

EGU General Assembly 2022 - Session TS11.1

Triassic-Jurassic tectonic evolution of the Baltic sector of the North German Basin: Regional extension, salt movement and large-scale uplift

Niklas Ahlrichs

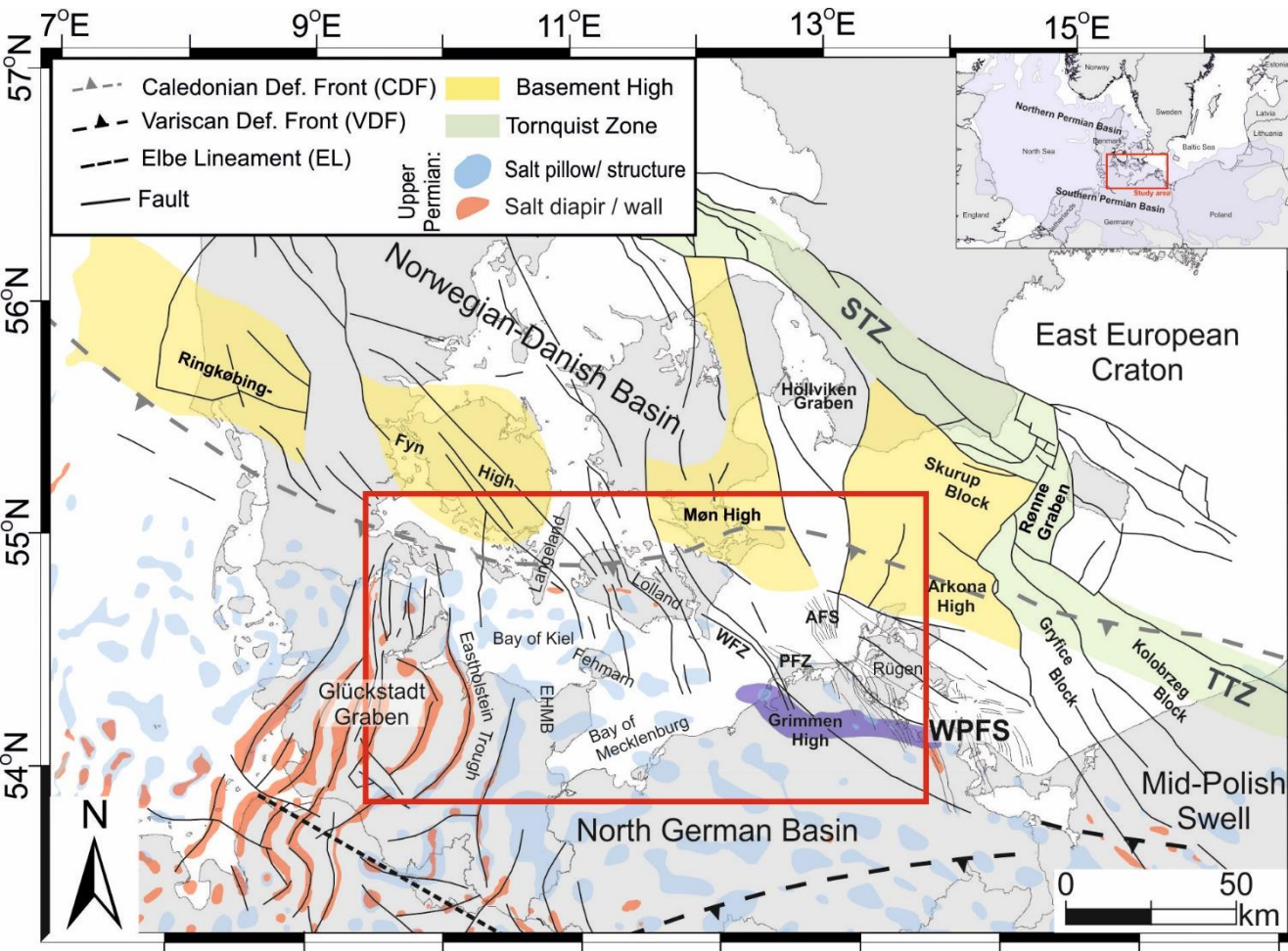
Vera Noack, Elisabeth Seidel, Christian Hübscher

Contact: niklas.ahlrichs@uni-hamburg.de

**Manuscript on this topic recently submitted to
Basin Research:**

Ahlrichs, N., Noack, V., Seidel, E., Hübscher, C.,
(2022). Triassic-Jurassic salt movement in the Baltic
sector of the North German Basin and its relation to
post-Permian regional tectonics. Submitted to Basin
Research.

Study area: the Baltic sector of the North German Basin



Major structural elements in the study area:

- North German Basin and its northern margin
- Basement highs: Ringkøbing-Fyn, Møn, Arkona highs
- Glückstadt Graben
- Western Pomeranian Fault System (WPFS) at northeastern basin margin
- Tornquist Zone

AFS: Agricola Fault System; EHMB: Eastholstein Mecklenburg Block; PFZ: Prerow Fault Zone; STZ: Sorgenfrei Tornquist Zone; TTZ: Tornquist-Teisseyre Zone; WFZ: Werre Fault Zone; WPFS: Western Pomeranian Fault System

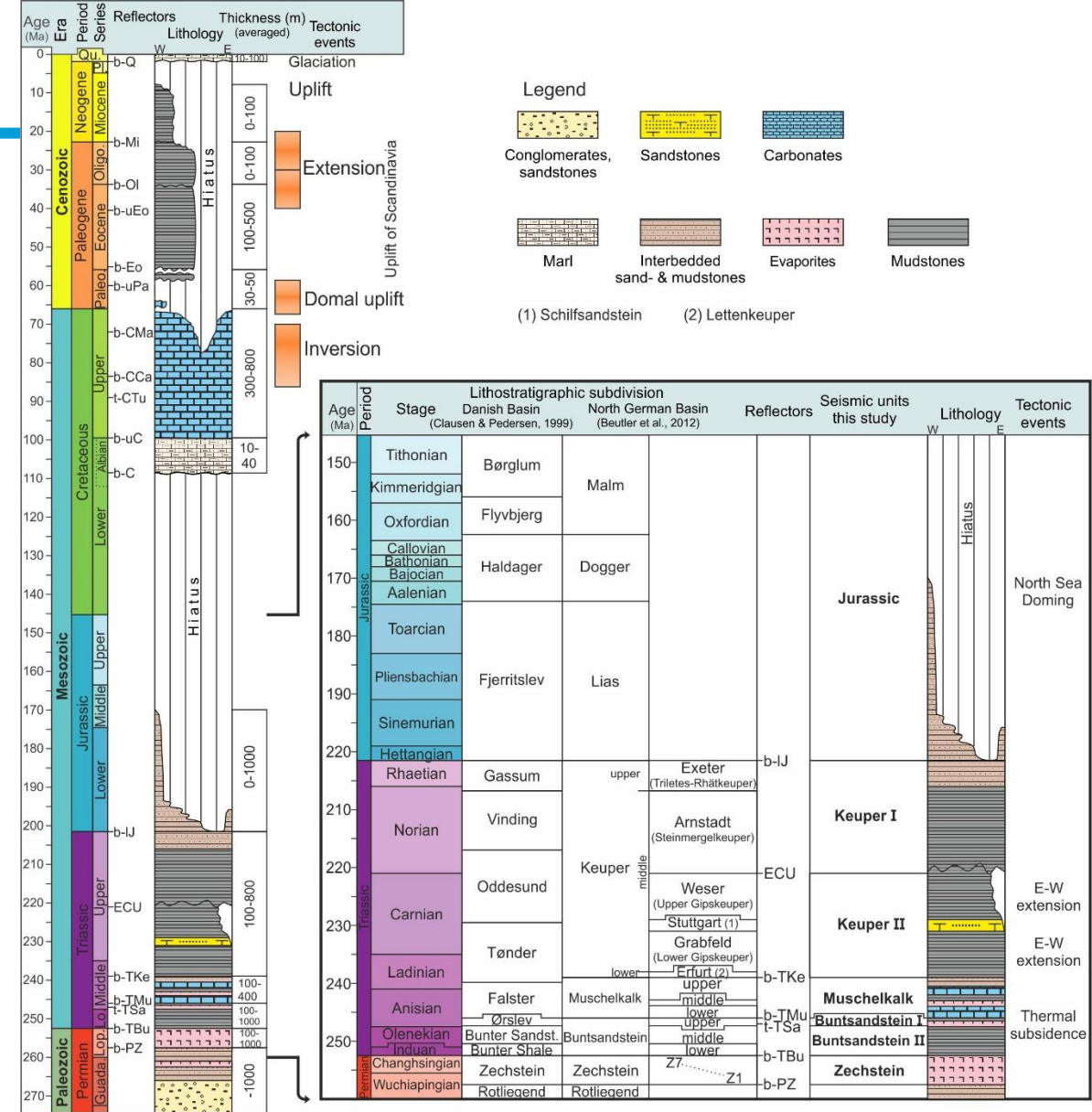
Ahlrichs et al. (submitted to Basin Research)

Geological Setting

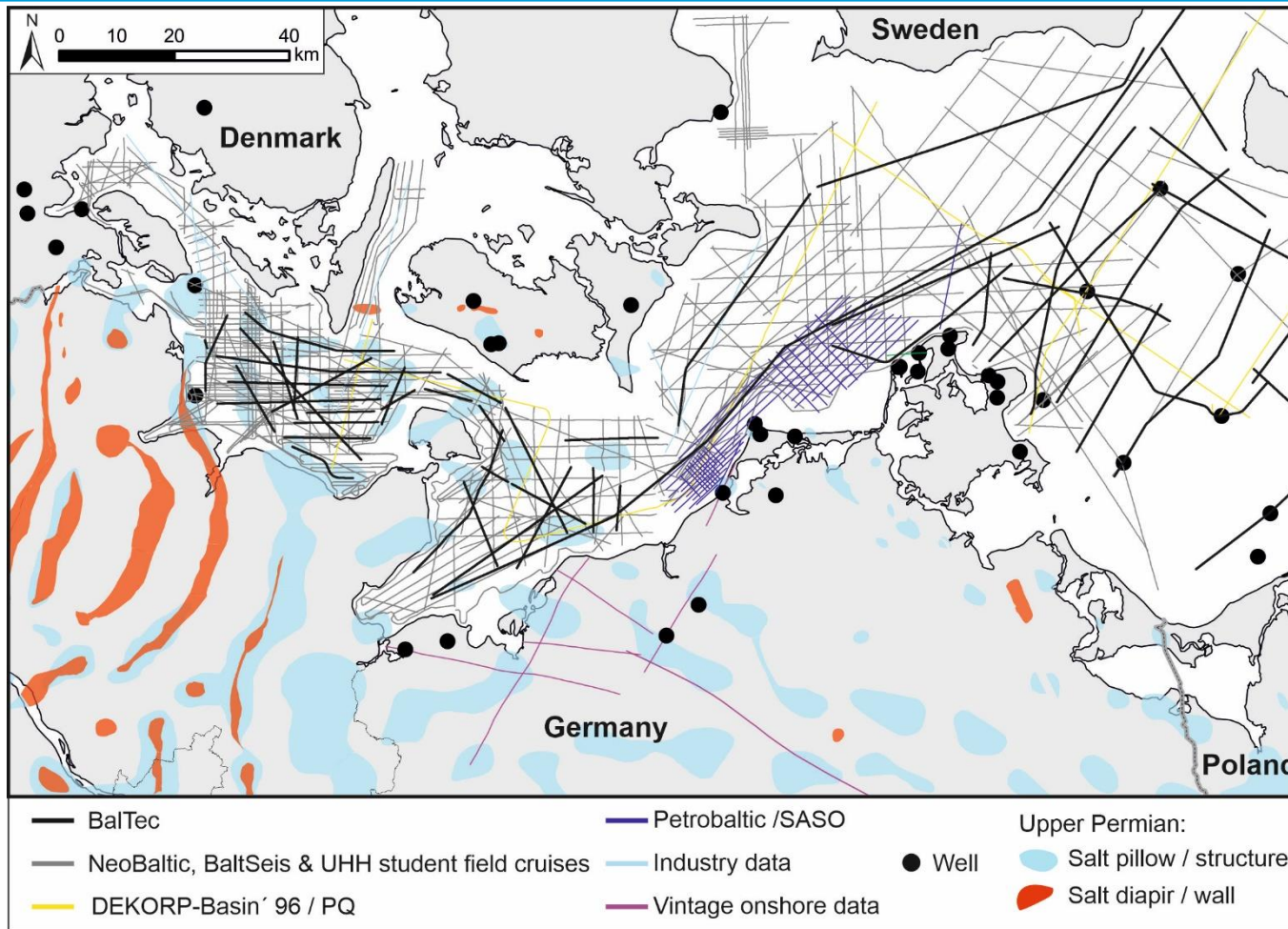
- Study area strongly influenced by salt tectonics
 - Zechstein evaporites

Main stages of basin development:

- Early to Middle Triassic thermal subsidence
 - Deposition of prekinematic Buntsandstein and Muschelkalk units
- Late Triassic regional extension and initial salt structure development
- Middle Jurassic uplift and erosion
- Late Cretaceous inversion and minor reactivation of salt movement
- Cenozoic extension and major reactivation of salt flow



Database: seismic data and wells



- Dense network of high-resolution 2D seismic data
- Onshore + offshore wells

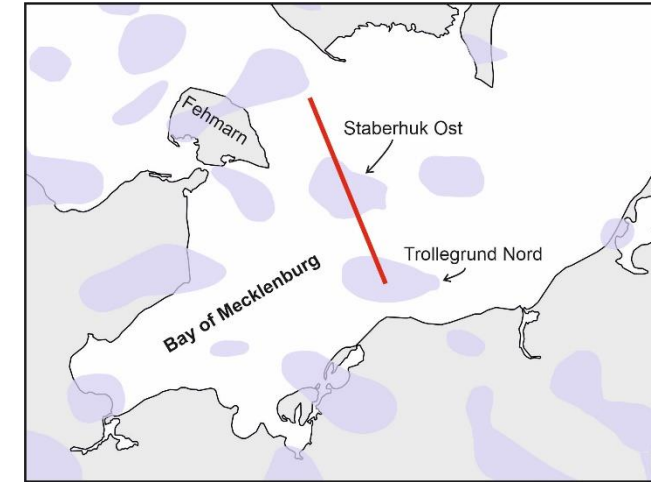
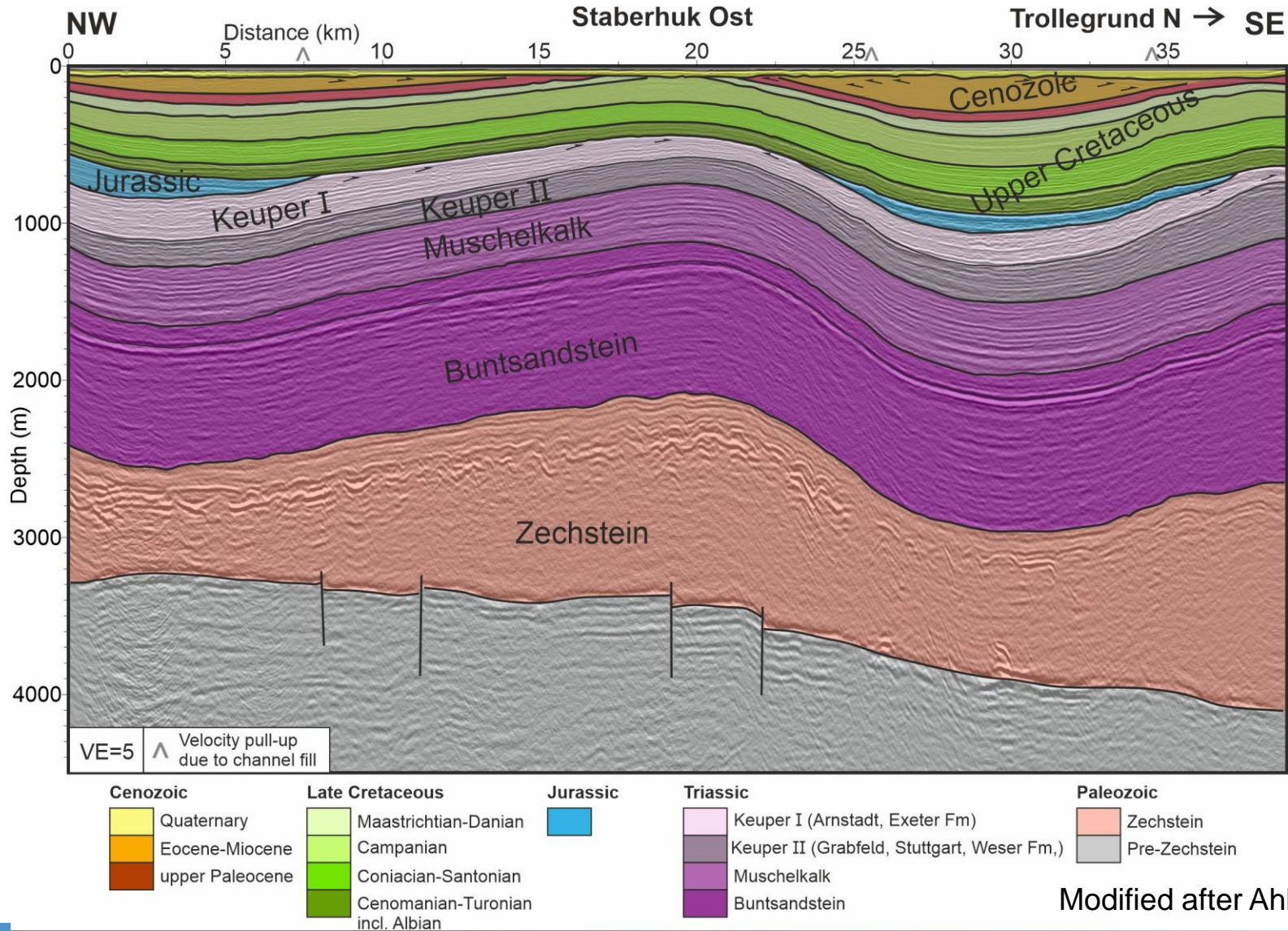


Improved stratigraphic subdivision
(beyond level of geological series)

Seismic data used for regional
mapping of Triassic - Jurassic units.

Salt structures after Vejbaek (1997) and Reinhold et al. (2008)

Seismic depth section from the Bay of Mecklenburg

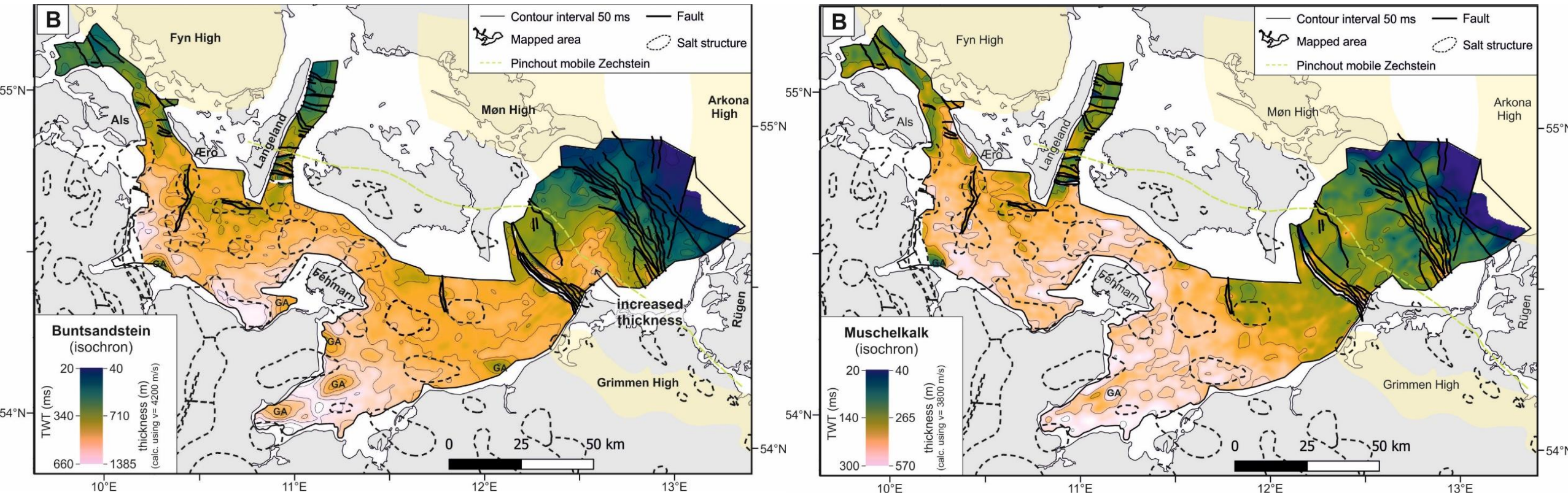


Lithostratigraphy

This study			Formations
Rhaetian	Keuper I	upper	Exeter
Norian			Arnstadt
	Keuper II	middle	Weser
			Stuttgart
			Grabfeld
Carnian		lower	Erfurt
Ladinian			

Modified after Ahlrichs et al. (2021)

Thickness (in TWT) of Buntsandstein and Muschelkalk units



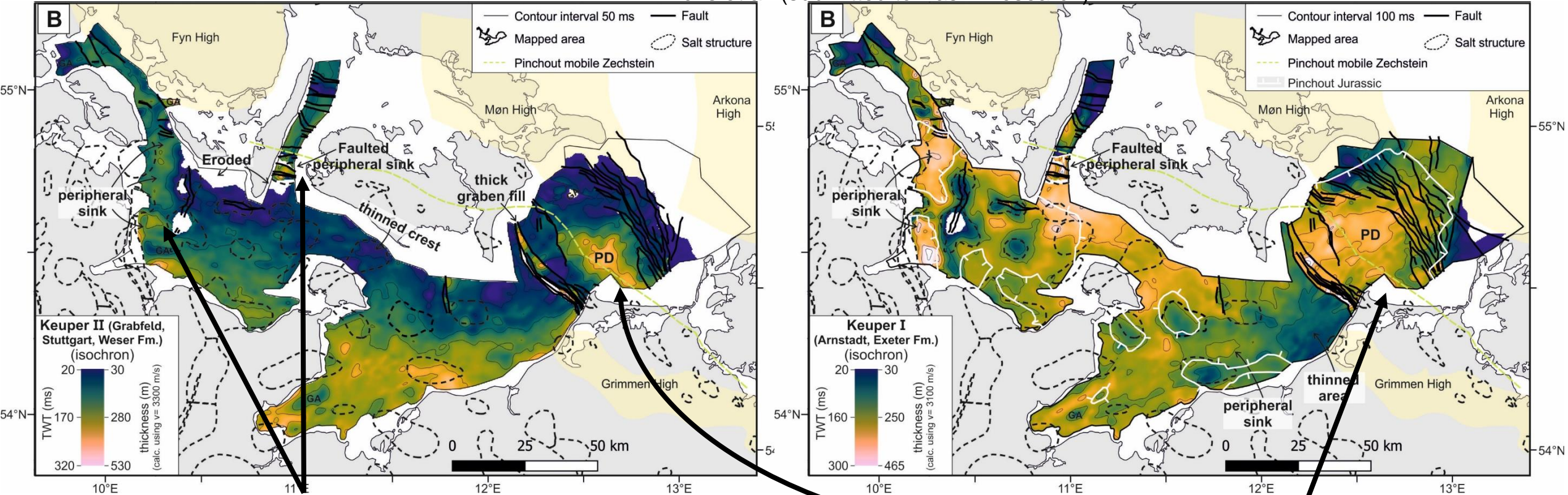
Ahlrichs et al. (submitted to Basin Research)

Local thickness variations do not correlate with salt structures

➡ These units were deposited prior to salt movement (prekinematic)

Thickness (in TWT) of Keuper unit

Ahlrichs et al. (submitted to Basin Research)



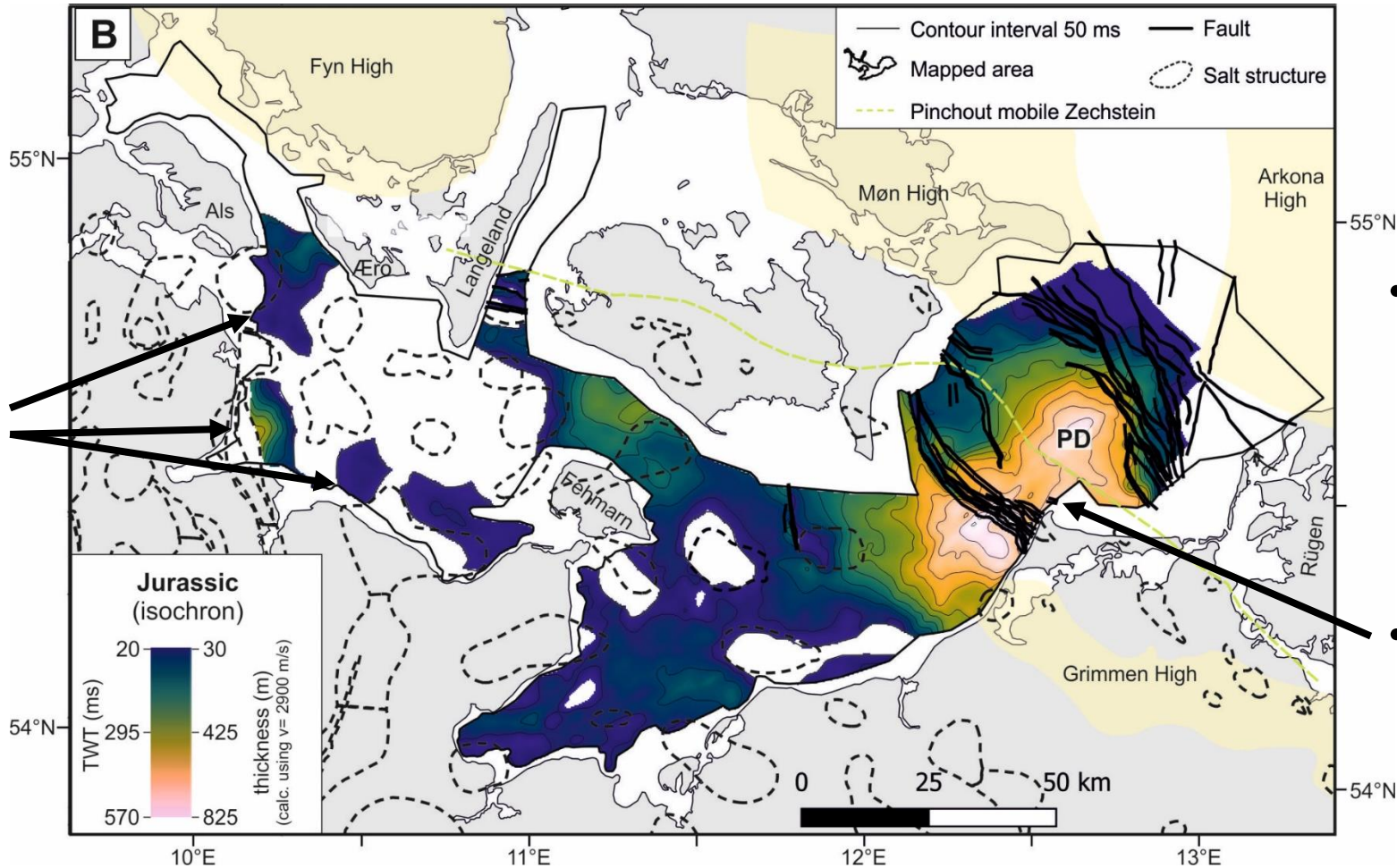
Development of peripheral sinks in the northeastern Glückstadt Graben and at the Kegnaes Diapir marking the onset of salt movement

Development of a transtensional subbasin at the northeastern basin margin

Lithostratigraphy			
This study		Formations	
Rhaetian	Keuper I	upper	Exeter
Norian			Arnstadt
Carnian	Keuper II	middle	Weser
			Stuttgart
			Grabfeld
Ladinian		lower	Erfurt

Thickness (in TWT) of Jurassic unit

Increased preservation of Jurassic unit above rim-synclines of salt structures indicates at least Early Jurassic salt movement



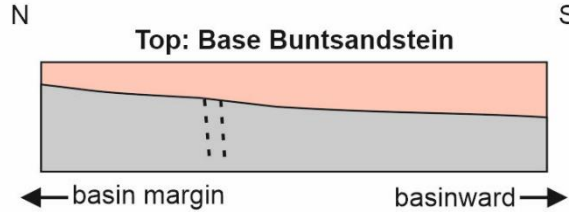
- Middle Jurassic uplift due to North Sea Doming causing widespread erosion.
- Widening of transtensional subbasin

Ahrlachs et al. (submitted to Basin Research)

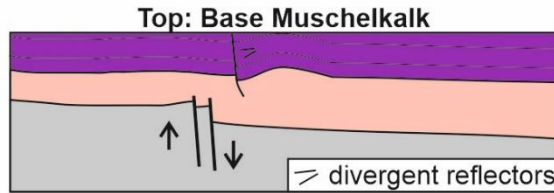
Diapirism at northern basin margin: the Kegnaes Diapir

Lithostratigraphy			
This study		Formations	
Rhaetian	Keuper I	upper	Exeter
Norian			Arnstadt
Carnian	Keuper II	middle	Weser
			Stuttgart
			Grabfeld
Ladinian		lower	Erfurt

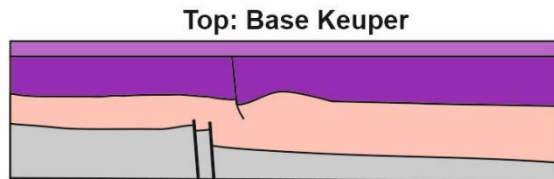
1) Zechstein



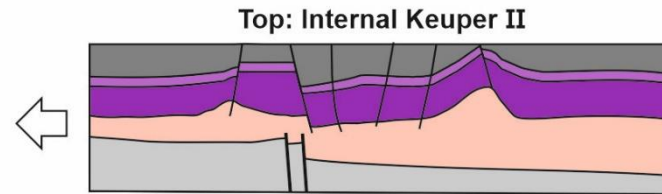
2) Triassic: Buntsandstein



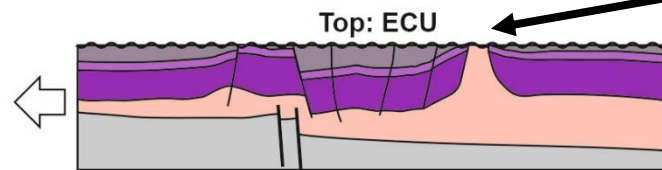
3) Triassic: Muschelkalk



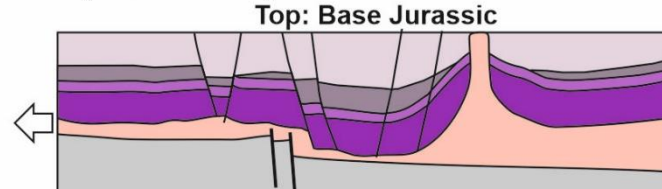
4) Triassic: Intra Keuper II



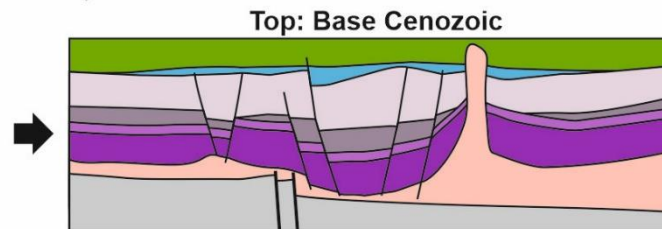
5) Triassic: End Keuper II



6) Triassic: Keuper I



7) Late Cretaceous

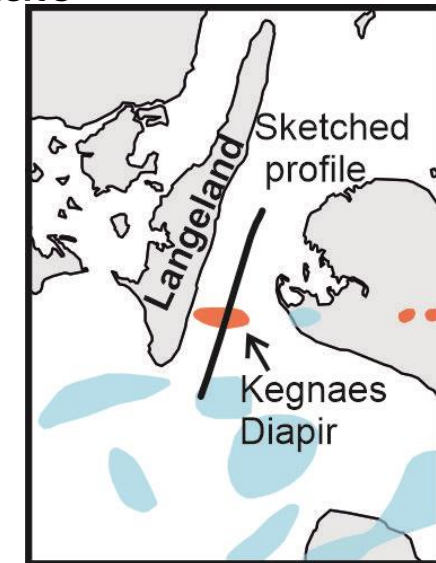


Ahlrichs et al. (submitted to Basin Research)

Erosional unroofing

Extension during deposition of Keuper units (Late Triassic)

Shortening during Late Cretaceous inversion mildly squeezes the diapir



Summary

- Initial salt structure development in the Baltic sector of the North German Basin in the Late Triassic during deposition of the Grabfeld, Stuttgart and Weser Formations (Ladinian – Carnian times).
- Contemporaneous development of a transtensional subbasin at the northeastern North German Basin margin.
- Triassic salt movement is triggered by regional extension.
- Salt movement continued at least during the Early Jurassic.
- Jurassic deposits strongly eroded due to widespread uplift related to the Mid Jurassic North Sea Doming event.

We are looking forward to your questions and comments!

Contact us:

- during the session TS11.1 Monday, 23. 05. 2022 - 08:30 – 11:08
- or via niklas.ahlrichs@uni-hamburg.de

References

- Ahlrichs, N., Noack, V., Seidel, E., Hübscher, C. (2022, submitted to Basin Research). Triassic-Jurassic salt movement in the Baltic sector of the North German Basin and its relation to post-Permian tectonics. Submitted to *Basin Research*.
- Reinhold, K., Krull, P., Kockel, F., & Rätz, J. (Cartographer). (2008). Salzstrukturen Norddeutschlands: Geologische Karte. 1:500000
- Vejbaek, O. V. (1997). Dybe strukturer i danske sedimentære bassiner. *Geologisk Tidsskrift*, 4, 1-31.
- Warsitzka, M., Kley, J., Jähne-Klingberg, F., & Kukowski, N. (2016). Dynamics of prolonged salt movement in the Glückstadt Graben (NW Germany) driven by tectonic and sedimentary processes. *International Journal of Earth Sciences*, 106(1), 131-155. doi:10.1007/s00531-016-1306-3