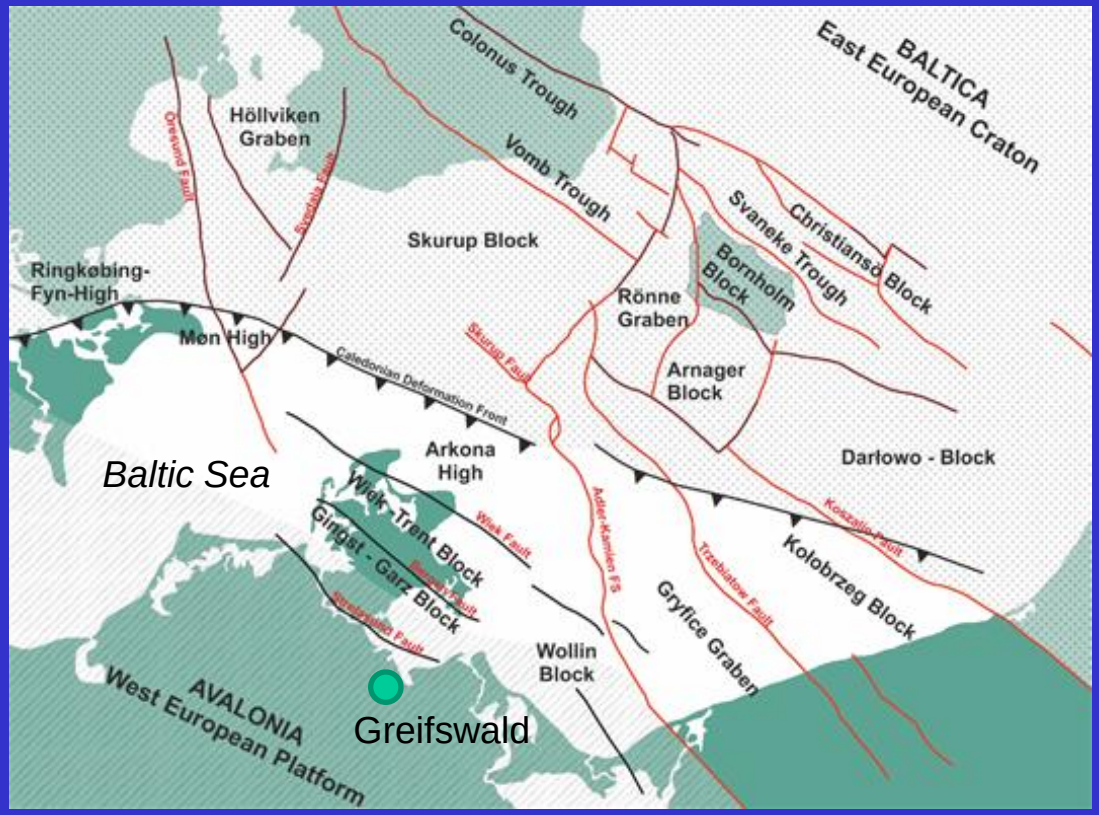
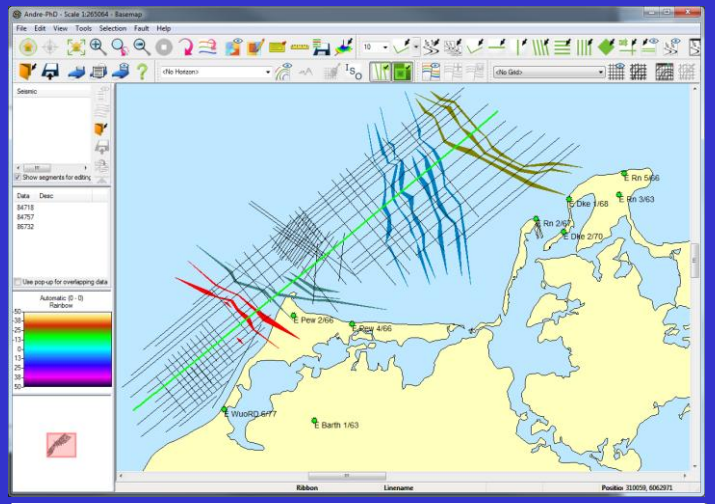
Steps towards a 3D model of the German Baltic Sea area – collaboration with academic research in the USO project



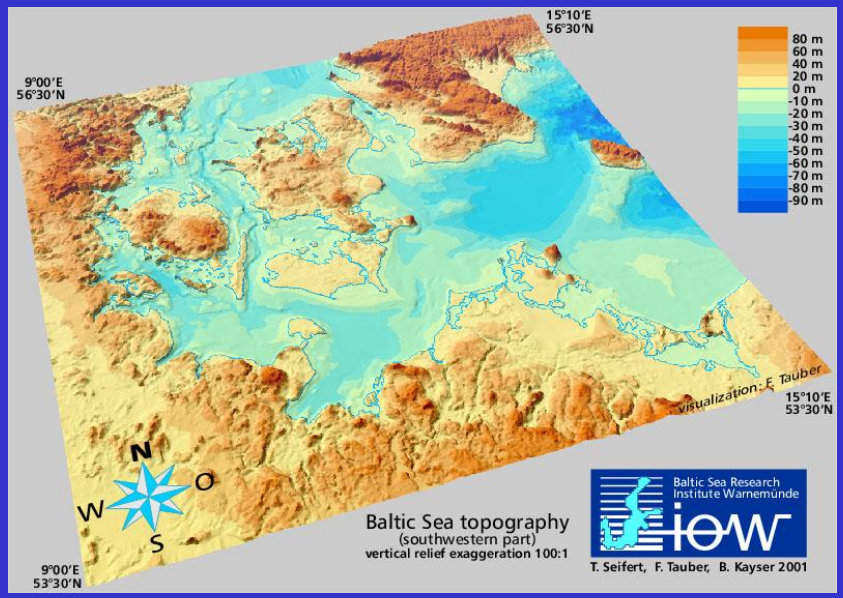


Karsten Obst[1], André Deutschmann[1], Elisabeth Seidel[2] & Martin Meschede[2]

[1]Geological Survey of Mecklenburg-Western Pomerania, [2]University of Greifswald

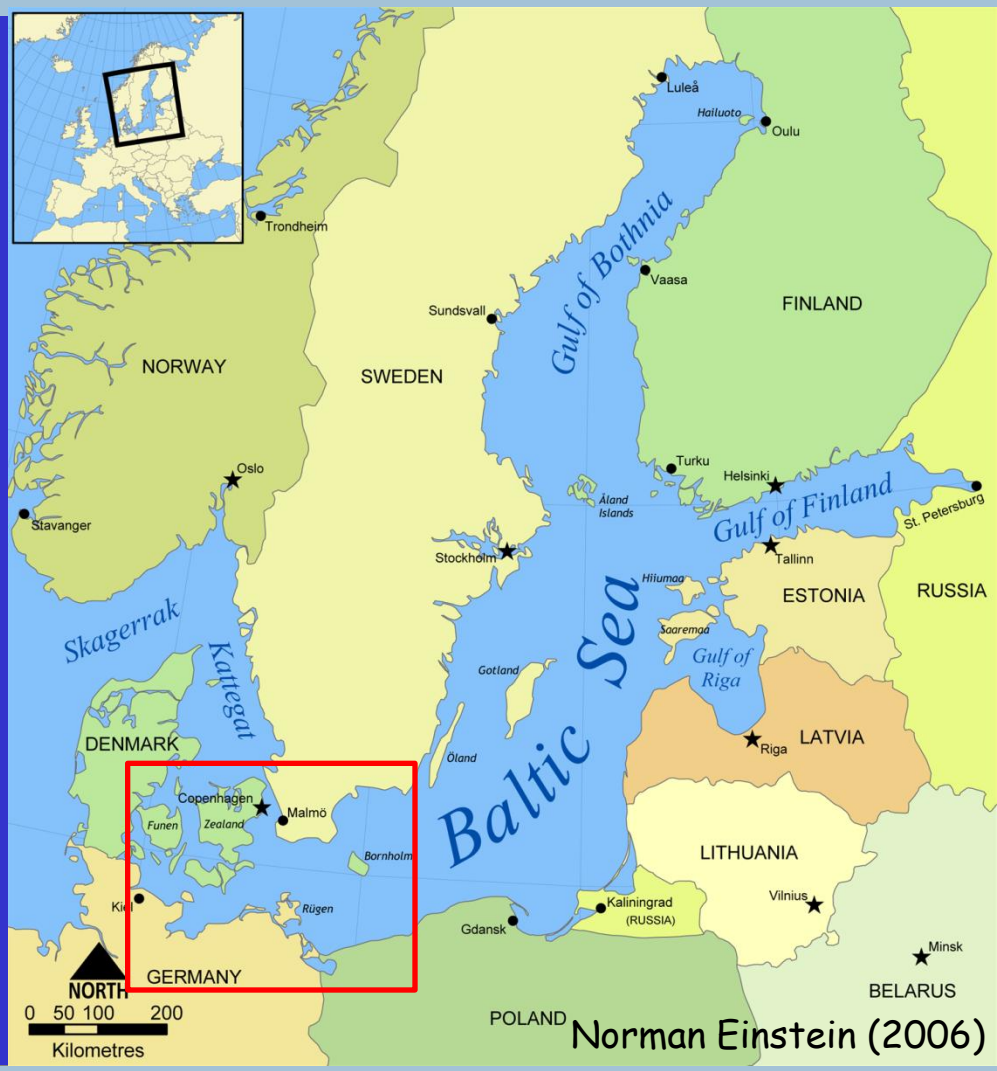
The USO project

Goals and project area



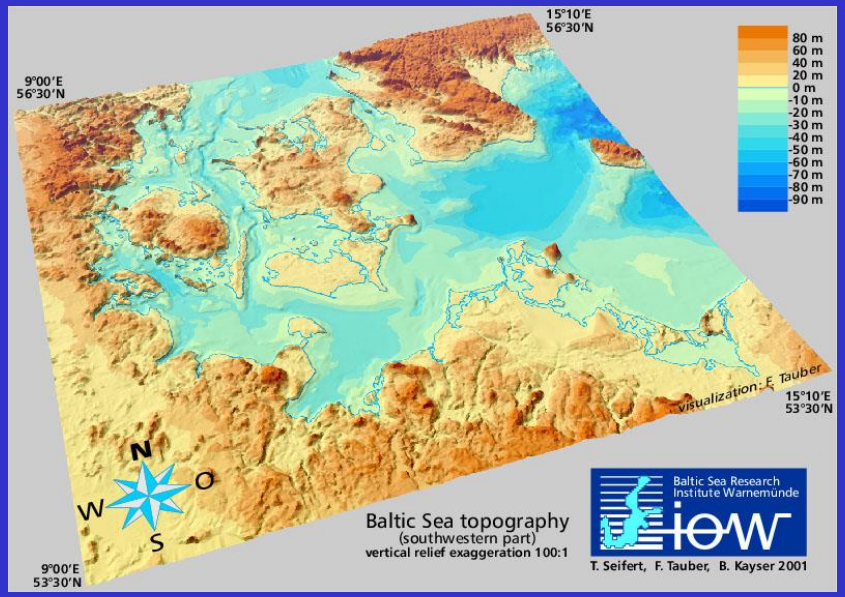
USO = „Untergrundmodell Südliche Ostsee“

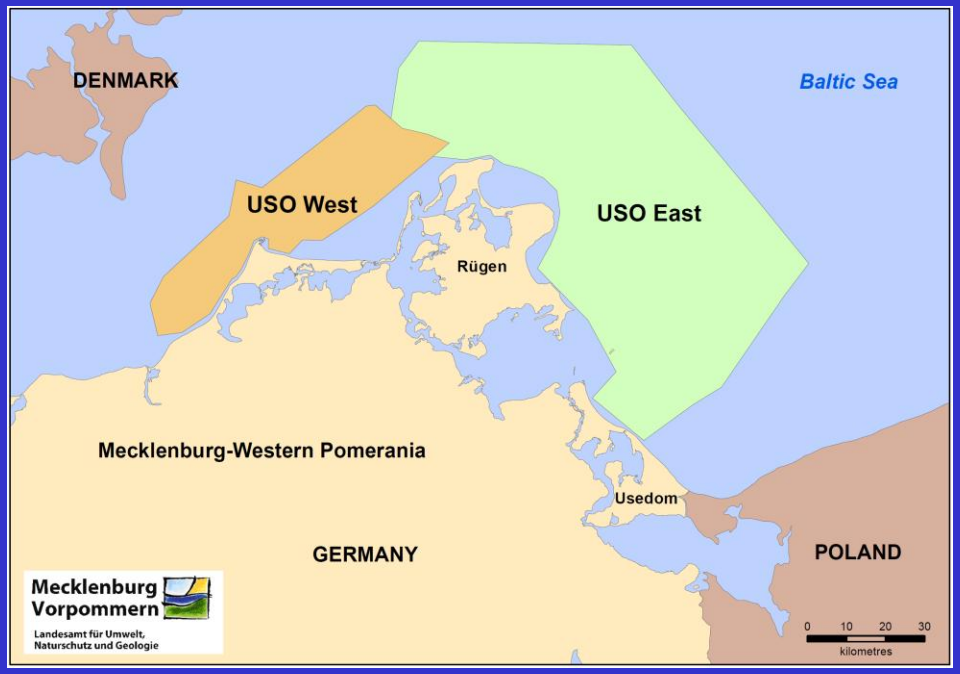
3D subsurface model of the southern Baltic Sea area



The USO project

Goals and project area





USO = „Untergrundmodell **S**üdliche **O**stsee“

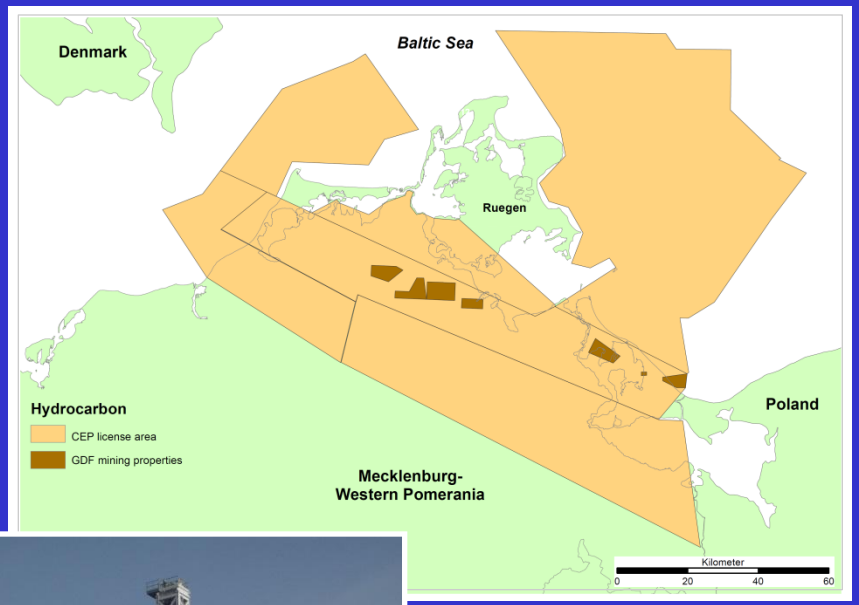
3D subsurface model of the southern Baltic Sea area

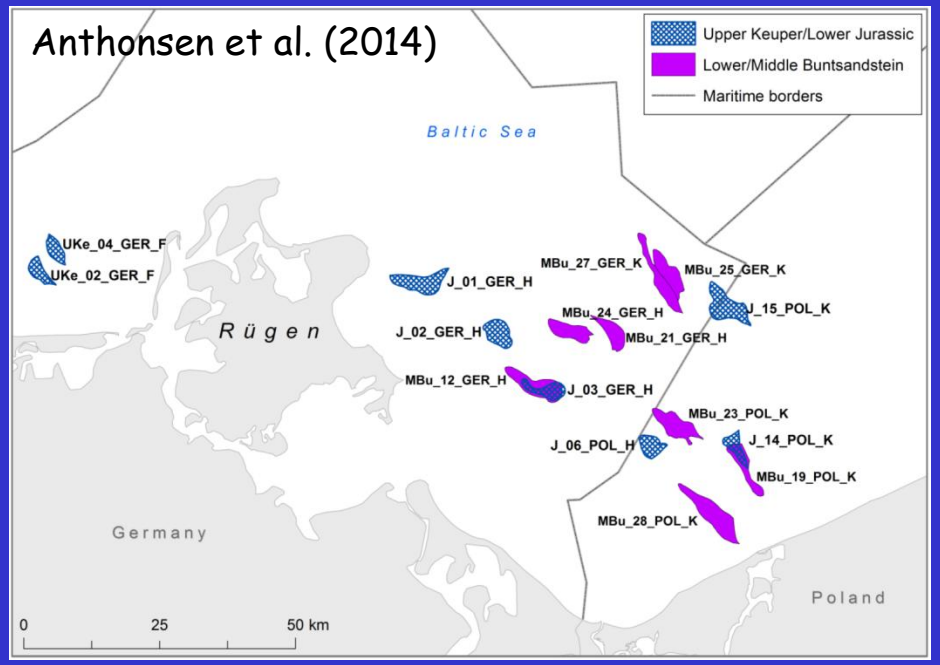
divided into two parts

characterized by different geological units and tectonic structures

The USO project

Goals and project area

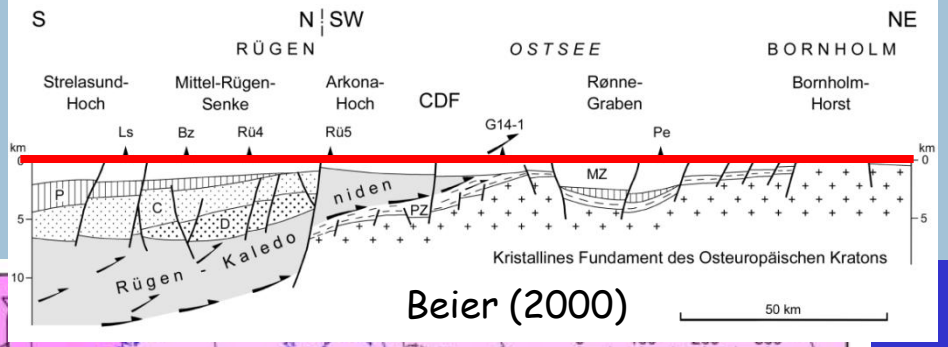


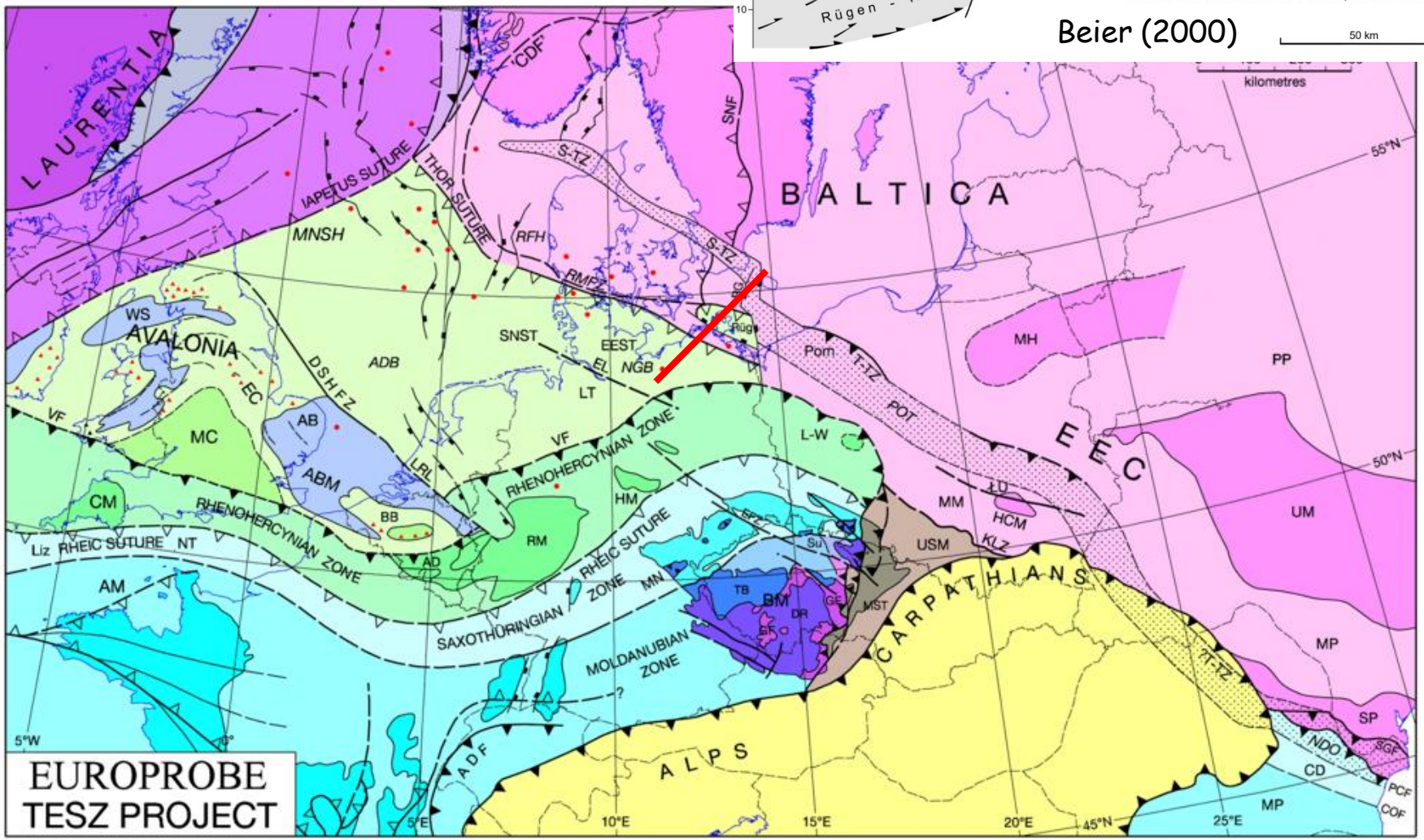


off-shore oil and gas exploration (Central European Petroleum Ltd.)
anticline structures for underground storage (e.g. CCS studies by Vattenfall A/S)

Geological framework

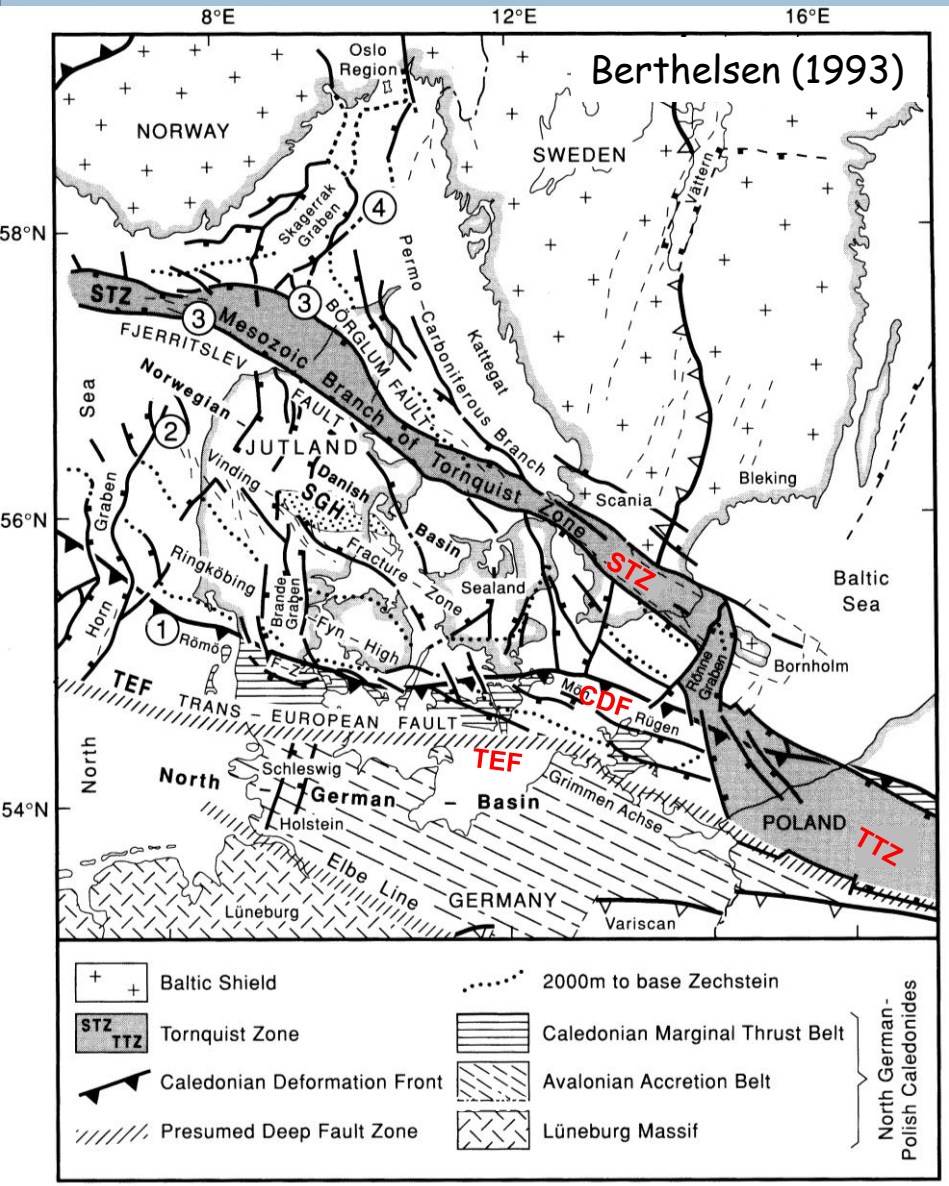
Major units and tectonic structures





Geological framework

Major units and tectonic structures



SW margin of the East European Craton (Fennoscandian Shield)

NW-SE trending faults
STZ = Sorgenfrei-Tornquist Zone
TTZ = Tornquist-Teisseyre Zone

Tornquist Fan (Thybo 2000)

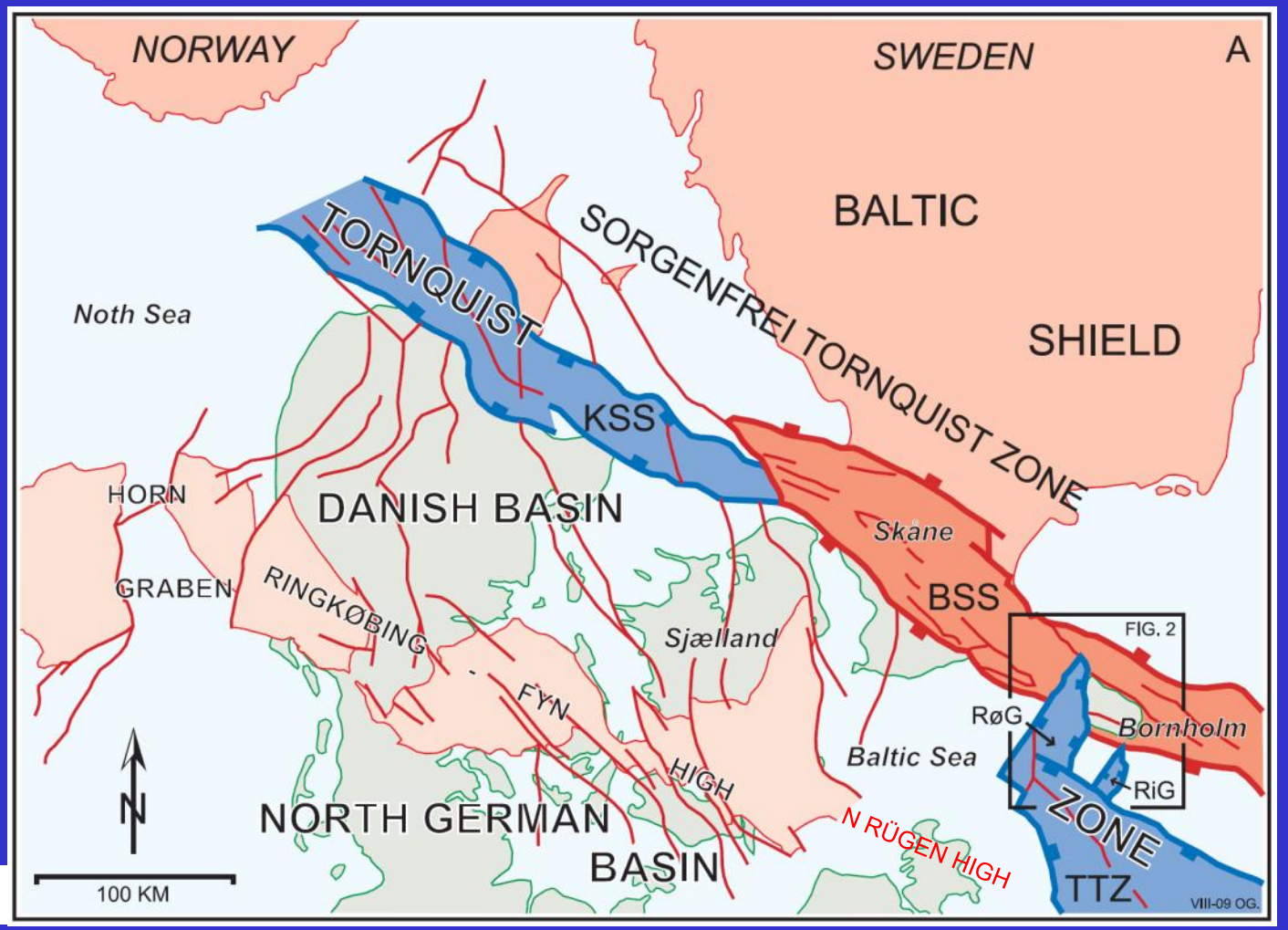
TEF = Transeuropean Fault

CDF = Caledonian Deformation Front

Geological framework

Major units and tectonic structures

Fennoscandian (Baltic) **Shield** basement rocks



Graversen (2009)

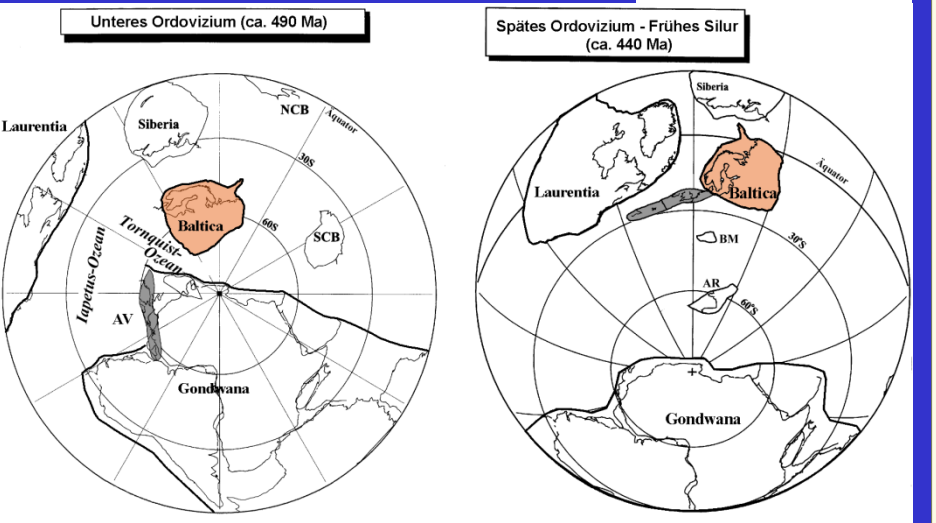
Geological framework

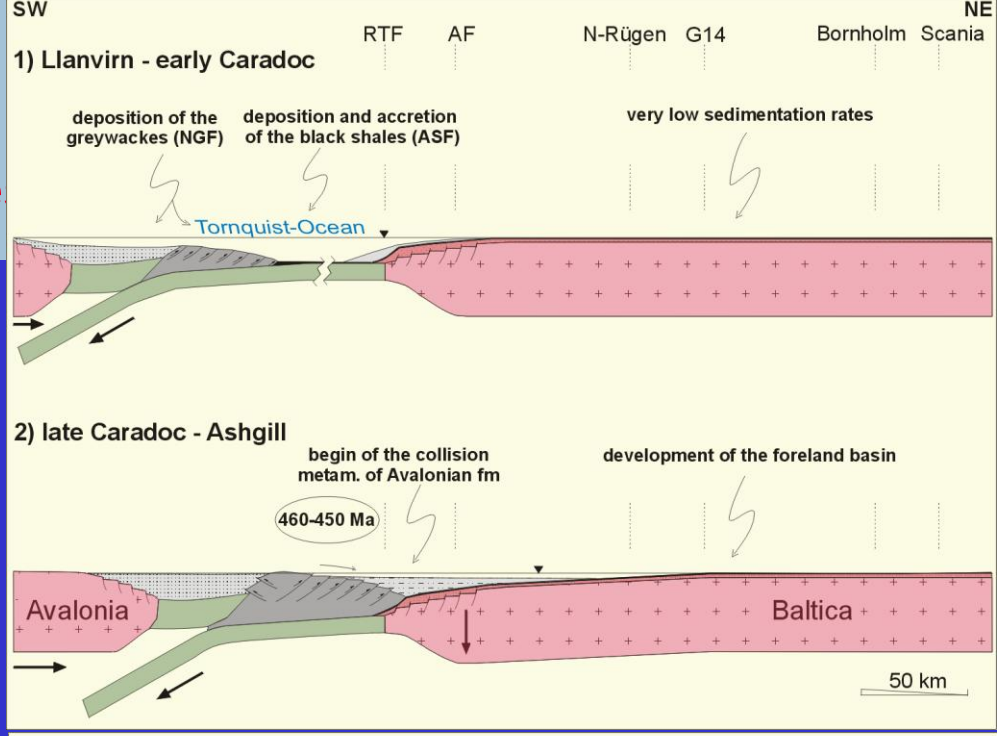
Major units and tectonic structure

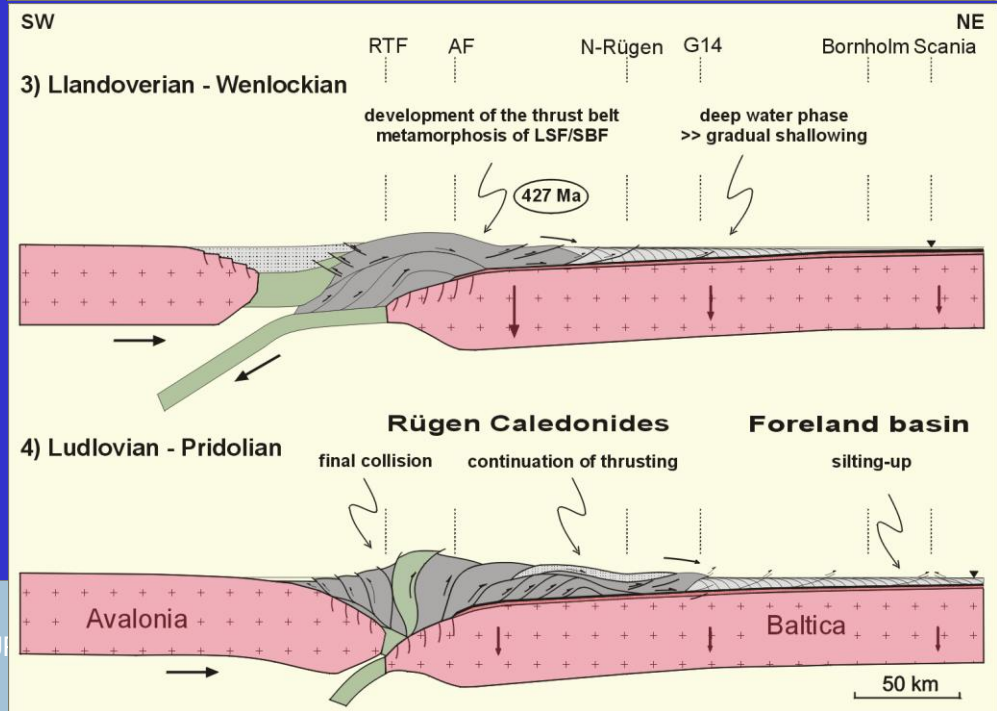
Fennoscandian (Baltic) Shield basement rocks

Caledonian deformation
Baltica-Avalonia

Beier (2000)







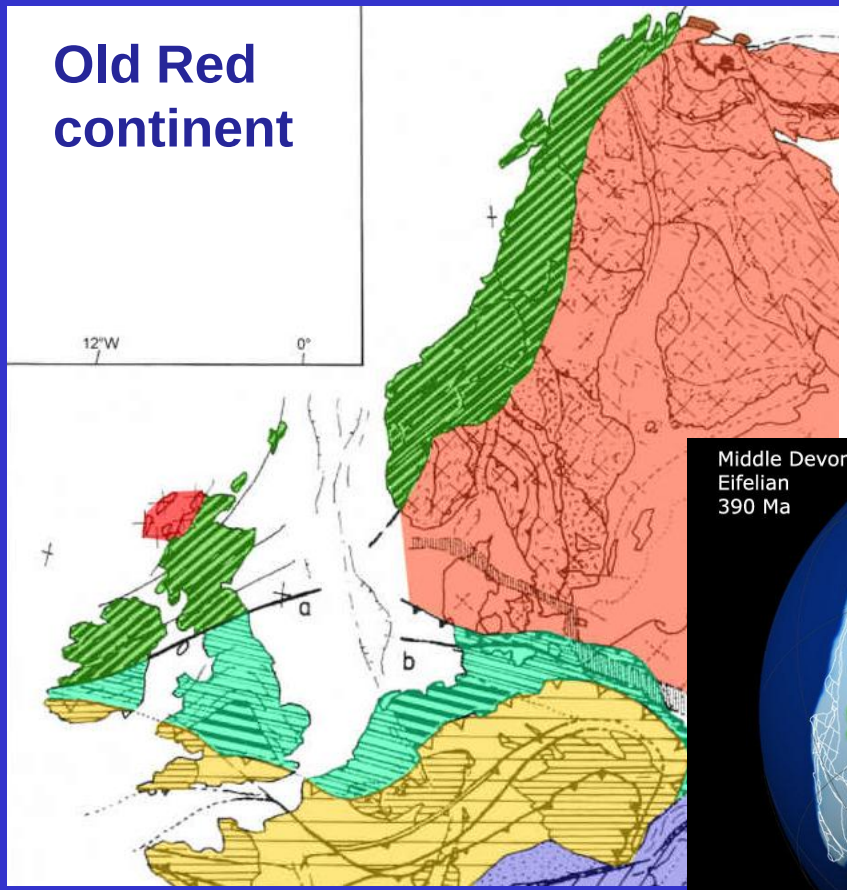
Geological framework

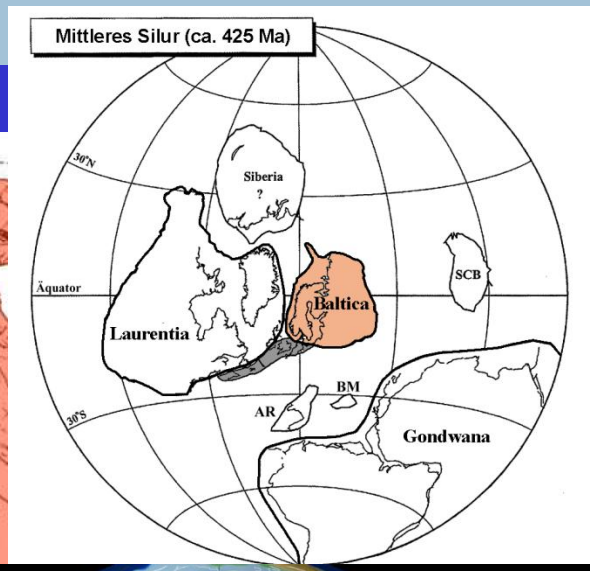
Major units and tectonic structures

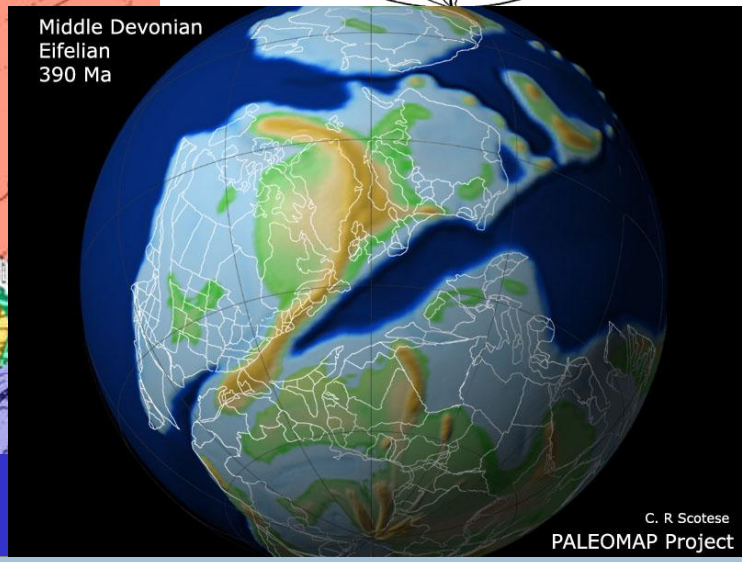
Fennoscandian (Baltic) Shield basement rocks

Caledonian deformation Baltica-Avalonia

Late Palaeozoic **shallow marine sedimentation**







Geological framework

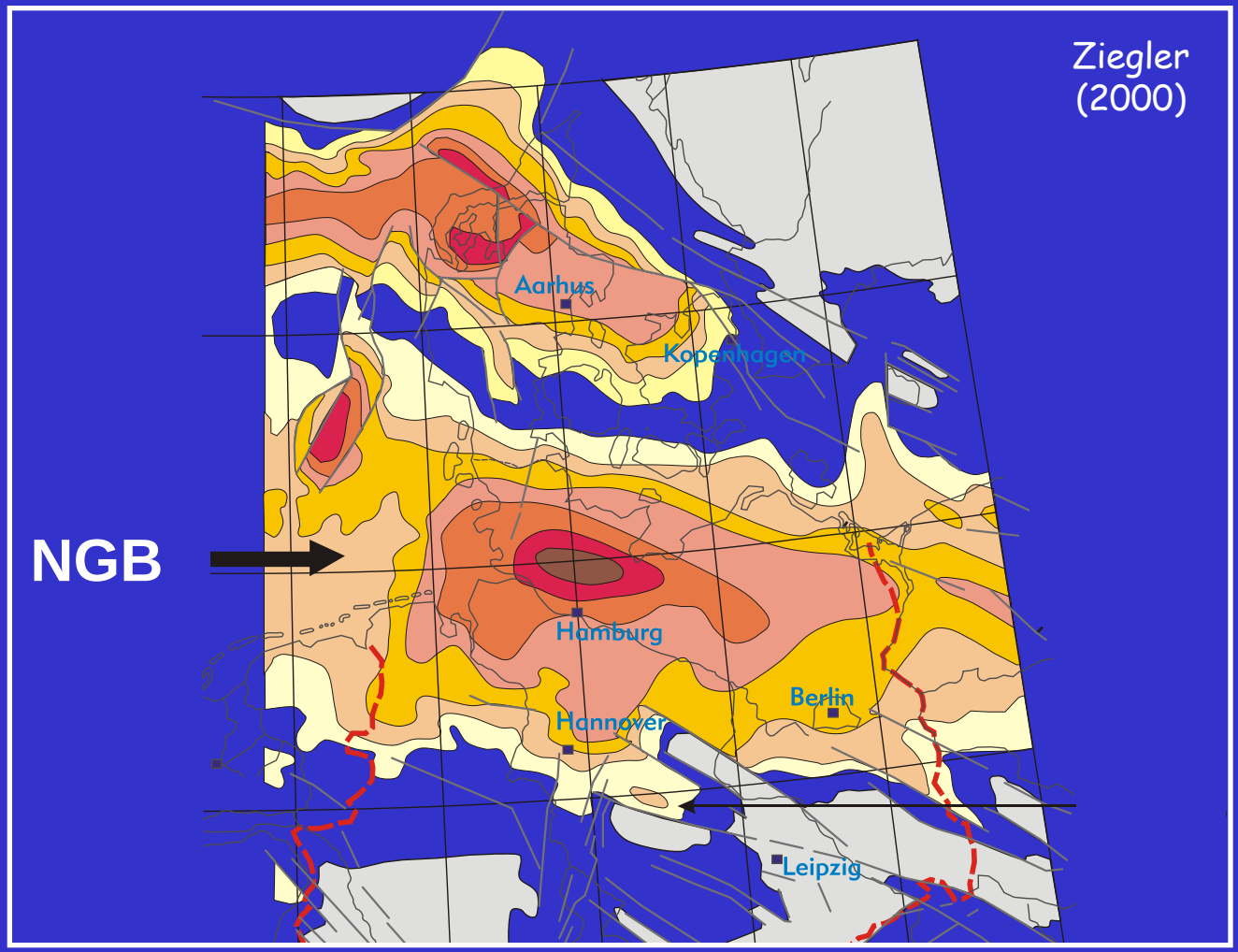
Major units and tectonic structures

Fennoscandian (Baltic) Shield basement rocks

Caledonian deformation Baltica-Avalonia

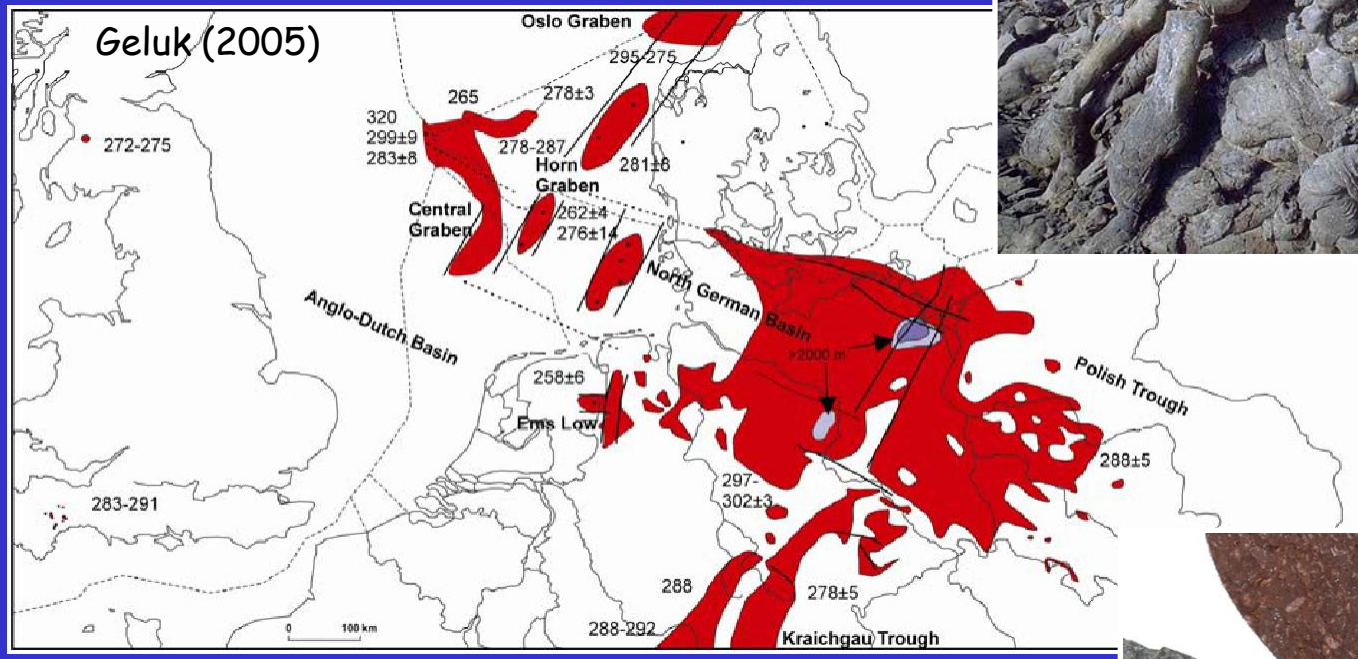
Late Palaeozoic shallow marine sedimentation

North German Basin (NGB)



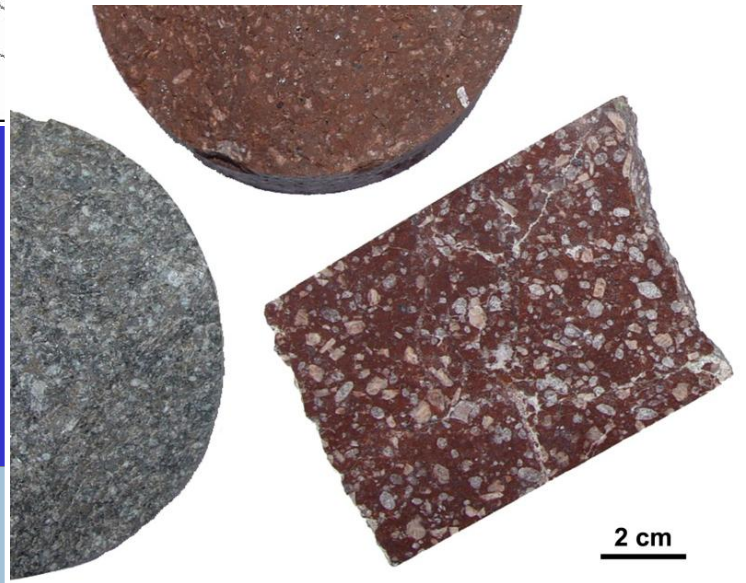
North German Basin

Evolution stages



Permo-Carboniferous rift magmatism

volcanic and sub-volcanic sequences up to more than 2.3 km thickness



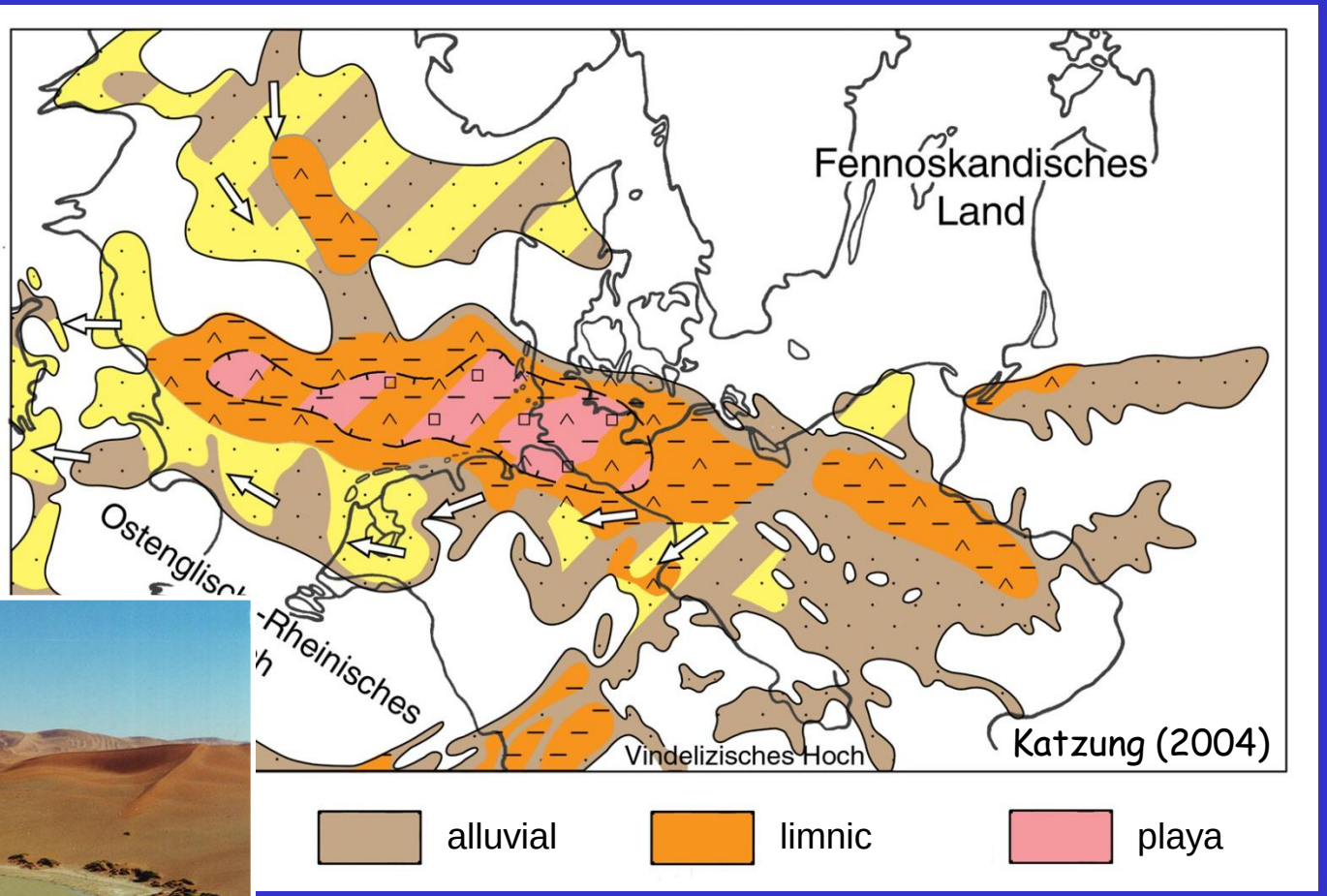
North German Basin

Evolution stages

Thermal Subsidence

intra-continental basin system

clastic Rotliegend sediments



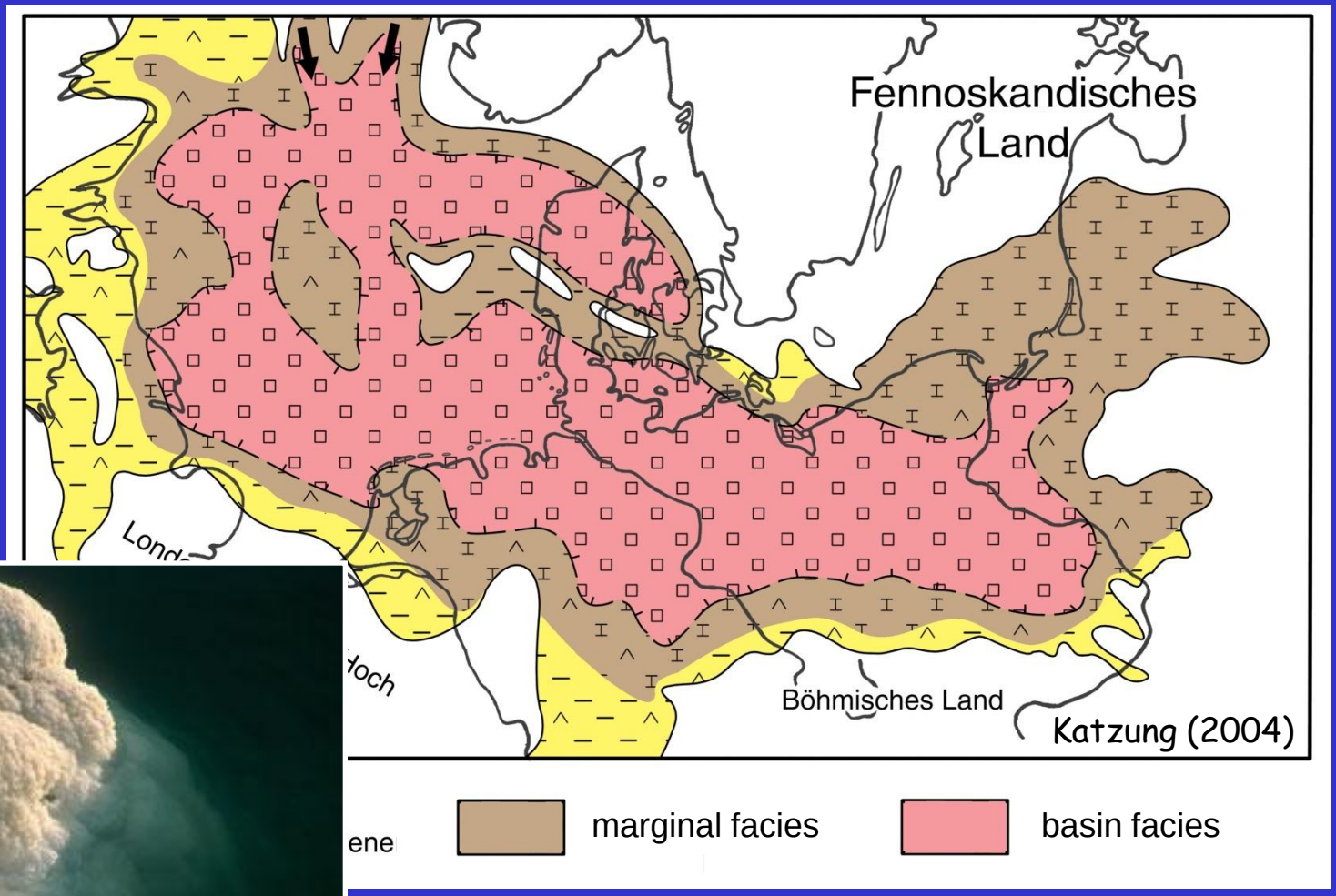
North German Basin

Evolution stages

Marine ingression + arid climate

cyclic evaporation

Zechstein salt layers

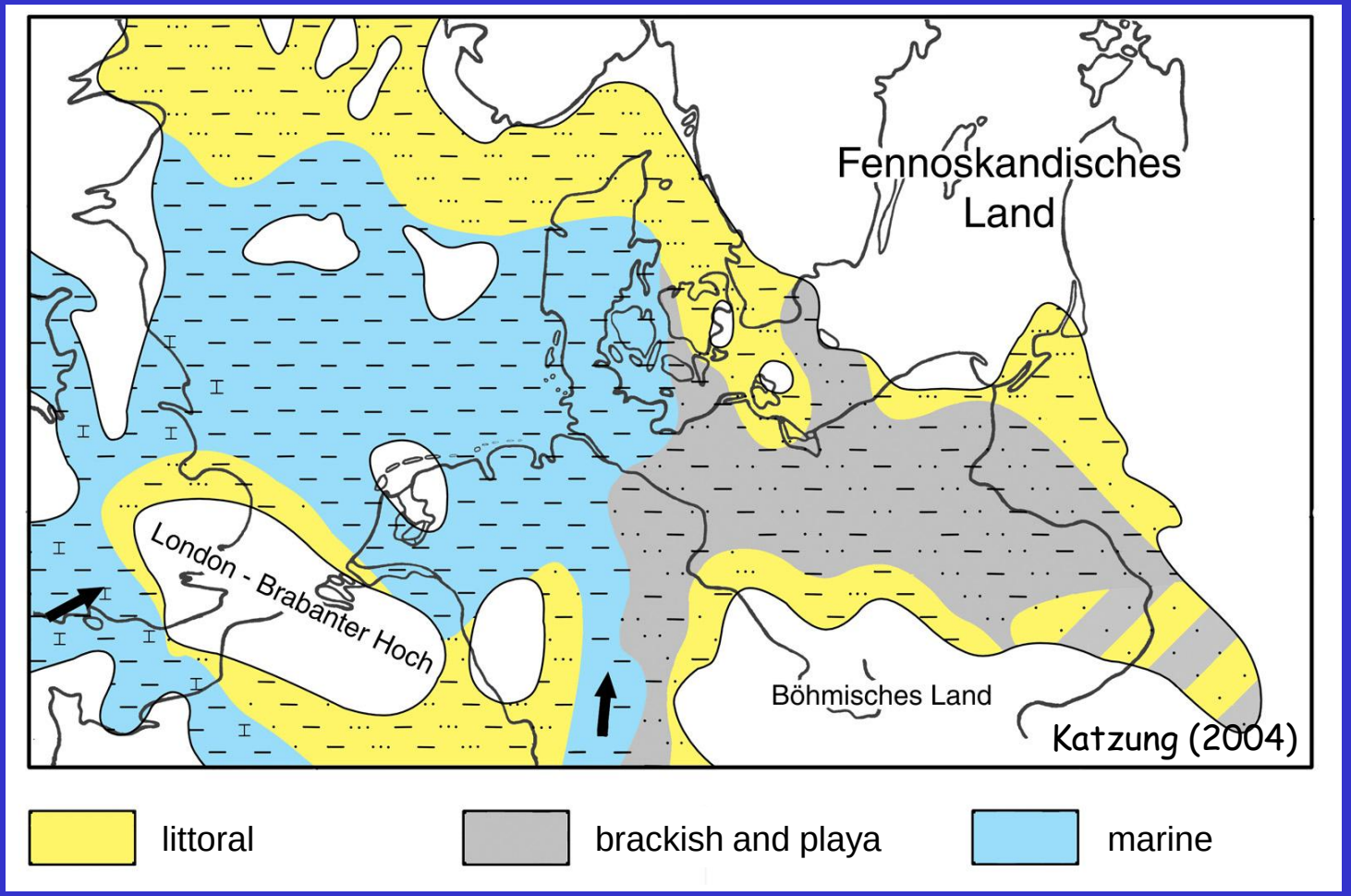


North German Basin

Evolution stages

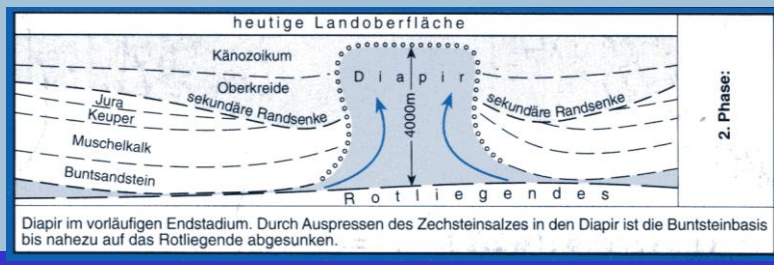
Trans- and regressions

terrestrial and marine Triassic sediments



Norddeutsches Becken

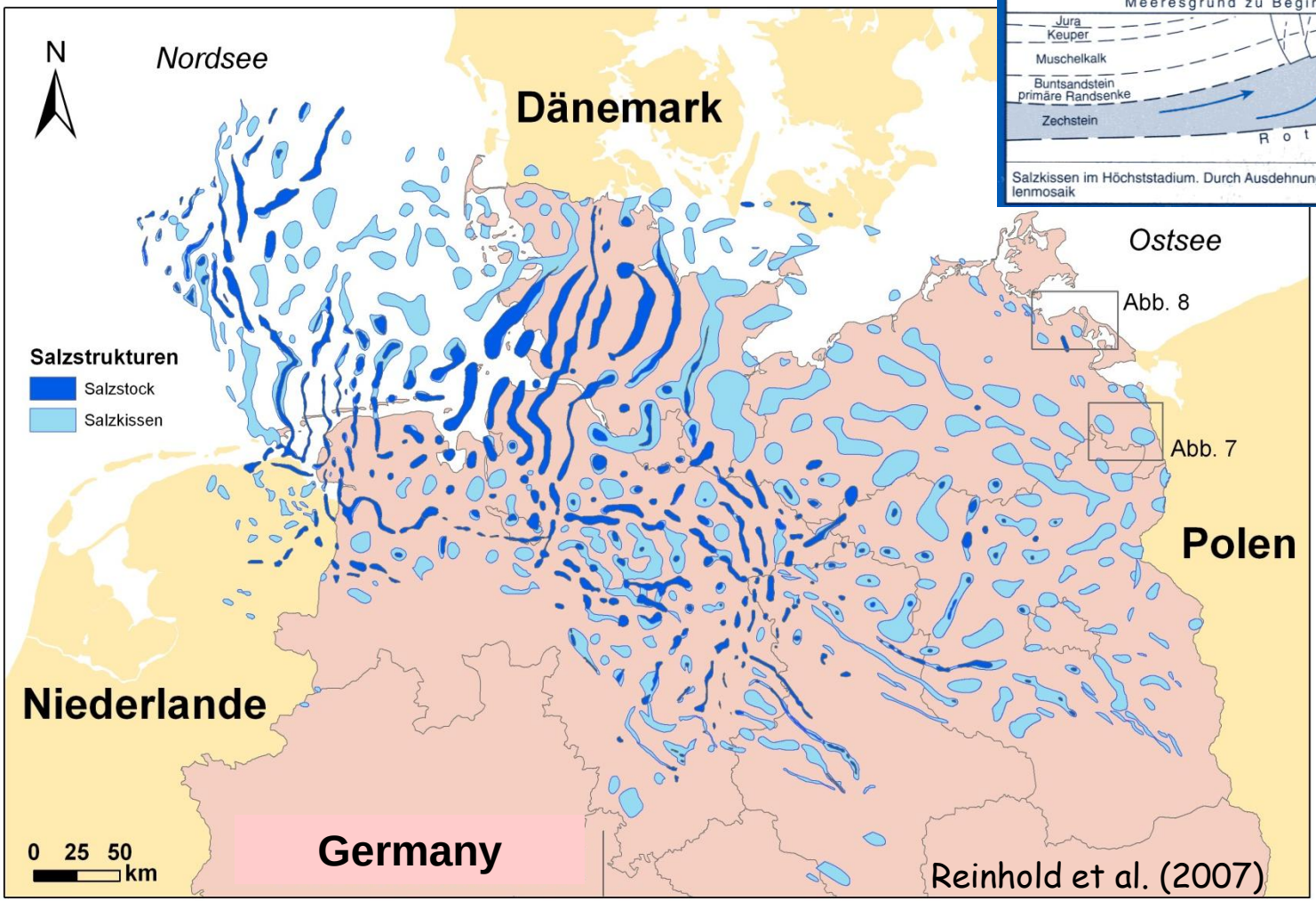
Geologische Entwicklung



Diapir im vorläufigen Endstadium. Durch Auspressen des Zechsteinsalzes in den Diapir ist die Buntsteinbasis bis nahezu auf das Rotliegende abgesunken.

Basin differentiation + halokinetic movements

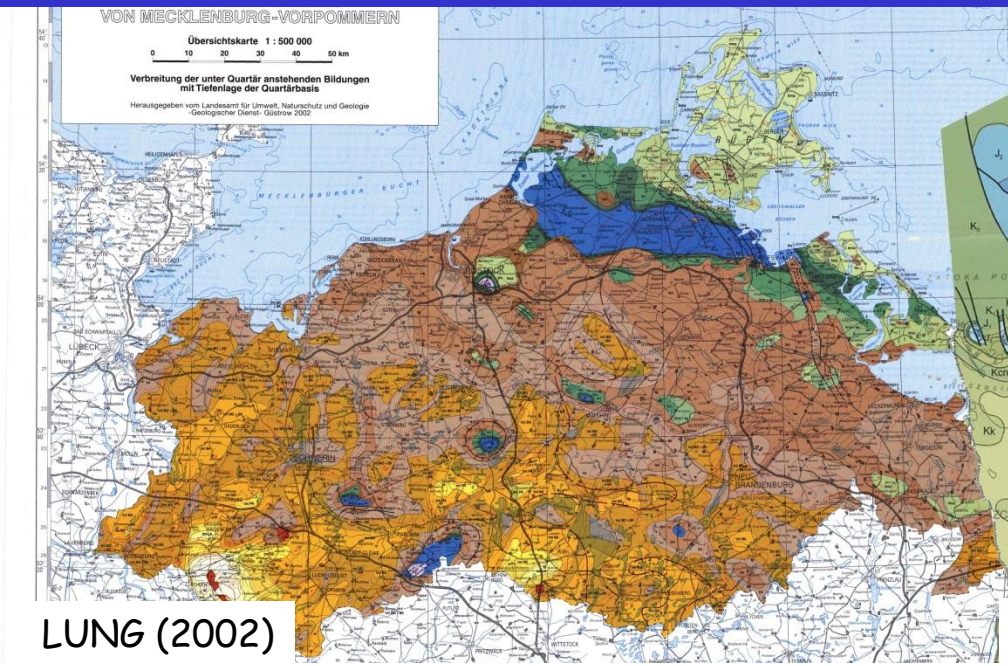
Salzkissen im Höchststadium. Durch Ausdehnung des Hangenden im Topbereich entsteht ein Bruchschollenmosaik



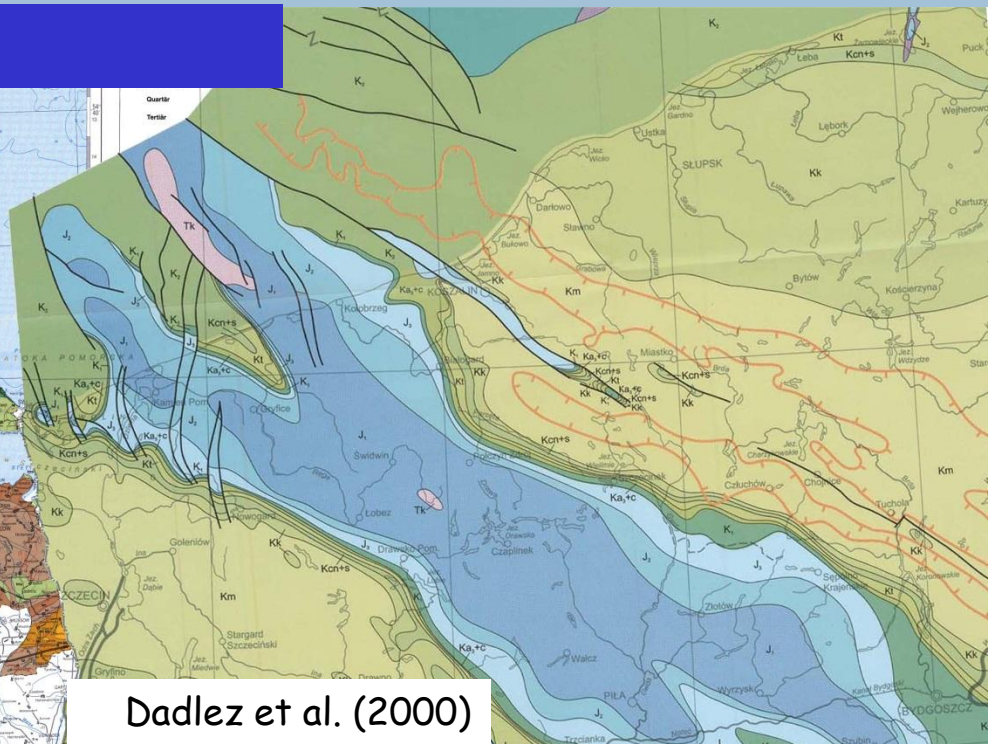
North German Basin

Evolution stages

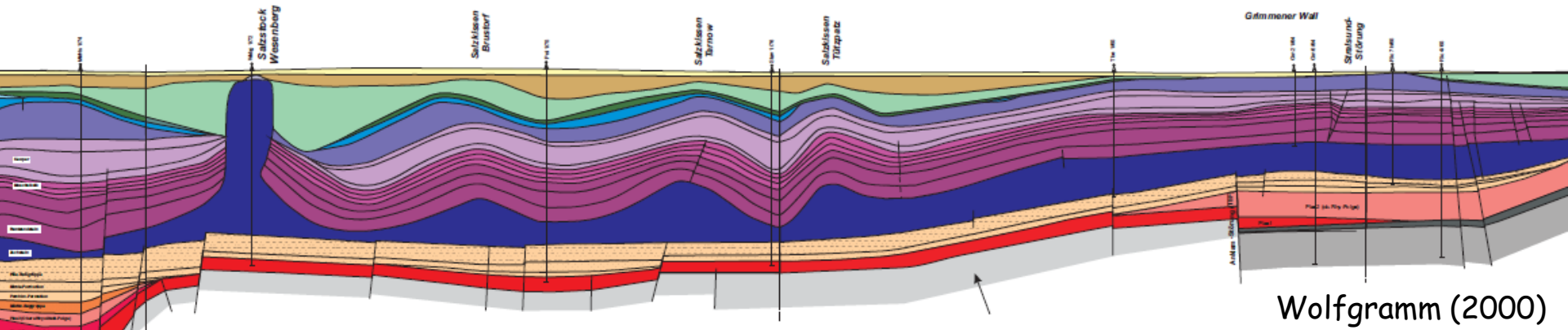
Late Cretaceous basin inversion



LUNG (2002)



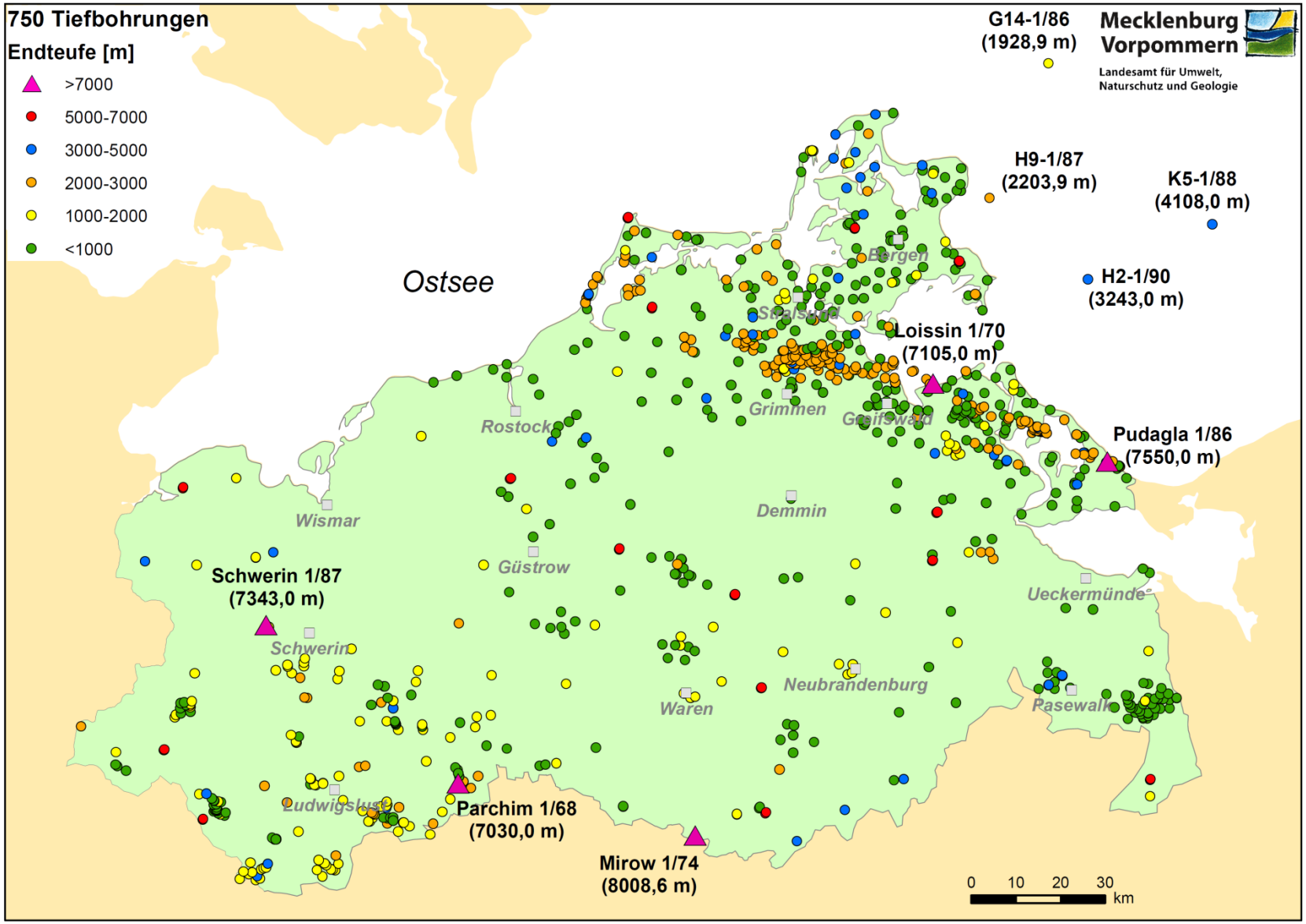
Dadlez et al. (2000)



Wolfgramm (2000)

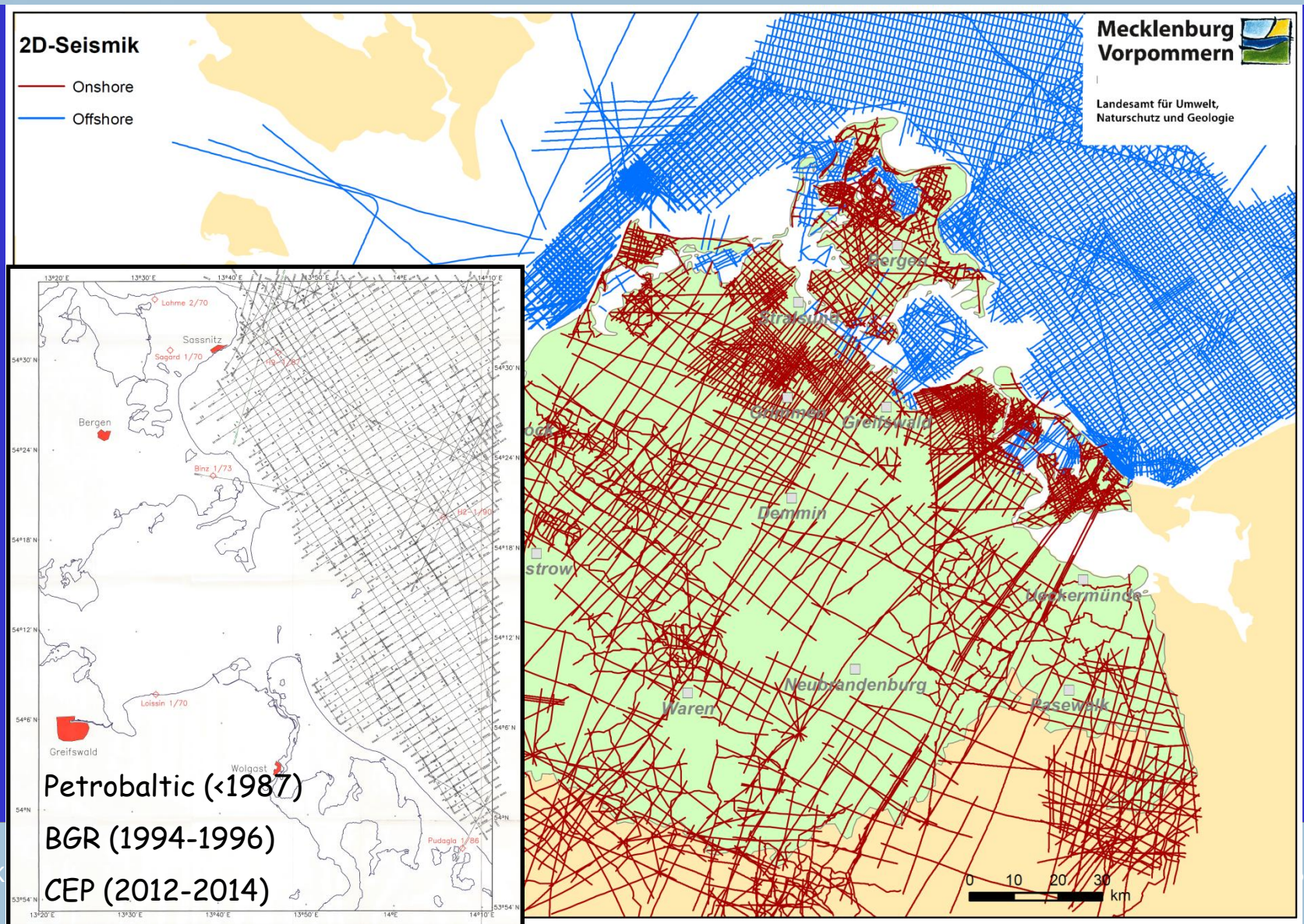
Data base

Well records and well logs



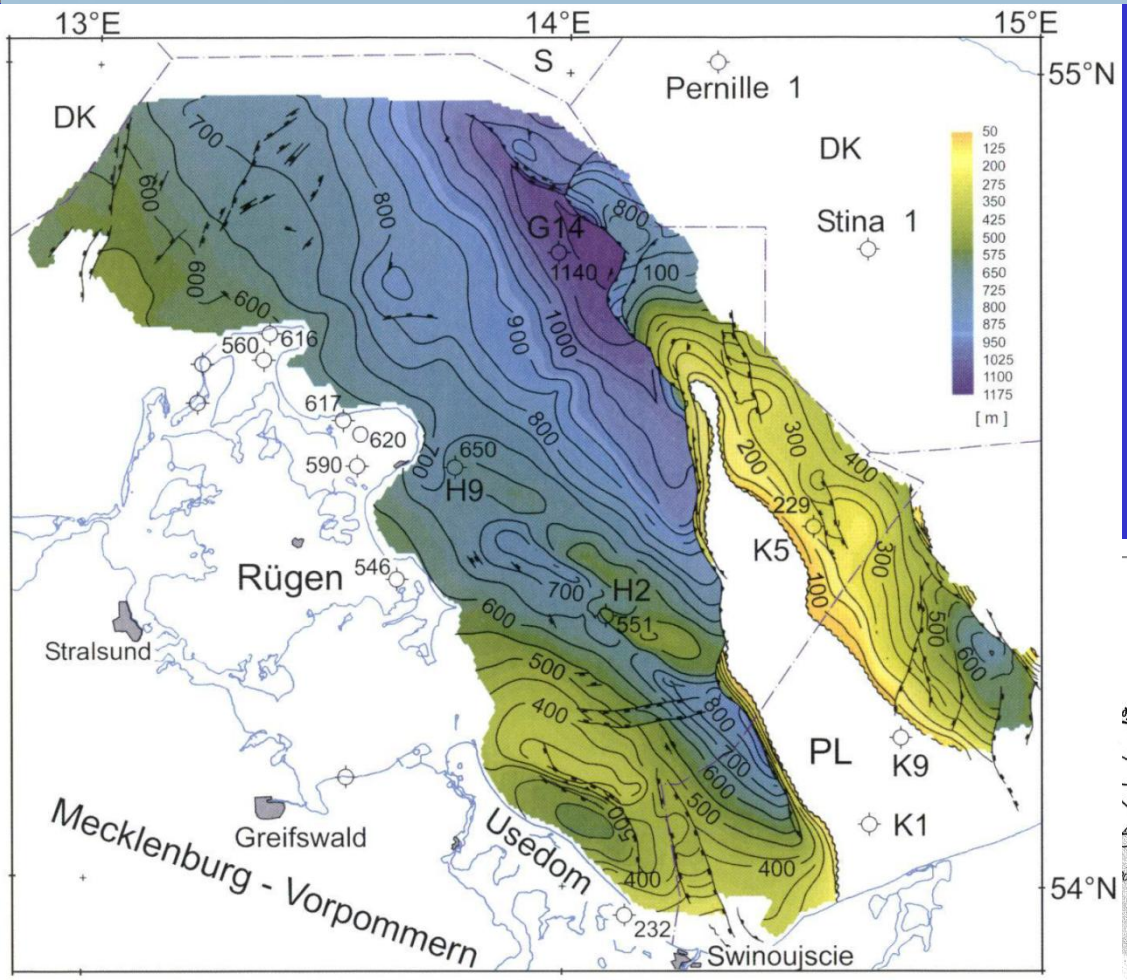
Data base

2D off-shore seismics



Data base

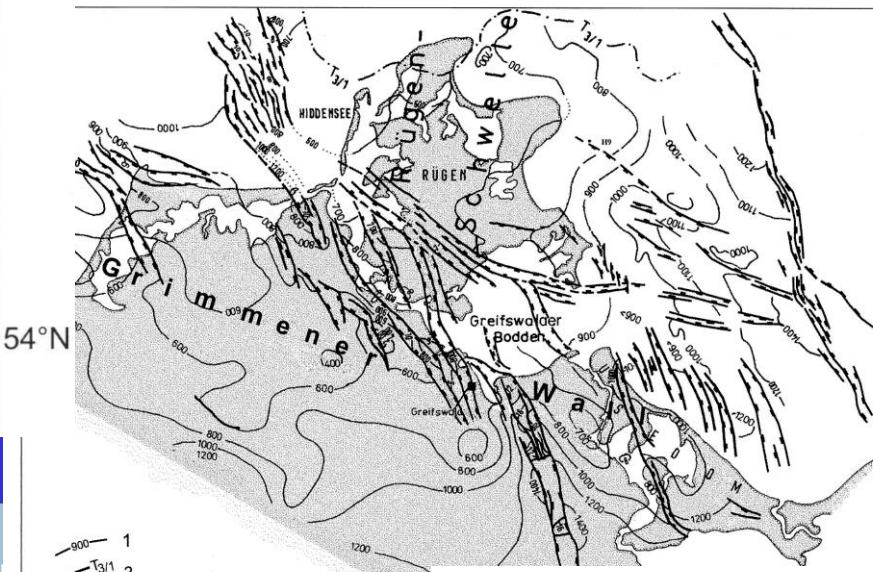
Geological maps



Schlüter et al. (1998)

Base Cretaceous map
Kamien anticline bordered by the **Adler Kamien fault** (W)

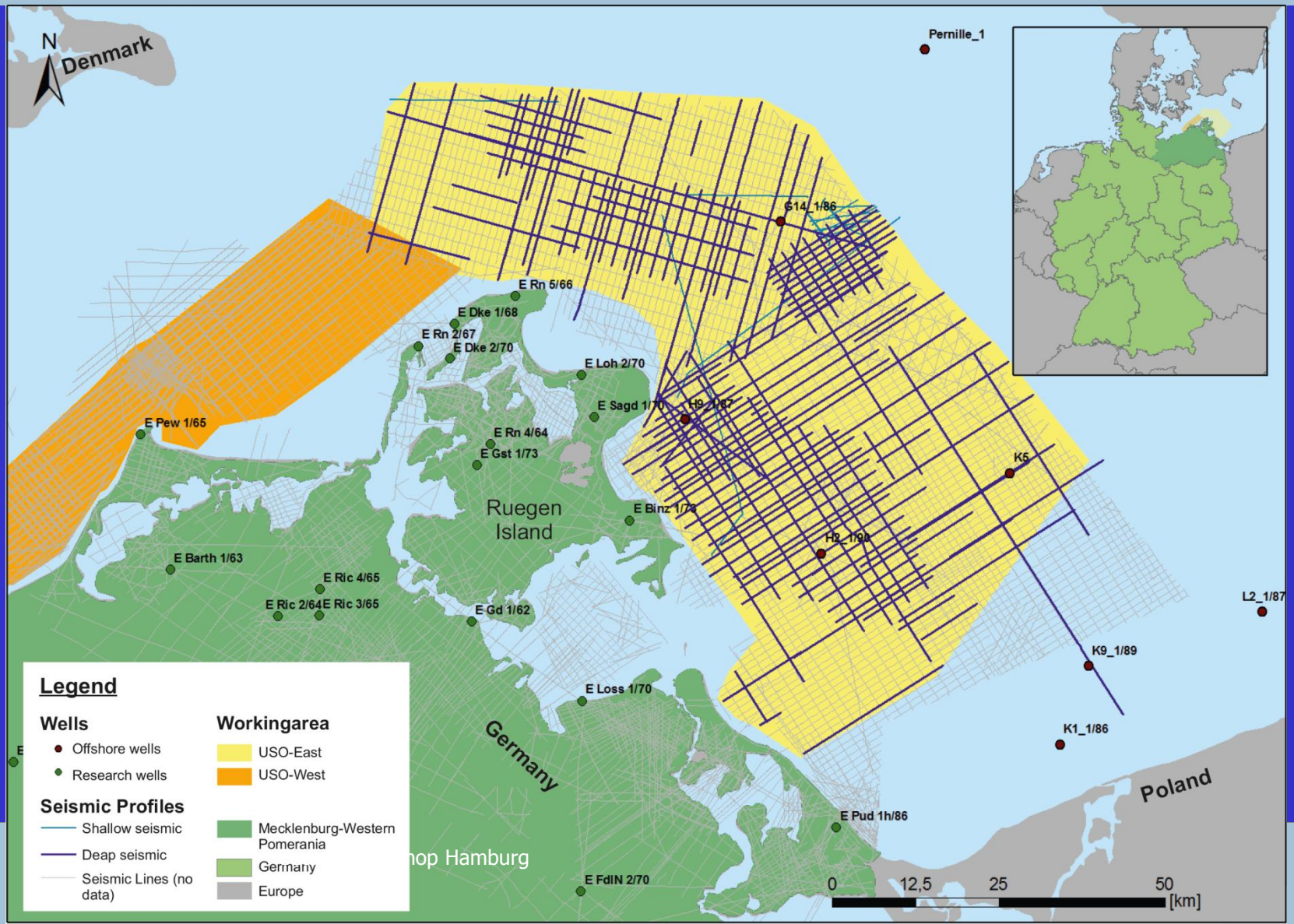
NNW-SSE striking **West Pomeranian fault system**



Krauß & Mayer (2004)

USO East

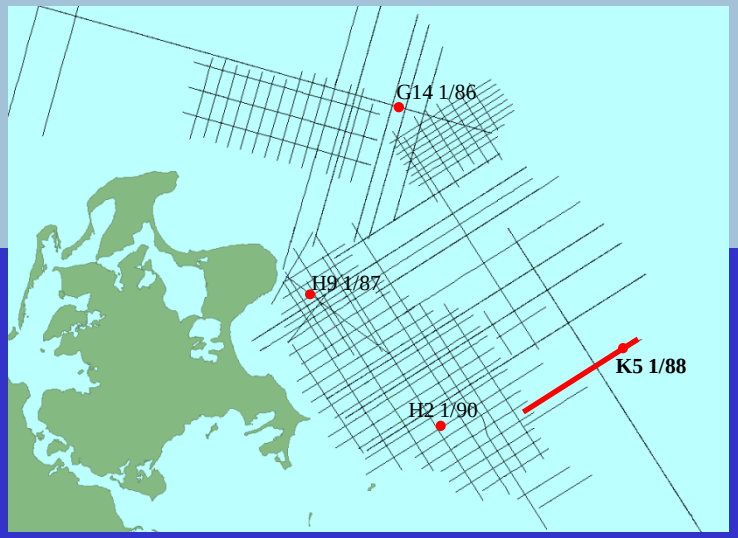
150 reprocessed seismic lines and 4 off-shore wells

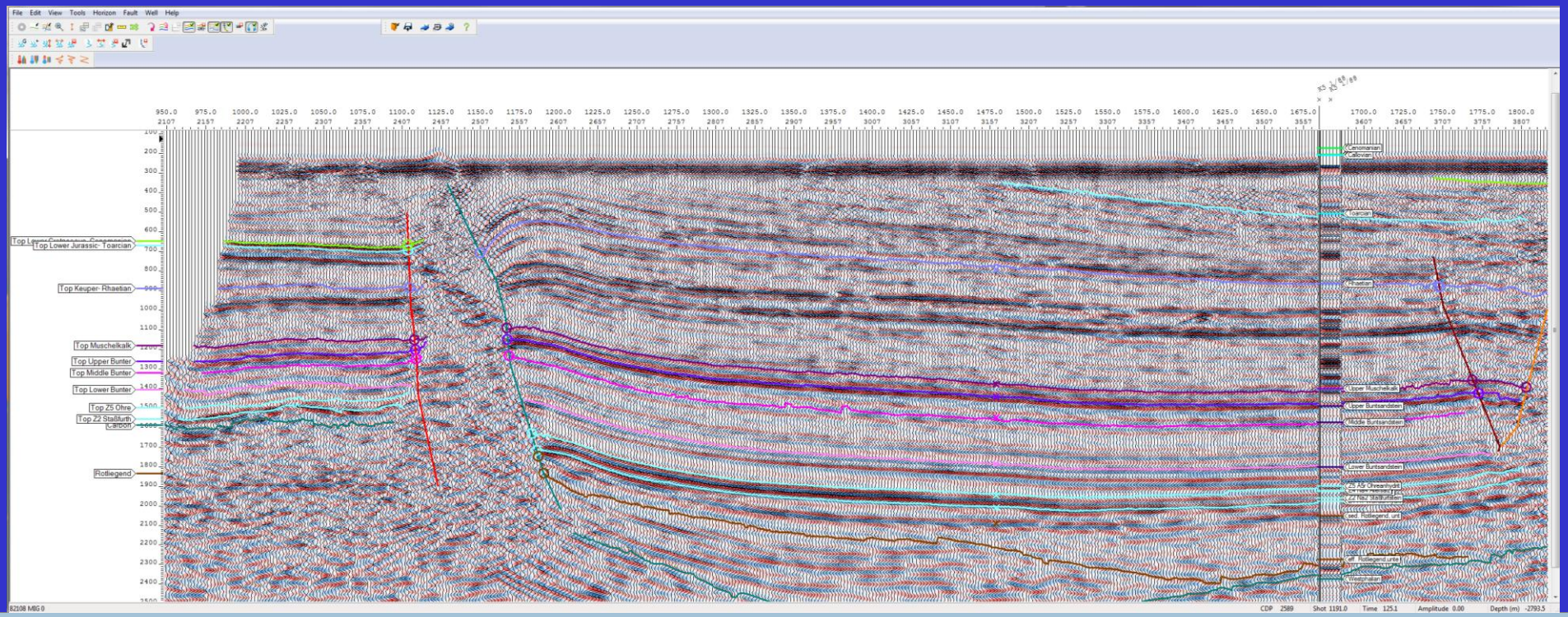


USO East

Seismic interpretation

Picking of prominent reflectors and correlation with well logs using SeisWare™



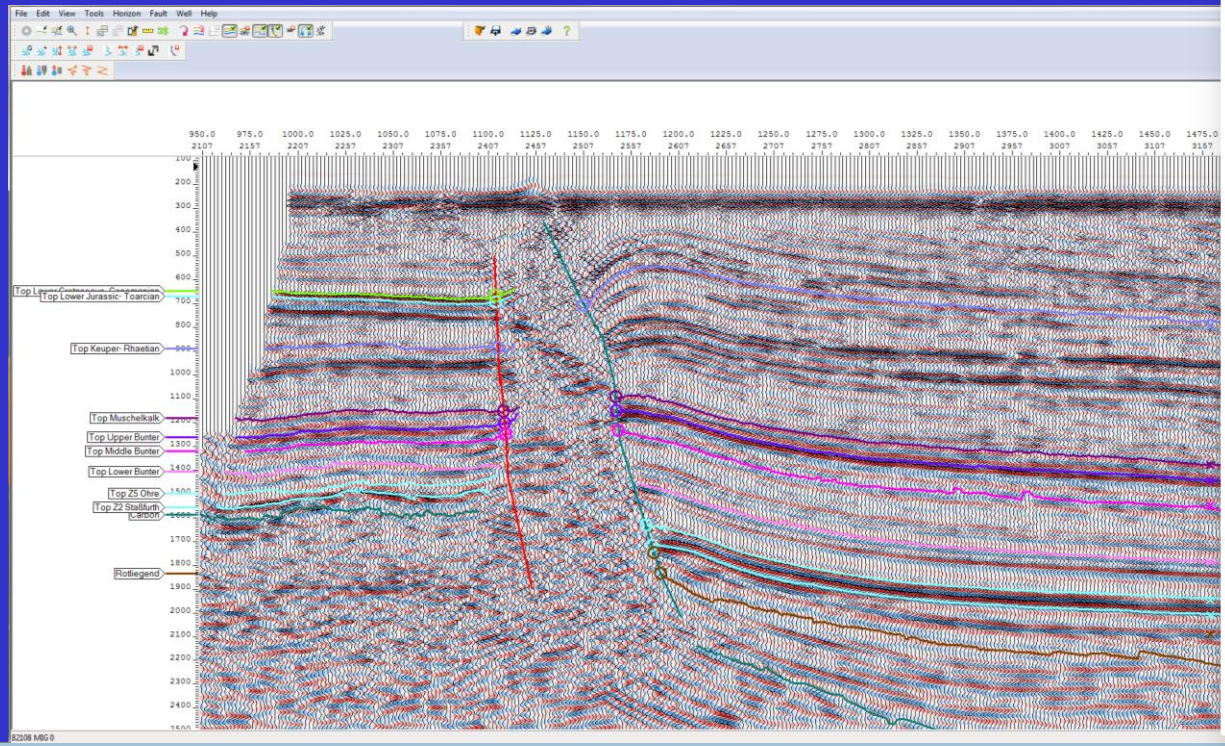


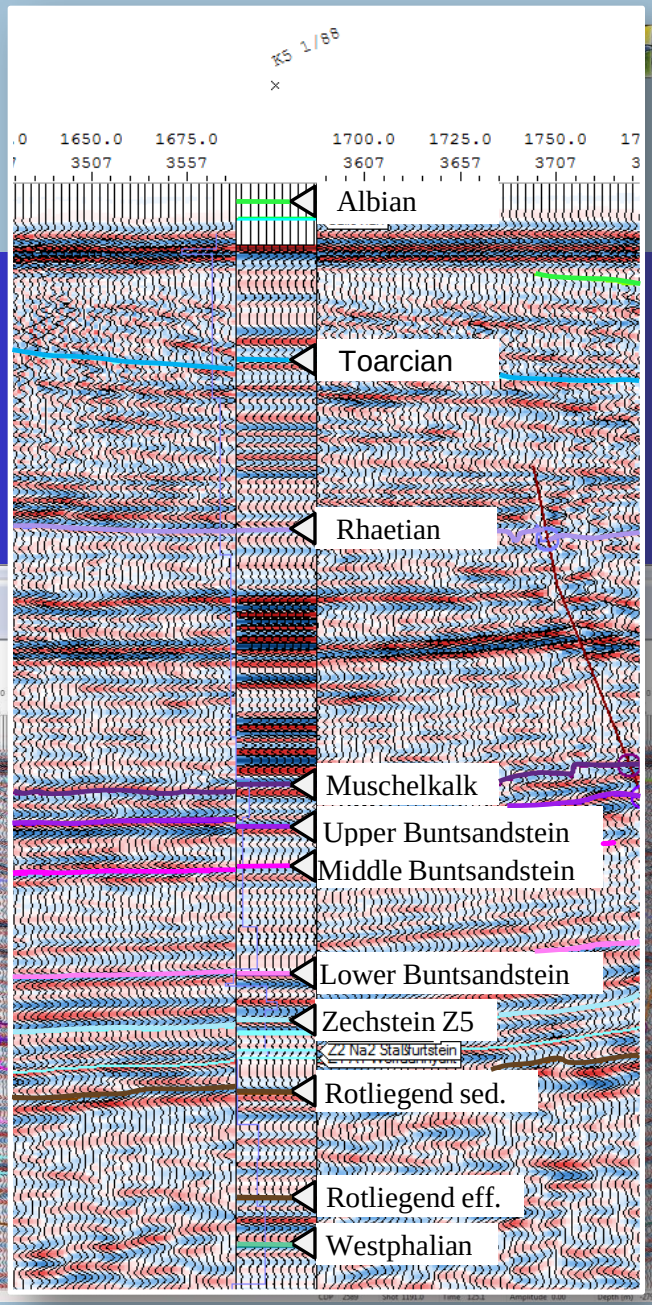
USO East

Seismic interpretation

Picking of prominent reflectors and correlation with well logs using SeisWare™

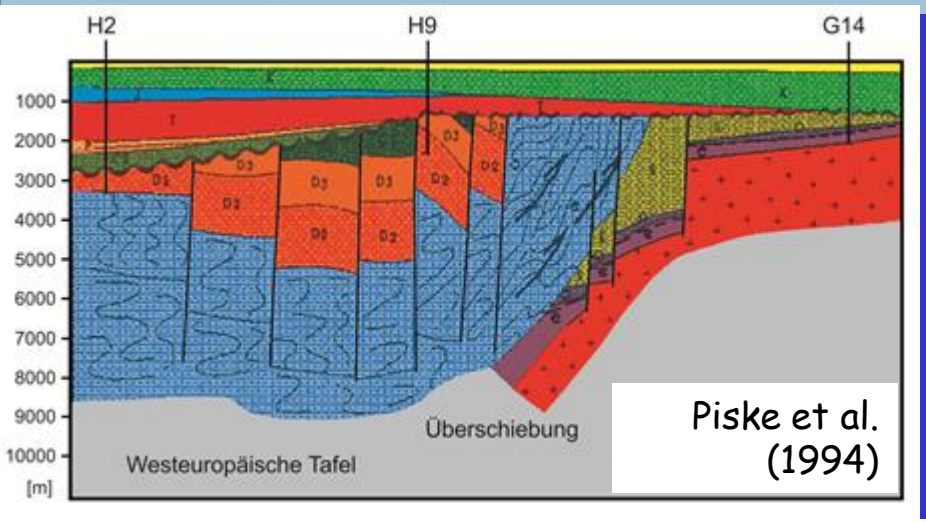
12 top layers



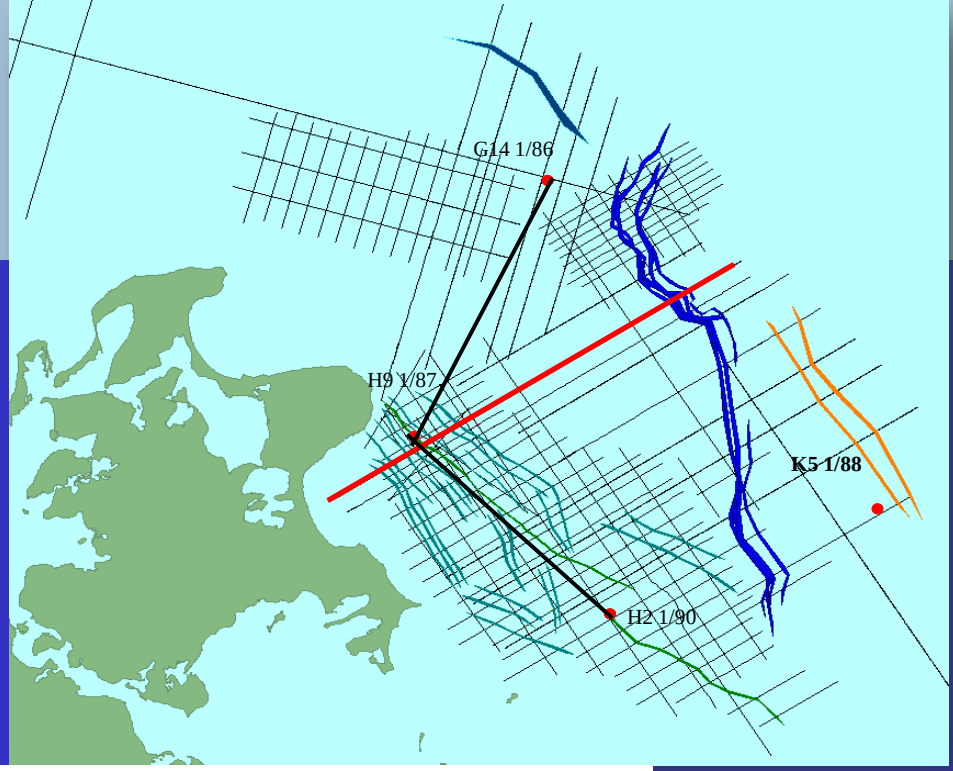


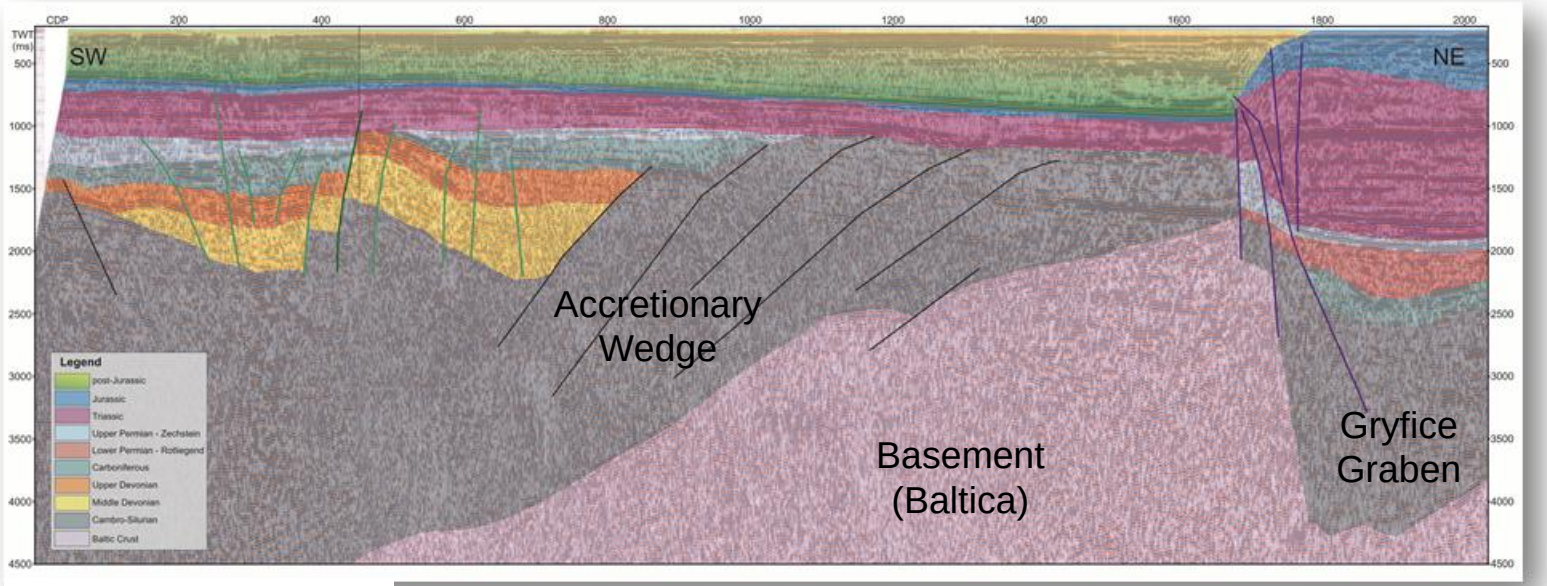
USO East

Seismic interpretation



Piske et al. (1994)

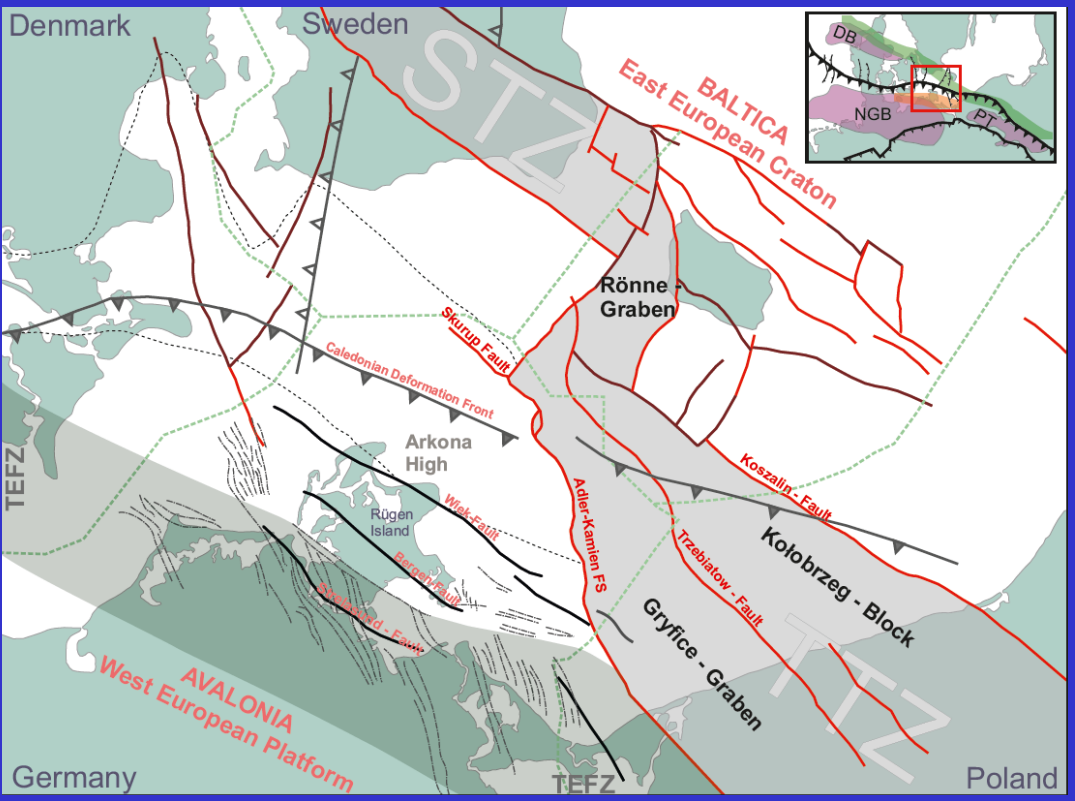




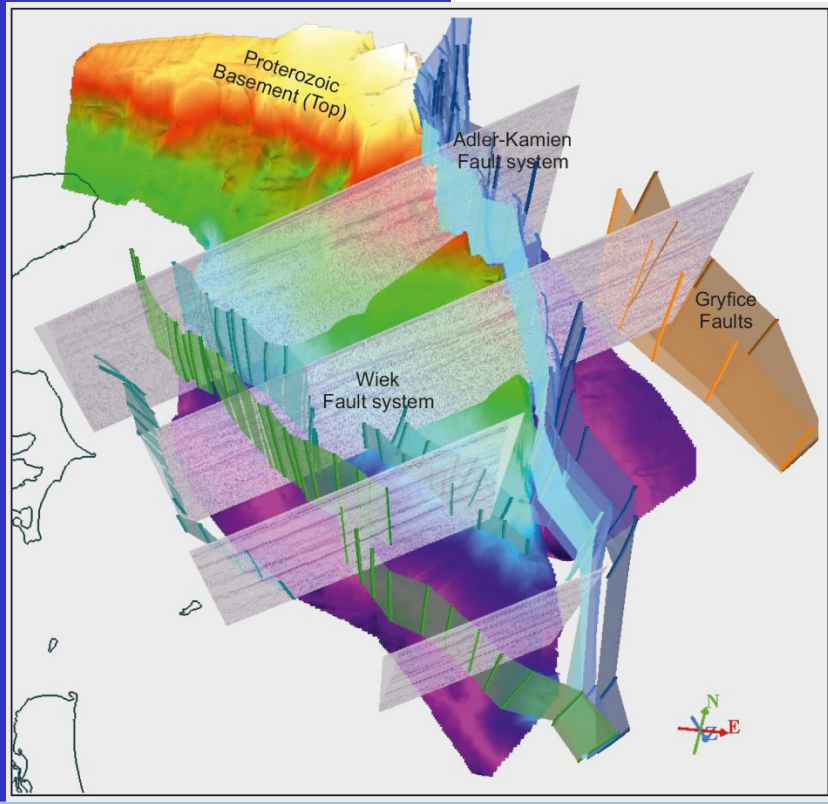
Seidel et al. (2014)

USO East

Visualization of reflectors and faults



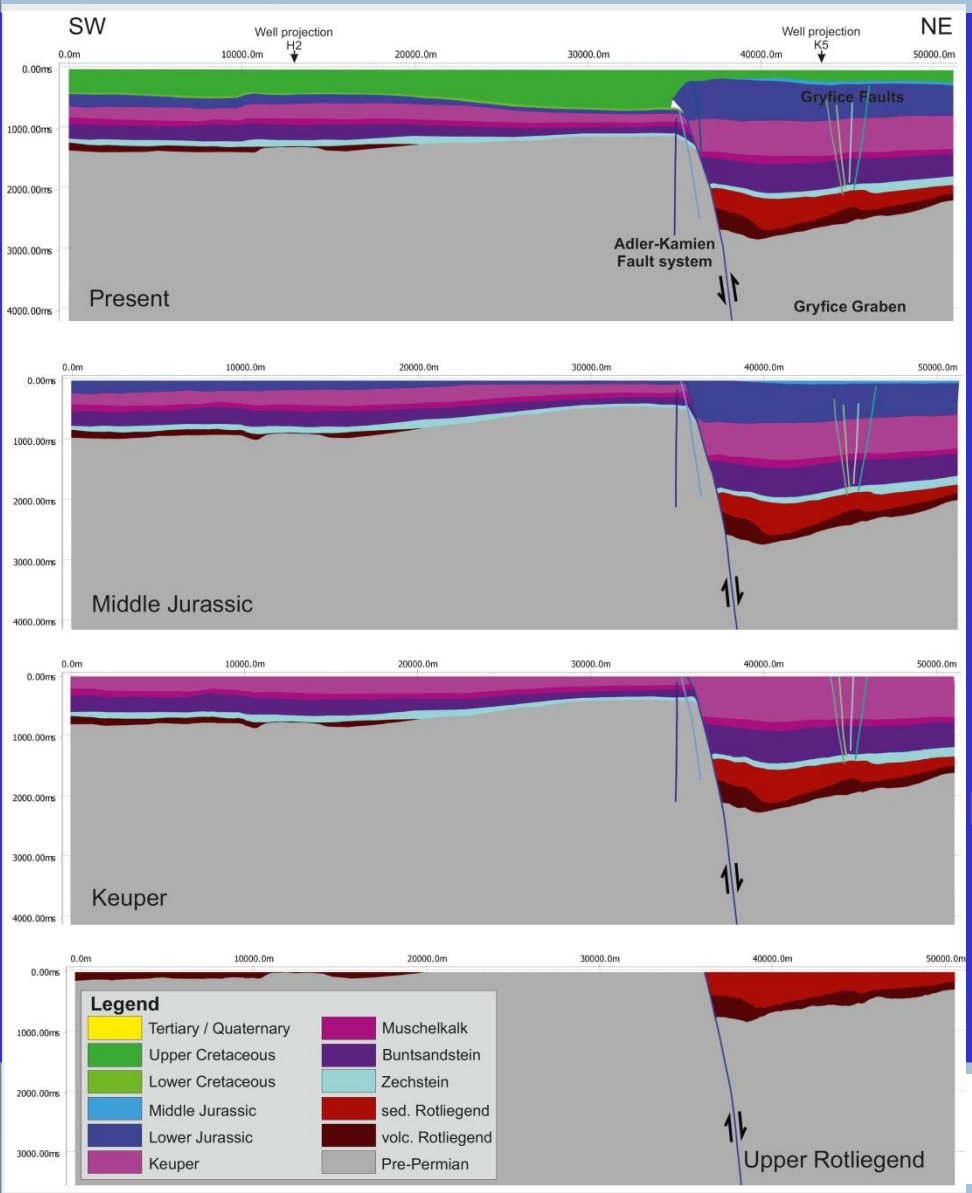
Seidel et al. (2015)



Identification of major fault systems
e.g. **Adler Kamien FS** and Wiek FS

USO East

Polyphase fault evolution

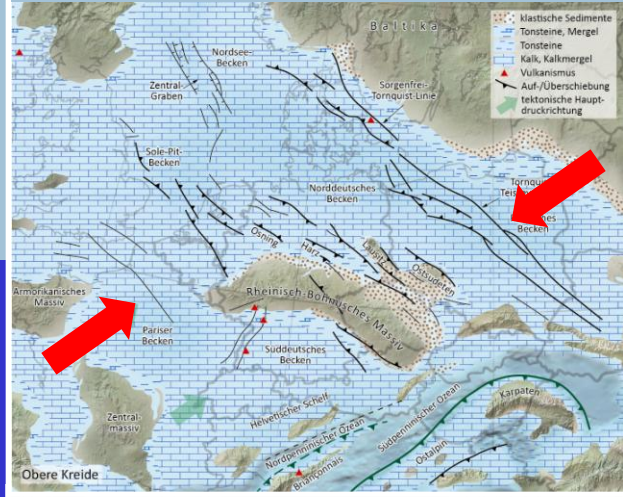


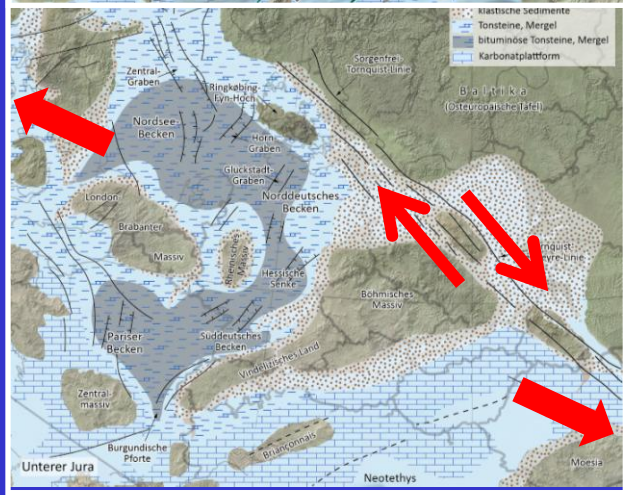
NE-SW compression (Upper Cretaceous)

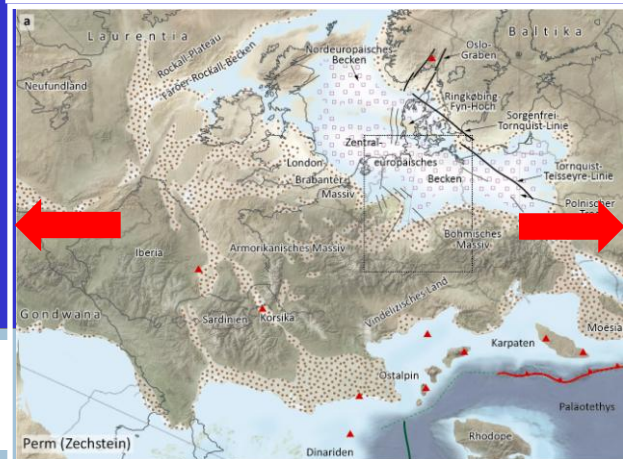
Transtension (Triassic/ Jurassic)

E-W extension (Upper Rotliegend to Lower Triassic)

Seidel et al. (2015)

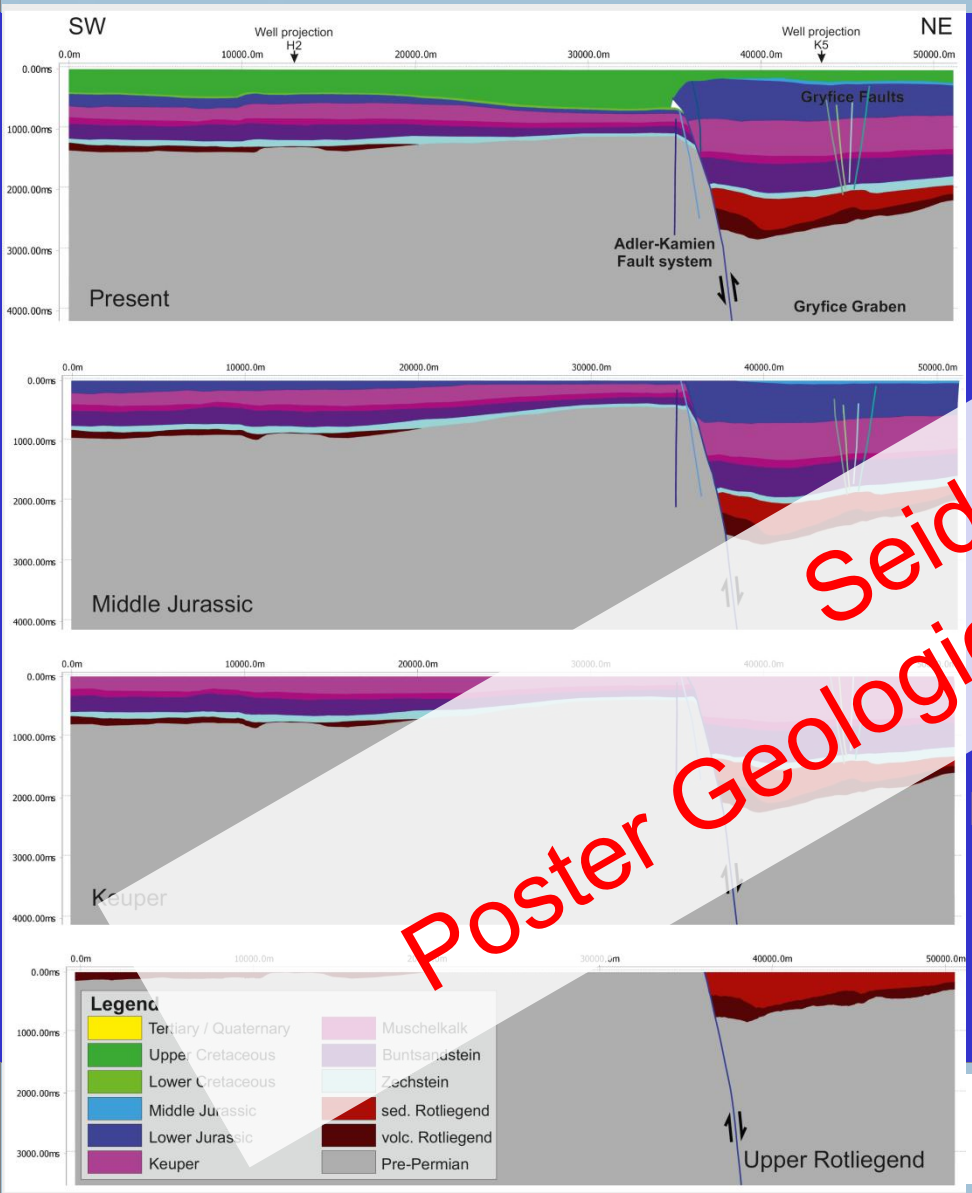






USO East

Polyphase fault evolution



NE-SW compression (Upper Cretaceous)

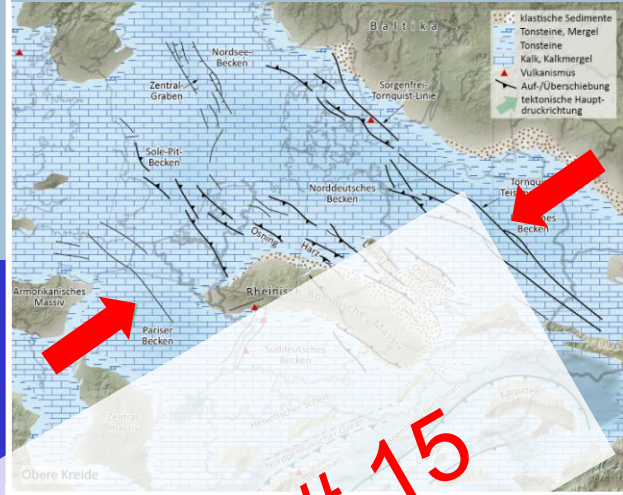
Transtension (Triassic/ Jurassic)

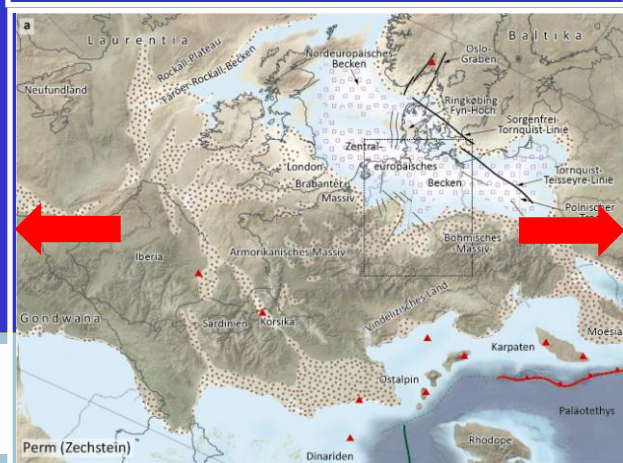
E-W extension (Upper Rotliegend to Lower Triassic)

Seidel et al. (2015)

Seidel et al. Geological 3D Modelling # 15

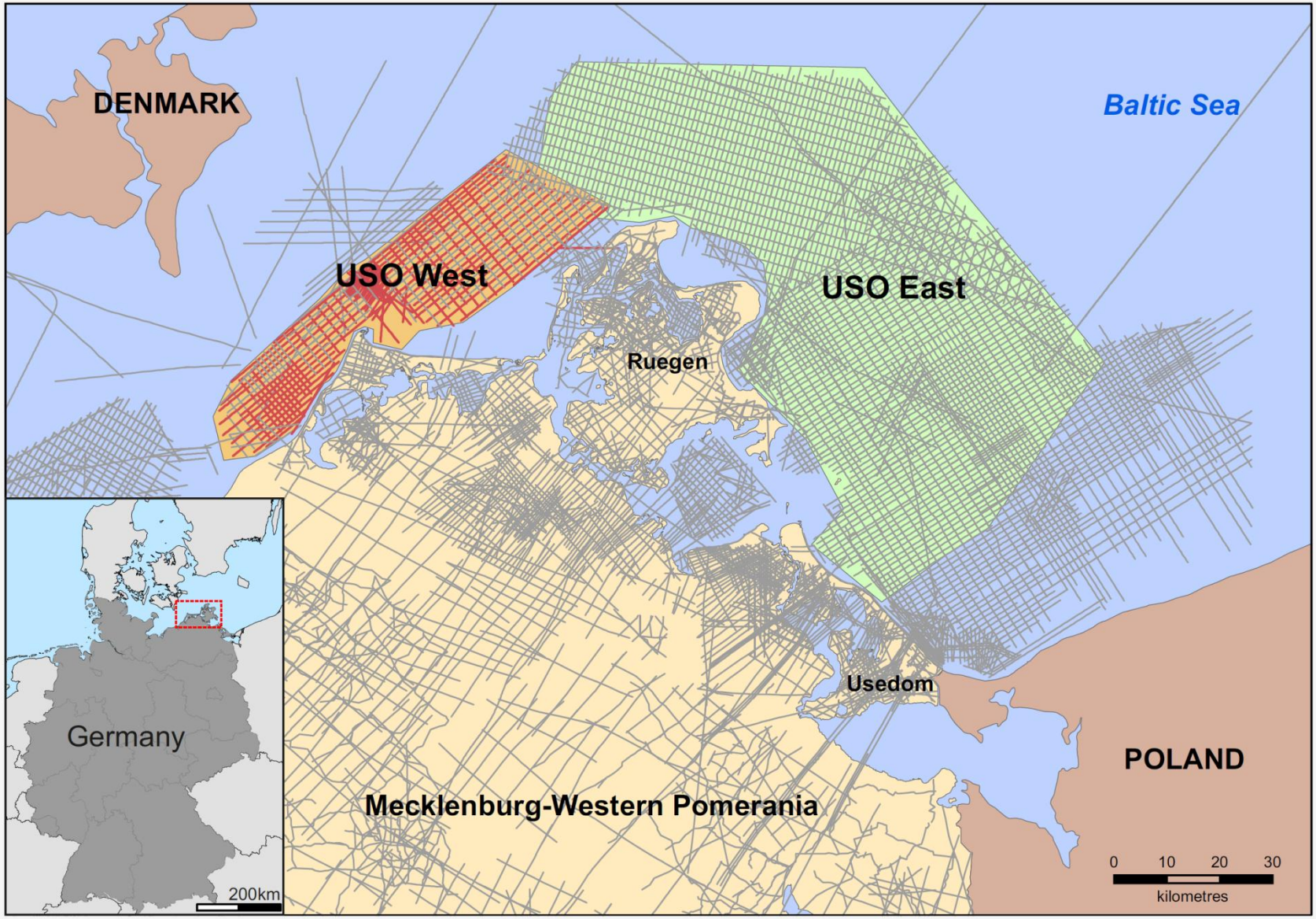
Poster





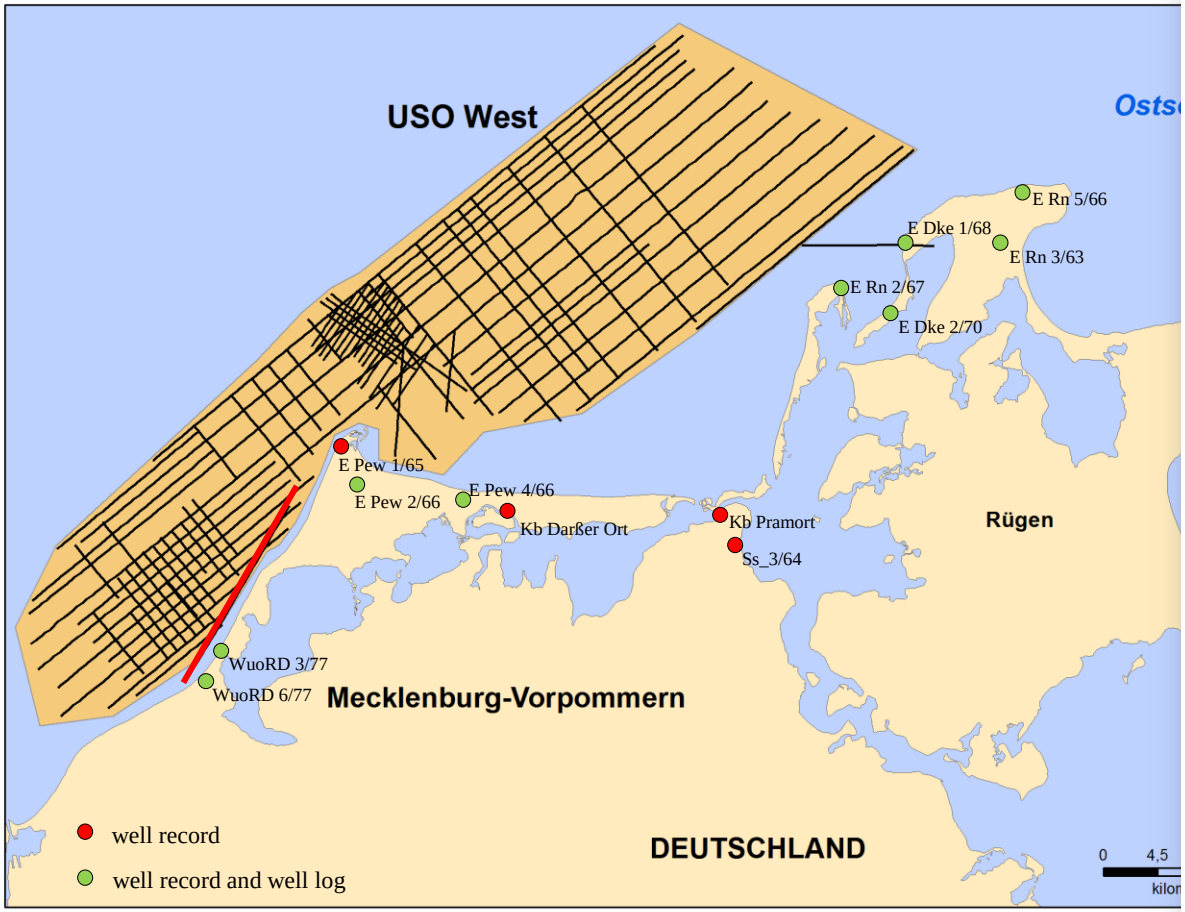
USO West

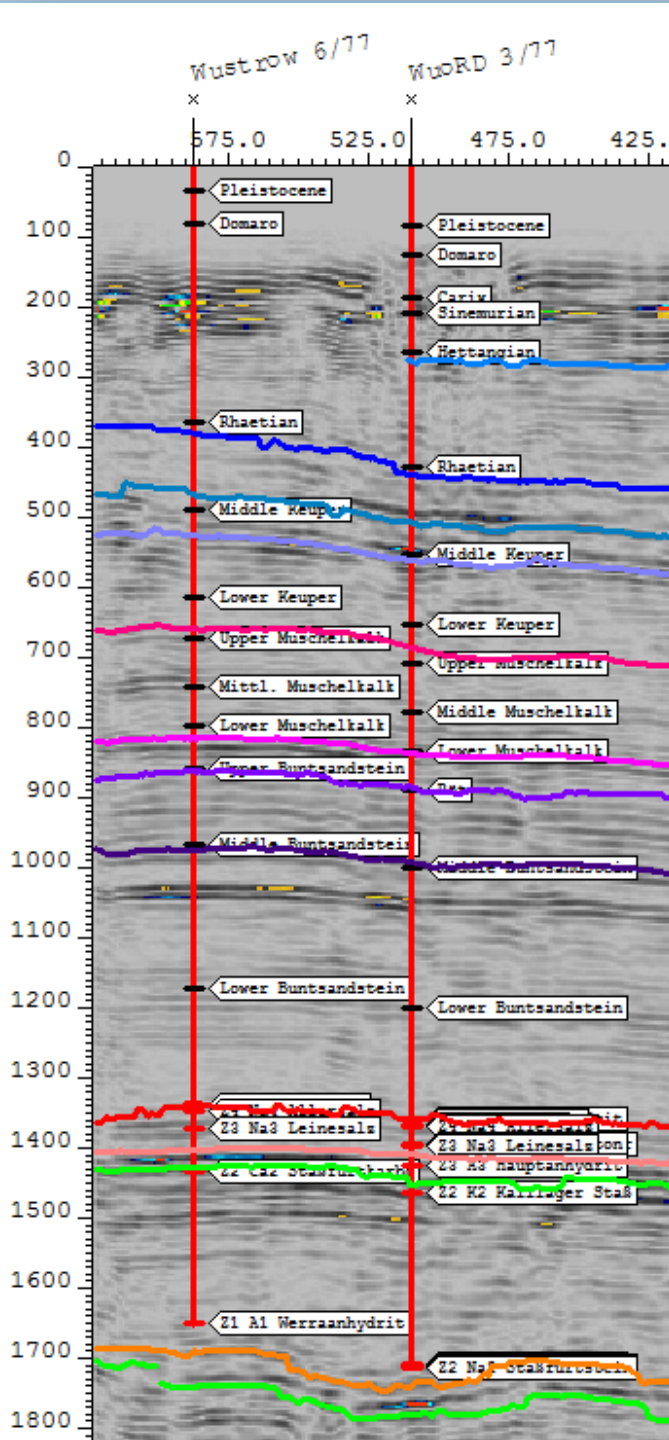
86 reprocessed seismic lines



USO West

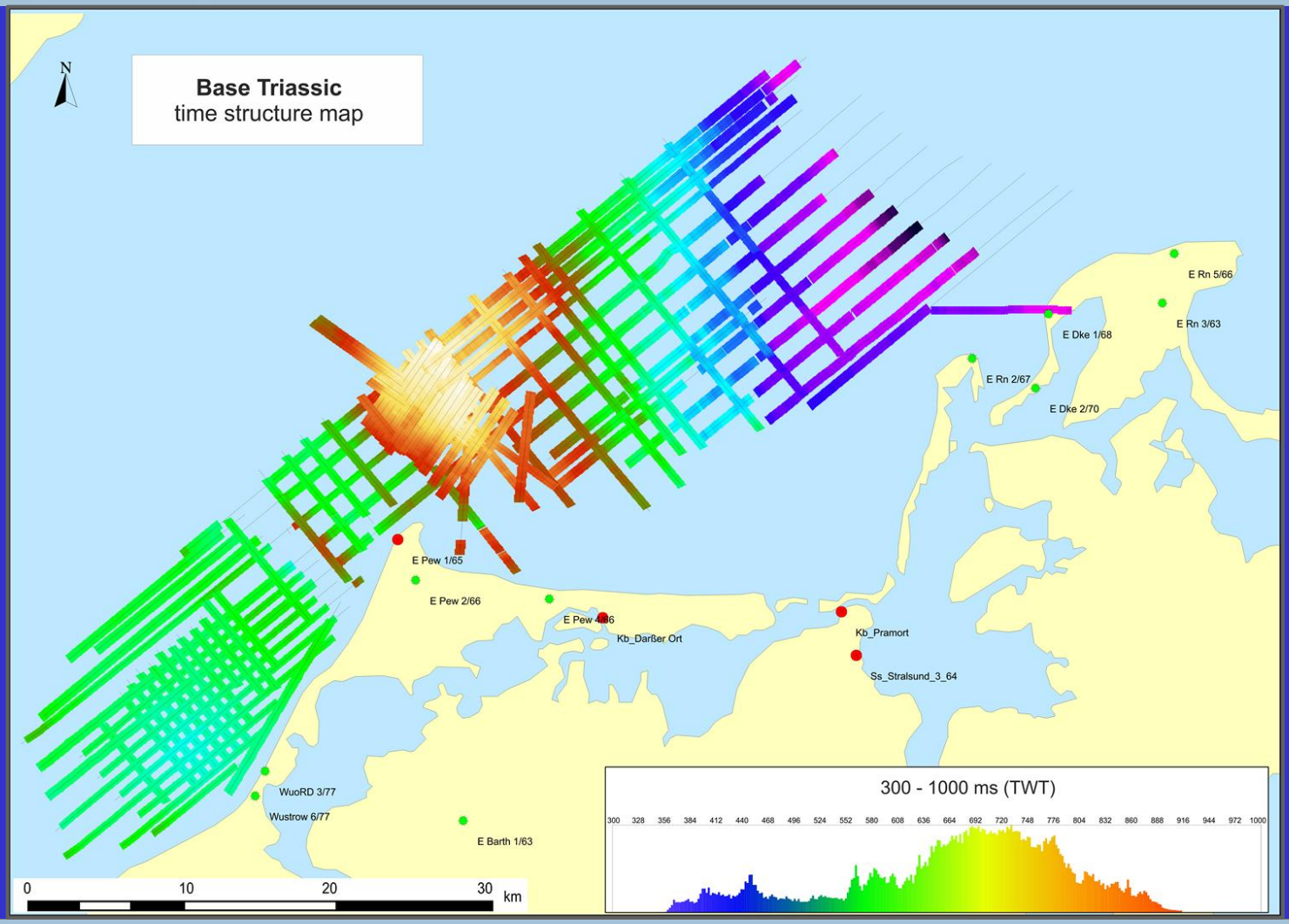
Seismic interpretation





USO West

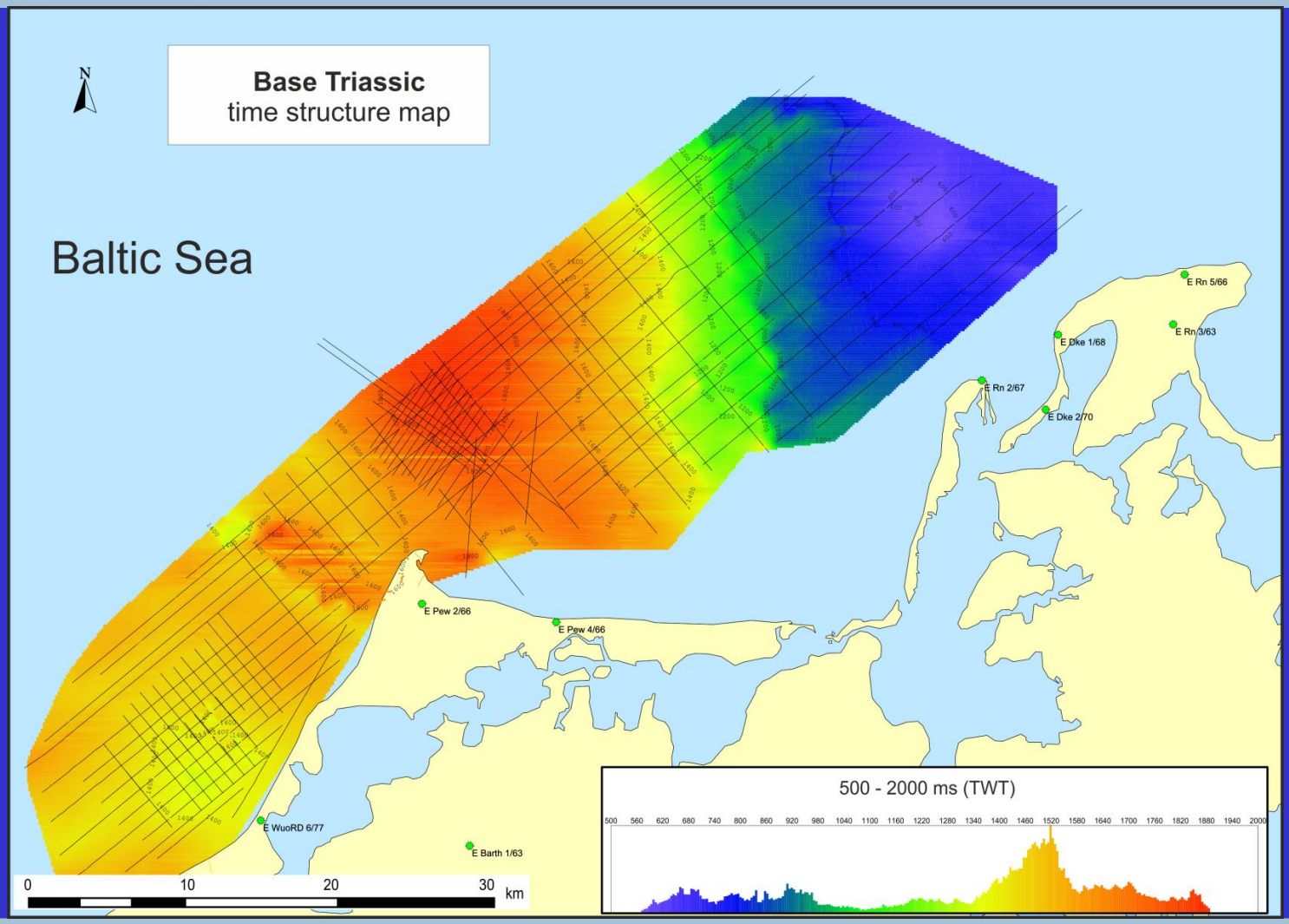
Seismic interpretation



coloured seismic lines for selected reflector

USO West

Seismic interpretation



coloured seismic lines for selected reflector

contour map using the Kriging method

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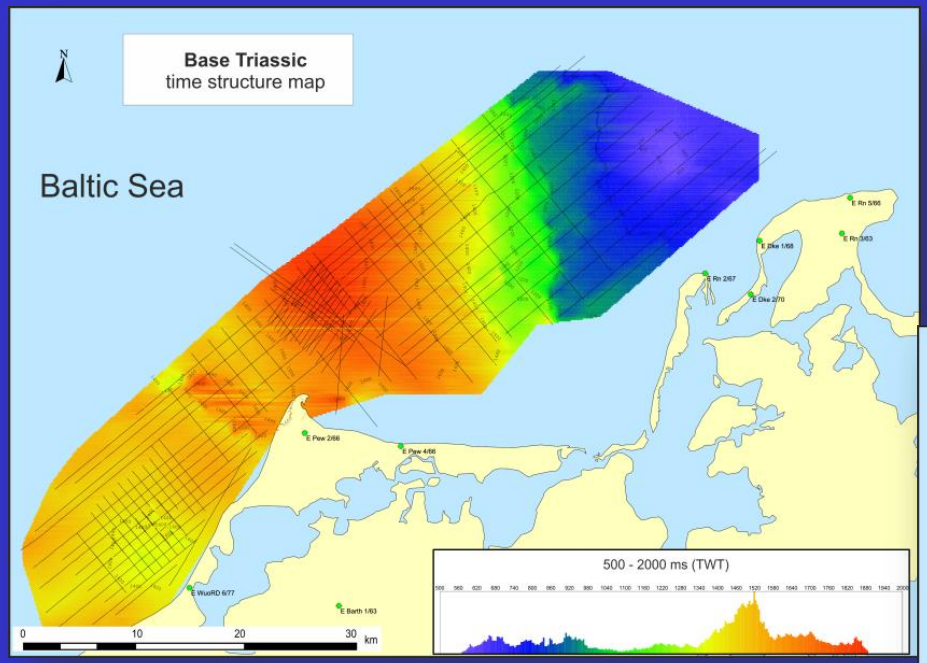
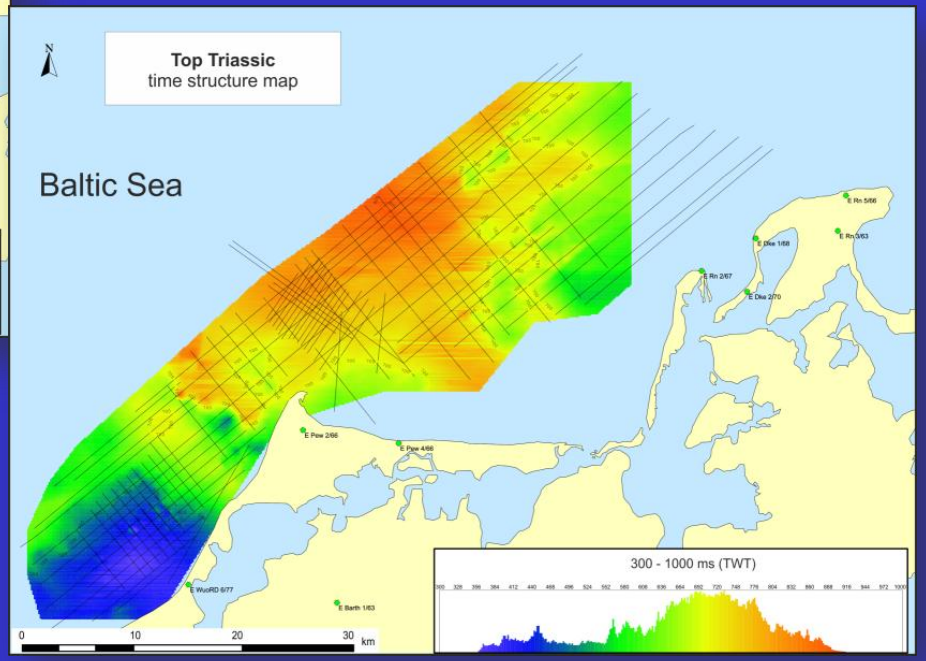
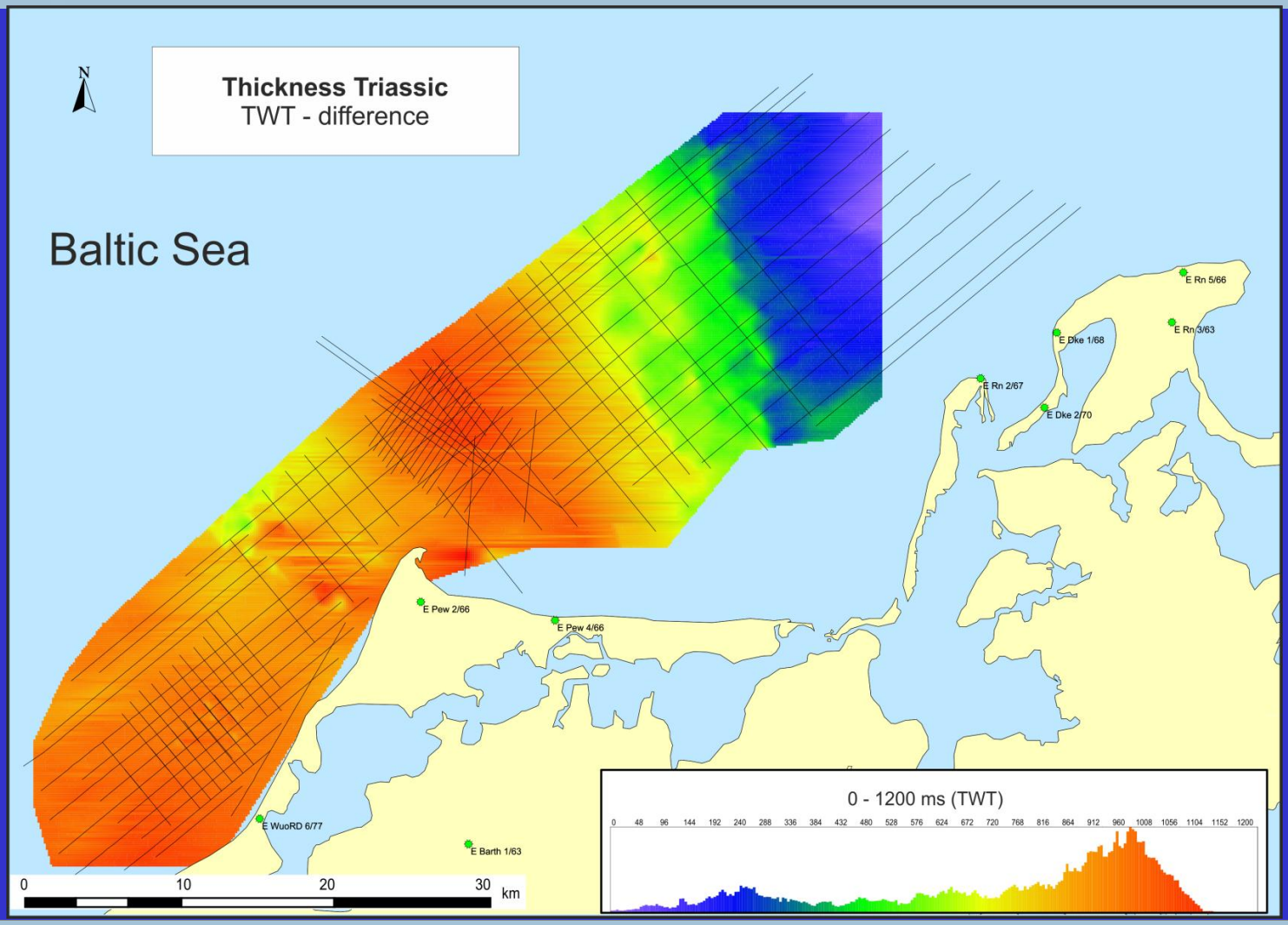
Seismic interpretation





USO West

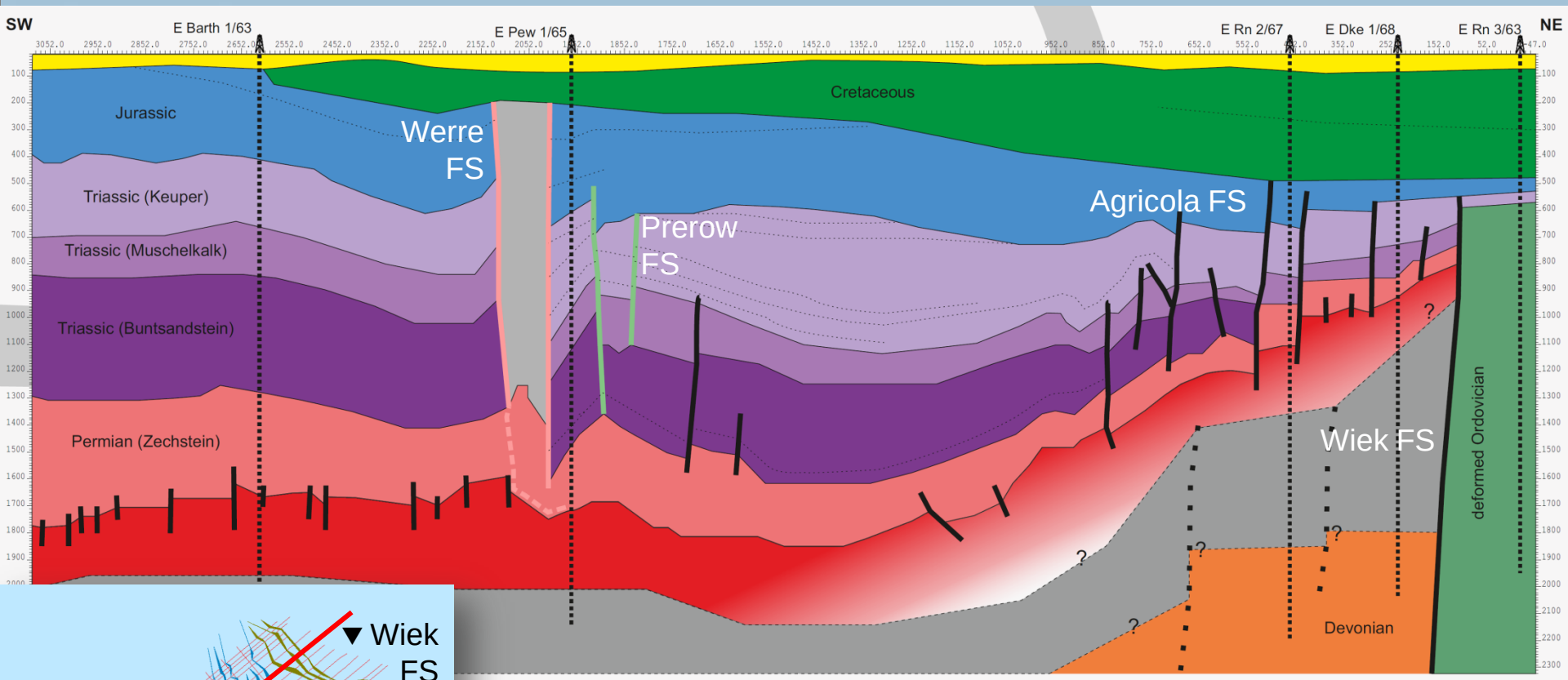
Seismic interpretation

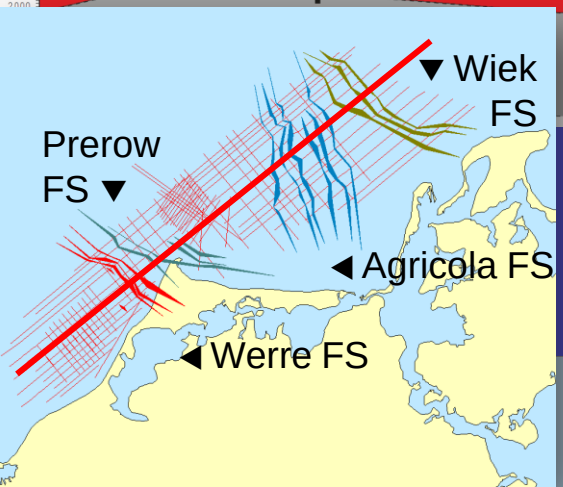


USO West

Seismic interpretation

Mecklenburg Vorpommern
Landesamt für Umwelt, Naturschutz und Geologie





Deutschmann et al. et al. (2014)

Fault systems
Wiek FS, Agricola FS, Prerow FS, Werre FS

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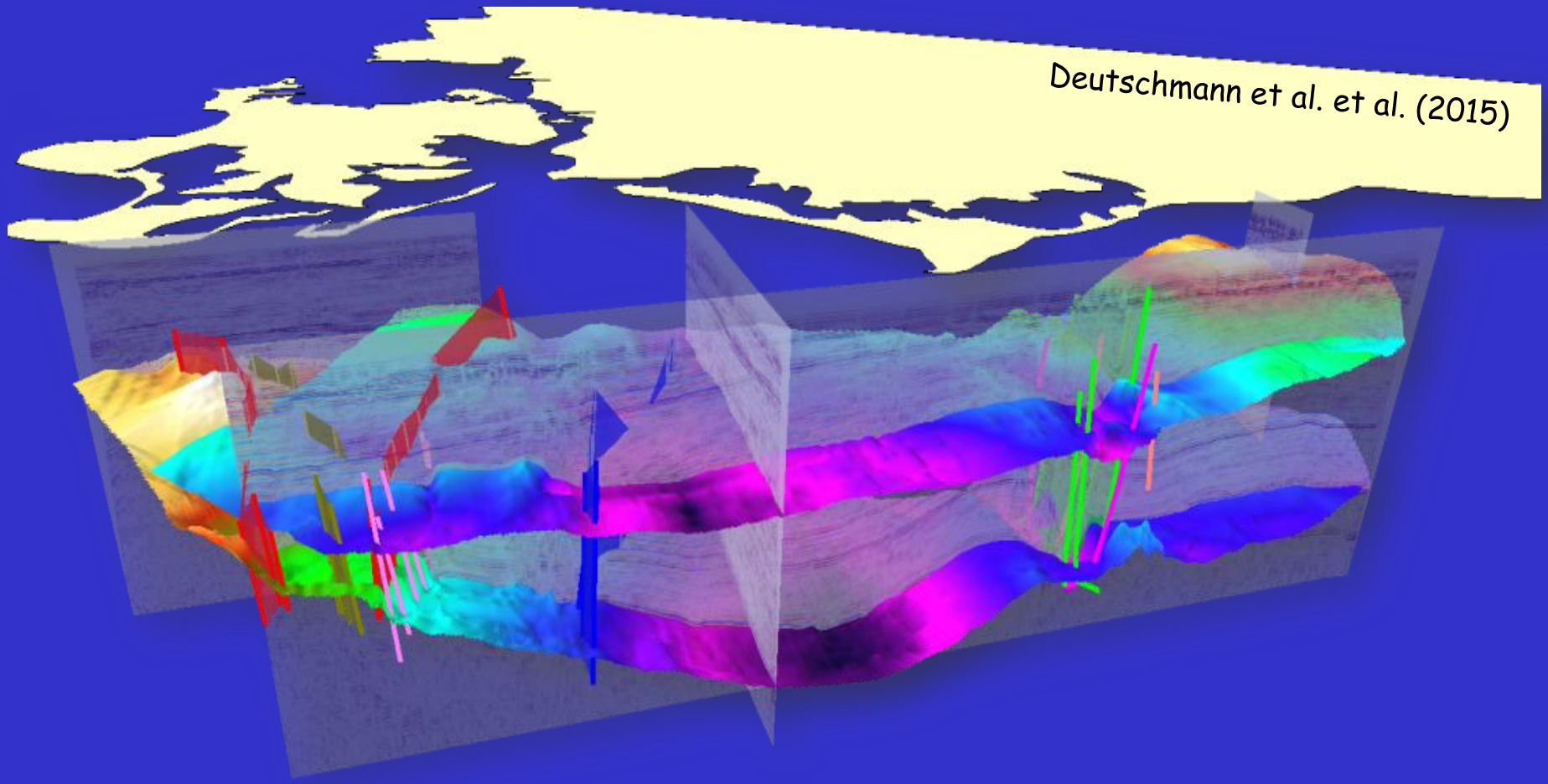
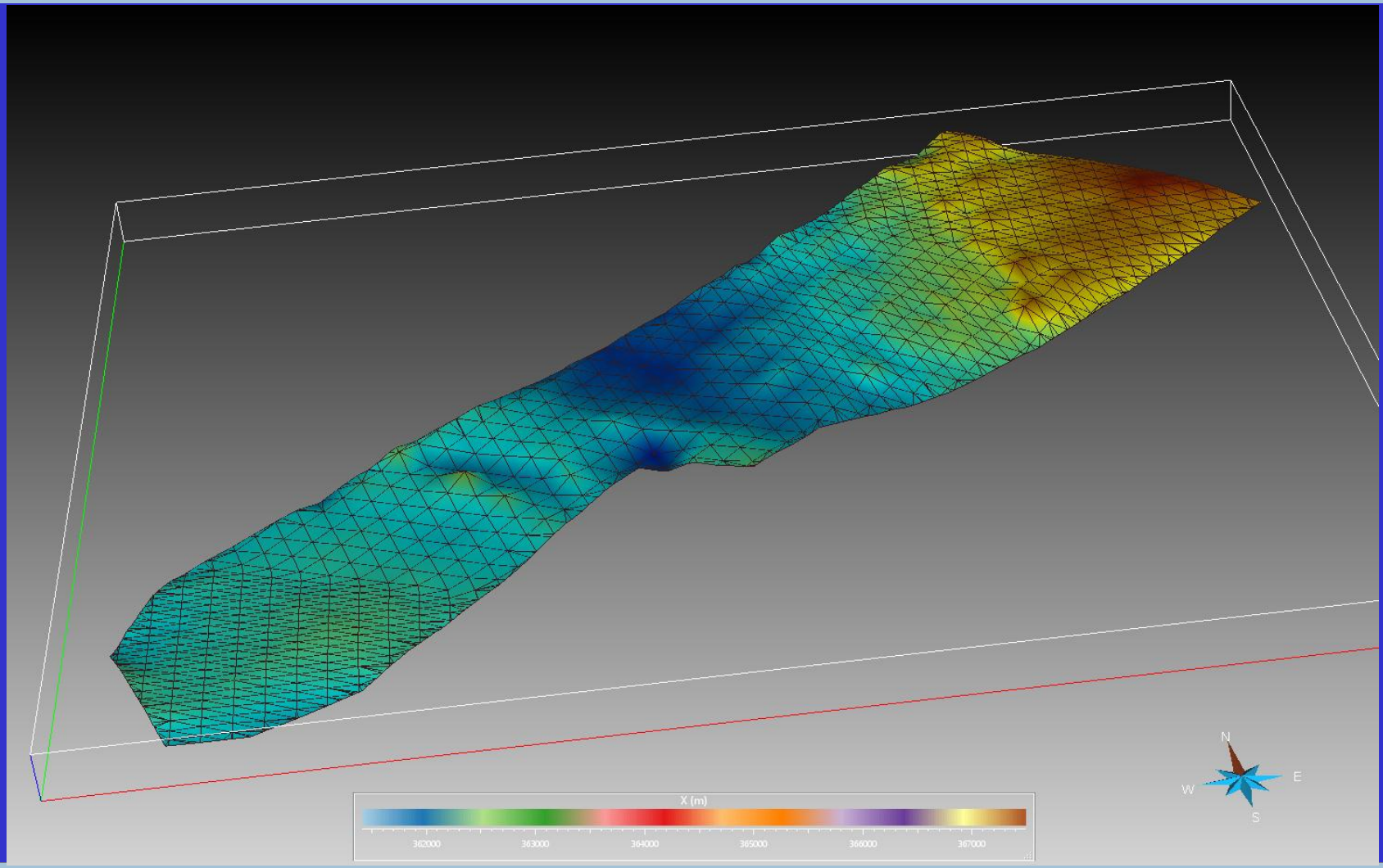
Visualization of reflectors and faults



USO West

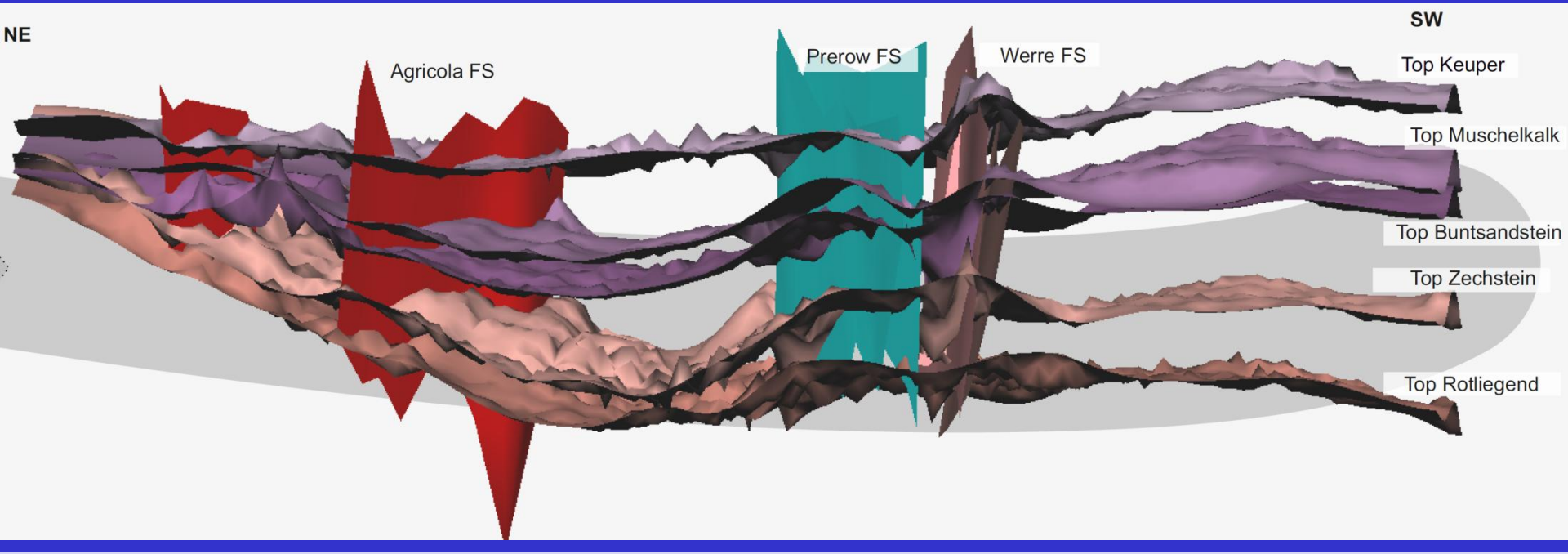
GOCAD Modelling



USO West

GOCAD Modelling

Mecklenburg Vorpommern
Landesamt für Umwelt, Naturschutz und Geologie



Deutschmann et al.
Poster Geological 3D Modelling # 7

Outlook

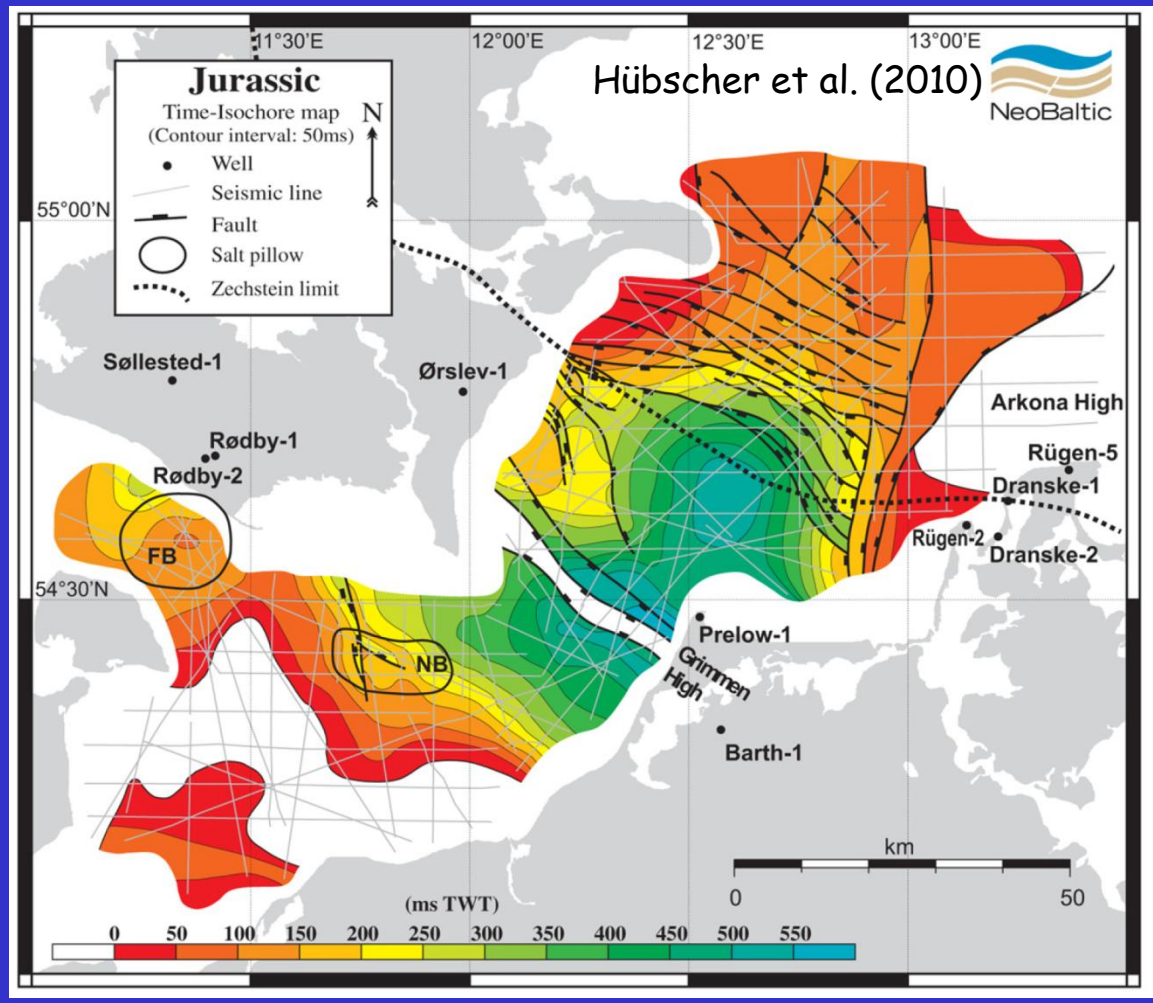
Next steps

time to depth conversion

correlation with results of other research groups

3D subsurface modell of the south-western Baltic Sea area
cooperation of German institutions (e.g. BGR, BSH, LUNG, LLUR) and universities

colaboration with surveys of Denmark, Poland, Sweden …



See you at the Baltic Sea?

Thank you for your attention!

Mecklenburg Vorpommern
Landesamt für Umwelt, Naturschutz und Geologie

K. Obst et al.