Int J Earth Sci (Geol Rundsch) (2005) 94: 779–781
DOI 10.1007/s00531-005-0036-8

EDITORIAL

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Dynamics of sedimentary basins: the example of the Central European Basin system

Published online: 15 September 2005

Sedimentary basins are compartments of the upper crust in which mineral and organic material have accumulated over millions of years. This material undergoes partial transformation at temperatures ranging from 0° to 300°C and pressures up to approximately 100 MPa. Due to their longevity and high contents of chemically metastable components, sedimentary basins can be regarded as long-term reactors. The substance turnover and product composition of such a georeactor depends essentially on both externally and internally operating processes which affect the sedimentary basin fill over long-geological periods. Such basins contain not only most of our energy and water resources, but also a great number of mineral resources. The main objective of this volume is to identify and quantify the major processes that control or affect the formation and evolution of sedimentary basins, including the fluid inventory. In order to achieve this goal, a wide range of modern geophysical, geochemical and geological tools is applied predominantly within the Special Research Project (SPP) 1135 of the German Science Foundation (DFG) which is integrated into the national research program Geotechnologies (BMBF, DFG) and which is supported by the German Oil and Gas Industry (DGMK, German Society for Petroleum and Coal Science and Technology, project 577). In addition co-operations with partners beyond the German borders have been established on an individual base.

The focus on the Central European Basin system has various reasons: the dominant technical one is that a wealth of seismic and borehole data were made available for scientific projects by the German petroleum industry three years ago, proposing new scientific insights which never before had been possible—several of the papers in this volume take advantage of this data set. On the other hand, the Central European Basin system is a complex sedimentary basin in which sediments accumulated over more than 250 million years under varying stress and strain conditions as well as sedimentary regimes, providing a complex geological puzzle to be decoded which may become a key example for other long-living multi-phase basins.

Following the Variscian consolidation of central Europe, the basin initiation started in the latest Carboniferous to earliest Permian with a short phase of enormous volcanism followed by a rapid phase of initial subsidence. During the following long-term thermal decay and subsidence, the general trend repeatedly was disturbed by additional tectonic events: a variety of subbasins evolved during the Triassic, late Jurassic and even the Cenozoic, providing additional localized depocentres with sediment thicknesses of more than 10 km as illustrated in Fig. 1. In addition, the basin suffered a relative uplift at various regions at different times with the most prominent during the latest Cretaceous to early Tertiary which, nevertheless, was strictly localized and did not affect the entire area. Although the basin appears seismically calm by the existing sparse seismic regional network, there is evidence for neotectonic activity in certain areas, providing a potential link between the long-term evolution and present-day applied problems.

Due to its history, the basin is anything but homogenous as illustrated by the superimposed Triassic rift structures illustrated in Fig. 2. Some of these structures have been partly enforced and modified by repeated activation of thick-salt deposits from late Permian times,

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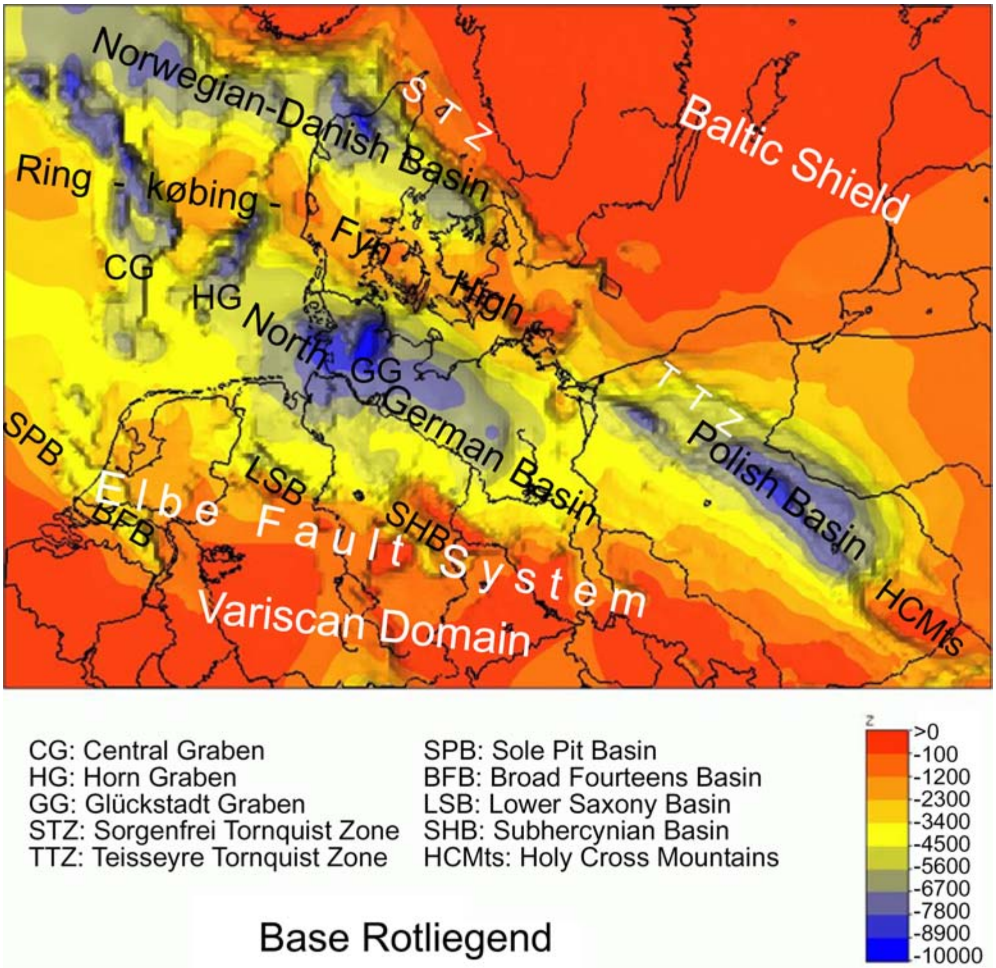

Fig. 1 Thickness of sedimentary rocks (Permian to Recent) in the Central European Basin system. (Courtesy of M. Scheck-Wenderoth)

leading to the development of many salt pillows, salt diapirs and salt walls (Fig. 2) of up to 8 km thickness, a process which continues even today and which may have been enforced during the prehistoric glaciations which also had some influence on oil and gas accumulations.

The variety of fluids, present within the basin area, provides another feature of interest. They range from water of highly variable salinity to oil, hydrocarbon gas, carbon dioxide and nitrogen gas and partly show a complex transport and reaction behaviour. All aforementioned fluids can be predominant in specific reservoirs within the basin and their origin is still poorly understood. Accordingly, several papers within this volume focus on possible explanations with respect to fluid origin and dynamics. In summary, both the salt dynamics under varying stress regimes and fluid generation and transport can be ideally studied in the Central European Basin system. Due to the vast and now available petroleum exploration and production data including numerous wells and seismic lines, it can be regarded as an ideal natural laboratory for sedimentary basin studies.

This Volume provides a 'mid term' overview about running projects of the DFG-SPP 1135 'Sedimentary Basin Dynamics' with its main interests focusing at (a) strain and stress in the upper crust leading to crustal extension and compression, evolution of fault zones, their influence on the crustal rheology and their effects on large-scale and regional subsidence as well as on the geothermal field, (b) inherent processes of a sedimentary system such as compaction, erosion, salt movement and fluid generation under the control of the external factors mentioned above, (c) transport processes involving the migration of gas and fluids through the pore space either by pressure-driven single-phase or multi-phase flow or by diffusion, their dependence on compaction, fault zones and the geothermal field as well as associated fluid–rock interactions, and (d) the supply and redistribution of sedimentary matter acting as a mirror of tectonic activities and climate changes. The papers in this volume are roughly following this line, although many of them deal with more than one of these aspects of basin evolution.

We hope that this collection of independent papers presents additional insight into the complex interactions in a multi-phase basin and especially raises interest in the Central European Basin system as a 'Natural Laboratory'. This well explored, but still not scientifically resolved model area crosses political boundaries between Denmark, Great Britain, The Netherlands, Norway,

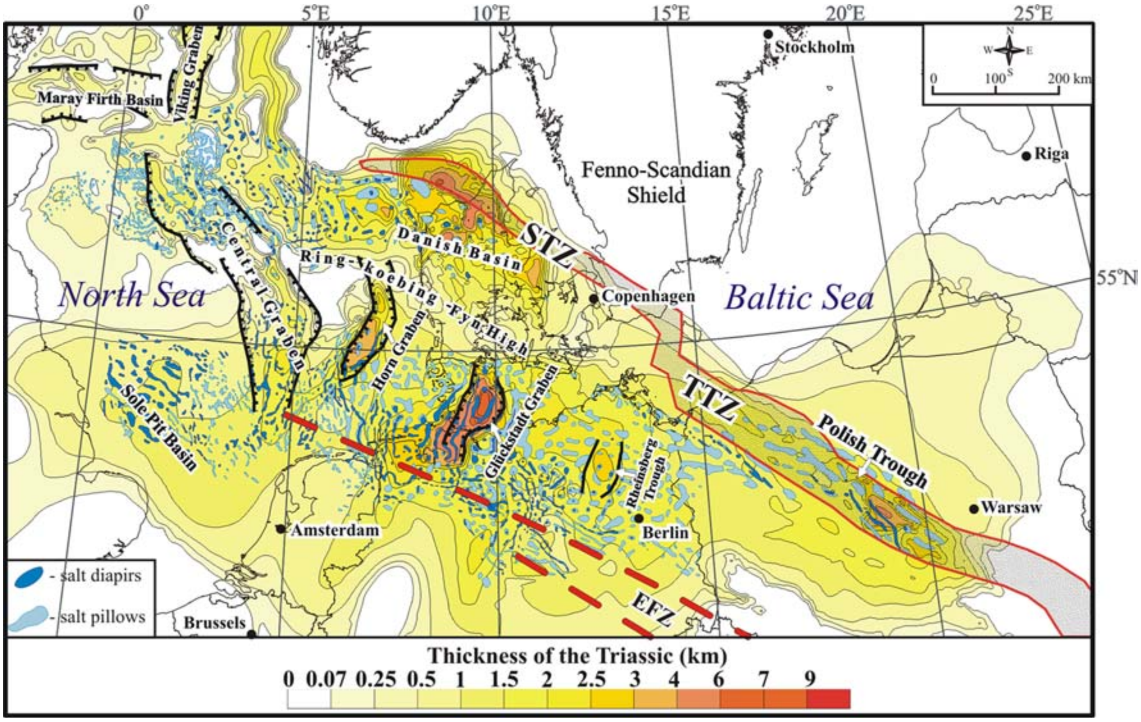

Fig. 2 Thickness of Triassic sedimentary rocks in the Central European Basin system, major graben structures and salt diapirs. (Courtesy of Y. Maystrenko)

Poland and Germany. In research funded by national science foundations, these boundaries still cause bureaucratic and legal obstacles and, therefore, at least in some instances prohibit more efficient cooperations. Hopefully, Europe will do better in the foreseeable future.