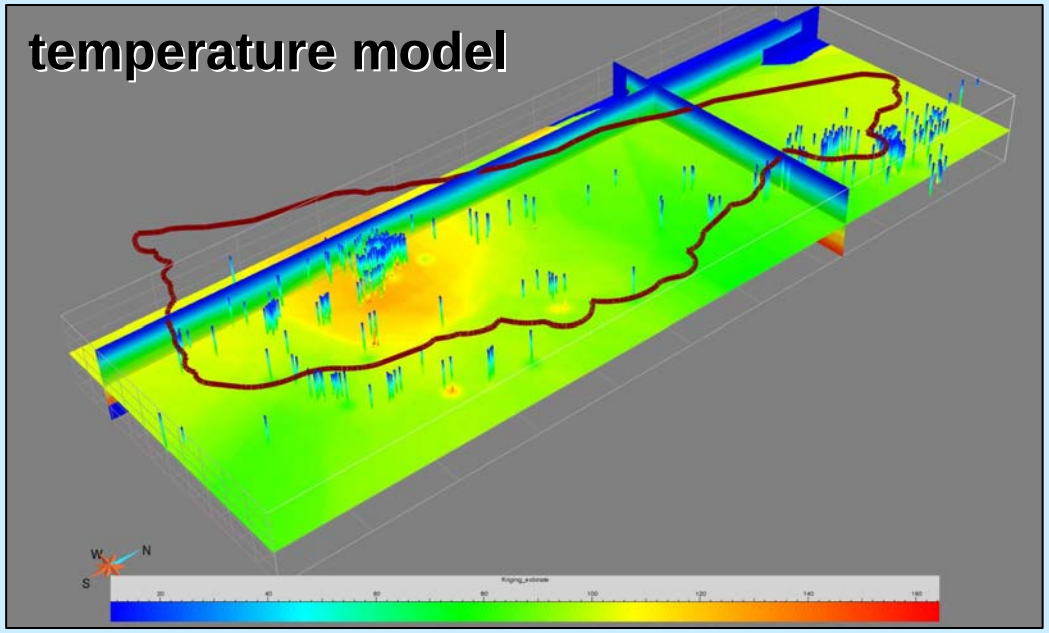
velocity model 2



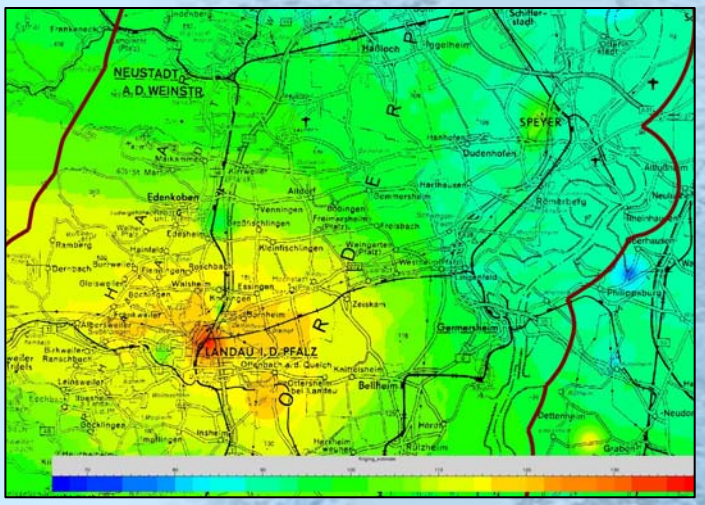
future!

- time - depth conversion
- conversion of 3d-model
- source: wells + 3d-model
- geological structures

Temperature modeling



temperature 1500m



- input data:
  - bottom hole temperatures (bht)
  - temperature logs
  - further temperatures measurements
- uniform bht corrections

- estimation with a kriging algorithm

Summary and future prospects

- GeORG is an Interreg project (BW, RLP, Fr, CH)
- aim: exploring of deep geopotentials
- geological model as a tool for the description of the 3d-configuration of the Upper Rhine Graben
- input data: geophysics, wells, hydrogeological & geothermal properties, results of previous projects
- extensive data harmonization
- 3d-modeling in time and depth domain, surfaces and volumes
- results will be available for professionals and the interested public

www.geopotenziale.org

Thanks for your attention