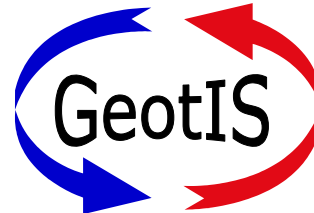




# ***Data Management and Visualisation of 3D-Objects in the Geothermal Information System GeotIS***



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Jens Gramenz, Carolin Kadner, Jörg Kuder, Evelyn Suchi,  
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Web Site:

<http://www.geotis.de>

Current Partners:

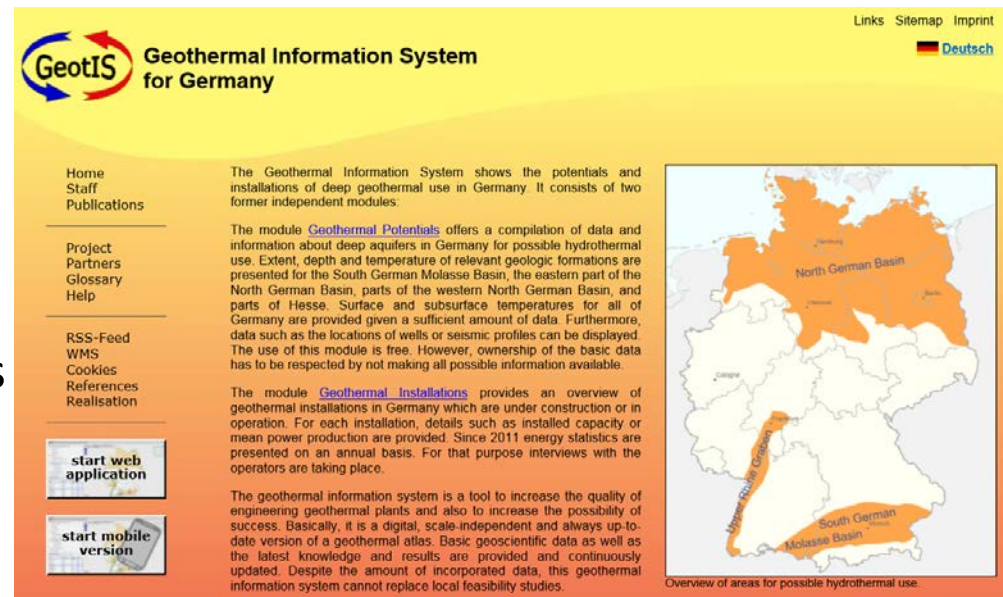


Landesamt für Umwelt,  
Naturschutz und Geologie

# GeotIS – Web-Based Geothermal Information System

- Location of geothermal facilities
- Operating parameters
- Geothermal energy statistics
- Areas of hydrothermal resources
- Well data
- Location of seismic surveys
- Stratigraphic models (3D)
- Subsurface temperature (3D)
- Hydraulic properties of formations
- Major fault network + fault literature

➔ <http://www.geotis.de>



The screenshot shows the GeotIS website for Germany. At the top left is the GeotIS logo, and to its right is the text "Geothermal Information System for Germany". In the top right corner, there are links for "Links", "Sitemap", and "Imprint", along with a "Deutsch" language selector. The main content area is divided into a left sidebar and a main text area. The sidebar contains navigation links: "Home", "Staff", "Publications", "Project", "Partners", "Glossary", "Help", "RSS-Feed", "WMS", "Cookies", "References", and "Realisation". Below these are buttons for "start web application" and "start mobile version". The main text area contains two paragraphs of introductory text and a map of Germany. The map highlights the "North German Basin" and "South German Molasse Basin" in orange, with a red line indicating the "Main Fault Zone". Below the map is the caption "Overview of areas for possible hydrothermal use".

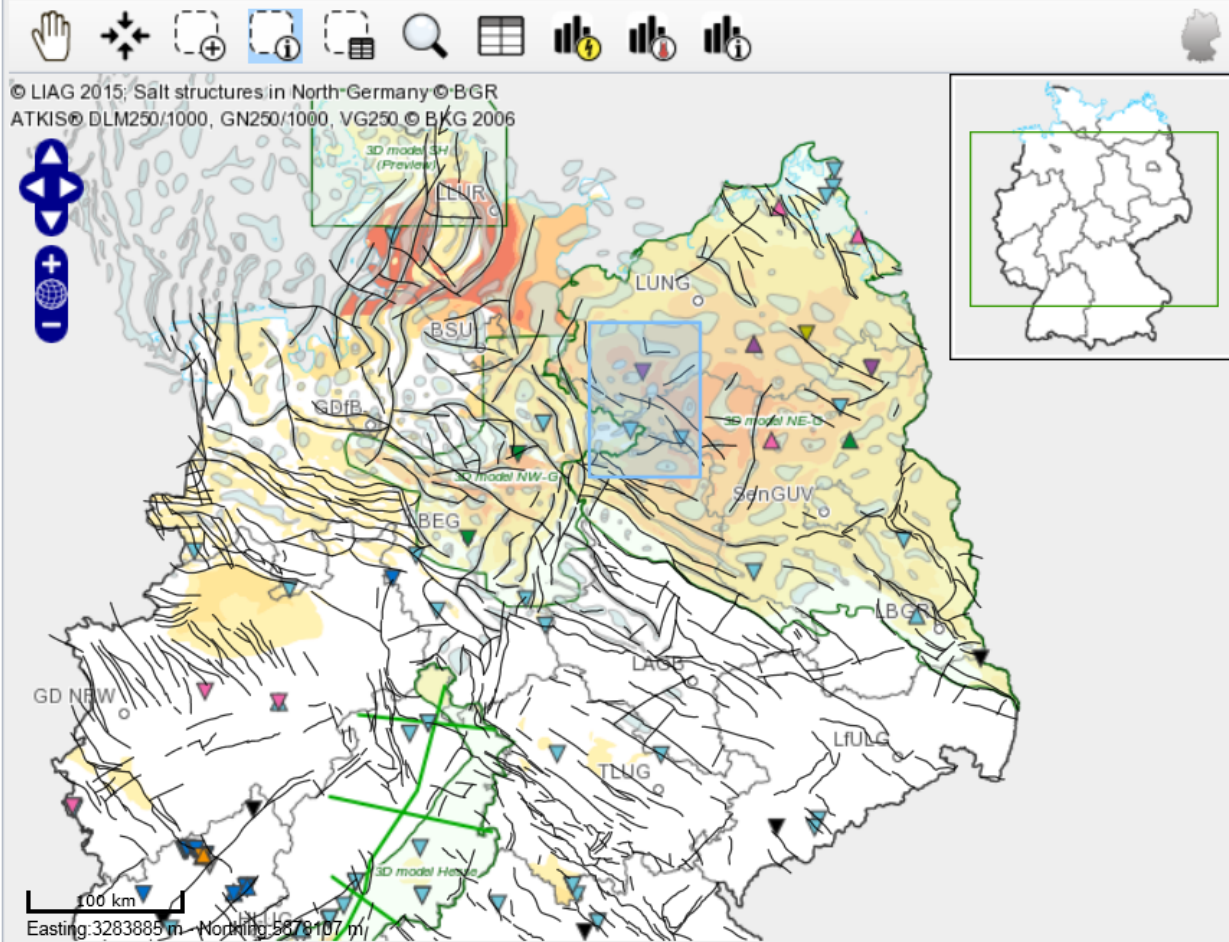
# GeotIS Web Interface

File Statistics Sections Functions State  
Help

- Installations (on - off)
- Thematic data
  - Wells
  - Static vertical sections
  - Fault zones (Preview)
  - Salt structures in North Germany
  - Seismics 2D
  - Seismics 3D
  - Areas with potential for hydrogeothermal exploitat

Information (Details)

cs Vertical plots Installations Fault zones				
Name	Primary use	Geoth. capacity [MW]	State	
Bad Wilsnack	Thermal spa	no data	Operating	<a href="#">i</a>
Gartow - Thermalsole-Brunnen	Thermal spa	no data	Operating	<a href="#">i</a>
Neustadt-Glewe	District heating	4.00	Operating	<a href="#">i</a>



# GeotIS Web Interface



File Statistics Sections Functions State

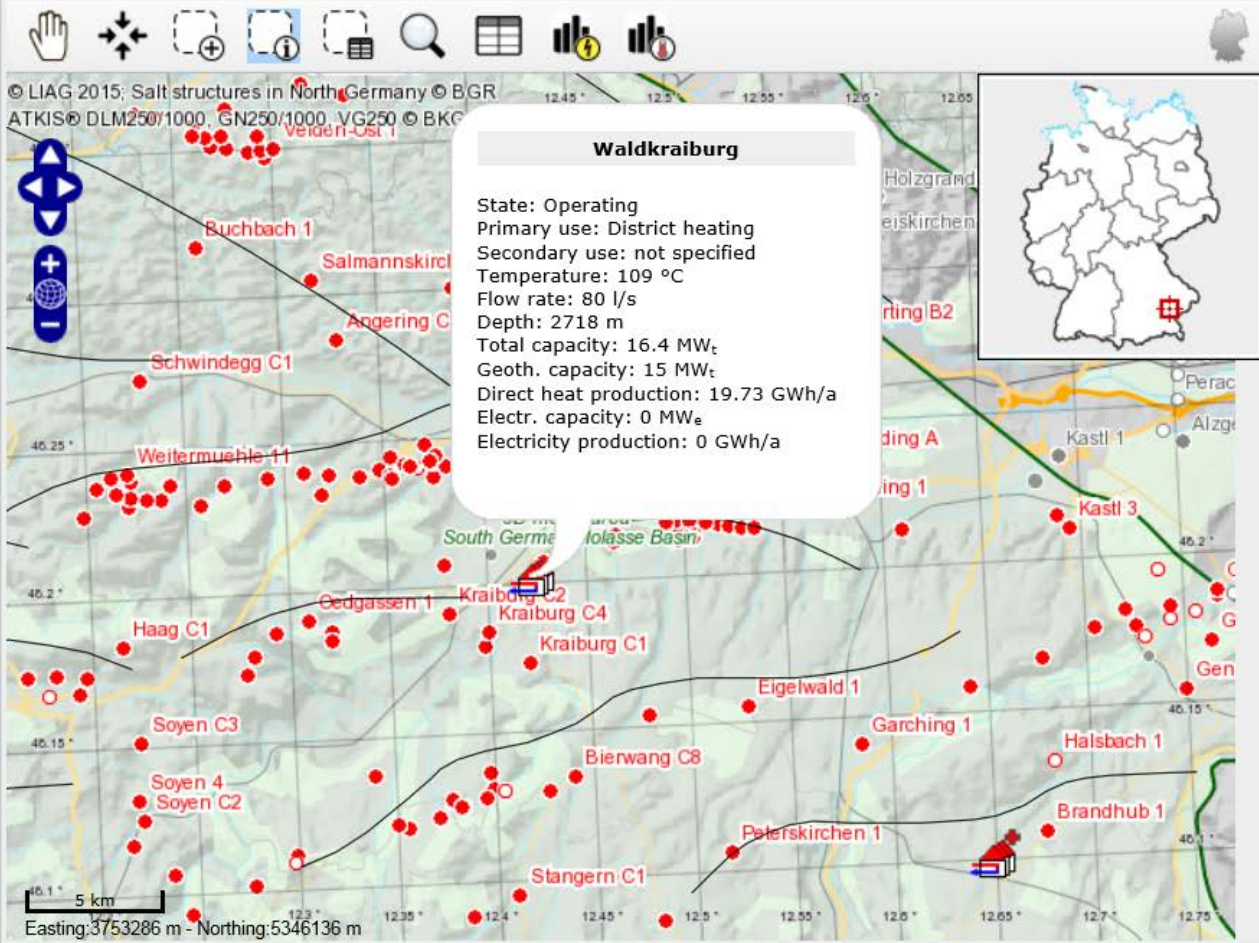
Help

- Seismics 2D
- Seismics 3D
- Areas with potential for hydrogeothermal explo
- 3D-Models (on - off) ⓘ
- Formation hydraulic conductivity (T/H)
- Concession areas
  - Baden-Wuerttemberg
  - Lower Saxony
- Geothermal atlas

## Information

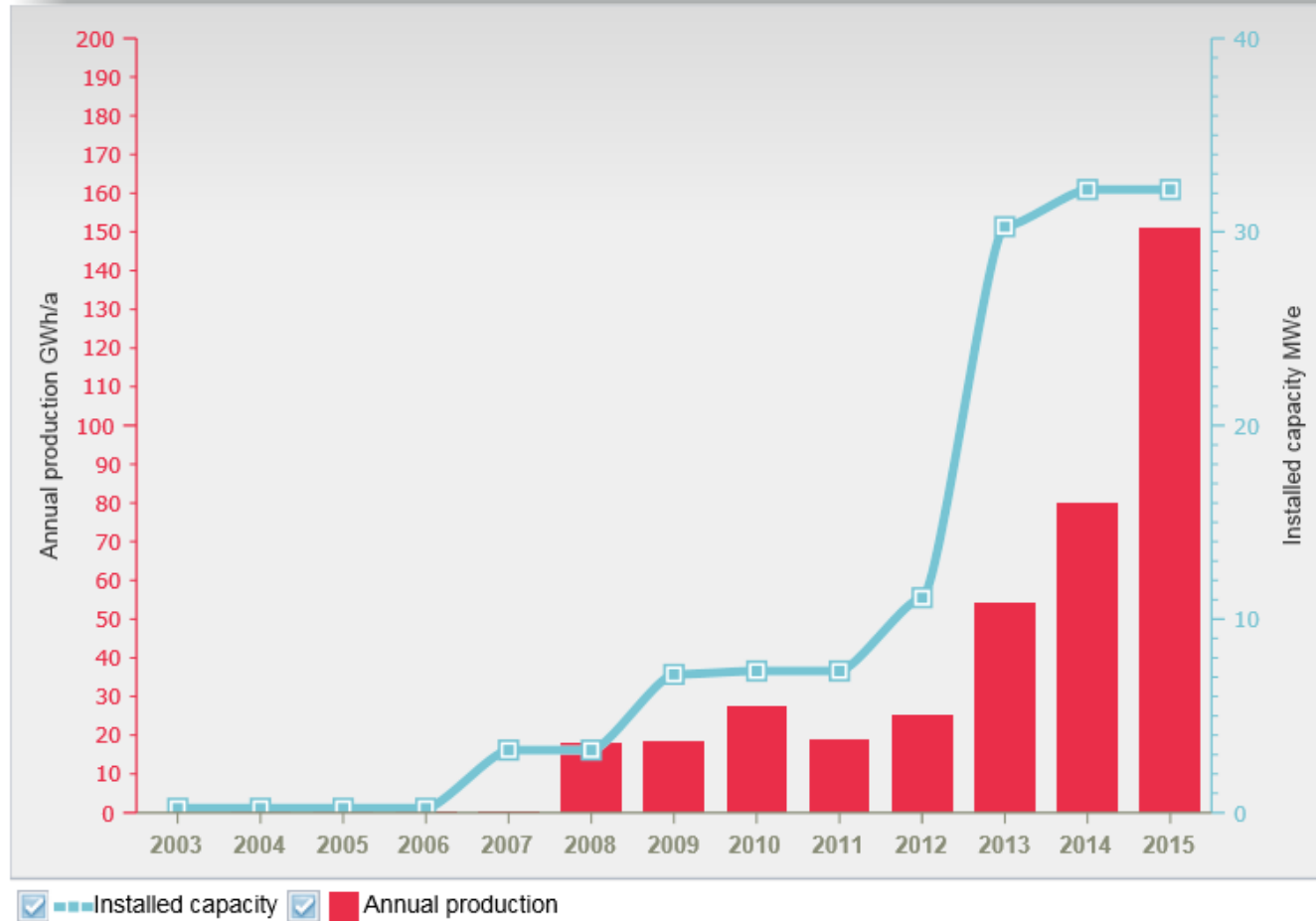
plots Installations Fault zones Info

Name	References	Link
Taufkirchen-Störung	1	ⓘ

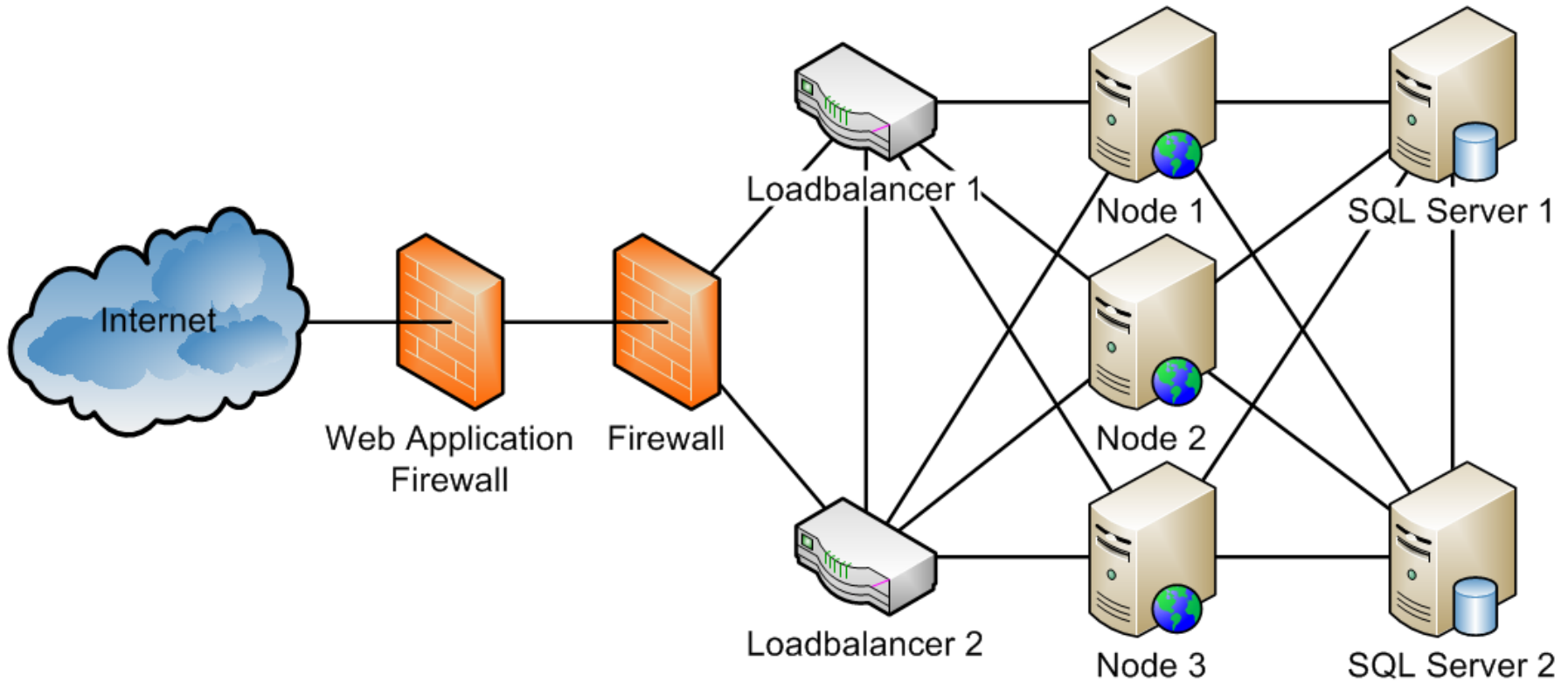


# GeotIS Energy Statistics

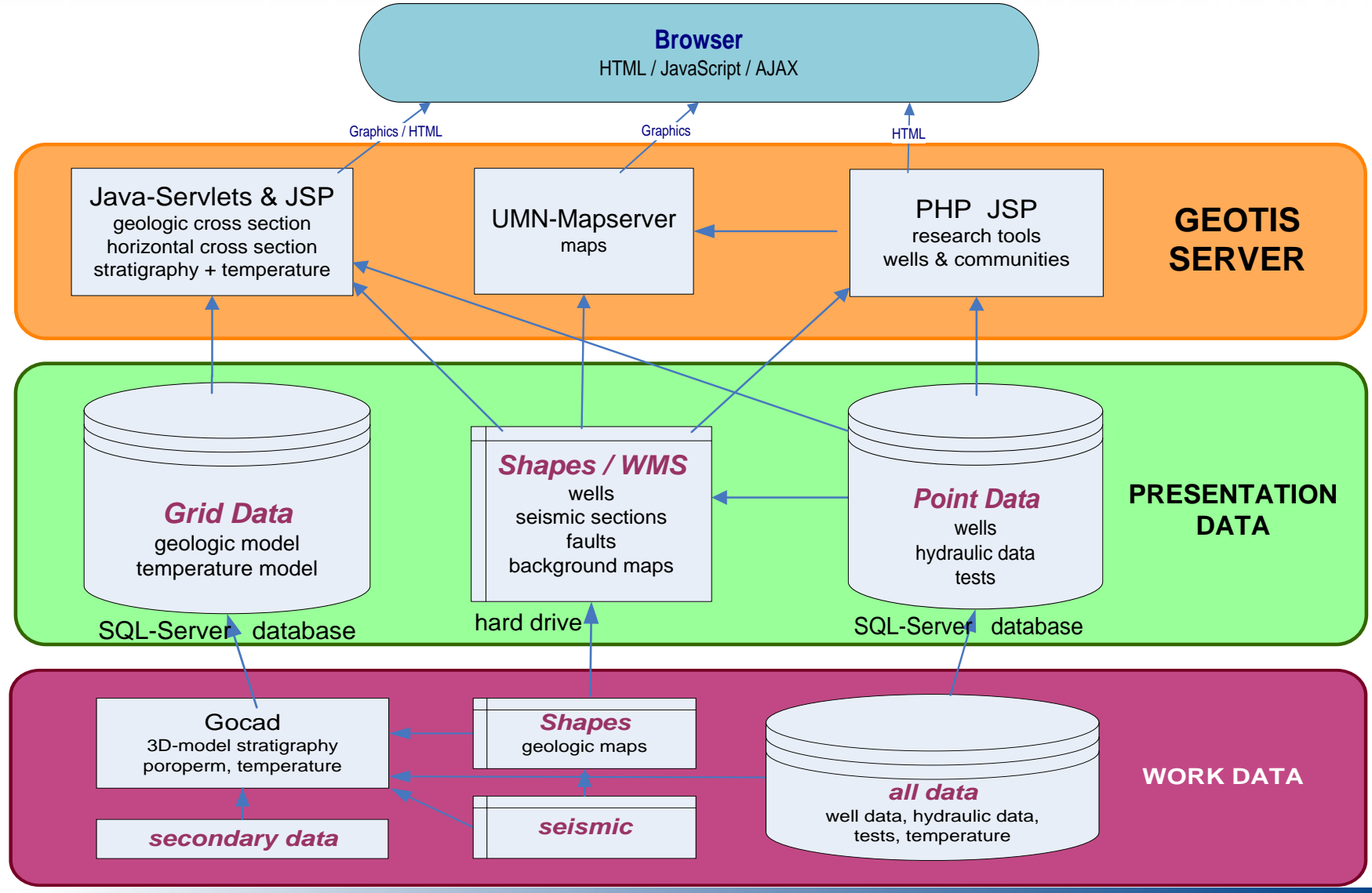
Installed capacity [ $\text{MW}_e$ ], Annual production [ $\text{GWh/a}$ ]



# GeotIS IT-Architecture

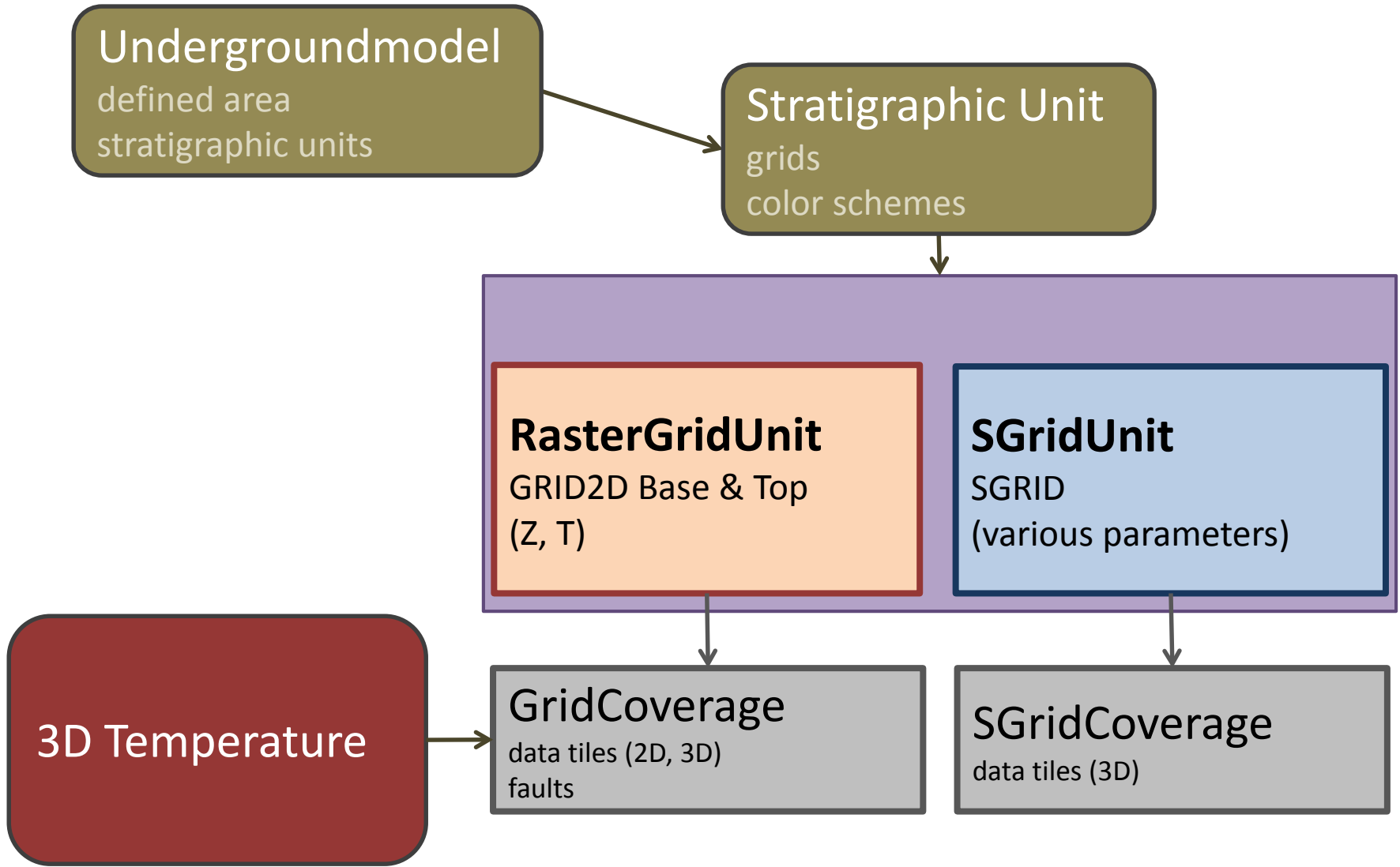


# 3 Layer Concept

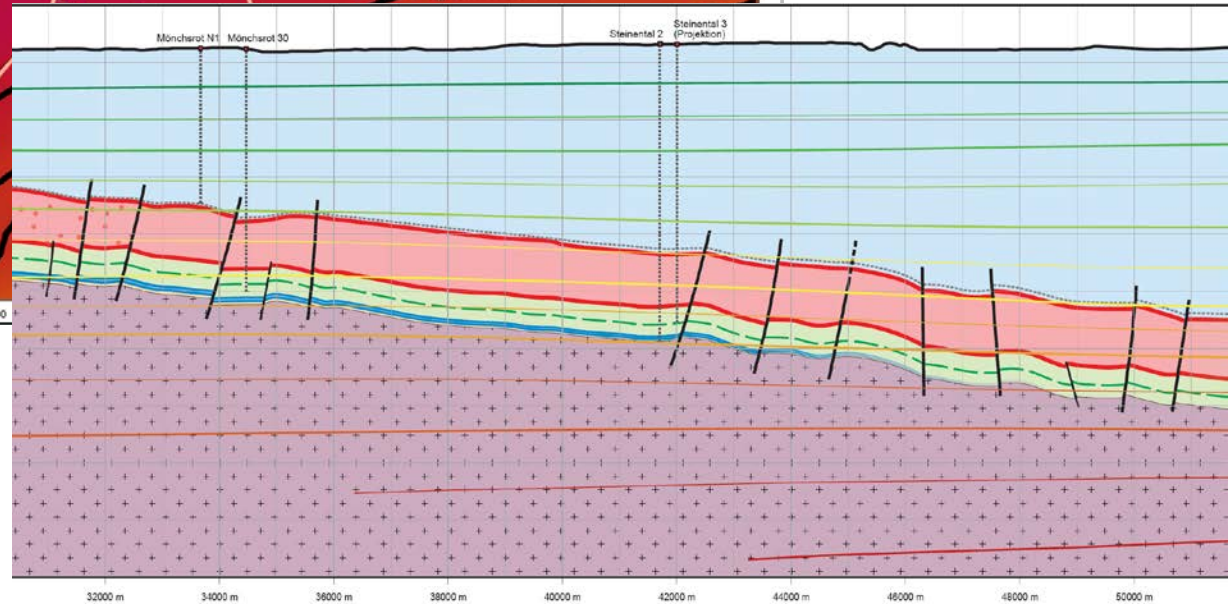
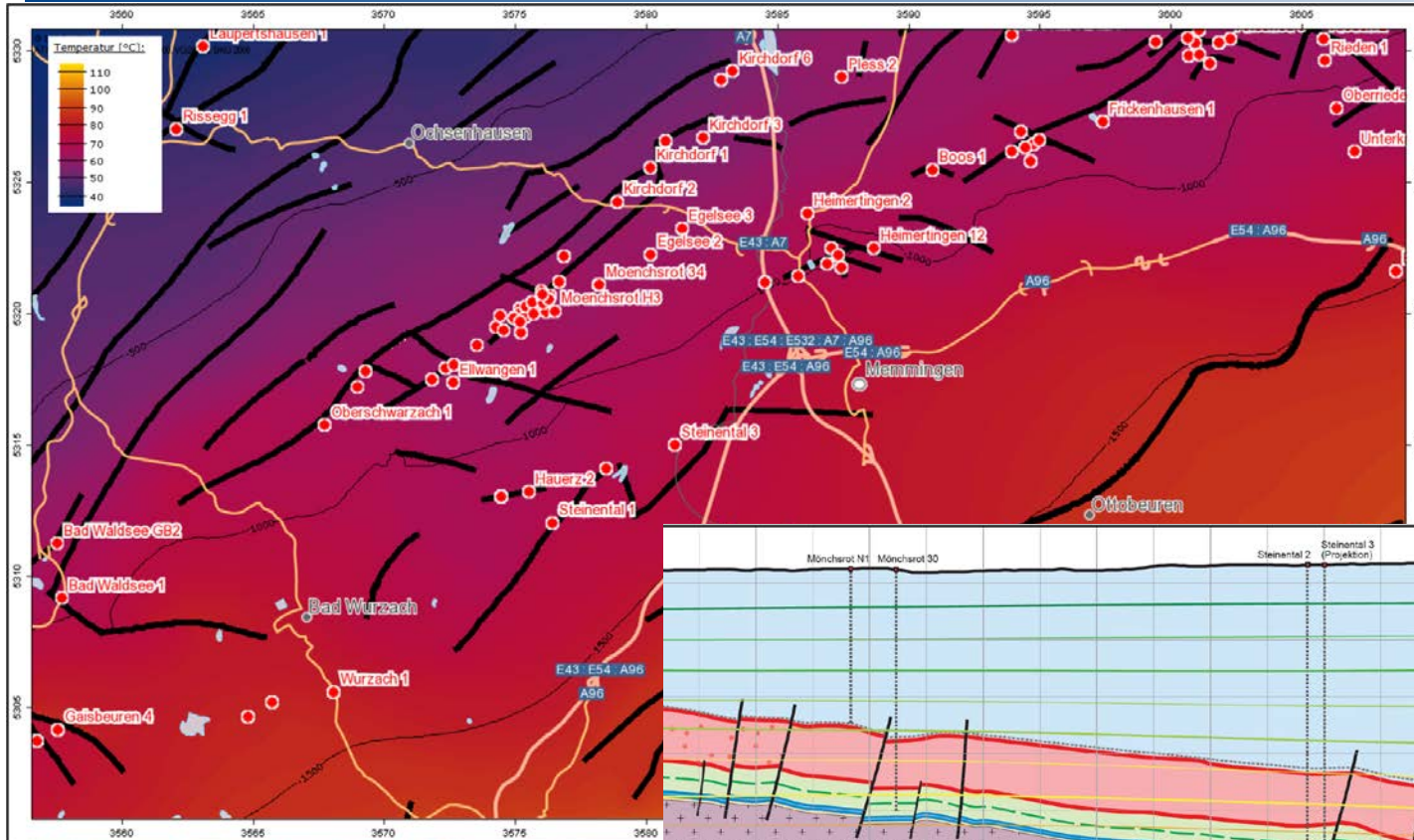




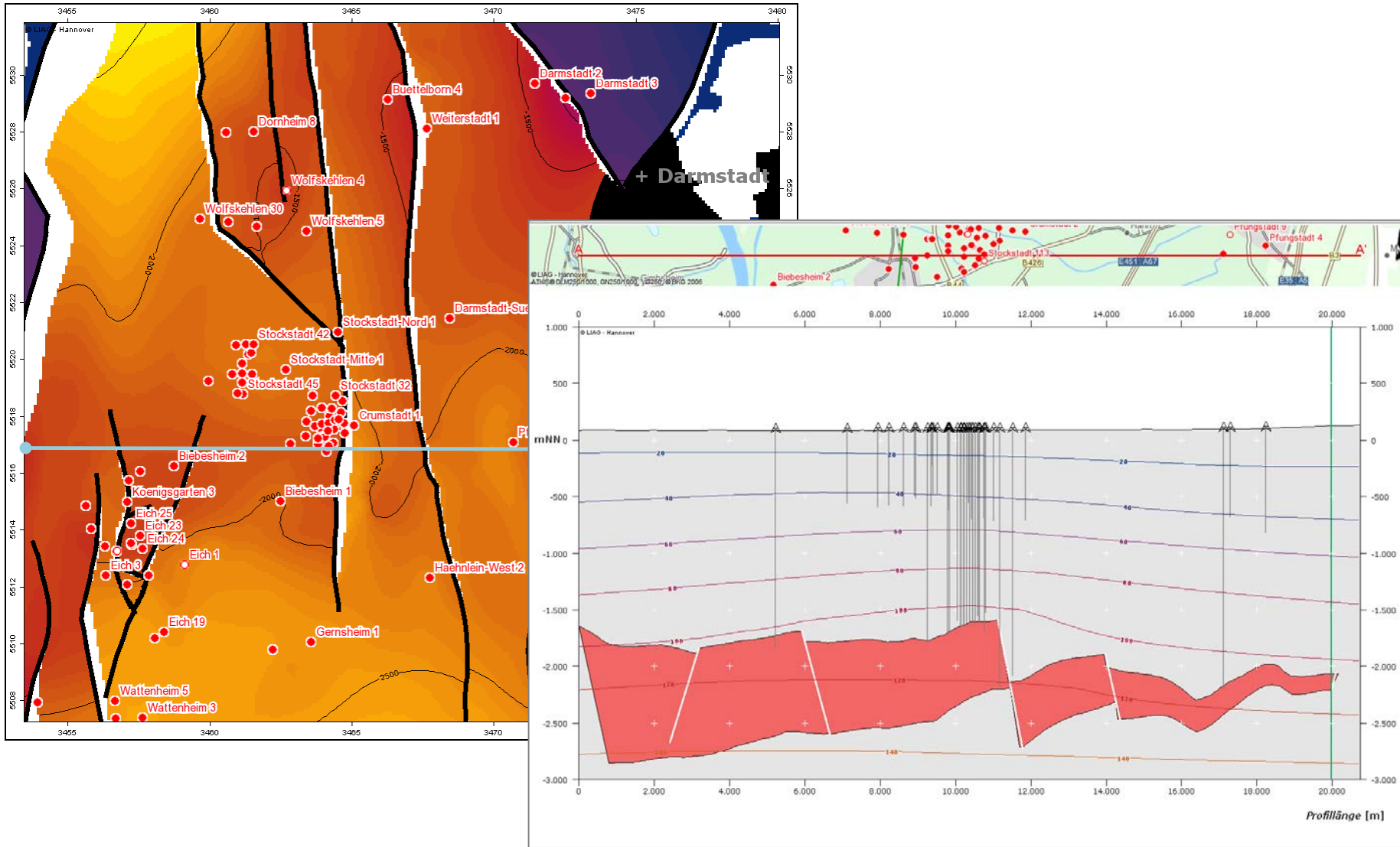
# Grid Data



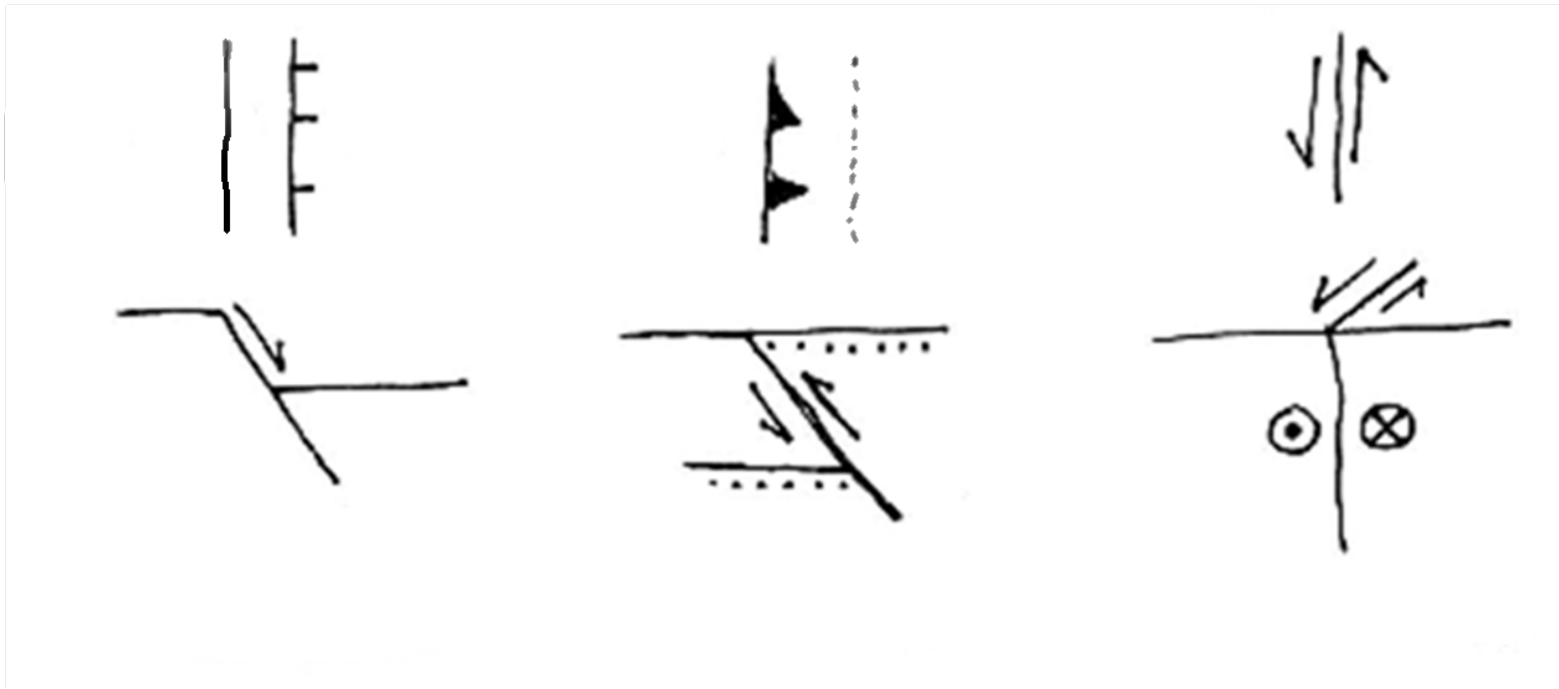
# Viualisation of Faults in GeotIS



# Visualisation of Faults and Interactive Cross Sections



# Visualisation of Faults in GeotIS



# 2½D Raster (GRID2D)

## TIN:

Triangular Irregular Network

Node spacing: 50 - 5000 m (variable)

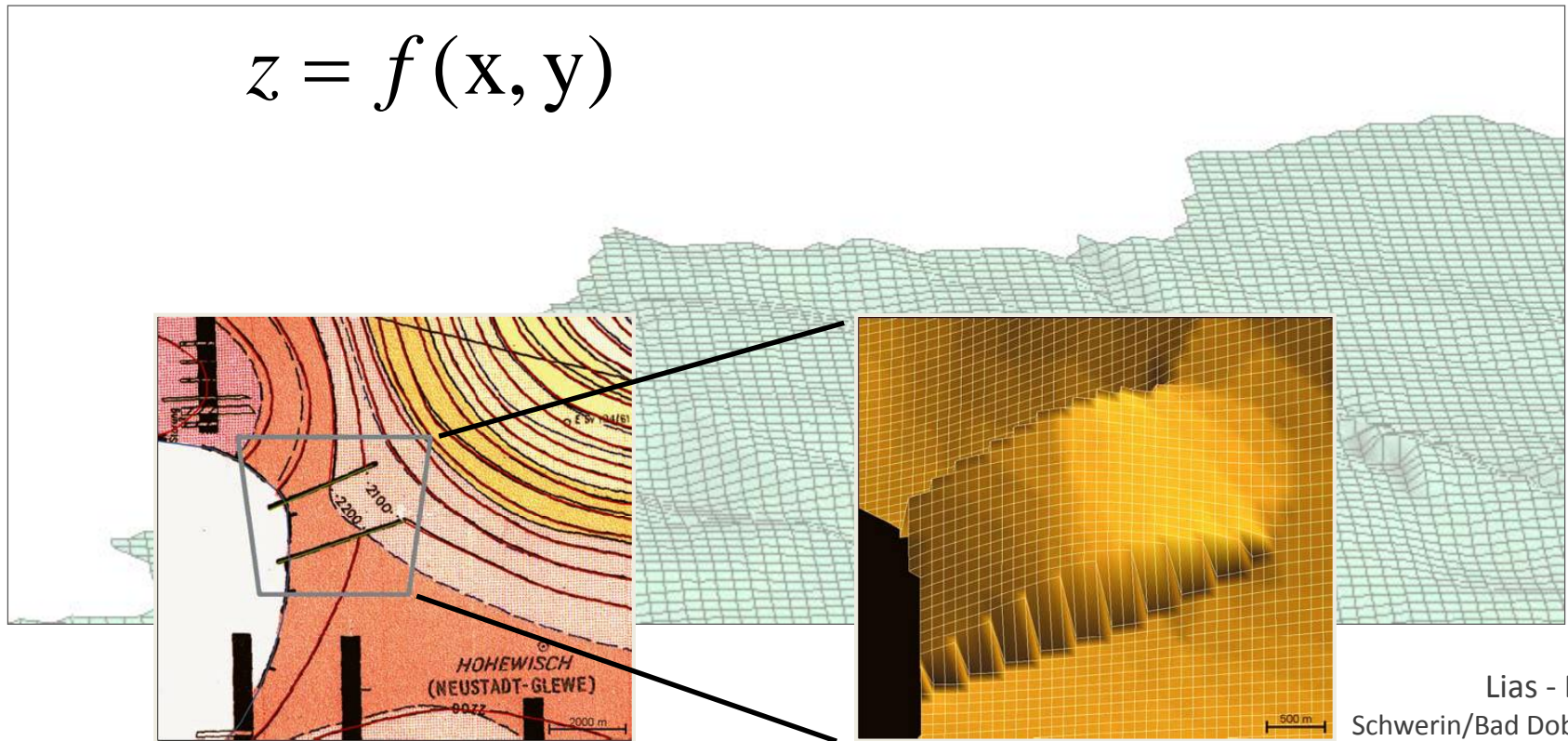
## GRID2D:

regular, orthogonal

Node spacing: 100 m (fixed)

Import as CPS3 file

$$z = f(x, y)$$



Lias - Base  
Schwerin/Bad Doberan

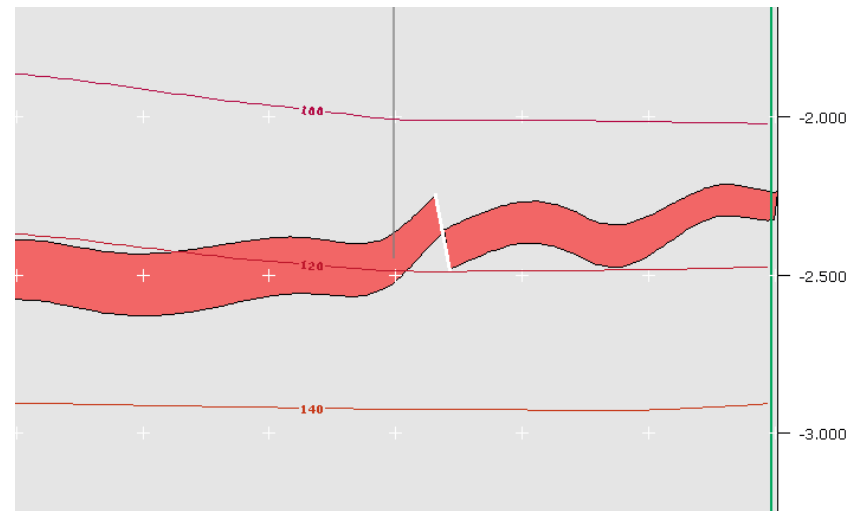
# 2½D Raster (Grid2D)

## Advantaes:

- Very fast grid operations
- cross sections and top views are simple to create
- Simple generalization (scale adaption)
- Little memory usage
- Export option in Gocad/Skua

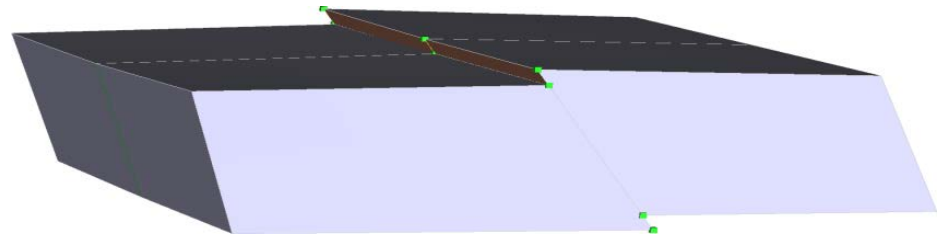
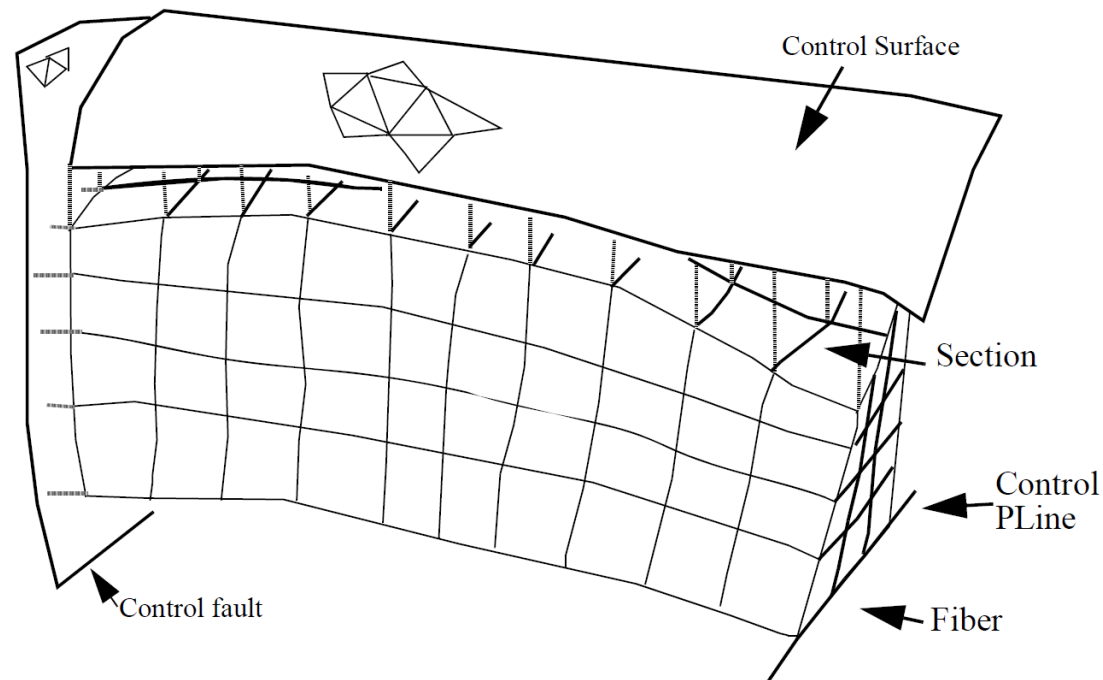
## Disadvantages:

- Fault geometry not part of grid
- Geometrical restrictions: no thrust faults or overturned formations
- Realization of normal faults are very laborious

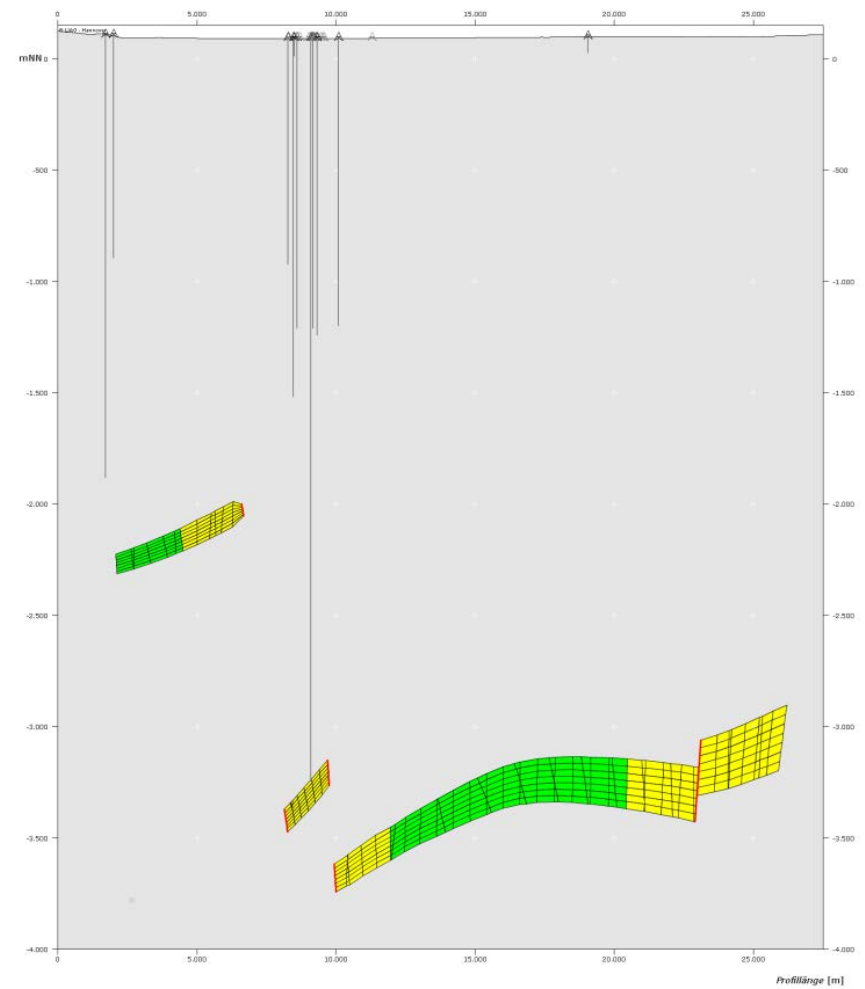
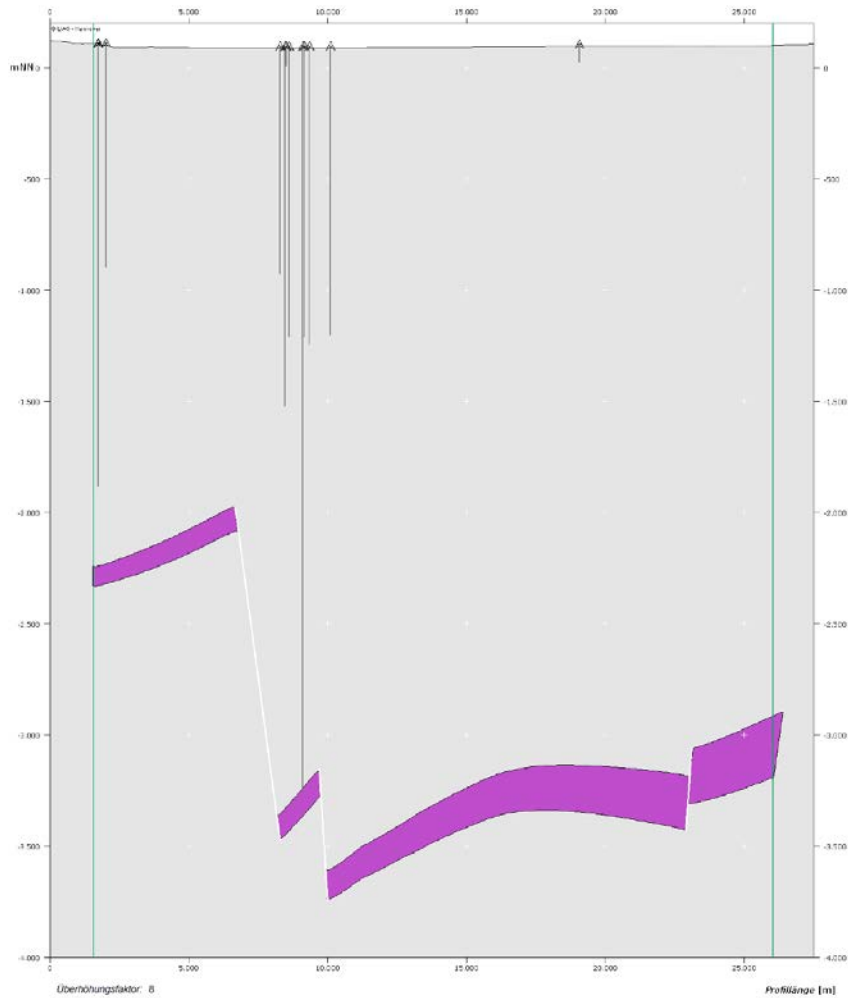


# Stratigraphic Grids (SGRID)

- **Hexahedron** network / volume grid (cells)
- Each node has its coordinate triplet ( $uvw \Leftrightarrow xyz$ )
- Properties are node or cell centred
- Cells follow horizons, fault planes or lines
- Faults are realised by splitting with up to 7 split nodes for one regular node
- Neighbour cells, dead cells, borders and faults are stored as binary flags
- Import as native Gocad/Skua file
- Easy transformation to tetrahedrons

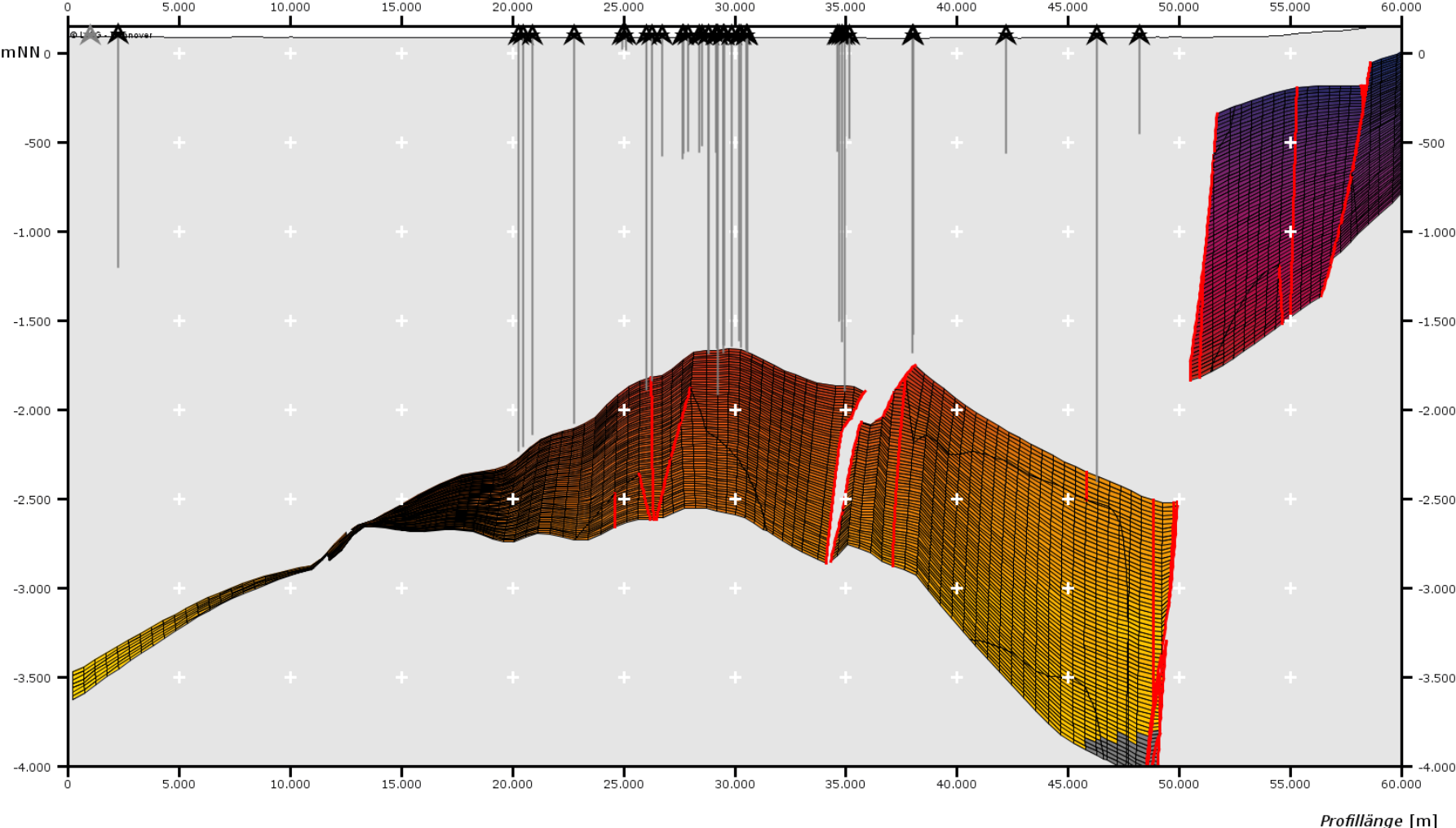


# Cross Sections Based on GRID2D & SGRID

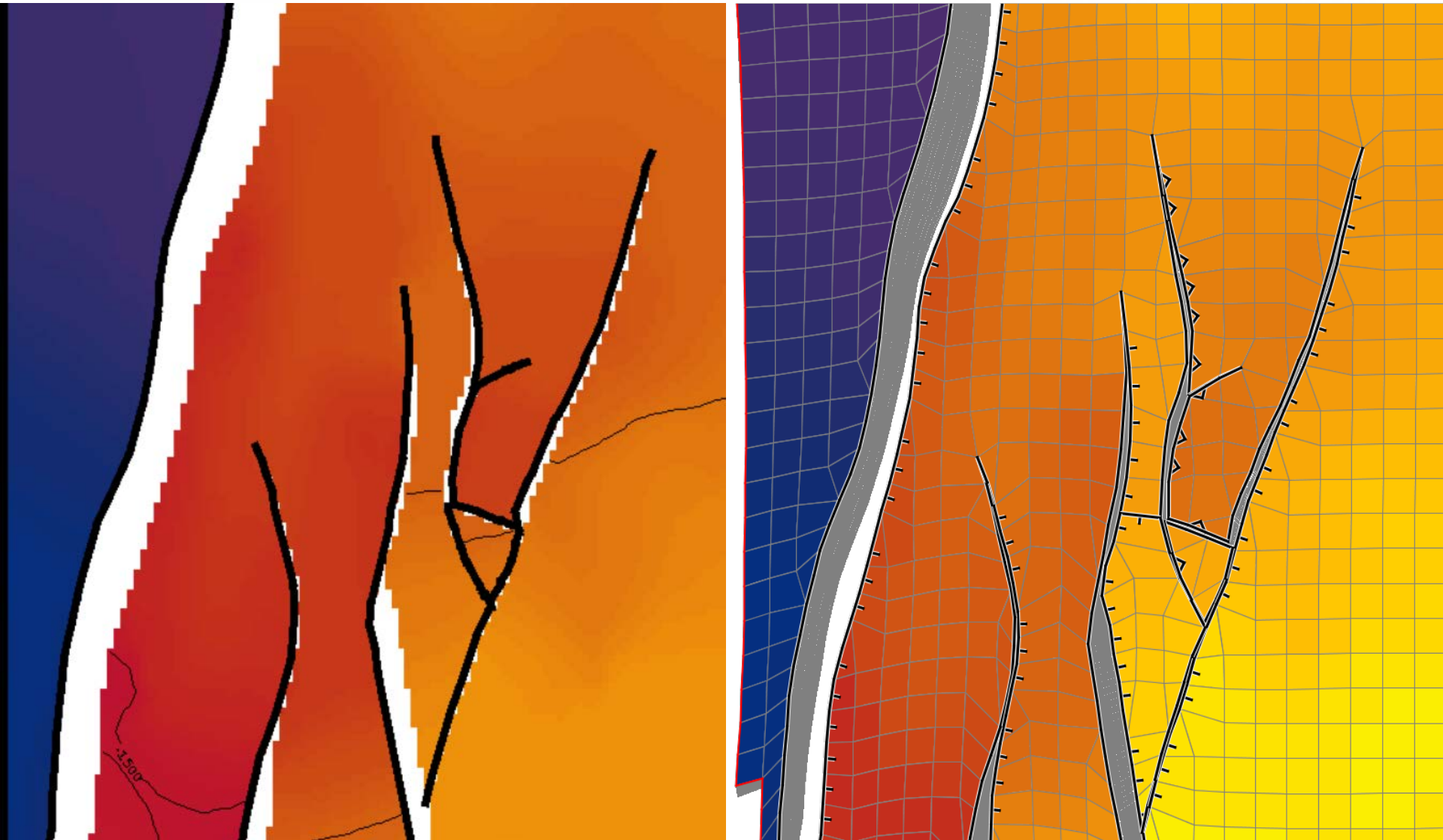




# Visualisation of Parameters on Cross Sections



# Top View Comparison GRID2D & SGRID



# SGRID Files (Gocad/Skua)

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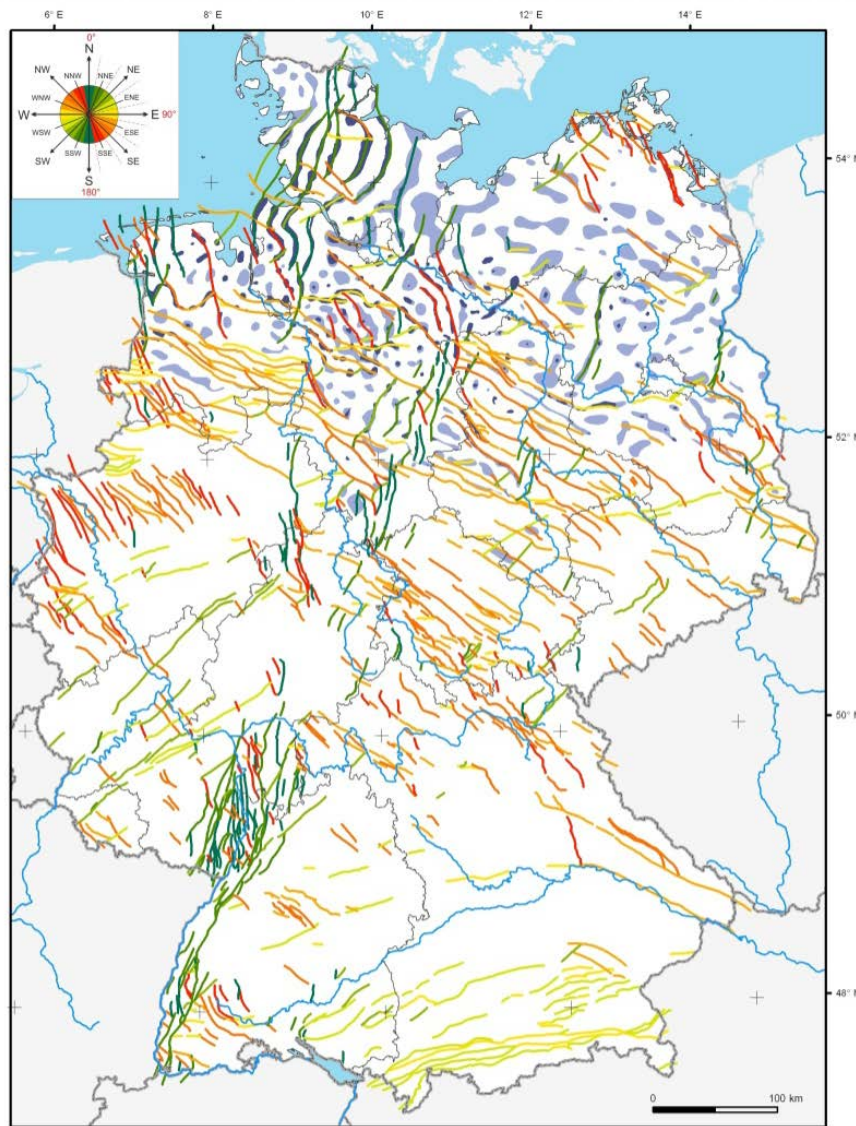
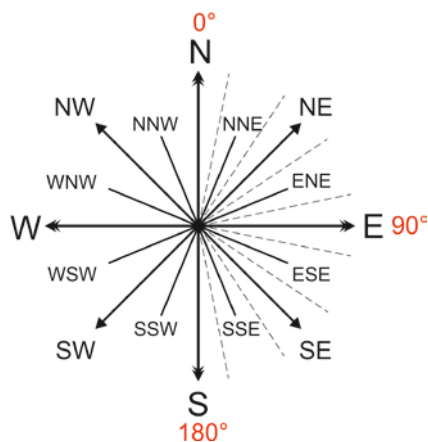
## Java Programme *geotisCore*

- reading SGrids
  - Filename.sg ✓
  - FilenameObjectname\_\_ascii@@ ✓
  - FilenameObjectname\_\_flags@@ ✓
  - FilenameObjectname\_\_region\_flags@@ X
- Validating Hexahedrons,  
killing flat cells ✓
- Generating cross section ✓
- Generating top view ✓

# Characterization of Fault Systems

Attributes of fault lineaments:

- Code number
- Category, horizon
- Name of fault zone
- Reference
- Length, strike
- Map sheet (GÜK200)



# Characterization of Fault Systems

## Literature Review:

- Approx. 1000 references in the records
- Linking lineaments with map sheets

Field	Value
Anzahl_GÜE	2
Bemerkung	
Code_Nr	Sz1212
FID	834
GUEK200_1	CC3918
GUEK200_2	CC3926
GUEK200_3	
GUEK200_4	
GUEK200_5	
GUEK200_BI	CC3918 (Hannover); CC3926 (Braunschweig)
Horizont	
ID_Nr	855
Kategorie	Sockelstörungen
Laenge_km	57
Name	Marienburg-Wienhausen-Störungszone
Quelle	Brückner-Röhling et al. (2002)
Shape	Polyline
Streich_°	34
Streichen	NE - SW

**Literatur-Verzeichnis – Geologische Störungen GÜK200-Kartenblatt CC 3918**

**Literatur-Verzeichnis – Geologische Störungen GÜK200-Kartenblatt CC 3926**

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Baldschuhn, R., Frisch, U. & Kockel, F. (1996): Geotektonischer Atlas von Nordwest-Deutschland 1:300.000. - Bundesanstalt für Geowissenschaften und Rohstoffe; Hannover.

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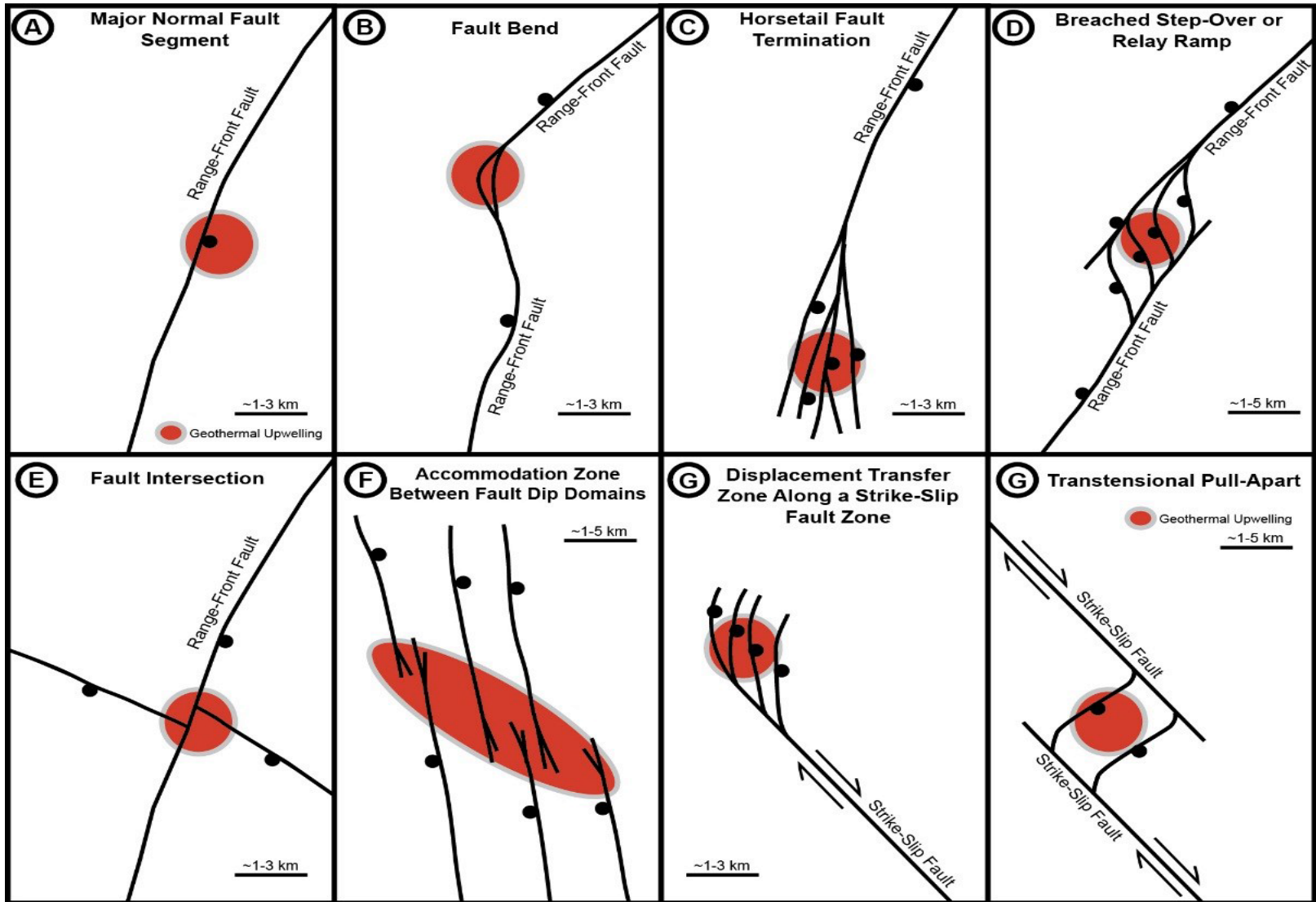
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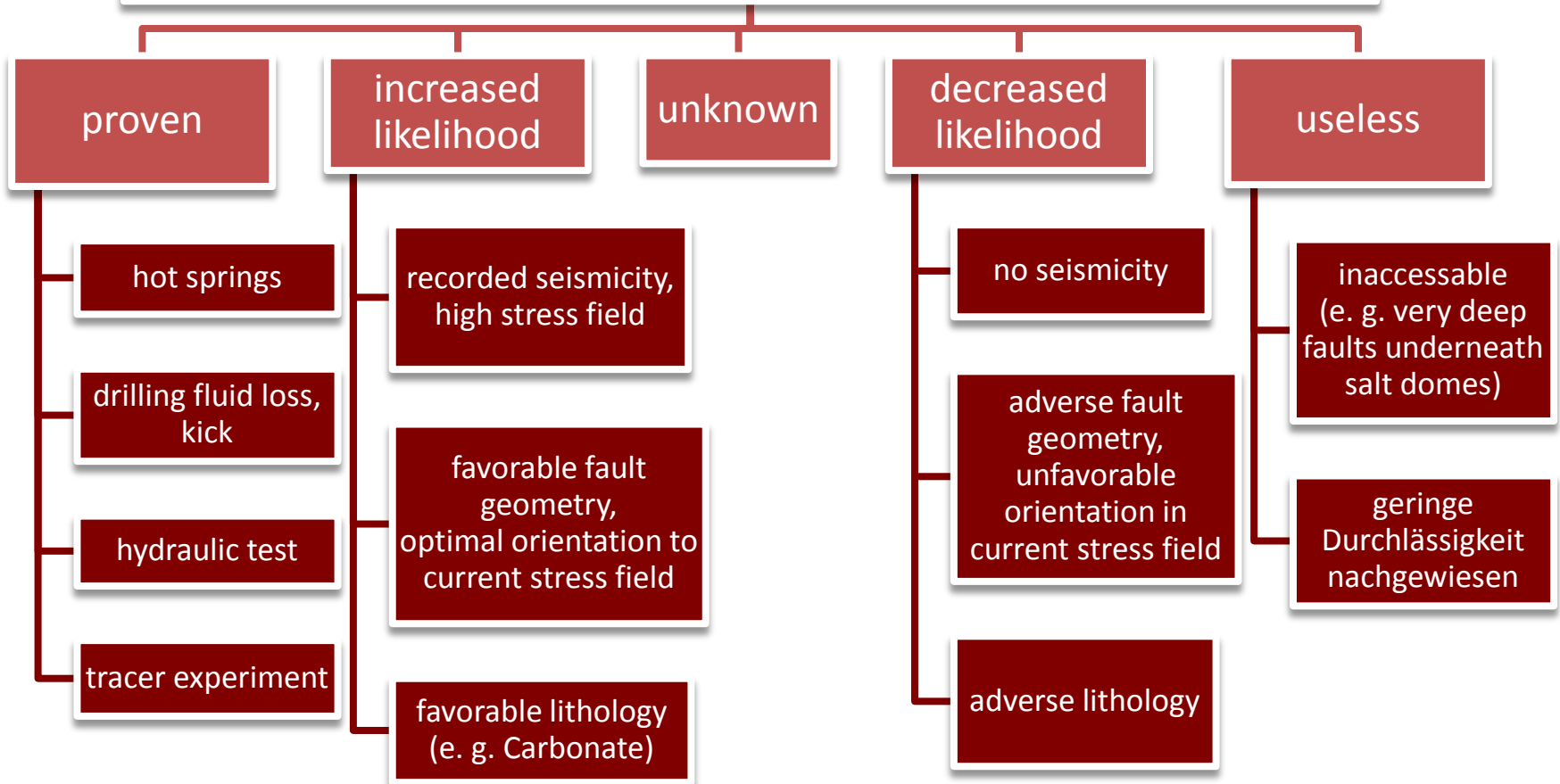
# Fault Geometric Setting



Faulds & Hinz (2015)

# Geothermal Classification of Deep Faults in Germany

## Fault categories according to hydraulic conductivity



# Summary

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- Web-GIS with complex client-server architecture
- Data storage in files and in a relational database (> 100 tables)
- Clear separation between working data and presentation data
- Sophisticated workflows for updating database
  - wells
  - geothermal output statistics
  - geologic models
  - temperature model
  - fault literature
- GeotIS improved data import interface
- New algorithms for SGRIDs visualization

☛ <http://www.geotis.de>